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HANFORD ENVIRONMENTAL DOSIMETRY UPGRADE PROJECT

GENII - THE HANFORD ENVIRONMENTAL RADIATION DOSIMETRY SOFTWARE SYSTEM

VOLUME 1: Conceptual Representation

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ABSTRACT

The Hanford Environmental Dosimetry Upgrade Project was undertaken to incorporate the internal dosimetry models recommended by the International Commission on Radiological Protection (ICRP) in updated versions of the environmental pathway analysis models used at Hanford. The resulting second generation of Hanford environmental dosimetry computer codes is compiled in the Hanford Environmental Dosimetry System (Generation II, or GENII). The purpose of this coupled system of computer codes is to analyze environmental contamination resulting from acute or chronic releases to, or initial contamination of, air, water, or soil. This is accomplished by calculating radiation doses to individuals or populations.

GENII is described in three volumes of documentation. The first volume describes the theoretical considerations of the system. The second volume is a Users' Manual, providing code structure, users' instructions, required system configurations, and QA-related topics. The third volume is a Code Maintenance Manual for the user who requires knowledge of code detail. It includes code logic diagrams, global dictionary, worksheets, example hand calculations, and listings of the code and its associated data libraries.

ACKNOWLEDGMENTS

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1.0 INTRODUCTION

At the direction of the U.S. Department of Energy (DOE), the Hanford Environmental Dosimetry Upgrade Project was undertaken by Pacific Northwest Laboratory (PNL)[a] to incorporate the internal dosimetry models recommended by the International Commission on Radiological Protection (ICRP) in updated versions of the environmental pathway analysis models used at Hanford. The resulting second generation of Hanford environmental dosimetry computer codes is compiled in the Hanford Environmental Dosimetry System (Generation II or GENII). The GENII system was developed by means of tasks designed to provide a state-of-the-art, technically peer-reviewed, documented set of programs for calculating radiation doses from radionuclides released to the environment. The initial task resulted in a system design requirements report, based on input from the community of potential Hanford users, providing general descriptions of the calculations that the final programs must perform. The recommendations of this report formed the basis for the remainder of the tasks, defining the elements that determined the equation formulation and parameter selection tasks. The complete report, Hanford Environmental Dosimetry Upgrade Project (HEDUP) Task 02 - System Design Requirements, is included here as the appendix.

The general requirements of the GENII system to be designed included the capabilities for calculating radiation doses for acute releases, with options for annual dose, committed dose, and accumulated dose; for calculating the same types of doses from chronic releases; for evaluating exposure pathways including direct exposure via water (swimming, boating, and fishing), soil (surface and buried sources), air (semi-infinite cloud and finite cloud geometries), inhalation pathways, and ingestion pathways. The release scenarios to be included were acute releases to air from ground level or elevated sources, or to water; chronic releases to air from ground level or elevated sources, or to water; and initial contamination of soil or surfaces. Source term variations to be accounted for included decay of radionuclides to the start of the exposure scenario, input of total radioactivity or specified

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(a) Pacific Northwest Laboratory is operated by Battelle Memorial Institute for the U.S. Department of Energy under Contract DE-AC06-76RLO 1830.

fractions, and input of measured concentrations in specified environmental media. Interfaces were to be provided for external calculations of atmospheric dispersion, geohydrology, biotic transport, and surface water transport. Target populations were to be identified by distance and direction for individuals, populations, and for intruders into contained sources.

As a result of the multitude of initial requirements on the design of the codes, the codes of the Hanford Environmental Dosimetry System can be used to determine radiation doses to individuals or populations from a wide variety of potential exposure scenarios. The core system may be used to calculate annual doses, dose commitments, or accumulated doses from acute or chronic releases of radioactive materials to air or water. This capability essentially replicates that provided in the past by the computer codes KRONIC (Strenge and Watson 1973), SUBDOSA (Strenge, Watson, and Houston 1975), DACRIN (Houston, Strenge, and Watson 1974; Strenge 1975), FOOD and ARRRG (Napier et al. 1980), and PABLM (Napier, Kennedy, and Soldat 1980). Annual doses, dose commitments, and accumulated doses can also be calculated from initial contamination of soil or surfaces, thus incorporating capabilities from PABLM and ONSITE/MAXI (Napier et al. 1984; Kennedy et al. 1986; Kennedy et al. 1987). A limited biotic transport capability is included, simulating the results of BIOPORT/MAXI (McKenzie et al. 1986). One of the codes creates factors relating sources of various geometries to dose rate; this is essentially a modified version of the shielding code ISOSHLD (Engel, Greenborg, and Hendrickson 1966; Simmons et al. 1967). An additional capability, that of predicting very-long-term doses from waste management operations to the public over periods of up to 10,000 years, is incorporated into the system essentially unchanged from the previously documented version of DITTY (Dose Integrated over Ten Thousand Years) (Napier, Peloquin, and Strenge 1986).

The Hanford Environmental Dosimetry System (GENII) is composed of seven linked computer codes and their associated data libraries. These codes and their linkages are illustrated in Figure 1.1. The computer programs are of three types: user interfaces (i.e., interactive, menu-driven programs to assist the user with scenario generation and data input), internal and external dose factor generators, and the environmental dosimetry programs. For maximum flexibility, the portion of the code used for analysis of

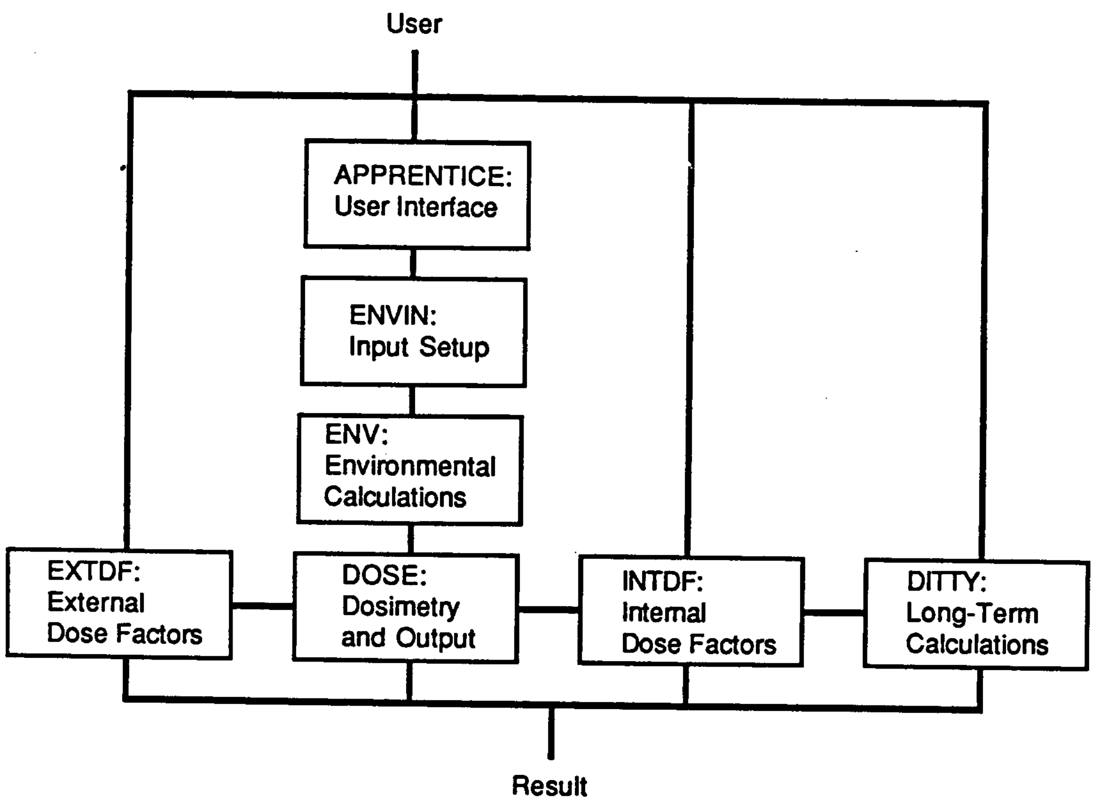

FIGURE 1.1. Current User/Computer Program Interaction in the GENII Software Package

short-term scenarios (as opposed to 10,000-year migration analyses) has been divided into three interrelated but separate programs that handle input organization and checking, environmental exposure, and dose calculations, respectively. The intent of each of these codes is described in Section 3.0 of this document.

GENII is described in three volumes of documentation. This volume describes the theoretical considerations of the system, including the conceptual diagrams, mathematical representations of the solutions, and descriptions of solution techniques, where appropriate. The second volume is a Users' Manual, providing code structure, users' instructions, required system configurations, and topics related to quality assurance (QA). The third volume is a Code Maintenance Manual for the user who requires knowledge of code details, including code logic diagrams, global dictionary, worksheets, example hand calculations, and listings of the code and its associated data libraries.

1.1 DEVELOPMENT OF THE GENII SYSTEM

A comprehensive set of codes (i.e., environmental pathway models and associated computer programs) has been developed and documented by PNL for estimating potential radiation doses to humans as a result of radionuclides in the environment. The codes address both routine and accidental releases of radionuclides to air or water in addition to other situations (e.g., residual contamination from spills or decommissioning operations). Internal radiation dose calculations are performed using the methods recommended by the ICRP as described in ICRP 26 and 30 (ICRP 1977; ICRP 1979-1982). The codes are based on existing Hanford models and codes, using updated formulations and transfer coefficients. Existing codes incorporated include DACRIN (Houston, Strenge, and Watson 1974; Strenge 1975), PABLM (Napier, Kennedy, and Soldat 1980), MAXI (Napier et al. 1984), DITTY (Napier, Peloquin, and Strenge 1986), SUBDOSA (Strenge, Watson, and Houston 1975), KRONIC (Strenge and Watson 1973), and ISOSHLD (Engel, Greenborg, and Hendrickson 1966). A user-friendly, interactive, driver program was developed to consolidate all code input and output requirements. The resultant codes are small enough to operate on a personal computer. All codes and data bases developed in the PNL project have been thoroughly peer-reviewed, tested, and documented.

The goal of this project was to develop a new generation of multipurpose mathematical models and computer programs. The resultant codes will be used for retrospective calculations of potential radiation doses resulting from routine Hanford emissions by groups within PNL, as well as by other Hanford contractors. The codes will also be used for prospective dose calculations for purposes such as siting facilities, environmental impact statements (EISs), and safety analysis reports (SARs). It was important that each user group provide input to the design of the proposed codes.

A task was initiated to define the system design requirements of the proposed codes. A committee of representatives from potential user groups was formed under the guidelines of the Hanford Dose Overview Program.

Recommendations of this group were incorporated with those of prospective PNL users to help define the needed capabilities.

Based on the recommendations developed, the relationships between radionuclide release, flux, concentration, and uptake were formulated. The pathways included are internal exposure through inhalation, crop ingestion, animal product ingestion, water consumption, and aquatic food product ingestion; and external exposure through air submersion, water immersion (swimming), and contaminated ground surfaces and objects. The equations are used as the basis for subsequent computerized implementation.

Solving the equations depends on the values of the transfer parameters used. Existing libraries of radionuclide-specific factors existed but had not been reviewed/updated for nearly 10 years. A literature review was performed of the most recent pertinent information with emphasis on Hanford-specific data. Parameters investigated included soil-to-plant concentration ratios (CRs), plant-to-animal product CRs, aquatic bioaccumulation factors, resuspension rates and resuspension factors (including mass loading rates), and selected specific-activity models (e.g., hydrogen-3 and carbon-14).

The most flexible structure for a new generation of environmental dosimetry models is similar to that shown as Figure 1.1. The major structural components are an environmental transport and human exposure module (incorporating most of the existing models) coupled to an internal dosimetry module. For convenience and ease of use, these are controlled by an interactive "driver" program. Most data inputs are through calls to data files (not shown in Figure 1.1).

1.2 QUALITY ASSURANCE ISSUES

The GENII package of codes was developed under a stringent QA plan based on the American National Standards Institute (ANSI) standard NQA-1 (ASME 1986) as implemented in the PNL Quality Assurance Manual PNL-MA-70.[a] All steps of the code development have been documented and tested. Extensive

(a) Procedures for Quality Assurance Program, PNL-MA-70, is a controlled document used internally at PNL. Information regarding the manual may be obtained from the Pacific Northwest Laboratory, Richland, Washington.

hand calculations have been performed and are available for review. An external peer review of the internal dosimetry portions of the code was held in Richland, Washington, the week of September 14, 1987. A second external review of the entire package was held in Richland the week of February 1, 1988. Copies of the reports issued by these reviewers are available. Recommendations of these review committees were then incorporated into the final product.

2.0 CONCEPTS IN ENVIRONMENTAL DOSIMETRY

Some basic interrelated concepts were used to develop the GENII code system, some explicitly labeled and some implicitly used. These concepts of "Exposure Scenario Definition" and "Exposure Pathways" are described in this section. Understanding the approaches taken to allow flexible scenario definition will aid the user in applying the codes. The general concepts of "scenarios" are described first, followed by description of the environmental pathways included in GENII.

2.1 SCENARIO DEFINITION

A "scenario" is a conceptual model that calculates patterns of human activity corresponding to actions, events, and processes that result in radiation exposure to individuals or groups of people. The GENII code package can evaluate doses resulting from two general scenario types: far-field and near-field. A far-field scenario is defined as one that determines the impact of a particular release of radioactive material into a wide environment, such as doses from releases from a stack to individuals or populations downwind. In a near-field scenario, the focus is on the doses an individual could receive at a particular location as a result of initial contamination or external sources, i.e., buried waste or contaminated soil. In a near-field scenario, contamination levels in specific environmental media may be known. A far-field scenario focuses outward from a source, and a near-field scenario focuses in toward a receptor. Of course, the two types are not mutually exclusive. Some doses to individuals from remote sources can be calculated as either far- or near-field with the same result. Specific examples of common types of far-field and near-field scenarios are given below.

2.1.1 Far-Field Scenarios

A number of commonly encountered scenarios may be classed as far-field. The following are types of releases of radioactive materials into the wider environment:

- chronic atmospheric releases - prospective or retrospective doses to individuals or populations at specified distances and directions from the radioactive source, via submersion, inhalation, deposition groundshine, and food pathways. This class of scenario is commonly used for demonstrating compliance to regulations that involve emission sources.

- acute atmospheric releases - prospective or retrospective doses to individuals or populations at specified distances and directions from an acute radioactive release, via submersion, inhalation, deposition groundshine, and food pathways. This class of scenario is often used in SARs or EISs.
- chronic surface water releases - prospective or retrospective doses to individuals and populations at specified distances downstream of a release point via swimming, boating, shoreline, drinking water, aquatic foods, irrigated terrestrial foods and animal products, soil contaminated via irrigation, and other pathways associated with liquid releases. This class of scenario is also often encountered during the demonstration of compliance with regulations.
- acute surface water releases - prospective or retrospective doses to individuals and populations at specified distances downstream of a release point via swimming, boating, shoreline, drinking water, aquatic foods, irrigated terrestrial foods and animal products, soil contaminated via irrigation, and other pathways associated with acute liquid releases. This class of scenario is also associated with SARs and EISs.

2.1.2 Near-Field Scenarios

Most other types of scenarios may be considered to be near-field. Examples are:

- initial surface contamination - individual doses resulting from contact with contaminated soil or surfaces via direct contact, resuspension, or crop uptake. Calculations of this nature can be used to analyze the impact of spills or remedial actions.
- initial subsurface contamination - individual doses resulting from contact with contaminated soil or surfaces via direct contact,

resuspension, or crop uptake. The surface soil may be contaminated via manual redistribution of the material or through biotic transport. Calculations of this nature can be used to analyze the impacts of waste management options. Often a time delay may be included to account for radioactive decay of the source.

- ground water contamination - prospective or retrospective doses to individuals and populations from a given water concentration via drinking water, irrigated terrestrial foods and animal products, soil contaminated via irrigation, and other pathways associated with liquid releases. This class of scenario is also often used in demonstrating compliance with regulations.

- cumulative effects - prospective calculations combining initial soil contamination with additional contributions from an external atmospheric or liquid source. This type of calculation is representative of how near-field and far-field calculations can conceptually be combined.

As seen in the above examples, the near-field and far-field scenarios are not necessarily mutually exclusive, and in some instances either approach may be used in defining them. An interactive user interface is provided with the GENII package to aid the user in scenario definition.

2.2 EXPOSURE PATHWAYS

Potential routes through which people may be exposed to radionuclides or radiation are called "exposure pathways." Examples of general pathways are external exposure, inhalation, and ingestion. The pathways are defined depending on the ways people could be exposed for a given circumstance. In this way, an appropriate collection of defined pathways can also be considered as the definition of an "exposure scenario." Because a conceptualization of the types of exposure must be made before the pathways can be fully defined, "scenarios" are usually defined before the parameters are selected for the "pathways."

The various exposure pathways available to users of the GENII package are illustrated in Figure 2.1. This logic diagram shows how known or assumed

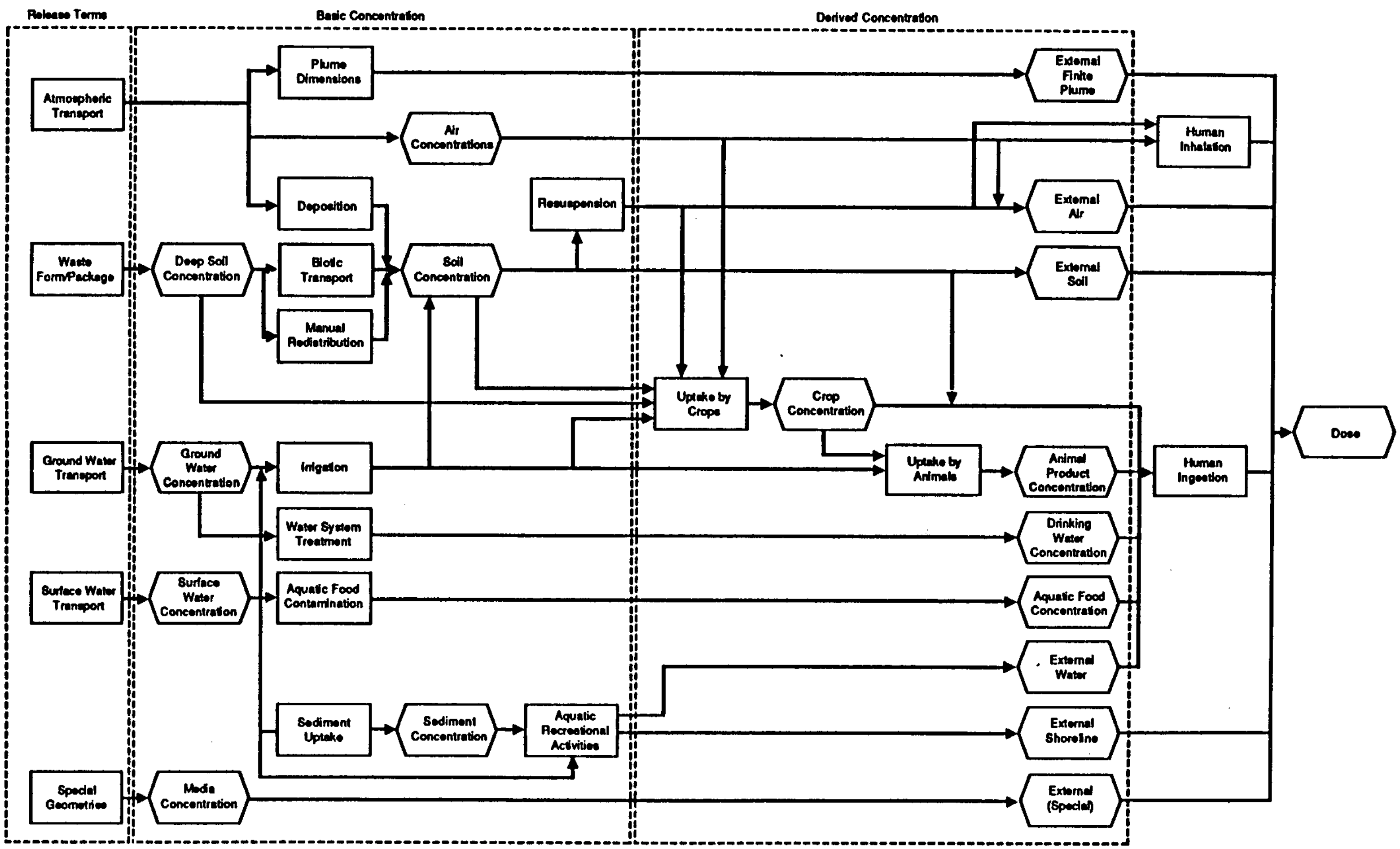

FIGURE 2.1. Available Exposure Pathways in the GENII Package

values may be propagated through defined steps to estimate radiation doses. In the GENII formulation, data regarding the radioactive release or radioactive contamination levels may be input to the calculations at different points in the calculation. These are represented on the diagram as hexagonal boxes.

In most calculations, the known quantity is generally the release quantity, designated the "Release Terms" in Figure 2.1. These terms may take the form of activity, or activity per unit time, released into the transport media of air, surface water, ground water, or soil. They are converted via appropriate models to concentrations in the corresponding media (if the basic media concentration is known, it may be input and the transport step omitted). The processes represented by square boxes in Figure 2.1 are simulated, resulting in the "Derived Concentrations." Again, if the Derived Concentrations are known, the earlier processes may be overridden. Finally, the human exposure parameters are factored in, and the dose is estimated.

To optimize flexibility, the capability to input precalculated values of atmospheric dispersion, ground water concentration, and surface water concentration has been included in the GENII package. In this way, if the simple methods incorporated in the GENII package are insufficient for a particular calculation, more sophisticated results may be achieved with minimal effort.

3.0 CODE FUNCTIONAL DESCRIPTIONS

The GENII system is composed of seven interrelated computer codes and their associated data libraries, as illustrated in Figure 1.1. The connection between the codes is through data transfer files. The output of one code is stored in a file that can be read by the next code in the system. Depending on the desired usage, the experienced user may also stop the process and edit the intermediate data transfer files to obtain specific information on the processes occurring or on intermediate results. Input and output details for each of the codes are provided in the Users' Manual, Volume 2 of the GENII documentation.

Section 3.0 describes the general functions and capabilities of each of the separate codes.

3.1 APPRENTICE

Detailed input to the GENII system consists of a multi-page data file containing the parameterized scenario description, radionuclide inventory data, and control parameters desired for a particular calculation. The APPRENTICE code is a not-quite-expert system that helps the user, through a series of interactive menus and questions, to prepare a text input file for the environmental dosimetry programs. In addition, APPRENTICE prepares a batch processing file to manage the file handling needed to control the operations of subsequent codes and prepare an output report.

Novice users will appreciate the pop-up help screens that are available in all sections of the program, the extensive logic that requests only pertinent input, default values available for all parameters, reasonable parameter value ranges, error checking for scenario incompatibilities, and checking for validity of file names. Experienced users will find that APPRENTICE has been constructed so that tutorial information does not get in the way of efficient scenario preparation. Pull-down menus allow the user substantial flexibility to modify a scenario under construction. The user can create multiple input files to execute under the control of a single batch-processing file that is generated by APPRENTICE in a relatively unobtrusive manner. File management is available within APPRENTICE; the user may view, copy, and rename files, as well as make subdirectories and change default paths.

3.2 ENVIN

The ENVIN module of the GENII package controls the reading of the input files optionally prepared by APPRENTICE and organizes the input for optimal use in the following environmental transport and exposure module, ENV. The ENVIN code interprets the basic input, reads the basic GENII data libraries and other optional input files, and organizes the input into sequential segments based on radionuclide decay chains.

Input to ENVIN occurs by means of a standardized file containing scenario, control, and inventory parameters. Radionuclide inventories can be put in as functions of release to air or water, concentration in basic environmental media (air, soil, or water), or concentration in foods. If certain atmospheric dispersion options have been selected, this module can generate tables of atmospheric dispersion parameters (X/Q) that will be used in later calculations. If the finite plume air submersion option is requested in addition to the atmospheric dispersion calculations, preliminary energy-dependent finite plume dose factors are also prepared. ENVIN prepares the data transfer files that are used as input by the ENV module. It also puts out the first portion of the calculation documentation - the run input parameters report.

3.3 ENV

The ENV module is the portion of the GENII package that calculates the environmental transfer, uptake, and human exposure to radionuclides that result from the chosen scenario for the defined source term. The code reads the input files from ENVIN, and then for each radionuclide chain sequentially performs the precalculations to establish the conditions at the start of the exposure scenario. Environmental concentrations of radionuclides are established at the beginning of the scenario by assuming decay of pre-existing sources, considering biotic transport of existing subsurface contamination, and defining soil contamination from continuing atmospheric or irrigation depositions. Then, for each year of postulated exposure, the code estimates air, surface soil, deep soil, and ground and surface water concentrations of each radionuclide in the chain. Human exposures and intakes of each radionuclide are calculated for the pathways of external exposure from finite or infinite atmospheric plumes; inhalation; external exposure from contaminated soil, sediments, and water; external exposure from special geometries; and internal exposures from consumption of terrestrial foods, aquatic foods, drinking water, animal products, and inadvertent intake of soil.

The intermediate information on annual media concentrations and intake rates are written to data transfer files. While these may be accessed directly, they are usually used as the input to the DOSE module of GENII.

3.4 DOSE

The DOSE module of the GENII package reads the annual intake and exposure rates defined by the ENV module and converts them to radiation dose. The calculation of external dose is done with precalculated factors from the EXTDF module, and the calculation of internal dose is done with precalculated factors from the INTDF module.

Radiation dose is proportional to the quantity of energy deposited per unit mass of irradiated tissue. The total "absorbed dose" is reported in units of "rad" (100 ergs/g) or, as in the International System of Units, commonly known as SI units, "gray," abbreviated "Gy" (1 J/kg). This is normalized to relative biological effect, depending on the type of radiation, in "dose equivalent" units of "rem" or "sievert" (Sv) in SI units. The length of time and mode of exposure designates the type of dose calculated.

ICRP 26 states that special considerations must be made "when the exposure is extended in time." The report defines "dose-equivalent commitment" to be the time integral of the dose rate in a given organ or tissue. The report then further defines the "committed dose equivalent" to be the dose that results " from a single intake of radioactive material into the body. This quantity, which may be considered to be a special case of dose-equivalent commitment, is the dose equivalent that will be accumulated over 50 years . . . following the intake" (i.e., a 50-year dose commitment). For convenience, a dose equivalent is usually simply called a "dose" (ICRP 1977, p. 6).

The types of doses calculated in the DOSE module include:

1. <u>One-Year Dose</u> - the population or individual dose that results from one year of exposure (external plus internal). This is the dose currently used for comparison with occupational exposure standards and the one originally used for comparison with public standards.

   The one-year dose is now used at Hanford as a measure of potential short-term impact from accidental releases during waste management operations. This situation is illustrated in Figure 3.1, where "Intake" shows a constant rate of radionuclide intake (through inhalation and/or ingestion) and "Dose Rate" shows the resulting dose rate to a tissue or organ. The integral of the dose rate over one year is the one-year dose (i.e., the area under the dose-rate curve).

2. <u>Committed Dose</u> - the population or individual dose that results from one year of external and internal exposure plus the extended internal dose that results from the one-year intake (ingestion plus inhalation). Normally, a 50- or 70-year dose-commitment period is used (i.e., the one-year intake period plus 49 or 69 years). This dose is the one currently being used by most of those who calculate public doses.

   The committed dose is used as a measure of the potential, longer-term impact of accidents and routine releases. This situation is illustrated in Figure 3.2, where "Intake" is the same as in Figure 3.1 and shows a constant rate of radionuclide intake over a one-year period. "Dose Rate" in Figure 3.2 shows the resulting dose rate, and the initial portion of the curve is identical to that of Figure 3.1. However, the residual radioactive material left in the body continues to produce a dose after the initial one-year period ends. The integral of the dose rate over 50 or 70 years gives the committed dose that results from one year of intake.

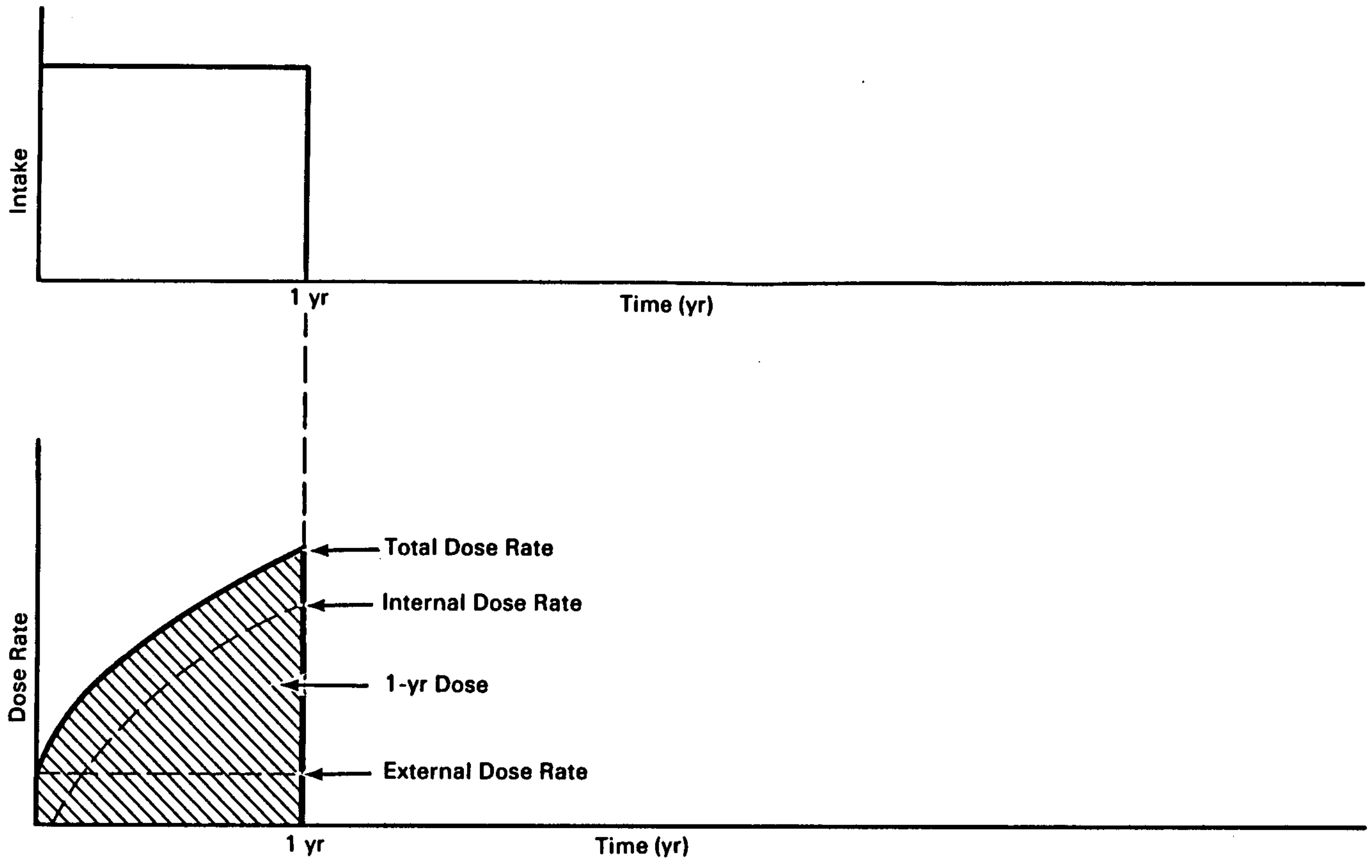

FIGURE 3.1. Situation Showing Constant Rate of Radionuclide Intake and Resulting One-Year Dose Rate to Tissue or Organ

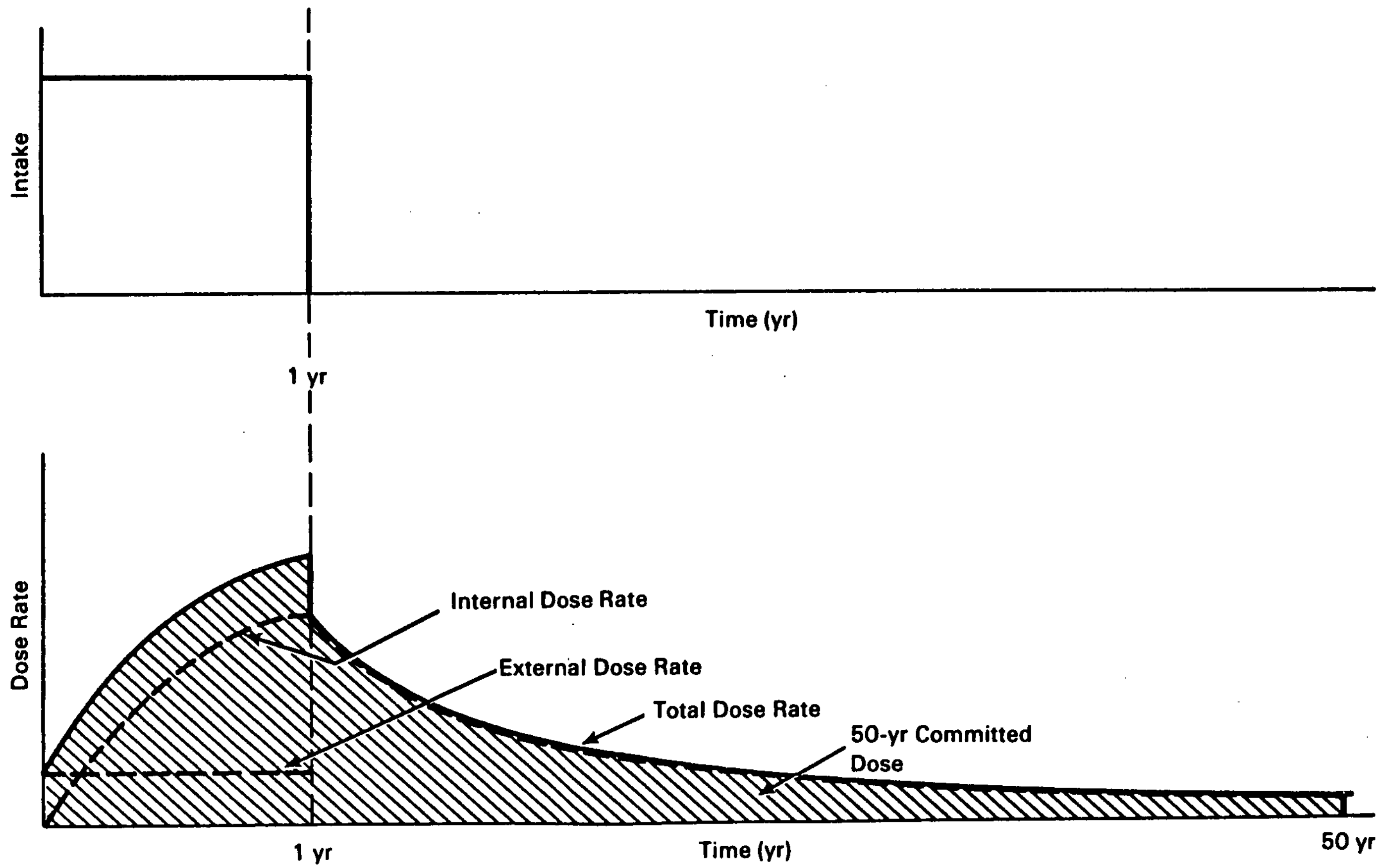

FIGURE 3.2. Situation Showing Committed Dose from One-Year Internal and External Exposure Plus Extended Internal Dose

3. Cumulative Dose - the population or individual lifetime dose (50- or 70-year) that results from external exposure plus intake via ingestion and inhalation. This includes the dose from radionuclides that accumulate (and physically decay) in the environment during the exposure period. The cumulative dose is used to assess the total potential impacts from operations that have chronic releases over a period of several years or from significant deposition resulting from accidents.

   Some parameters can be varied in calculating cumulative dose. One example used in the Hanford annual surveillance reports between CY 1982 and CY 1987 (Jaquish 1987) is a one-year release of radionuclides with resulting residual environmental contamination. The resulting rate of radionuclide intake is illustrated in Figure 3.3, "Intake." The residual environmentally deposited radionuclides decrease by physical decay. The resulting dose rate is illustrated in Figure 3.3, "Dose Rate."

   A more complicated example, shown in Figure 3.4, is of a release that continues for more than one year. Scenarios of this sort are routinely used in prospective estimates of the total potential impact of a facility (e.g., environmental impact statements or EISs).

4. Maximum Annual Dose - the largest annual dose that could occur during a specific period (e.g., 50 or 70 years). This calculation accounts for each year's external exposure plus the internal dose from radionuclides taken in during the year of interest and all previous years. The maximum annual dose is identified by including all organ doses. This type of dose estimate corresponds most closely to the existing annual dose limits for occupational and public exposure.

   The maximum annual dose is calculated for scenarios that consider human intrusion or long-term casual exposure to disposed wastes, for EISs, and for the allowable residual contamination level (ARCL) evaluations used for decommissioning operations. The maximum

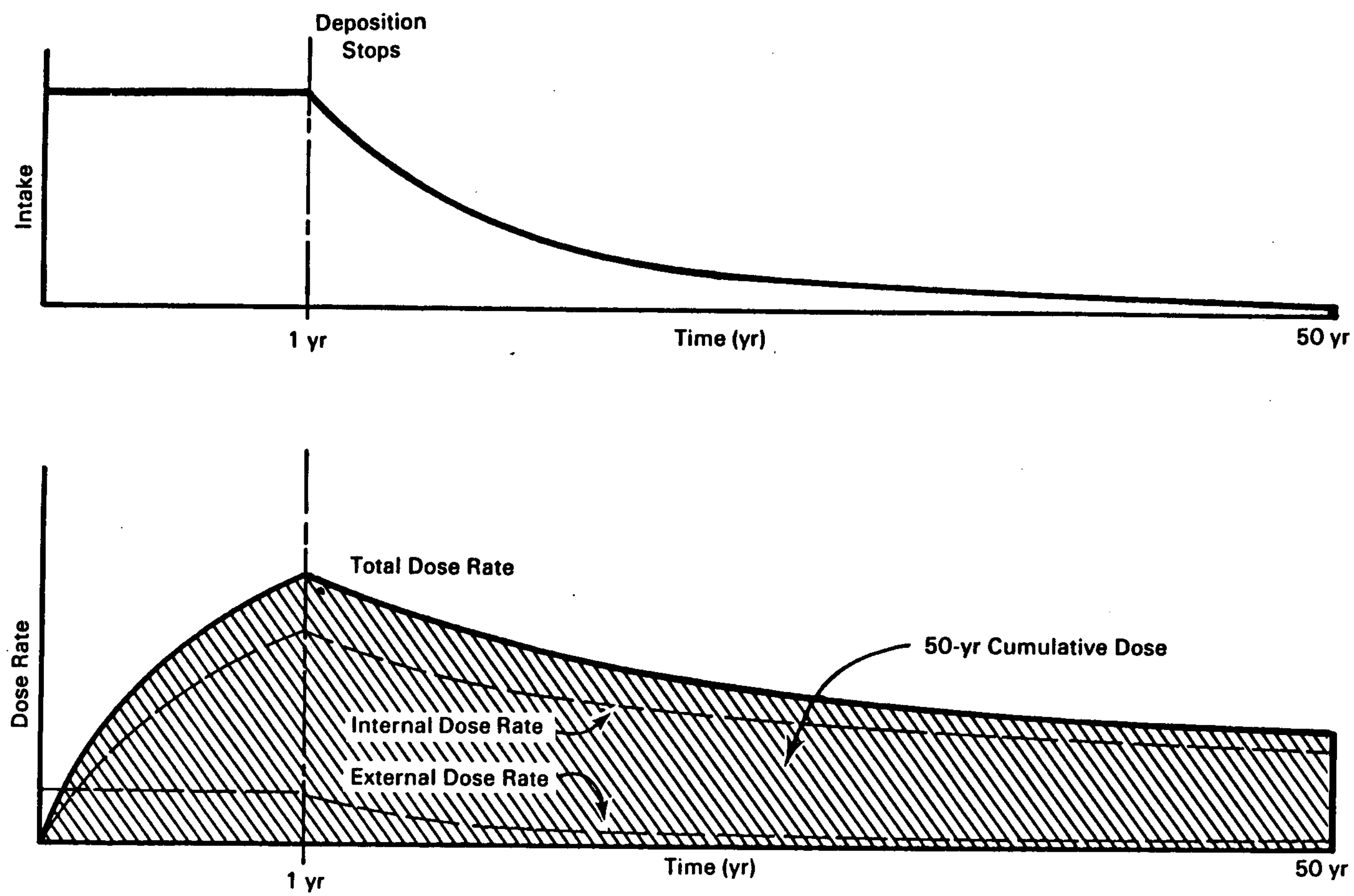

FIGURE 3.3. Situation Showing Cumulative Dose Resulting from Residual Environmental Contamination

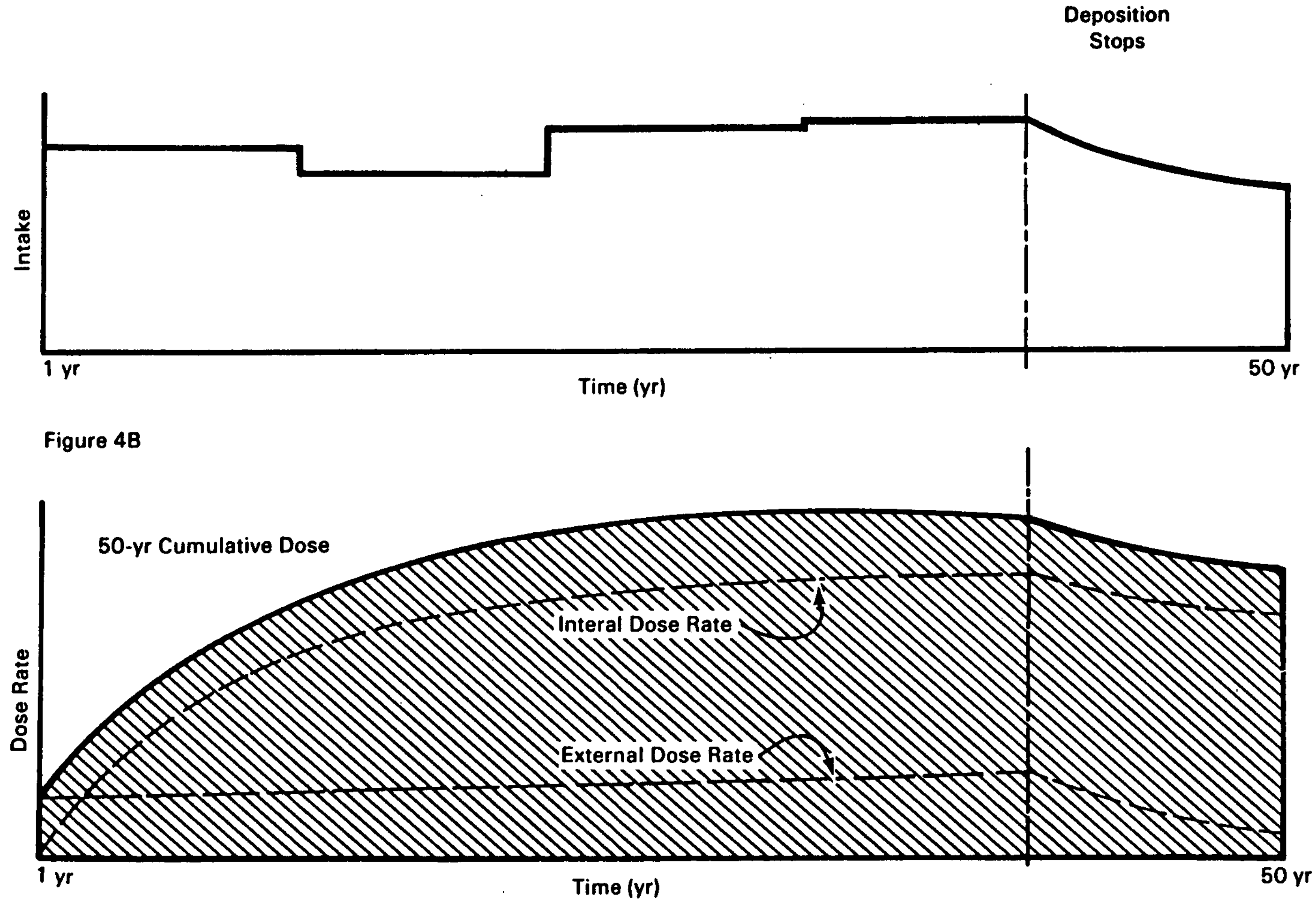

FIGURE 3.4. Situation Showing Radionuclide Release That Continues for More Than One Year

annual dose is calculated by assuming an initial concentration of radionuclides in soil, concrete, piping, and other materials. These concentrations are reduced over time by physical decay. The annual dose rate to the exposed individual from internally deposited radionuclides increases until the body burden reaches equilibrium with the environmental levels of the physically decaying radionuclides. The year that equilibrium occurs usually corresponds to the maximum dose rate. The maximum-dose-rate year may not occur until many years after the initial exposure. This situation is illustrated in Figure 3.5.

Because annual dose rates are calculated, the dose conversion factors from ICRP 30 are not usable; they are only for 50-year committed doses following an intake. The 50-year dose conversion factors cannot simply be divided by 50 to produce an "annual dose." The ICRP 30 factors are integrals similar to those illustrated in Figure 3.2, depending on the effective half time of the radionuclides in the body (ICRP 1979-1982).

The computer code for calculating the internal dose factors, INTDF, does not itself provide these type of doses. Instead, it is used to calculate the incremental organ doses for each year following an initial intake. The output is the incremental dose to each organ, which is then used in DOSE to assemble annual doses, dose commitments, and accumulated doses. The method by which these doses are assembled is illustrated in Figure 3.6. This technique minimizes the number of calculations needed from the internal dosimetry module.

Effective dose equivalent (EDE) calculated in DOSE is calculated in the manner presented in ICRP 26 (1977). That is

$$EDE = \sum_t w_t H_t \qquad (3.4.1)$$

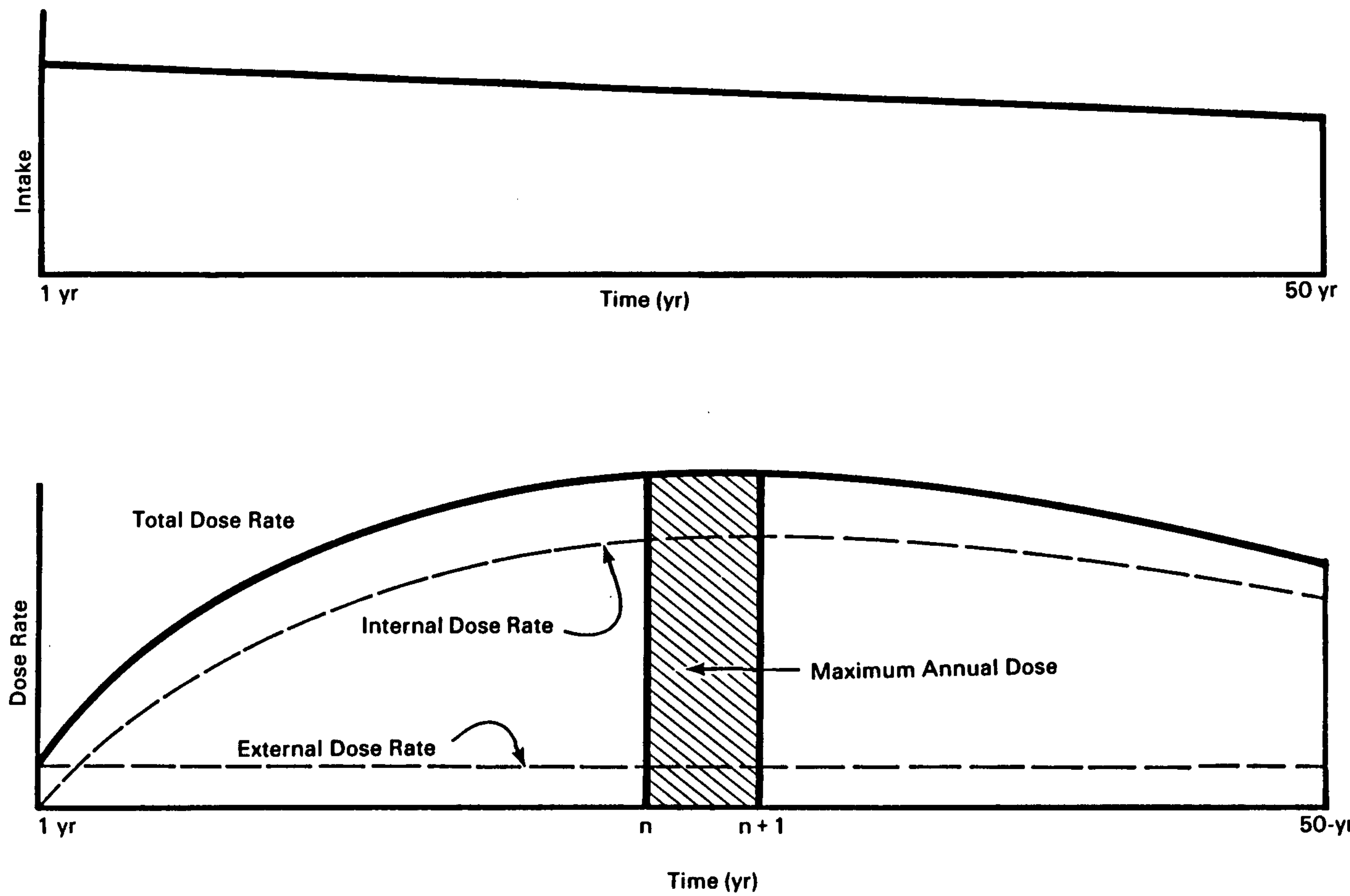

FIGURE 3.5. Situation Showing Maximum Annual Dose from Contaminating Exposure

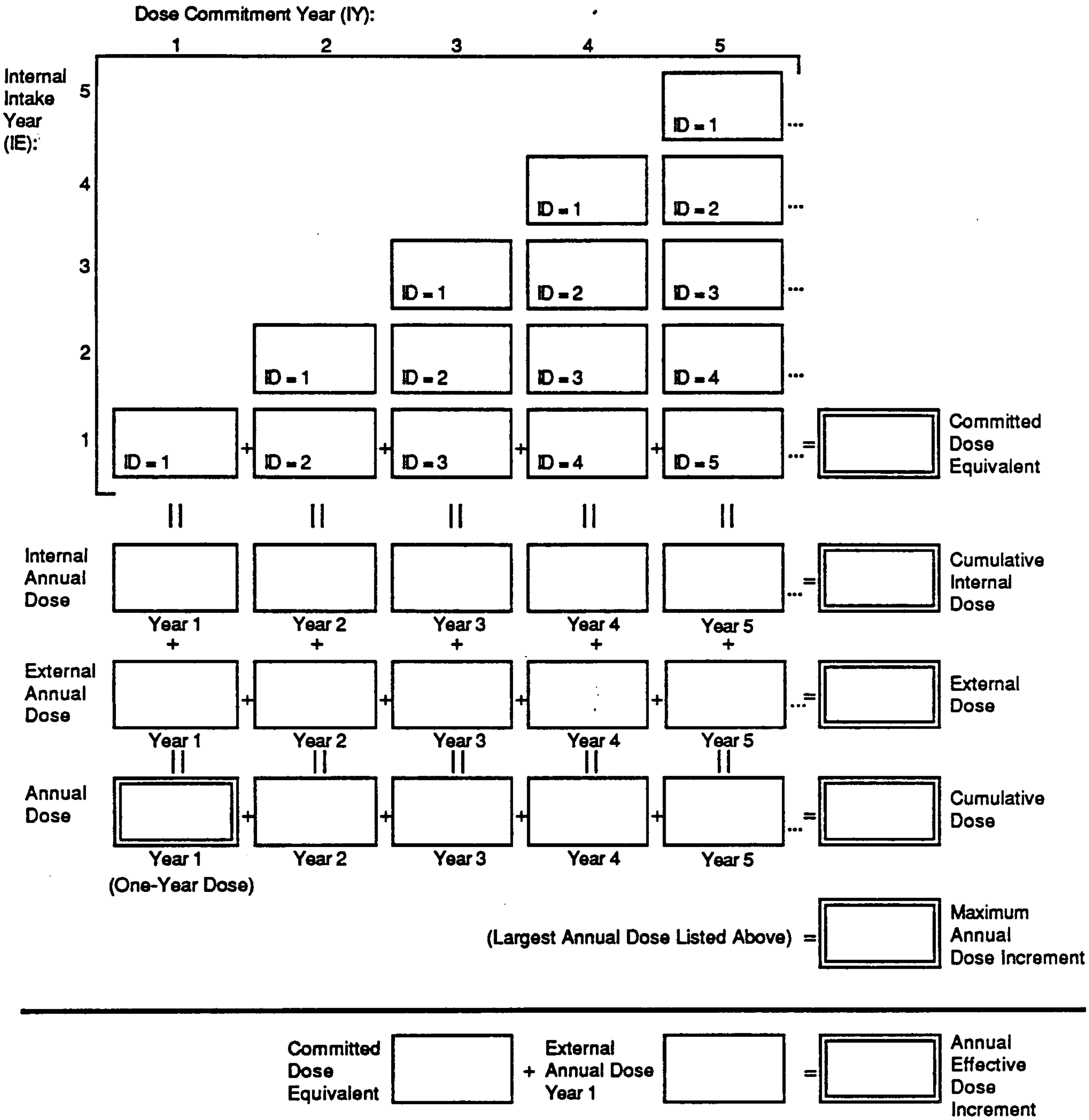

FIGURE 3.6. Conceptual Matrix Showing Calculation of Annual, Committed, and Cumulative Doses

The weighting factors (w_t) used are also those of the ICRP, given in ICRP 26 (1977) as:

Gonads	0.25
Breast	0.15
Red Bone Marrow	0.12
Lung	0.12
Thyroid	0.03
Bone Surfaces	0.03
Remainder	0.30

where the "remainder" is applied to the five other organs having the highest dose, with a weighting of 0.06 for each.

DOSE also prepares the remainder of the normal output report of doses, optional doses by pathway and by radionuclide. This output is combined with that from the ENVIN routine to comprise the total routine reports.

3.5 EXTDF

The EXTDF module is incorporated into the GENII package to allow easy and uniform calculation of external dose-rate factors for submersion in an infinite cloud of radioactive materials, immersion in contaminated water, and direct exposure to plane or slab sources of contamination. The EXTDF capability also allows for the creation of special dose-rate factors for sources of other geometries in the GENII system. The EXTDF code is a modification and enhancement of the well-known shielding code ISOSHLD (Engel, Greenborg, and Hendrickson 1966). The portion of ISOSHLD that can be used to calculate source strength from reactor fission fuel (the RIBD routines) has been eliminated. The data libraries of radionuclide decay information and gamma and beta yields have been updated from the DRALIST compilation of Kocher (1981b).

The ISOSHLD code uses a point kernel integration technique; i.e., the dose at the exposure point is the contribution from a large number of individual point sources. A numerical integration is carried out over the source volume to obtain the total dose. For a limited number of geometries, an analytical solution is used. The geometries available in the EXTDF are the standard 14 available in ISOSHLD, as listed in Table 3.1.

TABLE 3.1. Available EXTDF Geometries

Source Configuration	Shield Configuration
Point	Slab
Line	Slab
Spherical	Spherical
Spherical	Slab
Truncated Cone	Slab
Infinite Plane	Slab
Infinite Slab	Slab
Disc	Slab
Cylindrical (side)	Cylindrical
Cylindrical (side)	Slab
Cylindrical (side)	Cylindrical and Slab
Cylindrical (end)	Slab
Rectangular	Slab
Annular Cylinder	Cylindrical and Slab

EXTDF is limited to calculating normalized dose rate factors. It is not available for routine shielding calculations because it automatically reads and computes factors for unit inventories of all radionuclides in the GENII master nuclide library.

3.6 INTDF

The INTDF code is used to make estimates of the dose equivalents in a number of target organs from the activity in a given source organ. For each type of radiation i, the dose equivalent H_i in target organ T from radionuclide j in source organ S is the product of two factors:

- the total number of nuclear transformations of radionuclide j in organ S over the period of interest following intake
- the energy absorbed per gram in target organ T, suitably modified for the quality factor, from radiation of type i per transformation of radionuclide j in source organ S. In other words, for each radiation of type i from radionuclide j.

$$H(T \leftarrow S)_i = U_S \bullet 1.6 \bullet 10^{-13}\ SEE(T \leftarrow S)_i \bullet 10^3 \qquad (3.6.1)$$

where U_S = the number of transformations of radionuclide, j, in source organ, S, over the period of integration following intake of the radionuclide

$1.6 \bullet 10^{-13}$ = the number of joules in 1 MeV

$SEE(T \leftarrow S)_i$ (in MeV g^{-1} per transformation) = the specific effective energy for radiation type i, suitably modified by quality factor, absorbed in T from each transformation in S

10^3 = the conversion factor from g^{-1} to kg^{-1}.

In general, for the intake of any mixture of radionuclides, i.e. parent with daughters, the dose in target organ T from radioactivity in several different sources S is given by

$$H = 1.6 \bullet 10^{-10} \sum_S \sum_j [U_S \sum_i SEE(T \leftarrow S)_i]_j \qquad (3.6.2)$$

Most of the effort expended in the INTDF code is in calculating the integrated retentions of parent and daughter radionuclides in the source organs. Specific Effective Energies ($SEE(T \leftarrow S)$) for Reference Man (ICRP 1975) were obtained from Oak Ridge National Laboratory (ORNL) on magnetic tape.

The number of transformations of a radionuclide in any organ or tissue of the body during any period of time is the time integral of activity of the radionuclide within that organ or tissue over the stated period of time, referred to as U_S in the above equations. The function describing uptake and retention of a radionuclide in a body tissue following its ingestion or inhalation may be very complex. With certain exceptions (e.g., alkaline earth radionuclides in bone or iodine in the thyroid), the models used for this effort are based on the assumption that the body consists of a number of separate compartments. Any organ or tissue may comprise one or a number of compartments. Loss of the radionuclide from any compartment is assumed to be governed by first order kinetics. Therefore, the retention of any element in any organ or tissue will usually be described by either a single exponential term or the sum of a number of exponential terms.

The compartment model used for the respiratory system is that of the ICRP Task Group on Lung Dynamics (ICRP 1966). The Task Group Lung Model (TGLM) has been slightly revised by Johnson and Carver (1981) to simplify the differential equations describing the retention of material in the tracheobronchial compartment, which is the formulation currently used.

The compartment model of the gastrointestinal tract (GI tract) is based on the model developed by Eve (1966). This is the same model used by ICRP 30 (1979-1982) and Johnson and Carver (1981). The GI tract is assumed to consist of four sections, the stomach, small intestine, upper large intestine, and lower large intestine.

After a radionuclide has been inhaled or ingested it will be translocated to the body fluids at a rate determined by the rate constants for the different compartments in the respiratory and gastrointestinal systems and by the radioactive decay constant of the radionuclide. Its translocation thereafter to the compartments representing the various organs and tissues of the body is represented in the model by a transfer compartment, which is assumed to be cleared by first order kinetics with a half time of 6 hours, unless specifically given a different rate constant in the metabolic data. Transformations occurring in the transfer compartment are assumed to be uniformly distributed throughout the body.

3.7 DITTY

The codes described above are intended to consider the environmental consequences in the near term (approximately 0 to 100 years) following releases to the environment. Such programs are useful for most nuclear fuel cycle facilities, except nuclear waste disposal sites, which may have long-term impacts. The long transport times through waste barriers and ground water aquifers require that longer time periods be considered. The computer code DITTY was developed to calculate the total population exposure over long time periods (Napier, Peloquin, and Strenge 1986). This code was incorporated, with only minor revisions, into the GENII package to provide the necessary capability to evaluate long-term releases.

Total population exposure is dependent on many parameters that are subject to large variations over thousands of years. Therefore, the user must realize that the calculated results from use of DITTY are only estimates and are limited in accuracy by the validity of the input assumptions. The time variant input parameters include 1) air and water source terms, 2) atmospheric dispersion patterns, and 3) exposed population.

Source terms of DITTY may be defined for releases to the atmosphere or to water. Releases to water may be to wells or surface water via ground water. The actual release rates are specified in an input file as the curies per year released for selected years following time zero for the calculation. One such data set is defined for each radionuclide of interest. Sophisticated ground water transport programs are generally used to determine the time variant release rate following transport from a geologic repository to the environmental access point (well or surface water). A similar definition of release rate as a function of time is needed for atmospheric releases.

For releases to the atmosphere, estimates of dispersion patterns are needed to determine total exposure of the regional population. The purpose of the dispersion calculation is to provide estimates of ground-level air concentrations of released radioactivity as a function of distance and direction from the release location. The downwind air concentrations are related back to the release rate by use of "dispersion factors," which may be either supplied as input to the program or calculated by the program. When the program calculates the dispersion factors, meteorological data must be provided in the form of joint frequency of occurrence of windspeed, wind direction, and atmospheric stability. The dispersion calculation may be performed external to the program with the results entered through input, or joint frequency meteorological data may be supplied and dispersion factors calculated as a function of distance and direction. A straight-line crosswind-averaged Gaussian plume model is used for the dispersion calculation.

The regional population is defined for airborne and waterborne pathways as a function of time. For airborne pathways, the population is defined as a function of distance and direction corresponding to the locations for which dispersion factors are given or calculated. A population-weighted dispersion factor is calculated as the sum of the product of population and dispersion factor for each location. Alternatively, the population-weighted factor may be calculated external to the program and supplied as input.

The time frame for the calculation is any 10,000-year period. This period is broken into 143 periods of 70 years each. The average release in each of these periods is calculated from source-term data provided, and the total population dose to selected organs is determined for each period, as illustrated in Figure 3.7. The activity present during any period is the sum of material released during that period (uniformly released over 70 years) and residual material in the environment from releases in previous periods. The dose is calculated for all contributing pathways of exposure, including external exposure, inhalation, and ingestion of contaminated water and foods.

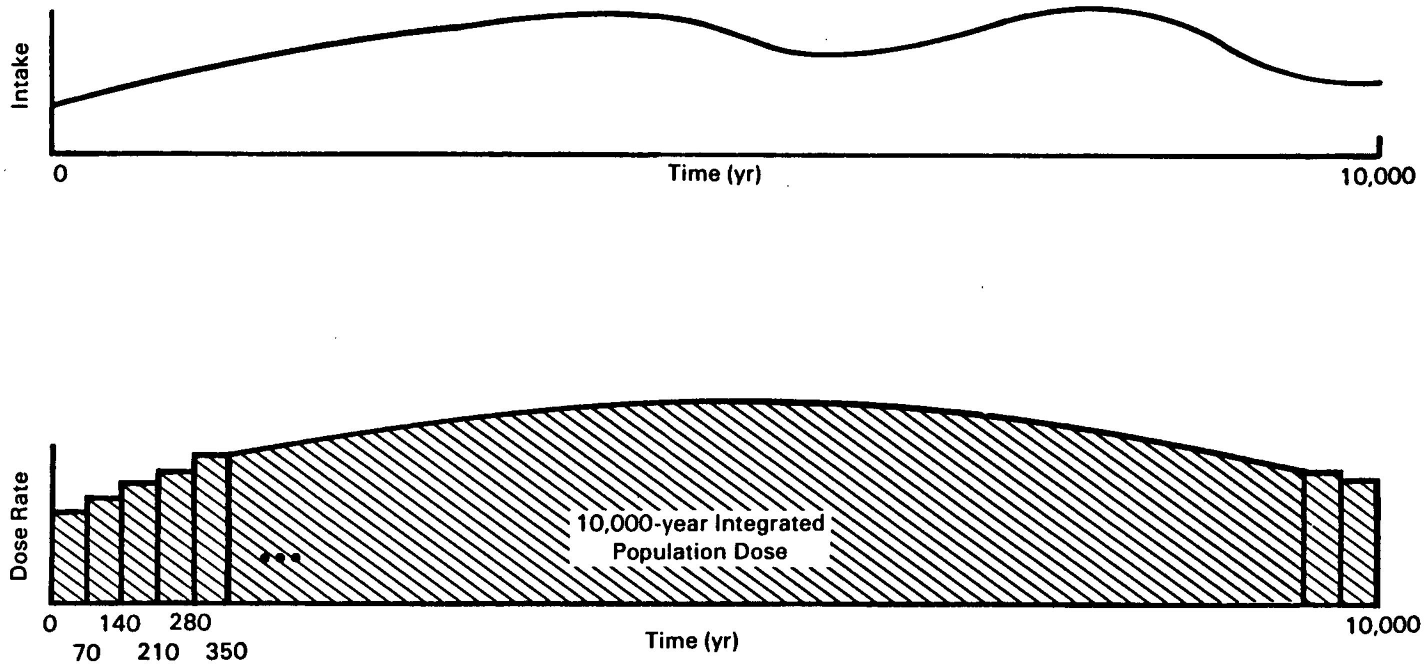

FIGURE 3.7. Calculational Scheme for Long-Term Integrated Population Doses

4.0 MATHEMATICAL REPRESENTATIONS

Section 4.0 describes the mathematical models and algorithms used in the GENII package. It is divided into two broad sections: the equations used in the short-term analyses (i.e., those for the core GENII package) and the equations used in the long-term analyses (those for the DITTY code). The first six subsections deal with the core GENII modules of internal dosimetry, external dosimetry, atmospheric dispersion, air submersion, aquatic pathways, and terrestrial pathways. The seventh subsection is, to some extent, a restating of the previous subsections in the nomenclature of the long-term calculation.

4.1 INTERNAL DOSIMETRY

For this work, estimates are made of the dose equivalents in a number of target organs from the activity in a given source organ. For each type of radiation i, the dose equivalent H_i in target organ T from radionuclide j in source organ S is the product of two factors:

- the total number of nuclear transformations of radionuclide j in organ S over the period of interest following intake
- the energy absorbed per gram in target organ T, suitably modified for the quality factor, from radiation of type i per transformation of radionuclide j in source organ S.

The number of nuclear transformations of the radionuclide in the body is a critical factor in the dose estimate. In order to implement the ICRP 30 type of calculations (ICRP 1979-1982), we have developed the INTDF code to solve this initial-value problem by means of a coupled set of differential equations.

4.1.1 The General Model

The complete compartment model or the general model used in most cases is illustrated in Figure 4.1. The TGLM lung model (ICRP 1966) and the Eve GI-tract model (Eve 1966) are connected to the transfer compartment. Each organ or tissue of deposition is assumed to consist of from one to four compartments, and from each of these compartments the radionuclide is

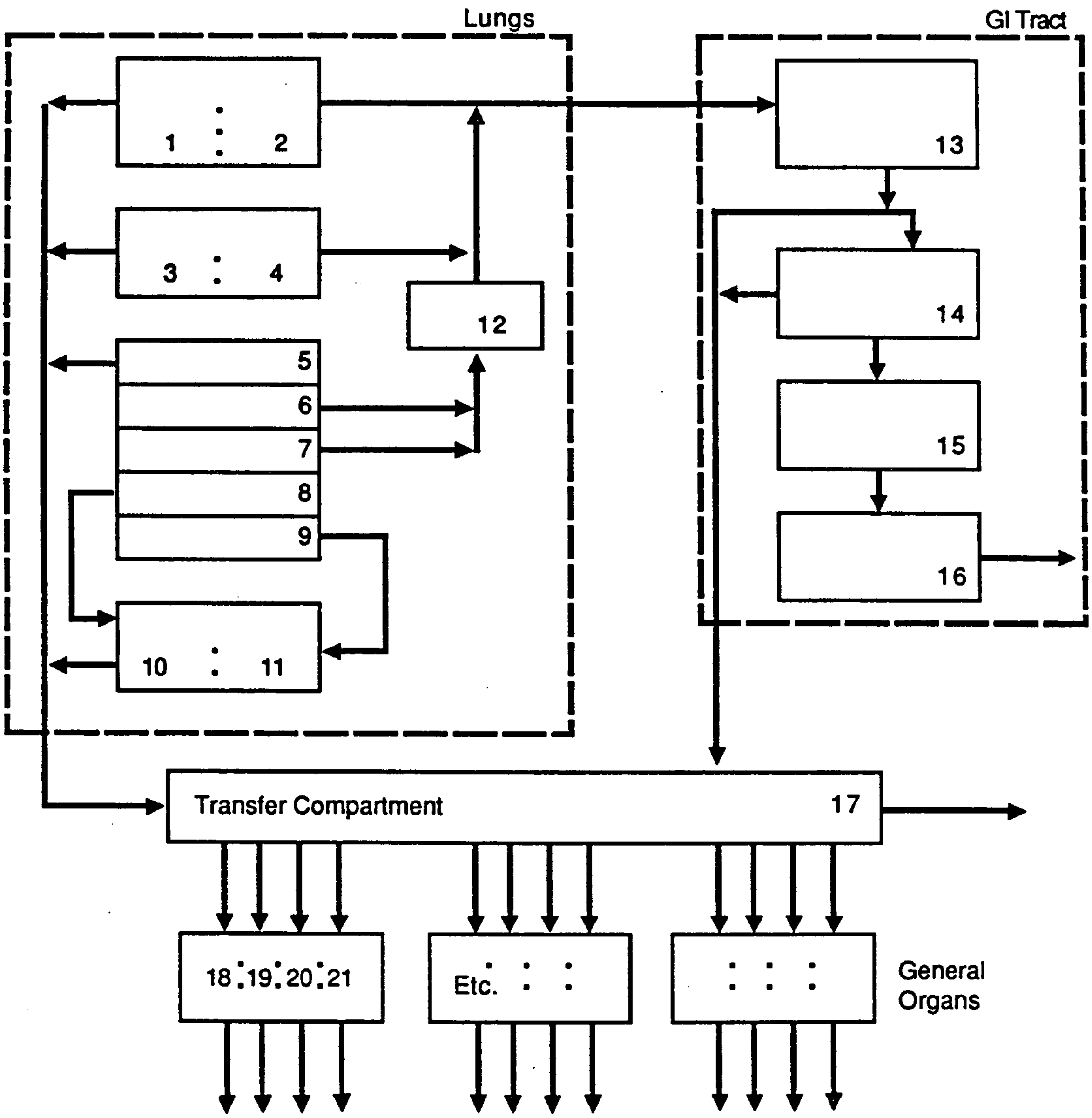

FIGURE 4.1. The General Model

translocated at an appropriate rate to the excretion pathways. For simplicity, it is assumed in the general model that no feedback to the transfer compartment occurs either from the routes of excretion or from the organ compartments. Special models for which this is not the case are described as in the following subsections.

The differential equations that govern the transport of materials through the compartments illustrated in Figure 4.1 are listed in Table 4.1. The parameters used in Table 4.1 are defined as:

Y_{ij} = the quantity of radionuclide j in compartment i as a function of time, Bq. For acute intakes, the model may be initialized with amounts of radionuclide j in compartments 1 to 9 and/or 13.

I(t) = the intake rate of radionuclide j into the body via inhalation (for equations for compartments 1 to 9) or ingestion (equation for compartment 13), Bq/day

D_i = the deposition fraction of inhaled radionuclides into the major physiological portions of the lung, dependent on the particle size. The deposition fractions used correspond to a set of equations fit to the curves in Figure 5.1 of ICRP 30, Part 1 (ICRP 1979a).

F_i = the fraction of deposited material assumed to reside in each of the lung compartments, dependent on the translocation class of the inhaled material. Values of F_i and D_i are given in Table 4.2.

λ_i = the rate constant describing the transfer of material out of compartment i, day^{-1}

Δ_{ij} = the net rate of radiological decay (or ingrowth) for radionuclide j in compartment i, Bq/day

δ_f = a Dirac delta function, where δ_f = 1.0 if f_1 is not equal to 1.0, and where δ_f = 0.0 if f_1 = 1.0

f_1 = the fractional uptake from the GI tract to the body

TABLE 4.1. Equations for the General Model Using Parameters Defined on Page 4.3

1. Lung Comparments

$$\frac{dY_{ij}}{dt} = I(t)\ D_i\ F_i - \lambda_i\ Y_{ij} - \Delta_{ij};\ i = 1,9$$

$$\frac{dY_{10j}}{dt} = \lambda_8\ Y_{ij} - \lambda_{10}\ Y_{10j} - \Delta_{10j}$$

$$\frac{dY_{11j}}{dt} = \lambda_9\ Y_{9j} - \Delta_{10j}$$

$$\frac{dY_{12j}}{dt} = \lambda_6\ Y_{6j} - \lambda_7\ Y_{7j} - \lambda_{12}\ Y_{12j} - \Delta_{12j}$$

2. GI-Tract Compartments

$$\frac{dY_{13j}}{dt} = (\lambda_2\ Y_{2j} + \lambda_4 + \lambda_{4j} + \lambda_{12}\ Y_{12j}) + I(t) - \lambda_{13}\ Y_{13j} - \Delta_{13j}$$

$$\frac{dY_{14j}}{dt} = \delta_f\ \lambda_{13}\ Y_{13j} - \frac{\delta_f\ f_1\ \lambda_{14}}{1 - f_1} + \lambda_{14}\ Y_{14j} - \Delta_{14j}$$

where $\delta_f = 1$ if $f_1 \neq 1.0$

$\delta_f = 0$ if $f_1 = 1.0$

$$\frac{dY_{ij}}{dt} = \lambda_{i-1}\ Y_{i-1,j} - \lambda_i\ Y_{ij} - \Delta_{ij};\ i = 15,\ 16$$

3. Transfer Compartment

$$\frac{dY_{17j}}{dt} = [\lambda_1\ Y_{1j} + \lambda_3\ Y_{3j} + \lambda_5\ Y_{5j} + \lambda_{10}\ Y_{10j}]$$

$$+ \left[\left(\frac{\delta_f\ f_1\ \lambda_{14}}{1 - f}\right) Y_{14j} + (1 - \delta_f)\ \lambda_{13}\ Y_{13j}\right] - \Delta_{17}\ Y_{17j} - \Delta_{17j}$$

4. Organ Compartments

$$\frac{dY_{ij}}{dt} = f_i\ \lambda_{17}\ Y_{17j} - \lambda_i\ Y_{ij} - \Delta_{ij};\ i = 18,\ 33$$

TABLE 4.2. Deposition Fractions and Clearance Half Times(a) ($t_{1/2}$) for the Lung Model

Region	D_i(b)	Compartment	Class D F_i	Class D $t_{1/2}$	Class W F_i	Class W $t_{1/2}$	Class Y F_i	Class Y $t_{1/2}$
Naso-	0.3	1	0.5	0.01	0.1	0.01	0.01	0.01
Pharangeal		2	0.5		0.9	0.4	0.99	0.4
Tracheo-	0.08	3	0.95	0.01	0.5	0.01	0.01	0.01
Bronchial		4	0.05	0.2	0.5	0.2	0.99	0.2
Pulmonary	0.25	5	0.8	0.5	0.15	50	0.05	500
		6	0	0	0.4	1	0.4	1
		7	0	0	0.4	50	0.4	500
		8	0.2	0.5	0.05	50	0.135	500
		9	0	0	0	0	0.015	500
Lymph		10	0	0.5	0	50	0	1000
		11	0	0	0	0	0	∞

(a) Modified from ICRP 19 (1972) in days.
(b) For a 1-μm-Activity Median Aerodynamic Diameter (AMAD) aerosol.

The term Δ_{ij} is developed using a recursive application of the Bateman equations (Bateman 1910), and the technique is further described in the following section on decay. However, it is used with the standard assumption that daughters produced in vivo can be described with the same metabolic parameters as the parent radionuclide. While this assumption is in general not valid, data in most cases do not exist from which the parameters for in vivo produced daughters can be estimated. Parameters can be estimated for the daughters not produced in vivo, but in general the daughters are transported to different organs than the parent. Even if the parent and daughter go to the same organ, the parameters describing the retention of the daughter taken up by the organ rather than produced in the organ are not necessarily the same.

Because the rates of excretion of the radionuclides from the body were not part of this investigation, the equations are not included that describe the elimination of material leaving the designated organs.

4.1.2 The Alkaline Earth Model

The alkaline earth model implemented in ICRP 30 (1979-1982) calculations is based on the power function representation given by ICRP 20 (1973). The preferred model was the recycling model of Johnson (1981b). This model uses extra compartments in mineral bone to replace the power functions and includes recycling of materials through the transfer compartment. This model is illustrated schematically in Figure 4.2.

The differential equations describing the lung and GI-tract models used with the alkaline earth model are the same as those used for the general model. The differential equations describing the unique portions of the alkaline earth model are given in Table 4.3. This model replaces the general organ model of the general model with specific compartments for cancellous (trabecular) bone, cortical (compact) bone, bone surfaces, and other soft tissues. Because these compartments include inward as well as outward transfers, the notation of the equations in Table 4.3 includes λ to be transfers into a compartment, and λ' to be transfer rates out of a compartment.

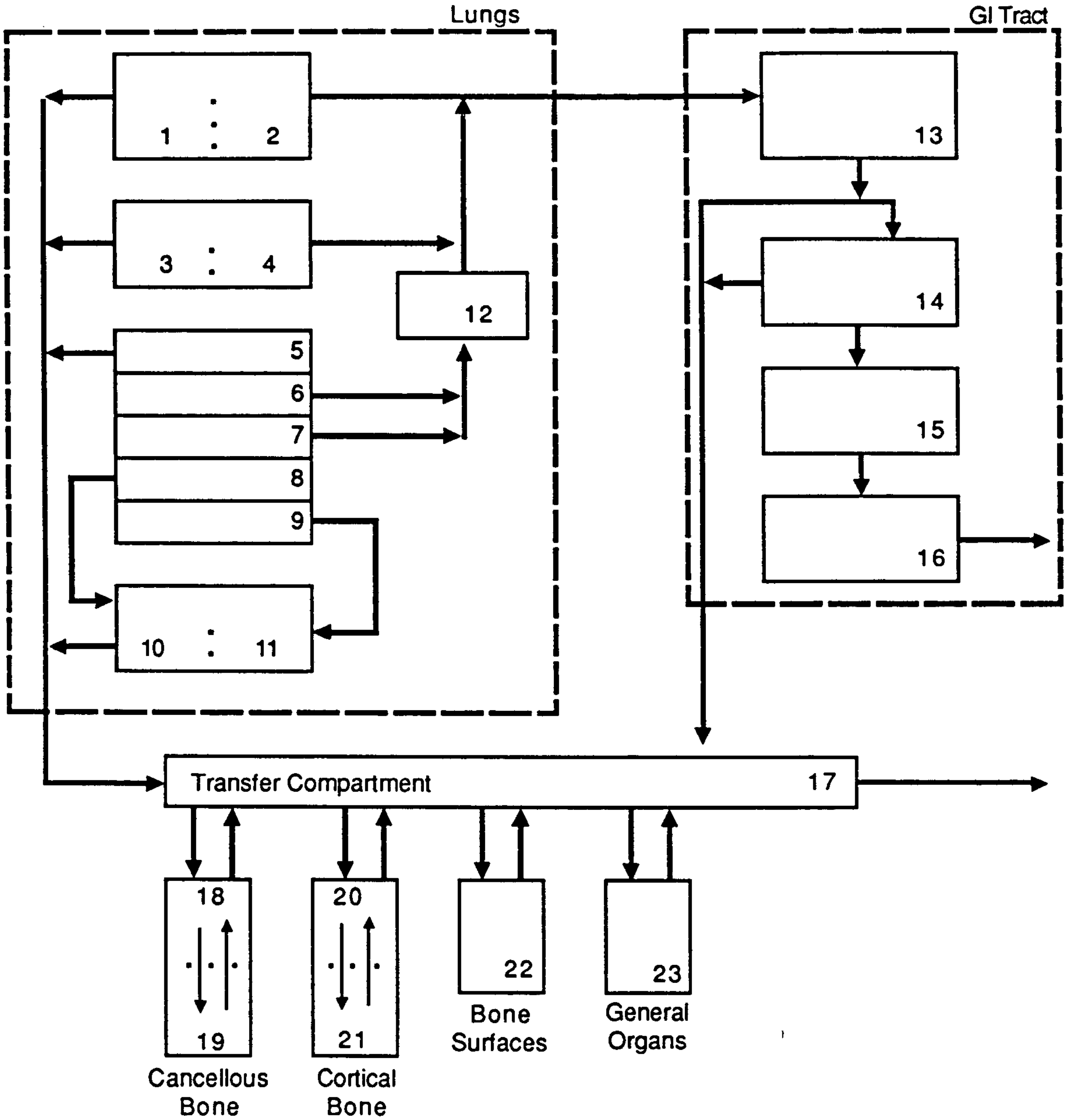

FIGURE 4.2. The Alkaline Earth Model

TABLE 4.3. Equations for the Alkaline Earth Model

1. and 2. Include Lung and GI-Tract Compartments Identical to Those of General Model

3. Transfer Compartment

$$\frac{dY_{17j}}{dt} = [\lambda_1 Y_{1j} + \lambda_3 Y_{3j} + \lambda_5 Y_{5j} + \lambda_{10} Y_{10j}]$$

$$+ \frac{\delta_f f_1 \lambda_{14}}{1 - f_1} Y_{14j} + (1 - \delta_f) \lambda_{13} Y_{13j}$$

$$+ \lambda'_{18} Y_{18j} + \lambda'_{20} Y_{20j} + \lambda'_{22} Y_{22j} + \lambda'_{23} Y_{23j}$$

$$- (\lambda_{17} + \lambda_{18} + \lambda_{20} + \lambda_{22} + \lambda_{23}) Y_{17} - \Delta_{17j}$$

4. Cancellous Bone Compartments

$$\frac{dY_{18j}}{dt} = \lambda_{18} Y_{17j} + \lambda'_{19} Y_{19j} - (\lambda'_{18} + \lambda_{19}) Y_{18j} - \Delta_{18j}$$

$$\frac{dY_{19j}}{dt} = \lambda_{19} \lambda_{18j} - \lambda'_{19} Y_{19j} - \Delta_{19j}$$

5. Cortical Bone Compartments

$$\frac{dY_{20j}}{dt} = \lambda_{20} Y_{17j} + \lambda'_{21} Y_{21j} - (\lambda'_{20} + \lambda_{21}) Y_{20j} - \Delta_{20j}$$

$$\frac{dY_{21j}}{dt} = \lambda_{21} Y_{20j} - \lambda'_{21} Y_{21j} - \Delta_{21j}$$

6. Bone Surface Compartment

$$\frac{dY_{22j}}{dt} = \lambda_{22} Y_{17j} - \lambda'_{22} Y_{22j} - \Delta_{22j}$$

7. Other Soft Tissue Compartment

$$\frac{dY_{23j}}{dt} = \lambda_{23} Y_{17j} - \lambda'_{23} Y_{23j} - \Delta_{23j}$$

4.1.3 The Iodine Model

The iodine model implemented is that of Johnson (1982), which includes the provisions for calculating doses to fetal thyroid from iodine ingestion by the mother. The lung and GI-tract models are the same as those of the general model, and the model for the maternal thyroid is essentially the same as that used for ICRP 30 (1979-1982). The model is illustrated in Figure 4.3. The differential equations that implement the model are listed in Table 4.4. All of the terms used are as defined above, with the addition of the fractional transfer terms f_f, for fraction to fetal thyroid from the maternal inorganic compartment, and f_m, for the fractional transfer to the maternal thyroid. The compartment for bladder is not used in the ICRP 30 model but is retained from Johnson in this implementation. The metabolic parameters for the thyroid are programmed into the subroutine, rather than read from the more general data library. These parameters are basically those of Johnson (1982), with the biological half time of iodine in the thyroid corrected to 80 days, as was actually used in ICRP 30 (see the errata to ICRP 30 Part 1 given at the end of ICRP 30 Part 3, 1981).

All decay products of the iodine as assumed to be stable or to escape the body before decaying (isotopes of the noble gas xenon).

The fetal thyroid model is included in the GENII system for future uses. The dose factors are not included in the routine tables of dose factor files normally accessed by the DOSE routine.

4.1.4 The Tellurium/Iodine Model

Some isotopes of tellurium decay to yield radioactive isotopes of iodine. It is assumed that all iodine produced in the body by the decay of tellurium is translocated instantaneously to the iodine inorganic transfer compartment. The metabolic behavior of iodine entering the inorganic transfer compartment this way is assumed to be governed by the model described above for iodine. The metabolic behavior of parent and daughter tellurium is governed by the general model.

The tellurium/iodine model is illustrated in Figure 4.4. The basic model is that of the general model, with the relevant portions of the iodine model included for iodine produced in the body. The equations implementing

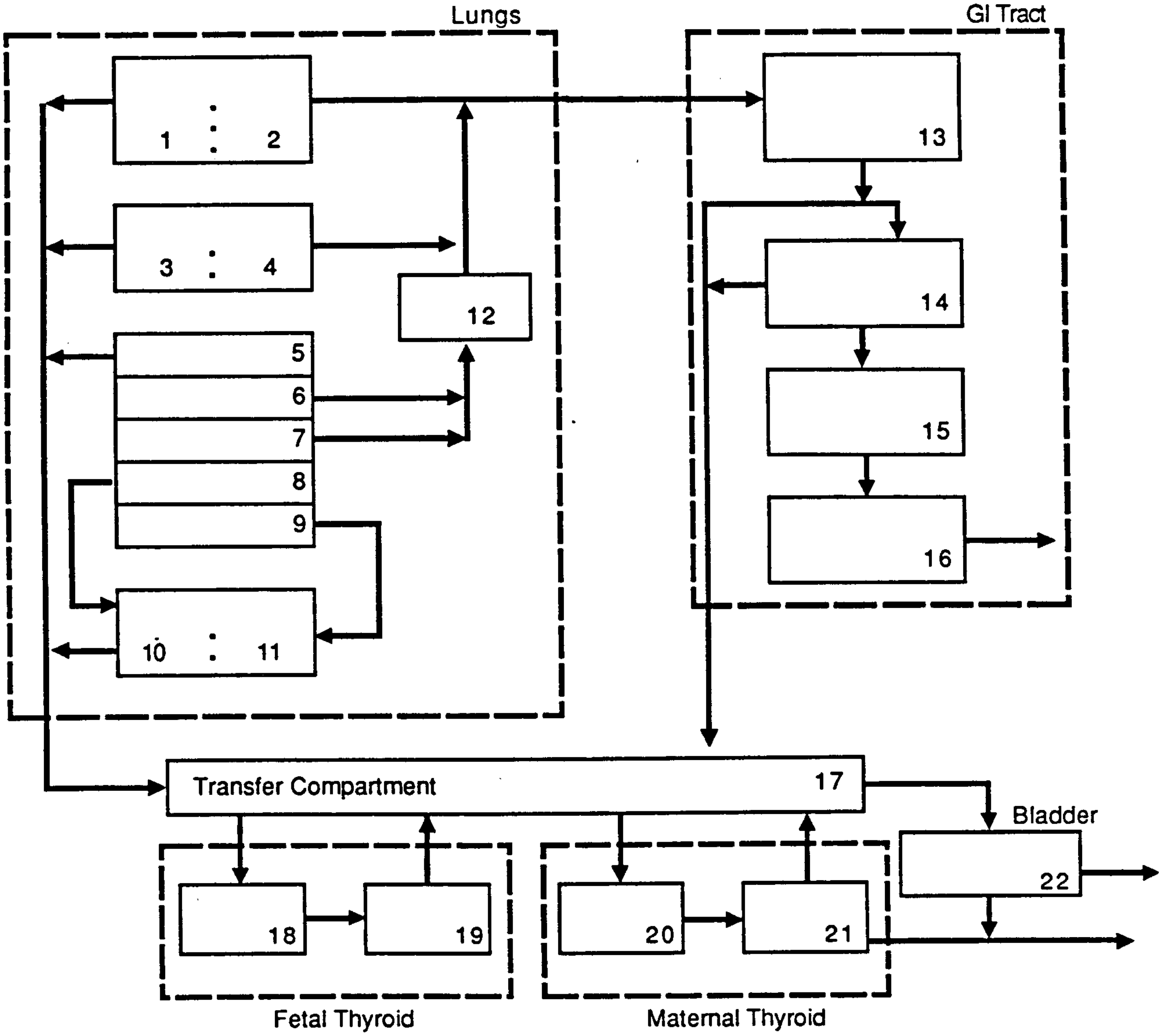

FIGURE 4.3. The Iodine Model

9 1 0 4 8 0 1 3 7

TABLE 4.4. Equations for the Iodine Model

1. and 2. Include Lung and GI-Tract Compartments Identical to Those of General Model

3. Transfer Compartment (Maternal Inorganic)

$$\frac{dY_{17}}{dt} = [\lambda_1 \lambda_{1j} + \lambda_3 Y_{3j} + \lambda_5 Y_{5j} + \lambda_{10} Y_{10j}] + \lambda_{13} Y_{13j}$$

$$+ \lambda_{19} Y_{19j} + 0.9 \lambda_{21} Y_{21j} - \lambda_{17} Y_{17j} - \Delta_{17j}$$

4. Fetal Organs (Thyroid and Organic Compartment)

$$\frac{dY_{18j}}{dt} = f_f \lambda_{17} Y_{17j} - \lambda_{18} Y_{18j} - \Delta_{18j}$$

$$\frac{dY_{19j}}{dt} = \lambda_{18} Y_{18j} - \lambda_{19} Y_{19j} - \Delta_{19j}$$

5. Maternal Organs (Thyroid and Organic Compartment)

$$\frac{dY_{20j}}{dt} = f_m \lambda_{17} Y_{17j} - \lambda_{20} Y_{20j} - \Delta_{20j}$$

$$\frac{dY_{21j}}{dt} = \lambda_{20} Y_{20j} - \lambda_{21} Y_{21j} - \Delta_{21j}$$

6. Bladder

$$\frac{dY_{22j}}{dt} = (1 - f_f - f_m) \lambda_{17} Y_{17j} - 0.1 *0.9* \lambda_{21} Y_{21j} - \lambda_{22} Y_{22j} - \Delta_{22j}$$

where $f_f = 0.0$, if age ≤ 90 days or age >270 days
$f_f = 0.03$ (age/90 - 1), if $90 <$ age ≤ 270 days
$f_m = 0.3$

7. Note: All xenon decay products are assumed to escape the body before decaying.

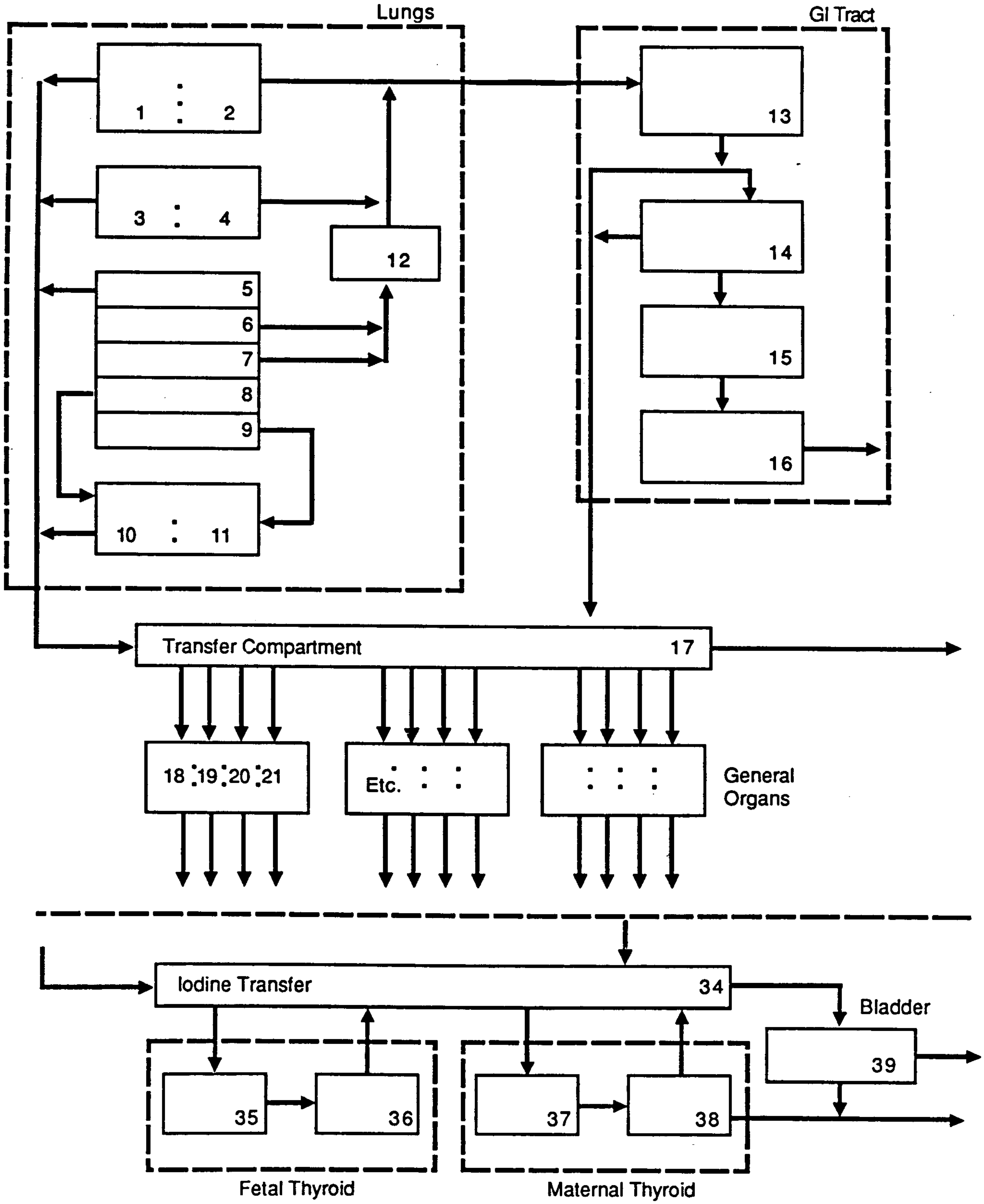

FIGURE 4.4. The Tellurium/Iodine Model

this model are essentially identical to those for the other two models, with appropriate revision of the maternal inorganic compartment to indicate that in vivo produced iodine is all moved instantaneously to that compartment. This equation is given in Table 4.5. The combination of the tellurium/iodine model including the fetal thyroid dose calculation capability is unique in our experience.

As with the basic iodine model, all xenon decay products of the iodine are assumed to escape the body before decaying.

4.1.5 The Radium/Radon Model

A special case of the alkaline earth model is implemented for the decay of Ra-226 through Rn-222. For this decay chain, radon is assumed to diffuse entirely out of soft tissues of the body before decaying and to retain only 30% in mineral bone tissues (ICRP 1979a). Daughter products of the radon are allowed to continue to build into the bone compartments. The equations used to implement this option are provided in Table 4.6.

4.1.6 The Tritium and Carbon Models

Tritium and carbon-14 are radionuclides handled by the general model (Section 4.1.1) in a slightly modified manner. Both are elements that are integral to the human metabolism.

Tritium is assumed to be in the form of tritiated water. All tritiated water ingested or inhaled is assumed to be completely and instantaneously absorbed into the transfer compartment. Tritiated water is assumed to be uniformly distributed among the soft tissues at any time following intake, where it is retained with a biological half time of 10 days. In addition, exposure to an atmosphere containing tritium results in intake of that material by absorption through intact skin. The combined total rate of intake of tritium in air is assumed to be 150% of the inhalation intake rate alone.

In a similar fashion, all intakes of carbon-14 are assumed to be completely and instantaneously absorbed into the transfer compartment. This is equivalent to assuming that inhaled material is carbon dioxide gas and that ingested materials are readily absorbed carbohydrates. Carbon is assumed to be distributed throughout the organs and tissues of the body, where it is

TABLE 4.5. Equations for the Tellurium/Iodine Model

1. All parent (tellurium) equations are identical to those of the general model.

2. Transfer Compartment (for iodine only) (Maternal Inorganic)

$$\frac{dy_{34j}}{dt} = \sum_{n} \Delta_{nj} + \lambda_{36} Y_{36j} + 0.9 \lambda_{38} Y_{38j} - \lambda_{34} Y_{34j}$$

   where n = total of all organs and all parents yielding iodine
   j = iodine index only.

3. All iodine transfers are governed as for iodine model (with the compartment indices as appropriate).

4. Note: All xenon decay products of iodine are assumed to escape the body before decaying.

TABLE 4.6. Equations for the Radium/Radon Model

1. All equations are identical to those of the alkaline earth model, with the exception of RN daughter handling.

2. Soft Tissue Compartments

   $\Delta_{ij} = 0.0$; j = RN222 index

3. Bone Compartments

   $\lambda'_{ij} = 0.3\ \Delta_{ij}$; j = RN222 index

   λ'_{ij} is then used throughout, replacing Δ_{ij}

retained with a biological half time of 40 days. This assumption is considered by ICRP 30 (ICRP 1979-1982) to yield realistic estimates for carbon-14-labeled metabolites and to overestimate doses from most other carbon-14-labeled compounds.

4.1.7 Decay Data

Radioactive nuclei sometimes decay through a number of unstable daughters before reaching a stable (or very-long-lived) end state. These decay chains are important in that the decay energies of the daughter products contribute to the total dose received from intake of the parent. The data on radionuclide half-lives, decay chains, and various fractional branching ratios within chains are largely taken from the DRALIST data of Kocher (1981b) for consistency with gamma energy data used elsewhere in the GENII code package. These data are listed in a standard library accessed by the computer codes.

Radionuclides of half-life less than 10 minutes are of little importance in environmental calculations and in terms of internal dose, except where they are members of longer decay chains. All decay data in the standard library that is used represent radionuclides with half-lives greater than 10 minutes. For chains with daughters with very short half-lives, the decay energy associated with these short-lived daughters has been assigned to the parent. This assignment includes correction of the SEE factors in the dose calculations. The appropriate branching ratios have been considered.

The computer programs within the GENII package include a generalized chain decay processor. This processor can give the activity of any member of a decay chain as a function of time from any initializing condition. Variants of the processor provide the total activities of chain members for conditions of continual input of the parent to a system. The chain processor (ACHAIN, with variants BCHAIN, DGCHAIN, etc.) operates on a recursive application of the Bateman equations (Bateman 1910).

The Bateman equations provide a simple means of solving the differential equations describing chain decay. The basic form of the equation is

$$A_n = N_{10} \left[C_1 e^{-\lambda 1t} + C_2 e^{-\lambda 2t} + \ldots + C_n e^{-\lambda nt} \right] \qquad (4.1.1)$$

$$C_i = \frac{\lambda_1 \lambda_2 \ldots \lambda_{i-1}}{\prod\limits_{\substack{j=1 \\ j=i}}^{n} (\lambda_j - \lambda_i)} \tag{4.1.2}$$

where A_n = the activity of the nth daughter

N_{10} = the initial activity of the parent at time t=0

λ_i = the decay constant for nuclide i of the chain.

For initial conditions where initial concentrations of the daughter radionuclides exist, the equations can be applied assuming each nuclide is the start of a chain. The results are then summed.

Another variant in general decay schemes is branching decay. In this case, the Bateman solution is applied by using partial decay constants (that is, the decay constant times the branching fraction) in the numerator of the constants C_i. If the decay chain branches and subsequently the two branches are rejoined (as in the natural radioactive series), the two branches are treated by this method as separate chains. The production of a common member beyond the branch point is the sum of the two paths.

4.1.8 Metabolic Data

Values for the fractional uptake of materials, their transfer coefficients from compartment to compartment, and their elimination rates are all contained in a standard computer library. The basic source of this information is the computer code GENMOD. Most of the data in this library is adapted directly from ICRP 30 (1979-1982). It also contains the specialized parameters for the alkaline earth model (Ca, Sr, Ba, Ra) of Johnson and Myers (1981).

The parameters for the iodine model have been deleted from the library and hard-wired into the computer code. This simplifies both the iodine model and especially the tellurium/iodine model.

In some instances, the parameters obtained from GENMOD have reverted to those of the ICRP because no documentation of the values that came in the original file was available. It could not be determined if those values were intentionally used. (A specific example is metabolic data for technetium in thyroid.)

The actinide metabolic data have been updated to account for the recommendations of ICRP 48 (1986). This includes new f_1 factors, as well as the half-time data and fractional uptake data for specific organs.

The data adopted from GENMOD includes metabolic data for infants (up to one year old). This portion of the data has not as yet been extensively explored. The methods of deriving this information are given briefly in Johnson and Carver (1981) and seem reasonable, but the information has not yet been verified. The data may eventually be used with some minor variations on the standard transfer rates for the lung and GI-tract model.

4.1.9 Dosimetric Data

As described above, once the integrated retentions of the radionuclides in the source organs have been calculated, the dose to each target organ is calculated for each radiation of type i from radionuclide j

$$H(T \leftarrow S)_i = U_S \bullet 1.6 \bullet 10^{-13}\, SEE(T \leftarrow S)_i \bullet 10^3 \qquad (4.1.3)$$

where U_S = the number of transformations of radionuclide j in source organ S over the period of integration following intake of the radionuclide

$1.6 \bullet 10^{-13}$ = the number of joules in 1 MeV

$SEE(T \leftarrow S)_i$ (in MeV g^{-1} per transformation) = the specific effective energy for radiation type i, suitably modified by quality factor, absorbed in T from each transformation in S

10^3 = the conversion factor from g^{-1} to kg^{-1}.

In general, for the intake of any mixture of radionuclides, i.e., parent with daughters, the dose in target organ T from radioactivity in several different sources S is given by

$$H = 1.6 \bullet 10^{-10} \sum_S \sum_j \left[U_s \sum_i SEE(T \leftarrow S)_i \right]_j \qquad (4.1.4)$$

The factors for specific effective energy are from a tape of SEE factors from ORNL.[(a)] For purposes of tabulating SEE values, the body is divided into a set of identified source and target regions with the remaining tissue assigned as "other". This region is largely muscle. The breast dose is based on the SEE values for "other" as a target.

The metabolic models used in the calculations partition the activity in the body among a number of organs and assign the residual to be uniformly distributed among the remaining tissues, generally referred to as the "other" tissue. This "other" tissue group does not necessarily correspond to that noted in the previous paragraph. Calculations of the number of nuclear transformations are performed for the lung, GI tract, transfer compartment, organs identified in the metabolic model, and the "other" tissue group (if it is identified in the model). The transformations in the transfer compartment are distributed among the "identified" organs and the "other" by mass fraction. The SEE value for "other" as a source is computed as

$$SEE(T \leftarrow TB) = \frac{M_{TB}\ SEE(T \leftarrow TB) - \sum_S M_S\ SEE(T \leftarrow S)}{M_{OTHER}} \tag{4.1.5}$$

where M_{TB} and M_S are the masses of the total body and source organs. The summation extends over all explicitly identified organs (source regions) in the metabolic model. The mass of the "other" tissue is

$$M_{OTHER} = M_{TB} - \sum_S M_S \tag{4.1.6}$$

The computer code for calculating internal dose, INTDF, does not itself provide effective dose equivalent (whole body dose). Instead, it calculates the incremental organ doses for each year following an initial intake. The output is the incremental dose to each organ, which is then used in other portions of the code to assemble annual doses, dose commitments, and

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(a) Personal communication from Keith Ackerman of Oak Ridge National Laboratory, Oak Ridge, Tennessee.

accumulated doses. The method by which these doses are assembled was described in Section 3.4.

4.2 EXTERNAL DOSIMETRY

The ISOSHLD code that is the basis of the EXTDF module of GENII has been documented and verified numerous times (Engel, Greenborg, and Hendrickson 1966; Simmons et al. 1967; Mansius 1969). It is a basic shielding code using the commonly accepted techniques of Rockwell (1956) or other standard references. Only the basic theory is reproduced here.

4.2.1 Point Kernel Integration

Figure 4.5 illustrates a point source of gamma-ray photons, S_o (in this example within a large cylindrical volume, S_v), that emits with equal intensity in all directions.

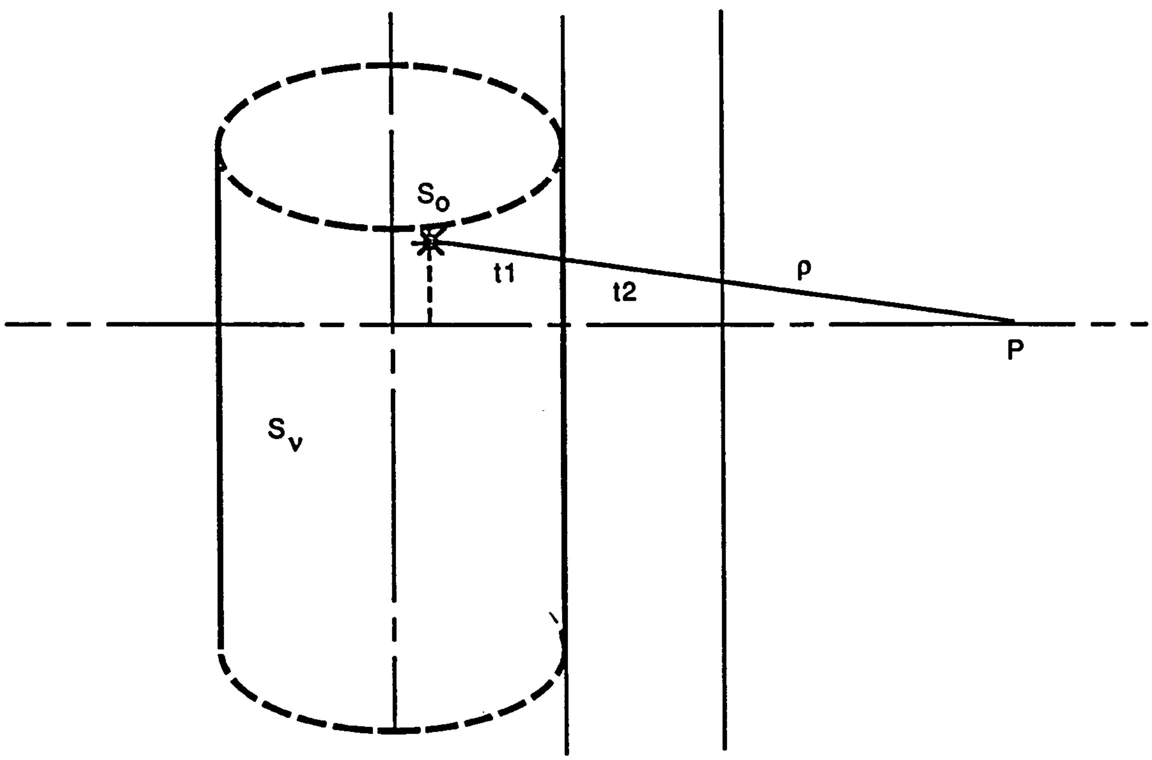

FIGURE 4.5. Point Source (S_o) Within a Finite Cylindrical Volume (S_v) at a Distance p from Point P Through Shields of Thickness t1 and t2

The dose rate at point P from photons originating at S_o is given by

$$D = \frac{S_o B\ e^{-b_1}}{K 4 \pi \rho^2} \tag{4.2.1}$$

where $b_1 = \sum_{i=1}^{N} \mu_i t_i$

D = dose rate, R/h

S_o = emission rate of gamma rays, photons/sec

B = build-up factor, dimensionless

μ_i = linear absorption coefficient of the ith shield, cm^{-1}

t_i = slant distance through the ith shield, cm

K = conversion of gamma-ray flux to dose rate

ρ = distance from source to dose point, cm

N = number of shields.

The dose rate at point P from photons of all initial energies originating at all points within the source volume, S_V, is given by

$$D_{tot} = \int_E \int_V \frac{S_o(E,V)\ B(E,b_1)\ e^{-b_1}}{K(E)\ 4\pi\rho^2(V)}\ dV\ dE \tag{4.2.2}$$

Equation (4.2.2) may be analytically integrated for a few simple geometries, and this technique is used to obtain some of the extended source dose formulas given in the shielding handbooks (Rockwell 1956; Etherington 1958; Blizard 1962). This equation may be numerically integrated for virtually any source geometry; however, only regular geometric shapes are normally considered suitable for computer integration. Complex geometric shapes are generally constructed by synthesis of simple shapes.

This numerical integration technique (commonly referred to as point kernel integration) divides the source volume into a number of differential volumes. The source energy is divided into a number of energy groups narrow enough to consider the build-up factors, attenuation coefficients, and dose conversion factors consistent over the energy range of the group. Each monoenergetic differential volume source is then treated as a point source, and the dose from each of these point sources is calculated. For each point source, new values of B, μ_i, t_i, ρ, S_o, b_1, and K are needed and are calculated using trigonometric relationships and basic data appropriate to the system geometry, source photon energies, and materials. Integration over source volume and source energy is then obtained by summing the dose contributions from all differential source volumes over all source energies.

4.2.2 Mixed Mass Attenuation Coefficients

Linked to EXTDF is a library of mass attenuation coefficients in 16 energy groups for 20 common materials. These materials are water, tissue, air, hydrogen, lithium, carbon, aluminum, titanium, iron, nickel, zirconium, tin, tungsten, lead, uranium, ordinary and magnetite concretes, strontium, promethium, and cerium. The attenuation coefficients are listed for materials of unit density. For each source and shield region, the code input requires the library material number and the material density. Up to five materials per region are allowed. Thus, EXTDF calculates region mixed mass attenuation coefficients, μ_i, for each region, i, by

$$\mu_i = \sum_j d_j \mu_j \qquad (4.2.3)$$

where j is the index of materials specified to be in region i. If a combination of the previous 10 materials will not adequately describe a desired shield material, the code user may add additional materials to this library.

4.2.3 The Build-Up Factor

Linked to EXTDF is a build-up factor library that contains, for 16 photon energies, the coefficients A, α_1, and α_2 of Taylor's equation (Rockwell 1986)

$$B = A\, e^{-\alpha_1 b_1} + (1-A)\, e^{-\alpha_2 b_1}, \qquad (4.2.4)$$

for dose build-up from a point isotropic source in seven materials: water, aluminum, iron, tin, tungsten, lead, and uranium. This material range covers the effective atomic numbers (EANs) from 4 to 92. The data in this library were taken from Goldstein (1959, p. 376).

In the process of kernel integration, the build-up factor for each differential source volume is calculated for all of the materials between source point and dose point. Values of t_i, the source point to dose point line of sight distance through the source and shield regions, are calculated for each new source point by trigonometric relationships. Values of μ_1 for each shield region are obtained from Equation (4.2.3). EXTDF then calculates b_1 for the line of sight from the source point to dose point, and b_1 is used in Taylor's equation to obtain the correct build-up, B.

Several considerations are discussed here in regard to how A, α_1, and α_2 (from the build-up factor library) are used. The method of selection is by effective atomic number. The EAN has been defined in a number of ways (discussed in Murty 1965); however, within EXTDF it is defined as

$$\mathrm{EAN} = \frac{\sum_j \frac{d_j Z_j}{A_j}}{\sum_j \frac{d_j}{A_j}} \tag{4.2.5}$$

where Z_j = atomic number of species j in the shield
A_j = atomic weight of species j in the shield
d_j = density of species j in the shield.

A particular shield region should be chosen whose characteristics will be used in calculating build-up through all shields in the system. This region is usually the last shield region, provided the region is thick compared to the sum thickness of the other regions. If no build-up region choice is made, the code will use the last defined region. The EAN is then calculated for the chosen region. EXTDF brackets this effective atomic number in the build-up factor table, calculates the build-up factors for both effective atomic numbers available in the library, and then interpolates to obtain the final build-up factor for use in the numerical integration.

Because the atomic weight for each material in the library is required for use in evaluating EAN, an effective atomic weight (EAW) was defined for the mixed elemental materials given in the library. These were calculated by

$$EAW = \frac{\sum_k N_k A_k}{\sum_k N_k} \tag{4.2.6}$$

where N_k is atomic density of species K in the mix, and A_k is the atomic weight of species k in the mix.

In summary, the build-up treatment in EXTDF includes all mean free paths in material between the source point and dose point and has the build-up characteristics of the last (or a particular specified shield region).

4.2.4 Conversion of Surface Dose to Effective Dose Equivalent

External dose rate calculations traditionally end at an exposure rate in air, in R/hr or equivalent units. The EXTDF results are used in conjunction with internal dose factors expressed in terms of effective dose equivalent, i.e., the weighted sum of organ doses. Therefore, all results are converted to effective dose equivalent using energy-dependent surface-dose to organ-dose conversion factors derived from information in Kocher (1981a). These values were derived from dose-rate factors for monoenergetic sources at the body surface given by O'Brien and Sanna (1976) and from scattered spectra for monoenergetic sources in an infinite atmospheric cloud given by Dillman (1974); the calculations were performed by Eckerman and Kerr in Kocher (1981a). The results are comparable to, but slightly larger than, those given by Kocher (1979) and Till and Meyer (1983). For GENII, these were weighted with the ICRP 26 (1977) organ weighting factors and summed to give the surface-dose to effective dose equivalent conversion factors listed in Table 4.7.

TABLE 4.7. Photon Energy Group Definitions Conversion Factors Used in the EXTDF Code

Group	Photon Energy Range, MeV	Average Photon Energy, MeV	Surface Dose to EDE Factor (rem/rad)
1	0.01 - 0.02	0.015	0.0424
2	0.02 - 0.03	0.025	0.131
3	0.03 - 0.04	0.035	0.267
4	0.04 - 0.05	0.045	0.410
5	0.05 - 0.06	0.055	0.507
6	0.06 - 0.07	0.065	0.550
7	0.07 - 0.08	0.075	0.59
8	0.08 - 0.09	0.085	0.62
9	0.09 - 0.1	0.095	0.65
10	0.1 - 0.2	0.15	0.67
11	0.2 - 0.3	0.25	0.66
12	0.3 - 0.4	0.35	0.65
13	0.4 - 0.55	0.475	0.65
14	0.55 - 0.75	0.65	0.66
15	0.75 - 0.9	0.825	0.67
16	0.9 - 1.1	1.0	0.68
17	1.1 - 1.35	1.225	0.7
18	1.35 - 1.6	1.475	0.72
19	1.6 - 1.8	1.7	0.74
20	1.8 - 2.0	1.9	0.76
21	2.0 - 2.2	2.1	0.765
22	2.2 - 2.4	2.3	0.77
23	2.4 - 2.6	2.5	0.775
24	2.6 - 2.8	2.7	0.777
25	2.8 - 3.2	3.0	0.78

4.3 ATMOSPHERIC DISPERSION

The dose to a receptor from an atmospheric release depends on the spatial and temporal distribution of radionuclides in the environment. This distribution is a function of the way in which the material is released and of the environment between the release point and the receptor. Atmospheric dispersion models describe the transport and diffusion of material released to the atmosphere. They may also describe the depletion of material as a result of deposition on surfaces, washout by precipitation, chemical transformations, and radioactive decay. Kao's report (1984) contains mathematical derivations of several general diffusion models.

Selection of a dispersion model for a specific application should be based on intended model use, source characteristics, and available meteorological data. Simple atmospheric models are appropriate for making concentration estimates to be used in evaluating potential doses for environmental impact statements and preliminary safety analyses because the releases are hypothetical, the receptors are not in the immediate vicinity of the release point, and the evaluation is based on assumed meteorological conditions. The simple models may also be appropriate for assessing the consequences of a routine release if the release is constant for prolonged periods and if no systematic spatial variations of the meteorological conditions occur. More complex models are required where topography has a significant effect on atmospheric transport and diffusion. In addition, complex models should be used for evaluating the consequences of accidental releases where actual meteorological data are available. Specialized models are required if concentration estimates are needed in the immediate vicinity of a release point. These specialized models require specific information about the geometry of the release because they must treat initial plume conditions. Briggs (1984) and Hosker (1984) discuss problems associated with modeling transport and diffusion near the source.

Simple atmospheric dispersion models are appropriate for estimating radiological doses from potential routine and accidental radionuclide releases at Hanford. For cases where simple models are not appropriate, the GENII package allows input or realistic data calculated independently of the

GENII models. GENII also includes an empirical building wake diffusion model that may be used to make concentration estimates near the source.

The GENII package implements a selection of straight-line Gaussian-plume models for use when appropriate. These models are used to estimate air concentrations on a grid for 16 directions and up to 10 distances. The GENII models make use of this information, along with information on individual location or population distribution, to project exposures from atmospheric releases.

4.3.1 Gaussian Plume Models

The straight-line Gaussian plume model is the basis of a set of dispersion models that are widely accepted for routine dose assessment applications. In a strict sense, these models are appropriate if:

1) the release is from a source that has dimensions that are small compared to the distances at which concentrations are to be estimated

2) the terrain is relatively flat and has uniform surface conditions in all directions

3) the atmospheric conditions at the time and location of the release completely control the transport and diffusion of material in the atmosphere.

It is not appropriate to apply these models to releases in valleys, near lake shores, or along coasts because they may produce unrealistic dose estimates.

The basic Gaussian plume model for a continuous release is

$$\bar{\chi} = \frac{Q'}{2\pi\sigma_y \sigma_z U} F(y)\ G(z) \tag{4.3.1}$$

where $\bar{\chi}$ = the concentration at the receptor (Ci/m^3)
Q' = the release rate (Ci/sec)
σ_y = the horizontal diffusion coefficient (m)
σ_z = the vertical diffusion coefficient (m)
U = the average wind speed (m/sec)
$F(y)$ = a horizontal off-axis correction term

$G(z)$ = a vertical off-axis correction term.

In this form, the x axis is assumed to be directed in the downwind (transport) direction, the y axis is directed to the left, and the z axis is directed vertically upward. The diffusion coefficients describe the spread of the plume and are functions of the atmospheric conditions and the time that it takes material to be transported from the release point to the receptor. In addition, they are frequently given as functions of atmospheric stability and distance from the source. Parameterization of diffusion coefficients is discussed in Section 4.3.2. Initial dilution of material in the plume is determined by the wind speed at the height of the release. If the release takes place at or near ground level, it is common practice to calculate the wind speed at 10 m above ground in computations.

The horizontal and vertical off-axis correction terms are dimensionless quantities that describe the decrease in concentration with increasing distance from the plume axis. The horizontal correction term has the form

$$F(y) = \exp[-0.5(y/\sigma_y{}^2] \tag{4.3.2}$$

where y is the horizontal distance to the plume axis in meters. At the plume axis, $y = 0$ and $F(y) = 1$. As the distance from the axis increases, $F(y)$ decreases in the familiar bell-shaped form that is characteristic of Gaussian curves. The initial form of the vertical off-axis correction term is similar to that given for $F(y)$. It is

$$G(z) = \exp\ \{-0.5[(z-h_e)/\sigma_z]^2\} \tag{4.3.3}$$

where z is the height of the receptor above ground in meters, and h_e is the effective release height in meters. The effective release height is the actual release height corrected as appropriate for initial plume rise or downwash. Estimating the effective release height is discussed in Section 4.3.3. Vertical diffusion is limited by the ground at the bottom of the atmosphere. Upward diffusion may also be limited. In this situation, the limit is called the top of the mixing layer.

The ground and the top of the mixing layer are generally assumed to reflect material. These characteristics are incorporated into G(z) by use of virtual sources below the ground and above the top of the mixing layer (e.g., see Csanady 1973). The resulting form of G(z) is

$$G(z) = \sum_{n=-\infty}^{\infty} \{\exp\{-0.5[(2nH-h_e + z)/\sigma_z]^2\} + \exp\{-0.5[(2nH-h_e - z)/\sigma_z]^2\}\} \tag{4.3.4}$$

where H is the mixing layer thickness (depth) in meters.

Several special cases of interest are included in this relationship. If source and receptor are at ground level and the mixing layer thickness is large compared to the vertical diffusion coefficient,

$$G(z) = 2.0 \tag{4.3.5}$$

For an elevated release and ground-level receptor, if the mixing layer thickness is large compared to the release height and the vertical diffusion coefficient, then

$$G(z) = 2.0 \exp[-0.5(h_e/\sigma_z)^2] \tag{4.3.6}$$

If the receptor is elevated but the remaining conditions remain true, then

$$G(z) = \exp\{-0.5[(h_e-z)/\sigma_z]^2\} + \exp\{-0.5[(h_e+z)/\sigma_z]^2\} \tag{4.3.7}$$

Finally, if the receptor is at ground level, the release is elevated, and the thickness is not large, then

$$G(z) = 2 \sum_{n=-\infty}^{\infty} \exp\{-0.5[(2nH-h_e)/\sigma_z]^2\} \tag{4.3.8}$$

As the plume grows vertically, it gradually becomes uniformly mixed throughout the mixing layer. Uniform mixing is reached when the vertical diffusion coefficient reaches approximately 0.8 H. Beyond the distance at which this occurs, the average concentration in the plume is given by

$$\bar{\chi} = \frac{Q'}{(2\pi)^{1/2}\sigma_y \, HU} F(y) \tag{4.3.9}$$

The Gaussian models, as defined by Equations (4.3.1) and (4.3.9), are most appropriate for estimating average concentrations for periods that are longer than the time of travel from the source to receptor and not so long that atmospheric conditions are likely to change. This restricts limits application of Equations (4.3.1) and (4.3.9) to periods of less than 12 hours and probably 6 hours or less. As the duration of a release increases, it becomes less likely that the wind direction has remained constant since the beginning of the release. To compensate for meandering of the wind, it is assumed that the material in a plume is uniformly distributed across a sector 22.5° in width ($\pi/8$ radians). With this assumption, the average concentration in a plume in which the vertical diffusion has not been limited becomes

$$\bar{\chi} = \frac{4\sqrt{2}\, Q'}{\pi^{3/2} \, x \, \sigma_z \, U} G(z) \tag{4.3.10}$$

where x is the distance between the source and receptor. In plumes with a uniform vertical concentration profile, the concentration becomes

$$\bar{\chi} = \frac{8\, Q'}{\pi \, x \, HU} \tag{4.3.11}$$

If the release continues, it becomes necessary to consider the effects of changes in atmospheric stability, wind speed, and mixing layer thickness, as well as larger changes in wind direction. Equations (4.3.10) and (4.3.11) can estimate the concentration in the plume under each combination of conditions, but it is no longer appropriate to assume that a receptor is always within the plume. The concentration at a receptor must be estimated by averaging the concentrations during periods when individual plume segments affect the receptor and as well as during the periods when the plume is elsewhere. This long-term average is given by

$$\bar{\chi} = \frac{4\sqrt{2}\,Q'}{\pi\,x} \sum_{j} \sum_{k} \sum_{l} \frac{G(z)}{\sigma_z\,U} P_{ijkl} \qquad (4.3.12)$$

where P_{ijkl} is the joint probability that the wind direction falls within class i and speed falls within class j, that the stability falls within class k, and that the mixing layer thickness falls within class l. It should be recalled that G(z) is a function of distance, stability, mixing layer thickness, and release height. The derivation of Equations (4.3.9) and (4.3.12) is discussed by Gifford (1968).

The Gaussian Plume based models embodied in Equations (4.3.1), (4.3.9), (4.3.10), (4.3.11), and (4.3.12) estimate average concentrations for continuous releases with constant release rates. These concentrations may be used to evaluate dose rates. Before doses may be estimated, it is necessary to convert the average concentration to exposure. This is done by multiplying the average concentration by the time that the receptor is within the plume. In the case of a release of finite duration, the release duration may be used in computing the exposure.

4.3.2 Diffusion Coefficients

A large number of experiments have been conducted to evaluate atmospheric diffusion coefficients. The results of these experiments have been used to relate diffusion coefficients to atmospheric stability and distance from the source. The most familiar set of relationships are contained in the Pasquill-Gifford-Turner (PGT) curves (Gifford 1961 and 1976).

Martin and Tikvart (1968) and Tadmor and Gur (1969) present mathematical approximations, respectively, to the PGT vertical and horizontal diffusion coefficient curves. These parameterizations have the general form

$$\sigma = Ax^B + C \tag{4.3.13}$$

where A, B, and C are assigned different values for computation of the horizontal and vertical diffusion coefficients. In computation of the horizontal diffusion coefficient, A has been assigned the values for seven atmospheric stability classes, B has a constant value of 0.9031, and C has a value of 0.0. For computation of vertical diffusion coefficients, A, B, and C are assigned values for seven stability classes and three distance ranges. The distance ranges are: 1) less than 100 m, 2) 100 to 1000 m, and 3) greater than 1000 m. Values for A, B, and C are given in Table 4.8. It should be noted that A and C are dimensional constants with units of m^{1-B} and meters, respectively.

4.3.3 Effective Release Height

Computating ground-level concentrations downwind of elevated releases requires that the effective release height be estimated. For free standing stacks, the effective release height is defined as

$$h_e = h_s + h_r - h_d \tag{4.3.14}$$

where h_s = the actual release height (m)

h_r = the plume rise due to momentum and buoyancy (m)

h_d = the plume downwash due to aerodynamic forces around the stack (m).

TABLE 4.8. Constant Values for Diffusion Coefficient Evaluation

Stability Class	Ay	Az Distance Range 1	Az 2	Az 3	Bz Distance Range 1	Bz 2	Bz 3	Cz Distance Range 1	Cz 2	Cz 3
A	0.3658	0.192	0.00066	0.00024	0.936	1.941	2.094	0	9.27	-9.6
B	0.2751	0.156	0.0382	0.055	0.922	1.149	1.098	0	3.3	2
C	0.2089	0.116	0.113	0.113	0.905	0.911	0.911	0	0	0
D	0.1471	0.079	0.222	1.26	0.881	0.725	0.516	0	-1.7	-13
E	0.1046	0.063	0.211	6.73	0.871	0.678	0.305	0	-1.3	-34
F	0.0722	0.053	0.086	18.05	0.814	0.74	0.18	0	-0.35	-48.6
G	0.0481	0.032	0.052	10.83	0.814	0.74	0.18	0	-0.21	-29.2

Equation (4.3.14) may also be used to define the effective release height for stacks in the vicinity of buildings, provided that the stack height is sufficient such that plumes emitted avoid entering the building wakes. As a general rule, a stack 2.5 times the height of nearby buildings is assumed to be equivalent to a freestanding stack.

Briggs (1984) discusses both plume rise and downwash. Plume rise is directly related to the momentum and buoyancy of the effluent and is inversely related to the wind speed. In addition, the extent of plume rise is affected by atmospheric stability and may be limited by the top of the mixing layer. Evaluation of plume rise requires information on stack dimensions and flow, effluent density and temperature, and ambient air temperature. The following relationships from Briggs (1984) provide a consistent set of plume rise estimates for all wind and stability conditions.

Two parameters, buoyancy flux and momentum flux, are used in computing plume rise. The buoyancy flux parameter, F_b, is defined as

$$F_b = g \left(\frac{\rho_a - \rho_o}{\rho_a} \right) w_o \, r_o^2 \qquad (4.3.15)$$

where g = the gravitational constant (9.8 m/sec^2)
ρ_o = the density of the plume (Kg/m^3)
ρ_a = the density of air (Kg/m^3)
w_o = the stack exit velocity (m/sec)
r_o = the inside radius of the stack (m).

The buoyancy flux parameter has dimensions of m^4/sec^3. The momentum flux parameter, F_m, is defined as

$$F_m = (\rho_o / r_a) \, w_o^2 \, r_o^2 \qquad 4.3.16$$

It has dimensions of m^4/sec^2.

The momentum component of plume rise, h_m, is assumed to be limited by atmospheric turbulence. It is given by

$$h_m = \frac{0.9\ [F_m/(Uu*)]^{1/2}}{0.4 + 1.2\ (U/w_o)} \qquad (4.3.17)$$

where U is the stack-height wind speed and u* is a characteristic wind speed associated with turbulence. The relationship between the characteristic wind speed and the measured speed is discussed in Section 4.3.6, Wind Profiles.

The buoyancy component of plume rise, h_b, is estimated using three equations. During unstable and neutral atmospheric conditions, the buoyancy rise component is given by

$$h_b = 1.54\ [F_b/(Uu*)]^{2/3}\ h_s^{1/3} \qquad (4.3.18)$$

During stable atmospheric conditions with a release height wind speed of 1 m/sec or more, the buoyancy rise component is given by

$$h_b = 2.6\ [F_b/(U_s]^{1/3} \qquad (4.3.19)$$

where s is a stability parameter. In stable atmospheric conditions, if the wind is less than 1 m/sec, the buoyant plume rise component is estimated as

$$h_b = 5.3\ [F_b/s^{3/2}]^{1/4} - 6\ r_o \qquad (4.3.20)$$

The stability parameter in Equations (4.3.19) and (4.3.20) is defined as

$$s = \frac{g}{\theta} \frac{\partial\theta}{\partial z} \qquad (4.3.21)$$

where g = the gravitational constant (9.8 m/sec)
θ = the potential temperature of the air (°K)
$\partial\theta/\partial z$ = the potential temperature lapse rate)(°K/m).

Near sea level, the stability parameter may be approximated as

$$s = c/T \tag{4.3.22}$$

where c is a constant that is defined by stability class, and T is the ambient air temperature (°K). The values of c for E, F, and G stability classes are 0.049, 0.27, and 0.49°K/sec^2, respectively.

When Equation (4.3.19) or (4.3.20) is used to compute the buoyant component of plume rise, the estimated rise is compared with the rise computed using Equation (4.3.18). The smaller of the plume rise estimates is then used in computing the final plume rise.

Final plume rise, which is the sum of the momentum and buoyant components, is subject to three constraints. If the release height is greater than the mixing layer thickness or if the stack exit velocity is equal to zero, final plume rise is set to zero. Otherwise, the rise is limited to one half of the distance between the top of the stack and the top of the mixing layer.

The plume rise component Equations (4.3.17), (4.3.18), (4.3.19), and (4.3.20), and the effective release height estimate in Equation (4.3.14) give the height of the plume after it has become essentially horizontal. These equations should not be used to estimate concentrations near the release point because small changes in effective release height result in large changes in estimated ground-level concentrations near the release point. If concentration estimates are needed for locations within a few hundred meters of a stack, the estimates should be made using more appropriate relationships. In most cases, concentration estimates near an elevated release should be viewed with caution, particularly if the release parameters or atmospheric conditions are not well known.

As the distance from the release point increases, the sensitivity of concentration as a function of release height decreases. In most atmospheric conditions, at distances greater than one or two kilometers, the concentration estimates for elevated release should not be sensitive to moderate changes in release height.

4.3.4 Building-Wake Diffusion Model

Atmospheric diffusion in building wakes is usually treated by modifying the Gaussian plume model to account for increased diffusion caused by buildings. However, analysis of building-wake diffusion data (Ramsdell 1988) shows that the usual methods of estimating the concentrations in wakes do not adequately describe the variations of the concentrations that are caused by changes in atmospheric conditions. An alternative model for centerline concentrations in building wakes, which was proposed by Ramsdell, is included in GENII. That model is based on a statistical analysis of diffusion data obtained at seven locations.

The basic form of the empirical building-wake diffusion model developed by Ramsdell (1988) is

$$\overline{\chi}/Q' = k\ x^{a}\ A^{b}\ U^{c}\ S^{d} \tag{4.3.23}$$

where x = distance from the release point (m)
A = projected building area (m^2)
S = atmospheric stability class; 1 = A, 2 = B, ...
k, a, b, c, d = parameters to be determined.

This model includes the same variables that have been included in previous models. However, it does not specify the way in which each of the variables enters the model. Multiple linear regression techniques were applied to building wake diffusion data for ground-level releases for a wide range of atmospheric conditions and distances to estimate parameter values for the model. Parameter values for the model are $k = 150$, $a = -1.2$, $b = -1.2$, $c = 0.68$, and $d = 0.5$.

Although the basic wake model provides a "best-fit" to the data in a least squares sense, it is not expected to model the concentrations near the source unless the size of the opening through which the release occurs is small and the flow through the opening is negligible. Similarly, the model does not asymptotically approach the Gaussian plume model as the distance from the source becomes large. To correct these deficiencies, the basic model is incorporated in the following composite model:

$$\overline{\chi}/Q' = \frac{1}{(F_o + F_p + F_w)} \tag{4.3.24}$$

where F_o = the flow rate associated with the release

F_p = the denominator of the Gaussian plume model defined in Equation (4.3.1) multiplied by a factor of 2

F_w = the reciprocal of the wake model defined in Equation (4.3.23).

In this model, the initial flow, F_o, is constant and does not contribute significantly at large distances. Both F_p and F_w increase as x increases. To get the model to asymptotically approach the Gaussian plume model at large distances, the wake-induced diffusion is limited by placing an upper limit on the distance used in the wake model. Further, the limit should be related to building size. In GENII, a characteristic building dimension equal to the square root of the building area is used to limit the wake diffusion contribution in Equation (4.3.24). F_w is allowed to increase until the distance increases to 20 times the characteristic building dimension. At larger distances, the wake diffusion contribution to Equation (4.3.24) is held constant at its maximum value.

The conservative approach to estimating the concentrations downwind of short stacks and roof-top vents is to assume that a release takes place at ground level unless the release point is 2.5 times the building height. However, a significant body of literature exists to support a less conservative assumption in which the behavior of plumes released from short stacks and roof-top vents depends on the ratio between the vertical velocity of the effluent and the wind speed at release height. When the ratio is large, plumes escape the wake; when it is small, they remain in the wake; and when the ratio has an intermediate value, they escape the wake part of the time and are entrained in the wake the remainder of the time.

Following the wake diffusion experiments at the Millstone Nuclear Power Station, Johnson et al. (1975) suggested a model, which they called a Split-H model, to account for this behavior of elevated releases. A modified version of the Split-H model is included in the U.S. Nuclear Regulatory Commission (NRC) Regulatory Guide 1.111 (NRC 1977c) and is implemented in the XOQDOQ model (Sagendorf, Goll, and Sandusky 1982), which is used in evaluating the consequences of routine releases from nuclear power plants. The NRC implementation of the Split-H model is included in the GENII building-wake model.

The Split-H model is applied to releases in which the actual release height is equal to or greater than the height of the tallest building in the area. Assuming this condition, a release is considered to be elevated when the ratio of vertical velocity to wind speed is equal to or greater than 5. If this ratio is between 1 and 5, the concentration is computed assuming that a portion of the release is elevated and the remainder is at ground level. Otherwise, the ratio is less than 1, and the release is considered to be a ground-level release.

The exact form of the NRC implementation of the model is

$$\bar{\chi}/Q' = M(\bar{\chi}/Q')_{entr} + (1-M)\ (\bar{\chi}/Q')_{elev} \tag{4.3.25}$$

where $\bar{\chi}/Q'$ = the normalized concentration predicted by the Split-H model

M = the fraction of time that the plume is entrained in the building wake

$(\bar{\chi}/Q')_{entr}$ = the normalized concentration in the building wake predicted for a ground-level release

$(\bar{\chi}/Q')_{elev}$ = the normalized concentration at ground level predicted for an elevated release.

The fraction of the time that the plume is entrained in the wake is estimated from the ratio of the effluent vertical velocity (w_o) to the release height wind speed (U_r) according to:

$$M = \begin{cases} 1 & w_o/U_r < 1.0 \\ 2.58 - 1.58\ (w_o/U_r) & 1.0 <= w_o/U_r < 1.5 \\ 0.3 - 0.06\ (w_o/U_r) & 1.5 <= w_o/U_r < 5.0 \\ 0 & w_o/U_r >= 5.0. \end{cases} \tag{4.3.26}$$

The 10-m wind speed is used in the GENII wake model except when the Split-H procedure is used. Then the release-height wind will be used to determine the fraction of time that the release is in the wake and will be used to estimate diffusion when the plume escapes the wake.

4.3.5 Deposition and Depletion

To estimate doses to individuals from contaminated soil and the farm product ingestion pathway, it is necessary to first estimate the amount of each radionuclide deposited on the ground. Two deposition mechanisms are frequently included in atmospheric models. The first mechanism, dry deposition, involves the settling of material on a surface as a result of gravitation and turbulent transport. In the second mechanism, called wet deposition, precipitation such as rain forms with particulate material, collides with particles, or absorbs gases and then carries the material to the surface. Wet deposition occurs during precipitation and results in a higher rate of surface contamination than dry deposition. However, dry deposition occurs whenever the concentration of material near the surface is greater than zero. As a result, in the vicinity of a source of routine release of radioactive nuclides, dry deposition is likely to be the primary process by which contamination occurs. Because of the infrequent precipitation in the Hanford environment, wet deposition is not considered further.

Although the deposition rate may be of some interest, the dose rate due to deposited material is a function of the total deposited material. The total surface contamination is given by

$$C_s = \overline{\chi}\, v_d\, t \qquad (4.3.27)$$

where C_s = the surface contamination (Ci/m^2)
v_d = the deposition velocity (m/sec)
$\overline{\chi}$ = the average air concentration (Ci/m^3)
t = the time period for which the average concentration was computed (sec).

The deposition velocity is a constant of proportionality between surface contamination rate and the concentration of contaminants in air. Deposition velocity depends on the substance and the surface, and the values of deposition velocity cover a wide range. Sehmel (1980, 1984) summarizes reported deposition velocities for many substances including iodine. For noble gases, a deposition velocity of zero is used; for most particulates, a deposition velocity of 0.001 m/sec is used; and for iodines, a deposition velocity of 0.01 m/sec is used.

Deposition on surfaces results in depletion of material from the plume. Although several methods exist to account for this depletion, they are generally not incorporated in simple atmospheric models even when deposition is included. As a result, air concentration estimated by simple models are biased to the high side.

4.3.6 Wind Profiles

The algorithms within the GENII code are based on wind speeds at specific heights. The height at which meteorological data have been obtained may or may not correspond to heights appropriate for the use in GENII. Consequently, a set of algorithms is provided within GENII to adjust wind speeds from the height of measurement to the height required. The algorithms are based on the diabatic wind profile model described by Panofsky and Dutton (1984). In this model, wind speed is a function of height above ground, surface roughness, the characteristic turbulence velocity, and a characteristic length associated with the atmospheric boundary layer.

The general form of the wind profile model is

$$U(z) = \frac{u^*}{0.4} \ln \left(\frac{z}{z_o} - \Psi \right) \qquad (4.3.28)$$

where $U(z)$ = the wind speed at height z (m/sec)

$u*$ = the characteristic velocity (m/sec)

z = the height above ground (m)

z_o = the surface roughness length (cm)

Ψ = a dimensionless empirical function of the ratio between the height above ground and the characteristic length, L, associated with the atmospheric boundary layer called the Monin-Obukov length (Golder 1972).

The Monin-Obukov length is positive for stable atmospheric conditions, negative for unstable conditions, and infinite for neutral conditions. Estimates of L^{-1} used in GENII are based on Golder (1972) which relates the inverse of the Monin-Obukov length to stability class and surface roughness length.

Wind profile data have been used to evaluate Ψ, which is a function of stability. For neutral stability, Ψ is equal to zero, and Equation (4.3.28) simplifies to the familiar logarithmic profile. For stable atmospheric conditions, Ψ is defined by

$$\Psi = - 5\ z/L \tag{4.3.29}$$

where L is the Monin-Obukov length in meters. The definition of Ψ for unstable conditions is considerably more complex. It is

$$\Psi = \ln \left[\left(0.5 + \frac{\phi^2}{2}\right)\left(0.5 + \frac{\phi}{2}\right)^2 - 2\ \mathrm{Atan}\ \phi + \frac{\pi}{2}\right] \tag{4.3.30}$$

where ϕ is defined as

$$\phi = (1 - 16\ z/L)^{1/4} \tag{4.3.31}$$

4.3.7 Atmospheric Dispersion Model Limitations

The atmospheric dispersion models discussed are all simple models. They yield reasonable yet conservative concentration estimates, provided that they are not misapplied.

As a general rule, the use of Equations (4.3.1) and (4.3.9) should be limited to potential releases of 30 minutes to 4 hours in duration. Equations (4.3.10) and (4.3.11) can be used to assess the consequences of potential releases 2 to 8 hours in duration, and Equation (4.3.12) can be used for potential releases with duration of 4 hours and longer. The fact that these ranges overlap should not imply that the models will yield identical results for release durations that fall within the overlap; they won't. When a release duration falls within an overlap, the choice between alternative equations should be based on an evaluation of the physical situation being modeled, and this evaluation should consider the source characteristics and meteorological situation.

The derivation of the dispersion models explicitly includes the assumptions that the release is from a point source and that the effluent travels in a straight line once it is released. Considering the point source assumption, Equations (4.3.1) and (4.3.9) through (4.3.11) should not be used to estimate concentrations too near the source. For relatively small sources, the models may be applied to estimate concentrations as close to the source as 800 m. However, if the source is in or near large buildings, these models should not be used to estimate concentrations closer to the source than 1600 m. Considering the straight-line assumption, the equations should not be used to estimate concentrations further than 80 km from the source under ideal conditions of flat terrain and no systematic spatial variations of the wind field. If topographic features may alter the wind field, the models should not be used to estimate concentrations on the opposite side of the features from the source.

The release duration and travel time to the receptor should also be considered when determining a maximum range for estimating concentrations. If the release is short compared to the travel time, assuming that the effluent travels at the wind speed, the equations may not provide realistic estimates of the concentration. Similarly, if the time required for the effluent to travel from the source to the receptor is more than a few hours, atmospheric conditions will likely change sufficiently during the transit period to make the concentration estimates unrealistic. Specifically, concentrations from releases made near sunrise will be systematically overestimated, and concentrations for releases near sunset will be underestimated. These considerations are particularly important when using Equations (4.3.1), (4.3.9), (4.3.10), and (4.3.11).

Other meteorological conditions of concern in applying Equations (4.3.1), (4.3.9), (4.3.10), and (4.3.11) include drainage winds, passages of fronts and other storms, and periods of low wind speeds. Each of these conditions can result in a significant departure from the modeling assumption that the release takes place in meteorological conditions that are not a function of time. Low wind speeds pose a particular problem because 1) the wind direction becomes poorly defined as the speed decreases and 2) the equations become undefined mathematically.

4.4 AIR SUBMERSION

Persons submersed in a plume of airborne material will receive radiation exposure from gamma and x-rays emitted external to the body. This exposure is generally referred to as external dose from air submersion and is dependent upon the type of radiation, the energy of the radiation, and the spatial distribution of the airborne radionuclides surrounding the receptor. Two methods are available in GENII to estimate the dose: 1) the semi-infinite plume model and 2) the finite plume model.

The semi-infinite plume model is based on the assumption that the plume is semi-infinite in size (bounded by the ground plane) and that the energy deposition per unit volume of air is equal to the rate of energy emission per unit volume. In contrast, the finite plume model considers the size and shape of the plume to estimate the actual dose rate at the center of the plume at ground level. Both methods may be applied to acute and chronic release situations.

4.4.1 Semi-Infinite Plume Model

For acute releases of radionuclides, the semi-infinite plume model for the air submersion dose is represented as follows:

$$Dl_i = Q_i (E/Q)\ DF_{si} \tag{4.4.1}$$

where Dl_i = individual dose from external exposure to the plume for radionuclide i (rem)

Q_i = total activity of radionuclide i released during the acute release period (curies)

E/Q = acute release atmospheric dispersion factor at the exposure location (sec/m^3)

DF_{si} = submersion dose factor precalculated from EXTDF program (rem per Ci - sec/m^3).

For chronic releases, the air submersion dose is calculated similarly:

$$Dl_i = Q_i' (\overline{\chi}/Q')\ DF_{si} \tag{4.4.2}$$

where Q_i' is the annual average release rate of radionuclide i (Ci/year), $\overline{X}/Q'$ is chronic release atmospheric dispersion factor at the exposure location (sec/m^3), and other terms are as defined above for acute releases.

4.4.2 Finite Plume Model

When the finite plume model is used, the geometry must be considered in evaluating the exposure. The evaluation involves use of pre-calculated factors representing volume integrals over the plume dimensions. Parameters important to this evaluation are plume size, release height, wind speed, and photon energy. Two empirical models are available, one for acute releases based on the bivariate Gaussian plume model, and one for chronic releases based on the crosswind averaged (sector width) Gaussian dispersion model. The exposure may be represented as follows for acute releases:

$$Dl_i \equiv Q_i \sum_j DRA_j \, E_{ij} \, Fc_j \qquad (4.4.3)$$

where DRA_j = acute release finite plume dose rate factor for photons in energy group j at the exposure location (rad dis)/(MeV Ci)

E_{ij} = effective photon energy released by radionuclide i in energy group j (MeV/dis)

Fc_j = surface-dose-to-effective-dose equivalent conversion factor for photon energy group j (rem/rad).

The surface-dose-to-effective-dose-equivalent conversion factor converts from air dose to effective dose equivalent for photons in energy group j. The photon energy emission data are read from a data library which contains photon data grouped into the six energy groups indicated in Table 4.9. The table also gives the surface-dose-to-effective-dose-equivalent conversion factors for each energy group. Photon data for each radionuclide are contained in the data library.

TABLE 4.9. Photon Energy Group Definitions and Conversion Factors Used in Finite-Plume Air Submersion Calculations

Group	Photon Energy Range, MeV	Average Photon Energy, MeV	Surface Dose to EDE Factor, rem/rad
1	<0.3	0.15	0.67
2	0.3 - 0.5	0.40	0.66
3	0.5 - 1.0	0.75	0.67
4	1.0 - 1.5	1.25	0.71
5	1.5 - 2.0	1.75	0.75
6	>2.0	2.25	0.78

For chronic releases, the air submersion dose is evaluated as follows:

$$D1_i = Q'_i \sum_j DRC_j\ E_{ij}\ Fc_j \qquad (4.4.4)$$

where DRC_j is the chronic release finite plume dose rate factor for photons in energy group j at the exposure location (rad dis)/(MeV Ci).

The acute release model uses an empirical function to evaluate the finite plume dose factor (DRA_j), depending on plume size (σ_y and σ_z), plume release height (h_e), and photon energy (subscript j). The empirical function was developed from finite plume dose rate factors calculated using the computer program SUBDOSA (Strenge, Watson, and Houston 1975). The analysis used the curve fitting program SSQMIN (Brown and Lin 1973; Brown 1973) to evaluate the constants of the empirical function. For ground-level releases, the dose rate factor is evaluated as follows:

$$DRAo_j = K_j\ Ro_j/(2\ \pi\ \sigma_y\ \sigma_z\ u) \qquad (4.4.5)$$

where K_j = units conversion factor (rad m^3 dis)/(MeV sec Ci)

Ro_j = ground-level release finite-plume correction factor for energy group j (dimensionless)

σ_y = crosswind horizontal standard deviation of plume size at the downwind exposure location (m)

σ_z = crosswind vertical standard deviation of plume size at the downwind exposure location (m)

u = average wind speed (m/sec).

The factor Ro_j is evaluated empirically as follows:

$$Ro_j = a_{1j}\ (\sigma_g)b_{1j} \text{ for } \sigma_g \leq 100 \text{ meters}$$

$$Ro_j = a_{2j}\ (\sigma_g)b_{2j} \text{ for } 100 < \sigma_g < 600 \text{ meters}$$

$$Ro_j \leq 1 \text{ for all } \sigma_g$$

where σ_g = geometric mean of plume dimensions (m)

$\sigma_g = (\sigma_y\ \sigma_z)^{1/2}$

a_{1j}, a_{2j}, b_{1j}, b_{2j} = empirical constants for energy group j.

Values for the empirical coefficients are given in Table 4.10.

For elevated releases, the dose rate factor is evaluated using the ground-level correction factor plus an effective release height as follows:

$$DRA_j = DRAo_j\ \exp[-(H_j^*)^2/(2\sigma_z)] \qquad (4.4.6)$$

where H_j^* = effective plume height for energy group j (m)

$H_j^* = Ho_j\ h\ (\sigma_y/\sigma_z)\ P_j$

where h = effective release height (m)

TABLE 4.10 Empirical Constants for the Ground-Level Correction Factor, Ro_j

Energy Group	a_{1j}	a_{2j}	b_{1j}	b_{2j}
1	0.007062	0.9623	0.1651	0.2779
2	0.007915	0.9222	0.1514	0.2813
3	0.008279	0.8839	0.08769	0.3713
4	0.007696	0.8854	0.07532	0.3900
5	0.006964	0.8941	0.06136	0.4215
6	0.005852	0.9038	0.04238	0.4740

$$
Ho_j = \begin{cases} 1 - d_j \, (h/\sigma_z)^{e_j} & \text{for } h/\sigma_z \leq 10 \\ f_j/(h/\sigma_z) & \text{for } h/\sigma_z > 10 \end{cases}
$$

$$
P_j = c_j \exp(-0.015 \, \sigma_z)
$$

where c_j, d_j, e_j, f_j are empirical constants for energy group j. Values for the empirical constants are given in Table 4.11.

TABLE 4.11. Empirical Constants for Effective Release Height, H_j^*

Energy Group	c_j	d_j	e_j	f_j
1	-0.19644	0.31637	0.38578	2.8173
2	-0.18854	0.29041	0.41921	2.8136
3	-0.18610	0.28409	0.42522	2.8053
4	-0.18601	0.28408	0.42532	2.8049
5	-0.18660	0.28414	0.42572	2.8039
6	-0.18710	0.28418	0.42610	2.8031

A similar empirical model is used to evaluate the finite plume dose rate factors for chronic releases (DRC_j). However, the release height dependence is handled differently, in that the empirical representation is defined for specific release height values. Preliminary evaluation of dose rate factors is made for the specific release heights, and these factors are then interpolated to provide dose rate factors for the desired release height. The empirical function development for chronic release dose rate factors is based on calculations performed using the KRONIC subprogram FDOSE (Strenge and Watson 1973) which performs the dose rate integration over the sector-averaged plume volume.

For ground-level releases, the dose rate factors are evaluated as follows for values of $\sigma_z \leq 200$ meters:

$$
DRCo_j = K_j \, [A_j + x_3 \ln \sigma_z] \tag{4.4.7}
$$

where $A_j = \begin{cases} x_2 & \text{when } x > 900 \text{ meters} \\ x_4 + x_1 \ln x & \text{when } x \leq 900 \text{ meters} \end{cases}$

$[A_j + \ln \sigma_z] \leq 1.0$

and as follows for values of $\sigma_z > 200$ meters:

$$DRCo_j = x_5/(\sigma_z\ W) \qquad (4.4.8)$$

where $DRCo_j$ = ground-level dose rate factor for photons in energy group j (rem dis)/(MeV Ci)

x = downwind distance (meters)

W = sector width at downwind distance x (meters)

$K_j, x_1, x_2, x_3, x_4, x_5$ = empirical constants.

Value s for the empirical constants are given in Table 4.12.

The user must perform the following steps in evaluating chronic dose rate factors for elevated releases:

1. If $\sigma z < S1_h$, set $\sigma_z = S1_h$.
2. If $\sigma_z < S2_h$, set xx = maximum of x and 2000 meters.
   and if $\sigma_z < S3_h$, $EF = X1_{hj} + X2_{hj} \ln(xx)$.
   or if $\sigma_z \geq S3_h$, $EF = EF\ (X4_{hj} + X5_{hj}\ xx)$
   Using these values,
   $$DRC_{hj} = 0.398942\ FK_j\ \sigma_z\ X3hj\ EF/(W\ \sigma_z)$$
   This completes the evaluation when $\sigma_z < S2_h$.
3. If $\sigma_z \geq S2_h$ <u>and</u> $\sigma_z < S4_h$,
   and if $x > Dx_{hj}$,
   evaluate $EG = \exp[X6_{hj} + X7_{hj} \ln \sigma_z]$ if $x > Dx_{hj}$.
   Otherwise, $EG = X8_{hj}\ (x^{X9}hj)\ \exp(X6_{hj} + X7_{hj} \ln \sigma_z)$
   and then evaluate
   $$DRC_{jh} = 0.398942\ FK_j\ \sigma_z\ EG/(W\ \sigma_z)$$
   This completes the evaluation when $S2_h \leq \sigma_z < S4_h$.
4. If $\sigma_z \geq S4_h$,
   $$DRC_{hj} = A_{hj}/(W\ \sigma_z)$$

TABLE 4.12. Empirical Constants for Ground-Level Sector Dose Rate Factors

Energy Group	A_k	x_1	x_2	x_3	x_4	x_5
1	0.0040	0.2154	1.232	-0.1732	-0.1374	0.191
2	0.0038	0.2056	1.328	-0.2005	0.0005606	0.199
3	0.0038	0.1763	1.246	-0.1961	0.1066	0.182
4	0.0036	0.1763	1.246	-0.1961	0.1066	0.182
5	0.00342	0.1745	1.207	-0.1888	0.07537	0.182
6	0.00342	0.1500	1.0385	-0.1609	0.05711	0.182

Parameters in the above calculational steps are previously defined in addition to the empirical constants A_{hj}, Dx_{hj}, $S1_h$ through $S4_h$, and $X1_{hj}$ through $X9_{hj}$. Values for the "S" constants (dependent only on release height) are given in Table 4.13. Values for A_{hj}, Dx_{hj}, and $X1_{hj}$ through $X9_{hj}$ are given in Tables 4.14 through 4.24, respectively.

TABLE 4.13. Values for "S" Parameters

Release Height Meters	Index	$S1_h$	$S2_h$	$S3_h$	$S4_h$
50	1	5	80	20	400
100	2	15	100	30	300
150	3	30	150	30	400
200	4	53	150	40	500
250	5	60	150	40	500

TABLE 4.14. Parameter A_{hj} Values

Release Height Meters	Index	Energy Group Index 1	2	3	4	5	6
50	1	0.1909	0.1995	0.1930	0.1897	0.1888	0.1916
100	2	0.1904	0.1947	0.1947	0.1908	0.1908	0.1927
150	3	0.1909	0.1974	0.1905	0.1875	0.1897	0.1914
200	4	0.1900	0.1971	0.1902	0.1873	0.1893	0.1914
250	5	0.1897	0.1968	0.1899	0.1870	0.1890	0.1911

TABLE 4.15. Parameter Dx_{hj} Values

Release Height Meters	Index	Energy Group Index 1	2	3	4	5	6
50	1	900	1000	950	1200	1150	1500
100	2	0	0	0	0	0	0
150	3	250	0	0	0	0	0
200	4	0	0	0	0	0	0
250	5	0	0	0	0	0	0

TABLE 4.16. Parameter $X1_{hj}$ Values

Release Height Meters	Index	Energy Group Index 1	2	3	4	5	6
50	1	-0.0079836	-0.0068464	-0.0052439	-0.0051147	-0.0048566	-0.0043104
100	2	-0.002566	-0.002611	-0.002612	-0.002612	-0.0025281	-0.001543
150	3	-0.0003225	-0.0004380	-0.0003760	-0.0003687	-0.0003970	-0.0004192
200	4	-0.0000072393	-0.0000218405	-0.0000287361	-0.0000315728	-0.000055851	-0.000055851
250	5	-2.78157E-7	-2.1792E-6	-5.79535E-6	-7.382326E-6	-1.12916E-5	-1.99375E-5

TABLE 4.17. Parameter $X2_{hj}$ Values

Release Height Meters	Index	Energy Group Index 1	2	3	4	5	6
50	1	0.0020302	0.0017336	0.0013365	0.0012986	0.0012306	0.0010886
100	2	0.0006260	0.0006320	0.0006176	0.0006642	0.00060655	0.0003799
150	3	0.00007903	0.0001071	0.000091789	0.0000901	0.00009696	0.00010234
200	4	0.0000017612	0.000005309	0.0000069799	0.0000076741	0.0000135817	0.0000135817
250	5	6.71701113E-8	5.25722E-7	1.39556E-6	1.78079E-6	2.72453E-6	4.815094E-6

TABLE 4.18. Parameter $X3_{hj}$ Values

Release Height Meters	Index	Energy Group Index 1	2	3	4	5	6
50	1	1.10853	1.12874	1.16066	1.15024	1.14787	1.14342
100	2	1.2196	1.200	1.200	1.200	1.1124	1.167
150	3	1.51233	1.43132	1.42964	1.41711	1.3893	1.35022
200	4	2.193499	1.95538	1.86565	1.832157	1.679025	1.679025
250	5	2.76218724	2.337204	2.109784	2.045505	1.950043	1.811961

TABLE 4.19. Parameter $X4_{hj}$ Values

Release Height Meters	Index	Energy Group Index 1	2	3	4	5	6
50	1	1.06496	1.05508	1.03420	1.0384	1.03637	1.036195
100	2	1.243	1.244	1.244	1.244	1.3268	1.3207
150	3	1.36939	1.37817	1.3972	1.3934	1.38817	1.37466
200	4	1.48126	1.45935	1.48287	1.457285	1.416737	1.416737
250	5	1.50715482	1.462071	1.4591397	1.430768	1.410792	1.376726

TABLE 4.20. Parameter $X5_{hj}$ Values

Release Height Meters	Release Height Index	Energy Group Index 1	2	3	4	5	6
50	1	-0.00014497	-0.000120429	-0.000107396	-0.000102495	-0.000089844	-0.0000729814
100	2	-0.0001404	-0.00009759	-0.00009817	-1.E-8	-0.0000285	-0.00008758
150	3	-0.000060141	0.000016914	0.00006756	0.000113459	0.00015535	0.00023030
200	4	-0.0000100728	0.000094251	0.000178964	0.000241717	0.000401386	0.000401386
250	5	2.31697304E-5	1.41925E-4	2.52501E-4	3.34745E-4	4.020886E-4	5.244587E-4

TABLE 4.21. Parameter $X6_{hj}$ Values

Release Height Meters	Release Height Index	Energy Group Index 1	2	3	4	5	6
50	1	-2.2101	-2.2101	-2.2827	-2.33404	-2.411	-2.411
100	2	-2.51	-2.51	-2.622	-2.622	-2.622	-2.6173
150	3	-2.83872	-2.83001	-2.86357	-2.87222	-2.88118	-2.90774
200	4	-3.20158	-3.19662	-3.17113	-3.12888	-2.819186	-2.819186
250	5	-4.11710167	-4.002866	-3.882893	-3.809661	-3.688744	-3.434422

TABLE 4.22. Parameter $X7_{hj}$ Values

Release Height Meters	Release Height Index	Energy Group Index 1	2	3	4	5	6
50	1	-0.6205	-0.6205	-0.6205	-0.6205	-0.6205	-0.6205
100	2	-0.568	-0.568	-0.568	-0.568	-0.568	-0.5843
150	3	-0.53759	-0.53616	-0.54130	-0.54504	-0.54449	-0.54523
200	4	-0.49928	-0.49664	-0.51172	-0.52408	-0.58410	-0.58410
250	5	-0.3576202	-0.37317	-0.40363	-0.42112	-0.44262	-0.49152

TABLE 4.23. Parameter $X8_{hj}$ Values

Release Height Meters	Release Height Index	Energy Group Index 1	2	3	4	5	6
50	1	0.1525	0.10602	0.10084	0.08425	0.07891	0.0587
100	2	0	0	0	0	0	0
150	3	0.950	0	0	0	0	0
200	4	0	0	0	0	0	0
250	5	0	0	0	0	0	0

TABLE 4.24. Parameter $X9_{hj}$ Values

Release Height Meters	Release Height Index	Energy Group Index 1	2	3	4	5	6
50	1	0.2761	0.3231	0.32880	0.3470	0.3607	0.3877
100	2	0	0	0	0	0	0
150	3	0	0	0	0	0	0
200	4	0	0	0	0	0	0
250	5	0	0	0	0	0	0

4.5 SURFACE WATER TRANSPORT MODELS

Optional surface water transport models are available in the GENII computer package for estimating, at selected water usage locations, the water concentration resulting from releases of radionuclides to nontidal rivers and near-shore lake environments. The mathematical models are the same as those employed in the LADTAP II computer program (Strenge, Peloquin, and Whelan 1986), which are based on work of Whelan as described a report by Codell, Key, and Whelan (1982). Nontidal rivers are freshwater bodies with unidirectional flow in definable channels. Near-shore lake environments are surface water areas that are near the shores of large open bodies of water and that have a straight shoreline, constant depth, and steady-state, unidirectional flow parallel to the shore.

The results of the surface water transport calculations are given in the form of a mixing ratio. The mixing ratio is the ratio of concentration at the usage location divided by the initial concentration. The ratio includes the effect of dispersion and transport. Effects of radiological decay are not considered in the surface water models but may be included separately by applying decay corrections based on transport time.

The surface water program solves for radionuclide concentrations in a river or large lake under the following limiting assumptions (Codell, Key, and Whelan 1982):

- constant flow depth
- constant downstream or longshore velocity
- straight river channel
- constant lateral dispersion coefficient
- continuous point discharge release of effluents
- constant river width.

Codell, Key, and Whelan (1982) note that applications of models similar to those described here should be restricted to those portions of the near-shore zone of a river or lake that are removed from the influence of the discharge. Initial dilution near the point of discharge is usually controlled by the momentum effects of jets.

For nontidal rivers, the assumed release point is on the near shore of the river with the water plant intake point located at a downstream distance x and a laterally offshore distance y. The water concentration (steady-state) at the downstream location is given by the following equation (NRC 1977b; Codell, Key, and Whelan 1982):

$$C = \frac{Q_b C_o}{udB} \left\{ 1+2 \sum_{i=1}^{\infty} \left[\exp - \left(\frac{i\pi}{udB}\right)^2 E_y u d^2 x \right] \cos \left(\frac{i\pi y}{B}\right) \right\} \tag{4.5.1}$$

where C = water concentration at the downstream location (defined by x and y), after continuous release for a given time period (Ci/L)

B = constant river width (m)

C_o = initial concentration of effluent entering the water body (Ci/L)

d = constant flow depth (m)

E_y = constant lateral turbulent dispersion coefficient (m^2/sec)

Q_b = effluent discharge rate to the receiving water body (m^3/sec)

u = average flow velocity (m/sec)

x = longitudinal (downstream) distance to location of interest (m)

y = lateral distance to water intake point from the near shore (m).

The mixing ratio is calculated as the ratio of C to C_o.

When the dilution volume is used, the water concentration is calculated as follows:

$$Cw_i = \frac{Q'w_i}{RV} \tag{4.5.2}$$

where $Q'w_i$ is the release rate of radionuclide i to the surface water body (Ci/sec), and V is the dilution volume for the receiving water body representative of the usage location (L/sec).

The dilution volume is equivalent to a river flow rate. This representative is available for use with all exposure pathways associated with contaminated water usage.

Acute surface water releases are considered by allowing the calculation of a time-integrated water concentration, E_w, (equivalent to the E/Q used in atmospheric transport) as

$$E_{w_i} = \frac{Q'w_i}{V}\,dt = \frac{Qw_i}{V} \tag{4.5.3}$$

Near-shore lake environments are described by a model similar to the river model. The NRC (1977b) has suggested use of a quasi-steady-state model valid for simulating contaminant transport in near-shore lake environments for distances up to 16 miles. The model is represented by the following equation:

$$C = \left(\frac{C_o Q_b}{(\pi x E_y E_z)^{\frac{1}{2}}}\right) \exp\left[-\frac{y^2 u}{4xE_y}\right] \sum_{i=-\infty}^{+\infty} \exp\left[-\frac{(2id - z)^2 u}{4xE_z}\right] \tag{4.5.4}$$

where E_z is the vertical turbulent dispersion coefficient (m^2/sec), z is the depth of discharge (m), and other terms are as previously defined.

To use Equations (4.5.1) and/or (4.5.4) in any analysis, the lateral (i.e., transverse) and vertical dispersion coefficients must be defined. Dispersion coefficients should be obtained by site-specific tracer studies whenever possible. Accurately defining dispersion coefficients for all riverain or lake environments under all conditions is difficult, if not impossible at this time. However, rough estimates can be defined. The coefficients are defined such that representative properties of the water body are considered when estimating.

If the absence of site-specific estimates of dispersion coefficients (Strenge, Peloquin, and Whelan 1986) has suggested use of the following expressions:

$$E_y = 0.06\ du \tag{4.5.5}$$

and

$$E_z = 0.0059\ du \tag{4.5.6}$$

Even though Equations (4.5.5) and (4.5.6) were developed for rivers, they are also suggested for use with near-shore lake environments.

4.6 SOIL CONTAMINATION MODEL

The GENII code simultaneously considers soils in three separate areas: residential soils, non-agricultural soils, and agricultural soils. The non-agricultural soils are used only in near-field scenarios for defining parameters for arid and humid climate biotic transport. Upon the initiation of human use of the soils, the soil reverts to either residential, if the person lives there, or agricultural, if he grows crops there. Each food pathway has its own associated soil, so a large number of soil zones can be active in a single simulation. A single soil zone is made up of from one to three compartments, as illustrated in Figure 4.6.

The surface soil is the portion on which deposition from the atmosphere and irrigation occurs, and that from which resuspension occurs. For most far-field scenarios, it is the only portion of the soil model that is used. Radionuclides may be lost from the surface soil through harvest removal, radiological decay, and leaching to deeper soil layers. In situations where subsurface contamination exists, radionuclides may be contained in waste packages or simply distributed in the soil. If the waste is in a package, it may be released to the soil using the waste package decomposition model. Radionuclides in the available subsurface soil (those not in packages) may be transported to the surface soils by root uptake by plants, by physical transport by native animals, or by human interactions through intrusion into the waste which result in redistribution of waste from deep to surface soil.

Although the model explicitly considers three compartments, the fourth is conceptually an uncontaminated layer in between the surface and deep soils. Although neglected in the model, the existence of such a layer may be easily simulated by appropriate application of rooting depth fractions (described in Section 4.7). A fraction of plant roots may be described as located in the surface soil layer, and another fraction as located in the deep soil. These two fractions may add to less than one if a clean soil layer intervenes.

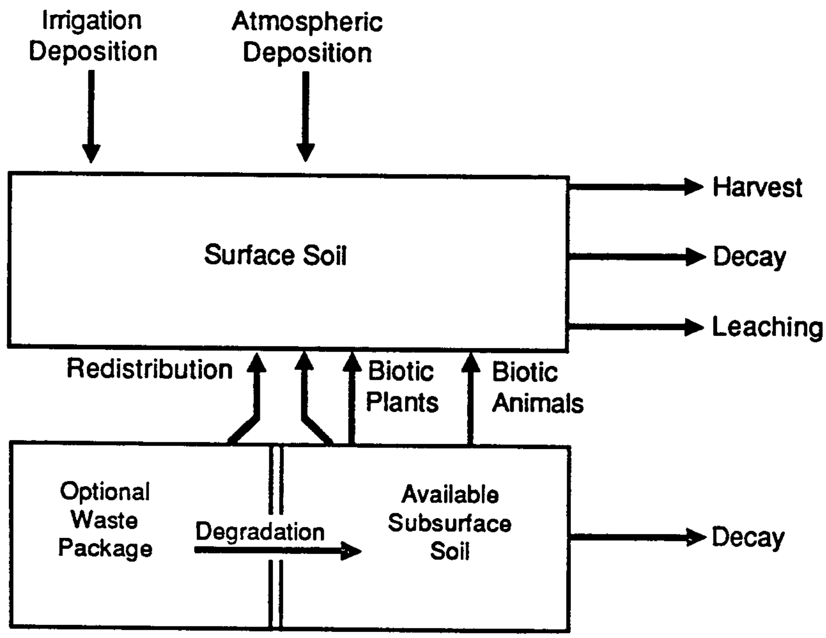

FIGURE 4.6. Schematic of Soil Compartment Interactions

4.6.1 Deposition Rates

For the air deposition pathway, the deposition rate, Du_i, is calculated from the air concentration and an average deposition velocity as

$$Du_i = Ca_i \, Vd_i \tag{4.6.1}$$

where Vd_i is the deposition velocity for radionuclide (m/sec).

For the water pathways, the deposition rate is calculated from the irrigation rate and water concentration as

$$Du_i = 25.4 \, Cw_i \, I/(2.592 \bullet 10^6 \, MY) \tag{4.6.2}$$

where I = irrigation water application rate (in./yr)

$2.592 \bullet 10^6$ = units conversion factor (sec/mo)

25.4 = number of liters in 1 in. applied over 1 m^2

MY = number of mo/yr that irrigation occurs.

4.6.2 Removal Rates

Radiological chain decay from each of the soil compartments is handled with the GENII chain decay processor. The soil compartment for each food type, animal type, and residential exposure is treated separately.

Removal from the surface soils through leaching into deeper soils is treated by means of a soil removal rate constant, λ_{wi}, which is a correction for long-term leaching of deposited radionuclides out of the surface soil rooting and resuspension zones. The values for λ_{wi} are calculated using the formula of Baes and Sharp (1981):

$$\lambda_{wi} = \frac{P + I - E}{d\ (1 + \rho/\theta\ kd_i)} \tag{4.6.3}$$

where
- P = total precipitation (cm/yr)
- I = total irrigation (cm/yr)
- E = total evapotranspiration (cm/yr)
- d = depth of the rooting zone (cm)
- ρ = soil bulk density (g/cm^3)
- θ = soil volumetric water content (mL/cm^3)
- kd_i = distribution coefficient for isotope i (mL/g).

For simplicity, the term $P + E - I$ is approximated as an overwatering term, implying about 15 cm/yr of percolation through the rooting zone and into deeper soil layers. The depth, d, is defined as 15 cm to be compatible with other portions of the code. Baes and Sharp (1981) show that the term ρ/θ averages about 3. Thus the soil removal constant for percolation can be considered as inversely proportional to the soil distribution coefficient, kd_i. The values used in GENII are based on the most conservative (i.e., largest) value of kd_i identified in a wide range of literature.

Harvest removal is simulated as a discrete process at the end of each calculational year. A quantity of each radionuclide equal to the product of the calculated vegetation concentration due to root uptake times the harvested yield (an input) is subtracted from the soil compartments. The subtraction is normalized by the root penetration factor.

4.6.3 Biotic Transport

Models are included to estimate the transport of radioactivity between soil layers by plants and animals. These models were developed to estimate potential radiation dose to man resulting from biotic transport of activity at low-level radioactive waste burial sites (McKenzie et al. 1986). Biotic pathways include translocation by plant root systems and by burrowing insects and small mammals. Examples of plants include grass, shrubs, and trees; examples of insects and mammals include pocket mice, badgers, harvester ants, and field mice.

Transport of activity by insects and mammals is described by the following simplified model:

$$Qs_{ni} = \sum_{j=i}^{a} Cs_{ni} \, M_{jn} \qquad (4.6.4)$$

where Qs_{ni} = the quantity of radionuclide i moved to the surface per year from soil stratum n (Ci/m^2 yr)

a = number of animal species considered

Cs_{ni} = concentration of radionuclide i in soil stratum n (Ci/m^3)

M_{jn} = mass of soil moved from soil stratum n to the surface by animal j (m^3/ha yr).

The burrowing activity is assumed to result in excavation of soil, all of which is deposited on the surface soil layer.

The transfer of activity by plants to the surface is estimated as follows:

$$QP_{ni} = \sum_{l=1}^{P} Cs_{ni} \, Bv_i \, R_{ln} \, B_l / K \qquad (4.6.5)$$

where QP_{ni} = quantity of radionuclide i moved from soil stratum u to the surface per year (Ci/m^2 yr)

P = number of plant species considered

Bv_i = soil-to-plant transfer factor (Ci/g plant per Ci/g soil)
R_{ln} = fraction of roots of plant l in soil stratum n (dimensionless)
B_l = total biomass production of plant l for a year (g/m^2 yr)
K = soil density (Kg/m3).

The quantity of activity brought to the surface is assumed to be uniformly distributed in the surface soil and available for entry into plant and animal product pathways in subsequent years. Other exposures include external dose from ground surface contamination and inhalation of suspended activity.

4.6.4 Manual Redistribution

Transport of material from the deep soil or contained waste compartments to the surface soils may occur via human disruption of a site. This is modeled simply using a manual redistribution factor. The manual redistribution factor relates the resultant surface soil concentration, in Ci/m^2, to the initial subsurface concentration, in Ci/m^3. Because the surface soil is modeled as a slab 15 cm thick, a scenario in which deep soils are brought up and overlay the previous surface would use a manual redistribution factor of 0.15 (e.g., 0.15 m^3 of deep soil is required to provide a 15-cm-thick layer over one m^2). Scenarios that result in proportionately less redistribution would be simple multiples of this value.

4.7 TERRESTRIAL EXPOSURE PATHWAYS

This section presents the environmental transport pathway models selected to estimate exposure of individuals or populations from releases of radionuclides to air or water. The primary exposure modes considered are inhalation, external exposure, and ingestion. The exposure analysis begins with environmental concentrations predicted by air and water transport models. Output from the exposure analysis is an estimate of the effective dose equivalent for either a maximally exposed individual or the collective dose to a defined population group. Optional input is that of radionuclide concentrations in various exposure pathway media derived from environmental monitoring data.

The mathematical models for the environmental transport pathway analysis are described in this section in general terms with emphasis given to definition of parameter requirements. For readability, activity units are show in this section as curies, although the code actually functions in "units of activity" (UoA), which are converted to becquerels or curies as required. Models are included for the major routes of transport of radionuclides from the release point to the point of intake or exposure by humans. The models used are generally of the type called the "concentration factor method" by ICRP 29 (1979b). The relationships between the environmental concentrations and human exposures are illustrated in Figure 2.1 on page 2.4. The four "transport" boxes on the left of the figure indicate the input to the terrestrial exposure analysis. The exposure pathways represented in this figure include the following:

- inhalation - primary mode of exposure for the air transport pathway
- drinking water ingestion - from all three water transport pathways
- aquatic food ingestion - from fish and shellfish produced in water contaminated from overland or surface water transport pathways
- crop ingestion - from farmlands contaminated by air transport and deposition, or from irrigation using water contaminated from the water transport pathways
- animal product ingestion - from animals fed contaminated crops (all transport pathways) or contaminated water (water transport pathways)
- external exposure to radionuclides - from contaminated air or soil (air transport pathway) and from aquatic recreational activities (swimming, boating, and shoreline activities for surface water transport pathways).

In the following discussions, the concentration of a radionuclide in air or water is assumed to be the starting point in the environmental transport analysis. For air pathways, the concentration may be represented in three forms, as follows:

1. average concentration, Ca_i, for time period, t

2. long-term time-integrated air concentration, $\bar{\chi}/Q' \times Q'$
3. short-term time-integrated air concentration, $E/Q \times Q$.

Each of these representations has equivalent units of Ci sec/m^3. These units are derived for the first representation by multiplying the air concentration by the exposure period, $Ca_i \times t$.

Chronic water pathways are represented by the average water concentration, Cw_i, for radionuclide i existing over the exposure period. This concentration is supplied as input to the program or is estimated from a relatively simple relationship as indicated in Section 4.5. Acute releases are represented by the time-integrated water concentration, Ew, in Ci-sec/L. No ground water or overland water transport models are included in this program.

Mathematical models and parameters required for each model are defined for each exposure pathway in the discussions below. The dose to an individual is the output of the exposure models. For simplicity, the dose parameters are referred to as "dose". Actually, the calculations are implemented to give dose as well as effective dose equivalent to selected organs. The dose conversion factors may be defined for whatever uptake and commitment period necessary, as specified by the user, for the particular case being analyzed. The representations in the equations, therefore, do not mention the uptake or commitment periods as such, but assume that appropriate factors will be used for the particular calculation being performed.

The formulations are complete, in that they all relate directly to dose. The coded equations are, in many cases, fragmented to allow more efficient use of intermediate parameters. Some equations given here have been simplified to eliminate unit conversion factors. The actual equations as coded are given in the hand-calculation worksheets supplied in the GENII Code Maintenance Manual, Volume 3 of this set of documentation.

4.7.1 Inhalation

Inhalation exposure may result from inhalations of the passing plume or from inhalation of resuspended activity. The dose to an individual from inhalation of contaminated air is calculated from the individual ventilation rate and the air concentration parameter.

$$Dn_i = 3.15 \cdot 10^7 \; B \; Ca_i \; f \; Dh_i \tag{4.7.1a}$$

$$Dn_i = 3.15 \cdot 10^7 \; B \; Q' \; \bar{\chi}/Q' \; Dh_i \tag{4.7.1b}$$

or $$Dn_i = B \; Q \; E/Q \; fc \; Dh_i \tag{4.7.1c}$$

where Dn_i = individual dose from inhalation (rem/yr)

$3.15 \cdot 10^7$ = the number of seconds in a year

B = ventilation (breathing) rate for exposed individuals (m^3/sec)

Ca_i = average air concentration of radionuclide i (Ci/m^3)

Dh_i = inhalation dose conversion factor for radionuclide i (rem per Ci inhaled)

f = fraction of year exposed to inhalation (dimensionless)

E/Q = short-term normalized time-integrated air concentration (sec/m^3)

$\bar{\chi}/Q'$ = long-term normalized time-integrated air concentration (sec/m^3)

Q = total release of radionuclide i (Ci)

Q' = average release rate of radionuclide i (Ci/sec)

fc = fraction of acute plume passage time spent in cloud (dimensionless).

Inhalation of resuspended activity uses the first form of the above representation (Equation 4.7.1a) with the air concentration estimated from either a resuspension factor or mass loading considerations. These methods are based on the assumption that the particulate matter in the air has the same activity as the soil at the location. This is represented mathematically using a resuspension factor as follows:

$$Ca_i = M \; Cs_i \tag{4.7.2}$$

where M is the resuspension factor (m^{-1}) and Cs_i is the soil concentration of radionuclide i (Ci/m^2).

The resuspension factor may be estimated in one of two ways - either by using a time-dependent function developed by Anspaugh et al. (1975) or by means of a mass loading factor. The Anspaugh resuspension factor is given as:

$$M = 10^{-4} \exp(-0.15 \sqrt{t}) + 10^{-9} \qquad (4.7.3a)$$

where M = resuspension factor (m^{-1})

10^{-4} = resuspension factor at time $t = 0$ (m^{-1})

0.15 = effective decay constant controlling the availability of material for resuspension ($day^{1/2}$)

t = time after deposition (days)

10^{-9} = resuspension factor after 17 years (m^{-1}).

The second term in Equation (4.7.3a), 10^{-9}, is added based on the assumption that no further measurable decrease in the resuspension factor process occurs after about 17 years, the longest period for which there are data available.

Alternatively, the resuspension factor may be calculated from the atmospheric mass loading as

$$M = S/\rho \qquad (4.7.3b)$$

where S = mass loading of soil in air (g/m^3)

ρ = soil surface density (g/m^2). A standard value of 224,000 g/m^2 to a depth of 15 cm is used.

Evaluation of the soil concentration was described in Section 4.6.

4.7.2 Drinking Water Ingestion

Exposure to radionuclides by means of the drinking water ingestion pathway may result from the ground water or surface water transport pathways. The overland transport pathway may contribute to contamination in surface water systems and thus indirectly contribute to drinking water ingestion of radionuclides (as indicated in Figure 2.1). The dose from the ingestion of water is calculated from the water concentration, water ingestion rate, a water treatment factor, and a decay correction (for transport through the water distribution system). The dose to an individual using a contaminated domestic water supply is calculated as follows:

$$Dw_i = Uw\ Cw_i\ Tf_i\ \exp(-\lambda_i\ tp)\ Dg_i \qquad (4.7.4a)$$

$$Dw_i = Uw\ Ew_i\ Tf_i\ \exp(-\lambda_i\ tp)\ Dg_i \qquad (4.7.4b)$$

where Dw_i = individual dose from water ingestion for radionuclide i (rem/yr)

Uw = water-intake rate for an individual (L/yr)

Cw_i = water concentration of radionuclide i (Ci/L)

Dg_i = ingestion dose conversion factor for radionuclide i (rem per Ci ingested)

Tf_i = water treatment purification factor, fraction of contaminant remaining after treatment for radionuclide i (dimensionless)

λ_i = radiological decay constant for radionuclide i (sec^{-1})

tp = time of transit through the water distribution system (sec)

Ew_i = time integrated water concentration (Ci sec/L).

The water concentration, Cw_i, represents the concentration at the usage location. This concentration can either be provided directly as input or estimated as shown in Section 4.5.

The water treatment purification factor accounts for removal of radionuclides during treatment in municipal water supply facilities. If no water treatment is performed, then the purification factor is 1. The daily water intake rate is dependent on the type of calculation being performed. For an individual at maximal exposure, a higher value is generally assumed than for an average individual or population analysis. Inadvertent ingestion of water during bathing could be represented by an increment to the daily intake rate. However, the amount is considered small (0.01 L/d) compared to the daily average intake from drinking water (2 L/d) and is not included in this analysis.

4.7.3 Aquatic Food Ingestion

Ingestion of contaminated aquatic foods is an exposure pathway considered for the surface-water transport pathways. Four types of aquatic foods are considered: fish, mollusks, invertebrates, and water plants. Fish represent organisms exposed in free-flowing rivers, lakes, or sea coasts. Mollusks and invertebrates represent organisms that live in water and feed in sediments. The radionuclide concentration in these organisms is related to the contaminant water concentration through bioaccumulation factors. The individual dose from chronic ingestion of aquatic foods is calculated for the water concentration and uptake rates as follows:

$$Da_i = \sum_{f=1}^{n} U_f \, Cw_i \, B_{if} \, \exp(-\lambda_i \, tp) \, Dg_i \qquad (4.7.5a)$$

where Da_i = individual dose from aquatic food ingestion for radionuclide i (rem)

Cw_i = water concentration (Ci/L)

B_{if} = bioaccumulation factor for aquatic food f (L/kg)

n = number of aquatic food types ingested

tp = time for decay from food harvest to consumption (sec)

U_f = consumption rate of aquatic food f, for individuals (kg/d).

For acute exposures, for a time-integrated water concentration of Ew_i, the dose is given as

$$Da_i = \sum_{f=1}^{n} U_f \, Ew_i \, B_{if} \, \exp(-\lambda_i \, tp) \, Dg_i \qquad (4.7.5b)$$

4.7.4 Crop Ingestion - Chronic Exposures

Two models are used for calculating human exposures to contaminated foods, one for chronic releases and one for acute releases. The acute model is an extension of the chronic model and is described in Section 4.7.6.

Irrigating with contaminated water or direct deposition of airborne contaminants onto plants can contaminate agricultural crops. Four food products associated with contaminated crop production are considered: leafy vegetables, root vegetables, grains, and fruit. The leafy vegetable category represents plants such as lettuce whose edible portions are above ground, exposed, and eaten directly with little processing. The root vegetable category represents all other vegetable crops where direct deposition has a much smaller chance of being incorporated directly into the edible portion of the plant. The model used to estimate radionuclide concentration in edible plant portions considers uptake from two pathways: direct deposition and absorption through roots from soil. The model is a variant of that prepared for the NRC for use in Regulatory Guide 1.109 (1977a). This model has been shown to be reasonable by direct comparison of modeled and measured values (Jaquish and Napier 1987). From direct deposition onto leaves, the radionuclide concentration in the plant at time of consumption is calculated as follows:

$$Cl_{ip} = Du_i \; Tv_p \; r \; [1 - \exp(-\lambda e_i \; te_p)] \; \exp(-\lambda_i \; th_p)/(\lambda e_i \; Y_p) \qquad (4.7.6)$$

where Cl_{ip} = concentration of radionuclide i in the vegetable for pathway p (leafy, root, grain, or fruit) from deposition onto leaves (Ci/kg)

Du_i = deposition rate from air or water onto farmlands ($Ci/m^2/sec$)

Tv_p = translocation factor from plant surfaces to edible parts of the plant (dimensionless), currently assumed at 1.0 for leafy vegetables and forage crops, and 0.1 for all other vegetation

r = fraction of initial deposition retained on the plant (dimensionless), discussed below

λe_i = effective weathering and decay constant (sec^{-1})

te_p = duration of the growing period for plant type p (sec)

th_p = time between harvest and consumption for the vegetable type (sec)

Y_p = yield of crop type p (kg/m^2).

From the root uptake pathway, radionuclide concentration in the plant is calculated as follows for air deposition pathways:

$$Cr_{ip} = [Cd_i \; R_{p2} + (Cs_i/P + Cb_i) \; R_{p1}] \; Bv_{ip} \; \exp(-\lambda_i \; th_p) \qquad (4.7.7)$$

9 1 0 4 8 0 1 9 4

where Cr_{ip} = plant concentration from uptake through roots for radionuclide I and plant type p (Ci/kg)

Bv_{ip} = soil-to-plant transfer factor for radionuclide i (dimensionless) and plant type p

Cb_i = residual soil concentration from previous years' deposition of radionuclide i (Ci/kg)

Cs_i = area soil concentration from air deposition for radionuclide i (Ci/m^2), discussed below

Cd_i = deep soil concentration for radionuclide i, Ci/kg, discussed below

P = effective soil density in the plow layer (kg/m^2)

R_{p1} = root penetration factor for surface soil, (dimensionless)

R_{p2} = root penetration factor for deep soil, (dimensionless).

This root penetration factor is included for special cases where the contamination is not uniform with soil depth. See the soil model discussion in Section 4.6. The factor allows a simple correction based on the fraction of the plant room system that is in contaminated soil. For example, if the contaminated soil is buried a meter or so below the surface, only a portion of the root system would reach the contamination. Uptake of radioactivity for such cases would likely be less than if the entire root system were in contact with the contamination.

The total plant concentration at the time of consumption is then calculated as the sum of the contributions from direct deposition and soil uptake as follows:

$$C_{ip} = Cl_{ip} + Cr_{ip} \tag{4.7.8}$$

where C_{ip} is the concentration of radionuclide i in crop type p at the time of consumption (Ci/kg).

The individual dose from ingestion of agricultural crops is estimated from the plant concentration in Equation (4.7.8) and the average consumption rate of vegetables as follows:

$$Dv_i = \sum_{p=1}^{4} U_p \, C_{ip} \, Dg_i \tag{4.7.9}$$

where Dv_i is the dose from consumption rate of contaminated crops (rem/yr), and U_p is the consumption rate of crop type p (leafy, root, grain, or fruit) in kg/yr. The summation is over the four vegetable types.

Interception Fraction, r

The interception fraction, r, for a given vegetation type is a factor that accounts for the fact that not all of the material deposited within a unit area will end up on vegetation surfaces. The fraction of the total deposition that initially resides on vegetation is the interception fraction, r, such that $0 < r < 1.0$.

The interception of materials in irrigation water is not well studied. Thus, a default value of 0.25 is used for all materials deposited on all vegetation types by irrigation.

An empirical relationship between biomass and interception fraction was originally suggested by Chamberlain (1967). This model has been expanded recently by Pinder, Ciravolo, and Bowling (1988) for grasses and other species. The following form of the equation is used for grasses, leafy vegetables, and grains:

$$r = 1.0 - \exp(-2.9 \, Y_p \, f_d) \tag{4.7.10a}$$

A similar equation is used for fruits and other vegetables:

$$r = 1.0 - \exp(-3.6 \, Y_p \, f_d) \tag{4.7.10b}$$

where f_d is the dry-to-wet biomass ratio, and Y_p is the standing biomass of the growing vegetation, kg(wet)/m^2. The dry-to-wet ratio is required because the Pinder formulations are given in terms of dry biomass. This formulation results in the need to define the growing biomass, as well as the harvested yield (for use with the harvest removal term defined in Section 4.6). The values currently in the GENII default files are given in Table 4.25.

The value formerly used at Hanford for the interception fraction was 0.25 for atmospheric deposition and for irrigation deposition. The newer formulations for atmospheric deposition tend to produce higher concentrations than did previous techniques.

4.7.5 Animal Product Ingestion - Chronic Exposures

Atmospheric deposition of contaminants onto feed crops and use of contaminated water to irrigate feed crops can result in the ingestion of contaminated crops by animals. In addition, contaminated water can be used for animal drinking water. Four animal products are considered: beef, poultry, cow milk, and eggs. In evaluating the radionuclide concentration in the beef, poultry, milk, and eggs, the animals are assumed to be feed crops containing radionuclide levels defined by Equation (4.7.8), without the decay correction between harvest and consumption [the exponential term with th_p in Equations (4.7.6) and (4.7.7)]. The animal product concentration resulting from animal ingestion of contaminated feed is calculated as follows:

$$Cf_{im} = C_{ip}\, F_{mi}\, f\, Qf\, \exp(-\lambda_i\, th_m) \qquad (4.7.11)$$

where Cf_{im} = concentration of radionuclide i in animal product m, from animal ingestion of contaminated feed (Ci/L for milk and Ci/kg for meat)

C_{ip} = concentration of radionuclide i in feed crop p, used by the animal (Ci/kg)

f = fraction of animal feed that is contaminated (dimensionless)

F_{mi} = transfer coefficient that relates daily intake rate by an animal to the concentration in an edible animal product (Ci/L milk per Ci/day for milk and Ci/kg meat per Ci/day for meat)

Qf = consumption rate of feed by the animal (kg/d)

th_m = holdup time between harvest or slaughter and consumption for the animal product (sec).

TABLE 4.25. Harvested Yield, Standing Biomass, and Ratio of Dry to Wet Vegetation Used in Interception and Harvest Removal Models

Category	Harvested[a] Yield (wet) for Soil Removal	Standing[b] Biomass (wet) for Interception	Dry-to-Wet[c] Ratio for Interception
Leafy Vegetables	2.0	2.0	0.10
Other Vegetables	4.0	2.0	0.25
Grain	0.6	0.8	0.18
Fruit	2.0	3.0	0.18
Meat: Forage/Hay	2.0[d]	1.0	0.20
Meat: Grain	0.6	0.8	0.18
Poultry & Eggs: Grain	0.6	0.8	0.18
Milk: Fresh Forage	3.0[d]	1.5	0.20
Milk: Hay	2.0[d]	1.0	0.20

(a) Adapted from data in Shor, Baes, and Sharp (1982) for the Washington counties of Benton, Franklin, and Yakima.
(b) Derived from data in Shor, Baes, and Sharp (1982), Strenge, Bander, and Soldat (1987), or Napier et al. (1980).
(c) Adapted from Till and Meyer (1983), Section 5.
(d) Multiple cuttings.

In evaluating the feed concentration, C_{ip}, from Equation (4.7.8), parameters representative of animal feed production are used which differ from vegetable production parameters for human consumption. For example, the growing period is usually set to 30 days to represent animal grazing habits.

The contribution to animal product concentration from animal ingestion of contaminated water is calculated as follows:

$$Cw_{im} = Cw_i \, F_{mi} \, fw \, Qw \, \exp(-\lambda_i \, th_m) \quad (4.7.12)$$

where Cw_{im} = concentration of radionuclide i in an animal product m, from animal ingestion of water (Ci/kg for meat and Ci/L for milk)

fw = fraction of animal water that is contaminated (dimensionless)

Qw = consumption rate of water by the animal (L/d).

Default values of the animal consumption rates used in the GENII code are given in Table 4.26.

The total concentration in the animal product is the sum of the contributions from feed and water intake:

$$C_{im} = Cw_{im} + Cf_{im} \tag{4.7.13}$$

where C_{im} is the concentration of radionuclide i in animal product m (Ci/kg) for beef and eggs, and Ci/L for milk).

The individual dose is calculated from the animal product concentration and the consumption rate of the products as follows:

$$D_{mi} = \sum_{m=1}^{4} U_m \, C_{im} \, Dg_i \tag{4.7.14}$$

where D_{mi} is the individual dose for radionuclide i from ingestion of animal product m (rem), and U_m is the average daily consumption rate of animal product m (L/d for milk and kg/d for meat). The summation is over the four animal product types - meat, milk, poultry, and eggs.

TABLE 4.26. Default Consumption Rates of Feed and Water by Farm Animals

Animal	Feed or Forage (kg/day)	Water (L/day)
Milk Cow	55	60
Beef Cattle	68	50
Poultry	0.12 (dry feed)	0.3

Adapted from Baker, Hoenes, and Soldat (1976).

4.7.6 Terrestrial Food Pathways Models - Acute Releases

Radionuclides deposited on farmland can result in human radiation exposure through farm product pathways. These pathways include food crops and animal products. Under accidental release conditions, the amount of activity ingested through these pathways is difficult to assess. The annual average parameter values and equilibrium bioaccumulation factors used in the chronic pathway analysis models are not directly applicable in describing radionuclide behavior during the short time periods considered in accidental release situations, but they may be more useful for estimating time-integrated dose. The GENII formulation for acute releases takes advantage of this. Information is not provided on dose rates, but estimates are given for total integrated dose for specific sets of assumptions. The GENII formulation is similar to, but an extension of, that used in the Belgian model DOSDIM (Govaerts, Martens, and Kretzchmer 1983). The GENII formulation is also conceptually similar to that used in the model PATHWAY (Whicker and Kirchner 1987), but it uses fewer input parameters.

The GENII formulation for acute releases is intended to be used in prospective assessments, for which the exact timing and conditions of an accident cannot be predicted. For conditions following an accident, the GENII models using known input concentrations should instead be used.

The basic input to the following derivation is season of year, which is actually a surrogate for a more complex set of assumptions concerning crop status and time until harvest. In brief:

- Winter accidents result in soil contamination which becomes a source of contamination via root uptake for all plant pathways for the remainder of the year.
- Spring accidents result in soil contamination for root vegetables, grains, and fruit (because of little plant development and long weathering times). They also result in deposition on leafy vegetables and pasture grass (thus causing milk and beef contamination). Human exposures to ingested contaminants via the leafy vegetable and milk pathways are moderated by the weathering of the initial contamination, using the model developed for the PABLM code by Napier (Till and Meyer 1983). A weathering time of up to three months is assumed.

- Summer accidents result in both soil and leaf contamination of all vegetable products and of forage for animals. A weathering time of one month is assumed for root vegetables, grains, and fruit; immediate harvest and use are assumed for leafy vegetables and forage using the PABLM continuous weathering model.
- Autumn accidents are assumed to occur immediately before harvest, resulting in no soil uptake for crops for that year.

The initiating parameter in all of the following equations is the initial deposition on the ground and plant surfaces. This may be defined from the integrated air concentration or the integrated water concentration as

$$Cs(t=0)_a = E/Q\ Q\ V_d \qquad (4.7.15)$$

$$Cs(t=0)_w = E_w\ I \qquad (4.7.16)$$

where $Cs(t=0)_a$ = the initial soil surface concentration (i.e., at time t=0) from atmospheric deposition, also interpreted as the total downward flux of material per unit area (Ci/m^2)

$Cs(t=0)_w$ = the initial soil surface concentration from irrigation deposition (Ci/m^2)

and other terms are as defined in prior sections.

The basic formulation for human intake of contaminated crops is dependent on the times of deposition, harvest, and consumption. The initial concentration on the plant can be expressed as

$$C_p(t=0) = r\ C_s(t=0)\ Tv_p/Y \qquad (4.7.17)$$

The initial plant concentration due to the initial deposition decreases over time by means of radiological decay and weathering. These processes are assumed to occur continuously from deposition to harvest. The plant concentration at harvest is calculated as

$$C_p(t=T_h) = C_p(t=0)\ e^{-\lambda e\ Th} \qquad (4.7.18)$$

where λe = an effective removal constant

$\lambda e = \lambda r + \lambda w$

λr = radiological decay constant

λw = weathering removal rate, based on a half time of 14 days.

After harvest, a delay period usually occurs before consumption of the food product begins. During this delay, additional radiological decay may occur. For some crops, the consumption period may last for weeks or months. To estimate the uptake during this period, consumption is assumed to occur at a uniform rate. The total intake is then given by a time integral over the consumption period

$$I = \int_0^{T_f} C_p(t=T_h)\ e^{-\lambda r t}\ U\ dt \qquad (4.7.19a)$$

or

$$I = U\ C_p(t=T_h)\ [1 - e^{-\lambda r\ T_f}]/\lambda r \qquad (4.7.19b)$$

where I = the total activity of a radionuclide ingested over a consumption period Tf (Ci)

U = the average daily ingestion rate of the crop over the ingestion period (kg/day)

T_f = the length of the uptake period (day).

The radiation dose received by a person ingesting this amount of activity can be determined using appropriate ingestion dose conversion factors.

This model may be extended for use with animal products. The animal is assumed to eat contaminated crops or drink contaminated water and produce contaminated products continuously over the consumption period defined for humans. The animal product concentration at the time of production is then given as

$$C_a(t) = C_p(t)\ F_{mi}\ f\ Qf \qquad (4.7.20)$$

This animal concentration is not strictly appropriate, because the equilibrium constant does not directly apply to the transient case; but the integral of the concentration is appropriate. The result for the animal product concentration is then used in Equation (4.7.19b) to estimate the total radionuclide intake by an individual consuming the particular animal product. This model is most appropriate for animal products in which the radionuclide concentration comes to a rapid equilibrium.

Application of the general equations is illustrated in Tables 4.27 through 4.30. These tables present the equations used for leafy vegetables, other vegetables, milk and meat, and other animal products for the four seasons. The equations yield the total time-integrated concentration realized by the consumer of the food product, in Ci-yr/kg, which when multiplied by the consumption rate in kg/yr gives in Ci the total intake of radionuclides resulting from the initial release.

For each of the equations in Tables 4.27 through 4.30, terms are included for uptake to the crop by means of root and leaf pathways. For winter and some spring pathways, the leaf route is set to zero. The plant is assumed dead above ground during winter. For autumn accidents, the root pathways are set to zero because the harvest is assumed to occur soon enough after the deposition that the plant has not come to an equilibrium with the soil. Most equations also explicitly contain the exponential term of Equation (4.7.19b). Those that do not, contain the term $[1/(\lambda r + \lambda w)]$. This is the exponential integrated to infinity, because the weathering term is so fast that the remainder of the integral term is negligible.

4.7.7 External Exposure

Land and surface-water transport pathways are involved in external radiation exposure. Individuals may be exposed to contaminated air and ground. They may also be exposed through aquatic recreational activities, such as boating, swimming, and shoreline water use. The radiation dose is calculated as follows from the water concentration or soil concentration, depending on which transport pathway is being studied.

TABLE 4.27. Acute Concentration Equations for Leafy Vegetables

WINTER

$$\left[C_{OA}\, e^{-\lambda_r 6mo} \frac{B_{vi}}{p} RF1 \quad + \quad 0.0 \right] e^{-\lambda_r t_h} \left(\frac{1 - e^{-\lambda_r 12mo}}{\lambda_r}\right) \quad \frac{Ci\text{-}yr}{kg}$$

SPRING

$$\left[(C_{OA} + C_{OW}) \frac{B_{vi}}{p} RF1 \left(\frac{1 - e^{-\lambda_r 12mo}}{\lambda_r}\right) + (C_{OA} I_A + C_{OW} I_W) \frac{T}{Y} \left(\frac{1 - e^{-(\lambda_r + \lambda_w) 12mo}}{\lambda_r + \lambda_w}\right) \right] e^{-\lambda_r t_h} \quad \frac{Ci\text{-}yr}{kg}$$

SUMMER

$$\left[(C_{OA} + C_{OW}) \frac{B_{vi}}{p} RF1 \left(\frac{1 - e^{-\lambda_r 12mo}}{\lambda_r}\right) + (C_{OA} I_A + C_{OW} I_W) \frac{T}{Y} \left(\frac{1 - e^{-(\lambda_r + \lambda_w) 12mo}}{\lambda_r + \lambda_w}\right) \right] e^{-\lambda_r t_h} \quad \frac{Ci\text{-}yr}{kg}$$

FALL

$$\left[0.0 \quad + (C_{OA} I_A + C_{OW} I_W) \frac{T}{Y} \left(\frac{1 - e^{-\lambda_r 12mo}}{\lambda_r}\right) \right] e^{-\lambda_r t_h} \quad \frac{Ci\text{-}yr}{kg}$$

TABLE 4.28. Acute Concentration Equations for Other Vegetables

	Root Term	Leaf Term	Holdup	Consumption Integral	
WINTER	$\Big[\ (C_{OA}\quad e^{-\lambda_r 6mo})\ \frac{B_{vi}}{P}\ RF1\ +$	0.0	$\Big]\ e^{-\lambda_r t_h}$	$\left(\frac{1-e^{-\lambda_r 12mo}}{\lambda_r}\right)$	$\frac{Ci\text{-}yr}{kg}$
SPRING	$\Big[(C_{OA} + C_{OW})e^{-\lambda_r 3mo}\ \frac{B_{vi}}{P}\ RF1\ +$	0.0	$\Big]\ e^{-\lambda_r t_h}$	$\left(\frac{1-e^{-\lambda_r 12mo}}{\lambda_r}\right)$	$\frac{Ci\text{-}yr}{kg}$
SUMMER	$\Big[(C_{OA} + C_{OW})e^{-\lambda_r 1mo}\ \frac{B_{vi}}{P}\ RF1\ +$	$(C_{OA}\ I_A + C_{OW}\ I_W)\ \frac{T}{Y}\ e^{-(\lambda_r+\lambda_w)1mo}$	$\Big]\ e^{-\lambda_r t_h}$	$\left(\frac{1-e^{-\lambda_r 12mo}}{\lambda_r}\right)$	$\frac{Ci\text{-}yr}{kg}$
FALL	$\Big[\quad 0.0$	$+\ (C_{OA}\ I_A + C_{OW}\ I_W)\ \frac{T}{Y}$	$\Big]\ e^{-\lambda_r t_h}$	$\left(\frac{1-e^{-\lambda_r 12mo}}{\lambda_r}\right)$	$\frac{Ci\text{-}yr}{kg}$

TABLE 4.29. Acute Deposition Integrated Concentration Equations for Milk and Beef

WINTER

Forage Equation:

Root / Leaf

$$\left(\left(C_{OA} e^{-\lambda_r 6mo} \frac{BVi}{P} RF1\right) FR + 0.0 = A\right.$$

Stored Feed:

Root / Leaf

$$\left(\left(C_{OA} e^{-\lambda_r 6mo} \frac{BVi}{P} RF1\right) (1-FR) + 0.0 = B\right.$$

Water:

$$Q_w E_w T_f = C$$

Final Equation:

$$\left\{(A + B) \left(\frac{1-e^{-\lambda_r 12mo}}{\lambda_r}\right) Qf + C\right\} F_{mi} e^{-\lambda_r t_h}$$

SPRING

Forage Equation:

Root / Leaf

$$\left[(C_{OA} + C_{OW}) \frac{BVi}{P} RF1 \left(\frac{1-e^{-\lambda_r 12mo}}{\lambda_r}\right) + (C_{OA} I_A + C_{OW} I_W) \frac{T}{Y} \left(\frac{1-e^{-(\lambda_r+\lambda_w) 12mo}}{(\lambda_r + \lambda_w)}\right)\right] FR = A$$

Stored Feed:

Root / Leaf

$$\left[(C_{OA} + C_{OW}) e^{-\lambda_r 3mo} \frac{BVi}{P} RF1 + 0.0\right] (1-FR) \left(\frac{1-e^{-\lambda_r 12mo}}{\lambda_r}\right) = B$$

Water:

$$Q_w E_w T_f = C$$

Final Equation:

$$\left\{(A + B)\ Qf + C\right\} F_{mi} e^{-\lambda_r t_h}$$

TABLE 4.29. (contd)

SUMMER

Forage Equation:

Root | Leaf

$$\left[(C_{OA}+C_{OW})\frac{BVi}{p}\,RF1\left(\frac{1-e^{-\lambda_r 12mo}}{\lambda_r}\right)+(C_{OA}I_A+C_{OW}I_W)\frac{T}{Y}\left(\frac{1-e^{-(\lambda_r+\lambda_w)12mo}}{(\lambda_r+\lambda_w)}\right)\right]FR = A$$

Stored Feed:

Root | Leaf

$$\left[(C_{OA}+C_{OW})\,e^{-\lambda_r 1mo}\frac{BVi}{p}\,RF1+(C_{OA}I_A+C_{OW}I_W)\frac{T}{Y}\,e^{-(\lambda_r+\lambda_w)1mo}\left(\frac{1-e^{-\lambda_r 12mo}}{\lambda_r}\right)(1-FR)\right] = B$$

Water:

$$Q_w\,E_w\,T_f = C$$

Final Equation:

$$\left\{(A+B)\,Qf+C\right\}F_{mi}e^{-\lambda_r t_h}$$

FALL

Forage Equation:

Root | Leaf

$$\left[0.0+(C_{OA}I_A+C_{OW}I_W)\frac{T}{Y}\left(\frac{1-e^{-\lambda_r 12mo}}{\lambda_r}\right)\right]FR = A$$

Stored Feed Equation:

$$\left[0.0+(C_{OA}I_A+C_{OW}I_W)\frac{T}{Y}\left(\frac{1-e^{-\lambda_r 12mo}}{\lambda_r}\right)\right](1-FR) = B$$

Water:

$$Q_w\,E_w\,T_f = C$$

Final Equation:

$$\left\{(A+B)\,Qf+C\right\}F_{mi}e^{-\lambda_r t_h}$$

TABLE 4.30. Acute Deposition Integrated Concentration Equations for Other Animals

	Grain Roots	Grain Leaves	Consumption Integral	Water Term	Holdup
WINTER	$\{[(C_{OA}\quad)e^{-\lambda_r 6mo}\frac{B_{vi}}{P}RF1 +$	0.0	$]\,Q_f\left(\frac{1-e^{-\lambda_r 12mo}}{\lambda_r}\right)$	$+ Q_w E_w T_f$	$\}F_{MI}e^{-\lambda_r th}$
SPRING	$\{[(C_{OA} + C_{OW})e^{-\lambda_r 3mo}\frac{B_{vi}}{P}RF1 +$	0.0	$]\,Q_f\left(\frac{1-e^{-\lambda_r 12mo}}{\lambda_r}\right)$	$+ Q_w E_w T_f\, PA$	$\}F_{MI}e^{-\lambda_r th}$
SUMMER	$\{[(C_{OA} + C_{OW})e^{-\lambda_r 1mo}\frac{B_{vi}}{P}RF1 +$	$(C_{OA} I_A + C_{OW} I_W)\frac{T}{Y} e^{-(\lambda_r+\lambda w)1mo}$	$]\,Q_f\left(\frac{1-e^{-\lambda_r 12mo}}{\lambda_r}\right)$	$+ Q_w E_w T_f$	$\}F_{MI}e^{-\lambda_r th}$
FALL	$\{[\quad 0.0$	$+ (C_{OA} I_A + C_{OW} I_W)\frac{T}{Y}$	$]\,Q_f\left(\frac{1-e^{-\lambda_r 12mo}}{\lambda_r}\right)$	$+ Q_w E_w T_f$	$\}F_{MI}e^{-\lambda_r th}$

Aquatic Recreational Activities

For water pathways, the recreational dose is

$$De_i = (0.5\ tb + ts)\ Cw_i\ Db_i + tf\ Cd_i\ W\ Ds_i \tag{4.7.21}$$

where De_i = dose to an individual from external exposure for radionuclide i, from aquatic recreational activities (rem)

Cd_i = sediment concentration of radionuclide i, deposited on shoreline from contaminated water (Ci/m^2)

tb = time spent by an individual in boating (h)

tf = time spent by an individual fishing or in shoreline activities (h)

ts = time spent by an individual swimming (h)

Db_i = external dose conversion factor for radionuclide i, for immersion in water (rem/h per Ci/L)

Ds_i = external dose conversion factor for exposure to a contaminated plane of radionuclide i (rem/h per Ci/m^2)

W = shore width factor to correct for finite size of shoreline (dimensionless).

The average sediment concentration is estimated from a model developed by Soldat, Robinson, and Baker (1974) relating water concentration to sediment concentration following a long period of deposition. The sediment concentration is given by the following expression:

$$Cd_i = 100\ T_i\ C_{wi}\ [1 - \exp(-\lambda_i\ T_b)] \tag{4.7.22a}$$

where T_b = length of time the sediment is exposed to the contaminated water (d)

T_i = physical half-life of the radionuclide (d)

100 = transfer constant from water to sediment ($L/m^2/d$).

The value of the transfer constant was derived for several radionuclides by using data obtained from analyzing water and sediment samples taken from the Columbia River between Richland, Washington, and the river mouth, and from Tillamook Bay, Oregon, 75 km south of the river mouth (Nelson 1965;

Toombs and Cutler 1968). The equation estimates an effective surface contamination for calculating gamma exposure rates to persons standing on sediment.

The shore-width factor, W, represents the fraction of dose from an infinite plane source an individual could receive from a given shoreline situation that may not be well described as an infinite plane (for which the dose factors are defined). The shore-width factor is essentially a geometric correction. Suggested values for W are derived from experimental data (Dunster 1971) and are presented in Table 4.31.

TABLE 4.31. Suggested Values for Shore-Width Factor

Shoreline Type	Shore-Width Factor
River Shoreline	0.2
Lake Shore	0.3
Nominal Ocean Site	0.5
Tidal Basin	1.0

For acute releases, the time-integrated water concentration, E_W, is used in place of the integral portion of Equation (4.7.22a) as

$$C_{di} = 100\ T_i\ E_W \qquad (4.7.22b)$$

Exposures from sediment are then calculated as given in Equation (4.7.21). For swimming and boating, certain assumptions have been incorporated. It is assumed that maximum individuals are exposed to the entire passage of the contaminated water. Populations, conversely, are assumed to completely avoid contamination. These assumptions are only valid if the acute release and transport times are short. Otherwise, the individual dose could be substantially over estimated. With these assumptions, Equation (4.7.21) can be rewritten as

$$De_i = 1.5\ Ew_i\ Db_i + tf\ Cd_i\ W\ Ds_i \qquad (4.7.23)$$

Contaminated Land

Generally, exposure to contaminated ground is important only for the air transport pathway because water transport pathways will not result in widespread contamination. Airborne deposition is assumed to cover the entire region of the defined population group, and all individuals are potentially exposed. However, in evaluating the maximally exposed individual dose, soil contamination from irrigation is also included as an external exposure route. The radiation dose is calculated from the soil concentration as follows:

$$Dx_i = ts \; Cs_i \; Ds_i \tag{4.7.24}$$

where Dx_i is dose to an individual from exposure to contaminated ground for radionuclide i (rem), and ts is the time of exposure to contaminated ground (h).

Inadvertent Ingestion of Soil and Water

Uptake of radionuclides may result from inadvertent ingestion of soil with foods or of water during recreational swimming. Soil ingestion is estimated conservatively using soil ingestion amounts of Kimbrough et al. (1983) presented in Table 4.32. Using the values in this table, an estimate of average soil ingestion over the lifetime of an individual can be obtained. This average value is 410 mg/d. The average individual dose from inadvertent ingestion of soil is then estimated as follows:

TABLE 4.32. Soil Ingestion by Age[a]

Age Group	Soil Ingested (mg/d)
0 - 9 mo	0
9 - 18 mo	1,000
1.5-3.5 yr	10,000
3.5-5 yr	1,000
> 5 yr	100

(a) Derived from Kimbrough et al. (1983).

$$Dd_i = 410\ td\ Cs_i\ Dg_i/2.24 \bullet 10^8 \quad (4.7.25)$$

where Dd_i = dose to an individual from inadvertent ingestion of soil (rem)
td = period of exposure to ingestion of soil (d)
410 = daily average soil ingestion rate (mg soil/d)
$2.24 \bullet 10^8$ = areal soil density (mg soil/m^2).

Inadvertent ingestion of water may also occur during recreational swimming. The amount ingested is assumed to be 10 mL per hour of swimming. The time of swimming (ts) as defined above for Equation (4.7.21) is used to estimate the average daily exposure as follows:

$$Dr_i = 0.01\ Cw_i\ ts\ Dg_i \quad (4.7.26)$$

where Dr_i is the dose to an individual from ingestion of water during recreational swimming (rem), and 0.01 is the inadvertent water ingestion rate during recreational swimming (L/hr).

4.7.8 Population Dose Calculations

The above models have described calculation of dose to individuals. Population doses can be estimated from the individual dose in two ways, depending on the basis for determining the exposure of the population group. If the number of people exposed by a given pathway is known, then the population dose for that pathway is estimated as the product of individual dose and population exposed as

$$D_{pi} = P_p\ D_{pi} \quad (4.7.27)$$

where P_{pi} = population dose for pathway p and radionuclide i (person-rem)
D_{pi} = dose to an individual from pathway p and radionuclide i (rem)
P_p = number of people exposed by pathway p (persons).

External exposure pathways and inhalation exposure use Equation (4.7.27). The ingestion pathway may also use Equation (4.7.27) if the amount of food produced is known to be sufficient to feed the given population. Or alternatively, base the number of people exposed on the amount of food produced. This is accomplished by considering the number of people that can be fed by the production using average ingestion rates.

$$P_p = K_p/(U_p\ t_p) \tag{4.7.28}$$

where P_p = population served by production of food type p (persons)

K_p = production of food type p during period of exposure (kg or L)

U_p = consumption rate of food type p during the period of exposure (kg/d or Ld)

t_p = period of exposure (d).

The population served as calculated by Equation (4.2.28) is then used in Equation (4.7.27) to estimate the population dose.

4.7.9 Special Models for ^3H and ^{14}C

The behavior of the radionuclides tritium and carbon-14 in exposure pathways is handled in a special manner. The concentrations of tritium or carbon-14 in environmental media (soil, plants, and animal products) are assumed to have the same specific activity (curies of radionuclide per kilogram of soluble element) as the contaminating medium (air or water). The fractional content of hydrogen or carbon in a plant or animal product is then used to compute the concentration of tritium or carbon-14 in the food product under consideration. The hydrogen content in both the water and the nonwater (dry) portion of the food product are used when calculating the tritium concentration. For airborne releases, it is assumed that plants obtain all their carbon from airborne carbon dioxide and that animals obtain all their carbon through ingestion of plants.

The transfer of ^{14}C from water to plants is difficult to model because plants acquire most of their carbon from the air. Currently available models for carbon-14 uptake by plants from water use specific-activity models relating the activity in the plants directly to the activity in irrigation water. This is extremely conservative in that it assumes that plants receive all of their carbon from water. An interim model is described here based on the ratio of grams of carbon-14 to grams of total carbon in soil and a correction for the amount of carbon plants obtain from soil.

The special models recommended for ^3H are described first followed by the ^{14}C models. The concentration of tritium in vegetation is calculated as

$$C_{Hp} = 9\ Cw_H\ F_{Hp} \tag{4.7.29}$$

where C_{Hp} = the concentration of ^3H in plant type p (Ci/kg)
Cw_H = the concentration of tritium in the environmental water (Ci/L)
F_{Hp} = the fraction of hydrogen in total vegetation.

The coefficient 9 converts tritium concentration in environmental water to concentration in hydrogen. The fractions of hydrogen in various food types are given in Table 4.33.

For airborne release, the concentration of ^3H in environmental water is calculated from the air concentration and the absolute humidity as follows:

$$Cw_H = Ca_H/H \tag{4.7.30}$$

where Ca_H is the average air concentration of ^3H (Ci/m^3), and H is the absolute humidity (L/m^3), taken to be 0.008 L/m^3 for Hanford.

The concentration of tritium in the animal product is

$$C_{Hm} = \frac{C_{Hp}Qf + Cw_H Qw}{F_{Hf}Qf + Qw/9}\ F_{Hm} \tag{4.7.31}$$

where C_{Hm} = concentration of ^3H in animal product m (Ci/kg or Ci/L)
C_{Hp} = concentration of ^3H in animal product feed crop p (Ci/kg)
Cw_H = concentration of ^3H in animal drinking water (Ci/L)
F_{Hf} = fraction of hydrogen in animal feed (dimensionless)
F_{Hm} = fraction of hydrogen in animal product m (dimensionless)
and other terms are as previously defined.

The models for ^{14}C are similar to those for ^3H. The concentration of carbon-14 in vegetation from irrigation is

TABLE 4.33. Fractions of Hydrogen and Carbon in Environmental Media, Vegetation, and Animal Products

Food or Fodder	Water f_w	Carbon (dry) f_c	Hydrogen (dry) f_h	Carbon[a] (wet) F_{cv}, F_{ca}	Hydrogen[b] (wet) F_{hv}, F_{ha}
Fresh fruits, vegetables, and grass	0.80	0.45	0.062	0.090	0.10
Grain and stored animal feed	0.12	0.45	0.062	0.40	0.068
Eggs	0.75	0.60	0.092	0.15	0.11
Milk	0.88	0.58	0.083	0.070	0.11
Beef	0.60	0.60	0.094	0.24	0.10
Poultry	0.70	0.67	0.087	0.20	0.10

Absolute humidity . . . . 0.008 L/m^3

Concentration of carbon in water . . . . 2.0 x 10^{-5} kg/L[c]

Concentration of carbon in air . . . . 1.6 x 10^{-4} kg/m^3[d]

Fraction of soil which is carbon 0.03

Soil moisture . . . . 0.1 L/kg

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

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

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

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

$$C_{Cp} = C_{wC}\ I\ t_{ep} \frac{0.1}{0.01\ P\lambda_{sC}} [1 - \exp(-\lambda_{sC}\ t_{ep})] \qquad (4.7.32)$$

where C_{Cp} = concentration of ^{14}C in plant type p (Ci/kg)
C_{wC} = concentration of ^{14}C in irrigation water
λ_{sC} = effective removal rate constant for 13C in soil (sec -1)
0.1 = the assumed uptake of 10% of plant carbon from soil
0.01 = the average fraction of soil that is carbon

and other terms are as previously defined. The concentration of ^{14}C in crops from atmospheric contamination is calculated as

$$C_{Cp} = C_{aC}\ F_{Cp}/P_C \qquad (4.7.33)$$

where C_{aC} = concentration of ^{14}C in air (Ci/m^3)
F_{Cp} = fraction of carbon in the plant (dimensionless)
P_C = concentration of carbon in air (kg/m^3).

The concentration of ^{14}C in animal products is calculated as

$$C_{Cm} = \frac{C_{Cp}Q_f + C_{wC}Q_w}{F_{Cf}Q_f + F_{Cw}Q_w} F_{Cm} \qquad (4.7.34)$$

where C_{Cm} = concentration of ^{14}C in animal product p (Ci/kg or Ci/L)
C_{Cp} = concentration of ^{14}C in crop used for animal feed (Ci/kg)
C_{wC} = concentration of ^{14}C in animal drinking water (Ci/L)
F_{Cf} = fraction of carbon in animal feed (dimensionless)
F_{Cw} = fraction of carbon in animal drinking water (dimensionless)
F_{Cm} = fraction of carbon in animal product m (dimensionless)

and other terms are as previously defined. This expression can be simplified for airborne releases by noting that the water concentration (C_{wC}) is zero, and the carbon content in plants is much higher than in water ($F_{Cf} \gg F_{Cw}$). The animal product concentration then becomes:

$$C_{Cm} = C_{Cp} \frac{F_{Cm}}{F_{Cf}} \qquad (4.7.35)$$

4.8 LONG-TERM CALCULATIONS

This section describes the mathematical models and algorithms used in the DITTY program. The discussion is divided into five parts as follows:

- source terms - specification and use
- airborne release - modes for estimating average air concentrations downwind of the release, and definition of the exposed population
- waterborne release - model for definition of exposed populations
- environmental concentrations - models to estimate important environmental pathway concentrations
- pathway dose calculations - models to determine total population doses from important pathways.

Most of the descriptions parallel those in the previous five sections, 4.3 to 4.7, modified for the 10,000-year integral formulation.

4.8.1 Incorporation of Long-Term Sources

The environmental source terms represent the rate at which radionuclides enter the environment through airborne or waterborne routes. The generation of source terms is normally performed by sophisticated computer programs for ground water transport. To interface easily with these programs, a general method for source-term specification was chosen: all radionuclide release-rate data are provided as time/rate data pairs. Each data pair gives a time (years after a reference time) and a release rate in curies per year for a given radionuclide. The data for each radionuclide are provided in a set of data pairs with up to 450 time points. Such a set is provided for each radionuclide of interest. Using this procedure, a different set of time points can be used for each radionuclide. Because of the great variation in transport properties among the radionuclides of interest in radioactive waste, it is important to be able to specify releases over a range of time periods.

To use the release rate data within the 70-year increment calculational scheme, the release rate data are interpolated and integrated to give the total activity released in each 70-year increment.

A special option is included to describe an acute release to the environment at the beginning of the time period. This acute release can be selected for either airborne or waterborne pathways. No more than one acute release per computer simulation is allowed.

4.8.2 Long-Term Airborne Releases

To estimate the radiation dose received from releases to the atmosphere, it is necessary to consider atmospheric transport of radionuclides. The atmospheric processes transport the radionuclides throughout the region surrounding the release point. The resulting distribution of material is important in determining the radiation exposure received by members of the regional population through potential exposure pathways. This section describes the methods available for specifying and estimating atmospheric dispersion.

Calculating population exposure is based on a spatial grid as described in Section 4.4.3. The population data set is specified as the number of people living within each area element of the grid at a given time. Sixteen directions and up to 10 distance intervals are used. The atmospheric dispersion calculation is based on joint frequency of occurrence data for wind speed, wind direction, and atmospheric stability for the site. One set of joint frequency data is given to be used with all population data. The downwind normalized air concentration is estimated for each area element using the long-term average equation provided in Section 4.3. If values of normalized air concentrations are already known, they may be supplied as input rather than calculations. The dispersion factors are used with the population distribution data to provide a population-weighted dispersion factor. The factor represents a population-weighted estimate of the average normalized air concentration for the region. The factor is calculated as follows:

$$PM(t) = \sum_{i=1}^{\text{directions}} \sum_{j=1}^{\text{distances}} P_{ij}(t) \, (\bar{\chi}/Q')_{ij} \qquad (4.8.1)$$

where PM(t) is the population-exposure factor at time t (person-sec/m^3), and $P_{ij}(t)$ is the number of people living in the area interval in direction j at distance i at time t (persons). As the equation indicates, the population exposure factor is a function of time. Changes in population over the 10,000-year period will be the primary cause of change in the population-exposure factor. While climate changes may also affect the factor, such changes are difficult to predict and are not considered.

Two options that determine population-exposure factors are available in DITTY for normalized air concentration values. When estimates of the total population change are known, the population exposure factor for the initial time may be calculated, and values for remaining time increments will then be calculated by ratio to population changes with time. If population distribution data are known as a function of time, they may be used to calculate population-exposure factors at each of the specified times, which are, in turn, interpolated for each 70-year increment.

Specifying population exposure factors can occur by direct input of factor at defined time points or by calculation from defined meteorological data and population data. When population exposure values are input, interpolations are made to determine the values at the midpoint of each 70-year time increment.

4.8.3 Long-Term Waterborne Releases

Pathways associated with waterborne releases include external exposure to contaminated water and sediment; ingestion exposure from drinking water, farm products (via irrigation), and aquatic foods; and inhalation of resuspended material after irrigation. The release of activity to water is described by a release rate in curies per year defined at specific times. The activity released is assumed to result in exposure of a regional population. Specification of the number of people exposed to waterborne pathways is performed similarly to definition of population for airborne pathways. The major difference is that only the total population is specified (spatial distribution is not needed).

Two methods are available for defining population data for waterborne release. The first method is to define the population exposed during each of the 143 70-year periods. The second method is to give the population present at specified times for interpolation at the midpoint of each 70-year period.

4.8.4 Long-Term Environmental Concentrations

In estimating exposure of the regional population from airborne as well as waterborne releases, it is necessary to determine radionuclide concentrations in several environmental media and exposure-pathway media. This section describes models used to estimate air, water, soil, sediment, and food concentrations for the important pathways. All radionuclide concentrations are expressed as time integrals over a 70-year period. This is done to facilitate dose calculations that use the concentration data.

Input to the pathway analysis is the total release of curies in each 70-year time period. The total release is combined with population and dispersion parameters to estimate an environmental parameter for the exposure analysis. For airborne releases, the value is calculated as:

$$A_c(i,t) = PM(t)\,\frac{3.16 \bullet 10^{-8}}{\lambda_{ri}} \int_{t_o}^{t_o+70} a_i(t)dt \qquad (4.8.2)$$

where $A_c(i,t)$ = population-weighted airborne release for radionuclide i over 70 years (person-Ci-yr^2/m^3)

$PM(t)$ = population exposure factor for time period t (person-sec/m^3)

λ_{ri} = radiological decay constant for radionuclide i (yr^{-1})

$a_i(t)$ = release rate of radionuclide i at time t (Ci/yr)

$3.169 \bullet 10^{-8}$ = conversion factor (yr/sec).

For waterborne releases, the water concentration parameter is calculated as:

$$W_c(i,t) = \frac{P(t)\ N\ M\ 1.119 \bullet 10^{-9}}{F_r\ \lambda_{ri}} \int_{t_o}^{t_o+70} C(t)dt \qquad (4.8.3)$$

where $W_c(i,t)$ = population-weighted water concentration for radionuclide i and time period t (person-Ci-yr^2/L)

$P(t)$ = population exposed to water for time period t (persons)

N = reconcentration factor (dimensionless)

M = mixing ratio (dimensionless)

F_r = flow rate of receiving water (ft^3/sec)

$C(t)$ = release rate to the receiving water (Ci/yr, at time t)

$1.119 \bullet 10^{-9}$ = conversion factor, $\dfrac{1}{28.31 \frac{L}{ft^3}\ 3.156 \bullet 10^7\ yr \frac{sec}{yr}} \left(\dfrac{ft^3\ yr}{L\ sec}\right)$.

The airborne pathway analysis used the air concentration parameter, $A_c(i,t)$, to determine several environmental concentrations:

- $S_{ca}(i,t)$, soil concentration parameter for radionuclide i, person-Ci-yr^2/kg
- $L_{ca}(i,p,t)$, time integral of leaf concentration for radionuclide i and pathway p, from air deposition and resuspension over the current period t, person-Ci-yr^2/kg
- $P_{ca}(i,p,t)$, time integral of plant concentration for radionuclide i and pathway p, from air-deposited contaminants on plants and root uptake over the current period t, person-Ci-yr^2/kg.

The soil concentration parameter is calculated from the air concentration parameter assuming deposition to be at a uniform rate over the 70-year period:

$$S_{ca}(i,t) = \frac{A_c(i,t)\ V_{di}}{7.069 \bullet 10^9} \left(\frac{1-e^{-\lambda_b t}}{\lambda_b}\right) \tag{4.8.4}$$

where V_{di} = deposition velocity for radionuclide i (m/sec)

λ_b = environmental decay constant (yr^{-1})

$7.069 \bullet 10^9$ = constant (224 kg/m^2 $\bullet$ 3.156 $\bullet$ 10^7 sec/yr).

The environmental decay constant, λ_b, is calculated as the sum of a radiological decay constant, λ_{ri}, and a soil removal constant for weathering λ_{wi}. The soil removal constant is a correction for long-term leaching of deposited radionuclides out of the soil rooting and resuspension zones. The values given for λ_{wi} are calculated using the formula of Baes and Sharp (1981) as given in Equation (4.6.3).

The time integral of leaf concentration is calculated from the air and soil concentration parameters assuming a constant soil concentration equal to the value at the end of the 70-year period. This is a conservative assumption. The equation is:

$$L_{ca}(i,p,t) = \frac{r\,V_{di}}{Y_p}\left[A_c(i,t) + 1.49 \bullet 10^{-8}\,S_{ca}(i,t)\right] \tag{4.8.5}$$

$$\left(\frac{1 - e^{-\lambda_{ei} T_p / 365}}{\lambda_{ei}}\right) 3.156 \bullet 10^{7}$$

where Y_p = crop yield for food pathway p (kg/m^2)

λ_{ei} = effective retention rate constant for radionuclide i (yr^{-1})

r = interception fraction, discussed in Section 4.7.4

λ_{ei} = λ_{ri} + 18.0838 (yr^{-1})

18.0838 = rate constant for a 14-day half time

T_p = growing period for food pathway, p (days)

0.25 = interception fraction (dimensionless)

$1.49 \bullet 10^{-8}$ = conversion factor, $1 \bullet 10^{-9}$ (m^{-1}) • 224/15 (kg/m^2)

365 = days per year

$3.156 \bullet 10^{7}$ = seconds per year.

The factor of $1 \bullet 10^{-9}$ (m^{-1}) represents a resuspension factor assumed constant, characteristic of aged deposition material (Anspaugh et al. 1975). It is assumed that the resuspended activity deposits on the plants near the soil from which it was suspended. Downwind transport of resuspended activity is not considered. The factor of 224 is the soil area density to a depth of 15 cm of 224 kg/m^2, and 15 cm is the plow depth through which the contamination is distributed. This value is included so that only the top centimeter of material (1/15 of the total) is considered available for resuspension. The leaf concentration as calculated above represents the time integral over a 70-year period.

The radionuclide concentration in edible parts of the plant includes material from direct deposition plus material from root uptake:

$$P_{ca}(i,p,t) = L_{ca}(i,p,t)\ T_{vp} + S_{ca}(i,t)\ B_{iv} \qquad (4.8.6)$$

where $P_{ca}(i,p,t)$ = time integral of plant concentrations for plant type p for radionuclide i and time period t (person-Ci-yr^2/kg)

T_{vp} = translocation factor of externally deposited radionuclides to edible parts of the plant (dimensionless)

B_{iv} = concentration ratio for plant uptake of radionuclide i, Ci/kg (wet weight plant) per Ci/kg (dry weight soil)

and other terms are as previously defined.

The concentration used for calculating uptake by population is the plant concentration for plant pathways. For animal pathways, the uptake is calculated as:

$$A_{ca}(i,p,t) = P_{ca}(i,p,t)\ S_{ip}\ Q_p \qquad (4.8.7)$$

where $A_{ca}(i,p,t)$ = time integral of animal product concentration for radionuclide i, animal product p, and time period t, period-Ci-yr^2/kg (person-Ci/yr^2/L for milk)

S_{ip} = transfer coefficient of radionuclide i from daily intake by animal to edible portion of animal product, Ci/L (milk) per Ci/day or Ci/kg (animal product) per Ci/day

Q_p = the consumption rate of contaminated feed or forage by the animal for animal product p (kg/day).

The waterborne pathway analysis uses the water concentration $W_c(i,t)$ to determine the following environmental concentrations:

- $S_{cw}(i,t)$, soil concentration for radionuclide i for the current period t for irrigation deposition, person-Ci-yr^2/kg
- $S_{dw}(i,t)$, sediment deposition concentration for radionuclide i for current period t for shoreline of contaminated water body, person-Ci-yr^2/m^2

- $L_{cw}(i,p,t)$, leaf concentrations for radionuclide i, plant type p, and time period t for irrigation deposition and resuspension, person-Ci-yr^2/kg
- $P_{cw}(i,p,t)$, plant concentration of radionuclide i and pathway p, from irrigation deposition onto plant and root uptake through soil, person-Ci-yr^2/kg.

The soil concentration at the end of the period is calculated assuming uniform deposition over the period.

$$S_{cw}(i,t) = \frac{W_c(i,t)\ I\ T_i}{224} \left(\frac{1 - e^{-\lambda_b T}}{\lambda_b}\right) \tag{4.8.8}$$

where I = irrigation rate (L/m^2 mo)

T_i = irrigation period (mo/yr)

224 = soil area density (kg/m^2).

The exponential term represents the integral over the 70-year period.

The concentration in the sediment is calculated similarly as:

$$S_{dw}(i,t) = W_c(i,t)\ 25300 \tag{4.8.9}$$

where 25300 is the constant to represent deposition to sediment, L/m^2/yr. The value of the sediment deposition constant (25300) is the same as that described in Section 4.7.7 with the units converted.

The concentration on leaves is calculated for contributions from direct irrigation deposition plus resuspension from soil:

$$L_{cw}(i,p,t) = \frac{0.25}{Y_p} [W_c(i,t) \bullet I \bullet 12 + s_{cw}(i,t) \bullet 0.47\ V_{di}]$$

$$\left(\frac{1 - e^{-\lambda_{ei} T_p/365}}{\lambda_{ei}}\right) \tag{4.8.10}$$

where 0.25 = plant interception fraction for irrigation (dimensionless)

Y_p = plant yield for plant type p (kg/m^2)

12 = unit conversion constant (mo/yr)

0.47 = conversion factor for resuspension

$0.47 = (10^{-9}\ m^{-1})\ (3.156 \bullet 10^7\ sec/yr)\ (224\ kg/m^2)\ (1/15)$

V_{di} = deposition velocity of resuspended activity (m/sec)

λ_{ei} = environmental weathering constant for 14-day half time, yr^{-1}

$\lambda_{ei} = \lambda_{ri} + 18.0838$.

The radionuclide concentration in edible parts of the plant is calculated for root uptake plus direct deposition as

$$P_{cw}(i,p,t) = L_{cw}(i,p,t)\ T_{vp} + S_{cw}(i,t)\ B_{iv} \tag{4.8.11}$$

where T_{vp} = translocation factor of externally deposited radionuclides to edible parts of plant (dimensionless)

B_{iv} = concentration ratio for plant uptake of radionuclide i, Ci/kg (wet weight plant) per Ci/kg (dry weight soil).

The total uptake of plants during the 70-year period is given by the above plant concentration parameter. For animal products, uptake is calculated for animal consumption of plants plus animal consumption of water as

$$A_{cw}(i,p,t) = S_{ip}\ [P_{cw}(i,p,t)\ Q_p + W_c(i,t)\ Q_{pw}] \tag{4.8.12}$$

where $A_{cw}(i,p,t)$ = time integral of animal product p, concentration in time t, for radionuclide i from waterborne pathways, person-Ci-yr^2/kg (person-Ci-yr^2/L for milk)

S_{ip} = transfer coefficient of radionuclide i from daily intake by animal to edible portion of animal product p, Ci/L (milk) per Ci/day or Ci/kg (animal product) per Ci/day

Q_p = the consumption rate of contaminated feed or forage by animal for animal type p (kg/day)

Q_{pw} = the consumption rate of water by animal for animal type p (L/d).

The time-integrated concentration in aquatic foods is calculated from the water concentrations as

$$A_{fw}(i,p,t) = W_c(i,t)\ B_{ip} \qquad (4.8.13)$$

where $A_{fw}(i,p,t)$ = time-integrated concentration of radionuclide i in aquatic food p (person-Ci-yr^2/kg)

B_{ip} = bioaccumulation factor for radionuclide i and aquatic food p (Ci/kg per Ci/L).

The time-integrated water concentration for the drinking water pathway is calculated as

$$A_{dw}(i,t) = W_c(i,t)\ C_i \qquad (4.8.14)$$

where $A_{dw}(i,t)$ = time-integrated concentration in drinking water for radionuclide i and time period t (person-Ci-yr^2/L)

C_i = water purification plant cleanup factor (dimensionless).

The radionuclides tritium and carbon-14 are handled in the special manner described in Section 4.7.9.

4.8.5 Long-Term Pathway Dose Calculations

The total dose received by the regional population is estimated as the sum of contributions from all pathways. The doses are calculated as the population dose received in each 70-year time period from material released to the environment during that period plus all previous periods. Precalculated dose conversion factors are used to estimate dose from uptake and environmental concentration. The exposure pathways are described in the following sections.

Air Submersion

Contributions for external exposure from air submersion are included for 1) submersion in the release plume, 2) submersion in resuspended activity from an initial airborne release, and 3) submersion in suspended activity from an initial irrigation water deposition. The dose is calculated as

$$D_{oei} = D_{ei}\, \lambda_{ri}\, 3.156 \bullet 10^{7} \left[A_c(i,t) + 1.49 \bullet 10^{-8} \bullet \left(S_{ca}(i,t) + S_{cw}(i,t)\right)\right] \tag{4.8.15}$$

where D_{oei} = population dose from air submersion to organ o from radionuclide i (person-rem)

D_{ei} = external exposure dose conversion factor for air submersion (rem per Ci-sec/m^3)

λ_{ri} = radiological decay constant for radionuclide i (yr^{-1})

$3.156 \bullet 10^7$ = conversion factor (sec/yr)

$A_c(i,t)$ = time-integrated air concentration of radionuclide i in time period t (person-Ci-yr^2/m^3)

$1.49 \bullet 10^{-8}$ = resuspension factor constant (kg/m^3)
= $(1 \bullet 10^{-9}\ m^{-1})$ (224 kg soil/m^2) (1/15)

$S_{ca}(i,t)$ = soil concentration parameter from airborne release of radionuclide i for time period t (person-Ci-yr^2/kg)

$S_{cw}(i,t)$ = soil concentration parameter from waterborne release of radionuclide i for time period t (person-Ci-yr^2/kg).

The contribution from deposited material is based on the concentration at the end of the current period. This concentration is assumed to occur throughout the period, which is a conservative assumption by no more than a factor of two. Resuspension is based on a constant resuspension factor of $10^{-9}\ m^{-1}$, representing resuspension of aged deposited material (Anspaugh et al. 1975). The resuspended activity is assumed to expose individuals in the vicinity of the soil from which it was suspended. Downwind transport of resuspended activity is not considered. The decay constant, λ_{ri}, is included to convert the units of radionuclide concentration from mass to activity. The calculations are performed in units proportional to mass to meet requirements of the chain decay processor, BCHAIN.

Inhalation

Inhalation exposure includes contributions from the released airborne activity plus the resuspended activity from airborne and irrigation water deposition. The dose is calculated as:

$$D_{ohi} = D_{hio}\, 3.156 \bullet 10^{7}\, \lambda_{ri}\, [A_c(i,t) + 1.49 \bullet 10^{-8} (S_{ca}(i,t) + S_{cw}(i,t))] \qquad (4.8.16)$$

where D_{ohi} = dose from inhalation exposure from organ o from radionuclide i (person-rem)

D_{hio} = inhalation dose conversion factor for radionuclide i and organ o (rem per Ci-sec/m^3)

and other terms are as previously defined.

<u>Terrestrial Ingestion Pathways</u>

Terrestrial pathways include ingestion of crops and animal products. The seven terrestrial ingestion pathways available are vegetable, grain, eggs, milk, beef, pork, and poultry. The dose for each pathway is calculated from the time-integrated food-product concentration. For plants, the dose is calculated as

$$D_{oti} = D_{gio}\, \lambda_{ri}\, U_p\, [P_{ca}(i,p,t) + P_{cw}(i,p,t)] \qquad (4.8.17)$$

and for animal products, the dose is calculated as

$$D_{oti} = D_{gio}\, \lambda_{ri}\, U_p\, [A_{ca}(i,p,t) + A_{cw}(i,p,t)] \qquad (4.8.18)$$

where D_{oti} = dose from terrestrial ingestion pathways for organ o (person-rem)

D_{gio} = ingestion dose conversion factor for radionuclide i and organ o (rem/Ci)

U_p = the usage rate by humans of food product p (kg/yr or L/yr for milk)

$P_{ca}(i,p,t)$ = time integral of plant concentration from airborne pathways for radionuclide i, plant type p, and time period t (person-Ci-yr^2/kg)

$P_{cw}(i,p,t)$ = time integral of plant concentration from waterborne pathways for radionuclide i, plant type p, and time period t (person-Ci-yr^2/kg)

$A_{ca}(i,p,t)$ = time integral of animal product concentration from airborne pathways for radionuclide i, animal product p, and time period t (person-Ci-yr^2/kg or person-Ci-yr^2/L for milk)

$A_{cw}(i,p,t)$ = time integral of animal product concentration from waterborne pathways for radionuclide i, animal product p, and time period t (person-Ci-yr^2/kg or person-Ci-yr^2/L for milk).

The total dose from terrestrial ingestion pathways is calculated by summing contributions from all plant and animal product food types.

Aquatic Ingestion Pathways

Ingestion pathways resulting from release of radionuclide to surface or ground water include ingestion of drinking water and aquatic foods. The five pathways available are fish, crustacea, molluscs, water plants, and drinking water. The dose for each pathway is calculated from the time-integrated aquatic media concentration as follows for aquatic foods:

$$D_{oai} = D_{gio} \lambda_{ri} U_a A_{fw}(i,p,t) \qquad (4.8.19)$$

and for drinking water:

$$D_{oai} = D_{gio} \lambda_{ri} U_a A_{dw}(i,t) \qquad (4.8.20)$$

where D_{oai} = dose from ingestion of aquatic food or water for organ o (person-rem)

U_a = the usage rate by humans of aquatic-food pathway a (kg/yr or L/yr for drinking water)

$A_{fw}(i,p,t)$ = time integral of aquatic food p, concentration for radionuclide i, in time period t (person-Ci-yr^2/kg)

$A_{dw}(i,t)$ = time integral of drinking water concentration for radionuclide i in time period t (person-Ci-yr^2/L).

External Exposures

External exposures result from proximity to contaminated ground, shoreline, and water. Swimming and shoreline doses are calculated from the time-integrated sediment concentration and water concentration as

$$D_{oew} = \lambda_{ri} \left[S_{dw}(i,t)\, D_{os}\, U_{sh}\, W + W_c(i,t)\, D_{ow}\, U_{sw}\right] \tag{4.8.21}$$

where D_{oew} = dose from external exposure to shoreline and water for organ o (person-rem)

D_{os} = external dose factor for organ o for exposure to contaminated soil or shoreline (rem/h per Ci/m_2)

D_{ow} = external dose factor for organ o for submersion in contaminated water (rem/h per Ci/L)

U_{sh} = time of exposure to contaminated shoreline (h/yr)

U_{sw} = time of exposure to contaminated water (h/yr)

$S_{dw}(i,t)$ = sediment concentration parameter for radionuclide i for the current time period t (person-Ci-yr/m^2)

$W_c(i,t)$ = time integral of water concentration for radionuclide i and time period t (person-Ci-yr^2/L)

W = shore-width factor for shoreline exposure (dimensionless).

The shore-width factor is an approximate correction to the infinite-plane geometry of the external exposure factors. To correct for the actual geometry of a river bank or beach, a shore-width factor is applied corresponding to the particular exposure situation. Suggested shore-width factors are given in Table 4.31. Contaminated soil can result from deposition of airborne material or from irrigation with contaminated water. The dose from external exposure to contaminated soil is calculated as

$$D_{oes} = \lambda_{ri}\, E_t\, D_{ow}\, 224 \left[S_{ca}(i,t) + S_{cw}(i,t)\right] \tag{4.8.22}$$

where D_{oes} = dose from external exposure to soil for organ o (person-rem)

E_t = time of exposure to contaminated ground (h/yr)

$S_{ca}(i,t)$ = soil concentration due to airborne deposition of radionuclide i at the end of time period t (person-Ci-yr/kg)

$S_{cw}(i,t)$ = soil concentration due to waterborne deposition of radionuclide i at the end of time period t (person-Ci-yr/kg)

224 = soil areal density (kg/m_2).

and other terms are as previously defined. Note that the external exposure is based on the integrated soil concentration for the current 70-year period.

5.0 SOLUTION TECHNIQUES

The GENII package of computer codes is written in standard FORTRAN 77 using a Leahey compiler. Most routines are simple algebraic solutions, and no special logic is employed. The exception is the INTDF code, which calculates internal dose factors and uses a general purpose solver for ordinary differential equations. The solver used is from the ODEPACK collection developed at Lawrence Livermore National Laboratory (Hindmarsh 1983). The specific portion if ODEPACK used is called LSODES.

The LSODES package solves explicit systems of stiff differential equations. Stiffness is related to the rate constants of the equations and may require large numbers of iterations for some solution techniques. LSODES uses a backwards differentiation formulation, based on the multistep methods first implemented by C. W. Gear (1971). The following description was adapted from a publication by Hindmarsh (1983):

> When solving a stiff system of size N, of the general form
>
> $$\dot{y} \equiv dy/dt = f(t,y)$$
>
> the LSODES package makes use of the Jacobian matrix of partial derivates
>
> $$J = \partial f/\partial y$$
>
> For stiff problems, LSODES uses the Backward Difference Formula (BDF)
>
> $$yn = \sum_{i=1}^{q} \alpha_i \, y_{n-1} + h \, \beta_o \, \dot{y}_n$$
>
> $$= a_n + h \, \beta_o \, f(t_n, y_n)$$
>
> where again q is the order (here $1 \leq q \leq 5$), and $\beta_0 > 0$. Stiffness makes functional iteration fail to converge for the step sizes of

interest, because of strong dependencies in f upon y. Therefore, LSODES uses a modified Newton iteration

$$-P\,[y_{n(m+1)} - y_{n(m)}] = y_{n(m)} - a_n - h\,\beta_0\,f(t_n, y_{n(m)})$$

where P is an NxN matrix approximating the Jacobian of the algebraic system to be solved:

$$P \simeq I - h\,\beta_0\,J,\ J = \partial f/\partial y$$

(Here I denotes the NxN identity matrix.) Again a prediction $y_{n(o)}$ is formed from an analogous explicit formula. This iteration differs from a true Newton method in that J is only evaluated periodically. In fact, J is evaluated only at predicted values $y_{n(o)}$ and only on those steps where a new value appears necessary, on the basis of a convergence failure or other indication. The same value of P (or its LU decomposition, if used) is used over all iterations in any one step, and typically also over several time steps, until a reevaluation of J and P is called for. (In the case of the LSODES solver, P is sometimes updated and LU-decomposed without a reevaluation of J.) Again, h and q are both varied to meet local error tolerance requirements.

In applying the BDF method to large stiff problems, it is important to note that a numerical solution of the linear system

$$Px = r$$

(x = correction vector, r = residual vector)

can very often easily take advantage of a sparse structure in P. This is accomplished either through suitable structured LU decompositions, or through iterative linear system methods that use a given matrix structure. The use of structure is especially important in solving ODE systems that come from time-dependent partial differential equation (PDE) systems by the method of lines, whereby spatial variables are discretized, leaving ODE's in time.

The LSODES package solves explicit systems $\dot{y} = f$, but treats the Jacobian matrix J as a general sparse matrix in the stiff case. In LSODES, linear systems are solved using parts of the Yale Sparse Matrix Package (YSMP) (Eisenstat et al. 1977a and 1977b). Recall that the systems to be solved have the form

$$Px = r,\ P = I - h\beta_0 J$$

where x is a correction vector, h is the step size, and β_0 is a scalar depending on the current method order. The solution of these systems involves several phases:

(a) Determination of sparsity structure. This is inferred from calls to the f routine.

(b) Determination of pivot order. Diagonal pivot locations are chosen, and the choice is based on maintaining maximum sparsity. This is done by YSMP (ODRV module) (Eisenstat et al. 1977a). The ordering algorithm (minimum degree algorithm) operates only on a symmetric sparsity structure, and in LSODES the structure used for this is that of $J + J^T$.

(c) Symbolic LU factorization of the matrix P. This is based only on sparsity and the pivot order, and uses the module in YSMP designed for nonsymmetric matrices with compressed pointer storage (CDRV module) (Eisenstat et al. 1977b).

(d) Construction of J. This is done internally by difference quotients. The number of f evaluations needed is kept to a minimum by a column grouping technique due to Curtis, Powell, and Reid (1974). J is stored internally in an appropriate packed form. Evaluations of J are done only occasionally, as explained below.

(e) Construction of $P = I - h\beta_0 J$. LSODES does not force a reevaluation of J whenever the existing P is deemed unsuitable for the corrector iterations. Instead, when the value of J contained in the stored value of P is likely to be usable (and P is not, only because $h\beta_0$ has changed significantly), then a new matrix P is constructed from the old one, with careful attention to roundoff error. This cuts down greatly on the total number of J evaluations.

(f) Numerical LU factorization of P. This is done by YSMP (CDRV module) in sparse form, and the array containing P is saved in the process. Because of the absence of partial pivoting for numerical stability, this operation can conceivably fail. However, this has only rarely been observed in practice, and if it does occur (with a current value of J), the step size h gets reduced and the difficulty disappears.

(g) Solution of $Px = r$. This is done by YSMP (CDRV module) using the existing sparse factorization of P. Because a modified Newton iteration is used, many values of r (i.e., many linear systems) can arise for the same P, and the separation of the various phases takes advantage of that fact.

The first three phases and part of the fourth (column grouping for difference quotients) are normally done only at the start of the problem. However, the user can specify that the sparsity structure is to be redetermined in the middle of the problem, and then these operations are repeated.

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APPENDIX

HEDUP SYSTEM DESIGN REQUIREMENTS

Hanford Environmental Dosimetry Upgrade Project (HEDUP)

TASK 02 -- SYSTEM DESIGN REQUIREMENTS

INTRODUCTION

Computer codes will be developed on this project for calculating radiation doses to humans from radionuclides released into the environment from Hanford Operations. The computer codes will be used by a number of different groups at Hanford for both retrospective calculations of the radiological impacts of routine Hanford emissions and also for prospective dose calculations, as required for various scenarios. The users would include, among others:

* PNL -- Environmental Evaluations Section, for calculating offsite radiation doses to the general public and the maximally exposed hypothetical individual, as required for preparation of the annual Hanford Environmental Monitoring Report,

-- Environmental and Risk Assessment Section, for use in developing environmental impact statements, safety analysis reports, radiological impacts studies, and environmental assessment work.

* RHO -- Nuclear and Safety Analysis Group, for accidental release analyses and routine release consequence analyses,

-- Regulatory and Safety Review Group, for evaluating the doses resulting from annual average stack releases, reviewing Clean Air Act compliance, and for performance assessments,

* HEDL -- Safety Analysis Group, for safety analyses, accident and chronic

release consequence studies, and environmental assessments,

-- Environmental and Radiological Engineering Group, for safety analyses, accident and chronic release consequence studies, and environmental assessments,

* UNC -- Radioactive Effluent Control Subsection, for estimating offsite impacts of radioactive releases for environmental assessments, decommissioning activities, and routine and accidental releases.

The computer code developed on this project must therefore be designed to match the needs of multiple users. A committee of representative potential user groups was formed under the coordination of the Hanford Dose Overview Committee to develop recommendations for computer code system design specifications to match the needs of each operating contractor.

This document identifies the system design requirements needed to make the computer codes user-friendly, compatible with current computer facilities, and well-suited to the calculational requirements of individual users.

System design requirements are grouped into the following categories:

1. General computational requirements
2. Computational facilities, hardware, and databases.
3. Code language.
4. Coding Standard and coding standard tools.
5. Input parameters and format:

   Release category and source term.

   Scenarios.

Meteorology.

Environmental transport.

Exposure pathways.

6. Dosimetry specifications.
7. Risk assessment calculations.
8. Integration of separate codes.
9. Customized pathway requirements.
10. Specialized scenario requirements.
11. Output format.
12. Graphics.
13. Documentation and instructions.
14. Error messages.
15. Updates and revisions.
16. Security.
17. Quality assurance.
18. Training.

These items are discussed in the following sections.

GENERAL COMPUTATIONAL REQUIREMENTS

The capabilities of the computer code shall include, as a minimum, the following:

1. Radiation doses for:

   (a) Acute exposure to radionuclides, with option for annual dose, 50-year committed dose, and 70-year committed dose, i.e. 1/1, 1/50, 1/70.

   (b) Chronic exposure to radionuclides, with option for annual dose, 50-year committed dose, 70-year committed dose, and the 50-year cumulative dose and 70-year cumulative dose for a user-specified number of years of exposure, i.e. 1/1, 1/50, 1/70, x/50, and x/70.

2. Exposure pathways to include:

   (a) Direct exposure via (1) water (swimming, boating and fishing), (2) soil (surface and buried depositions), (3) air (semi-infinite cloud and the finite plume), and (4) special geometries.

   (b) Inhalation pathways, in units of rem/Ci and Sv/Bq inhaled.

   (c) Ingestion pathways, in units of rem/Ci and Sv/Bq ingested.

3. Scenario designs to include:

   (a) Acute releases by (1) air at ground level or elevated levels, or by (2) water releases.

   (b) Chronic releases by (1) air at ground level or elevated levels, or by (2) water releases.

   (c) Initial contamination of (1) soil, (2) buildings and other surfaces, and (3) water.

4. Source term variations to include:

   (a) Decay of radionuclides to start of scenario.

   (b) Input of total radionuclide inventory or specified fraction.

   (c) Input of radionuclide concentrations (Ci/g, Ci/m^3, etc.)

   (d) Release rate of radionuclides to (1) air and (2) water.

5. Interface considerations:

   (a) Atmospheric dispersion.

   (b) Geohydrology.

   (c) Biotic transport.

   (d) Surface water transport.

   (e) Special shielding calculations.

6. Target population variations by distance and sector:

(a) Offsite individuals.

(b) Offsite populations.

(c) Onsite individuals.

(d) Intruders.

COMPUTATIONAL FACILITIES, HARDWARE AND DATABASES

The computer code shall be designed for implementation on the UNIVAC-1100 to provide optimum access to the code by users at Hanford contractor facilities. The code shall secondarily be designed for in-house VAX and other minicomputer systems. Design of the code for future application to IBM-PC/AT/XT (or compatible) systems should be considered for the future.

If necessary to improve data processing speeds, provision should be made for the code could to be run on the NAS-9060 LSIS (large scale information system) computer.

The code shall be available to authorized users "on demand." A convenient facility/user interface is desirable for on-line access on a priority basis for general purpose needs, and batch mode for routine work and preparation of the Hanford environmental monitoring report.

CODE LANGUAGE

The computer code shall be written in ANSI FORTRAN-77 standard language. This choice will facilitate conversion to other computing systems, modifications of the code, and necessary updating.

CODING STANDARD AND CODING STANDARD TOOLS

Programming shall follow the guidelines of the PNL Statistical Computing Unit FORTRAN coding standard. The coding standard is intended to provide a neat, uniform, and complete form of documentation and quality control, to streamline review efforts by standardizing the format of the code, and to make software maintenance a more simple task.

All FORTRAN routines shall consist of three blocks:

1. Definition block (routine name, limitations and prerequisites, arguments, logical names and files used, routines used),
2. Implementation block (development information, modification history, algorithms, constants, parameter statements, common blocks, and variables), and
3. Code block (data statements and code).

Common blocks, often used constants (parameter statements) and often used variable names shall be handled as stated in their respective sections.

Where applicable, the programmer should localize system-dependent calls, avoid dependency on internal word size (i.e., set up a constant word size), place constants in an up-front parameter file, put variables in Common block, use device names in front of file names, and hold to a limit of one routine per file.

INPUT PARAMETERS AND FORMAT

A user-friendly, menu-driven program will facilitate use of the code by many different Hanford users. An input screen would streamline initial

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data entry and specification of the type of calculation desired.

The option should be added for using a 'runstream' in place of the menu. Runstreams can be quickly copied or altered and used inplace of the menu to initialize a program run.

The code shall organize and display each input item to allow a user re-check of the data entry.

A namelist input, or the equivalent in standard FORTRAN language should be provided and standardized. The current DACRIN source term input system is much easier to use than the SUBDOSA system. The new code shall allow the user the flexibility of specifying any distance parameters desired.

The maximally exposed individual shall be determined from realistic assumptions concerning location of residence, dietary practices, and living conditions. Unlikely combinations of parameters should be avoided.

Release Category:
Both acute (accidental or one-time) and chronic releases shall be available as options in the calculation. The code shall allow 1) evaluation of acute releases via air submersion, ingestion, and inhalation pathways, and 2) evaluation of chronic releases via air submersion, inhalation, ingestion, and direct exposure (ground contamination, water immersion, etc.) pathways.

Scenarios:

By allowing the time parameters to be variable, such scenarios as the case of transient residents and intruders could be modeled by the user. The default condition, however, should be for the permanent resident.

Meteorology:

Three atmospheric dispersion models are needed in the code: 1) the straight-line gaussian model, 2) input tables of X/Q, and 3) 95 percentile X/Q. These models need to be as complete as possible to keep the results reproducible, standardized, and documented. The code should be able to handle specified distances of from 0.1 km to 72 km from the source. The release durations should be variable from as short a time as an instantaneous release, to times as long as one year.

The computer code shall allow simple incorporation of site-specific meteorology. The user shall be allowed to input X/Q values as a number, and the allowed range of X/Q values shall cover the range typical for Hanford conditions. An option shall be provided for ground-level radionuclide releases, and releases from any specified height above ground level. The straight-line model may be appropriate for most applications.

A user-friendly option shall be provided for the finite cloud model for both elevated releases and ground-level releases.

It would be useful if the code also took into account plume depletion and deposition from the plume to ground.

The PNL Atmospheric group should be involved in the preparation of the meteorological aspects of the code.

Environmental Transport:
The code shall take into account the effect of long-term weathering of radionuclides in soil, i.e. dispersion into the below-surface soil matrix.

Exposure Pathways:
Deposition on soil shall be considered for both atmospheric deposition and irrigation using contaminated water.

The uptake of radionuclides in the soil by plants shall be accounted for using current methods. The typical user will not have input data for this pathway, and must rely on the best available models, concentration ratios, or measured concentrations as currently recommended.

The uptake of radionuclides by farm animals shall take into account the ingestion of crops and the consumption of contaminated water.

Commonly used or typical exposure pathway parameters shall be established in the code as default values.

DOSIMETRY SPECIFICATIONS
GENMOD shall replace DACRIN; however, some of the valuable input/output features of DACRIN shall be retained. Internal dosimetry calculation shall be based on ICRP-30 models and biokinetic values for radionuclide residency and transport in the body.

GENMOD incorporates additional models other than those of the ICRP. These shall be available at the option of the user. These models include the alkaline earth model, the MIRD iron model, the ^{14}C model, etc.

Provision shall be made for revising biokinetic models and input parameters as updated values become available.

The code should permit the user the option of inserting desired input parameters (e.g. breathing rate, quantity of water or foodstuffs consumed), although such usage should be considered nonstandard and so identified to the user. Standard default values should be easily recognized.

The code shall calculate the effective dose equivalent for the average member of the general public in the sector and distance of interest, as well as for the maximally exposed individual.

The code shall provide integration of doses for any time period of choice following radionuclide release. This choice should be an input parameter.

The user shall be able to set up the dose calculation to provide the annual (one year) dose and dose equivalent, the 50-year committed dose equivalent, and cumulative doses expected from both acute and chronic exposures from ground level and elevated releases, as well as liquid releases to river and drinking water pathways.

The calculation shall account for radionuclide decay "in transit," i.e., the diminishing activity of radionuclides between time of release and time of exposure of the target individual.

DACRIN currently has the problem that erroneous results appear when dosimetry is requested for more than seven organs. The new code should permit the user to obtain dose data for all organs, including the skin.

Standard default values shall be given for breathing rates assumed for the exposed population, with the user option to change the values. Onsite occupancy factors shall be considered for the calculation of dose to the maximally exposed onsite individual.

The code shall allow the user to specify the activity median aerodynamic diameter of the inhaled aerosol for cases involving inhalation of radionuclides. The code shall calculate deposition fractions in the three major lung regions for the particle size selected, instead of prompting the user to supply those deposition fractions.

GENMOD currently provides output for Class D, W, or Y materials. Often, however, the radioactive aerosol may contain a mixture of Class D, W, and Y materials. GENMOD shall be modified to consider mixtures or combinations of different solubility classes, and produce output for that mixture.

In the foodchain pathway, an option shall be provided to specify the total crop production versus the number of people consuming those crops.

The population dose may be estimated from the average dose to the average resident times the number of persons involved. Doses shall therefore be calculated for individuals and then multiplied by the number of persons.

Age considerations should not be necessary at this time, but provision should be made for future incorporation of age-dependent models.

RISK ASSESSMENT CALCULATIONS

The code shall calculate the 50-year and 70-year committed effective dose equivalent for individuals, and the 50-year and 70-year effective dose equivalent commitment (i.e. the collective effective dose equivalent commitment) for populations.

INTEGRATION OF SEPARATE CODES

The final product will be a single code developed from several existing codes. This code shall carefully integrate all components to facilitate ease of program execution.

CUSTOMIZED PATHWAY REQUIREMENTS

None are identified at this time. Should the need arise, they could be added to the code, and provision should be made accordingly.

SPECIALIZED SCENARIO REQUIREMENTS

The option to allow input of externally-calculated meteorology data would cover any specialized scenarios, including release of radionuclides during postulated tornado conditions.

OUTPUT FORMAT

At the beginning of the report output, the input variables shall be repeated back for user verification.

The output shall be either in terms of (1) traditional quantities and units, such as rem, millirem, curies, etc., or (2) S.I. units, such as sievert, millisievert, becquerel, etc., at the option of the user.

The output format shall include consequences at any given input distance rather than requiring interpolation within a set group of distances (as currently the case with certain modes in SUBDOSA). The output shall match the desired input.

A summary of the doses calculated shall be provided for each contributing pathway and organ. The summary shall also include a listing of the major contributing radionuclides, and the percent of the total dose for each pathway contributed by each radionuclide.

Literature references to the published sources on which the computer code is based shall be incorporated into the program and should be callable, with printout capability, at the option of the user.

GRAPHICS

There are no graphics needs currently identified. However, it is expected that there will be a future need to graphically display numbers calculated by the computer code. An example might be a plot of X/Q versus distance from the point of release. A mechanism shall be designed therefore, to dump output into files for later graphics applications.

DOCUMENTATION AND INSTRUCTIONS

The user's manual shall be a living document that is updated whenever a change is made. User's manuals shall be maintained in three-ring binders that are easily updated. Numbered copies shall be distributed to individuals on a list of users.

ERROR MESSAGES

Error messages shall assist the user when improper input parameters or formats are used. Error messages should not occur when the data is properly entered.

All input errors shall be identified by the input routines prior to program execution.

UPDATES AND REVISIONS

Notices of code updates, and revised instructions shall be provided to potential users. A list of potential users shall be maintained so that revisions and notices may be distributed, as appropriate.

SECURITY

The computer code and associated databases are to be considered sensitive. Security measures shall be implemented to protect the code from access by unathorized users.

Configuration control shall be a feature of the software to protect the basic code from unauthorized changes. A control mechanism with sign-off procedures shall be implemented to protect the software from unauthorized modifications. Needed changes shall be validated before modification are permitted (see Quality Assurance).

QUALITY ASSURANCE

PNL's Procedures for License-related Programs for quality assurance shall be followed. Software control procedures are given in SCP-301 through SCP 312, and include:

-- magnetic media protection and control,

-- software development specification preparation and approval,

-- computer code verification and/or validation,

-- computer code configuration control,

-- computer code acceptance testing,

-- computer code and documentation change control,

-- computer code application control,

-- final internal development review of computer code and documentation,

-- computer software transfer,

-- utility code documentation, control, testing and use,

-- documenting and reporting discrepancies found during computer code control, testing and use, and

-- determination of software classification.

TRAINING

A short training program shall be developed at the completion of the code to instruct potential users on the execution of the code. A detailed stepwise instruction manual shall also be prepared. Training should consist of class sessions and hand-out instructions, with opportunity for hands-on testing of the code.

RMS SL * 134384

WBS: 12914
QA: N/A

NNA.920626.0036

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HANFORD ENVIRONMENTAL DOSIMETRY UPGRADE PROJECT

GENII - THE HANFORD ENVIRONMENTAL RADIATION DOSIMETRY SOFTWARE SYSTEM

VOLUME 2: USERS' MANUAL

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ABSTRACT

The Hanford Environmental Dosimetry Upgrade Project was undertaken to incorporate the internal dosimetry models recommended by the International Commission on Radiological Protection (ICRP) in updated versions of the environmental pathway analysis models used at Hanford. The resulting second generation of Hanford environmental dosimetry computer codes is compiled in the Hanford Environmental Dosimetry System (Generation II, or GENII). The purpose of this coupled system of computer codes is to analyze environmental contamination resulting from acute or chronic releases to, or initial contamination of, air, water, or soil. This is accomplished by calculating radiation doses to individuals or populations.

GENII is described in three volumes of documentation. This second volume is a Users' Manual, providing code structure, users' instructions, required system configurations, and QA-related topics. The first volume describes the theoretical considerations of the system. The third volume is a Code Maintenance Manual for the user who requires knowledge of code detail. It includes code logic diagrams, global dictionary, worksheets, example hand calculations, and listings of the code and its associated data libraries.

ACKNOWLEDGMENTS

This work was performed as part of the Dose Overview Project for the U.S. Department of Energy, Richland Operations Office. The authors would like to thank all those individuals who have helped make the development of this software package possible. Assisting in developing the project as well as the code package were the successive managers of the Dose Overview Project: Ron Kathren, the late Ed Watson, Jerry Martin, and R. Gene Schreckhise. Members of the Hanford Dose Overview Panel, including Darrell Fisher, Paul Rittman, and Janet Davis, provided the initial code capability requirements. Valuable developmental assistance was provided by S. Keith Hargrove, Mike Madison, Jaime Lara, and Phil Pohl, of the NORCUS REST and GEM programs. We especially thank Joe Soldat for extending his computer literacy as our chief test subject in code debugging. Finally, we would like to thank Peggy Upton, Marianna Cross, and their co-workers for suffering through editing and producing this series.

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GRDF.DAT

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DEFAULT.IN

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ISOLIB.DAT

DOSINC.OUT

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SEE.IN

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APPRENTICE.DAT

FIGURES - VOL. 2

TABLES - VOL. 2

<u>EXHIBIT - VOL. 2</u>

1.0 INTRODUCTION

At the direction of the U.S. Department of Energy (DOE), the Hanford Environmental Dosimetry Upgrade Project was undertaken at Pacific Northwest Laboratory (PNL)[a] to incorporate the internal dosimetry models recommended by the International Commission on Radiological Protection (ICRP) in updated versions of the environmental pathway analysis models used at Hanford. The resulting second generation of Hanford environmental dosimetry computer codes is compiled in the Hanford Environmental Dosimetry System (Generation II or GENII). The GENII system was developed by means of tasks designed to provide a state-of-the-art, technically peer-reviewed, documented set of programs for calculating radiation doses from radionuclides released to the environment. The initial task resulted in a system design requirements report, based on input from the community of potential Hanford users, providing general descriptions of the calculations that the final programs must perform. The recommendations of this report formed the basis for the remainder of the tasks, defining the elements that determined the equation formulation and parameter selection tasks. The complete report, Hanford Environmental Dosimetry Upgrade Project (HEDUP) Task 02-System Design Requirements, is included in Volume 1 as the appendix.

The general requirements of the system to be designed included the capabilities for calculating radiation doses for acute releases, with options for annual dose, committed dose, and accumulated dose; for calculating the same types of doses from chronic releases; for evaluating exposure pathways including direct exposure via water (swimming, boating, and fishing), soil (surface and buried sources), air (semi-infinite cloud and finite cloud geometries), inhalation pathways, and ingestion pathways. The release scenarios to be included were acute releases to air from ground level or elevated sources, or to water; chronic releases to air from ground level or elevated sources, or to water; and initial contamination of soil or surfaces. Source term variations to be accounted for included decay of radionuclides to the start of the exposure scenario, input of total radioactivity or specified

(a) Pacific Northwest Laboratory is operated by Battelle Memorial Institute for the U.S. Department of Energy under Contract DE-AC06-76RLO 1830.

fractions, and input of measured concentrations in specified environmental media. Interfaces were to be provided for external calculations of atmospheric dispersion, geohydrology, biotic transport, and surface water transport. Target populations were identified by distance and direction for individuals, populations, and for intruders into contained sources. To accommodate the multitude of initial requirements on the design of the codes, the codes of the Hanford Environmental Dosimetry System were written to determine radiation doses to individuals or populations from a wide variety of potential exposure scenarios. The core system may be used to calculate annual doses, dose commitments, or accumulated doses from acute or chronic releases of radioactive materials to air or water.

The Hanford Environmental Dosimetry System (GENII) is composed of seven linked computer codes and their associated data libraries. These codes and their linkages are illustrated in Figure 1.1. The computer programs are of three types: user interfaces (i.e., interactive, menu-driven programs to

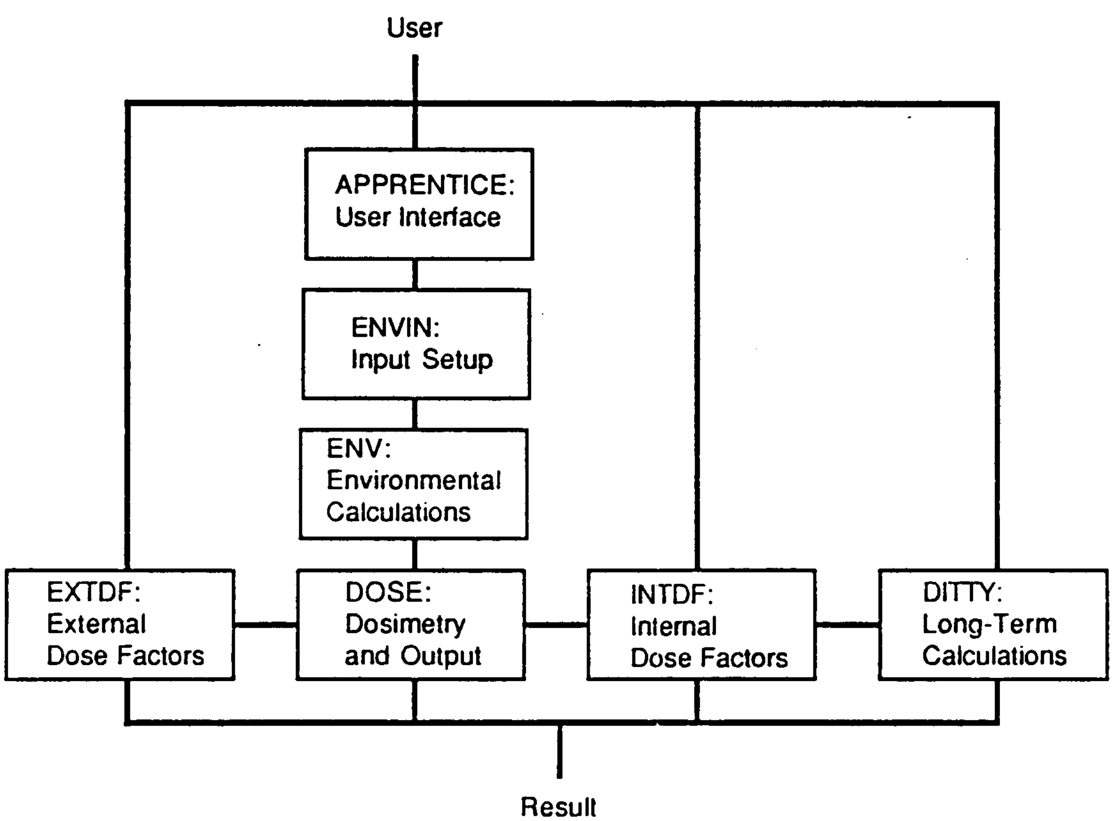


FIGURE 1.1. Component Programs of the GENII Software Package

assist the user with scenario generation and data input), internal and external dose factor generators, and the environmental dosimetry programs. For maximum flexibility, the portion of the code used for analysis of short-term scenarios (as opposed to 10,000-year migration analyses) has been divided into three interrelated but separate programs that handle input organization and checking, environmental exposure, and dose calculations, respectively.

GENII is described in three volumes of documentation. Volume 1 describes the theoretical considerations of the system, including conceptual diagrams, mathematical representation of the solutions, and descriptions of solution techniques, where appropriate. This, the second volume, is a Users' Manual, providing code structure, users' instructions, required system configurations, and topics related to quality assurance (QA). The third volume is a Code Maintenance Manual for the user who requires knowledge of code detail, including code logic diagrams, global dictionary, worksheets, example hand calculations, and listings of the code and its associated data libraries.

2.0 CODE STRUCTURE

The GENII Software Package comprises several computer programs and data libraries. The computer programs fall into three categories: 1) user interface (e.g., interactive menu-driven program to assist the user with scenario generation), 2) internal and external dose factor generators, and 3) the environmental dosimetry programs. APPRENTICE is the user interface for the short-term environmental dosimetry programs; EXTDF and INTDF generate internal and external dose rate factors, respectively; DITTY handles long-term environmental dosimetry. For maximum flexibility, the short-term environmental dosimetry portion has been divided into three interrelated but separate programs (ENVIN, ENV, and DOSE) that handle input organization and checking, environmental exposure, and dose calculations, respectively.

Two user interaction levels are defined for the GENII software package. With the first, Level 0, the user interacts with the user interface. With the second, Level 1, the user interacts directly with the text input files. Level 0 is helpful to the both the novice and the experienced user of the software package. Level 1 is intended for the experienced user of the software. DITTY, EXTDF, and INTDF are available only to the Level 1 user at this time.

Figure 2.1 depicts the software organization and the user interaction with the programs.

Figure 2.2 illustrates the data transfer mechanisms between the various program elements. Each of these input, output, and intermediate files is described in Section 2.2.

Figure 2.3 illustrates the data bases and their relationships to the various program components. These are further described in Section 2.3.

2.1 USER INTERACTION LEVELS

Two user interaction levels are defined for the GENII software package. The first, designated Level 0, is that at which most users will interact with the system. In Level 0, the user accesses the interactive program

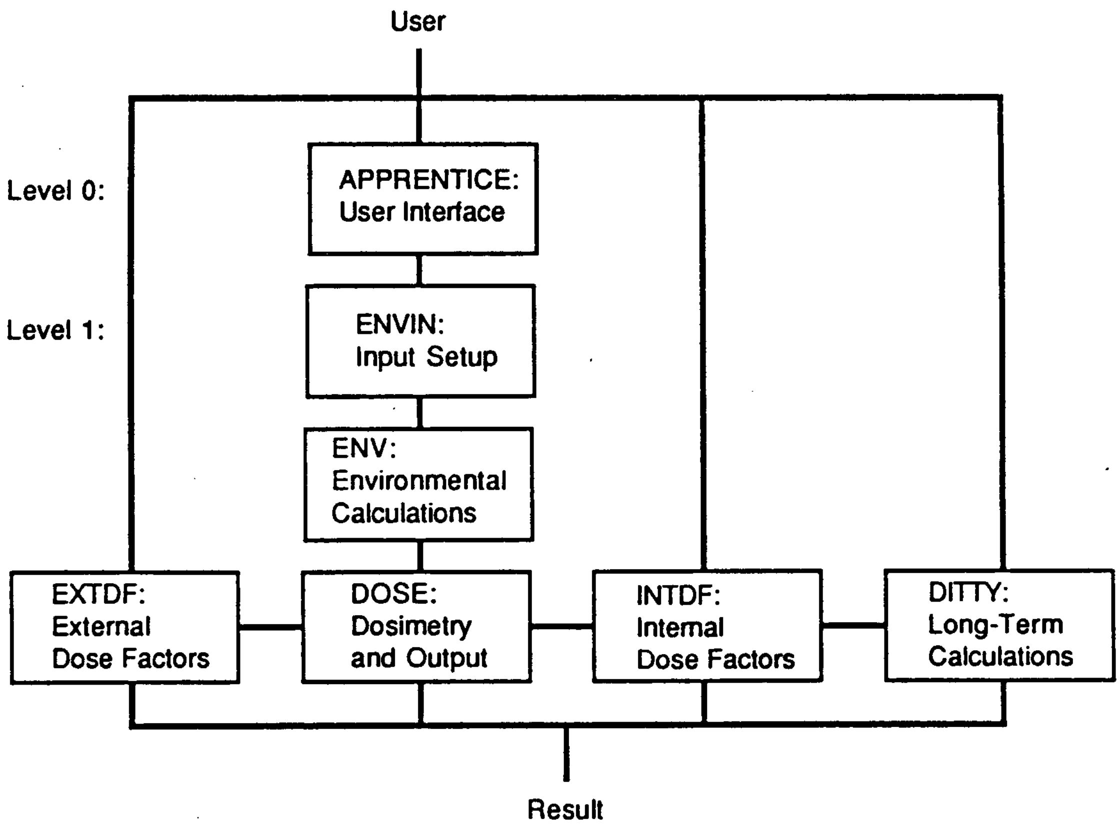
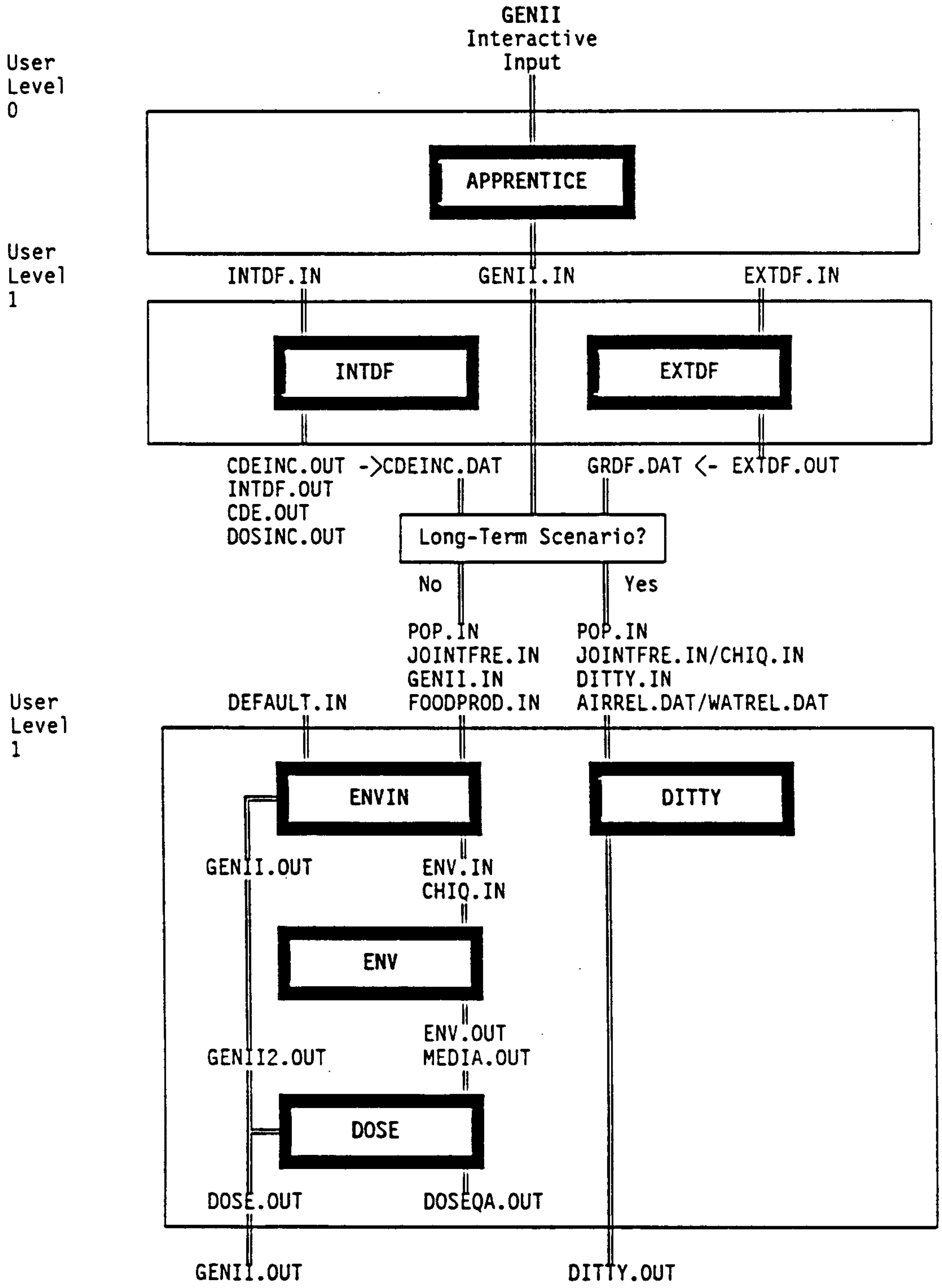


FIGURE 2.1. Organization and User Interaction Levels for the GENII Software Package



<u>FIGURE 2.2</u>. GENII File Relationships

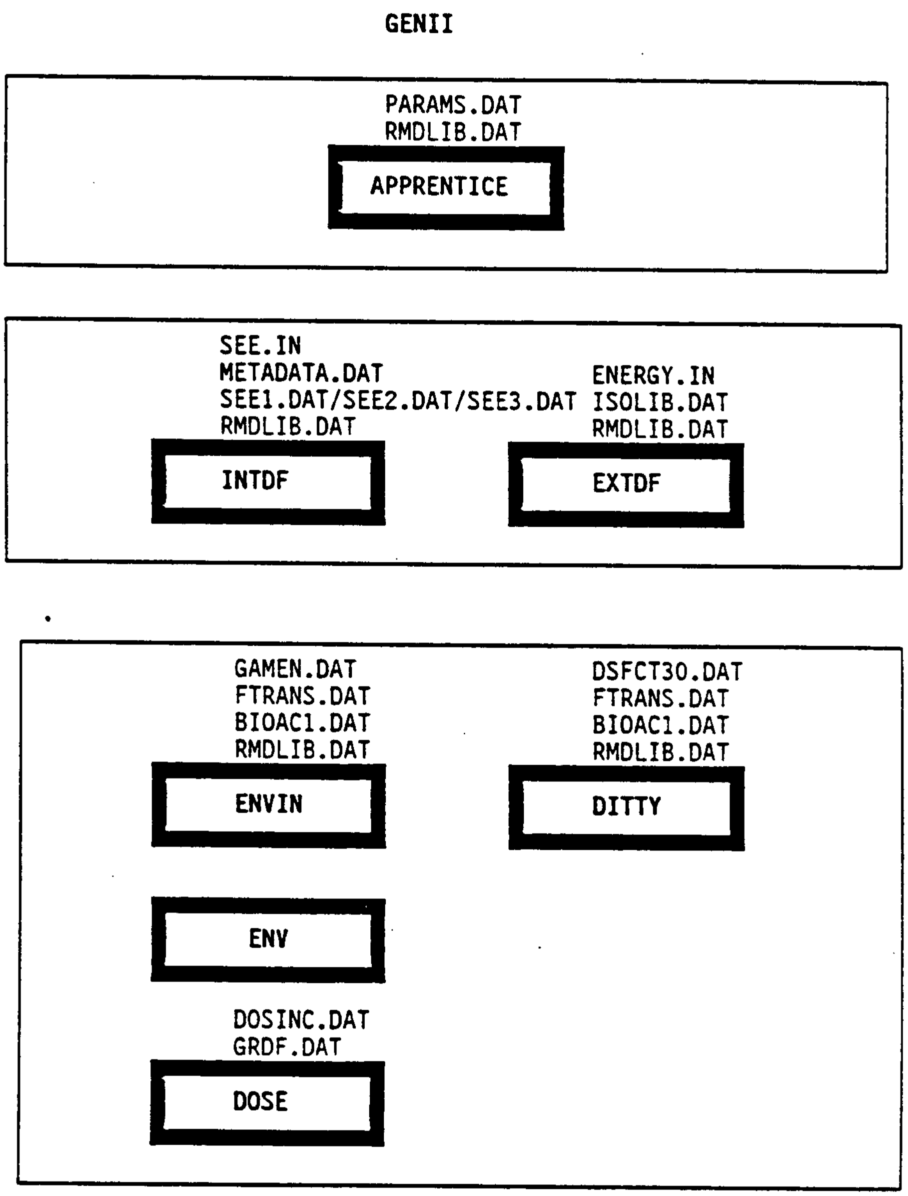


FIGURE 2.3. GENII Data File Requirements

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APPRENTICE, which handles all file handling and data input necessary for most applications. In Level 1, the user himself must create input files and assure that all intermediate library and data transfer files are appropriately handled.

2.1.1 Level 0 User Interaction - Environmental Dosimetry

APPRENTICE is a menu-driven user interface intended to simplify input preparation for both novice and experienced users of this software package. APPRENTICE solicits needed information from the user and prepares a text input file for the environmental dosimetry programs. In addition, a batch-processing file is prepared to manage file handing.

Novice users will appreciate the pop-up help screens that are available in all sections of the program, the extensive logic that requests only pertinent input, default values available for all parameters, reasonable parameter value ranges, error checking for scenario incompatibilities, and checking for validity of file names. Experienced users will find that APPRENTICE has been constructed so that help does not "get in the way" of efficient scenario construction. Pull-down menus allow the user substantial flexibility to modify a scenario under construction. The user can create multiple input files to execute under control of a single batch-processing file which is generated by APPRENTICE in a relatively transparent manner. File management is available within APPRENTICE; the user may view, copy, and rename files as well as make subdirectories and change default paths.

The following is the general procedure for Level 0 users.

1. Create a work subdirectory on the same drive as that on which GENII is located:

   MD \mydir

   where **mydir** is the name of the work subdirectory you wish to create.

2. Set the work subdirectory to default:

   CD \mydir

3. Execute APPRENTICE by typing:

   \GENII\APPRENTICE

2.1.2 Level 1 User Interaction - Environmental Dosimetry

Level 1 interaction is useful for modifying previously existing GENII input files, (e.g., if a source term has changed and doses must be recalculated). APPRENTICE creates two files that the user may modify: nnnnnnnn.IN and nnnnnnnn.BAT, where nnnnnnn is the file name specified in APPRENTICE. Nnnnnnnn.IN is the annotated input file to ENVIN/ENV/DOSE. Nnnnnnnn.BAT contains DOS commands that control program execution. Level 1 users modify these text files with a standard text editor and submit the batch-processing file as in Level 0. Sample files are included in Appendix A.

2.1.3 Level 1 User Interaction - External Dose Factors

EXTDF is a modified version of the ISOSHLD program. Input preparation for EXTDF is essentially the same as input preparation for ISOSHLD with the following exceptions:

- EXTDF is primarily a library generator. Consequently, the specification of radionuclides has been deleted from input. EXTDF automatically generates dose factors for all radionuclides listed in the master radionuclide library (file: RMDLIB.DAT). Energies of implicit daughters (listed to the right of the radionuclide in RMDLIB.DAT) are included with the parent.
- EXTDF outputs effective dose equivalent. (For surface-dose-to-effective-dose-equivalent conversion factors see Section 4.4.1 of Volume 1.)
- EXTDF expects its input to be located in the file buffer named **\GENII\EXTDF.IN** and will place output in the file buffer named **\GENII\EXTDF.OUT**. To execute, type the following commands:

```
COPY nnnnnnnn.IN \GENII\EXTDF.IN
\GENII\EXTDF
COPY \GENII\EXTDF.OUT nnnnnnnn.OUT
```

where **nnnnnnnn** is the unique file name of your EXTDF input. A sample input file is located in Appendix A.

2.1.4 Level 1 User Interaction - Internal Dose Factors

INTDF calculates integrated retentions and committed dose equivalents for radionuclides included in the master radionuclide library (file: RMDLIB.DAT).

- INTDF expects its input to be located in the file buffer named **\GENII\INTDF.IN** and will place output in the file buffer named **\GENII\INTDF.OUT**. To execute, type the following commands:

```
COPY nnnnnnnn.IN \GENII\INTDF.IN
\GENII\INTDF
COPY \GENII\INTDF.OUT nnnnnnnn.OUT
```

where **nnnnnnnn** is the unique file name of your INTDF input. A sample input file is located in Appendix A.

2.1.5 Level 1 User Interaction - DITTY Long-Term Calculations

Execution of DITTY is essentially as documented in Napier, Peloquin, and Strenge (1986), with the following exceptions:

- DITTY expects its input to be located in the file buffers as follows:

\GENII\DITTY.IN	-	Input file
\GENII\POP.IN	-	Population file
\GENII\JOINTFRE.IN	-	Joint frequency file (in format as provided on Hanford Data Supplementary Disk)
\GENII\AIRREL.IN	-	Air release input file
\GENII\WATREL.IN	-	Water release input file

- DITTY will place output in the file buffer named **\GENII\DITTY.OUT**.
- To execute DITTY, type the following commands:

```
COPY nnnnnnnn.IN \GENII\INTDF.IN
COPY mypop.IN \GENII\POP.IN
```

```
COPY myjf.IN \GENII\JOINTFRE.IN
COPY myair.IN \GENII\AIRREL.IN
COPY mywat.IN \GENIII\WATREL.IN
\GENII\DITTY
COPY \GENII\DITTY.OUT nnnnnnnn.OUT
```

where **nnnnnnnn** is the unique file name of your DITTY input, and **mypop**, **myjf**, **myair**, **mywat** are user-prepared files.

2.2 DATA TRANSFER FILE DESCRIPTIONS

The GENII package makes use of three basic types of data files: 1) data transfer files, 2) data libraries, and 3) working buffers. The data transfer files are used to input information to the codes and to transfer intermediate results from one code to the next. Data transfer files are described in this section. The data libraries are large static files of parameters necessary for the calculations, but with which the average user need not interact. The data libraries provided with GENII are described in Section 2.3. The working buffers are created and deleted during code execution, are transparent to the user, and are not described further.

2.2.1 ENVIN/ENV/DOSE Input File Buffer - GENII.IN

Program ENVIN expects to find an input file in the file buffer named GENII.IN. APPRENTICE handles transferring the user's input file into this file buffer. Consequently, use of this buffer is transparent to the Level 0 user. APPRENTICE writes an input file (named "nnnnnnnn.IN" where nnnnnnnn is a user-supplied name) for the user's scenario and stores the file in the default subdirectory. APPRENTICE also writes a batch file (named "nnnnnnnn.BAT", where nnnnnnnn is a user-supplied name) containing DOS (IBM 1985) commands to control execution of the programs. One of the commands in the batch file copies the user-named input file into GENII.IN in the \GENII subdirectory. GENII.IN is read by subroutine READIN of program ENVIN. The format of the file is constant with the exception of the inventory section, which may vary in length. See Section 3.2 for a detailed discussion on the format, preparation, and use of the input file.

2.2.2 Joint Frequency Input File Buffer - JOINTFRE.IN

Joint frequency meteorological data is read from the file buffer JOINTFRE.IN. The user is responsible for preparing joint frequency data in the file and record formats shown in Table 2.1. The file contains values representing the percent of time for persistence of each condition for specified numbers of wind speed groups, and atmospheric stability groups for 16 sectors. The grid sectors must correspond to the directions provided in the population input file buffer POP.IN. The formats shown in records 3 and 4 and in the joint frequency data sets are suggested; these records are processed with a free-formatted read statement. JOINTFRE.IN is read by

TABLE 2.1. Joint Frequency File and Record Format

Record Number	Field Number	Data Type	Field Size	Description
1	1	CHARACTER	80	Descriptive title
2	1	CHARACTER	80	(Not read by program. May contain additional descriptive and quality assurance data.)
3	1	INTEGER	5	Number of wind speed data groups in file
3	2	INTEGER	5	Number of atmospheric stability data groups in file
3	3	INTEGER	5	Number of seasons data groups in file (always one at this time)
3	4	INTEGER	5	Number of time-of-day data groups in file (always one at this time)
3	5	REAL	10	Height at which joint frequency data applies, m
4	1-10	REAL	7	Average wind speed for each windspeed group, m/sec
Joint Frequency Data Set				
1a	1-16	REAL	5	Percent of time for persistence of condition for directions into S, SSW, SW, ... (i.e., wind from N, NNE, NE ...)
:				
10a				(Each Joint Frequency Data Set contains data for 16 sectors [across]. Data are grouped first by atmospheric stability group and then by wind speed group.)

ACCMOD and CRONMOD in program ENVIN. An example of this file is shown with the sample problems in Appendix A of this report.

2.2.3 Chi/Q Input/Report File Buffer - CHIQ.IN

The user may request that Chi/Q values be generated from joint frequency data. If that is the case, the file buffer CHIQ.IN will contain the Chi/Q values generated upon completion of program ENVIN. Alternately, if known, the user may provide atmospheric dispersion factors as input in the file buffer CHIQ.IN. Options and file handling are controlled within APPRENTICE. ENV reads the Chi/Q values in CHIQ.IN and uses them to calculate air concentrations. If chronic exposure to a finite plume is considered, CHIQ.IN will also contain dose rate factors for each distance and direction of the grid for the six energy groups identified in Table 4.9 of Volume 1. Each data set consists of two identically formatted parts, the first for sector indices 1-8 (Wind toward: S-NNW) and the second for sector indices 9-16 (Wind toward: N-SSE). The file and record format as shown in Table 2.2 is based on the default number of distances (10).

TABLE 2.2. Chi/Q File and Record Format

Record Number	Field Number	Data Type	Field Size	Description
1	1	CHARACTER	80	Title of input file that created this file.
2	1	CHARACTER	80	(Not read by program. File creation date and time.)
3			80	(blank)
Chi/Q Data Set for Eight Sectors for Each of 10 Distances				
1a			7	(blank)
1a	1-8	INTEGER	9	Sector index, 1-8 or 9-16
2a			7	(blank)
2a	1-8	REAL	9	Effective wind speed (m/sec) for each sector indicated in data set record 1a
3a	1	REAL	7	Distance from source, m
3a	2-9	REAL	9	Chi/Q, m^3/sec, for sector indices 1-8 or 9-16, respectively
:				
12a				(One record for each distance)
13a			80	(blank)

TABLE 2.2. (contd)

Energy Group Dose Rate Factor Data Set - Six Data Sets (If Selected)

1b			7	(blank)
1b	1-8	INTEGER	9	Sector index, 1-8 or 9-16
2b	1	REAL	7	Distance from source, m
2b	2-9	REAL	9	Finite plume dose rate factor, (person rem dis/Ci MeV) for sector indices 1-8, or 9-16, respectively
:				
11b				(One record for each distance)
12b			80	(blank)

D/Q Data Set for Eight Sectors for Each of 10 Distances

1c			7	(blank)
1c	1-8	INTEGER	9	Sector index, 1-8 or 9-16
2c	1	REAL	7	Distance from source, m
2c	2-9	REAL	9	Normalized deposition factor, m^2/sec, for sector indices 1-8, or 9-16, respectively
:				
11c				(One record for each distance)
12c			80	(blank)

2.2.4 Population Grid Input File Buffer - POP.IN

Population distribution information is read from the file buffer named POP.IN. The grid used for population must correspond to the grid used for joint frequency and Chi/Q data. The file format is shown in Table 2.3. If DITTY population specification for chronic airborne releases Method Three is used, (see Section 3.5.1), population data sets should be stacked consecutively in the file for each time, T, specified in NAMELIST INPUT.

TABLE 2.3. Population File and Record Format

Record Number	Field Number	Data Type	Field Size	Description
1	1	CHARACTER	80	Title
2	1	CHARACTER	80	(Not read by program. File creation date and time.)
3			80	(blank)

TABLE 2.3. (contd)

Record Number	Field Number	Data Type	Field Size	Description
Population Data Set				
1a	1-10	INTEGER	8	Population for each distance for one sector
:				
16a				(One record for each sector starting with S)

2.2.5 Food Production Grid Input File Buffer - FOODPROD.IN

If a food production distribution is to be used for the ingestion population, option 3 (see Section 3.1 Line 115+M to 116+M) food distribution is read from the file buffer named FOODPROD.IN. A data set is read for each selected food type, terrestrial food types first followed by animal products, for each of the 10 x 16 grid points. Table 2.4 shows the file and record format for the food distribution file. FOODPROD.IN is read by module XQIN in program ENVIN.

TABLE 2.4. Food Distribution File and Record Format

Record Number	Field Number	Data Type	Field Size	Description
1	1	CHARACTER	80	Title
2	1	CHARACTER	80	(Not read by program. File creation date and time.)
3			80	(blank)
Food Distribution Data Set for Each Selected Food Type				
1a	1-10	REAL	8	Food production for each grid point, kg/yr, for each of 10 distances
:				
16a				(One record for each sector starting with S)

2.2.6 Parameter Default Value Input File - DEFAULT.IN

The user has the option of changing most default parameters used in GENII. Those parameters not included in the input file because they are infrequently changed are read from the file DEFAULT.IN. The user may edit

DEFAULT.IN with a standard text editor. It is recommended, if changes are made to DEFAULT.IN, that the title line (first line of the file) be changed for QA purposes. However, all changes from default parameter values will be noted in the output file. The parameter name, previous default value, and modified value will be listed. DEFAULT.IN is processed with free-formatted read statements and includes descriptive information and units to simplify modifications. The distribution version of the DEFAULT.IN is shown in Volume 3, Section 5.2.

2.2.7 ENV Input File Buffer - ENV.IN

Program ENVIN reads the user's input file, performs validity checks on the user's scenario, reads necessary library data, writes the input parameter report, and then writes a cryptic file of parameter values into the file buffer ENV.IN. Scenario-specific parameters are written first, followed by radionuclide-specific parameters organized into decay chains. ENV.IN is subsequently read by ENV. ENV.IN is written by subroutine RITENV and read by subroutines REDCAS and REDCHA. Use of this file is transparent to the user.

2.2.8 INTDF Input File Buffer - INTDF.IN

The INTDF input file is read from the file buffer INTDF.IN. The user is responsible for copying INTDF input files into this buffer in the \GENII subdirectory. Level 1 users may interact with the INTDF internal dosimetry computer program by creating a free-formatted input file. See the input preparation instructions in Section 3.4 for details.

2.2.9 DITTY Input File Buffer - DITTY.IN

The DITTY input file is read from the file buffer named DITTY.IN. The user is responsible for copying DITTY input files into this buffer in the \GENII subdirectory. Information on preparing this file is included with the user instructions in Section 3.5. DITTY.IN is read by subroutine CASE2.

2.2.10 DITTY Water Release Input File Buffer - WATREL.IN

In DITTY, when waterborne releases are to be read from the water release input buffer (IWAT > 0 and LUW $\neq$ 1), a file should be prepared in the format shown in Table 2.5. The first two records, title and number of data sets, are followed by a data set for each radionuclide.

TABLE 2.5. Activity Release Data File and Record Format

Record Number	Field Number	Data Type	Field Size	Description
1	1	CHARACTER	80	Title
2	1	INTEGER	5	Number of radionuclides that activity release data are supplied for
Radionuclide Release Data Set				
1a	1	CHARACTER	2	Element symbol for the current radionuclide
1a	2	CHARACTER	6	Atomic weight symbol for the current radionuclide
1a			2	(blank)
1a	3	INTEGER	5	Number of times for which release data will be supplied, ≤ 300. This parameter, NT, determines the number of records in the radionuclide data set.
2a	1	REAL	10	Time at which the current release rate is defined; years since start of release based on input parameter TZR (see Section 3.5). Parameter: TA(i).
2a	2	REAL	10	Release rate, Ci/yr, for the current radionuclide at time TA(i). Read in double precision and converted to single precision.
:				
NT				There are NT data records for each radionuclide.

2.2.11 DITTY Air Release Input File Buffer - AIRREL.IN

In DITTY, when airborne releases are to be read from the air release input buffer (IAIR > 0 and LUA $\neq$ 1), a file should be prepared in the format shown in Table 2.5. The first two records, title and number of data sets, are followed by a data set for each radionuclide.

2.2.12 EXTDF Input File Buffer - EXTDF.IN

The EXTDF input file is read from the file buffer named EXTDF.IN. The user is responsible for copying EXTDF input files into this buffer in the \GENII subdirectory. Information on preparing this file is included with the user instructions in Section 3.3. EXTDF.IN is read by module EXTDF.

2.2.13 ENV Report File Buffer - GENII2.OUT

For some scenarios, information is written to the report file buffer named GENII2.OUT during ENV execution. The APPRENTICE-generated batch-process file contains a command to copy the contents of this file buffer, along with the file buffers named GENII.OUT and DOSE.OUT to create the user's report file. GENII2.OUT is written by module XQCAL.

2.2.14 ENVIN Report File Buffer - GENII.OUT

The APPRENTICE-generated batch-process file that controls ENVIN/ENV/DOSE execution contains a command to copy the contents of the file buffer named GENII.OUT, along with the file buffers GENII2.OUT and DOSE.OUT, to a user-named report file. GENII.OUT contains the portion of the report written by the program ENVIN (in subroutine RITQA), namely the input parameter report. In general, only parameters used by the given scenario are included in the report.

2.2.15 DOSE Report File Buffer - DOSE.OUT

Dose results are written to the file buffer DOSE.OUT by the subroutines DOSSUM, RITBYR, RITBYP, and RITEDE. The reports to be written are selected by the user in APPRENTICE. The minimal set of reports includes the following:

- a one-page report showing the committed (CDE) and weighted (WDE) dose equivalent by organ, the effective dose equivalent (EDE), external dose, and annual effective dose equivalent (AEDE) for the given scenario. The controlling organ, exposure pathway, and radionuclide for the scenario are identified. The inhalation EDE and ingestion EDE are also listed.

- a one-page matrix report showing the dose components and their additive interrelationships for the first three years of the dose commitment period. This report is included to aid the user in understanding the dose terminology.

- a report by radionuclide of the following doses: inhalation EDE, ingestion EDE, external dose, internal EDE, and AEDE.

In addition, the user may request reports of CDE by exposure pathway, CDE by radionuclide, and external dose by exposure pathway. The contents of DOSE.OUT including the input parameter report are written to the user-named output file. Sample problem reports, in Volume 2 Appendix A, provide examples of the various reports available.

2.2.16 ENV Media Concentration Report File Buffer - MEDIA.OUT

Media concentrations are not part of the GENII standard output. However this information is available to the Level 1 user in the file buffer MEDIA.OUT. For chronic exposure scenarios the residential air, surface soil, deep soil, ground water, and irrigation surface water concentrations are shown for each radionuclide for each year of the exposure period. The surface water concentration at the source is also shown. For acute exposures, the residential average population-weighted air concentration and surface soil concentration, as well as the time-integrated surface water concentration, are shown for each radionuclide for each year of the exposure period for each of the four seasons. It is the user's responsibility to store the contents of MEDIA.OUT under a unique file name at the completion of each scenario. An example of MEDIA.OUT is shown with the sample problems in Volume 2, Appendix A.

2.2.17 DOSE Summary Dose Report File Buffer - DOSEQA.OUT

The ENVIN/ENV/DOSE sequence is frequently used in applications that require several executions of the code. When this occurs, it is useful to have summary information available for preliminary results-checking, QA recording, and report generation. With each execution of DOSE, the file buffer named DOSEQA.OUT is appended with a one-line summary record. Table 2.6 describes each field in the summary record. This file can be copied and erased at will. It is efficient to delete the file from time to time, otherwise the file may become quite large. This report is written by module DOSSUM of program DOSE.

TABLE 2.6. Summary Dose Report Record Format

Field Number	Data Type	Field Size	Description
1	CHARACTER	18	First 18 characters of the scenario title
		1	Colon as title delimiter
2	REAL	8	Effective dose equivalent from inhalation
3	REAL	8	Effective dose equivalent from ingestion
4	REAL	8	External Dose
5	REAL	8	Effective dose equivalent
6	REAL	8	Annual effective dose equivalent
7	CHARACTER	4	Dose units: rem or Sv for individual, Prem or PSv for person-rem or person-Sv
8	CHARACTER	3	Flag for organ receiving largest commitment. Flag consists of first three letters of organ name.
9	CHARACTER	3	Flag indicating environmental pathways providing largest dose contribution. Flags are: "Inh" for inhalation, "Ing" for ingestion, and "Ext" for external.
10	CHARACTER	6	Radionuclide providing largest dose contribution
11	CHARACTER	8	Date of execution
12	CHARACTER	8	Time of execution
13	CHARACTER	1	"T" if near-field scenario, "F" if far-field scenario
14	CHARACTER	1	"T" if acute exposure, "F" if chronic exposure
15	CHARACTER	1	"T" if population dose, "F" if individual dose
		1	(blank)
16	CHARACTER	24	"T" if each of environmental exposure pathways is considered, "F" if not. The environmental pathways listed in order are: 1 - external exposure from plume 2 - inhalation uptake 3 - external exposure from ground 4 - leafy vegetable ingestion 5 - root vegetable ingestion 6 - grain ingestion 7 - fruit ingestion 8 - meat ingestion 9 - poultry ingestion 10 - cow milk ingestion 11 - egg ingestion 12 - inadvertent soil ingestion 13 - water ingestion while swimming 14 - external exposure from swimming 15 - external exposure from boating 16 - external exposure from shoreline activities 17 - drinking water ingestion 18 - fish ingestion 19 - mollusk ingestion 20 - crustacea ingestion 21 - aquatic plant ingestion

TABLE 2.6. (contd)

			22 - external exposure from deep soil 23 - external exposure from buried waste 24 - (unused)
17	INTEGER	2	Length of intake (yr)
18	INTEGER	2	Length of release (yr)
19	INTEGER	2	Length of dose commitment period (yr)

2.2.18 ENV Output File Buffer - ENV.OUT

Program ENV writes yearly environmental exposure rates by pathway and radionuclide to the output file buffer ENV.OUT in subroutine RITEXP. The file is subsequently read by DOSE in subroutine DOSCTL. Use of this file is transparent to the user.

2.2.19 INTDF Report File Buffer - INTDF.OUT

INTDF.OUT contains the report generated by the INTDF program. The file consists of the following reports for each radionuclide chain:

- input and program-assigned parameter report
- optional report (if detailed report flag has been set "on" in the input file) of SEE factors for each radionuclide
- the number of nuclear transformations over the given time period in the source organs and tissues, oral and inhalation, for each radionuclide chain member
- CDE for the given time period in target organs and tissues, oral and inhalation
- statistics detailing the amount of computational work performed by the LSODES solver.

It is the user's responsibility to save the output of this file buffer under a unique name. The file is written by the subroutines RITINT and RITEND. The report for Sample Problem 5, shown in Appendix A, is an example of this report.

2.2.20 INTDF CDE Yearly Increment File Buffer - CDEINC.OUT

CDE yearly increments are written to the file CDEINC.OUT. Use of this file is transparent to the user. The output from this file is used to generate the internal dose factor library, DOSINC.OUT, that is used by program DOSE to calculate doses. The file contains data sets for each radionuclide considered in the execution organized as follows in Table 2.7.

TABLE 2.7. CDE Yearly Increment File and Record Format

Record Number	Field Number	Data Type	Field Size	Description
1	1	CHARACTER	1	Exclamation point. Indicates beginning of radionuclide data set.
1			1	(blank)
1	2	CHARACTER	2	Alphabetical element symbol as specified in the radionuclide master library
1	3	CHARACTER	6	Atomic weight and possible metastable designation as specified in the radionuclide master library
1	4	CHARACTER	8	Inhalation classification used in calculations as defined above. Included for QA.
1	5	CHARACTER	14	F_1 value used in calculations. Included for QA.
1	6	CHARACTER	13	Date of calculation. Included for QA.
1	7	CHARACTER	12	Time of calculation. Included for QA.
1			3	(blank)
1	8	CHARACTER	7	Type of exposure, either acute or chronic. Included for QA.
1	9	CHARACTER	8	Dose units. Included for file readability and QA.
2	1	INTEGER	3	Number of organs considered. Parameter: NORG
2	2-26	INTEGER	3	Organ index of each organ considered as specified in the master organ list
3	1-25	INTEGER	3	Number of years for which ingestion dose increments are supplied for each organ specified in record #2

TABLE 2.7. (contd)

Organ Data Sets for Ingestion:

1a	1	CHARACTER	1	Flag indicating ingestion ("G"). Included for file readability.
1a	2-16	REAL	8	Yearly ingestion dose increment starting with the first year of exposure for this organ, Sv/Bq or Sv/Bq-yr
2a			1	(blank)
2a	2a-15	REAL	8	Yearly ingestion dose increment as defined above
:				
n				As needed for the number of years of data for this organ as identified in record 3

Organ Data Subsets for Inhalation:

1b	1	CHARACTER	1	Flag indicating inhalation ("H"). Included for file readability.
1b	2-16	REAL	8	Yearly inhalation dose increment starting with the first year of exposure for this organ, Sv/Bq or Sv/Bq-yr
2b			1	(blank)
2b	1-15	REAL	8	Yearly inhalation dose increment as defined above
:				
n				As needed for the number of years of data for this organ as identified in record 3

This file is written by subroutine RITINC. For an example of this file format, see the listing of the file DOSINC.OUT in Section 5.2 of Volume 3.

2.2.21 INTDF CDE File Buffer - CDE.OUT

Committed dose equivalent data sets are output in a form useful for library generation in the file CDE.OUT Output from this file was used to create the DITTY internal dose factor library DSFCT30.DAT. A data set for each radionuclide considered is generated in the following format in Table 2.8.

TABLE 2.8. CDE File and Record Format

Record Number	Field Number	Data Type	Field Size	Description
1	1	CHARACTER	2	Alphabetical element symbol as specified in the radionuclide master library
1	2	CHARACTER	6	Atomic weight, also metastable (m) designation
			7	(descriptive information)
1	3	CHARACTER	1	Translocation classification as described under RMDLIB.DAT
1			5	(descriptive information)
1	4	REAL	9	F_1 value used to calculate result. Included for QA.
1			5	(blank)
1	5	CHARACTER	10	Date of calculation. Included for QA.
1	6	CHARACTER	10	Time of calculation. Included for QA.
1	7	CHARACTER	10	Type of exposure, acute or chronic. Included for readability and QA.
1	8	CHARACTER	10	Units of result. Included for readability and QA.
2	1	INTEGER	3	Number of organs for which data is included for this radionuclide
2	2-n	INTEGER	3	Master organ index of each organ considered
3			5	(blank)
3	1-n	CHARACTER	8	Descriptive title of each organ as ordered in Record 2. Included for readability.
4	1	CHARACTER	1	Flag indicating dose factor type: "G" for ingestion. Included for readability.
4	2	INTEGER	3	Number of years in the dose commitment period. Included for QA and readability.
4	3-n	REAL	8	Ingestion committed dose equivalent, units as shown in Record 1 for each organ as ordered in Record 2.
5	1	CHARACTER	1	Flag indicating dose factor type: "H" for inhalation. Included for readability.
5	2	INTEGER	3	Number of years in the dose commitment period. Included for QA and readability.
5	3-n	REAL	8	Inhalation committed dose equivalent, units as shown in Record 1 for each organ as ordered in Record 2

2.2.22 DITTY Report File Buffer - DITTY.OUT

The input parameter report and dose results of program DITTY are written to the output file buffer DITTY.OUT. It is the user's responsibility to store the contents of the file buffer under a unique file name. DITTY.OUT is written by modules QAPAGE and REPORT. An example of this file is the output from Sample Problem 7, found in Appendix A.

2.2.23 DITTY Summary Dose Report File Buffer - DITTYQA.OUT

DITTY is frequently used in applications that require several executions of the code. When this occurs, it is useful to have summary information available for preliminary results-checking, QA recording, and report generating. With each execution of DITTY, the file buffer named DITTYQA.OUT is appended with a one line summary record. Table 2.9 describes each field in the summary record. This file can be copied and erased at will. It is efficient to delete the file from time to time, otherwise the file may become quite large. This report is written by module REPORT.

TABLE 2.9. DITTY Summary Dose Report Record Format

Field Number	Data Type	Field Size	Description
1	CHARACTER	18	First 18 characters of the scenario title
		1	Colon as title delimiter
2	REAL	8	Cumulative population dose equivalent received by population over the 10,000-yr period
3	CHARACTER	4	Unit flag for preceding dose, "Prem" indicating person-rem
4	CHARACTER	6	Radionuclide providing largest contribution to population dose
6	INTEGER	3	Index of 70-yr period in which highest population dose increment was received
7	REAL	8	Maximum individual dose
8	CHARACTER	4	Units for preceding dose
9	CHARACTER	6	Radionuclide providing largest contribution to individual dose
10	INTEGER	3	Index of 70-yr period in which maximum individual dose was received
11	INTEGER	5	Year of scenario in which maximum individual dose was received
12	CHARACTER	8	Date of execution
13	CHARACTER	8	Time of execution

2.2.24 EXTDF Report File Buffer - EXTDF.OUT

The file buffer named EXTDF.OUT is used to store the report file from EXTDF executions. Input parameter values are printed as are selected output units. Dose factors are printed in a format that simplifies library generation. EXTDF.OUT is written by modules EXTDF and SHORT. It is the user's responsibility to store the contents of the file under a unique file name.

2.3 DATA LIBRARY DESCRIPTIONS

The data files that provide tabulated values of constants for the calculations are described in this section.

2.3.1 Radionuclide Master Library - RMDLIB.DAT

The radionuclide master data library (RMDLIB.DAT) contains all radiological decay data in addition to the specification of all radionuclides for which data is included in the GENII Software System. The radionuclides are organized into decay chains ordered by atomic number under the radionuclides highest in the chain. RMDLIB.DAT is read by subroutine RLIBIN and is used by programs ENVIN, DITTY, INTDF, and EXTDF. Calculations of radioactive decay and daughter ingrowth are performed in the subroutines CHAIN and DGCHAIN, using the decay chain data of RMDLIB.DAT and the decay equations of Bateman (1910). RMDLIB currently contains information on 245 radionuclides.

RMDLIB contains one record for each radionuclide plus a header record and a trailer record. The header record contains the file title (FORTRAN format: A80) and a blank trailer record. The balance of the records contain information as shown in Table 2.10.

TABLE 2.10. Radionuclide Master Library Record Structure

Field Number	Data Type	Field Size	Description
1	CHARACTER	2	Alphabetical element symbol. Parameter: ELTM
2	CHARACTER	6	Atomic weight, also metastable (m) designation. Parameter: AWM
3	REAL	10	Radiological half-life, days. Parameter: TR
4	INTEGER	2	Indicator of relative position in decay chain (1 is highest position)
5	INTEGER	2	Indicator of precursor in decay chain (as identified in column 4 of the precursor, zero indicates no precursors). Parameter: IFR
6	REAL	7	Branching ratio for primary precursor. Parameter: DKF
7	INTEGER	2	Indicator of alternate precursor in decay chain. Parameter: IFR
8	REAL	7	Branching ratio for alternate precursor. Parameter: DKF
9	INTEGER	4	Atomic number. Parameter: ATNO
		1	(blank)
10	CHARACTER	1	Special-purpose flag used for research applications, input as a character field to set logical flag, used by EXTDF
11	INTEGER	2	Applicable internal dosimetry model used by INTDF where: 0-use General Model, 1-use Alkaline Earth Model, 2-use Iodine Model. Parameter: IMODM
		1	(blank)
12	CHARACTER	1	Flag indicating whether radionuclide is a bone-volume seeker (V), bone-surface seeker (S), or not applicable (N). Parameter: BONED
13	CHARACTER	1	Translocation classification. Parameter: TCLASS
14	INTEGER	2	Number of implicit daughters built into radionuclide. Parameter: NDAU
15-17			First implicit daughter data set
:			:
36-38			Eighth implicit daughter data set

Each implicit daughter data set consists of three columns containing the alphabetical element symbol, atomic weight plus metastable designation, and branching ratio as specified in fields 1, 2, and 6, respectively. The associated parameter name for the branching ratio is BRANCH.

Translocation refers to the rate at which radionuclides are transported by body fluids from the lungs to the blood and GI tract after inhalation (sometimes referred to as inhalation class or solubility class). For inhalation calculations, translocation classifications are made for each organ based on the usage of the Task Group Lung Model (ICRP 1966). The translocation flags used in RMDLIB.DAT refer to the following classes as defined by the ICRP (1966):

D - Class D Materials:	A maximum clearance time of less than a day
W - Class W Materials:	A maximum clearance time of a few days to a few months
Y - Class Y Materials:	A maximum clearance half time of six months to a few years.

Columns 1-14 are read with the FORTRAN format (A2, A6, E10.2, I2, 2(I2, F7.4), I4, 1X, A1, 1X, I1, 1X, 2A1, I2). If the number of implicit daughters is greater than 0, the record is reread with the FORTRAN format (52X, 8(A2,A6, F5.3, 1X)). RMDLIB.DAT is listed in Volume 3, Section 5.2.

2.3.2 Metabolic Data Library - METADATA.DAT

Johnson's (Johnson and Carver 1981, Johnson and Myers 1981) metabolic data library has been modified and expanded for use with the INTDF internal dosimetry program. The adult metabolic data is taken from ICRP 30 (1979a, 1980, 1981b) with minor exceptions. The library contains adult and infant data on uptake by blood, f_1 values for each inhalation class, distribution and retention in organs, as well as fraction of excretion via urine and feces. Excretion data is not used in INTDF.

The file consists of a header record containing title information and data sets for each element, adult or infant. Each data set contains three data records followed by up to four organ data subsets, followed by a single record indicating the end of the data set. Each of the organ data subsets consists of four records each, one record for each biological half time (organ/tissue sub-compartment). The last organ data subset is for remaining tissues/organs, classified as "OTHER." Organ data sets for the Alkaline Earth Model are ordered more stringently. Alkaline Earth Model data subsets are ordered as trabecular/cancellous bone, cortical bone, and bone surface, followed by "OTHER". The file format is shown in Table 2.11.

TABLE 2.11. Metabolic Data Set Record Format

Record Number	Field Number	Data Type	Field Size	Description
1	1	INTEGER	3	Atomic number of element
2	1	CHARACTER	14	Descriptive name of element, not used by program
2			1	(blank)
2	2	CHARACTER	1	Age indicator, A-Adult and I-Infant (Only adult information is processed in this version of INTDF.)
2			7	(blank)
2	3	REAL	5	Biological rate constant for the transfer compartment (blood and body fluids), d^{-1} Parameter: RTBLOOD
2	4	REAL	5	Fraction of excretion from blood via urine, (not used by INTDF)
2	5	REAL	5	Fraction of excretion from blood via feces, (not used by INTDF)
3	1	REAL	n	F_1 value for Inhalation Class D material
3	2	REAL	n	F_1 value for Inhalation Class W material
3	3	REAL	n	F_1 value for Inhalation Class Y material

Alkaline Earth Model Organ/Tissue Subset

1a			1	(blank)
1a	1	CHARACTER	8	Bone compartment name, ("BONE CAN", "BONE COR", or "BONE SUR") or "OTHER"
1a			1	(blank)
1a	2	REAL	10	Fraction of material going from transfer compartment to each bone or OTHER sub-compartment. Parameter: TCBONE or TCOTHR
1a	3	REAL	10	Biological rate constant for each bone or OTHER sub-compartment, d^{-1}. Parameter: RTBONE or RTOTHR
1a	4	REAL	10	Fraction of material excreted via urine, (not used by INTDF)
1a	5	REAL	10	Fraction of material excreted via feces, (not used by INTDF)
:				
4a				One record for each of four sub-compartments

TABLE 2.11. (contd)

All Other Models Subset

1b		1		(blank)
1b	1	CHARACTER	8	Organ name as specified in the master organ list
1b			1	(blank)
1b	2	REAL	10	Fraction of material going from transfer compartment to each organ/tissue sub-compartment. Parameter: TCBONE, TCORG, or TCOTHR
1b	3	REAL	10	Biological rate constant for each organ/tissue sub-compartment, d^{-1}. Parameter: RTBONE, RTORG, or RTOTHR
1b	4	REAL	10	Fraction of material excreted via urine, (not used by INTDF)
1b	5	REAL	10	Fraction of material excreted via feces, (not used by INTDF)
:				
4b				One record for each of four sub-compartments.

Last Record

4			1	(blank)
4	1	CHARACTER	8	"END "

Record 1 is read in subroutine METLIB with the FORTRAN format (A14, 1X, A1, 7X, 3F5.3). Record 2 is processed with a free-formatted read. Each organ/tissue sub-compartment record is read as (1X, A8, 1X, 4E10.3). METADATA.DAT is listed in Volume 3, Section 5.2.

2.3.3 Radionuclide List By Atomic Number - RMDBYELE.DAT

To simplify scenario construction in APPRENTICE, radionuclides are displayed sorted by atomic number and mass number. The file RMDBYELE.DAT is a sorted list of radionuclides included in the master radionuclide library. The file consists of a header record with title information followed by records consisting of the two-character alphabetic symbol followed by the six-character atomic weight and possible metastable designation. RMDBYELE.DAT is read by BASIC subroutine MENU5 and is listed in Volume 3, Section 5.2.

2.3.4 Food Transfer Library - FTRANS.DAT

The food transfer factor library, FTRANS.DAT, contains factors used in programs ENV and DITTY relating concentrations of elements in soil to concentrations in farm products grown on that soil, and relating concentrations in animal feed to concentrations in animal products. The library also contains air deposition velocities. Sources of these parameters are to be published in a separate document. The file consists of a header record with title information, a second record containing column headings for file readability (not processed by the programs), followed by a record for each element included in the radionuclide master. The record format for this file is shown in Table 2.12.

TABLE 2.12. Food Transfer Library Record Format

Field Number	Data Type	Field Size	Description
1	CHARACTER	2	Alphabetical element symbol as specified in the radionuclide master library
2	REAL	9	Elemental deposition velocity from air to ground, m/sec. Parameter: DPVLT, DPVL
3	REAL	9	Food transfer coefficient for leafy vegetables/fresh animal forage, pCi/g plant (dry) per pCi/g soil (dry). Parameter: BVIT(1,n)
4	REAL	9	Food transfer coefficient for root vegetables, pCi/g plant (dry) per pCi/g soil (dry). Parameter: BVIT(2,n)
5	REAL	9	Food transfer coefficient for grains/stored animal feed, pCi/g plant (dry) per pCi/g soil (dry). Parameter: BVIT(3,n)
6	REAL	9	Food transfer coefficient for fruit, pCi/g plant (dry) per pCi/g soil (dry). Parameter: BVIT(4,n)
7	REAL	9	Food transfer coefficient for beef, d/kg. Parameter: FMIT(1,n)
8	REAL	9	Food transfer coefficient for poultry, d/kg. Parameter: FMIT(2,n)
9	REAL	9	Food transfer coefficient for cow milk, d/L. Parameter: FMIT(3,n)
10	REAL	9	Food transfer coefficient for eggs, d/kg. Parameter: FMIT(4,n)
11	REAL	9	Leaching rate (percolation) of radionuclides out of the surface soil layer (top 15 cm), yr^{-1}. Parameter: LEACHT

The FORTRAN format for each record is (A2, 9E9.2). FTRANS.DAT is read and dry plant weights are converted to wet weights in subroutines ENVLIB and FOOLIN. A listing of the file is included in Volume 3, Section 5.2.

2.3.5 Bioaccumulation Library - BIOAC1.DAT

The bioaccumulation library, BIOAC1.DAT, contains the factors used by ENV and DITTY to relate the concentration of radionuclides in aquatic biota to the concentration of radionuclides in the water. There are separate factors for fresh and salt water. Also included are factors representing the fraction of chemical elements passing through conventional municipal water treatment plants. These parameters and their selection processes will be documented in a separate report. The file consists of a header record with title information, a second record containing column headings for file readability (not processed by the programs), followed by a record for each element included in the radionuclide master library. The record format for this file is shown in Table 2.13.

TABLE 2.13. Bioaccumulation Library Record Format

Field Number	Data Type	Field Size	Description
1	CHARACTER	2	Alphabetical symbol as specified in the master radionuclide library
2	REAL	9	Bioaccumulation factor for fish in salt water, pCi/kg per pCi/L. Parameter: BIOACT(1,n)
3	REAL	9	Bioaccumulation factor for mollusk in salt water, pCi/kg per pCi/L. Parameter: BIOACT(2,n)
4	REAL	9	Bioaccumulation factor for crustacea in salt water, pCi/kg per pCi/L. Parameter: BIOACT(3,n)
5	REAL	9	Bioaccumulation factor for aquatic plants in salt water, pCi/kg per pCi/L. Parameter: BIOACT(4,n)
6	REAL	9	Bioaccumulation factor for fish in fresh water, pCi/kg per pCi/L. Parameter: BIOACT(1,n)
7	REAL	9	Bioaccumulation factor for mollusk in fresh water, pCi/kg per pCi/L. Parameter: BIOACT(2,n)
8	REAL	9	Bioaccumulation factor for crustacea in fresh water, pCi/kg per pCi/L. Parameter: BIOACT(3,n)
9	REAL	9	Bioaccumulation factor for aquatic plants in fresh water, pCi/kg per pCi/L. Parameter: BIOACT(4,n)
10	REAL	9	Drinking water clean-up factor, dimensionless. Parameter: DWCLET

The FORTRAN format for each record is (A2, 9E9.2). BIOAC1.DAT is read by subroutines ENVLIB and BIOLIN. A listing of the file is included in Volume 3, Section 5.1.

2.3.6 External Dose Factor Library - GRDF.DAT

External dose factors for air submersion, water surface, soil surface, deep soil and buried waste for each radionuclide specified in the master library are found in the file GRDF.DAT. Values in the library were calculated by the EXTDF program. All values are effective dose equivalent, calculated as the weighted sum of the organ doses.

GRDF.DAT is used by programs DOSE and DITTY. The file consists of a header record with title information, three records containing column headings for file readability (not processed by the programs), and followed by a record for each radionuclide included in the radionuclide master library in the format shown in Table 2.14.

TABLE 2.14. External Dose Factor Library Record Format

Field Number	Data Type	Field Size	Description
1	CHARACTER	2	Alphabetical element symbol as specified in the master radionuclide library
2	CHARACTER	6	Atomic weight plus possible metastable specification as included in the master radionuclide library
3	REAL	8	External dose factor for air immersion, Sv/yr per Bq/m^3. Parameter: DAIT
4	REAL	10	External dose factor at water surface, Sv/yr per Bq/L. Parameter: DBIT
5	REAL	10	External dose factor for the soil surface, Sv/yr per Bq/"m^3" to a depth of 15 cm. Input value is divided by 0.15 before storing in parameter DSIT.
6	REAL	10	External dose factor for deep soil or buried waste with a clean overburden of 15 cm, Sv/yr per Bq/m^3. Parameter: DDIT(n,1)
7	REAL	10	External dose factor for deep soil or buried waste with a clean overburden of 0.5 m, Sv/yr per Bq/m^3. Parameter: DDIT(n,2)
8	REAL	10	External dose factor for deep soil or buried waste with a clean overburden of 1.0 m, Sv/yr per Bq/m^3. Parameter: DDIT(n,3)
9	REAL	10	External dose factor for a plane surface, Sv/yr per Bq/m^2. Not used at this time.

The FORTRAN format for each record is (A2, A6, E8.2, 5E10.2). GRDF.DAT is read by subroutines REDFIL and GRDLIN. A listing of the file is included in Volume 3, Section 5.2.

2.3.7 Radioactive Decay Data for RMDLIB - ENERGY.DAT

Radioactive decay energies for the EXTDF program are read from a specialized version of DRALIST (Kocher 1981). The specialized file, named ENERGY.DAT, contains data sets for radionuclides as ordered in RMDLIB.DAT. Energies for implicit daughters, as identified in RMDLIB.DAT, have been added to the parent. Data set and record organization is the same as those of DRALIST. This file is read by module NRGLIB. ENERGY.DAT is listed in Volume 3, Section 5.2.

2.3.8 DITTY Internal Dose Factor Library - DSFCT30.DAT

Committed dose equivalents from chronic exposure for 70 years are stored in the file DSFCT30.DAT for use by DITTY. Data sets for this file are generated by INTDF. The library consists of a title record followed by a data set for each radionuclide included in RMDLIB.DAT. The format of the data sets are shown in Table 2.8. DSFCT30.DAT is listed in Volume 3, Section 5.2.

2.3.9 Attenuation Coefficients and Build-Up Factor Library - ISOLIB.DAT

EXTDF uses attenuation coefficients and build-up factors of the ISOSHLD (Engle 1966) program. This data is stored in the file named ISOLIB.DAT. Build-up factor coefficients are handled differently for energy groups 1 through 9 (0.01 to 0.1 MeV) and for groups 10 to 25 (0.1 to 3.2 MeV).

Attenuation coefficients are included for 20 common materials and are based on unit density. Mixed attenuation coefficients are calculated using Equation (4.2.3) of Volume 1. Each attenuation coefficient data set consists of three records containing data for 25 average group energies defined in Table 4.7 of Volume 1.

Build-up factors for energy groups 1 through 9 have been calculated using the "straight ahead" approximation. The build-up factors are tabulated for six atomic numbers (13, 26, 50, 74, 82, 92), five representative energies (0.01, 0.02, 0.05, 0.1, 0.2), and seven absorption mean free-path (μx) values

(1, 2, 4, 7, 10, 15, 20). Build-up factors for a particular solution are obtained by linear interpolation within this table.

The build-up factor library for groups 10 through 25 contains coefficients A, α_1, α_2 for the point isotopic source dose build-up factor [Taylor's formula (Rockwell 1956), Equation (4.2.4) in Volume 1]. These data are tabulated for seven materials: water, aluminum, iron, tin, tungsten, lead, and uranium (with effective atomic numbers 4, 13, 26, 50, 74, 82, and 92, respectively). The effective atomic number of a single shield region (in which build-up is considered characteristic of all shield regions) is used for interpolating in this library. Each build-up factor data sets consists of six records.

The file and record formats of ISOLIB.DAT are shown in Table 2.15. ISOLIB.DAT is listed in Volume 3, Section 5.2.

TABLE 2.15. ISOLIB.DAT File and Record Format

Record Number	Field Number	Data Type	Field Size	Description
1	1	CHARACTER	80	Title
Attenuation Coefficient Data Sets				
1a	1	CHARACTER	7	Material name (first record of data set only)
1a	2	INTEGER	2	Material number
1a	3	INTEGER	1	Data set record number (1, 2, or 3)
1a	4-12	REAL	7	Mass attenuation coefficient for nine energy levels
1a	13	REAL	3	Atomic number (first record of data set only)
1a	14	REAL	3	Atomic weight (first record of data set only)
Build-Up Factors for Energy Groups 10 Through 25 Data Sets				
1b			8	(Not read by program)
1b	1	INTEGER	1	Material number
1b	2	INTEGER	1	Data set record number
1b	3	REAL	7	Coefficients for eight energy groups: Records 1-2 A_1, Records 3-4 α_1, Records 5-6 α_2

TABLE 2.15. (contd)

1b	10	REAL	3	Atomic number
1b	11	INTEGER	1	Flag set to 1 if this is the last record of last data set of this type.

Build-Up Factors for Energy Groups One Through Nine Data Sets

1c	1	INTEGER	2	Atomic number
1c	2	INTEGER	2	First absorption mean free path value for which factors are given for five energies this record
1c	3	INTEGER	2	Second absorption mean free path value for which factors are given for five energies this record
1c	4-13	REAL	6	Build-up factors for five energies for absorption mean free paths as identified in fields 2 and 3

2.3.10 Committed Dose Equivalent Yearly Increment Library - DOSINC.DAT

Committed dose equivalent yearly increments are stored in binary form in the file named DOSINC.DAT. CDE yearly increment data sets for each radionuclide were generated with INTDF. The output from the file buffer named CDEINC.OUT was accumulated in the file buffer named DOSINC.OUT. A title line was added to DOSINC.OUT, and the utility program UNFORMAT was executed to generate the binary version of the file named DOSINC.DAT. Note that in the distribution package, the file DOSINC.OUT has been stripped of data, as only the title of the file is read from DOSINC.OUT during ENVIN/ENV/DOSE execution. Data set record formats are shown in Table 2.7. The text version of this file is shown in Volume 3, Section 5.2.

2.3.11 Gamma Energy Library - GAMEN.DAT

Finite plume calculations use energy per disintegration, (MeV/dis), for six energy groups for each radionuclide. The energy ranges of the six groups are shown in Table 4.9 of Volume 1. This information is stored in the file named GAMEN.DAT. The file is composed of a title record followed by records of the format shown in Table 2.16. The gamma energy library is read by module ENVLIB of program ENVIN. GAMEN.DAT is listed in Volume 3, Section 5.2.

TABLE 2.16. Gamma Energy Library Record Format

Field Number	Data Type	Field Size	Description
1	CHARACTER	2	Alphabetic element symbol as specified in the master radionuclide library
2	CHARACTER	6	Atomic weight plus possible metastable specification as included in the master radionuclide library
3-8	REAL	8	Energy per disintegration for six energy groups

2.3.12 Specific Effective Energy Library - SEEn.DAT

Specific effective energy data sets have been extracted from the ORNL data file (personal communication, Keith Eckerman) used to produce ICRP Publication 30 (1979a, 1979b, 1980, 1981a, 1981b, 1982a, 1982b) for radionuclides included in RMDLIB.DAT. Because of the volume of this data, the data has been split into three files and converted to an abbreviated (header and trailer records removed) binary format. SEE1.DAT consists of data sets for radionuclides with atomic numbers 1-43, SEE2.DAT of those with atomic numbers 44 through 80 and SEE3.DAT contains the remainder. The utility program UNSEE is used to create the binary version of the files.

2.4 EXTERNAL FILE NAME ASSIGNMENTS - FILENAME.DAT

GENII assigns each external file (data, input, or output) a unique logical unit number (LUN). All file names and there associated LUNs are transparent to the user; APPRENTICE generates the necessary commands to handle the user's input and output files. However, the experienced user in the course of research may wish to assign experimental data libraries. This is possible because all file names and LUNs are stored in the file named "FILENAME.DAT". GENII looks first in the users default directory for "FILENAME.DAT". If not found, the distribution version of the file stored in the GENII subdirectory is used. "FILENAME.DAT" consists of 49 records containing the file names for LUNs 2-50, ("FILENAME.DAT" is assigned in LUN 1). Each record contains the information shown in Table 2.17. The contents of the 49 records are shown in Table 2.18.

TABLE 2.17. File Name Assignments Record Structure

Field Number	Data Type	Field Size	Description
1	INTEGER	2	Logical unit number (Not read by the program, included for readability). Parameter: LUN
		8	(blank)
2	CHARACTER	30	File name, including drive specification and path. Parameter: FILN

The FORTRAN format for each record is (10X, A30). "FILENAME.DAT" is read by the subroutine OPNFIL and is used by all programs in the software package. A listing of "FILENAME.DAT" is shown in Volume 3, Section 5.2.

TABLE 2.18. Logical Unit Numbers, Default File Names, and Usage of External Files in the GENII Software Package

Logical Unit Number	Default File Name	File Usage
2	\GENII\RMDLIB.DAT	Radionuclide master library
3	\GENII\METADATA.DAT	Metabolic data library
4	\GENII\RMDBYELE.DAT	Radionuclide list sorted by atomic number and mass number
5	\GENII\GENII.IN	GENII input file buffer
6	\GENII\GENII.OUT	GENII report file buffer
7	\GENII\WORK.BUF	Work space used by various programs in the software package
8	\GENII\FTRANS.DAT	Food transfer library
9	\GENII\BIOAC1.DAT	Bioaccumulation library
10	\GENII\GRDF.DAT	External dose factor library
11	\GENII\ENV.IN	ENV input file buffer
12	\GENII\DOSSUM.DAT	Dose report format file
13	\GENII\ENV.OUT	ENV output file buffer
14	\GENII\DOSE.OUT	DOSE report file buffer
15	\GENII\INTDF.OUT	INTDF report file buffer
16	\GENII\CDEINC.OUT	Committed dose equivalent yearly increment INTDF output file
17	\GENII\DITTY.OUT	DITTY report file buffer
18	\GENII\INTDF.IN	INTDF input file buffer
19		unused
20	\GENII\CDE.OUT	Committed dose equivalent INTDF output file
21	\GENII\MEDIA.OUT	Air, water, and soil concentration report file buffer
22	\GENII\DEFAULT.IN	Parameter default value input file
23	\GENII\JOINTFRE.IN	Joint frequency input file buffer

TABLE 2.18. (contd)

24	\GENII\CHIQ.IN	Chi/Q input/output file buffer
25		unused
26	\GENII\ENERGY.DAT	DRALIST for RMDLIB with implicit daughters built into parent
27	\GENII\POP.IN	Population grid input file buffer
28	\GENII\GENII2.OUT	Second GENII report file buffer
29	\GENII\FOODPROD.IN	Food production grid input file buffer
30	\GENII\DSFCT30.DAT	DITTY internal dose factors
31	\GENII\WATREL.IN	DITTY water release input file buffer
32	\GENII\AIRREL.IN	DITTY air release input file buffer
33	\GENII\DITTY.IN	DITTY input file buffer
34	\GENII\ISOLIB.DAT	EXTDF ISOSHLD library
35	\GENII\EXTDF.IN	EXTDF input file buffer
36	\GENII\EXTDF.OUT	EXTDF report file buffer
37	\GENII\DOSINC.OUT	Text version of committed dose equivalent yearly increment file
38	\GENII\GAMEN.DAT	Gamma energies for each of 6 energy groups
39	\GENII\DOSEQA.OUT	Summary dose report/quality assurance log file
40	\GENII\DOSINC.DAT	Binary version of committed dose equivalent yearly increment file
41	\GENII\SEE.IN	Label format file for the utility program SEERPT
42		Unused
43		Unused
44	\GENII\SEERPT.OUT	Report file of the utility program SEERPT
45	\GENII\SEE1.DAT	Specific effective energies for radionuclides with mass numbers < 44
46	\GENII\SEE2.DAT	Specific effective energies for radionuclides with mass numbers > 43 and < 81
47	\GENII\SEE3.DAT	Specific effective energies for radionuclides with mass numbers > 80
48		Unused
49	\GENII\WORK2.BUF	Workspace used by various programs in the software package
50	\GENII\WORK3.BUF	Workspace used by various programs in the software package

3.0 USERS' INSTRUCTIONS

3.1 APPRENTICE

APPRENTICE is an interactive, menu-driven input generator for most applications of the GENII system. The code is largely self-documenting by means of numerous pull-down help screens. Description of the use of the code is therefore limited to general instructions. Detailed descriptions of the various options available in APPRENTICE are provided to the user as the code is used. General instructions on the use of APPRENTICE are:

1. Use left and right arrows on numeric keypad to move to another menu. There are 12 main menus in APPRENTICE. You will see only those menus that are appropriate for the scenario under construction.
2. Use down arrow on numeric keypad to pull a menu down.
3. Use return key to select an item.
4. Use the F1 key or select Help from the menu. Assistance is available throughout APPRENTICE by accessing pop-up help screens.
5. Use APPRENTICE to assist you with scenario construction in the following ways:
   - APPRENTICE checks for option incompatibilities and alerts you when these are discovered.
   - APPRENTICE asks questions pertinent only to the current scenario.
   - APPRENTICE provides default values for all variables. You may select between maximum individual and average individual parameters.
   - APPRENTICE checks all input variables against reasonable bounds.
6. Use APPRENTICE when scenario construction is complete to request a file name for storing your scenario. A GENII input file will be created with a file extension of ".IN". An execution file will be created with a ".BAT" extension.

7. Create multiple input files in an APPRENTICE execution if desired. Simply select "Another Scenario" after you have selected "Write file" on the final menu. APPRENTICE will return you to the first menu. All variable selections from the previous scenario remain in effect unless changed. A single execution file will be generated for processing the series of scenarios.

8. Exit APPRENTICE quickly without saving your scenario if desired. Simply press the Esc key several times until the final menu appears.

3.2 ENVIRONMENTAL DOSIMETRY PACKAGE: ENVIN/ENV/DOSE

The "main line" GENII programs are ENVIN, ENV, and DOSE. These three codes perform input checking and atmospheric dispersion calculations, environmental transport and exposure calculations, and dosimetry calculations, respectively. All calculations performed by these three codes are controlled by an input file named GENII.IN, which may be created by the user interface code APPRENTICE or directly by the user. An example of the GENII.IN file is presented as Exhibit 3.1. A line-by-line description of the parameters and options defined in GENII.IN is given in the paragraphs following the exhibit, with the code variable name in capital letters.

EXHIBIT 3.1. Example GENII.IN File

```
######################### Program GENII Input File ############  8 Jul 88 ####
Title: Demonstration Case for Example
       \GENII\exit.in                              Created on 09-09-1988 at 10:24
OPTIONS========================= Default =====================================
F    Near-field scenario?      (Far-field)    NEAR-FIELD: narrowly-focused
F    Population dose?         (Individual)                release, single site
F    Acute release?             (Chronic)     FAR-FIELD:  wide-scale release,
     Maximum Individual data set used                     multiple sites
                               Complete                               Complete
TRANSPORT OPTIONS============ Section    EXPOSURE PATHWAY OPTIONS===== Section
T  Air Transport                  1      T  Finite plume, external      5
F  Surface Water Transport        2      F  Infinite plume, external    5
F  Biotic Transport (near-field) 3,4     T  Ground, external            5
F  Waste Form Degradation (near) 3,4     F  Recreation, external        5
                                         T  Inhalation uptake           5,6
REPORT OPTIONS=======================    F  Drinking water ingestion    7,8
T  Report AEDE only                      F  Aquatic foods ingestion     7,8
F  Report by radionuclide                T  Terrestrial foods ingestion 7,9
F  Report by exposure pathway            T  Animal product ingestion    7,10
F  Debug report on screen                F  Inadvertent soil ingestion

INVENTORY ####################################################################

 4    Inventory input activity units: (1-pCi  2-uCi  3-mCi  4-Ci  5-Bq)
 0    Surface soil source units (1- m2  2- m3  3- kg)
      Equilibrium question goes here

      --------|----Release Terms------|----------Basic Concentrations---------|
      Use when| transport selected    | near-field scenario, optionally       |
      --------|-----------------------|---------------------------------------|
      Release |       Surface Buried  |       Surface Deep    Ground  Surface |
      Radio-  |Air    Water   Waste   |Air    Soil    Soil    Water   Water   |
      nuclide |/yr    /yr     /m3     |/L     /unit   /m3     /L      /L      |
      --------|------- ------- -------|------- ------- ------- ------- -------|
      SR90     5.0E-02
      I 131    3.0E+00
      CS137    1.0E-01

      --------|----Derived Concentrations-----|
      Use when|  measured values are known    |
      --------|-------------------------------|
      Release |Terres. Animal  Drink   Aquatic|
      Radio-  |Plant   Product Water   Food   |
      nuclide |/kg     /kg     /L      /kg    |
      --------|------- ------- ------- -------|

 TIME ########################################################################

 1    Intake ends after (yr)
 50   Dose calc. ends after (yr)
 1    Release ends after (yr)
 0    No. of years of air deposition prior to the intake period
 0    No. of years of irrigation water deposition prior to the intake period
```

```

FAR-FIELD SCENARIOS (IF POPULATION DOSE) ####################################

0          Definition option: 1-Use population grid in file POP.IN
0                             2-Use total entered on this line

NEAR-FIELD SCENARIOS ########################################################

           Prior to the beginning of the intake period: (yr)
0            When was the inventory disposed?  (Package degradation starts)
0            When was LOIC?  (Biotic transport starts)
0          Fraction of roots in upper soil (top 15 cm)
0          Fraction of roots in deep soil
0          Manual redistribution: deep soil/surface soil dilution factor
0          Source area for external dose modification factor (m2)
TRANSPORT ##################################################################
           ====AIR TRANSPORT==================================SECTION 1=====
                   0-Calculate PM              |0         Release type (0-3)
 2         Option: 1-Use chi/Q or PM value     |T         Stack release (T/F)
                   2-Select MI dist & dir      |60.       Stack height (m)
                   3-Specify MI dist & dir     |100.0     Stack flow (m3/sec)
0          Chi/Q or PM value                   |5.0       Stack radius (m)
0          MI sector index (1=S)               |25.       Effluent temp. (C)
0          MI distance from release point (m)  |0         Building x-section (m2)
T          Use jf data, (T/F) else chi/Q grid  |0         Building height (m)

           ====SURFACE WATER TRANSPORT=========================SECTION 2=====
0          Mixing ratio model: 0-use value, 1-river, 2-lake
0          Mixing ratio, dimensionless
0          Average river flow rate for: MIXFLG=0 (m3/s), MIXFLG=1,2 (m/s),
0          Transit time to irrigation withdrawl location (hr)
           If mixing ratio model > 0:
0              Rate of effluent discharge to receiving water body (m3/s)
0              Longshore distance from release point to usage location (m)
0              Offshore distance to the water intake (m)
0              Average water depth in surface water body (m)
0              Average river width (m), MIXFLG=1 only
0              Depth of effluent discharge point to surface water (m), lake only

           ====WASTE FORM AVAILABILITY=========================SECTION 3=====
0                    Waste form/package half life, (yr)
0                    Waste thickness, (m)
0                    Depth of soil overburden, m

           ====BIOTIC TRANSPORT OF BURIED SOURCE================SECTION 4=====
T          Consider during inventory decay/buildup period (T/F)?
T          Consider during intake period (T/F)?   | 1-Arid non agricultural
0          Pre-Intake site condition..............| 2-Humid non agricultural
                                                  | 3-Agricultural

EXPOSURE ###################################################################

           ====EXTERNAL EXPOSURE===============================SECTION 5=====
           Exposure time:              |   Residential irrigation:
```

910480455

```
8766.0    Plume (hr)                     | T       Consider: (T/F)
4380.0    Soil contamination (hr)        | 0       Source: 1-ground water
0         Swimming (hr)                  |                 2-surface water
0         Boating (hr)                   | 0       Application rate (in/yr)
0         Shoreline activities (hr)      | 0       Duration (mo/yr)
0       Shoreline type: (1-river, 2-lake, 3-ocean, 4-tidal basin)
0       Transit time for release to reach aquatic recreation (hr)
0       Average fraction of time submersed in acute cloud (hr/person hr)

        ====INHALATION=======================================SECTION 6=====
8766.0  Hours of exposure to contamination per year
0       0-No resus-  1-Use Mass Loading          2-Use Anspaugh model
0         pension      Mass loading factor (g/m3)   Top soil available (cm)

        ====INGESTION POPULATION=============================SECTION 7=====
 1      Atmospheric production definition (select option):
0         0-Use food-weighted chi/Q, (food-sec/m3), enter value on this line
          1-Use population-weighted chi/Q
          2-Use uniform production
          3-Use chi/Q and production grids (PRODUCTION will be overridden)
0       Population ingesting aquatic foods, 0 defaults to total (person)
0       Population ingesting drinking water, 0 defaults to total (person)
F       Consider dose from food exported out of region (default=F)

        Note below: S* or Source: 0-none, 1-ground water, 2-surface water
                                  3-Derived concentration entered above
        ==== AQUATIC FOODS / DRINKING WATER INGESTION========SECTION 8====

F       Salt water? (default is fresh)

        USE          TRAN-   PROD-    -CONSUMPTION- |
        ?   FOOD     SIT     UCTION   HOLDUP  RATE  |
        T/F TYPE     hr      kg/yr    da      kg/yr |       DRINKING WATER
        --- ------   -----   -------  ------  ----- |------------------------
        F   FISH     0.00    0.0E+00   0.00    0.0  | 0       Source (see above)
        F   MOLLUS   0.00    0.0E+00   0.00    0.0  | T       Treatment? T/F
        F   CRUSTA   0.00    0.0E+00   0.00    0.0  | 0       Holdup/transit(da)
        F   PLANTS   0.00    0.0E+00   0.00    0.0  | 0       Consumption (L/yr)

        ====TERRESTRIAL FOOD INGESTION======================SECTION 9=====

        USE          GROW    --IRRIGATION--          PROD-     --CONSUMPTION--
        ?   FOOD     TIME    S RATE   TIME    YIELD  UCTION    HOLDUP   RATE
        T/F TYPE     da      * in/yr  mo/yr   kg/m2  kg/yr     da       kg/yr
        --- ------   -----   - -----  -----   -----  -------   ------   ------
        T   LEAF V   90.00   0  0.0    0.0     1.5   0.0E+00     1.0     30.0
        T   ROOT V   90.00   0  0.0    0.0     4.0   0.0E+00     5.0    220.0
        T   FRUIT    90.00   0  0.0    0.0     2.0   0.0E+00     5.0    330.0
        T   GRAIN    90.00   0  0.0    0.0     0.8   0.0E+00   180.0     80.0

        ====ANIMAL PRODUCTION CONSUMPTION===================SECTION 10====

        ---HUMAN---- TOTAL   DRINK    ------------STORED FEED--------------
 USE    CONSUMPTION  PROD-   WATER    DIET  GROW  -IRRIGATION--       STOR-
```

```
?    FOOD    RATE   HOLDUP UCTION   CONTAM   FRAC- TIME  S RATE  TIME    YIELD AGE
T/F  TYPE    kg/yr   da     kg/yr   FRACT.   TION   da   * in/yr mo/yr   kg/m3 da
---  ------ ------ -----  ------  -------   ----  ----  - ----- -----   ----- -----
T    BEEF     80.0  15.0    0.00     0.00   0.00  90.0  0   0.0  0.00    0.80 180.0
T    POULTR   18.0   1.0    0.00     0.00   0.00  90.0  0   0.0  0.00    0.80 180.0
T    MILK    270.0   1.0    0.00     0.00   0.00  45.0  0   0.0  0.00    2.00 100.0
T    EGG      30.0   1.0    0.00     0.00   0.00  90.0  0   0.0  0.00    0.80 180.0
                                              -------------FRESH FORAGE-----------
     BEEF                                   0.00  45.0  0   0.0  0.00    2.00 100.0
     MILK                                   0.00  30.0  0   0.0  0.00    1.50   0.0

##############################################################################
```

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Line 1: The first line is a file identifier line for the GENII.IN file. Because the file is written by and read by formatted commands, changes to the basic format can result in the inability to transfer data. This line contains the date of the last revision to the formatting of this file. Should future changes to the codes require changes to the format of this input file, this date will indicate whether or not the file will be successfully read by ENVIN.

Line 2: This line is a title line for the specific input case, TITLS.

Line 3: This line provides the name of the specific input file created by APPRENTICE that was copied into GENII.IN. It also provides the date and time at which the file was created, INFILN.

Line 4: OPTIONS header line.

Line 5: Near-field or far-field scenario option flag, NEAR. A "scenario" is a conceptual model of patterns of human activity corresponding to actions, events, and processes that result in radiation exposure to individuals or groups. A "far-field" scenario is one defined to determine the impacts of a particular release of radioactive material into a wide environment, such as doses from releases from a stack to individuals or populations downwind. In a "near-field" scenario, focus is on possible doses to an individual at a particular location resulting from initial contamination or contaminated external sources, e.g., buried waste or contaminated soil. In a near-field scenario, contamination levels in specific environmental media may be known. A far-field scenario can be characterized as coming in to a receptor. Of course, the two types are not mutually exclusive - some doses to individuals from remote sources can be calculated as either far- or near-field with the same result. Specific examples of common types of far-field and near-field scenarios include:

CHRONIC ATMOSPHERIC RELEASE - prospective or retrospective doses to individuals or populations at specified distances and directions from the source, via submersion, inhalation, deposition groundshine, and food pathways. This class of scenario is commonly used for showing compliance with regulations that apply to emission sources.

ACUTE ATMOSPHERIC RELEASES - prospective or retrospective doses to individuals or populations at specified distances and directions from an acute release via submersion, inhalation, deposition groundshine, and food pathways. This class of scenario is often used in Safety Analysis Reports (SARs) or Environmental Impact Statements (EISs).

CHRONIC SURFACE WATER RELEASES - prospective or retrospective doses to individuals or populations at specified distances downstream of a release point via swimming, boating, shoreline exposure, drinking water, aquatic foods, irrigated terrestrial foods and animal products, soil contaminated from irrigation, and other pathways associated with liquid releases. This class of calculation is also often encountered in showing compliance with regulations.

ACUTE SURFACE WATER RELEASES - prospective or retrospective doses to individuals and populations at specified distances downstream of a release point via swimming, boating, shoreline exposure, drinking water, aquatic foods, irrigated terrestrial foods and animal products, soil contaminated from irrigation, and other pathways associated with acute liquid releases. This class of calculations is also associated with SARs and EISs.

INITIAL SURFACE CONTAMINATION - individual doses resulting from contact with contaminated soil or surfaces via direct contact, resuspension, or crop uptake. Calculations of this nature can be used to analyze the impacts of spills or remedial actions.

INITIAL SUBSURFACE CONTAMINATION - individual doses resulting from contact with contaminated soil or surfaces via direct contact, resuspension, or crop uptake. The surface soil may be contaminated via manual redistribution of the material or via biotic transport. Calculations of this nature can be used to analyze the impacts of waste management options. Often a time delay may be included to take into account the radioactive decay of the source.

GROUNDWATER CONTAMINATION - prospective or retrospective doses to individuals and populations from a given water concentration via irrigation and other pathways associated with liquid releases. This class of calculations is also often encountered when showing compliance with regulations.

CUMULATIVE EFFECTS - prospective calculations combining initial soil contamination with additional contributions from an external atmospheric or liquid source. This type of calculation is representative of how near-field and far-field calculations can conceptually be combined.

Line 6: Population or individual dose calculation flag, POPDOS. Scenarios may be constructed to calculate either doses to representative members of critical groups (individuals) or collective doses to regional populations or subpopulations. Note that individual doses may be calculated for either near-field or far-field scenarios but that population doses are defined for far-field scenarios (because locally-measured or locally-predicted values cannot be representative over wide areas).

Line 7: Acute or chronic release flag, ACUTE. For scenarios involving release of radioactive materials into the environment, the input may be either of short duration (a matter of minutes to a few days) or continuous or routine (such that annual average parameters are appropriate). Note that scenarios involving exposure to pre-existing soil, vegetation, or ground water contamination must be treated as chronic.

Line 8: This line contains a reminder of the type of individual exposure parameters used for inhalation, ingestion, and external exposure. Two sets of recommended default parameters are provided to ease data entry for the APPRENTICE code. The "Average Individual" set is representative of the population average exposure and dietary habits, and should be used for most population dose calculations. The "Maximum Individual" set provides upper bound parameters you may override. All default parameters may be overridden; however, they provide an adequate basis for most generic calculations.

If you find that you are regularly resetting particular parameters, you may revise the default parameter file by editing the PARAMS.DAT file accessed by APPRENTICE. The format of this file is described in Section 2.3.

Note: Only the first column of each of these lines 5, 6, and 7 is read, as a True or False logical variable. The remainder of the line is information to allow ease of editing and is not read by the ENVIN program. Similar structure is true of all the remaining lines of the GENII.IN file, i.e., only the fields necessary to transmit information are read.

Lines 9 and 10: Spacing and header lines for transport and exposure pathway options.

Line 11, Column 1: Atmospheric transport flag, AIR. In most calculations, the known quantity is generally the release quantity. This may take the form of activity, or activity per unit time, released into the transport media of air or surface water, or in the case of buried waste, into soil via waste package degradation and biotic transport. These are converted via appropriate models to concentrations in the corresponding media. The transport flags of lines 11 through 14 indicate which models are to be activated.

Line 12, Column 1: Surface water transport flag, SWAT.

Line 13, Column 1: Biotic transport flag (only activated for near-field scenarios with subsurface contamination), BIOT.

Line 14, Column 1: Waste form degradation flag (only activated for near-field scenarios with buried wastes), BURWAS.

Line 15, Column 1: A blank field.

Line 16, Column 1: The Report Options header.

Line 17, Column 1: Flag for type of dose calculation, OUTEDE. Various levels of detail are available in the output report. The Annual Effective Dose Equivalent (AEDE) is the committed dose from one year of exposure (Volume 1, Figure 3.2). If this option is not selected, cumulative doses (Volume 1, Figure 3.3 or 3.4) from continued exposure (for the number of years you specify in the TIMES menu) will also be calculated and reported. Additional information can be requested on AEDE and cumulative dose-by-radionuclide or dose-by-exposure-pathway as controlled by the flags on lines 18 and 19. Note that all of these options result in an increased number of pages of output.

Line 18, Column 1: Flag to provide report of exposure by radionuclide, OUTRAD.

Line 19, Column 1: Flag to provide report of exposure by pathway, OUTPTH.

Line 20, Column 1: Flag to provide debugging output, DEBUG. For users interested in the intermediate workings of the code, selected information can be displayed on the screen during calculations. This information is cryptic, fast-scrolling, and slows the calculations. Interpretation requires use of the code listings provided in Volume 3 of this PNL-6584 series.

Line 11, Column 2: Flag to activate finite plume external exposure pathway, FINITE. The potential routes through which people may be exposed to radionuclides or radiation are called "exposure pathways." The general pathways can be thought of as external exposure, inhalation, and ingestion. The flags in Column 2 of lines 11 through 20 control the pathways for which results are calculated. The pathways are chosen depending on the ways people can be exposed for a given circumstance. In this way, an appropriate collection of defined pathways can also be considered to be a definition of an "exposure scenario." Because the types of exposure must be conceptualized before the pathways can be fully defined, "scenarios" are usually defined before the parameters are selected for the "pathways."

Note that either the flag on line 11 or on line 12 can be true, but not both simultaneously. Also, note that the flag on line 11 can be true only if joint frequency data is to be input (the flag on the last line of the atmospheric transport options, described below).

Line 12, Column 2: Infinite plume external exposure flag, AIREXT.

Line 13, Column 2: Soil exposure external exposure flag, GROUND.

Line 14, Column 2: Aquatic recreation (swimming, boating, shoreline) exposure flag, RECRE.

Line 15, Column 2: Inhalation exposure flag, INHAL.

Line 16, Column 2: Drinking water ingestion exposure flag, DRINK.

Line 17, Column 2: Aquatic foods ingestion exposure flag, AQFOOD.

Line 18, Column 2: Terrestrial foods (crops) ingestion exposure flag, TFOOD.

Line 19, Column 2: Animal product (meat, milk, eggs) ingestion exposure flag, ANFOOD.

Line 20, Column 2: Inadvertent soil ingestion model exposure flag, SLING.

Line 21 to 23: Inventory editing header.

Line 24: Selection of radionuclide inventory activity units, IUNIT. GENII requires information on the source of radioactivity in order to continue. You have the option of using either SI units or the various multiples of conventional units. Note that if you are entering source term information for more than one environmental medium, the units used must be consistent within a single case.

Line 25: Selection of surface soil inventory units - the source may be entered in terms of area, volume, or mass, SOLUNT.

Line 26: Reserved line for future development work.

Lines 27 through 34: Inventory editing headers. "Release Terms" are sources to air or water or concentrations in buried wastes. "Basic Concentrations" may be calculated from the release terms, or if known may be entered and the transport steps omitted from the calculations. "Derived Concentrations," if known, may be entered and both the transport and environmental pathway calculations bypassed.

Lines 35 to 35+N: Inventories of radionuclides may be entered here for release or basic concentrations. If derived concentrations are to be used, line 35 may be left blank. Units are as defined on lines 24 and 25. Note that these are formatted reads; therefore the entries must be within the fields defined by the editing headers.

Lines 36+N to 42+N: Derived concentration editing header.

Lines 43+N to 43+M: Inventories of derived concentrations of radionuclides may be entered here. If only release terms and/or basic concentrations are to be used, line 43+N may be left blank. Again, these are formatted reads that must fall within the limits defined by the editing headers.

Lines 44+M to 45+M: Time editing header. The time step available for GENII simulations is integer-years. Within this constraint, scenarios may be constructed by defining the length of time a person is exposed (intake ends), the period for which the dose commitment is calculated (dose calculation ends), the length of time during which the individual(s) is/are exposed that the active radionuclide release continues, and the length of time before the beginning of the exposure that deposition via air or water occurred (for determining soil accumulation). Refer to Figure 3.1 for definition of the various time adjustments available.

Line 46+M: Length of time over which the intake occurs (time from "Intake Begins" to "Intake Ends" in Figure 3.1), NTKEND, yr. If the AEDE ONLY option has been selected for the reports, only one year will be used.

Line 47+M: Length of time over which dose calculation is integrated (time from "Intake Begins" to "Dose Calculation Ends" in Figure 3.1), DCEND, yr.

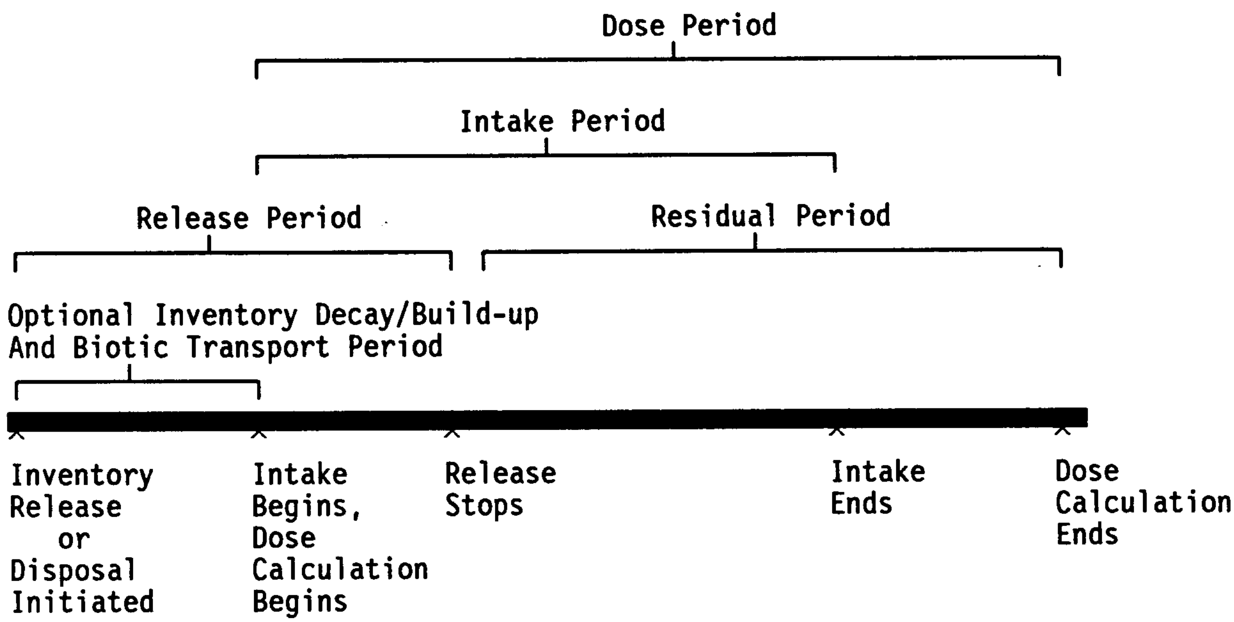

FIGURE 3.1. Time Line for Periods from Release of Radioactive Material Through Completion of Dose Calculations

Line 48+M: Length of time over which release occurs during exposure (time from "Intake Begins" to "Release Stops" in Figure 3.1), RELEND, yr. If the AEDE ONLY option has been selected for the reports, only one year will be used.

Line 49+M: Length of time prior to time "Intake Begins" that inventory atmospheric release was initiated (the early portion of the "Release Period" of Figure 3.1), BEFAIR, yr.

Line 50+M: Length of time prior to time "Intake Begins" that inventory surface water release and irrigation were initiated (the early portion of the "Release Period" of Figure 3.1), BEFIRR, yr.

Lines 51+M to 53+M: Far-field scenario parameter editing header.

Line 54+M: To calculate population doses, you will be asked to input consumption/exposure parameters for an average individual in the population. GENII will then use these average parameters times the number of people to calculate collective dose. The code can either figure a total population for you by summing from a grid that you must provide through input buffer POP.IN, or you can simply enter the total. This line defines whether the grid or the total will be used, POPOPT.

Line 55+M: If only the total population is being used, enter it on this line, POPIN, persons.

Line 56+M to 59+M: Near-field scenario editing header. If you have selected "Buried Waste or Deep Soil" as a source, radioactive decay of the source from the quantity initially disposed and release from waste packages to soil can be calculated by entering the appropriate decay time in the following lines. If "Buried Waste Transport" has been requested, the length of time that the biota have had contact with the waste (assumed to start at the time of loss of institutional control) can be entered.

Line 60+M: The length of time prior to the time "Intake Begins" that the inventory "Disposal" was initiated (refer to Figure 3.1), BEFORE, yr.

Line 61+M: The length of time prior to the time that "Intake Begins" that Loss of Institutional Control (LOIC) occurred, allowing biotic transport to begin, LOIC, yr.

Line 62+M: A two-compartment model of plant roots is allowed: vegetation uptake is assumed to be proportional to the fraction of roots contacting 1) the mixed surface soil layer and 2) the layer of contaminated buried soil. (These two layers can be separated by a third, clean layer.) These root fractions are used in the regular plant concentration model, the harvest removal model, and the plant portion of the biotic transport model. The upper soil fraction is entered on this line, RF1.

Line 63+M: The deep soil root fraction is entered on this line, RF2.

Line 64+M: For scenarios involving physical disruption that mixes deeply buried waste (in ci/m^3) with surface soil (in Ci/m^2), a "Manual Redistribution" factor is available, MANULR. (A handy factor to remember is that throughout GENII, 1 Ci/m^3 = 0.15 Ci/m^2.)

Line 65+M: A simple geometric model of dose rate reduction for small surface areas is provided. Enter the area of the contaminated surface on this line in square meters, FRSIZ.

Lines 66+M to 67+M: Transport editing header.

Line 68+M, Column 1: Blank field.

Line 69+M, Column 1: A number of options are available to determine air concentrations from releases. These may be based on several levels of knowledge. The user may either input a chi/Q value or request that one be calculated. When a chi/q value is input, no decay correction is made by GENII. The user should calculate a decay correction for each radionuclide (if transit time is known) and the input release term reduced accordingly.

In the chronic individual calculation, three options of increasing complexity are available to determine the annual average atmospheric dispersion values:

- The simplest for GENII is to directly input a precalculated chi/Q, in sec/m^3. XOQOPT = 1.
- The next in complexity is when the user specifies the location of the individual, in terms of distance and direction from the source, and asks GENII to compute the chi/Q for that location. This option

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requires that the user also have available one of two data sets: either a grid of precalculated chi/Q values or a set of joint frequency data for the source location. (See Section 2.3 for the format of these external data files.) If you choose to use the joint frequency data option, you must also enter data on the characteristics of the source, including whether or not release is elevated or ground level, and whether or not plume rise is calculated. XOQOPT = 3.

- Finally, if either a chi/Q grid or joint frequency file is available, you may instead direct GENII to search and find (select) the location of the maximally exposed individual via the air pathway. These options require data as described above for the specific individual, plus they require a population grid so that GENII does not assume an individual location where nobody lives. XOQOPT = 2.

In the chronic population calculation, three options of increasing complexity are available to determine the annual average atmospheric dispersion values.

The simplest for GENII is to directly input a precalculated population-weighted chi/Q value, in person-sec/m^3. XOQOPT = 1.

The next in complexity is where the user provides both a grid of precalculated chi/Q values and a matching grid of population, and allows GENII to cross-multiply the two to create a population-weighted chi/Q. XOQOPT = 0.

The third option requires the user to supply a joint frequency distribution in place of the chi/Q grid, and to allow the code to create the chi/Q grid. (See Section 2.3 for the format of the chi/Q and joint frequency files.) If you choose to use the joint frequency input option, you must also enter data on the characteristics of the source, including whether or not release is elevated or ground level and whether or not plume rise is calculated. XOQOPT = 0.

Note that you cannot request the "FINITE PLUME" submersion model without using one of the joint frequency options.

To determine the time-integrated air concentration for the acute individual exposure, two options are available.

The first is through input of a precalculated E/Q, in sec/m^3. XOQOPT = 1.

The second is to specify the distance and direction of the individual from the release point. This option requires that the user provide either a grid of precalculated E/Q values or a set of joint frequency data for the source location. (See Section 2.3 for the format of these external files.) If you choose to use the joint frequency option, the code will calculate the E/Q which is not exceeded more than 5% of the time for the specified location (i.e., the 95th percentile E/Q). For this option you must enter data on the source characteristics (including whether or not it is an elevated or ground-level release, whether or not to use the plume rise model, or whether or not to use the building wake model). XOQOPT = 3.

Note that you cannot request the "FINITE PLUME" submersion model without using one of the joint frequency options.

Two options are available for determining the population-weighted, time-integrated air concentration for acute population exposures.

The simplest is through user input of a precalculated population-weighted E/Q, in person-sec/m^3. XOQOPT = 1.

The second option is to specify the direction from the source for which the calculation is desired. This option requires that the user provide either a grid of precalculated E/Q values or a set of joint frequency data for the source location (see Section 2.3 for the format of these external files), and in addition a population grid file. If you choose the joint frequency option, the code will calculate the population-weighted E/Q which is not exceeded more than 5% of the time for the specified direction (i.e., the 95th percentile population-weighted E/Q). For this option you must enter data on the source characteristics (including whether or not it is an elevated or ground-level release, whether or not to use the plume rise model, and whether or not to consider the building wake model). XOQOPT = 3.

Note that you cannot request the "FINITE PLUME" submersion model without using one of the joint frequency options.

Line 70+M to 71+M, Column 1: Blank Fields.

Line 72+M, Column 1: Input chi/Q or population-weighted chi/Q, if used, goes on this line, XOQI, sec/m^3 or person-sec/m^3.

Line 73+M, Column 1: Sector index for the location of the Maximum Individual, MIDIR. The sector indices are:

1-S	5-W	9-N	13-E
2-SSW	6-WNW	10-NNE	14-ESE
3-SW	7-NW	11-NE	15-SE
4-WSW	8-NNW	12-ENE	16-SSE

Line 74+M, Column 1: Distance of Maximum Individual from the release point, meters, MIDIST.

Line 75+M, Column 1: Flag for use of joint frequency data, as defined by XOQOPT, JFIN.

Line 68+M, Column 2: Identifier for type of atmospheric release, IRELES.

The key is:

0 - Ground-level, open area

1 - Elevated stack greater than 2.5 times the height of the nearest building

2 - Elevated building vent

3 - Building vent below roof level

Line 69+M, Column 2: Flag for use of effective stack height (rather than calculate plume rise, STACK.

Line 70+M, Column 2: Stack height or effective stack height, SHITE, m.

Line 71+M, Column 2: Stack flow rate (for plume rise), SFLOW, m3/s.

Line 72+M, Column 2: Stack radius (for plume rise), SRAD, m.

Line 73+M, Column 2: Effluent temperature (for plume rise), ETEMP, degree C.

Line 74+M, Column 2: Building cross-sectional area (for building wake model), BUILDX, m^2.

Line 75+M, Column 2: Building height (for building wake model), BUILDH, m.

Line 76+M to 77+M: Surface Water Transport editing header. Three options are available to determine the surface water concentrations from chronic releases - a simple dilution volume model and more complex models of river and lake dispersion. The dilution volume model requires only input of the annual average flow of the receiving water body (i.e., river) and allows adjustment by a multiplicative input mixing ratio. The river and lake models generate mixing ratios and, from them, water concentrations as functions of flow velocity, water depth, effluent discharge rate, longshore and offshore distance, and other parameters.

Because of the nature of the acute model for surface water transport, only one model is available to determine time-integrated water concentrations. Required input is the average flow of the receiving water body and a multiplicative mixing ratio (usually 1.0 unless otherwise known). The entire source is assumed to be carried off by the river/lake flow.

Line 78+M: Indicator for which mixing ratio model to use. MIXFLG. Key is:

0 - Use input value on next line
1 - Calculate using the river model
2 - Calculate using the lake model

Line 79+M: Input mixing ratio for MIXFLG = 0, MIXR.

Line 80+M: Average river flow rate, SWFLOW. For MIXFLG = 0, the units are m^3/s; for MIXFLG = 1 or 2, the units are m/s.

Line 81+M: Transit time to irrigation withdrawal location, SWTT, h.

Line 82+M: Blank field.

Line 83+M: Rate of effluent discharge to receiving lake or river, SWQB, m^3/s.

Line 84+M: Longshore (downstream) distance from release point to withdrawal location, SWLSX, m.

Line 85+M: Offshore distance from the release point to the inlet location, SWOSY, m.

Line 86+M: Average water depth of receiving lake or river, SWDPTH, m.

Line 87+M: Average river width (for MIXFLG = 1 only), SWIDTH, m.

Line 88+M: Depth of effluent discharge point (in lake model only), SWDZ, m.

Lines 89+M to 90+M: Waste Form Availability editing header.

Line 91+M: Waste form or waste package half-life. "Buried Waste" acts as an additional soil compartment that feeds "Deep Soil" at a rate determined by the waste decomposition half-life. PACKHL, yr.

Line 92+M: Waste thickness. For near-field scenarios involving either "Buried Waste" or "Deep Soil", an estimate of the thickness of the contaminated zone is required for the harvest removal model. WASDEP, m.

Line 93+M: Depth of soil overburden. The depth to the top of this zone is required by the animal portion of the model of soil the animals might move. OVRBRD, m.

Lines 94+M to 95+M: Biotic Transport editing header.

Line 96+M: Flag for activating biotic transport during the period before exposure (refer to Figure 3.1). BTPRE.

Line 97+M: Flag for activating biotic transport during the intake period (refer to Figure 3.1). BTNTK.

Line 98+M: Index for the site conditions before the assumed exposure, BTDSET. Biotic transport may result in radionuclides reaching surface soil from "Buried Waste" or "Deep Soil" both during the period following waste disposal and loss of institutional control but before the initial time of human exposure via this scenario (the "Years since LOIC"). Biotic transport may also continue during the exposure period. Three possibilities are provided for the conditions existing at the site before the start of this scenario's exposure: arid non-agricultural uses, humid non-agricultural uses, or agricultural uses. The parameters that describe these conditions are simplifications of those used in McKenzie et al. (1982 and 1983).

Line 99+M to 104+M: Exposure editing header. The "EXTERNAL EXPOSURE" parameters help define the time during which the individuals or populations are exposed to sources of direct radiation from contaminated air, soil, water, or sediments. GENII uses fairly simple exposure geometries - shielding corrections for buildings, etc. are not included. If desired, simple reductions for shielding may be incorporated by reducing the time assumed for exposure.

For exposure to an acute air concentration, the fraction of time during plume passage that the person(s) is exposed is input. For exposures to soil and sediment following acute deposition, the exposure is modeled as chronic to a decaying source. Note that, if swimming and boating have been selected, certain assumptions have been "hard-wired" into the code for the acute case (100% exposure for maximum individual, 0% exposure for populations); so no inputs are requested.

Line 105+M, Column 1: Length of external exposure per year to chronic atmospheric plumes, HRPLUM, h.

Line 106+M, Column 1: Length of external exposure per year to soil contamination, HRGRD, h.

Line 107+M, Column 1: Length of time spent per year swimming in contaminated water, HRSWIM, h.

Line 108+M, Column 1: Length of time spent by individuals per year boating, HRBOAT, h.

Line 109+M, Column 1: Length of time spent by individuals exposed in shoreline activities, HRSHOR, h.

Line 105+M, Column 2: Flag for activating irrigation of residential soils (to model external exposure to irrigated soil), RESIRR.

Line 106+M, Column 2: Index for source of residential irrigation water, IRRSR, key is 1 - ground water, 2 - surface water.

Line 108+M, Column 2: The application rate of residential irrigation water, RIRR, inches/year.

Line 109+M, Column 2: Application period of residential irrigation, IRTIMR, Months/year.

Line 110+M: Index for type of shoreline at the exposure location, SHRTYP.

Key is : 1 - River shore

2 - Lake shore

3 - Ocean beaches

4 - Tidal basin

Line 111+M: Travel time of water from the release point to the recreational exposure point, RECTT, h.

Line 112+M: For the acute air submersion model, the fraction of total plume travel time that the individual spends in the plume, FRCLOD.

Line 113+M to 114+M: Inhalation editing header. GENII considers two sources for inhalation exposure: plumes from acute or chronic sources and resuspension from soil contamination. Exposure to plumes may be characterized by the time spent at a location within the plume, in hours/year for chronic exposure or fraction of plume passage time for acute releases, as defined in lines 103+m and 110+m above. Two models describing resuspension are available if desired. The Mass Loading model relates the local air concentration to the local soil concentration by assuming that dust in the air has the same concentrations as the soil. The Anspaugh model (Anspaugh 1975) is a time-dependent function relating surface activity to air concentration. GENII uses a fraction of the upper soil compartment to represent the surface activity.

Line 115+M: Hours per year an individual spends exposed to contaminated air from either chronic plumes or from resuspension. HRINH, h.

Line 116+M: Flag for activating resuspension models, IRES. Key is:

0 - No resuspension

1 - Use mass loading model

2 - Use Anspaugh (1975) model

Line 117+M: If IRES = 1, the mass loading factor XMLF, g/m^3. If IRES = 2, the depth of the top layer of soil that is available for resuspension AVALSL, cm.

Line 118+M to 119+M: Ingestion Population editing header. A common assumption in the older Hanford environmental codes was that food crops are produced and eaten where the people live. While not a bad assumption for individuals, this can lead to inaccuracies when the people live on one side of a source and the crops are grown on the other, or when not enough food is grown to support the entire population. GENII allows several options, of increasing complexity, to deal with food production.

The user may input a precalculated normalized food-production-weighted chi/Q value (option 0), analogous to a population-weighted chi/Q.

You may select to use the same distribution as used for the population, essentially assuming that the field and people are co-located (option 1).

If you know how much food is produced but not necessarily where, you may assume the crops are grown uniformly throughout the 80-km grid (option 2).

Finally, if you know the actual food production distribution, prepared as a file of values in kg/yr for each of the 10 x 16 grid points for each food type, this may be used with the chi/Q grid input or calculated for the population (option 3).

Note that with options 2 and 3, the potential for doses to people outside the region resulting from crop export may be considered, if desired.

Note: Only the option assuming co-location of crops and population (option 1) is currently available for acute releases. Model development for the other options is as yet incomplete.

Line 120+M: Option selection for food production, FOQOPT.

LINE 121+M: If FOQOPT = 0, then the food-weighted chi/Q is entered on this line, FOQ, kg-sec/m^3.

Line 122+M to 124+M: Editing information.

Line 125+M: The number of people ingesting the aquatic food harvest, AQUPOP, persons, if different than the total population. If a zero is entered on this line, the total population is assumed to eat aquatic foods. If you know the total consumption values (for instance, 100,000 kg of vegetables) and don't really care about how many people it feeds, put in a population of 1 and enter the other values later when required.

Line 126+M: The number of people drinking water from the contaminated source, DWPOP, persons, if different than the total population. If a zero is entered on this line, the total population is assumed to drink from the source.

Line 127+M: An option is available to consider the total production of foods in the assessment area. If not enough food is grown to support the population at the level of consumption indicated, a correction is made. Also, if more food is grown than can be consumed, an effective population can be developed to consider export from the region. The flag for this option is on this line, EXPORT.

Line 128+M to 132+M: Aquatic Food/Drinking Water editing header.

Line 133+M: Flag for consideration of freshwater or marine bioaccumulation factors for the aquatic food pathways, ISALT.

Line 134+M to 138+M: Aquatic Food/Drinking water editing header.

Line 139+M to 142+M, Columns 1 to 5: For each of the aquatic food types you select with the flag in the first column (AQF), several parameters must be entered. These include travel time of the radionuclides in the water to the point where the fish/etc. are caught (AQUTT), h, and the time between harvest and consumption (HLDUP2), day. These allow for proper accounting of decay for short-lived nuclides. Individual aquatic food consumption rates are also input here (USAG), kg/yr. In addition, if the export flag is on, the total production of aquatic food products may be entered (TPRODQ), kg/yr. Note that this is a formatted read, so the values entered must line up in the fields defined by the editing header.

Line 139+M to 142+M, Column 6: Because GENII allows simultaneous consideration of several sources of contamination (surface water and ground water), you need to indicate which source is to be used for drinking on Line 139+M, DWSRC. The key for the sources is:

0 - None

1 - Ground water

2 - Surface water

3 - Derived concentration from lines 42+N to 42+M

You will also need to indicate on Line 140+M whether the drinking water is treated through a water treatment facility (DWTRET). If so, reductions in concentration for filtration/cleanup will be calculated. The travel time of the water through the distribution system is also input on Line 141+M , HOLDDW, days, to allow calculation of decay of short-lived nuclides. Consumption of drinking water, (DWUSAG, L/yr), is input on Line 142+M.

Line 143+M to 149+M: Terrestrial Food editing header.

Line 150+M to 153+M: Input of terrestrial food parameters. For each of the terrestrial food types you select (flag TFD), several parameters must be entered. These help define the conditions under which the crops are grown, such as the length of the growing season (GRWP, days), the conditions of irrigation (source flag IRRST: irrigation rate RIRR, inches/year; irrigation period IRTIMT, months/year), and the yield of the crop (YELD, kg/m^2) as well as the total production, if required (TPRODT, kg/year). Individual food holdup times between harvest and storage (HLDUP, days) and consumption rates (CONS, kg/year) are also input here. Note that this is a formatted read, all input parameters must conform to the fields defined by the editing headers.

Note: Growing time is only used for the years after the release in acute cases. If you are only looking at dose commitment from the first year of exposure, whatever value you enter will be ignored.

Line 154+M to 161+M: Animal Product editing header.

Line 162+M to 165+M: For each of the animal products you may select (flag ANF), several parameters must be entered to define the conditions under which the products are produced. This includes not only the amount of each product consumed by humans (CONS2, kg/yr) and its holdup time (HLDUPA, days), but also the conditions for the foods that the animals themselves eat. The total production of each food type in the assessment area may be entered if required (TPRODA, kg/yr). The fraction of the drinking water that the animals consume (DWFACA) from contaminated sources is entered. Some animals are allowed two food sources (fresh forage and stored feed), so information on stored fraction (DIETFR), growing period (GRWPA, days), irrigation sources (IRRSA), rates (RIRRA, inches/year), times (IRTIMA, months/year), yields (YELDA, kg/m^2), and storage times (STORTM, days) must be provided for crops eaten by the animals. This information is entered on these lines for the stored feed. Note that these are formatted reads, and the information must fit in the fields defined by the editing headers.

Line 166+M: Fresh Forage editing header.

Line 167+M to 168+M: Some animals are allowed two food sources (fresh forage and stored feed), so information on diet fraction (DIETFR), growing period (GRWPA, days), irrigation sources (IRRSA), rates (RIRRA, inches/year), times (IRTIMA, months/year), yields (YELDA, kg/m^2), and storage times (STORTM, days) must be provided for the crops the animals eat. These are entered on these lines for the fresh forage eaten by beef and milk cattle. Note that these are formatted reads, and the information must fit in the fields defined by the editing headers.

Line 169+M to 170+M: File delineation header.

3.3 EXTDF

EXTDF is a streamlined and updated version of the radionuclide shielding code ISOSHLD (Engle 1966). The input to the code is supplied through an ASCII text file designated EXTDF.IN. This section describes the format for the EXTDF input file. The input is subdivided into three portions, following the original ISOSHLD convention: a title, NAMELIST, and shield specification.

3.3.1 Title

The initial input line is a Case Title, which is read and copied verbatim on the output of the code. Use this line as a unique identifier for the calculation being performed.

3.3.2 NAMELIST

The second input grouping is the NAMELIST input. NAMELIST is a useful FORTRAN specification allowing selective input of variables. NAMELIST variables have default values (i.e., the program assigns a value to the variable if the user does not specify a value in the input.) A principle advantage of the NAMELIST format is that values for which the defaults are acceptable, or which are not used in a particular calculation, need not be initialized. All of the NAMELIST variables that EXTDF accepts as input are defined below, along with their default values. The NAMELIST variables are grouped into four categories: source distribution, geometry, shielding, and integration.

In the NAMELIST the variable name is written out, followed by an equal sign and the numeric value assigned to that variable. NAMELISTs begin and end with the character "&" and in EXTDF are identified by the word "INPUT" immediately following the first "&". The last "&" must be preceded by a blank space. All lines in a NAMELIST field must begin with a blank space. NAMELIST entries are separated by commas. Array values may be input independently of the value of other array entries, as long as the variable name includes the array position.

A NAMELIST parameter, IEXTU, has been added for specifying input/output units. A unit input of 1.0 is automatically defined for each radionuclide. The following values of IEXTU and their corresponding units are as follows:

0	- rem/h per Ci/cm3	(ISOSHLD default)
1	- mrem/h per Ci/m3	(MAXI1)
2	- mrem/yr per μCi/cm3	(Kocher)
3	- person Sv/yr per Bq/m3	(GENII air)
4	- person Sv/yr per Bq/L	(GENII on water surface)
5	- mrem/yr per μCi/cm2	(Kocher)
6	- person Sv/yr per Bq/m2	(GENII ground)
7	- mrem/yr per pCi/m3	(IMPACTS-BRC ground)

Source Distribution

EXTDF is intended for generating normalized tables of external dose rate factors for various geometries. Therefore, the sources are generally assumed to be unit sources. However, a common input multiplier, WIN, is available. This multiplier can be used to increase or decrease every input radionuclide inventory by a specific amount. The default value is 1.0, a normalized input strength. The radioactive source need not be uniformly distributed within the source material. The variable SSV1 can be used to create an exponential source strength distribution. Legal values are between -10 and +10. If no value is specified, the program uses zero; i.e., a uniform source distribution. Details on the geometries that allow the use of the SSV1 parameter are given below.

Shielding

The variable NSHLD tells the program how many shields will be used in this problem. A maximum of five is permitted. The program automatically inserts a layer of air as the last shield before the detector (dose point) if the entire distance is not specified as containing shields.

The variable JBUF tells the program which material should be used in computing the build-up factor. If no value is entered, JBUF is automatically set to NSHLD. The common shielding convention is to assign JBUF to the outermost shield (i.e. that closest to the detector) that has at least one relaxation length of material for the energy groups giving the majority of the dose rate. A relaxation length is the inverse of the linear attenuation coefficient. If the outermost shield is not thick enough, then the thickest shield (in terms of relaxation lengths) should be chosen for the build-up factor.

Geometry

The IGEOM variable sets the geometrical shape of the source and shields. Table 3.1 provides the available options.

For each geometry, additional NAMELIST variables specify the dimensions of the source and the distance from the source to the detector. These variables are X, the total distance from the back of the source to the detector; T, the thickness of each of the shield regions; SLTH, the length of the source; Y, the vertical distance from the end of the source to the detector; ANG1, the shield normal angle; and ANG2, the detector angle. All dimensions are in centimeters, all angles are in degrees. Not all of the variables are required for each geometry selection. Definition of these parameters for each geometry is illustrated in the geometry diagrams, Figures 3.2 through 3.12. These diagrams are taken directly from the original ISOSHLD documentation (Engle 1966; Simmonds 1967).

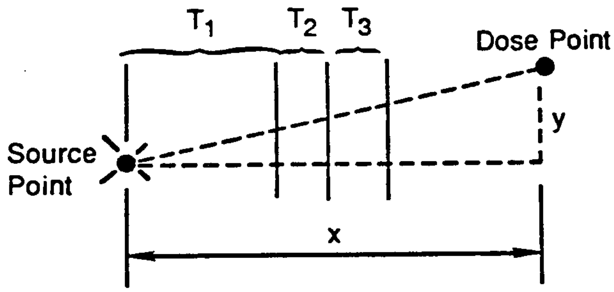
TABLE 3.1. IGEOM Values and Their Relationships to Sources and Shields

IGEOM Value	Source Configuration	Shield Configuration
1	Point	Slab
2	Line	Slab
3	Spherical	Spherical
4	Spherical	Slab
5	Truncated Cone	Slab
5	Infinite Plane	Slab
5	Infinite Slab	Slab
6	Disc	Slab
7	Cylindrical (side)	Cylindrical
8	Cylindrical (side)	Slab
9	Cylindrical (side)	Cylindrical and Slab
10	Cylindrical (end)	Slab
11	Rectangular	Slab
12	Annular Cylinder	Cylindrical and Slab

Integration Variables

The EXTDF solution technique includes a point kernel integration, in which the source is represented as a series of point sources in space and the contribution from each point is calculated and summed to a total dose rate. The number and orientation of the point sources are determined by the integration variables selected by the user. These are NTHETA, NPSI, and DELR. The variables NTHETA and NPSI determine how many intervals the source is divided into. The variable DELR is the thickness of the pieces, in centimeters. Not all of the geometries require specification of these parameters. They are required only for geometries 7 through 12.

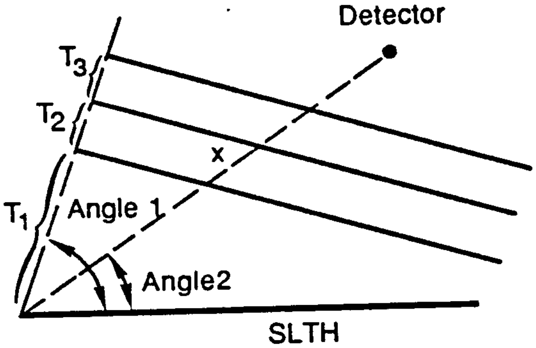
The optimal choices for these variables depend on the distance from the source and the geometry. Typically, the best choices are values of NTHETA and NPSI that give volumes that are not much larger than the distance from the face of the source. DELR should be no more than one relaxation length in the source material. When the detector is close to the source, DELR should be less than one-half of a relaxation length.



INPUT VARIABLES

T_1, T_2, T_3 = shield thicknesses
IGEOM = 1
X = Perpendicular distance to detector
Y = Parallel distance to detector

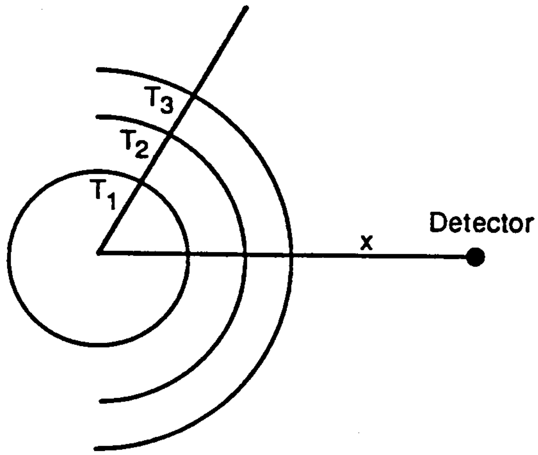
FIGURE 3.2. Point Source - Slab Shields



INPUT VARIABLES

IGEOM = 2
X = Distance to detector
Angle 1 = Shield normal angle
Angle 2 = Detector angle
SLTH = Source length
T_1, T_2, T_3 = Shield thicknesses

FIGURE 3.3. Line Source - Slab Shields

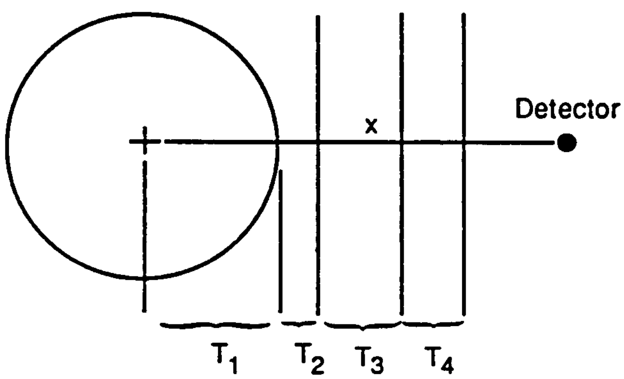


INPUT VARIABLES

IGEOM = 3
X = Distance from center to detector
T_1 = Source radius
T_2, T_3 = Shield radii

Note: Constant source strength distribution only for spherical source

FIGURE 3.4. Spherical Source and Shields

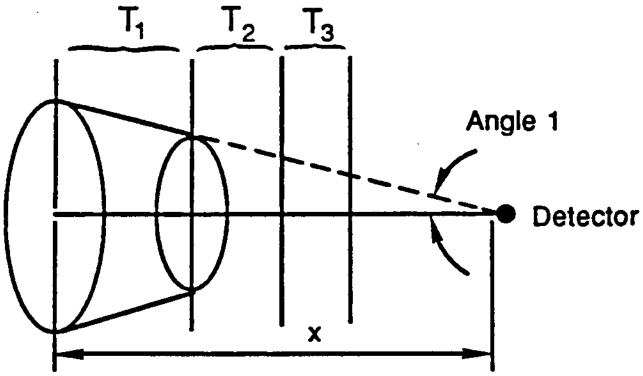


INPUT VARIABLES

IGEOM = 4
X = Distance from center to detector
T_1 = Source radius
T_2, T_3, etc. = shield thicknesses

Note: Constant source strength distribution only for spherical source. Shield region 2 surrounds the source.

FIGURE 3.5. Spherical Source - Slab Shields



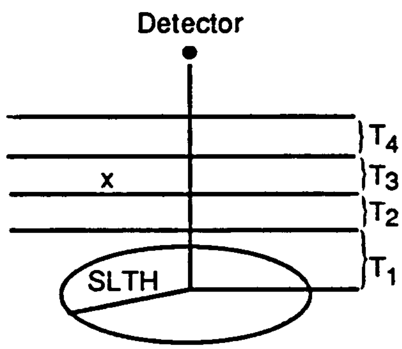
INPUT VARIABLES

IGEOM = 5
Angle 1 = Cone angle
T(1) = Source thickness
X = Distance to detector from opposite face

Notes: If Angle 1 = 90.0° (infinite slab source), then the source strength is input in activity per unit volume.

If T(1) = 0 and Angle 1 = 90.0° (infinite plane source), then the source is input in activity per unit area.

FIGURE 3.6. Truncated Cone Source - Slab Shields

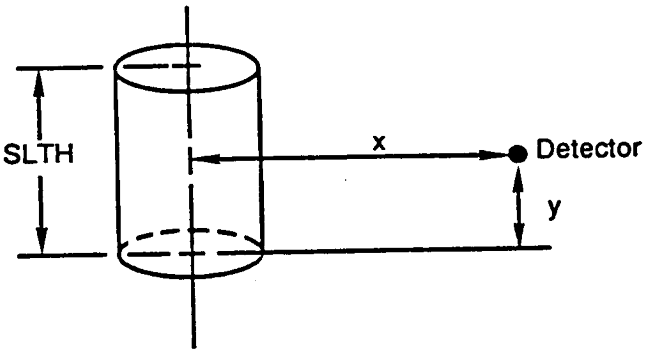


INPUT VARIABLES

IGEOM = 6
SLTH - Disk radius
X = Distance from center to detector

Note: Source strength input is in activity per unit area.

FIGURE 3.7. Disk Source - Detector on Centerline - Slab Shields

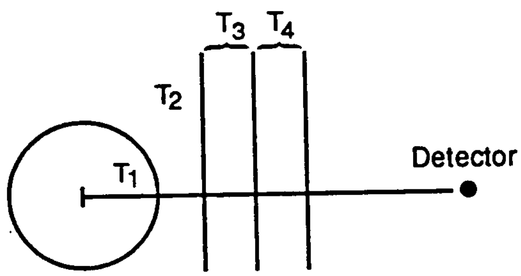


INPUT VARIABLE

IGEOM = 7 for cylindrical shields
IGEOM = 8 for slab shields
SLTH = Length of source
X = Radial distance to detector from centerline of source
Y = Vertical distance from end of source to detector

a. Cylindrical Source, Isometric View.

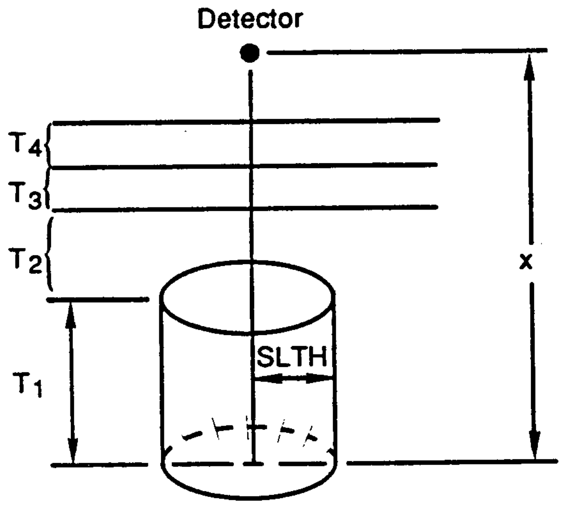
Note: Y may not be greater than SLTH. (When a value of Y greater than SLTH is entered, the program arbitrarily sets Y = 0.)



b. Cylindrical Source, End View.

Note: With slab shield, the second shield region surrounds the source.

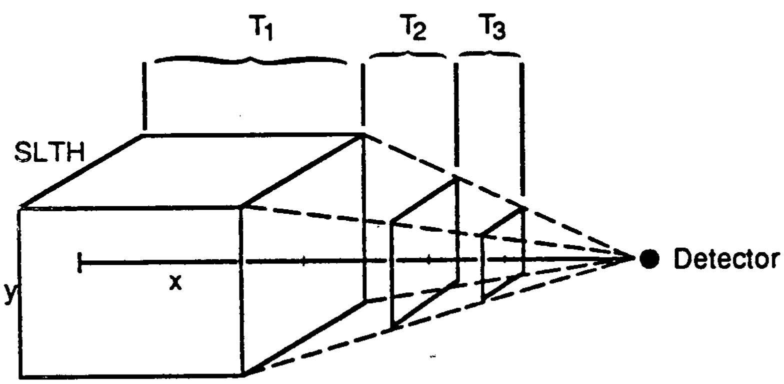
FIGURE 3.8. Cylindrical Source - Cylindrical and Slab Shields



INPUT VARIABLES

IGEOM = 9
SLTH = Radius
T_1 = Cylinder length
X = Distance to detector from opposite end
T_2, T_3, T_4 = Shield thicknesses

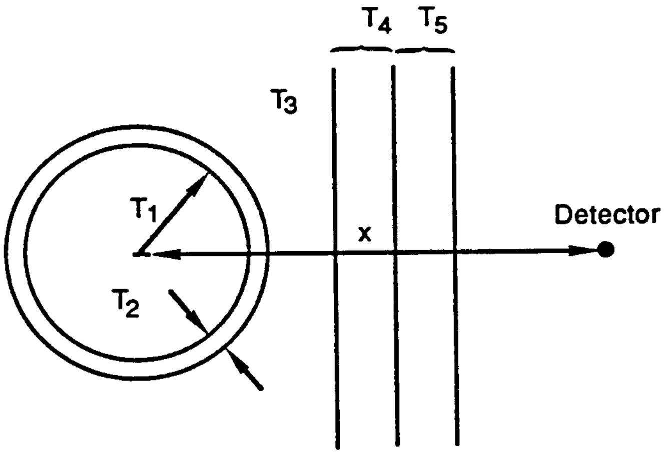
FIGURE 3.9. End Cylindrical Source - Detector on Centerline - Slab Shields



INPUT VARIABLES

IGEOM = 10
X = Distance to detector from opposite fact of source
Y = Height of source
SLTH = Length of source
T_1 = Thickness of source
T_2, T_3 = Shield thicknesses

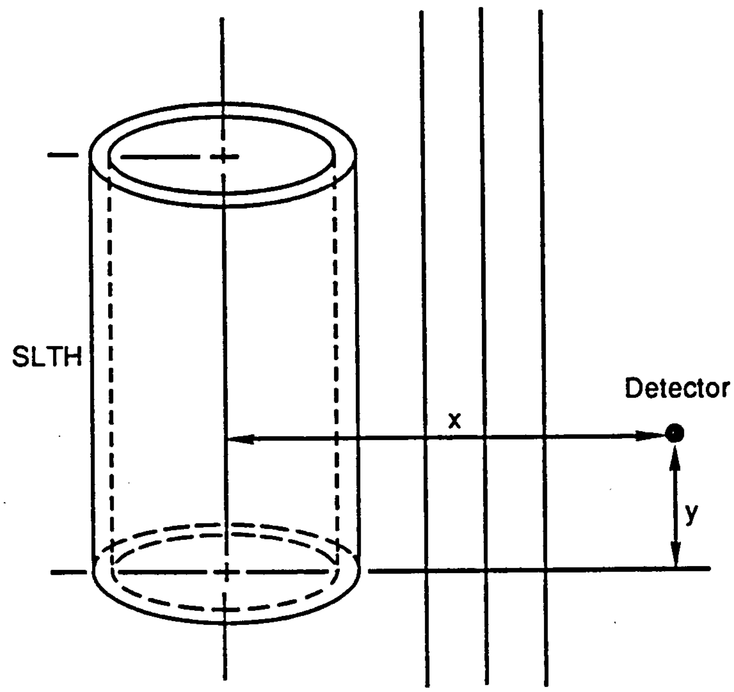
FIGURE 3.10. Rectangular Source - Detector on Centerline - Slab Shields



INPUT VARIABLES

IGEOM = 11
SLTH = Length of source
X = Radial distance to detector from centerline of source
Y = Vertical distance from end of source to detector
T_1 = Radius of source
T_2 = Wall thickness of container
T_3 = Distance from container outer wall to first slab shield

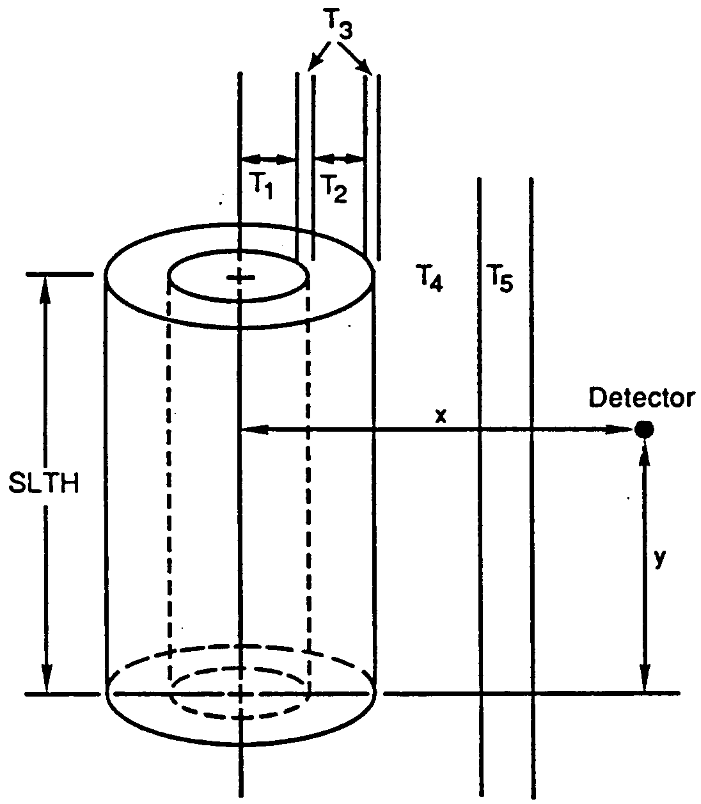
a. Plan View



b. Isometric View

Note: Second shield, T(2), is cylindrical. The third shield, T(3), has slab face but surrounds the first and second shields. The remaining shields are slabs. (When a value of Y greater than SLTH is entered, the program arbitrarily sets y = 0.)

FIGURE 3.11. Cylindrical Source - Cylindrical and Slab Shields



<u>INPUT VARIABLES</u>

IGEOM = 12
T_1 = Inner radius of the annulus
T_2 = Annulus width (source)
T_3 = Container wall thickness
SLTH = Length of source
X = Radial distance to detector from centerline of source
Y = Vertical distance from end of source to detector
T_4, T_5 = Shield thicknesses

Notes: Y may not be greater than SLTH. (When a value of Y greater than SLTH is entered, the program arbitrarily sets Y = 0.)

T_3 is the thickness of the inner and outer walls of the container, which must be equal.

<u>FIGURE 3.12</u>. Annular Cylindrical Source - Cylindrical and Slab Shields

3.3.3 Shield Material Specification

Following the NAMELIST comes the shield specification block. There may be up to five shields, and each shield may be composed of a single material or a mixture of an unlimited number of materials (up to all 20 available materials). For alloys or homogeneous mixtures of materials, the density of each material as it is found in that shield is used. Data is read in an unformatted format; each line specifies the density, in grams/cm^3, of one material for each of the five shields. Each line must contain a continuation key, the material identification number, and the density of that material in each of the shields. The continuation key is an integer, either zero if there are additional materials to be considered, or a one if this is the last material. The material identification number corresponds to the definitions given in Table 3.2. Note that because the read is free format, zero values must be entered. Thus, one key, one identification number, and five densities will always be on each line.

3.4 INTDF

The INTDF code produces radiation dose factors using the techniques of ICRP 30 (1979a, 1979b, 1980, 1981a, 1981b, 1982a, 1982b). A single run will generate both ingestion and inhalation dose factors. The dose factors are prepared as both dose commitments, by organ for the uptake and integration periods desired, and as annual dose increments. Output from the calculation is summarized on the standard output file INTDF.OUT, the dose commitments are stored in file CDE.OUT, and the dose increments are stored in file CDEINC.OUT. Manipulation of these output files allows the creation of the dose factor files used by the DITTY and DOSE routines.

Input to INTDF is brief. The first line is reserved for a title, which is reproduced on each page of output and in the data summary files. On the following four lines the user indicates:

- the number of years to consider
- whether or not (True/False) the exposure is acute or chronic (i.e., whether the dose factors are being created for the DOSE or DITTY routine)

TABLE 3.2. Shield Material Specifications Available in EXTDF

Identification Number	Material	Usual Specific Gravity	Effective Atomic Number	Effective Atomic Number
1	Water	1.0	4	6
2	Tissue	1.0	4	6
3	Air	0.00129	7	14
4	Hydrogen	0.00008	1	1
5	Lithium	0.532	3	7
6	Carbon	2.0	6	12
7	Aluminum	2.702	13	27
8	Titanium	4.5	22	48
9	Iron	7.8	26	56
10	Nickel	8.90	28	59
11	Zirconium	6.44	40	91
12	Tin	7.3	50	119
13	Tungsten	19.3	74	184
14	Lead	11.35	82	207
15	Uranium	18.75	92	238
16	Ordinary Concrete	2.35	10	19
17	Magnetite Concrete	3.76	12	24
18	Strontium	2.6	38	88
19	Promethium		61	145
20	Cerium		96	245

- particle size in microns, to allow determination of lung deposition from inhalation
- whether or not (True/False) the specific effective energies should be printed in the output file (when set, additional output is printed to the screen during execution, which may be used in tracing the internal calculations).

The remaining lines of the input section consist primarily of instructions to the Livermore Solver for Ordinary Differential Equations (Stiff) which is embedded in the code (Hindmarsh 1983). It is generally not necessary for the user to modify these parameters for the INTDF application. The values provided in the sample problems have been developed through numerous tests, and have been shown to both result in accurate results and minimize computational time for all radionuclides in the GENII libraries. The LSODES parameters have been left in the input to facilitate research use of the INTDF module. The LSODES control parameters are:

- the relative error tolerance parameter, RTOL,
- the absolute error tolerance parameter, ATOL. RTOL and ATOL are used in the LSODES numerical iteration scheme to control the number of iterations required and maintain accuracy of the integrated result. The solver controls the vector E = E(I) of estimated local errors in the integrated retention vector Y according to an inequality of the form Root-Mean-Square Norm E(I)/EWT(I) < 1.0, where EWT(I) = RTOL * ABS(Y(I)) + ATOL. Values of 10^{-6} for RTOL and 10^{-8} for ATOL have been tested and found adequate.
- the maximum absolute time step size the solver is allowed to take, ASSA. Because annual dose increments are calculated, and the code operates on a time unit of days, this has been set to 365 days.
- the initial time step size that the solver should use, HSTART. A value of 10^{-6} days has been found to accommodate all short transients associated with the radionuclides of interest.
- the maximum number of iterations the solver is allowed to take to reach convergence on any one call, NSC. This prevents the machine from getting into infinite loops if there is an error. A value of 700 is recommended as adequate for the calculations of dose factors.

A final input line relates to a developmental capability planned for INTDF. The capability is not completely developed to calculate radiation dose to the thyroid of a developing fetus as a result of maternal radionuclide intake of iodine, and dose factors for fetal exposures are not included in the dose factor files routinely addressed by the DOSE or DITTY programs.

The fetal dose calculation capability should not be used in other than research applications with this version.

Following the input section, the user enters radionuclides to be considered, up to a maximum of 100. Nuclide names must match the spelling of those in RMDLIB. Be careful to enter a return after the last radionuclide, and do not include any blank lines in the file.

3.5 DITTY

Use of the computer program DITTY requires proper assignment of several data files and careful preparation of an input record file. This section describes preparation of the input record file. This file has been designed to allow efficient use of the computer program with minimum effort by the user in preparing input records. Each execution of DITTY can have an unlimited number of cases. An execution file for DITTY contains the following classes of records:

1. A master radionuclide control list defining any radionuclides considered in this set. Radionuclides considered in any of the cases in the set are based on the interrelationship of several parameters:
   - time of release in relation to time period considered
   - type of release (acute or chronic) and whether that type of release is considered in a particular problem of a set
   - release pathway (airborne or waterborne) and whether that pathway is considered in a particular problem of the set
   - input options for release data; whether release data is read for this case or whether release data is in effect from a previous problem.
2. A group of records for each problem in the set consisting of the following types of records:
   - title for this case (Note: the title for the first case of a set is positioned before the master radionuclide list.)
   - a NAMELIST parameter set
   - air concentration factors, optional

- joint frequency data, optional
- population distribution data (record types 8 and 9), optional
- activity airborne release data, optional
- activity waterborne release data, optional.

The order of the records is determined by control integers as indicated in the input record logic diagram of Figure 3.13. This diagram should be referred to when preparing input records for DITTY. Each record type is discussed in the following sections.

3.5.1 Case Structure Parameters

The first record for each run is a title for the first case as described in Table 3.3.

At the beginning of each run, names of all radionuclides to be considered are read. These names are used to select needed data from library files. The number of names is read followed by the names of the radionuclides. The data record formats are described in Table 3.4. The maximum number of radionuclides allowed is 100. This number includes any unsolicited daughters which will automatically be added to the master list by the program. Addition of daughters is determined by decay chain information in the radionuclide data library (see Section 2.3.1.).

The spelling of the radionuclide name symbols must correspond to the spelling given in the master radionuclide data library, Section 2.3.1.

3.5.2 NAMELIST INPUT Parameters

The data records for the master radionuclide list are read at the beginning of each run. The remaining records are read for each case as determined by input parameters. Control parameters and selected model parameters are read next in a NAMELIST INPUT record set. The first record of this set must begin with INPUT in columns 2-7, and the last record must end with END in any column except column 1. Each parameter is supplied by setting it equal to the desired value. For example, to set the parameter IPATH to 2, enter IPATH = 2 starting after column 8 on the first record. Array values are specified by including the array subscript. For example, to set position 2

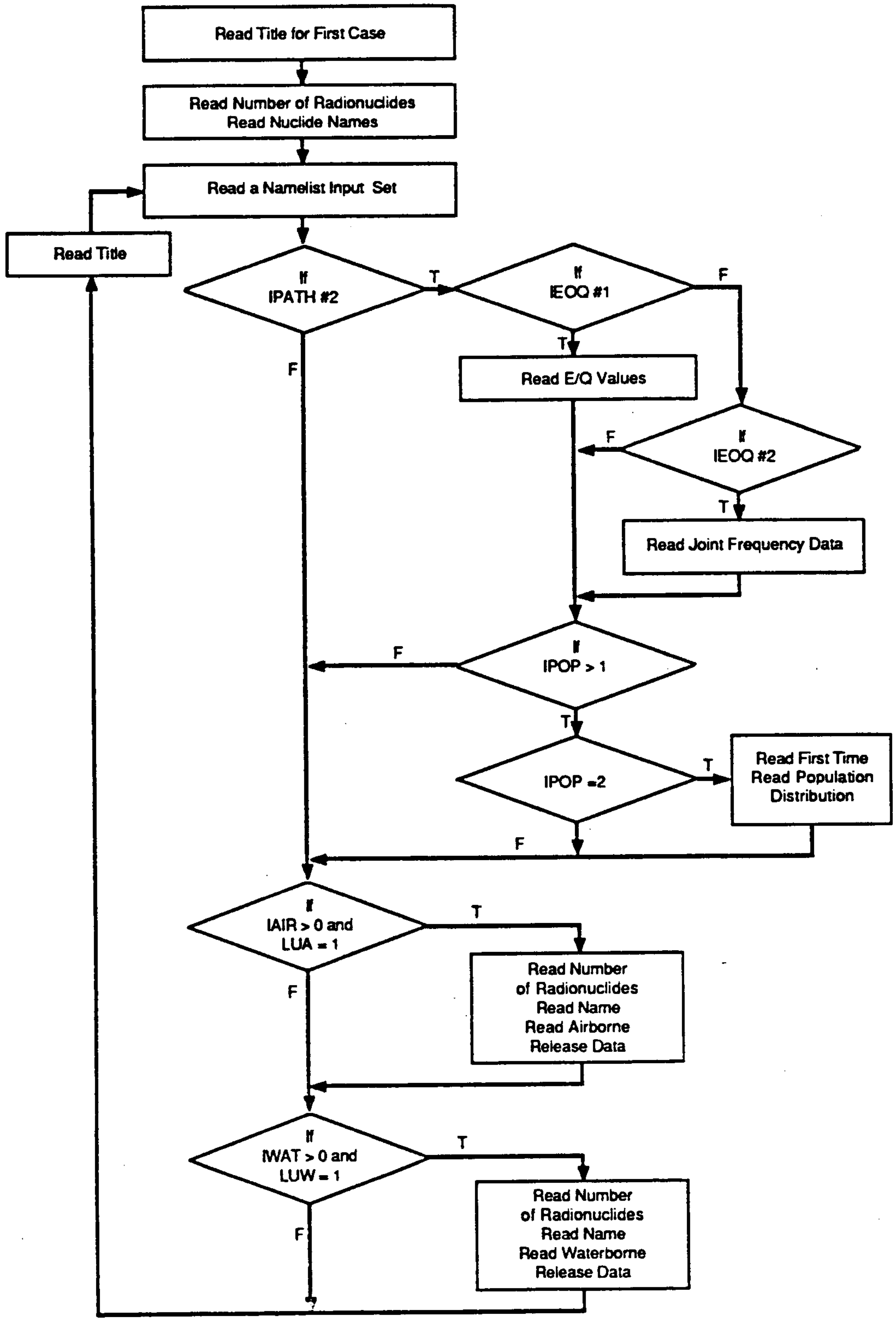


FIGURE 3.13. DITTY Input Logic Diagram

9 1 0 4 8 0 4 9 3

TABLE 3.3. Case Title Format

Variable	Columns	Format	Description
CASTTL(2)	1-80	20A4	Descriptive title for the current run to be printed on output report headings

TABLE 3.4. Master Radionuclide Name Format

Parameter	Columns	Format	Description
NIN	1-5	I5	Number of radionuclide names to be read, $1 \leq NIN \leq 100$ ($1 \leq NIN \leq 25$ for IBM-PC)
E(i)	1-2	A2	Element symbol for a radionuclide.
A(i)	3-8	A6	Atomic weight symbol for the radionuclide

of the array LORG to 6, enter LORG(2) = 6. Each entry must be separated by a comma. The NAMELIST INPUT parameters recognized by "DITTY" are described in Section 3.5.1 by the following categories:

- general control integers
- time references
- site grid description
- atmospheric dispersion
- population description
- waterborne pathways
- terrestrial pathways (for airborne and waterborne releases)
- graphical output selection options.

A. General Control Integers

IAC — To consider an acute release period at the beginning of the first 70-yr period, set IAC > 0. Default is IAC = 0.

IAIR — This parameter is set positive if airborne release activity data are to be read. Default is IAIR = 0.

IPATH — This parameter selects pathways to be considered as follows:

$IPATH \leq 0$; airborne and waterborne
$IPATH = 1$; airborne only
$IPATH \geq 2$; waterborne only

No default value is specified for IPATH.

IREDE This parameter controls printing of detailed reports of dose by radionuclide and by pathway. If IREDE > 0, additional reports are printed.

IWAT This parameter is set positive if waterborne release activity data are to be read. Default is IWAT = 0.

LUA This parameter selects the input logical file unit for reading of airborne release activity data as follows:

LUA = 1; use input file
LUA ≠ 1; use data file buffer AIRREL.IN (see Section 2.2.11)

Default is LUA = 1.

LUW This parameter selects the input logical file unit for reading of waterborne release activity data as follows:

LUW = 1; use input file
LUW ≠ 1; use data file buffer WATREL.IN (see Section 2.2.10)

Default is LUW = 1.

ISALT This parameter determines if fresh or saltwater factors are considered in bioaccumulation factors as follows:

ISALT = 0; freshwater
ISALT = 1; saltwater

Default is ISALT = 0

B. Time Reference Parameters

TZ The beginning of the ten-thousand-year dose period is given by this parameter in years A.D. Default is TZ = 2000.

TZR The beginning of the release history data is given by this parameter in years A.D. TZR is used for both airborne and waterborne release data. Default is TZR = 2000. For acute exposure case, TZR must be equal to TZ.

C. Site Grid Description Parameters

DIST(10) These values represent the distance from the release point to the midpoint of each distance interval, meters. Default values are not specified for DIST.

NDIST This integer gives the number of distance intervals to be considered, $1 \leq$ NDIST ≤ 10. Default is NDIST = Ø.

NSECT This integer gives the number of sectors to be considered in the calculation of population dispersion factors (PM) and in the atmospheric dispersion calculation. $1 \leq$ NSECT ≤ 16. Default is NSECT = 16.

D. Atmospheric Dispersion Parameters

IEOQ This integer is used to control reading and calculation of atmospheric dispersion data as follows:

IEOQ ≤ 0; use previous data

IEOQ = 1; read normalized air concentrations from data file buffer CHIQ.IN (see Section 2.2.3)

IEOQ = 2; read joint frequency data from data file buffer JOINTFRE.IN (see Section 2.2.2) and calculate normalized air concentration

IEOQ = 3; use previous data to calculate normalized air concentration

IEOQ 3; use previous data.

Default is IEOQ = 0.

HS This parameter gives the effective release height for airborne release. HS is used when normalized air concentrations are to be calculated (IEOQ = 2 or 3). Default is HS = 0.

E. Population Description Parameters

Population Parameters for Chronic Airborne Releases

Population dispersion factors are required for each 70-yr increment of the 10,000 year integration period (143 increments). Six options are provided for generation of the population dispersion factors for chronic airborne releases.

Method One. The first method allows the user to supply all values through input (IPOP = 1).

Method Two. The second method (IPOP = 2) uses an initial population distribution to generate the population dispersion factor for the first time increment. Then the increase in total population is supplied as a function of time and the program increases the population dispersion factor in proportion to the population increase.

The user supplies the initial distribution in the file buffer POP.IN (see Section 2.2.4).

Method Three. The third method (IPOP = 3) uses population distributions at specified times read from file buffer POP.IN (see Section 2.2.4). Population dispersion values are calculated for each specified time. These values are interpolated to determine the population dispersion values for each 70-yr increment.

Method Four. The fourth method (IPOP = 4) allows specification of population dispersion values at specified times. This data is interpolated to determine values for each 70-yr increment.

Method Five. The fifth method (IPOP = 5) uses the previous population distribution data but new $\bar{\chi}/Q'$data to generate the first time value for PM (air) or PL (water).

The second, third, and fifth methods use atmospheric dispersion data ($\bar{\chi}/Q'$ values) as calculated in subroutine EOVRQ or supplied on input.

Method Six. The sixth method (IPOP = 6) indicates that there is no chronic release. Use of this method ensures that population is specified properly for a case with an acute release only.

IPOP This control integer selects the method for determining population dispersion factors for airborne releases as follows:

IPOP $\leq$ 0; use previous value. No additional population input required.

IPOP = 1; supply all 144 values for array PM in NAMELIST INPUT.

IPOP = 2; read population data for the first time, T(1), and calculate PM. Then generate PM for other times from population (PM1) and time (T) data by ratio with initial total population. Supply NAMELIST INPUT parameters NTA, T, and PM1.

IPOP = 3; read population data for each time from file buffer POP.IN and calculate PM for each time.

IPOP = 4; supply population dispersion factors in array PM1 at times T, and interpolate this data to generate PM values for each 70-yr increment. Supply values for NAMELIST INPUT parameters NTA, T, and PM1.

IPOP = 5; use previous population distribution data but recalculate the first time value for PM using new $\bar{\chi}/Q'$data. This method is similar to method 2 except no population data is read. No additional population input required.

IPOP = 6; There will be no chronic release during this case (IPA must be used).

IPOP > 6; not allowed.

Default is IPOP = 4.

NTA — This integer gives the number of times for which airborne population history data are supplied in arrays PM1 and T. $1 \leq NTA \leq 20$. Default is 1.

PM(144) — Population dispersion factor, person-sec/m^3 for airborne releases for each 70-yr period. This is an effective population-weighted $\bar{\chi}/Q'$.

PM1(20) — This array gives population dispersion factor data for airborne releases corresponding to times in array T. This data is used when IPATH $\leq$ 1 and IPA > 1 or when IPOP = 2, 4, or 5. When IPOP = 2, the data represents total population at each time. When IPOP = 4, the data represents population dispersion factors. When IPOP = 5, previous data are used (the form is not important). When IPA > 1, the data represents population dispersion factors unless IPOP = 2, in which case total population values are given. Default values are not specified for PM1.

POPT(2) — This array gives total population for airborne releases at each time given in array T. POPT is used for IPATH $\leq$ 1 and IPOP = 2 or 5. Default is all POPT values set to zero.

T(20) — This array gives times at which population data is supplied for airborne releases. Times are in years A.D. T is used when IPATH $\leq$ 1 and IPOP = 2, 4, or 5 or IPA > 1.

<u>Population Parameters for Acute Airborne Releases</u>

IPA — This control integer indicates the method (see text for discussion of methods) for specifying the population dispersion factor for the acute release period for airborne releases.

IPA $\leq$ 0; use previous values
IPA = 1; use the value given for PMA
IPA = 2; calculate the value for time TZ from calculated time history data; population data for chronic airborne release must be entered if this option is selected.

Default is IPA = 1.

PMA — This parameter is the population dispersion factor for the acute airborne release period used when IAC > 0 and IPA = 1. Default value is PMA = 0.

Population Parameters for Chronic Waterborne Releases

IPOPL — This control integer selects the method for determining populations for waterborne release as follows:

IPOPL $\leq$ 0; use previous PL values. No additional population input required.

IPOPL = 1; supply all 144 values for array PL in NAMELIST INPUT.

IPOPL = 2; supply total population value data in arrays PL1 and TL and generate PL values by interpolation. Provide values for NAMELIST INPUT parameters NTL, TL, and PL1.

IPOPL > 2; not allowed.

Default is IPOPL = 2.

NTL — This integer gives the number of times for which waterborne population history data are supplied in arrays PL1 and TL. $1 \leq$ NTL ≤ 20. Default is 1.

PL(144) — This array gives total population for waterborne pathways for the acute period, PL(1) and each 70-yr period (143). Default is all values set to zero.

PL1(20) — This array gives total population for waterborne pathways corresponding to times in array TL. This data is used when IPL > 1 or when IPOPL = 2. Default is all PL1 values set to zero.

TL(20) — This array gives time at which population data is supplied for waterborne releases. Times are in years A.D. TL is used when IPATH $\neq$ 1 and either IPL > 1 or IPOPL = 2. Default values for TL are zero.

Population Parameters for Acute Waterborne Releases

IPL — This control integer indicates the method for specifying population data for the acute release period for waterborne releases.

IPL $\leq$ 0; use previous values. No additional population required.
IPL = 1; use the value given for PPL
IPL > 1; calculate the value for time TZ from given population time history data. Population data for chronic waterborne release must be entered if this option is set > 1.

PPL — This parameter is the total population for the acute waterborne release period used when IAC > 0 and IPL = 1. Default value is PPL = 0.

F. Waterborne Pathway Parameters

CFLO This parameter is used in calculating the dilution of liquid releases. It is the flow rate, in cubic feet per second (cfs), of the water into which the radionuclides are released. A default value is not specified for CFLO.

RECON This parameter is also used in calculating liquid dilution. It is used in particular cases where the inlet to a contamination facility is downstream of the outlet where reconcentration may occur. Default is 1.0.

RM This parameter is used in calculating liquid dilution where the receptor is near the release point. It relates the amount of the river flow actually mixed with the released radionuclides. $0 \leq RM \leq 1$. Default is 1.0.

USAGE(7) This array contains input values of the consumption or exposure rates for the waterborne pathway parameters for individuals:

1. fish consumption, kg/yr
2. crustacea consumption, kg/yr
3. mollusk consumption, kg/yr
4. water plant consumption, kg/yr
5. drinking water consumption, L/yr
6. exposure to contaminated sediments, h/yr
7. swimming in contaminated water, h/yr.

G. Terrestrial Pathway Parameters

CONSUM(7) This array contains values of consumption rates, kg/h, for the terrestrial pathways for individuals:

1. leafy vegetables
2. other vegetables
3. eggs
4. milk
5. beef
6. unused
7. poultry.

EXTIM This parameter relates the average time, h/yr, that an individual spends exposed to surface soils contaminated by either atmospheric or irrigation deposition.

GWRP(7) This growing period (time of foliage above ground) for the 7 crops enumerated under the variable CONSUM. For the animal products, GRWP is the time above ground for feed or forage.

MOPYR This value is the months per year that irrigation is used on crops.

RIRR This parameter is the irrigation rate of the crops under CONSUM. The units in DITTY are L/m^2/month. For the animal products, this is the irrigation rate of the animal forage crops.

YELD(7) This array contains the crop or forage yield, kg/m^2, for the 7 pathways under CONSUM.

H. <u>Graphical Output Control Parameters</u>

Some QA input data and results from DITTY1 calculations are presented as graphical functions of the data versus time. Various parameters may be plotted as described below.

IGRPM This parameter allows plotting of the population weighted $\bar{\chi}/Q'$ (PM) versus time if initialized. Default is IGRPM = 0.

IGRPL This parameter allows plotting of the total population affected by aquatic pathways if nonzero. Default is IGRPL = 0.

IGRTNU This parameter allows plotting of the total radionuclide release rate, in curies per 70-yr period versus time, if nonzero. Default is IGRTNU = 0.

IGRNUC This parameter allows plotting of the release rates of individual radionuclides, curies per 70-yr period, versus time if nonzero. If IGRNUC is equal to zero, a numeric report of release activity is printed for each radionuclide. Default is IGRNUC = 0.

IGRDOS This parameter allows plotting of the dose to each organ versus time in the output if nonzero. Default: IGRDOS = Ø.

3.5.3 Other Input Parameters

The NAMELIST parameter IEOQ controls input of atmospheric dispersion data. When IEOQ = 1, normalized air concentration data (E/Q) are read from file buffer CHIQ.IN (see Section 2.2.3).

When IEOQ = 2, the normalized air concentration values are to be calculated from annual average meteorological data of joint frequency of occurrence of wind speed, atmospheric stability, and wind direction. This data is read from file buffer JOINTFRE.IN (see Section 2.2.2).

When the population control integer IPOP is equal to 2, one set of population distribution data is read from file buffer POP.IN (see Section 2.2.4).

Airborne release data may be included in the input stream (IAIR > and ILUA = 1). One set of records is read for each radionuclide. Reading is terminated by placing a zero value for parameter NT of the last record of the set. These records are described in Table 3.5.

When waterborne releases are to be included in the input stream (IWAT > 0 and LUW = 1), the data are read as for the airborne release set using the format of Table 3.5.

TABLE 3.5. Radionclide Release Data Format

Parameter	Columns	Format	Description
NNAT	1-5	I5	Number of radionuclides for which activity release data are supplied
E	1-2	A2	Element symbol for the current radionuclide
A	3-8	A6	Atomic weight symbol for the current radionuclide
	9-10	2X	Blank
NT	11-15	I5	Number of times for which release rates will be supplied, NT $\leq$ 300. When NT $\leq$ 0, reading of activity release data is terminated. NT determines the number of data records to be read.
TA(i)	1-10	E10.2	Time at which the current release rate is defined. Years since start of release and based on parameter TZR.
C(i)	11-20	E10.2	Release rate, Ci/yr, for the current radionuclide at time TA(i).

Calculations are performed after input of necessary data. If additional cases are to be considered, the same data formats are used based on new values given for the control parameters in the new NAMELIST set. Each succeeding case starts with input of a title record and a NAMELIST INPUT set.

4.0 SYSTEM REQUIREMENTS

The GENII Software Package will run on an IBM-PC AT or equivalent computer configured with an 80287 math co-processor, 640 kilobytes random-access memory, a minimum of 5 megabytes on-line disk storage, and operating under IBM DOS 3.1 or newer version.

Portions of the GENII Software Package have been tested on a number of IMB-PC/AT compatible machines. Versions of GENII have been established on microcomputers manufactured by GRID, NEC, Hewlett-Packard, and IBM. The IBM machines have included the new PS/2 System 50 and System 80. No machine-based incompatabilities have been found.

The GENII Software System is distributed on either 5.25-inch, 1.2 megabyte disks, or on 3.5-inch, 720 kilobyte disks. An automatic install procedure has been included with the software. To install the GENII Software Package, do the following:

1. Insert the GENII Distribution Disk # 1 in the A: floppy disk drive.
2. Type **A:** and press **Enter**.
3. Type: **INSTALL n:**, where **n** designates the hard disk you wish GENII to be installed on, and press **Enter**.
4. Respond as requested by the install procedure.

The installation procedure will create a subdirectory named GENII on the designated drive and then copy files into that subdirectory.

For the GENII Software Package to function properly, the following commands must be in the **CONFIG.SYS** file in the root directory of the disk drive which is used to boot the system:

```
FILES=20
BUFFERS=24
DEVICE=ANSI.SYS
```

Refer to the IBM DOS reference manual (IBM 1985) for details on installing these commands.

5.0 QUALITY ASSURANCE RELATED TOPICS

The GENII software package was developed in a framework for complying with the requirements of ANSI/ASME NQA-1-1983, Quality Assurance Program Requirements for Nuclear Power Plants, Supplement 3S-1, Supplementary Requirements for Design Control. NQA-1 specifies that for hardware design control, the following shall be addressed:

- design input
- design process, including design analysis
- design verification
- change control
- interface control
- documentation and records.

The QA procedures used during the development of the GENII software package are an interpretation of these hardware requirements for software.

Design input is specified through research project planning documents. This requirement was met through the preparation of the System Design Requirements presented as the Appendix to Volume 1 (Napier et al. 1988a).

The design process consisted of developing and internally testing software, developing test cases, and documenting software in accordance with the design input. The GENII package has been extensively tested and verified by hand, using the hand calculation worksheets of Volume 3 (Napier et al. 1988b), and benchmarked against similar Hanford environmental dosimetry programs. A 10-volume set of test documentation is available for review from the authors upon request. The design process concluded with analysis of the final design by means of a Final Internal Development Review (FIDR). Two external peer reviews were held, as described in Section 1.2 of Volume 1; these constitute the FIDR for the GENII package.

Following the FIDR, the GENII code was placed under configuration management. Through this management, all changes and versions have been controlled and documented. Change control has been instituted; only authorized and approved changes can be made to the working versions. A list of users is maintained, and revisions are distributed to this list when necessary.

Additional volumes of change documentation records are available. This three-volume set contains all necessary documentation of the code, models, and implementation methods for GENII Version 1.359. Further revisions will be documented, and revised documentation will be issued if necessary.

In addition to the development requirements, NQA-1 addresses applications of software. The controlled versions of the code may be obtained from the authors, with sufficient documentation to assure correctness of the proposed application. Users must maintain applications records logs for all applications of the code outside of the Hanford Environmental Dosimetry Upgrade Project.

The GENII Software Package is made up of six programs written in FORTRAN and one written in compiled BASIC. The FORTRAN programs are compiled using the Lahey F77L compiler (Lahey Computer Systems 1986). The BASIC program is distributed in a version compiled with the Microsoft QuickBASIC 3.0 compiler (Microsoft 1987). The BASIC program uses modules and subroutines from the Komputerwerk FINALLY! and FINALLY! Modules libraries (Komputerwerk 1986a, 1986b). The GENII System codes have been developed and tested using these products, and unanticipated problems may occur if other compilers are used.

6.0 REFERENCES

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APPENDIX A

SAMPLE PROBLEM INPUT AND OUTPUT

APPENDIX A

SAMPLE PROBLEM INPUT AND OUTPUT

Example input files and the resultant code outputs are listed in this appendix. Seven sample problems are presented with all required external data files. These seven examples provide a glimpse of the range of capabilities of the GENII package. They are, however, by no means exhaustive, and within the limitations of the printed page they can only be used as indicators of the types of calculations that may be performed using the GENII system. Each sample problem is briefly described, and the salient parts of the output are noted. These sample outputs may be used by persons installing the GENII package to compare it to calculated results to assure that the codes are functioning properly on particular hardware configurations.

A.1 GENII SAMPLE PROBLEM 1

The first sample problem represents a chronic release of a spectrum of radionuclides to the atmosphere through a stack with an effective height of 89 meters. The release is assumed to last for a period of one year, exposures of the public surrounding the release point are assessed for the 1-year release, and a 50-year dose commitment is calculated. Because this is a population dose calculation, an external data file providing the population distribution is needed. The air submersion dose is to be calculated using the finite-plume model. Therefore, an external data file of the joint frequency of occurrence of wind speed, wind direction, and stability class is also required. People are exposed via air submersion, inhalation, direct exposure to deposited materials on the ground, and ingestion of food crops and animal products.

The GENII input file created by APPRENTICE for this scenario is presented as Exhibit A.1. The required population data file, to be copied into the POP.IN file buffer, is presented in Exhibit A.2. The required joint frequency data file, to be copied into the JOINTFRE.IN file buffer, is presented as Exhibit A.3. These are typical working data files similar to those used for dose calculations for Hanford annual environmental reports.

EXHIBIT A.1. GENII Input File - Sample Problem 1

```
######################## Program GENII Input File ############ 8 Mar 88 ####
Title: GENII Sample Problem 1
     \genii\sam\sample1.in                          Created on 08-05-1988 at 15:10
OPTIONS======================= Default =====================================
F    Near-field scenario?      (Far-field)    NEAR-FIELD: narrowly-focused
T    Population dose?         (Individual)                release, single site
F    Acute release?             (Chronic)     FAR-FIELD:  wide-scale release,
     Average Individual data set used                     multiple sites
                                  Complete                               Complete
TRANSPORT OPTIONS=========== Section    EXPOSURE PATHWAY OPTIONS===== Section
T  Air Transport                  1     T  Finite plume, external       5
F  Surface Water Transport        2     F  Infinite plume, external     5
F  Biotic Transport (near-field)  3     T  Ground, external             5
F  Waste Form Degradation (near)  4     F  Recreation, external         5
                                        T  Inhalation uptake            6
REPORT OPTIONS======================    F  Drinking water ingestion     7,8
T  Report AEDE only                     F  Aquatic foods ingestion      7,8
F  Report by radionuclide               T  Terrestrial foods ingestion  7,9
F  Report by exposure pathway           T  Animal product ingestion     7,10
F  Debug report on screen               F  Inadvertent soil ingestion

INVENTORY ##################################################################

 4   Inventory input activity units: (1-pCi  2-uCi  3-mCi  4-Ci  5-Bq)
 0   Surface soil source units (1- m2  2- m3  3- kg)
     Equilibrium question goes here

     --------|----Release Terms------|----------Basic Concentrations---------|
     Use when| transport selected    | near-field scenario, optionally       |
     --------|-----------------------|---------------------------------------|
     Release |        Surface Buried |        Surface Deep    Ground  Surface|
     Radio-  |Air     Water   Waste  |Air     Soil    Soil    Water   Water  |
     nuclide |/yr     /yr     /m3    |/L      /unit   /m3     /L      /L     |
     --------|------- ------- -------|------- ------- ------- ------- -------|
     H 3      7.0E+01
     C 14     1.0E+00
     KR85     7.0E+04
     SR90     2.0E-04
     NB95     1.0E-05
     RU103    2.0E-04
     RU106    2.0E-02
     SB125    1.0E-03
     I 129    5.0E-01
     I 131    2.0E-04
     CS134    1.0E-05
     CS137    4.0E-05
     PM147    1.0E-03
     PB212    2.0E-01
     BI212    1.0E-01
     U 234    2.0E-06
```

EXHIBIT A.1. (contd)

```
U 235     7.0E-08
U 238     2.0E-06
PU238     3.0E-05
PU241     3.0E-03
AM241     1.0E-04
PU239     4.0E-04

--------|----Derived Concentrations-----|
Use when|  measured values are known    |
--------|-------------------------------|
Release |Terres. Animal  Drink   Aquatic|
Radio-  |Plant   Product Water   Food   |
nuclide |/kg     /kg     /L      /kg    |
--------|------- ------- ------- -------|


TIME ########################################################################

1    Intake ends after (yr)
50   Dose calc. ends after (yr)
1    Release ends after (yr)
0    No. of years of air deposition prior to the intake period
0    No. of years of irrigation water deposition prior to the intake period

FAR-FIELD SCENARIOS (IF POPULATION DOSE) ####################################

 1          Definition option: 1-Use population grid in file POP.IN
0                              2-Use total entered on this line

NEAR-FIELD SCENARIOS ########################################################

            Prior to the beginning of the intake period: (yr)
0             When was the inventory disposed?  (Package degradation starts)
0             When was LOIC?  (Biotic transport starts)
0           Fraction of roots in upper soil (top 15 cm)
0           Fraction of roots in deep soil
0           Manual redistribution: deep soil/surface soil dilution factor

TRANSPORT ###################################################################
            ====AIR TRANSPORT====================================SECTION 1=====
                    0-Calculate PM            |
0           Option: 1-Use chi/Q or PM value   |T           Stack release (T/F)
                    2-Select MI dist & dir    |89.0        Stack height (m)
                    3-Specific MI dist & dir  |0           Stack flow (m3/sec
0           Chi/Q or PM value                 |0           Stack radius (m)
16          MI sector index (1=S)             |0           Effluent temp. (C)
5.3E+4      MI distance from release point (m)
T           Use joint frequency data, otherwise chi/Q grid
```

EXHIBIT A.1. (contd)

```
          ====SURFACE WATER TRANSPORT==========================SECTION 2=====
0         Mixing ratio model: 0-use value, 1-river, 2-lake, 3-river flow
0         Mixing ratio, dimensionless
0         Average river flow rate for: MIXFLG=0,3 (m3/s), MIXFLG=1,2 (m/s),
0         Transit time to irrigation withdrawal location (hr)
          If mixing ratio model > 0:
0           Rate of effluent discharge to receiving water body (m3/s)
0           Longshore distance from release point to usage location (m)
0           Offshore distance to the water intake (m)
0           Average water depth in surface water body (m)
0           Average river width (m), MIXFLG=1 only
0           Depth of effluent discharge point to surface water (m), lake only

          ====WASTE FORM AVAILABILITY==========================SECTION 3=====
0         Waste form/package half life, (yr)
0         Waste thickness, (m)
0         Depth of soil overburden, m

          ====BIOTIC TRANSPORT OF BURIED SOURCE================SECTION 4=====
T         Consider during inventory decay/build-up period (T/F)?
T         Consider during intake period (T/F)?   | 1-Arid non agricultural
0         Pre-Intake site condition..............| 2-Humid non agricultural
                                                 | 3-Agricultural

EXPOSURE ######################################################################

          ====EXTERNAL EXPOSURE================================SECTION 5=====
          Exposure time:                 |   Residential irrigation:
8766.0      Plume (hr)                   | T       Consider: (T/F)
2920.0      Soil contamination (hr)      | 0       Source: 1-ground water
0           Swimming (hr)                |                 2-surface water
0           Boating (hr)                 | 0       Application rate (in/yr)
0           Shoreline activities (hr)    | 0       Duration (mo/yr)
0         Shoreline type: (1-river, 2-lake, 3-ocean, 4-tidal basin)
0         Transit time for release to reach aquatic recreation (hr)
0         Average fraction of time submersed in acute cloud (hr/person-hr)

          ====INHALATION=======================================SECTION 6=====
8766.0    Hours of exposure to contamination per year
0         0-No resus-  1-Use Mass Loading          2-Use Anspaugh model
0           pension      Mass loading factor (g/m3)   Top soil available (cm)

          ====INGESTION POPULATION=============================SECTION 7=====
 1        Atmospheric production definition (select option):
0           0-Use food-weighted chi/Q, (food-sec/m3), enter value on this line
            1-Use population-weighted chi/Q
            2-Use uniform production
            3-Use chi/Q and production grids (PRODUCTION will be overridden)
```

EXHIBIT A.1. (contd)

0	Population ingesting aquatic foods, 0 defaults to total (person)
0	Population ingesting drinking water, 0 defaults to total (person)
F	Consider dose from food exported out of region (default=F)

Note below: S* or Source: 0-none, 1-ground water, 2-surface water
3-Derived concentration entered above

==== AQUATIC FOODS / DRINKING WATER INGESTION=========SECTION 8====

F	Salt water? (default is fresh)

USE ? T/F	FOOD TYPE	TRAN-SIT hr	PROD-UCTION kg/yr	-CONSUMPTION- HOLDUP da	RATE kg/yr	DRINKING WATER	
F	FISH	0.00	0.0E+00	0.00	0.0	0	Source (see above)
F	MOLLUS	0.00	0.0E+00	0.00	0.0	T	Treatment? T/F
F	CRUSTA	0.00	0.0E+00	0.00	0.0	0	Holdup/transit(da)
F	PLANTS	0.00	0.0E+00	0.00	0.0	0	Consumption (L/yr)

====TERRESTRIAL FOOD INGESTION======================SECTION 9=====

USE ? T/F	FOOD TYPE	GROW TIME da	--IRRIGATION-- S *	RATE in/yr	TIME mo/yr	YIELD kg/m2	PROD-UCTION kg/yr	--CONSUMPTION-- HOLDUP da	RATE kg/yr
T	LEAF V	90.00	0	0.0	0.0	1.5	0.0E+00	14.0	15.0
T	ROOT V	90.00	0	0.0	0.0	4.0	0.0E+00	14.0	140.0
T	FRUIT	90.00	0	0.0	0.0	2.0	0.0E+00	14.0	64.0
T	GRAIN	90.00	0	0.0	0.0	0.8	0.0E+00	180.0	72.0

====ANIMAL PRODUCTION CONSUMPTION===================SECTION 10====

USE ? T/F	FOOD TYPE	---HUMAN---- CONSUMPTION RATE kg/yr	HOLDUP da	TOTAL PROD-UCTION kg/yr	DRINK WATER CONTAM FRACT.	-------------STORED FEED------------- DIET FRAC-TION	GROW TIME da	-IRRIGATION-- S *	RATE in/yr	TIME mo/yr	YIELD kg/m3	STOR-AGE da
T	BEEF	70.0	34.0	0.00	0.00	0.25	90.0	0	0.0	0.00	0.80	180.0
T	POULTR	8.5	34.0	0.00	0.00	1.00	90.0	0	0.0	0.00	0.80	180.0
T	MILK	230.0	4.0	0.00	0.00	0.25	45.0	0	0.0	0.00	2.00	100.0
T	EGG	20.0	18.0	0.00	0.00	1.00	90.0	0	0.0	0.00	0.80	180.0
						-------------FRESH FORAGE-----------						
	BEEF					0.75	45.0	0	0.0	0.00	2.00	100.0
	MILK					0.75	30.0	0	0.0	0.00	1.50	0.0

###

EXHIBIT A.2. Required GENII Population Data File - Sample Problem 1

```
200 Area Population (Sommer, Rau, and Robinson, PNL-4010)
Created 5-Nov-87, updated 19-Feb-88 RAP
    0     0     0     0     0     0   1532   1489    195   1799
    0     0     0     0     0     0    905   5283    652    129
    0     0     0     0     0     0   1190  19786   2182    459
    0     0     0     0     0     5   1840   5063  15088   4573
    0     0     0     0     0    32    648    949   6874  78635
    0     0     0     0     0    73    444    802    833   2833
    0     0     0     0     0     0    555    398    493   1454
    0     0     0     0     0     0    246    456    864   4521
    0     0     0     0     0     0    174   1124    772   1957
    0     0     0     0     0     0     92    656   5547  14822
    0     0     0     0     0     0    262   5930   2963    596
    0     0     0     0     0     0    235    773   2366    435
    0     0     0     0     0     0    340   1329   1659    588
    0     0     0     0     0     0    283   1374    230    652
    0     0     0     0     0     0   6757  48661  50519   3474
    0     0     0     0     0     0   1997  13161   2717   5218
```

EXHIBIT A.3. Required GENII Joint Frequency Data File - Sample Problem 1

```
200 AREA - 89 M - Pasquill A - F (1983 - 1987 Average)
Created 10-Mar-88 RAP
   8    6    1    1    89.0
  .89   2.65  4.7   7.15   9.8   12.7  15.6   19.0
 0.30 0.27 0.29 0.19 0.23 0.20 0.13 0.12 0.11 0.08 0.06 0.07 0.10 0.08 0.14 0.13
 0.17 0.10 0.09 0.09 0.10 0.05 0.05 0.03 0.05 0.03 0.03 0.02 0.04 0.04 0.04 0.07
 0.16 0.12 0.10 0.06 0.08 0.06 0.07 0.03 0.02 0.01 0.01 0.03 0.04 0.03 0.06 0.09
 0.77 0.51 0.41 0.35 0.49 0.49 0.44 0.32 0.36 0.19 0.20 0.28 0.43 0.47 0.59 0.58
 0.29 0.14 0.12 0.12 0.21 0.21 0.31 0.25 0.31 0.19 0.22 0.25 0.46 0.39 0.39 0.25
 0.24 0.15 0.11 0.12 0.20 0.18 0.25 0.23 0.27 0.20 0.25 0.31 0.54 0.45 0.45 0.31
 0.94 0.48 0.37 0.40 0.58 0.48 0.41 0.35 0.35 0.22 0.31 0.24 0.29 0.29 0.59 0.77
 0.27 0.15 0.12 0.11 0.13 0.13 0.07 0.08 0.09 0.05 0.08 0.04 0.08 0.15 0.24 0.23
 0.22 0.09 0.07 0.07 0.11 0.07 0.10 0.05 0.07 0.04 0.05 0.03 0.04 0.09 0.19 0.22
 0.65 0.41 0.26 0.27 0.39 0.35 0.34 0.23 0.28 0.22 0.25 0.29 0.55 0.85 1.11 0.75
 0.26 0.09 0.08 0.09 0.23 0.28 0.22 0.25 0.32 0.20 0.28 0.47 0.76 0.82 0.61 0.37
 0.22 0.08 0.08 0.07 0.12 0.20 0.24 0.22 0.35 0.34 0.40 0.67 1.14 0.88 0.70 0.37
 0.43 0.24 0.16 0.11 0.12 0.10 0.11 0.10 0.15 0.20 0.35 0.38 0.29 0.32 0.63 0.39
 0.08 0.06 0.04 0.03 0.04 0.02 0.04 0.04 0.02 0.06 0.06 0.08 0.07 0.11 0.17 0.09
 0.04 0.03 0.01 0.02 0.01 0.00 0.02 0.01 0.02 0.03 0.04 0.07 0.08 0.06 0.15 0.09
 0.23 0.12 0.05 0.06 0.09 0.12 0.17 0.14 0.18 0.15 0.25 0.32 0.62 1.09 1.06 0.37
 0.15 0.06 0.05 0.05 0.07 0.10 0.13 0.16 0.22 0.16 0.29 0.59 1.27 1.26 0.74 0.30
 0.09 0.05 0.04 0.03 0.07 0.07 0.21 0.18 0.28 0.27 0.38 0.83 1.31 1.21 0.86 0.31
 0.08 0.11 0.05 0.02 0.01 0.00 0.02 0.03 0.04 0.10 0.30 0.38 0.24 0.26 0.43 0.10
 0.03 0.02 0.01 0.00 0.00 0.00 0.01 0.01 0.02 0.04 0.04 0.10 0.05 0.07 0.10 0.03
```

EXHIBIT A.3. (contd)

0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.03	0.03	0.06	0.06	0.05	0.10	0.01
0.11	0.11	0.04	0.02	0.02	0.03	0.08	0.09	0.10	0.17	0.25	0.37	0.62	0.97	0.77	0.16
0.09	0.04	0.02	0.01	0.01	0.05	0.07	0.08	0.11	0.13	0.25	0.41	1.17	1.24	0.73	0.16
0.04	0.01	0.02	0.01	0.03	0.05	0.10	0.16	0.12	0.10	0.20	0.51	0.88	0.92	0.61	0.12
0.01	0.02	0.02	0.02	0.00	0.00	0.00	0.01	0.01	0.03	0.09	0.17	0.10	0.11	0.30	0.04
0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.04	0.04	0.02	0.03	0.06	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.02	0.02	0.03	0.05	0.01
0.02	0.03	0.01	0.01	0.00	0.00	0.02	0.03	0.08	0.14	0.20	0.20	0.36	0.74	0.47	0.03
0.02	0.02	0.01	0.00	0.00	0.00	0.04	0.04	0.06	0.07	0.14	0.18	0.40	0.79	0.50	0.06
0.01	0.00	0.01	0.00	0.00	0.01	0.05	0.05	0.02	0.02	0.04	0.12	0.20	0.31	0.16	0.04
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.08	0.10	0.04	0.05	0.14	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.01	0.01	0.02	0.03	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.02	0.03	0.00
0.02	0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.05	0.11	0.14	0.12	0.19	0.47	0.47	0.02
0.03	0.02	0.01	0.01	0.00	0.00	0.00	0.01	0.05	0.05	0.09	0.12	0.18	0.37	0.31	0.03
0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.01	0.00	0.01	0.03	0.04	0.04	0.09	0.05	0.01
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.01	0.00	0.03	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.01	0.01	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.04	0.07	0.05	0.04	0.21	0.20	0.01
0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.04	0.03	0.05	0.10	0.10	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.02	0.01	0.01	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.04	0.07	0.03	0.05	0.08	0.04	0.01
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.03	0.04	0.02	0.00	0.05	0.06	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00

They provide the user with examples of the types and magnitude of data that might be required.

The output of the GENII simulation based on the above input is presented as Exhibit A.4. This is a fairly typical GENII output; it consists of three separate portions, which can be identified by the page number in the upper right hand portion of the printed output. The portion identified by page numbers A.n is the Quality Assurance output portion. The input values and scenario description flags are repeated in the output to allow checking of the calculation assumptions. The portion identified by page numbers B.n includes the results of the (optional) atmospheric dispersion calculations. In the case of Sample Problem 1, this is a one-page report providing the calculated population-weighted atmospheric dispersion factor.

The portion identified with page numbers C.n includes the actual dose calculation results. For Sample Problem 1, this consists of three summary pages. The first, page C.1, illustrates the effective dose equivalent summary calculation, from which individual organ doses may be obtained. This page also provides a summary table of the dominant organ, dominant radionuclide, and dominant exposure pathway. The second page, C.2, illustrates the dose assembly matrix (defined in Figure 3.6 of Volume 1 in this GENII series) from which the annual dose, effective dose equivalent, cumulative dose, and maximum annual dose may be obtained in a single calculational run. In this example, because the exposure time was only one year, the contributions shown in this dose matrix for years two and three are set to zero. The third page, C.3, provides the dose contribution by radionuclide, as a function of ingestion, inhalation, and external exposure.

A.2 GENII SAMPLE PROBLEM 2

The second sample problem represents the calculation of the dose to a maximally exposed individual from the chronic release of radionuclides into surface water. The individual is assumed to drink river water, to consume fish from the river, to make recreational use of the river, and to irrigate crops and animal feed with the water. External doses result from exposure to the water, to sediments, and to irrigated soil. No contribution to dose is considered from inhalation, that pathway is specifically turned off.

EXHIBIT A.4. GENII Output File Sample Problem 1

GENII Dose Calculation Program
(Version 1.351 30-Aug-88)

Case title: GENII Sample Problem 1

Executed on: 09/27/88 at 16:59:06

This is a far-field (wide-scale release, multiple site) scenario.
Release is chronic
Dose to exposed population of 3.409E+05

THE FOLLOWING TRANSPORT MODES ARE CONSIDERED
Air

THE FOLLOWING EXPOSURE PATHS ARE CONSIDERED:
Finite plume, external
Ground, external
Inhalation uptake
Terrestrial foods ingestion
Animal product ingestion

THE FOLLOWING TIMES ARE USED:

Intake ends after (yr):	1.0
Dose calculations ends after (yr):	50.0
Release ends after (yr):	1.0

========== FILE NAMES AND TITLES OF FILES/LIBRARIES USED ==========

\genii\sam\sample1.in	9-27-88
GENII Default Parameter Values (3-Aug-88 RAP)	8-12-88
RMDLIB - Radionuclide Master Library (29-Aug-88 RAP)	8-29-88
Food Transfer Factor Library - (RAP 29-Aug-88) (UPDATED LEACHING FA	8-29-88
External Dose Factors for GENII in person-Sv/yr per Bq/n (28-Aug-88	8-29-88
Internal Yearly Dose Increments (Sv/Bq) 29-Aug-88 RAP	8-29-88
200 Area Population (Sommer, Rau, and Robinson, 1981, PNL-4010)	

200 AREA - 89 M - Pasquill A - F (1983 - 1987 Average)

==========

	----Release Terms------		
Release Radio- nuclide	Air Ci/yr	Surface Water Ci/yr	Buried Source Ci/m3
H 3	7.0E+01	0.0E+00	0.0E+00
C 14	1.0E+00	0.0E+00	0.0E+00

EXHIBIT A.4. (contd)

KR85	7.0E+04	0.0E+00	0.0E+00
SR90	2.0E-04	0.0E+00	0.0E+00
NB95	1.0E-05	0.0E+00	0.0E+00
RU103	2.0E-04	0.0E+00	0.0E+00
RU106	2.0E-02	0.0E+00	0.0E+00
SB125	1.0E-03	0.0E+00	0.0E+00
I 129	5.0E-01	0.0E+00	0.0E+00
I 131	2.0E-04	0.0E+00	0.0E+00
CS134	1.0E-05	0.0E+00	0.0E+00
CS137	4.0E-05	0.0E+00	0.0E+00
PM147	1.0E-03	0.0E+00	0.0E+00
PB212	2.0E-01	0.0E+00	0.0E+00
BI212	1.0E-01	0.0E+00	0.0E+00
U 234	2.0E-06	0.0E+00	0.0E+00
U 235	7.0E-08	0.0E+00	0.0E+00
U 238	2.0E-06	0.0E+00	0.0E+00
PU238	3.0E-05	0.0E+00	0.0E+00
PU241	3.0E-03	0.0E+00	0.0E+00
AM241	1.0E-04	0.0E+00	0.0E+00
PU239	4.0E-04	0.0E+00	0.0E+00

========== AIR TRANSPORT ==========

Joint frequency data input.

8.9E+01 Effective stack height (m)

========== EXTERNAL EXPOSURE ==========

8.8E+03 Hours of exposure to plume

2.9E+03 Hours of exposure to ground contamination

========== INHALATION ==========

8.8E+03 Hours of exposure to contamination per year

Resuspension not considered

========== INGESTION POPULATION ==========

1 Atmospheric production definition: 1 - Use population-weighted chi/Q

Food production in region assumed to equal consumption.

========== TERRESTRIAL FOOD INGESTION ==========

FOOD TYPE	GROW TIME d	--IRRIGATION-- S *	RATE in/yr	TIME mo/yr	YIELD kg/m2	PROD-UCTION kg/yr	--CONSUMPTION-- HOLDUP d	RATE kg/yr
Leaf Veg	90.0	0	0.0	0.0	1.5		14.0	1.5E+01
Oth. Veg	90.0	0	0.0	0.0	4.0		14.0	1.4E+02
Fruit	90.0	0	0.0	0.0	2.0		14.0	6.4E+01
Cereals	90.0	0	0.0	0.0	0.8		180.0	7.2E+01

EXHIBIT A.4. (contd)

ANIMAL FOOD INGESTION

FOOD TYPE	HUMAN CONSUMPTION RATE kg/yr	HUMAN HOLDUP d	TOTAL PRODUCTION kg/yr	DRINK WATER CONTAM FRACT.	DIET FRACTION	GROW TIME d	S *	IRRIGATION RATE in/yr	IRRIGATION TIME mo/yr	YIELD kg/m3	STORAGE d
					STORED FEED						
Meat	7.0E+01	34.0		0.00	0.3	90.00	0	0.0	0.0	0.80	180.0
Poultry	8.5E+00	34.0		0.00	1.0	90.00	0	0.0	0.0	0.80	180.0
Cow Milk	2.3E+02	4.0		0.00	0.3	45.00	0	0.0	0.0	2.00	100.0
Eggs	2.0E+01	18.0		0.00	1.0	90.00	0	0.0	0.0	0.80	180.0
					FRESH FORAGE						
Meat					0.75	45.0	0	0.0	0.0	2.00	100.0
Cow Milk					0.75	30.0	0	0.0	0.0	1.50	0.0

Input prepared by: ____________________ Date: __________

Input checked by: ____________________ Date: __________

GENII Dose Calculation Program
(Version 1.351 30-Aug-88)

Case title: GENII Sample Problem 1

Executed on: 09/27/88 at 17:01:43 Page B. 1

1.6E-03 Population-weighted chi/Q

Source area external dose modification factor: 1.00000

GENII Dose Calculation Program
(Version 1.351 30-Aug-88)

Case title: GENII Sample Problem 1

Executed on: 09/27/88 at 17:07:11 Page C. 1

Release period:	1.0
Uptake/exposure period:	1.0
Dose commitment period:	50.0
Dose units:	Person-rem

Organ	Committed Dose Equivalent	Weighting Factors	Weighted Dose Equivalent
Gonads	9.8E-02	2.5E-01	2.4E-02
Breast	1.0E-01	1.5E-01	1.5E-02
R Marrow	2.1E-01	1.2E-01	2.6E-02
Lung	4.0E-01	1.2E-01	4.9E-02
Thyroid	2.0E+02	3.0E-02	6.1E+00
Bone Sur	1.3E+00	3.0E-02	3.8E-02
Liver	1.9E-01	6.0E-02	1.2E-02
LL Int.	1.0E-01	6.0E-02	6.2E-03
UL Int.	9.5E-02	6.0E-02	5.7E-03
S Int.	9.3E-02	6.0E-02	5.6E-03
Stomach	5.9E-02	6.0E-02	3.5E-03
Internal Effective Dose Equivalent			6.3E+00
External Dose			3.3E-02
Annual Effective Dose Equivalent			6.3E+00

Controlling Organ:	Thyroid
Controlling Pathway:	Ing
Controlling Radionuclide:	I 129
Inhalation EDE:	1.3E-01
Ingestion EDE:	6.1E+00

```
--------------------------------------------------------------------------
                    GENII  Dose Calculation Program
                     (Version 1.351 30-Aug-88)

Case title:   GENII Sample Problem 1

Executed on:  09/27/88 at 17:07:11                             Page C.  2
--------------------------------------------------------------------------

Release period:                                              1.0
Uptake/exposure period:                                      1.0
Dose commitment period:                                     50.0
Dose units:                                               Person-rem



             Dose Commitment Year
                  1          2          3      ...
            ________________________________
Internal   :|
Intake     :|
Year:      3|                       0.0E+00    ...
            |                          +
           2|            0.0E+00    0.0E+00    ...                  Internal
            |               +          +                            Effective
           1| 5.5E+00 + 6.0E-01 + 6.9E-02 + ...   =   6.3E+00       Dose
                                                                    Equivalent
               ||         ||         ||
Internal                                                            Cumulative
Annual        5.5E+00 + 6.0E-01 + 6.9E-02 + ...   =   6.3E+00       Internal
Dose                                                                Dose
               +          +          +                  +
External
Annual        3.3E-02   0.0E+00   0.0E+00    ...      3.3E-02
Dose
               ||         ||         ||                 ||
Annual                                                              Cumulative
Dose          5.6E+00 + 6.0E-01 + 6.9E-02 + ...   =   6.3E+00       Dose

                                                                    Maximum
                                                      5.6E+00       Annual
                                                                    Dose Occurred
                                                                    In Year   1
```

EXHIBIT A.4. (contd)

GENII Dose Calculation Program
(Version 1.351 30-Aug-88)

Case title: GENII Sample Problem 1
Executed on: 09/27/88 at 17:07:11

Release period: 1.0
Uptake/exposure period: 1.0
Dose commitment period: 50.0
Dose units: Person-rem

Radio-nuclide	Inhalation Effective Dose Equivalent	Ingestion Effective Dose Equivalent	External Dose	Internal Effective Dose Equivalent	Annual Effective Dose Equivalent
H 3	2.5E-03	1.3E-02	0.0E+00	1.6E-02	1.6E-02
C 14	8.4E-04	5.1E-02	0.0E+00	5.2E-02	5.2E-02
KR 85	0.0E+00	0.0E+00	3.3E-02	0.0E+00	3.3E-02
SR 90	1.7E-05	5.8E-05	2.9E-10	7.6E-05	7.6E-05
Y 90	2.6E-08	3.0E-06	1.5E-08	3.0E-06	3.1E-06
NB 95	2.4E-08	2.3E-08	1.6E-08	4.7E-08	6.3E-08
RU 103	7.7E-07	5.6E-07	2.3E-07	1.3E-06	1.6E-06
PD 103	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
RH 103M	3.5E-10	8.8E-09	1.0E-10	9.2E-09	9.3E-09
RU 106	4.0E-03	7.8E-04	4.4E-05	4.8E-03	4.8E-03
SB 125	5.3E-06	4.3E-06	5.3E-06	9.6E-06	1.5E-05
TE 125M	1.1E-09	1.6E-06	4.8E-09	1.6E-06	1.6E-06
I 129	3.3E-02	6.1E+00	7.6E-05	6.1E+00	6.1E+00
I 131	2.6E-06	1.5E-04	3.1E-07	1.5E-04	1.5E-04
XE 131M	0.0E+00	0.0E+00	2.1E-11	0.0E+00	2.1E-11
CS 134	1.8E-07	4.3E-06	1.8E-07	4.5E-06	4.7E-06
CS 137	4.6E-07	1.3E-05	3.0E-07	1.3E-05	1.3E-05
PM 147	1.7E-05	1.9E-06	9.4E-11	1.9E-05	1.9E-05
SM 147	7.5E-17	4.0E-16	0.0E+00	4.7E-16	4.7E-16
PB 212	1.2E-02	3.1E-04	5.9E-06	1.2E-02	1.2E-02
BI 212	1.3E-03	7.6E-06	5.1E-05	1.3E-03	1.3E-03
U 234	1.1E-04	7.3E-08	2.2E-12	1.1E-04	1.1E-04
U 235	3.7E-06	2.6E-09	6.7E-11	3.7E-06	3.7E-06
TH 231	2.1E-12	1.3E-10	4.0E-12	1.3E-10	1.3E-10
PA 231	1.0E-14	3.9E-12	2.3E-16	3.9E-12	3.9E-12
AC 227	1.2E-19	1.5E-14	6.8E-21	1.5E-14	1.5E-14
TH 227	0.0E+00	2.8E-17	5.9E-18	2.8E-17	3.4E-17
FR 223	0.0E+00	1.0E-19	3.6E-20	1.0E-19	1.4E-19
RA 223	0.0E+00	2.1E-16	1.5E-17	2.1E-16	2.3E-16
U 238	1.0E-04	6.7E-08	1.2E-12	1.0E-04	1.0E-04
TH 234	1.2E-10	2.0E-08	4.6E-10	2.0E-08	2.0E-08

EXHIBIT A.4. (contd)

PA 234	9.3E-16	5.1E-12	7.0E-11	5.1E-12	7.5E-11
PU 238	3.7E-03	1.2E-05	1.8E-11	3.7E-03	3.7E-03
PU 241	6.4E-03	2.5E-05	1.4E-15	6.4E-03	6.4E-03
AM 241	1.9E-02	4.4E-04	6.3E-09	1.9E-02	1.9E-02
PU 239	5.1E-02	1.8E-04	2.7E-10	5.2E-02	5.2E-02

All data required to perform this calculation is contained in the input file, no additional data files are needed.

The input file to perform this calculation is provided as Exhibit A.5. The output resulting from the calculation is given in Exhibit A.6.

The output of GENII Sample Problem 2 is similar in form to that of Sample Problem 1. Only two of the output portions are listed, those labeled with page numbers A.n and C.n. As with problem 1, those labeled with A.n page numbers are the quality assurance pages, repeating the input for record purposes. Those labeled C.n are the dose results. No pages of the sequence B.n were produced in this example, because no atmospheric dispersion calculations were requested.

For brevity in this document, pages C.1 and C.2 have been omitted. The formats of these pages are identical with those provided in Exhibit A.4 for Sample Problem 1; the pages provide the effective dose equivalent summary and the dose assembly matrix grid.

The page labeled C.3 in Exhibit A.6 provides the doses for Sample Problem 2 listed by exposure pathway for the organs for which dose is calculated, for the internal exposures. The page labeled C.4 provides the external doses by exposure pathway. The organ-related information has been included in the doses presented through the derivation of the dose factors, as described in Section 4 of Volume 1 of this GENII series, and so it is not reported. Internal doses to the organs are reported by radionuclide on page C.5. A final page, C.6, has been omitted from this report. Its format is the same as that shown for page C.3 of Sample Problem 1, the total dose listed by radionuclide.

A.3 GENII SAMPLE PROBLEM 3

The third sample problem represents the prospective calculation of the impacts to the population in a selected downwind sector of an acute accidental release of radionuclides to air. Rather than having the code calculate the 95th percentile value of the air concentration, a value of the time-integrated atmospheric dispersion parameter, E/Q, is input to this sample. Because the E/Q is input, the infinite-plume submersion model must be used.

EXHIBIT A.5. GENII Input File- Sample Problem 2

```
######################## Program GENII Input File ############ 7 Mar 88 ####
Title: GENII Sample Problem 2
      \genii\sam\sample2.in                         Created on 08-05-1988 at 15:41
OPTIONS======================= Default =====================================
F    Near-field scenario?       (Far-field)    NEAR-FIELD: narrowly-focused
F    Population dose?          (Individual)                release, single site
F    Acute release?              (Chronic)     FAR-FIELD:  wide-scale release,
     Maximum Individual data set used                      multiple sites
                                 Complete                            Complete
TRANSPORT OPTIONS=========== Section   EXPOSURE PATHWAY OPTIONS===== Section
F  Air Transport                  1     F  Finite plume, external       5
T  Surface Water Transport        2     F  Infinite plume, external     5
F  Biotic Transport (near-field)  3     T  Ground, external             5
F  Waste Form Degradation (near)  4     T  Recreation, external         5
                                        F  Inhalation uptake            6
REPORT OPTIONS=====================     T  Drinking water ingestion     7,8
T  Report AEDE only                     T  Aquatic foods ingestion      7,8
T  Report by radionuclide               T  Terrestrial foods ingestion  7,9
T  Report by exposure pathway           T  Animal product ingestion     7,10
F  Debug report on screen               F  Inadvertent soil ingestion

INVENTORY #################################################################

 4   Inventory input activity units: (1-pCi  2-uCi  3-mCi  4-Ci  5-Bq)
 0   Surface soil source units (1- m2  2- m3  3- kg)
     Equilibrium question goes here

     --------|----Release Terms------|----------Basic Concentrations---------|
     Use when|  transport selected   | near-field scenario, optionally       |
     --------|-----------------------|---------------------------------------|
     Release |        Surface Buried |       Surface Deep    Ground  Surface |
     Radio-  |Air     Water   Waste  |Air    Soil    Soil    Water   Water   |
     nuclide |/yr     /yr     /m3    |/L     /unit   /m3     /L      /L      |
     --------|------- ------- -------|------- ------- ------- ------- -------|
     H 3              5.3E+03
     I 129            9.0E-03

     --------|----Derived Concentrations-----|
     Use when|  measured values are known    |
     --------|-------------------------------|
     Release |Terres. Animal  Drink   Aquatic|
     Radio-  |Plant   Product Water   Food   |
     nuclide |/kg     /kg     /L      /kg    |
     --------|------- ------- ------- -------|
```

EXHIBIT A.5. (contd)

```
TIME ########################################################################

1     Intake ends after (yr)
50    Dose calc. ends after (yr)
1     Release ends after (yr)
0     No. of years of air deposition prior to the intake period
0     No. of years of irrigation water deposition prior to the intake period

FAR-FIELD SCENARIOS (IF POPULATION DOSE) ####################################

0           Definition option: 1-Use population grid in file POP.IN
0                              2-Use total entered on this line

NEAR-FIELD SCENARIOS ########################################################

            Prior to the beginning of the intake period: (yr)
0             When was the inventory disposed?  (Package degradation starts)
0             When was LOIC?  (Biotic transport starts)
0           Fraction of roots in upper soil (top 15 cm)
0           Fraction of roots in deep soil
0           Manual redistribution: deep soil/surface soil dilution factor

TRANSPORT ###################################################################
            ====AIR TRANSPORT=====================================SECTION 1=====
                    0-Calculate PM          |
 1          Option: 1-Use chi/Q or PM value |F          Stack release (T/F)
                    2-Select MI dist & dir  |0          Stack height (m)
                    3-Specifc MI dist & dir |0          Stack flow (m3/sec
0           Chi/Q or PM value               |0          Stack radius (m)
0           MI sector index (1=S)           |0          Effluent temp. (C)
0           MI distance from release point (m)
T           Use joint frequency data, otherwise chi/Q grid

            ====SURFACE WATER TRANSPORT===========================SECTION 2=====
 0          Mixing ratio model: 0-use value, 1-river, 2-lake, 3-river flow
1.0         Mixing ratio, dimensionless
2860.0      Average river flow rate for: MIXFLG=0,3 (m3/s), MIXFLG=1,2 (m/s),
24.0        Transit time to irrigation withdrawl location (hr)
            If mixing ratio model > 0:
0.0           Rate of effluent discharge to receiving water body (m3/s)
0.0           Longshore distance from release point to usage location (m)
0.0           Offshore distance to the water intake (m)
0.0           Average water depth in surface water body (m)
0             Average river width (m), MIXFLG=1 only
0             Depth of effluent discharge point to surface water (m), lake only

            ====WASTE FORM AVAILABILITY===========================SECTION 3=====
0           Waste form/package half life, (yr)
0           Waste thickness, (m)
0           Depth of soil overburden, m
```

EXHIBIT A.5. (contd)

```
        ====BIOTIC TRANSPORT OF BURIED SOURCE================SECTION 4=====
T       Consider during inventory decay/build-up period (T/F)?
T       Consider during intake period (T/F)?    | 1-Arid non agricultural
0       Pre-Intake site condition.............. | 2-Humid non agricultural
                                                | 3-Agricultural

EXPOSURE ###################################################################

        ====EXTERNAL EXPOSURE================================SECTION 5=====
        Exposure time:                    |  Residential irrigation:
0         Plume (hr)                      | T      Consider: (T/F)
4380.0    Soil contamination (hr)         | 2        Source: 1-ground water
100.0     Swimming (hr)                   |                  2-surface water
100.0     Boating (hr)                    | 40.0     Application rate (in/yr)
500.0     Shoreline activities (hr)       | 6        Duration (mo/yr)
1       Shoreline type: (1-river, 2-lake, 3-ocean, 4-tidal basin)
8       Transit time for release to reach aquatic recreation (hr)
0       Average fraction of time submersed in acute cloud (hr/person-hr)

        ====INHALATION=======================================SECTION 6=====
0       Hours of exposure to contamination per year
0       0-No resus-  1-Use Mass Loading          2-Use Anspaugh model
0         pension     Mass loading factor (g/m3)   Top soil available (cm)

        ====INGESTION POPULATION=============================SECTION 7=====
0       Atmospheric production definition (select option):
0         0-Use food-weighted chi/Q, (food-sec/m3), enter value on this line
          1-Use population-weighted chi/Q
          2-Use uniform production
          3-Use chi/Q and production grids (PRODUCTION will be overridden)
0       Population ingesting aquatic foods, 0 defaults to total (person)
0       Population ingesting drinking water, 0 defaults to total (person)
F       Consider dose from food exported out of region (default=F)

        Note below: S* or Source: 0-none, 1-ground water, 2-surface water
                                  3-drinking water system
        ==== AQUATIC FOODS / DRINKING WATER INGESTION=========SECTION 8====

F       Salt water? (default is fresh)

        USE          TRAN-  PROD-     -CONSUMPTION- |
        ?   FOOD     SIT    UCTION    HOLDUP  RATE  |
        T/F TYPE     hr     kg/yr     da      kg/yr |        DRINKING WATER
        --- ------   -----  -------   ------  ----- | -------------------------
        T   FISH     0.00   1.5E+04   1.00    40.0  | 2      Source (see above)
        F   MOLLUS   0.00   0.0E+00   0.00    0.0   | T      Treatment? T/F
        F   CRUSTA   0.00   0.0E+00   0.00    0.0   | 1      Holdup/transit(da)
        F   PLANTS   0.00   0.0E+00   0.00    0.0   | 730    Consumption (L/yr)
```

EXHIBIT A.5. (contd)

====TERRESTRIAL FOOD INGESTION=====================SECTION 9=====

USE ? T/F	FOOD TYPE	GROW TIME da	S *	--IRRIGATION-- RATE in/yr	TIME mo/yr	YIELD kg/m2	PROD-UCTION kg/yr	--CONSUMPTION-- HOLDUP da	RATE kg/yr
T	LEAF V	90.00	2	35.0	6.0	1.5	0.0E+00	1.0	30.0
T	ROOT V	90.00	2	40.0	6.0	4.0	0.0E+00	5.0	220.0
T	FRUIT	90.00	2	35.0	6.0	2.0	0.0E+00	5.0	330.0
T	GRAIN	90.00	2	0.0	0.0	0.8	0.0E+00	180.0	80.0

====ANIMAL PRODUCTION CONSUMPTION==================SECTION 10====

USE ? T/F	FOOD TYPE	---HUMAN---- CONSUMPTION RATE kg/yr	HOLDUP da	TOTAL PROD-UCTION kg/yr	DRINK WATER CONTAM FRACT.	------STORED FEED------ DIET FRAC-TION	GROW TIME da	S *	-IRRIGATION-- RATE in/yr	TIME mo/yr	YIELD kg/m3	STOR-AGE da
T	BEEF	80.0	15.0	0.00	1.00	0.25	90.0	2	0.0	0.00	0.80	180.0
T	POULTR	18.0	1.0	0.00	1.00	1.00	90.0	2	0.0	0.00	0.80	180.0
T	MILK	270.0	1.0	0.00	1.00	0.25	45.0	2	47.0	6.00	2.00	100.0
T	EGG	30.0	1.0	0.00	1.00	1.00	90.0	2	0.0	0.00	0.80	180.0
						------FRESH FORAGE------						
	BEEF					0.75	45.0	2	47.0	6.00	2.00	100.0
	MILK					0.75	30.0	2	47.0	6.00	1.50	0.0

##

EXHIBIT A.6. GENII Output File - Sample Problem 2

GENII Dose Calculation Program
(Version 1.351 30-Aug-88)

Case title: GENII Sample Problem 2

Executed on: 09/27/88 at 17:07:30 Page A. 1

This is a far-field (wide-scale release, multiple site) scenario.
Release is chronic
Individual dose

THE FOLLOWING TRANSPORT MODES ARE CONSIDERED
- Surface Water

THE FOLLOWING EXPOSURE PATHS ARE CONSIDERED:
- Ground, external
- Recreation, external
- Drinking water ingestion
- Aquatic foods ingestion
- Terrestrial foods ingestion
- Animal product ingestion

THE FOLLOWING TIMES ARE USED:

Intake ends after (yr):	1.0
Dose calculations ends after (yr):	50.0
Release ends after (yr):	1.0

========== FILE NAMES AND TITLES OF FILES/LIBRARIES USED ==========

\genii\sam\sample2.in	8-05-88
GENII Default Parameter Values (3-Aug-88 RAP)	8-12-88
RMDLIB - Radionuclide Master Library (29-Aug-88 RAP)	8-29-88
Food Transfer Factor Library - (RAP 29-Aug-88) (UPDATED LEACHING FA	8-29-88
Bioaccumulation Factor Library - (30-Aug-88) RAP	8-30-88
External Dose Factors for GENII in person-Sv/yr per Bq/n (28-Aug-88	8-29-88
Internal Yearly Dose Increments (Sv/Bq) 29-Aug-88 RAP	8-29-88

Release Radio-nuclide	Release Terms Air Ci/yr	Surface Water Ci/yr	Buried Source Ci/m3
H 3	0.0E+00	5.3E+03	0.0E+00
I 129	0.0E+00	9.0E-03	0.0E+00

EXHIBIT A.6. (contd)

========== SURFACE WATER TRANSPORT ==========

0	Mixing ratio model: 0-use value, 1-river, 2-lake, 3-river flow
2.4E+01	Transit time to irrigation withdrawl location (h)
2.9E+03	Average water flow rate for: MIXFLG=1,2 (m/s), MIXFLG=0,3 (m3/s)
1.0E+00	Mixing ratio, dimensionless

========== EXTERNAL EXPOSURE ==========

4.4E+03	Hours of exposure to ground contamination
2	Residential irrigation source 1-ground water, 2-surface water
4.0E+01	Residential irrigation application rate (in/yr)
6.0E+00	Residential irrigation duration (mo/yr)
1.0E+02	Hours of exposure from swimming
1.0E+02	Hours of exposure from boating
5.0E+02	Hours of exposure from shoreline activities
1	Shoreline type: 1-river, 2-lake, 3-ocean, 4-tidal basin
8.0E+00	Surface water transit time to recreational site (h)

========== DRINKING WATER SOURCE/IRRIGATION ==========

7.3E+02	Drinking water consumption rate (l/yr)
2	Drinking water source: 1-ground, 2-surface, 3-system
T	Drinking water treatment: T/F
1.0	Drinking water transit/holdup time (d)

========== AQUATIC FOODS INGESTION ==========

FOOD TYPE	TRANSIT h	PRODUCTION kg/yr	----CONSUMPTION---- HOLDUP d	RATE kg/yr
Fish	0.00E+00	1.50E+04	1.00E+00	4.00E+01

========== TERRESTRIAL FOOD INGESTION ==========

FOOD TYPE	GROW TIME d	--IRRIGATION-- S *	RATE in/yr	TIME mo/yr	YIELD kg/m2	PRODUCTION kg/yr	--CONSUMPTION-- HOLDUP d	RATE kg/yr
Leaf Veg	90.0	2	35.0	6.0	1.5	0.00E+00	1.0	3.0E+01
Oth. Veg	90.0	2	40.0	6.0	4.0	0.00E+00	5.0	2.2E+02
Fruit	90.0	2	35.0	6.0	2.0	0.00E+00	5.0	3.3E+02
Cereals	90.0	2	0.0	0.0	0.8	0.00E+00	180.0	8.0E+01

EXHIBIT A.6. (contd)

========== ANIMAL FOOD INGESTION ==========

FOOD TYPE	---HUMAN---- CONSUMPTION RATE kg/yr	HOLDUP d	TOTAL PRODUCTION kg/yr	DRINK WATER CONTAM FRACT.	DIET FRACTION	GROW TIME d	S *	-IRRIGATION-- RATE in/yr	TIME mo/yr	YIELD kg/m3	STORAGE d
					STORED FEED						
Meat	8.0E+01	15.0	0.0E+00	1.00	0.3	90.00	2	0.0	0.0	0.80	180.0
Poultry	1.8E+01	1.0	0.0E+00	1.00	1.0	90.00	2	0.0	0.0	0.80	180.0
Cow Milk	2.7E+02	1.0	0.0E+00	1.00	0.3	45.00	2	47.0	6.0	2.00	100.0
Eggs	3.0E+01	1.0	0.0E+00	1.00	1.0	90.00	2	0.0	0.0	0.80	180.0
					FRESH FORAGE						
Meat					0.75	45.0	2	47.0	6.0	2.00	100.0
Cow Milk					0.75	30.0	2	47.0	6.0	1.50	0.0

Input prepared by: ____________________ Date: ____________

Input checked by: ____________________ Date: ____________

Source area external dose modification factor: 1.00000

EXHIBIT A.6. (contd)

GENII Dose Calculation Program
(Version 1.351 30-Aug-88)

Case title: GENII Sample Problem 2

Executed on: 09/27/88 at 17:08:32 Page C. 3

Release period:	1.0
Uptake/exposure period:	1.0
Dose commitment period:	50.0
Dose units:	Rem

Committed Dose Equivalent by Exposure Pathway

Pathway	Lung	Stomach	S Int.	UL Int.	LL Int.	Bone Su	R Marro	Testes
Leaf Veg	6.9E-08	4.0E-08	7.3E-08	7.3E-08	7.3E-08	3.4E-08	6.9E-08	6.9E-08
Oth. Veg	5.0E-07	2.9E-07	5.3E-07	5.3E-07	5.3E-07	2.4E-07	5.0E-07	5.0E-07
Fruit	1.1E-06	6.5E-07	1.2E-06	1.2E-06	1.2E-06	5.5E-07	1.1E-06	1.1E-06
Cereals	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Meat	2.5E-07	1.5E-07	2.7E-07	2.7E-07	2.7E-07	1.2E-07	2.5E-07	2.5E-07
Poultry	5.0E-08	2.9E-08	5.3E-08	5.3E-08	5.3E-08	2.4E-08	5.0E-08	5.0E-08
Cow Milk	9.4E-07	5.4E-07	1.0E-06	1.0E-06	1.0E-06	4.6E-07	9.4E-07	9.4E-07
Eggs	8.8E-08	5.1E-08	9.3E-08	9.3E-08	9.3E-08	4.3E-08	8.8E-08	8.8E-08
Swim Ing	7.5E-09	4.4E-09	8.0E-09	8.0E-09	8.0E-09	3.7E-09	7.5E-09	7.5E-09
Water	2.7E-06	1.6E-06	2.9E-06	2.9E-06	2.9E-06	1.3E-06	2.7E-06	2.7E-06
Fish	1.4E-07	8.4E-08	1.5E-07	1.5E-07	1.5E-07	7.1E-08	1.5E-07	1.4E-07
Total	5.9E-06	3.4E-06	6.2E-06	6.2E-06	6.2E-06	2.9E-06	5.9E-06	5.9E-06

EXHIBIT A.6. (contd)

Pathway	Ovaries	Muscle	Thyroid	Bladder
Leaf Veg	6.9E-08	6.9E-08	3.8E-07	5.1E-11
Oth. Veg	5.0E-07	5.0E-07	8.0E-07	5.1E-11
Fruit	1.1E-06	1.1E-06	1.4E-06	4.5E-11
Cereals	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Meat	2.5E-07	2.5E-07	4.6E-07	3.4E-11
Poultry	5.0E-08	5.0E-08	5.0E-08	1.3E-14
Cow Milk	9.4E-07	9.4E-07	3.1E-06	3.6E-10
Eggs	8.8E-08	8.8E-08	1.1E-07	3.4E-12
Swim Ing	7.5E-09	7.5E-09	9.2E-09	2.7E-13
Water	2.7E-06	2.7E-06	3.2E-06	7.9E-11
Fish	1.4E-07	1.4E-07	1.8E-06	2.7E-10
Total	5.9E-06	5.9E-06	1.1E-05	8.9E-10

EXHIBIT A.6. (contd)

```
------------------------------------------------------------------------------
                      GENII  Dose Calculation Program
                       (Version 1.351 30-Aug-88)

Case title:   GENII Sample Problem 2

Executed on:  09/27/88 at 17:08:32                                 Page C.  4
------------------------------------------------------------------------------

Release period:                                             1.0
Uptake/exposure period:                                     1.0
Dose commitment period:                                    50.0
Dose units:                                            Rem


                    External Dose by Exposure Pathway

Pathway
---------------  -------
Sur Soil         1.4E-12
Swim Ext         1.8E-13
Boating          9.2E-14
Shore            1.2E-12
---------------  -------
Total            2.9E-12
```

GENII Dose Calculation Program
(Version 1.351 30-Aug-88)

Case title: GENII Sample Problem 2

Executed on: 09/27/88 at 17:08:32 Page C. 5

Release period:	1.0
Uptake/exposure period:	1.0
Dose commitment period:	50.0
Dose units:	Rem

Committed Dose Equivalent by Radionuclide

Radionuclide	Lung	Stomach	S Int.	UL Int.	LL Int.	Bone Su	R Marro	Testes
H 3	5.9E-06	3.4E-06	6.2E-06	6.2E-06	6.2E-06	2.9E-06	5.9E-06	5.9E-06
I 129	3.4E-10	3.9E-10	3.1E-10	2.9E-10	3.1E-10	2.7E-09	1.4E-09	2.7E-10
Total	5.9E-06	3.4E-06	6.2E-06	6.2E-06	6.2E-06	2.9E-06	5.9E-06	5.9E-06

Radionuclide	Ovaries	Muscle	Thyroid	Bladder
H 3	5.9E-06	5.9E-06	5.9E-06	0.0E+00
I 129	2.9E-10	6.8E-10	5.4E-06	8.9E-10
Total	5.9E-06	5.9E-06	1.1E-05	8.9E-10

Doses are calculated for exposure to radioactive materials deposited on the ground, on food crops, and on animal fodder. Because the code is working in a prospective mode, doses are calculated four times, that is assuming the release occurred in the winter, spring, summer, or autumn.

Because the population-weighted E/Q is input, neither the population data file nor the atmospheric dispersion data files are necessary. All the needed data is available in the input file. The data input file is presented in Exhibit A.7. The resultant output file is presented as Exhibit A.8.

The initial pages of output for Sample Problem 3 reflect the input. The page of atmospheric dispersion data, B.1, has been omitted from this document to save space, because it merely repeats the input E/Q value. The code produces extensive information about the exposures for each season. The format can be the same for each season as those shown for Sample Problems 1 and 2. For simplicity, only the effective dose equivalent summary pages for the four seasons are shown here. These are identified as pages C.1, C.4, C.7, and C.10 in Exhibit A.8. A detailed review of these outputs shows that the inhalation and submersion doses are the same for each season, as expected. However, the ingestion doses are smallest if an accident were to occur in winter when the agricultural productivity is lowest. Ingestion doses peak in autumn because, for that season, accidents are assumed to occur immediately before harvest.

The output data file MEDIA.OUT prepared by this example is given as Exhibit A.9. This file shows the integrated air, soil, and water concentrations calculated for each radionuclide for each season. The MEDIA.OUT file is not routinely printed, and must be accessed by the user <u>directly after</u> each GENII simulation.

A.4 GENII SAMPLE PROBLEM 4

The fourth sample problem displays the near-field scenario capabilities of the GENII package. In this scenario, an intruder is assumed to contact contaminated soil buried 5 meters below the ground through a drilling intrusion. The short exposure times and low manual redistribution factor are representative of someone inadvertently bringing a small amount of contaminated material to the soil surface and being exposed for a short time.

EXHIBIT A.7. GENII Input File - Sample Problem 3

```
######################## Program GENII Input File ############ 8 Mar 88 ####
Title: GENII Sample Problem 3
       \genii\sam\sample3.in                       Created on 08-05-1988 at 15:40
OPTIONS======================== Default ====================================
F    Near-field scenario?      (Far-field)    NEAR-FIELD: narrowly-focused
T    Population dose?         (Individual)                release, single site
T    Acute release?             (Chronic)     FAR-FIELD:  wide-scale release,
     Average Individual data set used                     multiple sites
                               Complete                                 Complete
TRANSPORT OPTIONS=========== Section     EXPOSURE PATHWAY OPTIONS===== Section
T  Air Transport                  1      F  Finite plume, external      5
F  Surface Water Transport        2      T  Infinite plume, external    5
F  Biotic Transport (near-field)  3      T  Ground, external            5
F  Waste Form Degradation (near)  4      F  Recreation, external        5
                                         T  Inhalation uptake           6
REPORT OPTIONS======================     F  Drinking water ingestion    7,8
T  Report AEDE only                      F  Aquatic foods ingestion     7,8
F  Report by radionuclide                T  Terrestrial foods ingestion 7,9
F  Report by exposure pathway            T  Animal product ingestion    7,10
F  Debug report on screen                F  Inadvertent soil ingestion

INVENTORY ###################################################################

 4   Inventory input activity units: (1-pCi  2-uCi  3-mCi  4-Ci  5-Bq)
 0   Surface soil source units (1- m2  2- m3  3- kg)
     Equilibrium question goes here

     --------|----Release Terms------|----------Basic Concentrations---------|
     Use when| transport selected    | near-field scenario, optionally       |
     --------|-----------------------|---------------------------------------|
     Release |        Surface Buried |       Surface Deep    Ground  Surface|
     Radio-  |Air     Water   Waste  |Air    Soil    Soil    Water   Water  |
     nuclide |/yr     /yr     /m3    |/L     /unit   /m3     /L      /L     |
     --------|------- ------- -------|------- ------- ------- ------- -------|
     SM153    2.8E-4
     EU154    6.8E-6
     EU155    7.0E-6
     EU156    7.8E-4
     CO60     1.2E-6
     CR51     2.9E-6
     FE59     2.5E-6
     FE55     3.0E-5

     --------|----Derived Concentrations-----|
     Use when| measured values are known     |
     --------|-------------------------------|
     Release |Terres. Animal  Drink   Aquatic|
     Radio-  |Plant   Product Water   Food   |
     nuclide |/kg     /kg     /L      /kg    |
     --------|------- ------- ------- -------|
```

EXHIBIT A.7. (contd)

```
TIME ##########################################################################

1       Intake ends after (yr)
50      Dose calc. ends after (yr)
0       Release ends after (yr)
0       No. of years of air deposition prior to the intake period
0       No. of years of irrigation water deposition prior to the intake period

FAR-FIELD SCENARIOS (IF POPULATION DOSE) ######################################

2          Definition option: 1-Use population grid in file POP.IN
1                             2-Use total entered on this line

NEAR-FIELD SCENARIOS ##########################################################

           Prior to the beginning of the intake period: (yr)
0            When was the inventory disposed?  (Package degradation starts)
0            When was LOIC?  (Biotic transport starts)
0          Fraction of roots in upper soil (top 15 cm)
0          Fraction of roots in deep soil
0          Manual redistribution: deep soil/surface soil dilution factor

TRANSPORT #####################################################################
           ====AIR TRANSPORT====================================SECTION 1=====
                   0-Calculate PM        |
1          Option: 1-Use chi/Q or PM value |F          Stack release (T/F)
                   2-Select MI dist & dir  |0          Stack height (m)
                   3-Specify MI dist & dir |0          Stack flow (m3/sec
6.8E-3     Chi/Q or PM value               |0          Stack radius (m)
0          MI sector index (1=S)           |0          Effluent temp. (C)
0          MI distance from release point (m)
F          Use joint frequency data, otherwise chi/Q grid

           ====SURFACE WATER TRANSPORT=========================SECTION 2=====
0          Mixing ratio model: 0-use value, 1-river, 2-lake, 3-river flow
0          Mixing ratio, dimensionless
0          Average river flow rate for: MIXFLG=0,3 (m3/s), MIXFLG=1,2 (m/s),
0          Transit time to irrigation withdrawl location (hr)
           If mixing ratio model > 0:
0            Rate of effluent discharge to receiving water body (m3/s)
0            Longshore distance from release point to usage location (m)
0            Offshore distance to the water intake (m)
0            Average water depth in surface water body (m)
0            Average river width (m), MIXFLG=1 only
0            Depth of effluent discharge point to surface water (m), lake only

           ====WASTE FORM AVAILABILITY=========================SECTION 3=====
0          Waste form/package half life, (yr)
0          Waste thickness, (m)
0          Depth of soil overburden, m
```

EXHIBIT A.7. (contd)

```
        ====BIOTIC TRANSPORT OF BURIED SOURCE================SECTION 4=====
T       Consider during inventory decay/build-up period (T/F)?
T       Consider during intake period (T/F)?  | 1-Arid non agricultural
0       Pre-Intake site condition.............| 2-Humid non agricultural
                                              | 3-Agricultural

EXPOSURE ###################################################################

        ====EXTERNAL EXPOSURE================================SECTION 5=====
        Exposure time:                  |  Residential irrigation:
0         Plume (hr)                    | T      Consider: (T/F)
2920.0    Soil contamination (hr)       | 0      Source: 1-ground water
0         Swimming (hr)                 |                2-surface water
0         Boating (hr)                  | 0      Application rate (in/yr)
0         Shoreline activities (hr)     | 0      Duration (mo/yr)
0       Shoreline type: (1-river, 2-lake, 3-ocean, 4-tidal basin)
0       Transit time for release to reach aquatic recreation (hr)
1.0     Average fraction of time submersed in acute cloud (hr/person-hr)

        ====INHALATION=======================================SECTION 6=====
2920.0  Hours of exposure to contamination per year
0       0-No resus-  1-Use Mass Loading          2-Use Anspaugh model
0         pension      Mass loading factor (g/m3)   Top soil available (cm)

        ====INGESTION POPULATION=============================SECTION 7=====
 1      Atmospheric production definition (select option):
0         0-Use food-weighted chi/Q, (food-sec/m3), enter value on this line
          1-Use population-weighted chi/Q
          2-Use uniform production
          3-Use chi/Q and production grids (PRODUCTION will be overridden)
0       Population ingesting aquatic foods, 0 defaults to total (person)
0       Population ingesting drinking water, 0 defaults to total (person)
F       Consider dose from food exported out of region (default=F)

        Note below: S* or Source: 0-none, 1-ground water, 2-surface water
                                  3-Derived concentration entered above
        ==== AQUATIC FOODS / DRINKING WATER INGESTION=========SECTION 8====

F       Salt water? (default is fresh)

        USE          TRAN-  PROD-     -CONSUMPTION-  |
        ?   FOOD     SIT    UCTION    HOLDUP  RATE   |
        T/F TYPE     hr     kg/yr     da      kg/yr  |      DRINKING WATER
        --- ------ -----  --------  ------  -----    |-------------------------
        F   FISH    0.00  0.0E+00    0.00    0.0     | 0      Source (see above)
        F   MOLLUS  0.00  0.0E+00    0.00    0.0     | T      Treatment? T/F
        F   CRUSTA  0.00  0.0E+00    0.00    0.0     | 0      Holdup/transit(da)
        F   PLANTS  0.00  0.0E+00    0.00    0.0     | 0      Consumption (L/yr)
```

EXHIBIT A.7. (contd)

====TERRESTRIAL FOOD INGESTION======================SECTION 9=====

USE ? T/F	FOOD TYPE	GROW TIME da	--IRRIGATION-- S *	RATE in/yr	TIME mo/yr	YIELD kg/m2	PROD-UCTION kg/yr	--CONSUMPTION-- HOLDUP da	RATE kg/yr
T	LEAF V	90.00	0	0.0	0.0	1.5	0.0E+00	14.0	15.0
T	ROOT V	90.00	0	0.0	0.0	4.0	0.0E+00	14.0	140.0
T	FRUIT	90.00	0	0.0	0.0	2.0	0.0E+00	14.0	64.0
T	GRAIN	90.00	0	0.0	0.0	0.8	0.0E+00	180.0	72.0

====ANIMAL PRODUCTION CONSUMPTION===================SECTION 10====

USE ? T/F	FOOD TYPE	---HUMAN---- CONSUMPTION RATE kg/yr	HOLDUP da	TOTAL PROD-UCTION kg/yr	DRINK WATER CONTAM FRACT.	-------------STORED FEED------------- DIET FRAC-TION	GROW TIME da	-IRRIGATION-- S *	RATE in/yr	TIME mo/yr	YIELD kg/m3	STOR-AGE da
T	BEEF	70.0	34.0	0.00	0.00	0.00	90.0	0	0.0	0.00	0.80	0.0
T	POULTR	8.5	34.0	0.00	0.00	0.00	90.0	0	0.0	0.00	0.80	0.0
T	MILK	230.0	4.0	0.00	0.00	0.00	45.0	0	0.0	0.00	2.00	0.0
T	EGG	20.0	18.0	0.00	0.00	0.00	90.0	0	0.0	0.00	0.80	0.0
						-------------FRESH FORAGE------------						
	BEEF					0.00	45.0	0	0.0	0.00	2.00	100.0
	MILK					0.00	30.0	0	0.0	0.00	1.50	0.0

##

EXHIBIT A.8. GENII Output File - Sample Problem 3

GENII Dose Calculation Program
(Version 1.351 30-Aug-88)

Case title: GENII Sample Problem 3

Executed on: 09/28/88 at 14:36:46 Page A. 1

This is a far-field (wide-scale release, multiple site) scenario.
Release is acute
Dose to exposed population of 1.000E+00

THE FOLLOWING TRANSPORT MODES ARE CONSIDERED
- Air

THE FOLLOWING EXPOSURE PATHS ARE CONSIDERED:
- Infinite plume, external
- Ground, external
- Inhalation uptake
- Terrestrial foods ingestion
- Animal product ingestion

THE FOLLOWING TIMES ARE USED:

Intake ends after (yr):	1.0
Dose calculations ends after (yr):	50.0

========== FILE NAMES AND TITLES OF FILES/LIBRARIES USED ======================

\genii\sam\sample3.in	9-28-88
GENII Default Parameter Values (3-Aug-88 RAP)	8-12-88
RMDLIB - Radionuclide Master Library (29-Aug-88 RAP)	8-29-88
Food Transfer Factor Library - (RAP 29-Aug-88) (UPDATED LEACHING FA	8-29-88
External Dose Factors for GENII in person-Sv/yr per Bq/n (28-Aug-88	8-29-88
Internal Yearly Dose Increments (Sv/Bq) 29-Aug-88 RAP	8-29-88

==

	----Release Terms------		
Release Radio- nuclide	Air Ci/yr	Surface Water Ci/yr	Buried Source Ci/m3
SM153	2.8E-04	0.0E+00	0.0E+00
EU154	6.8E-06	0.0E+00	0.0E+00
EU155	7.0E-06	0.0E+00	0.0E+00
EU156	7.8E-04	0.0E+00	0.0E+00
CO60	1.2E-06	0.0E+00	0.0E+00
CR51	2.9E-06	0.0E+00	0.0E+00

EXHIBIT A.8. (contd)

FE59	2.5E-06	0.0E+00	0.0E+00
FE55	3.0E-05	0.0E+00	0.0E+00

========== AIR TRANSPORT ==========

6.8E-03 Input population-weighted E/Q value (s/m3)

========== EXTERNAL EXPOSURE ==========

1.0E+00 Fraction of time spent in cloud

2.9E+03 Hours of exposure to ground contamination

========== INHALATION ==========

2.9E+03 Hours of exposure to contamination per year

Resuspension not considered

========== INGESTION POPULATION ==========

1 Atmospheric production definition: 1 - Use population-weighted chi/Q

Food production in region assumed to equal consumption.

========== TERRESTRIAL FOOD INGESTION ==========

FOOD TYPE	GROW TIME d	--IRRIGATION-- S *	RATE in/yr	TIME mo/yr	YIELD kg/m2	PRODUCTION kg/yr	--CONSUMPTION-- HOLDUP d	RATE kg/yr
Leaf Veg	90.0	0	0.0	0.0	1.5		14.0	1.5E+01
Oth. Veg	90.0	0	0.0	0.0	4.0		14.0	1.4E+02
Fruit	90.0	0	0.0	0.0	2.0		14.0	6.4E+01
Cereals	90.0	0	0.0	0.0	0.8		180.0	7.2E+01

========== ANIMAL FOOD INGESTION ==========

FOOD TYPE	---HUMAN---- CONSUMPTION RATE kg/yr	HOLDUP d	TOTAL PRODUCTION kg/yr	DRINK WATER CONTAM FRACT.	DIET FRACTION	GROW TIME d	-IRRIGATION-- S *	RATE in/yr	TIME mo/yr	YIELD kg/m3	STORAGE d
					-------------STORED FEED-------------						
Meat	7.0E+01	34.0		0.00		90.00	0	0.0	0.0	0.80	0.0
Poultry	8.5E+00	34.0		0.00		90.00	0	0.0	0.0	0.80	0.0
Cow Milk	2.3E+02	4.0		0.00		45.00	0	0.0	0.0	2.00	0.0
Eggs	2.0E+01	18.0		0.00		90.00	0	0.0	0.0	0.80	0.0
					-------------FRESH FORAGE-------------						
Meat						45.00	0	0.0	0.0	2.00	0.0
Cow Milk						30.00	0	0.0	0.0	1.50	0.0

==========

9 1 0 4 8 0 5 4 3

EXHIBIT A.8. (contd)

Input prepared by: ______________________________ Date: ______________

Input checked by: ______________________________ Date: ______________

==

EXHIBIT A.8. (contd)

GENII Dose Calculation Program
(Version 1.351 30-Aug-88)

Case title: Winter: GENII Sample Problem 3

Executed on: 09/28/88 at 14:39:30 Page C. 1

Acute release	
Uptake/exposure period:	1.0
Dose commitment period:	50.0
Dose units:	Person-rem

Organ	Committed Dose Equivalent	Weighting Factors	Weighted Dose Equivalent
Gonads	5.0E-06	2.5E-01	1.2E-06
Breast	3.7E-06	1.5E-01	5.5E-07
R Marrow	1.5E-05	1.2E-01	1.8E-06
Lung	1.4E-04	1.2E-01	1.7E-05
Thyroid	2.1E-06	3.0E-02	6.4E-08
Bone Sur	5.7E-05	3.0E-02	1.7E-06
LL Int.	7.3E-05	6.0E-02	4.4E-06
Liver	5.2E-05	6.0E-02	3.1E-06
UL Int.	2.9E-05	6.0E-02	1.7E-06
Kidneys	1.1E-05	6.0E-02	6.4E-07
S Int.	9.7E-06	6.0E-02	5.8E-07
Internal Effective Dose Equivalent			3.3E-05
External Dose			5.8E-06
Annual Effective Dose Equivalent			3.9E-05

Controlling Organ:	Lung
Controlling Pathway:	Inh
Controlling Radionuclide:	EU156
Inhalation EDE:	3.3E-05
Ingestion EDE:	7.3E-09

EXHIBIT A.8. (contd)

GENII Dose Calculation Program
(Version 1.351 30-Aug-88)

Case title: Spring: GENII Sample Problem 3

Executed on: 09/28/88 at 14:40:32 Page C. 4

Acute release	
Uptake/exposure period:	1.0
Dose commitment period:	50.0
Dose units:	Person-rem

Organ	Committed Dose Equivalent	Weighting Factors	Weighted Dose Equivalent
Gonads	8.3E-06	2.5E-01	2.1E-06
Breast	4.3E-06	1.5E-01	6.4E-07
R Marrow	1.6E-05	1.2E-01	1.9E-06
Lung	1.4E-04	1.2E-01	1.7E-05
Thyroid	2.4E-06	3.0E-02	7.2E-08
Bone Sur	5.8E-05	3.0E-02	1.7E-06
LL Int.	1.3E-04	6.0E-02	7.7E-06
Liver	5.4E-05	6.0E-02	3.2E-06
UL Int.	5.0E-05	6.0E-02	3.0E-06
S Int.	1.6E-05	6.0E-02	9.5E-07
Kidneys	1.1E-05	6.0E-02	6.6E-07
Internal Effective Dose Equivalent			3.9E-05
External Dose			5.8E-06
Annual Effective Dose Equivalent			4.5E-05

Controlling Organ:	Lung
Controlling Pathway:	Inh
Controlling Radionuclide:	EU156
Inhalation EDE:	3.3E-05
Ingestion EDE:	6.3E-06

EXHIBIT A.8. (contd)

GENII Dose Calculation Program
(Version 1.351 30-Aug-88)

Case title: Summer: GENII Sample Problem 3

Executed on: 09/28/88 at 14:41:32 Page C. 7

Acute release
Uptake/exposure period: 1.0
Dose commitment period: 50.0
Dose units: Person-rem

Organ	Committed Dose Equivalent	Weighting Factors	Weighted Dose Equivalent
Gonads	1.0E-05	2.5E-01	2.5E-06
Breast	4.8E-06	1.5E-01	7.1E-07
R Marrow	1.7E-05	1.2E-01	2.0E-06
Lung	1.4E-04	1.2E-01	1.7E-05
Thyroid	2.7E-06	3.0E-02	8.2E-08
Bone Sur	6.1E-05	3.0E-02	1.8E-06
LL Int.	1.5E-04	6.0E-02	9.2E-06
UL Int.	5.9E-05	6.0E-02	3.5E-06
Liver	5.7E-05	6.0E-02	3.4E-06
S Int.	1.9E-05	6.0E-02	1.1E-06
Kidneys	1.1E-05	6.0E-02	6.8E-07
Internal Effective Dose Equivalent			4.2E-05
External Dose			5.8E-06
Annual Effective Dose Equivalent			4.8E-05

Controlling Organ:	LL Int.
Controlling Pathway:	Inh
Controlling Radionuclide:	EU156
Inhalation EDE:	3.3E-05
Ingestion EDE:	9.5E-06

EXHIBIT A.8. (contd)

GENII Dose Calculation Program
(Version 1.351 30-Aug-88)

Case title: Autumn: GENII Sample Problem 3

Executed on: 09/28/88 at 14:42:32 Page C. 10

Acute release
Uptake/exposure period: 1.0
Dose commitment period: 50.0
Dose units: Person-rem

Organ	Committed Dose Equivalent	Weighting Factors	Weighted Dose Equivalent
Gonads	3.0E-05	2.5E-01	7.6E-06
Breast	1.1E-05	1.5E-01	1.6E-06
R Marrow	2.7E-05	1.2E-01	3.2E-06
Lung	1.5E-04	1.2E-01	1.8E-05
Thyroid	7.1E-06	3.0E-02	2.1E-07
Bone Sur	8.3E-05	3.0E-02	2.5E-06
LL Int.	4.0E-04	6.0E-02	2.4E-05
UL Int.	1.5E-04	6.0E-02	9.3E-06
Liver	8.4E-05	6.0E-02	5.0E-06
S Int.	5.0E-05	6.0E-02	3.0E-06
Stomach	2.3E-05	6.0E-02	1.4E-06
Internal Effective Dose Equivalent			7.6E-05
External Dose			5.8E-06
Annual Effective Dose Equivalent			8.1E-05

Controlling Organ: LL Int.
Controlling Pathway: Ing
Controlling Radionuclide: EU156

Inhalation EDE: 3.3E-05
Ingestion EDE: 4.3E-05

EXHIBIT A.9. GENII MEDIA.OUT Putput File Sample Problem 3

GENII Dose Calculation Program
(Version 1.351 30-Aug-88)

Case title: GENII Sample Problem Three

Executed on: 09/28/88 at 14:37:35 Page 2

Radio-nuclide	Season or Year	------Residential------ Average Population-Weighted Air Ci sec/m3	Surface Soil Ci/m2	Time Integrated Surface Water Ci yr/L
CR51	Winter	2.0E-08	2.2E-12	0.0E+00
CR51	Spring	2.0E-08	2.2E-12	0.0E+00
CR51	Summer	2.0E-08	2.2E-12	0.0E+00
CR51	Autumn	2.0E-08	2.2E-12	0.0E+00
FE55	Winter	2.0E-07	1.8E-10	0.0E+00
FE55	Spring	2.0E-07	1.8E-10	0.0E+00
FE55	Summer	2.0E-07	1.8E-10	0.0E+00
FE55	Autumn	2.0E-07	1.8E-10	0.0E+00
FE59	Winter	1.7E-08	3.0E-12	0.0E+00
FE59	Spring	1.7E-08	3.0E-12	0.0E+00
FE59	Summer	1.7E-08	3.0E-12	0.0E+00
FE59	Autumn	1.7E-08	3.0E-12	0.0E+00
CO60	Winter	8.2E-09	7.6E-12	0.0E+00
CO60	Spring	8.2E-09	7.6E-12	0.0E+00
CO60	Summer	8.2E-09	7.6E-12	0.0E+00
CO60	Autumn	8.2E-09	7.6E-12	0.0E+00
SM153	Winter	1.9E-06	1.5E-11	0.0E+00
SM153	Spring	1.9E-06	1.5E-11	0.0E+00
SM153	Summer	1.9E-06	1.5E-11	0.0E+00
SM153	Autumn	1.9E-06	1.5E-11	0.0E+00
EU154	Winter	4.6E-08	4.4E-11	0.0E+00
EU154	Spring	4.6E-08	4.4E-11	0.0E+00
EU154	Summer	4.6E-08	4.4E-11	0.0E+00
EU154	Autumn	4.6E-08	4.4E-11	0.0E+00
EU155	Winter	4.8E-08	4.4E-11	0.0E+00
EU155	Spring	4.8E-08	4.4E-11	0.0E+00
EU155	Summer	4.8E-08	4.4E-11	0.0E+00
EU155	Autumn	4.8E-08	4.4E-11	0.0E+00
EU156	Winter	5.3E-06	3.2E-10	0.0E+00
EU156	Spring	5.3E-06	3.2E-10	0.0E+00
EU156	Summer	5.3E-06	3.2E-10	0.0E+00
EU156	Autumn	5.3E-06	3.2E-10	0.0E+00

Scenarios of this nature are frequently used in environmental impact statements involving waste disposal.

The input for this scenario is contained in the GENII input file. The input is shown in Exhibit A.10. The resulting output is presented in Exhibit A.11.

The initial pages define the scenario and repeat the input. No atmospheric dispersion calculations were performed, so no pages labeled B.n were produced. As for the other GENII samples, an effective dose equivalent summary page and a dose assembly matrix page were printed but omitted from this output to conserve space. Dose by exposure pathway is presented on page C.3 and dose by radionuclide on page C.4. The format of these pages is similar to that of the outputs of the other sample problems.

Note that for the scenario defined, no terrestrial food pathways or animal products were used. Therefore, no mention is made of these on the quality assurance pages.

A.5 INTDF SAMPLE PROBLEM

The INTDF code is used to prepare internal radiation dose factors for the other codes of the GENII package. Input is quite simple. The sample input file shown in Exhibit A.12 demonstrates the calculation of the 50-year dose commitments for the organs defined to be exposed from a single inhalation or ingestion intake of cobalt-60. Other radionuclides could be added to the calculation simply by appending them to the end of this file.

The output file resulting from the input of Exhibit A.12 is presented in Exhibit A.13. The first page of this file defines the input conditions and lists the metabolic data retrieved from the metabolic data library. If the DEBUG flag had been set TRUE in the input file, an additional set of pages displaying the specific effective energies (SEE) used in the dose calculation would have also been printed. The last page presents the total integrated retention (total number of disintegrations of cobalt-60 in each organ) and the calculated organ dose commitments. These numbers may be compared to those published by the ICRP in Publication 30 (ICRP 1979).

EXHIBIT A.10. GENII Input File -Sample Problem 4

```
######################### Program GENII Input File ########### 22 Apr 88 ####
Title: GENII Sample Problem 4
      \genii\sam\sample4.inN                       Created on 08-05-1988 at 16:03
OPTIONS======================== Default =====================================
T    Near-field scenario?       (Far-field)     NEAR-FIELD: narrowly-focused
F    Population dose?          (Individual)                 release, single site
F    Acute release?              (Chronic)      FAR-FIELD:  wide-scale release,
     Maximum Individual data set used                       multiple sites
                                  Complete                                Complete
TRANSPORT OPTIONS============  Section   EXPOSURE PATHWAY OPTIONS===== Section
F  Air Transport                   1       F  Finite plume, external       5
F  Surface Water Transport         2       T  Infinite plume, external     5
F  Biotic Transport (near-field)  3,4      T  Ground, external             5
F  Waste Form Degradation (near)  3,4      F  Recreation, external         5
                                           T  Inhalation uptake            6
REPORT OPTIONS=======================      F  Drinking water ingestion     7,8
T  Report AEDE only                        F  Aquatic foods ingestion      7,8
F  Report by radionuclide                  F  Terrestrial foods ingestion  7,9
T  Report by exposure pathway              F  Animal product ingestion     7,10
F  Debug report on screen                  F  Inadvertent soil ingestion

INVENTORY ####################################################################

 1   Inventory input activity units: (1-pCi  2-uCi  3-mCi  4-Ci  5-Bq)
 1   Surface soil source units (1- m2  2- m3  3- kg)
     Equilibrium question goes here
```

Use when	Release Terms transport selected			Basic Concentrations near-field scenario, optionally				
Release Radio-nuclide	Air /yr	Surface Water /yr	Buried Waste /m3	Air /L	Surface Soil /unit	Deep Soil /m3	Ground Water /L	Surface Water /L
CO60						2.14E12		
NI59						9.29E10		
NI63						1.21E13		
SR90						2.14E09		
ZR93						7.86E10		
NB94						4.29E09		
MO93						1.43E09		
TC99						2.14E08		
EU152						1.43E10		
EU154						1.14E10		

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EXHIBIT A.10. (contd)

```
--------|----Derived Concentrations-----|
Use when|  measured values are known    |
--------|-------------------------------|
Release |Terres. Animal  Drink   Aquatic|
Radio-  |Plant   Product Water   Food   |
nuclide |/kg     /kg     /L      /kg    |
--------|------- ------- ------- -------|


TIME ######################################################################

1     Intake ends after (yr)
50    Dose calc. ends after (yr)
0     Release ends after (yr)
0     No. of years of air deposition prior to the intake period
0     No. of years of irrigation water deposition prior to the intake period

FAR-FIELD SCENARIOS (IF POPULATION DOSE) ##################################

0            Definition option: 1-Use population grid in file POP.IN
0                               2-Use total entered on this line

NEAR-FIELD SCENARIOS ######################################################

             Prior to the beginning of the intake period: (yr)
100.0          When was the inventory disposed?  (Package degradation starts)
0              When was LOIC?  (Biotic transport starts)
1.0          Fraction of roots in upper soil (top 15 cm)
0            Fraction of roots in deep soil
2.8E-3       Manual redistribution: deep soil/surface soil dilution factor
1000.0       Source area for external dose modification factor (m2)
TRANSPORT #################################################################
             ====AIR TRANSPORT=====================================SECTION 1=====
                     0-Calculate PM           |
 1           Option: 1-Use chi/Q or PM value  |F          Stack release (T/F)
                     2-Select MI dist & dir   |0          Stack height (m)
                     3-Specify MI dist & dir  |0          Stack flow (m3/sec
0            Chi/Q or PM value                |0          Stack radius (m)
0            MI sector index (1=S)            |0          Effluent temp. (C)
0            MI distance from release point (m)
T            Use joint frequency data, otherwise chi/Q grid

             ====SURFACE WATER TRANSPORT==========================SECTION 2=====
0            Mixing ratio model: 0-use value, 1-river, 2-lake
0            Mixing ratio, dimensionless
0            Average river flow rate for: MIXFLG=0 (m3/s), MIXFLG=1,2 (m/s),
0            Transit time to irrigation withdrawl location (hr)
             If mixing ratio model > 0:
0              Rate of effluent discharge to receiving water body (m3/s)
0              Longshore distance from release point to usage location (m)
```

EXHIBIT A.10. (contd)

```
0         Offshore distance to the water intake (m)
0         Average water depth in surface water body (m)
0         Average river width (m), MIXFLG=1 only
0         Depth of effluent discharge point to surface water (m), lake only

        ====WASTE FORM AVAILABILITY==========================SECTION 3=====
0       Waste form/package half life, (yr)
10.0    Waste thickness, (m)
5.0     Depth of soil overburden, m

        ====BIOTIC TRANSPORT OF BURIED SOURCE================SECTION 4=====
T       Consider during inventory decay/build-up period (T/F)?
T       Consider during intake period (T/F)?  | 1-Arid non agricultural
0       Pre-Intake site condition.............| 2-Humid non agricultural
                                              | 3-Agricultural

EXPOSURE ###########################################################################

        ====EXTERNAL EXPOSURE================================SECTION 5=====
        Exposure time:                  |  Residential irrigation:
1.0       Plume (hr)                    | T      Consider: (T/F)
40.0      Soil contamination (hr)       | 0      Source: 1-ground water
0         Swimming (hr)                 |                2-surface water
0         Boating (hr)                  | 0      Application rate (in/yr)
0         Shoreline activities (hr)     | 0      Duration (mo/yr)
0       Shoreline type: (1-river, 2-lake, 3-ocean, 4-tidal basin)
0       Transit time for release to reach aquatic recreation (hr)
0       Average fraction of time submersed in acute cloud (hr/person-hr)

        ====INHALATION=======================================SECTION 6=====
1.0     Hours of exposure to contamination per year
1       0-No resus-  1-Use Mass Loading          2-Use Anspaugh model
.0001     pension      Mass loading factor (g/m3)   Top soil available (cm)

        ====INGESTION POPULATION=============================SECTION 7=====
0       Atmospheric production definition (select option):
0         0-Use food-weighted chi/Q, (food-sec/m3), enter value on this line
          1-Use population-weighted chi/Q
          2-Use uniform production
          3-Use chi/Q and production grids (PRODUCTION will be overridden)
0       Population ingesting aquatic foods, 0 defaults to total (person)
0       Population ingesting drinking water, 0 defaults to total (person)
F       Consider dose from food exported out of region (default=F)

        Note below: S* or Source: 0-none, 1-ground water, 2-surface water
                                  3-Derived concentration entered above
        ==== AQUATIC FOODS / DRINKING WATER INGESTION=========SECTION 8====

F       Salt water? (default is fresh)
```

EXHIBIT A.10. (contd)

USE ? T/F	FOOD TYPE	TRAN-SIT hr	PROD-UCTION kg/yr	-CONSUMPTION- HOLDUP da	RATE kg/yr
F	FISH	0.00	0.0E+00	0.00	0.0
F	MOLLUS	0.00	0.0E+00	0.00	0.0
F	CRUSTA	0.00	0.0E+00	0.00	0.0
F	PLANTS	0.00	0.0E+00	0.00	0.0

DRINKING WATER	
0	Source (see above)
T	Treatment? T/F
0	Holdup/transit(da)
0	Consumption (L/yr)

====TERRESTRIAL FOOD INGESTION=====================SECTION 9=====

USE ? T/F	FOOD TYPE	GROW TIME da	--IRRIGATION-- S *	RATE in/yr	TIME mo/yr	YIELD kg/m2	PROD-UCTION kg/yr	--CONSUMPTION-- HOLDUP da	RATE kg/yr
F	LEAF V	90.00	0	0.0	0.0	1.5	0.0E+00	1.0	30.0
F	ROOT V	90.00	0	0.0	0.0	4.0	0.0E+00	5.0	220.0
F	FRUIT	90.00	0	0.0	0.0	2.0	0.0E+00	5.0	330.0
F	GRAIN	90.00	0	0.0	0.0	0.8	0.0E+00	180.0	80.0

====ANIMAL PRODUCTION CONSUMPTION==================SECTION 10====

USE ? T/F	FOOD TYPE	---HUMAN---- CONSUMPTION RATE kg/yr	HOLDUP da	TOTAL PROD-UCTION kg/yr	DRINK WATER CONTAM FRACT.	-------------STORED FEED------------- DIET FRAC-TION	GROW TIME da	-IRRIGATION-- S *	RATE in/yr	TIME mo/yr	YIELD kg/m3	STOR-AGE da
F	BEEF	80.0	15.0	0.00	0.00	0.25	90.0	0	0.0	0.00	0.80	180.0
F	POULTR	18.0	1.0	0.00	0.00	1.00	90.0	0	0.0	0.00	0.80	180.0
F	MILK	270.0	1.0	0.00	0.00	0.25	45.0	0	0.0	0.00	2.00	100.0
F	EGG	30.0	1.0	0.00	0.00	1.00	90.0	0	0.0	0.00	0.80	180.0
						-------------FRESH FORAGE------------						
	BEEF					0.75	45.0	0	0.0	0.00	2.00	100.0
	MILK					0.75	30.0	0	0.0	0.00	1.50	0.0

##

EXHIBIT A.11. GENII Output File - Sample Problem 4

GENII Dose Calculation Program
(Version 1.351 30-Aug-88)

Case title: GENII Sample Problem 4

Executed on: 09/27/88 at 17:09:09 Page A. 1

This is a near field (narrowly-focused, single site) scenario.
Release is chronic
Individual dose

THE FOLLOWING EXPOSURE PATHS ARE CONSIDERED:
  Infinite plume, external
  Ground, external
  Inhalation uptake

THE FOLLOWING TIMES ARE USED:
  Intake ends after (yr): 1.0
  Dose calculations ends after (yr): 50.0

========== FILE NAMES AND TITLES OF FILES/LIBRARIES USED ====================

\genii\sam\sample4.inN	8-05-88
GENII Default Parameter Values (3-Aug-88 RAP)	8-12-88
RMDLIB - Radionuclide Master Library (29-Aug-88 RAP)	8-29-88
External Dose Factors for GENII in person-Sv/yr per Bq/n (28-Aug-88	8-29-88
Internal Yearly Dose Increments (Sv/Bq) 29-Aug-88 RAP	8-29-88

==

1 Surface soil input unit: (1-m2, 2-m3, 3-kg)

	----------Basic Concentrations---------				
Release Radio- nuclide	Air pCi/L	Surface Soil pCi/m2	Deep Soil pCi/m3	Ground Water pCi/L	Surface Water pCi/L
CO60	0.0E+00	0.0E+00	2.1E+12	0.0E+00	0.0E+00
NI59	0.0E+00	0.0E+00	9.3E+10	0.0E+00	0.0E+00
NI63	0.0E+00	0.0E+00	1.2E+13	0.0E+00	0.0E+00
SR90	0.0E+00	0.0E+00	2.1E+09	0.0E+00	0.0E+00
ZR93	0.0E+00	0.0E+00	7.9E+10	0.0E+00	0.0E+00
NB94	0.0E+00	0.0E+00	4.3E+09	0.0E+00	0.0E+00
MO93	0.0E+00	0.0E+00	1.4E+09	0.0E+00	0.0E+00
TC99	0.0E+00	0.0E+00	2.1E+08	0.0E+00	0.0E+00
EU152	0.0E+00	0.0E+00	1.4E+10	0.0E+00	0.0E+00
EU154	0.0E+00	0.0E+00	1.1E+10	0.0E+00	0.0E+00

91048 0555

EXHIBIT A.11. (contd)

========== NEAR-FIELD PARAMETERS ==========

100.0	Inventory disposed n years prior to beginning of intake period
0	LOIC occurred n years prior to beginning of intake period
1.0E+00	Fraction of roots in upper soil (top 15 cm)
0.0E+00	Fraction of roots in deep soil
2.8E-03	Manual redistribution: deep soil/surface soil dilution factor
1000.0	Source area for external dose modification factor (m2)

========== WASTE FORM AVAILABILITY ==========

0.0E+00	Waste form/package half life, yr
1.0E+01	Thickness of buried waste, m
5.0E+00	Depth of soil overburden, m

========== EXTERNAL EXPOSURE ==========

1.0E+00	Hours of exposure to plume
4.0E+01	Hours of exposure to ground contamination

========== INHALATION ==========

1.0E+00	Hours of exposure to contamination per year
1	Resuspension model: 1-Mass Loading, 2-Anspaugh
1.0E-04	Mass loading factor (g/m3)

==========

Input prepared by: ______________________ Date: ____________

Input checked by: ______________________ Date: ____________

==========

Source area external dose modification factor: 0.940000

EXHIBIT A.11. (contd)

GENII Dose Calculation Program
(Version 1.351 30-Aug-88)

Case title: GENII Sample Problem 4

Executed on: 09/27/88 at 17:11:20 Page C. 3

Uptake/exposure period: 1.0
Dose commitment period: 50.0
Dose units: Rem

Committed Dose Equivalent by Exposure Pathway

Pathway	Lung	Stomach	S Int.	UL Int.	LL Int.	Bone Su	R Marro	Testes
Inhale	1.1E-07	4.4E-09	4.3E-09	6.9E-09	1.5E-08	2.0E-07	2.2E-08	6.5E-09
Total	1.1E-07	4.4E-09	4.3E-09	6.9E-09	1.5E-08	2.0E-07	2.2E-08	6.5E-09

Pathway	Ovaries	Muscle	Thyroid	Kidneys	Liver	Spleen	S Wall
Inhale	6.8E-09	6.9E-09	6.9E-09	3.7E-10	1.4E-10	7.4E-10	9.0E-13
Total	6.8E-09	6.9E-09	6.9E-09	3.7E-10	1.4E-10	7.4E-10	9.0E-13

External Dose by Exposure Pathway

Pathway	
Plume	0.0E+00
Sur Soil	1.9E-03
Dep Soil	1.7E-07
Total	1.9E-03

GENII Dose Calculation Program
(Version 1.351 30-Aug-88)

Case title: GENII Sample Problem 4

Executed on: 09/27/88 at 17:11:20 Page C. 4

Uptake/exposure period: 1.0
Dose commitment period: 50.0
Dose units: Rem

Radio-nuclide	Inhalation Effective Dose Equivalent	Ingestion Effective Dose Equivalent	External Dose	Internal Effective Dose Equivalent	Annual Effective Dose Equivalent
CO 60	9.2E-13	0.0E+00	2.6E-06	9.2E-13	2.6E-06
NI 59	8.9E-11	0.0E+00	1.1E-06	8.9E-11	1.1E-06
NI 63	1.4E-08	0.0E+00	1.0E-07	1.4E-08	1.1E-07
SR 90	4.5E-11	0.0E+00	5.8E-09	4.5E-11	5.8E-09
Y 90	1.9E-12	0.0E+00	3.2E-07	1.9E-12	3.2E-07
MO 93	7.4E-13	0.0E+00	1.4E-08	7.4E-13	1.4E-08
ZR 93	7.8E-09	0.0E+00	9.3E-10	7.8E-09	8.7E-09
NB 93M	2.9E-09	0.0E+00	3.7E-07	2.9E-09	3.7E-07
NB 94	2.0E-09	0.0E+00	1.8E-03	2.0E-09	1.8E-03
TC 99	1.0E-12	0.0E+00	4.1E-10	1.0E-12	4.1E-10
EU 152	2.1E-11	0.0E+00	2.8E-05	2.1E-11	2.8E-05
EU 154	1.4E-12	0.0E+00	1.4E-06	1.4E-12	1.4E-06

EXHIBIT A.12. GENII Input File - Problem 5

```
GENII Sample Problem 5 (INTDF)
50        'No. of years to consider
T         'Acute? if false then chronic
1.0       'Particle size, micron
F         'Print SEE's and Debug print statements?
1.0-6     'Relative error tolerance (LSODES2)
1.0-8     'Absolute error tolerance (LSODES2)
365.0     'Absolute step size allowed (LSODES2)
1.0-6     'Initial step size (LSODES2)
700       'Number of steps to reach convergence allowed (LSODES2)
F         10.0         'Fetal dose, age (da)
C060
```

EXHIBIT A.13. GENII Output File - Sample Problem 5

INTDF Dose Calculation Program
(Version 1.351 30-Aug-88)

Case title: GENII Sample Problem 5 (INTDF)
Executed on: 09/27/88 at 17:12:04 Page 1

1 CO60 V Y 1.92E+03 3.61E-04 0 0.00E+00 0 0.00E+00

	General Model
	Acute exposure
Dose commitment period:	50.0000
Particle size:	1.00000
Lung deposition fractions:	
Nasal-pharynx region:	0.287834
Pulmonary region:	0.235379
Traecheo-bronchial region:	0.800000E-01
Integration method:	LSODES2 equation solver
Relative error tolerance:	0.100000E-05
Absolute error tolerance:	0.100000E-07
Absolute step size allowed:	365.000
No. of steps to convergence allowed:	700
Starting time step:	0.100000E-05

Organ	Organ Index	Target?	Compartment Index	Organ Mass	ORGMLT	ORGING	ORGINH
Lung	1	T	18	1.0E+03	1.0E+00	1.5E-02	0.0E+00
Lymph	2	F	19	0.0E+00	1.0E+00	0.0E+00	0.0E+00
Stomach	3	T	20	2.5E+02	1.0E+00	0.0E+00	0.0E+00
S Int.	4	T	21	4.0E+02	1.0E+00	0.0E+00	0.0E+00
UL Int.	5	T	22	2.5E+02	1.0E+00	0.0E+00	0.0E+00
LL Int.	6	T	23	1.3E+02	1.0E+00	0.0E+00	0.0E+00
Bone Sur	7	T	24	0.0E+00	0.0E+00	0.0E+00	0.0E+00
R Marrow	8	T	24	1.5E+03	0.0E+00	2.2E-02	2.3E-02
Bone Cor	9	F	24	4.0E+03	8.0E-01	0.0E+00	0.0E+00
Bone Can	10	F	24	1.0E+03	2.0E-01	0.0E+00	0.0E+00
Testes	11	T	25	3.5E+01	0.0E+00	5.2E-04	5.3E-04
Ovaries	12	T	25	1.1E+01	0.0E+00	1.6E-04	1.7E-04
Muscle	13	T	25	2.8E+04	0.0E+00	4.2E-01	4.2E-01
Thyroid	14	T	25	2.0E+01	0.0E+00	3.0E-04	3.0E-04
Liver	17	T	26	1.8E+03	1.0E+00	0.0E+00	0.0E+00
Other	23	T	25	0.0E+00	0.0E+00	5.4E-01	5.5E-01

Transfer compartment rate: 1.39000

EXHIBIT A.13. (contd)

INTDF Dose Calculation Program
(Version 1.351 30-Aug-88)

Case title: GENII Sample Problem Five (INTDF)

Executed on: 09/27/88 at 17:12:04 Page 2

No. of OTHER compartments (TCMULT): 3 0.958913

TC, RT:	1	0.270000	0.115517
TC, RT:	2	0.900000E-01	0.115517E-01
TC, RT:	3	0.900000E-01	0.866375E-03

No. of bone compartments (TCMULT): 0 0.724638E-01

No. of specified organs (TCMULT): 1 2.61E-02

No. of specified organ compartments: 3

Organ Name	Comp. Index	Organ Index	Sub Index	TCORG (frac)	RTORG (rate)
Liver	1	1	1	0.30E-01	0.12E+00
Liver	2	1	2	0.10E-01	0.12E-01
Liver	3	1	3	0.10E-01	0.87E-03

Input prepared by: ____________________ Date: __________

Input checked by: ____________________ Date: __________

EXHIBIT A.13. (contd)

INTDF Dose Calculation Program
(Version 1.351 30-Aug-88)

Case title: GENII Sample Problem 5 (INTDF)

Executed on: 09/27/88 at 17:12:04 Page 3

Number of Nuclear Transformation Over 50 Years
In Source Organs or Tissue per Unit Intake of Activity
(Transformations/Bq) of C060

Inhalation Class Y
F1: 5.0E-02

Oral

	C060
Lung	0.0E+00
Stomach	3.6E+03
S Int.	1.4E+04
UL Int.	4.4E+04
LL Int.	8.2E+04
Bone	2.3E+02
Other	3.6E+05
Liver	4.0E+04

Inhalation

	C060
Lung	9.7E+06
Stomach	1.9E+03
S Int.	7.3E+03
UL Int.	2.4E+04
LL Int.	4.4E+04
Bone	2.5E+02
Other	4.1E+05
Liver	4.5E+04

Committed Dose Equivalent Over 50 Years
In Target Organs or Tissue per Unit Intake of Activity
(Sv/Bq) of C060

	Lung	Stomach	S Int.	UL Int.	LL Int.	Bone Sur	R Marrow
Oral	8.7E-10	1.5E-09	3.5E-09	5.6E-09	1.1E-08	8.4E-10	1.3E-09
Inhalation	3.3E-07	2.6E-08	6.7E-09	9.0E-09	7.6E-09	1.3E-08	1.6E-08

	Testes	Ovaries	Muscle	Thyroid	Liver
Oral	1.2E-09	3.1E-09	1.1E-09	8.3E-10	2.4E-09
Inhalation	1.7E-09	4.6E-09	1.7E-08	1.5E-08	3.2E-08

EXHIBIT A.13. (contd)

	Oral	Inhalation
Number of steps taken by the LSODES solver:	347	339
Number of F (DIFEQ2) evaulations:	453	469
Number of Jacobian evaluations:	7	7
Length of RWORK actually required:	964	998
Length of IWORK actually required:	30	30
Number of non-zero elements in Jacobian matrix:	82	93

A.6 EXTDF SAMPLE PROBLEM

The EXTDF code is used to prepare data files of external dose rate factors for use by the other codes of the GENII package. The input is quite short. No radionuclides need to be specified because the code reads the radionuclide master data file RMDLIB and calculates factors for every nuclide in the list. The input to this sample problem is shown in Exhibit A.14. The geometry demonstrated in Exhibit A.14 is an infinite slab source one meter thick with a 15-cm overburden. The dose point of interest is one meter above the surface of the covering overburden.

Output from the example calculation is given in Exhibit 15. The output defines the nature and composition of the various shield layers, provides information on the selected shield thicknesses and geometry, and provides limited information on the build-up factors used in the calculations. The column of radionuclides and associated dose rate factors is purposely formatted in this fashion to ease editing incorporation into the GENII system data files. This structure is compatible with the GENII file GRDF.DAT. The units displayed are selected using the IEXTU parameter illustrated in Exhibit A.14. Selection of this parameter must be appropriate to the geometry chosen. The user is referred to the input instructions.

A.7 DITTY SAMPLE PROBLEM

The DITTY sample problem represents the most common use of DITTY; the calculation of long-term population dose to a downstream population from a time-varying release to surface water. The input file for Sample Problem 7 is presented as Exhibit A.16. The waterborne release is given in terms of curies/year released into the river. The input of the source to the river is selected in this example to be via an input file copied into the input buffer WATREL.DAT. This file is presented as Exhibit A.17. The sample input file of Exhibit A.17 contains data for three radionuclides as a series of time/release quantity pairs. Because the parameter TZR is not set in the DITTY input file, the times in the WATREL file are assumed to be years since the start of the release in the year 2000 A.D.

EXHIBIT A.14. GENII Input File - Sample Problem 6

```
GENII Sample Problem 6 (EXTDF)
 &INPUT
  JBUF = 1,
  IGEOM=5,
  IEXTU = 3,
  ANG1 = 90.0, NSHLD=3,
  X = 215.,
  T =       100.0,  15.0,  100.0,
 &END
0   16       1.8    0.0    0.0   0.0    0.0
0   16       0.0    1.8    0.0   0.0    0.0
1    3       0.0    0.0 .00129   0.0    0.0
```

EXHIBIT A.15. GENII Output File - Problem 6

EXTDF Dose Calculation Program
(Version 1.351 30-Aug-88)

Case title: GENII Sample Problem 6 (EXTDF)

Executed on: 09/27/88 at 17:20:15 Page 1

Shield composition (gm/cc):

	1	2	3	4	5
ORDCONC	1.8E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
ORDCONC	0.0E+00	1.8E+00	0.0E+00	0.0E+00	0.0E+00
AIR	0.0E+00	0.0E+00	1.3E-03	0.0E+00	0.0E+00

Shield thickness (cm):
1.0E+02 1.5E+01 1.0E+02

Geometry index: 5
INFINITE SLAB source
SLAB shield
Distance to detector: 2.150E+02 cm
Angle: 0.0 degrees
Source thickness: 100.00 cm
Taylor build-up data for shield: 1
with effective atomic number: 10.0

===

Input prepared by: ______________ Date: ________

Input checked by: ______________ Date: ________

===

Units are person-Sv/yr per Bq/m3 (GENII)

H 3	0.00E+00
BE10	1.66E-15
C 14	8.89E-19
N 13	9.53E-11
F 18	9.23E-11
NA22	2.77E-10
NA24	1.07E-09
SI31	2.32E-13
P 32	1.56E-13

EXHIBIT A.15. (contd)

P 33	2.12E-17
S 35	1.31E-18
CL36	5.16E-15
K 40	2.87E-11
AR39	1.71E-15
AR41	1.90E-10
CA41	0.00E+00
CA45	2.40E-17
SC46	2.83E-10
CR51	2.43E-12
MN54	9.20E-11
MN56	3.27E-10
FE55	0.00E+00
FE59	1.73E-10
CO57	7.80E-13
CO58	1.08E-10
CO60	3.83E-10
NI59	0.00E+00
NI63	6.96E-24
NI65	9.62E-11
CU64	1.80E-11
ZN65	9.85E-11
ZN69M	4.53E-11
ZN69	1.45E-14
GA72	5.28E-10
AS76	5.68E-11
SE75	1.17E-11
SE79	5.17E-19
BR82	3.36E-10
BR83	6.85E-13
KR83M	8.11E-26
BR84	4.29E-10
KR85M	4.00E-12
KR85	2.11E-13
KR87	1.72E-10
RB87	3.08E-17
KR88	4.44E-10
RB88	1.57E-10
KR89	3.89E-10
RB89	4.04E-10
SR89	1.14E-13
SR87M	2.03E-11
RB86	1.41E-11
SR85	4.74E-11
SR90	1.28E-15
Y 90	3.83E-13
SR91	8.95E-11
Y 91M	5.96E-11
Y 91	6.76E-13
SR92	2.55E-10

Y 92	4.41E-11
Y 93	1.62E-11
MO93	0.00E+00
ZR93	1.35E-24
NB93M	0.00E+00
ZR95	7.83E-11
NB95M	1.59E-12
NB95	9.19E-11
ZR97	2.64E-11
NB97M	6.14E-11
NB97	6.44E-11
NB94	1.55E-10
MO99	1.29E-11
TC99M	6.18E-13
TC99	4.52E-17
TC101	2.77E-11
RU103	4.67E-11
PD103	7.62E-15
RH103M	1.13E-25
RU105	7.20E-11
RH105	6.03E-12
RU106	2.36E-11
PD107	0.00E+00
PD109	8.98E-14
AG110M	3.54E-10
AG111	1.78E-12
CD109	0.00E+00
CD113M	1.76E-15
CD115M	3.61E-12
CD115	1.82E-11
IN115M	1.16E-11
IN111	6.56E-12
IN114M	9.35E-12
SN113	1.23E-13
IN113M	1.60E-11
SN117M	6.14E-13
SN119M	6.42E-19
SN121M	0.00E+00
SN121	0.00E+00
SN123	1.08E-12
I 125	5.10E-23
SN125	5.06E-11
SB125	4.23E-11
TE125M	1.96E-15
SN126	3.53E-14
SB126M	1.56E-10
SB126	2.71E-10
SB122	4.97E-11
SB124	3.09E-10
SB127	6.43E-11

EXHIBIT A.15. (contd)

TE127M	7.22E-15
TE127	5.10E-13
TE123M	5.83E-13
TE129M	2.84E-12
TE129	5.62E-12
I 129	5.72E-19
TE131M	1.87E-10
TE131	4.14E-11
I 131	2.65E-11
XE131M	1.36E-14
TE132	5.58E-12
I 132	2.82E-10
TE133M	3.38E-10
TE133	1.24E-10
I 133	5.93E-11
XE133M	6.50E-13
XE133	2.84E-14
TE134	7.85E-11
I 134	3.41E-10
CS134M	8.95E-14
CS134	1.77E-10
I 130	2.07E-10
I 135	2.70E-10
XE135M	3.87E-11
XE135	7.86E-12
CS135	4.52E-18
XE137	2.64E-11
CS137	5.33E-11
XE138	2.30E-10
CS138	4.65E-10
CS139	6.25E-11
BA139	1.43E-12
BA140	1.59E-11
LA140	3.64E-10
CS136	2.70E-10
BA141	9.76E-11
LA141	8.96E-12
CE141	3.36E-13
BA142	1.20E-10
LA142	6.63E-10
CE143	1.36E-11
PR143	1.45E-14
CE144	7.61E-14
PR144M	1.70E-19
PR144	6.99E-12
PR142	1.02E-11
ND147	8.51E-12
PM147	2.83E-17
SM147	0.00E+00
PM148M	2.24E-10

EXHIBIT A.15. (contd)

PM148	9.44E-11
PM149	5.01E-13
PM151	2.31E-11
SM151	1.25E-22
SM153	3.35E-13
EU152M	4.07E-11
EU152	1.63E-10
EU154	1.63E-10
EU155	1.67E-13
EU156	2.55E-10
GD153	2.10E-13
GD159	2.19E-12
TB160	1.41E-10
TB161	2.85E-15
DY165	1.56E-12
HO166M	1.45E-10
HO166	3.73E-12
ER169	1.15E-16
ER171	2.08E-11
TA182	1.90E-10
W 181	1.51E-15
W 185	4.86E-16
W 187	4.30E-11
RE187	0.00E+00
OS185	6.43E-11
OS191	1.83E-13
IR192	6.68E-11
HG203	4.89E-12
TH230	4.90E-16
RA226	2.50E-14
RN222	2.83E-10
PB210	1.31E-20
BI210	3.15E-14
PO210	9.75E-16
U 232	5.06E-16
TH232	2.92E-16
RA228	9.00E-31
AC228	1.40E-10
TH228	1.77E-14
RA224	3.05E-13
PB212	3.68E-12
BI212	3.39E-10
U 234	2.78E-16
U 236	3.56E-18
U 235	8.96E-13
TH231	1.82E-14
PA231	1.68E-12
AC227	6.81E-16
TH227	3.42E-12
FR223	1.40E-12

EXHIBIT A.16. (contd)

RA223	1.66E-11
U 237	2.09E-12
NP237	5.14E-14
PA233	1.37E-11
U 233	1.26E-15
TH229	4.33E-13
RA225	8.50E-17
AC225	2.27E-11
U 238	3.11E-18
TH234	2.05E-12
PA234	2.46E-10
PU236	2.64E-18
PU237	2.33E-13
AM242M	1.14E-15
AM242	6.85E-14
CM242	7.11E-20
PU242	8.15E-20
NP238	8.65E-11
PU238	8.71E-20
CM244	5.23E-20
PU244	9.13E-23
U 240	4.10E-11
PU240	9.66E-20
CM245	3.35E-13
PU241	0.00E+00
AM241	7.18E-17
CM246	8.91E-23
CM247	3.52E-11
CM243	2.07E-12
PU243	1.92E-13
AM243	1.82E-14
NP239	3.17E-12
PU239	3.30E-16
CM248	4.83E-20
CF252	8.61E-19

EXHIBIT A.16. GENII Input File - Sample Problem 7

```
GENII Sample Problem 7:  DITTY Long-Term Surface Water Release
    3
H 3
C 14
CL36
 &INPUT IWAT=1, IPATH=2, LUW=2, IPOPL=2,
  CFLO=120000.,
  RM=1.0,
  PL1(1)=294830.,391538.,431210.,469891.,1273208.,4932964.,
  TL(1)=1990., 2100.,2200.,2300.,2990.,11900.,
  NTL=6,
  USAGE(1)=0.3,0.,0.,0.,438.,17.,17.,
  CONSUM(1)=15.,276.,20.,230.,40.,30.,8.5,
  EXTIM=2920.,MOPYR=6, RIRR=150.,
  GRWP(1)=90.,90.,90.,30.,3*90.,
  YELD(1)=1.5,4.,0.84,1.3,3*0.84,
 &END
```

EXHIBIT A.17. GENII Input File WATREL.DAT - Sample Problem 7

```
DITTY Sample Surface Water Release Input
3
C 14          50
6.1872E+027.2649E-03
6.6604E+024.7932E-02
7.1708E+021.5038E-01
7.7210E+022.5798E-01
8.3143E+023.1270E-01
8.9541E+023.3794E-01
9.6439E+023.4616E-01
1.0388E+033.4491E-01
1.1190E+033.4169E-01
1.2054E+033.3814E-01
1.2987E+033.3434E-01
1.3992E+033.3030E-01
1.5077E+033.2600E-01
1.6245E+033.2142E-01
1.7506E+033.1656E-01
1.8865E+033.1140E-01
2.0331E+033.0592E-01
2.1911E+033.0013E-01
2.3615E+032.9401E-01
2.5452E+032.8755E-01
2.7433E+032.8074E-01
2.9569E+032.7358E-01
3.1872E+032.6606E-01
3.4355E+032.5819E-01
3.7033E+032.4996E-01
3.9921E+032.4138E-01
4.3034E+032.3246E-01
4.6391E+032.2320E-01
5.0011E+032.1364E-01
5.3914E+032.0379E-01
5.8122E+031.9367E-01
6.2660E+031.8333E-01
6.7553E+031.7279E-01
7.2829E+031.6211E-01
7.8518E+031.5133E-01
8.4652E+031.4051E-01
9.1266E+031.2970E-01
9.8398E+031.1898E-01
1.0609E+041.0841E-01
1.1438E+049.8066E-02
1.2332E+048.8013E-02
1.3296E+047.8325E-02
1.4336E+046.9070E-02
1.5456E+046.0312E-02
1.6665E+045.2109E-02
1.7968E+044.4509E-02
1.9373E+043.7552E-02
```

2.0888E+043.1263E-02
2.2522E+042.5657E-02
2.4284E+043.5549E-14
H 3 26
6.1872E+024.7039E-17
6.4163E+024.0034E-17
6.6541E+022.6880E-17
6.9010E+021.4335E-17
7.1572E+026.1280E-18
7.4231E+022.1265E-18
7.6991E+026.0920E-19
7.9855E+021.4723E-19
8.2828E+023.0781E-20
8.5913E+025.7119E-21
8.9116E+029.6142E-22
9.2440E+021.4889E-22
9.5889E+022.1358E-23
9.9470E+022.8412E-24
1.0319E+033.4999E-25
1.0704E+033.9820E-26
1.1105E+034.1724E-27
1.1520E+034.0137E-28
1.1951E+033.5332E-29
1.2399E+032.8366E-30
1.2863E+032.0698E-31
1.3346E+031.3676E-32
1.3846E+038.1527E-34
1.4365E+034.3675E-35
1.4904E+032.0941E-36
1.5464E+038.9489E-38
CL36 51
6.1872E+022.0473E-04
6.4163E+026.3379E-04
6.6541E+021.6255E-03
6.9010E+023.4837E-03
7.1572E+026.3087E-03
7.4231E+029.7953E-03
7.6991E+021.3290E-02
7.9855E+021.6134E-02
8.2828E+021.8013E-02
8.5913E+021.9020E-02
8.9116E+021.9457E-02
9.2440E+021.9610E-02
9.5889E+021.9652E-02
9.9470E+021.9661E-02
1.0319E+031.9661E-02
1.0704E+031.9659E-02
1.1105E+031.9658E-02
1.1520E+031.9656E-02
1.1951E+031.9654E-02

EXHIBIT A.17. (contd)

1.2399E+031.9652E-02
1.2863E+031.9650E-02
1.3346E+031.9647E-02
1.3846E+031.9645E-02
1.4365E+031.9643E-02
1.4904E+031.9640E-02
1.5464E+031.9638E-02
1.6044E+031.9635E-02
1.6647E+031.9632E-02
1.7273E+031.9630E-02
1.7922E+031.9627E-02
1.8596E+031.9624E-02
1.9295E+031.9620E-02
2.0021E+031.9617E-02
2.0774E+031.9614E-02
2.1556E+031.9610E-02
2.2368E+031.9606E-02
2.3210E+031.9603E-02
2.4084E+031.9599E-02
2.4991E+031.9595E-02
2.5933E+031.9590E-02
2.6910E+031.9586E-02
2.7925E+031.9581E-02
2.8978E+031.9577E-02
3.0070E+031.9572E-02
3.1204E+031.9566E-02
3.2382E+031.9561E-02
3.3603E+031.9334E-02
3.4871E+039.1797E-03
3.6187E+033.2974E-04
3.7553E+037.5749E-07
3.8971E+031.8652E-10

EXHIBIT A.18. GENII Output File - Sample Problem 7

DITTY Dose Calculation Program
(GENII Version 1.339 22-Aug-88)

Integrated population dose calculated for chronic liquid release
Release from time 2000. A.D. onward for 10,000 years
Case title: GENII Sample Problem 7: DITTY Long-Term Surface Water Release
Executed on: 08/25/88 at 14:43:15.0 Page 1

---- DATA LIBRARIES USED ----(File)-----

Master Radionuclide Data:	(2)
RMDLIB - Radionuclide Master Library (4-Dec-87 RAP)	
Food Concentration Ratios:	(8)
Food Transfer Factor Library - PNL xxxx (BAN 19-Aug-88) (UPDATED LEACHING FA	
Fresh Water Bioaccumulation Factors:	(9)
Bioaccumulation Factor Library - PNL xxxx (5-Aug-88)	
External Exposure D.F.'s:	(10)
External Dose Factors for GENII in person-Sv/yr per Bq/n (23-Mar-88 RAP)	
Inhalation/Ingestion D.F.'s:	(30)
DITTY Internal Dose Factors - 19-Aug-88 (RAP)	
Waterborne Release Data:	(31)
DITTY Sample Surface Water Release Input	

---- MASTER RADIONUCLIDE CONTROL LIST ----

H 3 C 14 CL36

---- TERRESTRIAL/AQUATIC PATHWAY DATA FOR AN AVERAGE INDIVIDUAL ----

Pathway	Growing Period (days)	Yield (kg/m2)	Consumption (kg/yr)	Pathway	Usage (kg or hr/yr)
LEAFY VEG	9.0E+01	1.5E+00	1.5E+01	FISH	3.0E-01
OTHER VEG	9.0E+01	4.0E+00	2.8E+02	CRUSTACEA	0.0E+00
EGGS	9.0E+01	8.4E-01	2.0E+01	MOLLUSKS	0.0E+00
MILK	3.0E+01	1.3E+00	2.3E+02	PLANTS	0.0E+00
BEEF	9.0E+01	8.4E-01	4.0E+01	DRINKING WATER	4.4E+02
PORK	9.0E+01	8.4E-01	3.0E+01	SEDIMENT EXPOSU	1.7E+01
POULTRY	9.0E+01	8.4E-01	8.5E+00	SWIMMING TIME	1.7E+01

External Exposure Time: 2.92E+03 hr/yr

---- LIQUID RELEASE PARAMETERS ----

River Flow Rate, (ft3/sec) :	1.2E+05	Months/Year Irrigated :	6.0E+00
Reconcentration Ratio :	1.0E+00	Irrigation Rate	
Mixing Ratio :	1.0E+00	(liters/m2/month) :	1.5E+02

EXHIBIT A.18. (contd)

Input Prepared By: ______________________________ Date: _______________

Input Checked By: ______________________________ Date: _______________

DITTY Dose Calculation Program
(GENII Version 1.339 22-Aug-88)

Integrated population dose calculated for chronic liquid release
Release from time 2000. A.D. onward for 10,000 years
Case title: GENII Sample Problem 7: DITTY Long-Term Surface Water Release
Executed on: 08/25/88 at 14:43:15.0 Page 2

---- WATER RELEASE OF EACH RADIONCLIDE PER 70-YR PERIOD (Ci) ----

Radio-nuclide	Period/	Activity	Period/	Activity	Period/	Activity	Period/	Activity	Period/	Activity
H 3	9	5.1E-16	10	1.9E-15	11	2.8E-16	12	1.4E-17	13	3.8E-19
	14	7.9E-21	15	1.6E-22	16	3.4E-24	17	6.8E-26	18	1.2E-27
	19	2.1E-29								
C 14	9	1.4E-01	10	4.0E+00	11	1.3E+01	12	2.0E+01	13	2.3E+01
	14	2.4E+01	15	2.4E+01	16	2.4E+01	17	2.4E+01	18	2.4E+01
	19	2.3E+01	20	2.3E+01	21	2.3E+01	22	2.3E+01	23	2.3E+01
	24	2.2E+01	25	2.2E+01	26	2.2E+01	27	2.2E+01	28	2.2E+01
	29	2.2E+01	30	2.1E+01	31	2.1E+01	32	2.1E+01	33	2.1E+01
	34	2.1E+01	35	2.0E+01	36	2.0E+01	37	2.0E+01	38	2.0E+01
	39	2.0E+01	40	2.0E+01	41	1.9E+01	42	1.9E+01	43	1.9E+01
	44	1.9E+01	45	1.9E+01	46	1.9E+01	47	1.8E+01	48	1.8E+01
	49	1.8E+01	50	1.8E+01	51	1.8E+01	52	1.8E+01	53	1.8E+01
	54	1.7E+01	55	1.7E+01	56	1.7E+01	57	1.7E+01	58	1.7E+01
	59	1.7E+01	60	1.7E+01	61	1.6E+01	62	1.6E+01	63	1.6E+01
	64	1.6E+01	65	1.6E+01	66	1.6E+01	67	1.6E+01	68	1.5E+01
	69	1.5E+01	70	1.5E+01	71	1.5E+01	72	1.5E+01	73	1.5E+01
	74	1.5E+01	75	1.5E+01	76	1.4E+01	77	1.4E+01	78	1.4E+01
	79	1.4E+01	80	1.4E+01	81	1.4E+01	82	1.4E+01	83	1.4E+01
	84	1.4E+01	85	1.3E+01	86	1.3E+01	87	1.3E+01	88	1.3E+01
	89	1.3E+01	90	1.3E+01	91	1.3E+01	92	1.3E+01	93	1.3E+01
	94	1.2E+01	95	1.2E+01	96	1.2E+01	97	1.2E+01	98	1.2E+01
	99	1.2E+01	100	1.2E+01	101	1.2E+01	102	1.2E+01	103	1.2E+01
	104	1.1E+01	105	1.1E+01	106	1.1E+01	107	1.1E+01	108	1.1E+01
	109	1.1E+01	110	1.1E+01	111	1.1E+01	112	1.1E+01	113	1.1E+01
	114	1.0E+01	115	1.0E+01	116	1.0E+01	117	1.0E+01	118	1.0E+01
	119	1.0E+01	120	1.0E+01	121	9.9E+00	122	9.8E+00	123	9.7E+00
	124	9.6E+00	125	9.5E+00	126	9.5E+00	127	9.4E+00	128	9.3E+00
	129	9.2E+00	130	9.1E+00	131	9.1E+00	132	9.0E+00	133	8.9E+00
	134	8.8E+00	135	8.8E+00	136	8.7E+00	137	8.6E+00	138	8.6E+00

	139	8.5E+00	140	8.4E+00	141	8.3E+00	142	8.3E+00	143	8.2E+00
CL36	9	3.5E-03	10	1.4E-01	11	6.2E-01	12	1.1E+00	13	1.3E+00
	14	1.4E+00	15	1.4E+00	16	1.4E+00	17	1.4E+00	18	1.4E+00
	19	1.4E+00	20	1.4E+00	21	1.4E+00	22	1.4E+00	23	1.4E+00
	24	1.4E+00	25	1.4E+00	26	1.4E+00	27	1.4E+00	28	1.4E+00
	29	1.4E+00	30	1.4E+00	31	1.4E+00	32	1.4E+00	33	1.4E+00
	34	1.4E+00	35	1.4E+00	36	1.4E+00	37	1.4E+00	38	1.4E+00
	39	1.4E+00	40	1.4E+00	41	1.4E+00	42	1.4E+00	43	1.4E+00
	44	1.4E+00	45	1.4E+00	46	1.4E+00	47	1.4E+00	48	1.4E+00
	49	1.2E+00	50	7.7E-01	51	4.2E-01	52	1.0E-01	53	1.4E-02
	54	2.5E-03	55	3.1E-05	56	5.9E-06				

DITTY Dose Calculation Program
(GENII Version 1.339 22-Aug-88)

Integrated population dose calculated for chronic liquid release
Release from time 2000. A.D. onward for 10,000 years
Case title: GENII Sample Problem 7: DITTY Long-Term Surface Water Release
Executed on: 08/25/88 at 14:43:15.0 Page 3

---- POPULATION DATA ----

Population for Chronic Waterborne Release at the following Times A.D.:

Time	Population
1990.	2.9E+05
2100.	3.9E+05
2200.	4.3E+05
2300.	4.7E+05
2990.	1.3E+06
11900.	4.9E+06

DITTY Dose Calculation Program
(GENII Version 1.339 22-Aug-88)

Integrated population dose calculated for chronic liquid release
Release from time 2000. A.D. onward for 10,000 years
Case title: GENII Sample Problem 7: DITTY Long-Term Surface Water Release
Executed on: 08/25/88 at 14:43:15.0 Page 4

Population for Waterborne Release:

Period/PL	Period/PL	Period/PL	Period/PL	Period/PL	Period/PL
0 0.0E+00	1 3.3E+05	2 3.9E+05	3 4.2E+05	4 4.5E+05	5 4.9E+05
6 5.7E+05	7 6.5E+05	8 7.3E+05	9 8.1E+05	10 8.9E+05	11 9.8E+05
12 1.1E+06	13 1.1E+06	14 1.2E+06	15 1.3E+06	16 1.3E+06	17 1.3E+06
18 1.4E+06	19 1.4E+06	20 1.4E+06	21 1.5E+06	22 1.5E+06	23 1.5E+06
24 1.5E+06	25 1.6E+06	26 1.6E+06	27 1.6E+06	28 1.7E+06	29 1.7E+06
30 1.7E+06	31 1.7E+06	32 1.8E+06	33 1.8E+06	34 1.8E+06	35 1.9E+06
36 1.9E+06	37 1.9E+06	38 1.9E+06	39 2.0E+06	40 2.0E+06	41 2.0E+06
42 2.1E+06	43 2.1E+06	44 2.1E+06	45 2.1E+06	46 2.2E+06	47 2.2E+06
48 2.2E+06	49 2.3E+06	50 2.3E+06	51 2.3E+06	52 2.3E+06	53 2.4E+06
54 2.4E+06	55 2.4E+06	56 2.5E+06	57 2.5E+06	58 2.5E+06	59 2.5E+06
60 2.6E+06	61 2.6E+06	62 2.6E+06	63 2.7E+06	64 2.7E+06	65 2.7E+06
66 2.7E+06	67 2.8E+06	68 2.8E+06	69 2.8E+06	70 2.9E+06	71 2.9E+06
72 2.9E+06	73 3.0E+06	74 3.0E+06	75 3.0E+06	76 3.0E+06	77 3.1E+06
78 3.1E+06	79 3.1E+06	80 3.2E+06	81 3.2E+06	82 3.2E+06	83 3.2E+06
84 3.3E+06	85 3.3E+06	86 3.3E+06	87 3.4E+06	88 3.4E+06	89 3.4E+06
90 3.4E+06	91 3.5E+06	92 3.5E+06	93 3.5E+06	94 3.6E+06	95 3.6E+06
96 3.6E+06	97 3.6E+06	98 3.7E+06	99 3.7E+06	100 3.7E+06	101 3.8E+06
102 3.8E+06	103 3.8E+06	104 3.8E+06	105 3.9E+06	106 3.9E+06	107 3.9E+06
108 4.0E+06	109 4.0E+06	110 4.0E+06	111 4.0E+06	112 4.1E+06	113 4.1E+06
114 4.1E+06	115 4.2E+06	116 4.2E+06	117 4.2E+06	118 4.2E+06	119 4.3E+06
120 4.3E+06	121 4.3E+06	122 4.4E+06	123 4.4E+06	124 4.4E+06	125 4.4E+06
126 4.5E+06	127 4.5E+06	128 4.5E+06	129 4.6E+06	130 4.6E+06	131 4.6E+06
132 4.6E+06	133 4.7E+06	134 4.7E+06	135 4.7E+06	136 4.8E+06	137 4.8E+06
138 4.8E+06	139 4.8E+06	140 4.9E+06	141 4.9E+06	142 4.9E+06	143 4.9E+06

DITTY Dose Calculation Program
(GENII Version 1.339 22-Aug-88)

Integrated population dose calculated for chronic liquid release
Release from time 2000. A.D. onward for 10,000 years
Case title: GENII Sample Problem 7: DITTY Long-Term Surface Water Release
Executed on: 08/25/88 at 14:43:15.0 Page 5

Lifetime Effective Cumulative Dose Equivalent as a Function of Time

Period	Year	Dose
until	until	
10	2630.	2.29E-02
11	2700.	7.89E-01
12	2770.	3.73E+00
13	2840.	8.89E+00
14	2910.	1.53E+01
15	2980.	2.24E+01
16	3050.	2.99E+01
17	3120.	3.76E+01
18	3190.	4.54E+01
19	3260.	5.32E+01
20	3330.	6.12E+01
21	3400.	6.94E+01
22	3470.	7.76E+01
< shortened for presentation >		
138	11590.	1.02E+03
139	11660.	1.03E+03
140	11730.	1.04E+03
141	11800.	1.05E+03
142	11870.	1.05E+03
143	11940.	1.06E+03
144	12010.	1.07E+03

Dose in units of person-rem;
that is the cumulative population dose received by the local population over 10,000 years with an assumed 70-yr individual lifetime.

EXHIBIT A.18. (contd)

DITTY Dose Calculation Program
(GENII Version 1.339 22-Aug-88)

Integrated population dose calculated for chronic liquid release
Release from time 2000. A.D. onward for 10,000 years
Case title: GENII Sample Problem 7: DITTY Long-Term Surface Water Release
Executed on: 08/25/88 at 14:43:15.0 Page 9

Cumulative Population Dose Equivalent by Radionuclide

Radio-nuclide	Effective Dose Equivalent	External Dose	Annual Effective Dose Equivalent	Percent Of Total Dose
H 3	1.3E-18	9.9E-29	1.3E-18	0
C 14	9.6E+02	4.7E-02	9.6E+02	90
CL 36	1.1E+02	3.2E-04	1.1E+02	9

Dose in units of person-rem;
that is the cumulative population dose received by the local population with an assumed 70-yr individual lifetime.

EXHIBIT A.17. (contd)

DITTY Dose Calculation Program
(GENII Version 1.339 22-Aug-88)

Integrated population dose calculated for chronic liquid release
Release from time 2000. A.D. onward for 10,000 years
Case title: GENII Sample Problem 7: DITTY Long-Term Surface Water Release
Executed on: 08/25/88 at 14:43:15.0 Page 10

Maximum Dose Increment Received By Population
In Year 5430 (70-yr Time Period Number No: 49)

Organ	Cumulative Dose Equivalent	Weighting Factors	Weighted Cumulative Dose Equivalent
Gonads	1.2E+01	2.5E-01	2.9E+00
Breast	1.2E+01	1.5E-01	1.8E+00
R Marrow	1.2E+01	1.2E-01	1.4E+00
Lung	1.2E+01	1.2E-01	1.4E+00
Thyroid	1.2E+01	3.0E-02	3.5E-01
Bone Sur	6.0E+00	3.0E-02	1.8E-01
S Int.	1.2E+01	6.0E-02	7.5E-01
UL Int.	1.2E+01	6.0E-02	7.5E-01
LL Int.	1.2E+01	6.0E-02	7.5E-01
Stomach	8.1E+00	6.0E-02	4.9E-01
Cumulative Effective Dose Equivalent			1.1E+01
External Dose			3.6E-04
Lifetime Effective Cumulative Dose Equivalent			1.1E+01

Dose in units of person-rem;
that is the cumulative population dose received by the local population
with an assumed 70-yr individual lifetime.

DITTY Dose Calculation Program
(GENII Version 1.339 22-Aug-88)

Integrated population dose calculated for chronic liquid release
Release from time 2000. A.D. onward for 10,000 years
Case title: GENII Sample Problem 7: DITTY Long-Term Surface Water Release
Executed on: 08/25/88 at 14:43:15.0 Page 11

Maximum Dose Increment Received By Individual (rem)
In Year 5430 (70-yr Time Period Number No: 49)

Radio-nuclide	Effective Dose Equivalent	External Dose	Annual Effective Dose Equivalent	Percent Of Total Dose
H 3	0.0E+00	0.0E+00	0.0E+00	0
C 14	3.2E-06	1.6E-10	3.2E-06	67
CL 36	1.6E-06	4.7E-12	1.6E-06	32

DITTY Dose Calculation Program
(GENII Version 1.339 22-Aug-88)

Integrated population dose calculated for chronic liquid release
Release from time 2000. A.D. onward for 10,000 years
Case title: GENII Sample Problem 7: DITTY Long-Term Surface Water Release
Executed on: 08/25/88 at 14:43:15.0 Page 12

Population Internal Dose To Organ by Radionuclide
In Year 5430 (70-yr Time Period Number No: 49)

Radionuclide	Lung	Stomach	S Int.	UL Int.	LL Int.	Bone Su	R Marro	Testes
H 3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C 14	7.9E+00	4.5E+00	8.5E+00	8.5E+00	8.5E+00	4.1E+00	7.9E+00	7.9E+00
CL 36	3.7E+00	3.6E+00	4.0E+00	4.0E+00	4.0E+00	1.9E+00	3.7E+00	3.7E+00
Total internal	1.2E+01	8.1E+00	1.2E+01	1.2E+01	1.2E+01	6.0E+00	1.2E+01	1.2E+01

Radionuclide	Ovaries	Muscle	Thyroid	Kidneys	Liver	Spleen	S Wall
H 3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C 14	7.9E+00	8.1E+00	7.9E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CL 36	3.7E+00	3.7E+00	3.9E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Total internal	1.2E+01	1.2E+01	1.2E+01	0.0E+00	0.0E+00	0.0E+00	0.0E+00

Population Air Submersion and External Incremental Dose by Radionuclide
In Year 5430 (70-yr Time Period Number No: 49)

Radionuclide	Air Submer-sion	Exter-nal
H 3	0.0E+00	0.0E+00
C 14	4.4E-10	3.5E-04
CL 36	5.9E-12	1.0E-05
Total external	4.5E-10	3.6E-04

Dose in units of person-rem;
that is the cumulative population dose received by the local population with an assumed 70-yr individual lifetime.

EXHIBIT A.18. (contd)

DITTY Dose Calculation Program
(GENII Version 1.339 22-Aug-88)

Integrated population dose calculated for chronic liquid release
Release from time 2000. A.D. onward for 10,000 years
Case title: GENII Sample Problem 7: DITTY Long-Term Surface Water Release
Executed on: 08/25/88 at 14:43:15.0 Page 13

Population Internal Dose To Organ by Exposure Pathway

In Year 5430 (70-yr Time Period Number No: 49)

Pathway	Lung	Stomach	S Int.	UL Int.	LL Int.	Bone Su	R Marro	Testes
Inhalation	1.5E-04	8.7E-05	1.6E-04	1.6E-04	1.6E-04	7.9E-05	1.5E-04	1.5E-04
Ingestion (Terr)	6.4E+00	5.1E+00	6.8E+00	6.8E+00	6.8E+00	3.3E+00	6.3E+00	6.4E+00
Ingestion (Aqua)	4.8E+00	2.8E+00	5.2E+00	5.2E+00	5.2E+00	2.5E+00	4.8E+00	4.8E+00
Drinking Water	3.9E-01	2.4E-01	4.2E-01	4.2E-01	4.2E-01	2.0E-01	3.9E-01	3.9E-01
Total internal	1.2E+01	8.1E+00	1.2E+01	1.2E+01	1.2E+01	6.0E+00	1.2E+01	1.2E+01

Pathway	Ovaries	Muscle	Thyroid	Kidneys	Liver	Spleen	S Wall
Inhalation	1.5E-04	1.5E-04	1.5E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ingestion (Terr)	6.4E+00	6.4E+00	6.5E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ingestion (Aqua)	4.8E+00	5.0E+00	4.8E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Drinking Water	3.9E-01	4.0E-01	3.9E-01	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Total internal	1.2E+01	1.2E+01	1.2E+01	0.0E+00	0.0E+00	0.0E+00	0.0E+00

Dose in units of person-rem;
that is the cumulative population dose received by the local population
with an assumed 70-yr individual lifetime.

9 1 0 4 8 0 5 8 5

As can be seen in Exhibit A.16, the river flow averages 120,000 cfs, and the release is assumed to be uniformly mixed in the river by the time it reaches the majority of the users of the water. The exposed population grows from 295,000 people in the year 1990 to about 4.9 million in ten thousand years. The population is assumed to drink the river water and to eat a small amount of fish from the river. Crops are irrigated with the river water for 6 months/year at a rate of 150 liters/m^2/month. The consumption parameters used mirror those defaults for an average individual provided in APPRENTICE.

The output for this sample problem is presented as Exhibit A.18. The pages are numbered in the upper right-hand corner. For this example, much of the interpretive graphic output has been turned off, to shorten the output. The first page is a quality assurance page, repeating and summarizing the input. The second page is a summary of the WATREL.DAT input file, with the releases integrated over the 70-year time increments used in DITTY. Page three repeats the population input data (this can be a larger output if the atmospheric dispersion options are turned on). The fourth page provides the population interpolated linearly into each of the 143 70-year time intervals. Pages 5 through 8 provide the cumulative lifetime population doses as a function of time for each time interval, in person-rem. The output has been shortened for presentation in this document. Page 9 presents the total cumulative population dose equivalent contributed by each radionuclide, in person-rem. The maximum incremental population dose, that is, the population dose received during the single 70-year time interval at which the population dose rate was the greatest, is given on page 10. The maximum dose increment received by an average individual in this population, during the period of maximum population dose accrual, by radionuclide, is given on page 11. The total population organ doses during the maximum dose rate period are given by radionuclide on page 12. Finally, the total population internal dose by organ by pathway during the maximum dose rate period is presented on page 13.

A.8 SAMPLE PROBLEM CALCULATION BATCH FILE

The sample problems are provided as a part of the GENII system distribution package, on a separate disk. Upon the establishment of the GENII system on a new computer, it is wise to run the sample problems and compare the calculated output with the samples provided in this document to ensure that the system is functioning correctly. This may be done in a single step using a batch file. The batch file used to prepare the sample problems in this appendix is provided on the sample problem disk. On the disk it is called simply SAMPLE.BAT. It is shown here as Exhibit A.19. This batch file was established for the GENII system resident on hard disk labeled C:, in a \GENII\ subdirectory, with the sample input on a floppy disk in drive A:. The batch file may be modified as needed for other situations.

A few comments may be made about this batch file. The "rem" notation is the DOS notation for a comment line. No commands are executed for the lines beginning with "rem". The "erase" command is standard APPRENTICE technique for assuring that correct data is used in all calculations. It clears the input file buffers of previously used information. Thus, if the user forgets to assign a file, the run will terminate rather than continue with the wrong input file. If no files are active with those names, a "FILE NOT FOUND" message will be displayed on the control monitor. This is an informative message, and should not be interpreted to mean that something is wrong. The "if errorlevel" commands are statements that prevent the code from performing unnecessary calculations should any one module of the system fail for any reason. Should you run the batch file and get results for the samples at the beginning and the end of the file, but not for one in the middle, it is because a single module has failed for some reason, and the batch file has circumvented the error and continued with the next set.

EXHIBIT A.19. GENII Execution Control File - All Sample Problems

```
CLS
rem                    GENII Sample Problem Execution Control File
rem                    5-Aug-88 RAP
rem
rem
rem                    GENII
rem                    Hanford Environmental Dosimetry Software System
rem
rem                    Pacific Northwest Laboratory
rem                    Richland WA
rem
rem                    Contact:  Bruce Napier (509) 375-3896
rem
 echo off
 erase  c:\genii\genii.in
 erase  c:\genii\pop.in
 erase  c:\genii\jointfre.in
 erase  c:\genii\chiq.in
 erase  c:\genii\foodprod.in
 erase  c:\genii\env.in
 erase  c:\genii\genii.out
 erase  c:\genii\env.out
 erase  c:\genii\genii2.out
 erase  c:\genii\dose.out
echo on
 copy a:jf20089.ave  c:\genii\jointfre.in
 copy a:pop200.87 c:\genii\pop.in
 copy a:sample1.in c:\genii\genii.in
 c:\genii\envin
 if errorlevel 1 goto stop1
 c:\genii\env
 if errorlevel 1 goto stop1
 c:\genii\dose
 if errorlevel 1 goto stop1
rem
 copy c:\genii\genii.out+ c:\genii\genii2.out+ c:\genii\dose.out a:sample1.out
rem
:stop1
rem
 echo off
 erase  c:\genii\genii.in
 erase  c:\genii\pop.in
 erase  c:\genii\jointfre.in
 erase  c:\genii\chiq.in
 erase  c:\genii\foodprod.in
 erase  c:\genii\env.in
 erase  c:\genii\genii.out
 erase  c:\genii\env.out
 erase  c:\genii\genii2.out
 erase  c:\genii\dose.out
```

```
echo on
 copy a:sample2.in c:\genii\genii.in
 c:\genii\envin
 if errorlevel 1 goto stop2
 c:\genii\env
 if errorlevel 1 goto stop2
 c:\genii\dose
 if errorlevel 1 goto stop2
rem
 copy c:\genii\genii.out+ c:\genii\genii2.out+ c:\genii\dose.out a:sample2.out
rem
:stop2
rem
 echo off
 erase  c:\genii\genii.in
 erase  c:\genii\pop.in
 erase  c:\genii\jointfre.in
 erase  c:\genii\chiq.in
 erase  c:\genii\foodprod.in
 erase  c:\genii\env.in
 erase  c:\genii\genii.out
 erase  c:\genii\env.out
 erase  c:\genii\genii2.out
 erase  c:\genii\dose.out
echo on
 copy a:sample3.in c:\genii\genii.in
 c:\genii\envin
 if errorlevel 1 goto stop3
 c:\genii\env
 if errorlevel 1 goto stop3
 c:\genii\dose
 if errorlevel 1 goto stop3
rem
 copy c:\genii\genii.out+ c:\genii\genii2.out+ c:\genii\dose.out a:sample3.out
rem
:stop3
rem
 echo off
 erase  c:\genii\genii.in
 erase  c:\genii\pop.in
 erase  c:\genii\jointfre.in
 erase  c:\genii\chiq.in
 erase  c:\genii\foodprod.in
 erase  c:\genii\env.in
 erase  c:\genii\genii.out
 erase  c:\genii\env.out
 erase  c:\genii\genii2.out
 erase  c:\genii\dose.out
echo on
 copy a:sample4.in c:\genii\genii.in
```

EXHIBIT A.19. (contd)

```
 c:\genii\envin
 if errorlevel 1 goto stop4
 c:\genii\env
 if errorlevel 1 goto stop4
 c:\genii\dose
 if errorlevel 1 goto stop4
rem
 copy c:\genii\genii.out+ c:\genii\genii2.out+ c:\genii\dose.out a:sample4.out
rem
:stop4
rem
copy a:sample5.in c:\genii\intdf.in
c:\genii\intdf
copy c:\genii\intdf.out a:sample5.out
rem
copy a:sample6.in c:\genii\extdf.in
c:\genii\extdf
copy c:\genii\extdf.out a:sample6.out
rem
copy a:sample7.in c:\genii\ditty.in
copy a:watrel.dat c:\genii\watrel.dat
c:\genii\ditty
copy c:\genii\ditty.out a:sample7.out
```

REFERENCES

International Commission on Radiological Protection (ICRP). 1979. "ICRP Publication 30, Limits for Intakes of Radionuclides by Workers." Supplement to Part 1, *Annals of the ICRP*, Vol. 3, No. 1-4, Pergamon Press, New York, New York.

Sommer, D. J., R. G. Rau, and D. C. Robinson. 1981. *Population Estimates for the Areas Within a 50-Mile Radius of Four Reference Points on the Hanford Site*. PNL-4010, Pacific Northwest Laboratory, Richland, Washington.

APPENDIX B

SELF-GENERATED DIAGNOSTICS

APPENDIX B

SELF-GENERATED DIAGNOSTICS

The GENII Software Package generates an alphabetical list of messages contained in Table B.1. The error type of each message is identified. There are five error types: 1) warnings, 2) scenarios errors, 3) program errors, 4) scenario/file errors, and 5) program/file errors. User response to these error types varies based on user interaction level.

Level 0 users of GENII may encounter warning messages. These should be considered informational; no action is necessary. Because Level 0 users interact with APPRENTICE, no scenario errors or scenario/file errors should be encountered. APPRENTICE should have ensured that all scenario errors and most scenario/file errors were avoided. However, in the continual process of upgrading APPRENTICE, errors may have been introduced. All scenario errors should be handled as program errors. Scenario/file errors indicate problems with the population, joint frequency, Chi/Q, or food production files. The authors should be notified of all program and file errors.

Level 1 users may encounter all five types of error messages. Warnings are informational only; no action is necessary. Scenario errors are frequently introduced when the user directly edits an input file. Scenario/file errors indicate a problem with the auxiliary input files. The authors should be notified of all program errors. If the user has not made any changes to the GENII data libraries, the authors should also be notified of any program/file errors.

B.1 SCENARIO ERRORS

Scenario errors reflect incompatibilities between option selections and input parameter values. Subroutine CHECK of program ENVIN attempts to identify scenario incompatibilities and stop execution of the program so that the user may make corrections before exposure and dose calculations are performed. When using the ENVIN/ENV/DOSE package, scenario errors are usually caused when edits are made to the input file. For example, an option flag is turned on, but changes are not made to the corresponding input parameters. Some options require complex input logic and consequently are more difficult than others to change at Level 1 usage. Notably, air transport options, near/far-field classification, and individual/population classification are more difficult to modify without error. If scenario errors are not corrected after the initial attempts, it is suggested that the user regenerate the scenario using APPRENTICE. It is probable that 1) the input file may have been corrupted or 2) the user needs APPRENTICES's guidance in constructing the particular scenario.

B.2 PROGRAM ERRORS

The authors have provided an error/upgrade form to assist the user in error notification and the authors in software configuration control. Use the form shown in Exhibit B.1 to notify the authors of program errors. It is most helpful if the input file (nnnnnnnn.IN), execution file (nnnnnnnn.BAT), and any auxiliary input files (e.g., population, joint frequency) are included on floppy disk.

B.3 SCENARIO/FILE ERRORS

If population, joint frequency, Chi/Q, or food production files have been prepared, the user should check the formats of any population, joint frequency, Chi/Q, and food production files used against the descriptions in Sections 2.2.2-2.2.5. Level 1 users should refer to Sections 2.2.1-2.2.12 for assistance in determining the cause of scenario/file errors.

B.4 PROGRAM/FILE ERRORS

Program/file errors usually indicate that the user, in attempting to expand the application of GENII for research purposes, has made incorrect changes to data files used by GENII. Check file format and usage as presented in Section 2.3 to determine the source of the error.

TABLE B.1. Self-Generated Diagnostics

Error Message		Error Type
	Cannot open file F77L.ERR, error # xxx	program
ACTIN:	Error - number of radionuclides: NNACT = xxxxxx	scenario
ACTIN:	Error - number of time periods. Radionuclide: xxxxxx, Times: yyyyyy	scenario
ACTIN:	Inventory for xxxxxx was outside 10,000-year time period.	warning
ACTIN:	NT for radionuclide xxxxxx is too large: yyyyyyy	scenario
ACTIN:	Radionuclide xxxxxx in release file not included in master list.	scenario
ACTIN:	Read error encountered. N: xxxxxx, T(N): yyyyyyy, C(N): zzzzzz	scenario/ file
ACUTE1:	XOQOPT invalid in AIRCAL: xxx	scenario
AIRLIN:	No internal dose factors for xxxxxx.	warning
BCHAIN:	Error in BCHAIN, positive argument xxxxxxxx.	program
CASE2:	NAMELIST read error encountered.	scenario
CHAIN:	Error in CHAIN, positive argument xxxxxxxx.	program
CHECK:	Air transport cannot be considered with basic concentrations.	scenario
CHECK:	Air transport option cannot be 2 or 3 for population.	scenario
CHECK:	Animal food storage times not input to acute scenario, defaults used.	warning
CHECK:	Average wind speed cannot be zero, sector xxx.	scenario
CHECK:	Basic concentration may not be input for path x when yyyyyyyy transport selected.	scenario
CHECK:	Cannot calculate population dose for near field scenario.	scenario
CHECK:	Cannot consider finite plume with input air concentration.	scenario

TABLE B.1. (contd)

Error Message		Error Type
CHECK:	Cannot consider irrigation or air deposition during a non-agricultural scenario.	scenario
CHECK:	Cannot drink or irrigate with salt water.	scenario
CHECK:	Chi/Q value must be entered when air transport option = 1.	scenario
CHECK:	Deep soil is considered. Waste depth cannot be zero.	scenario
CHECK:	Derived concentration may not be input for path x when transport or basic concentrations are input.	scenario
CHECK:	Drinking water exposure flag should be set.	scenario
CHECK:	Drinking water is from water system; however, no derived conc. has been entered.	scenario
CHECK:	Drinking water source flag incorrect.	scenario
CHECK:	Finite and infinite cloud exposures cannot be considered in one scenario.	scenario
CHECK:	Finite plume cannot be considered when chi/Q value entered.	scenario
CHECK:	Invalid air transport option for individual.	scenario
CHECK:	Invalid animal product no: xxx irrigation source index.	scenario
CHECK:	Invalid atmospheric production definition for ingestion population.	scenario
CHECK:	Invalid E/Q input option for acute release.	scenario
CHECK:	Invalid population definition option: xxx	scenario
CHECK:	Invalid residential irrigation source index.	scenario
CHECK:	Invalid terrestrial food no: xxx irrigation source index.	scenario
CHECK:	Loss of institutional control occurred before waste was stored. Invalid.	scenario

TABLE B.1. (contd)

Error Message	Error Type
CHECK: Maximum individual distance and direction must be entered when air transport option = 3. MI distance: xxxxxx MI direction index (where 1 is S -> N): yyyy	scenario
CHECK: Maximum number of distances that can be considered is 10. Input value for NDIST is xxx.	scenario
CHECK: Minimum distance cannot be less than yyy.	scenario
CHECK: No xxxxxxxx exposure paths have been selected: Please check input file.	scenario
CHECK: Not stack release, effluent temp. set to 0.0.	warning
CHECK: Not stack release, stack flow radius set to 0.0.	warning
CHECK: Not stack release, stack flow rate set to 0.0.	warning
CHECK: Not stack release, stack height set to 0.0.	warning
CHECK: Population grid must be used with air transport option = 0.	scenario
CHECK: Population grid must be used with air transport option = 2.	scenario
CHECK: Population-weighted chi/Q value must be entered when air transport option = 1.	scenario
CHECK: Production not specified for export.	scenario
CHECK: Stack radius cannot be zero.	scenario
CHECK: Surface water depth and flow rate cannot = 0.0	scenario
CHECK: Surface water flow rate cannot = 0.0.	scenario
CHECK: Surface water width, depth, or flow rate cannot = 0.0	scenario
CHECK: Waste degradation incompatible with far-field scenario.	scenario
CHECK: Waste thickness cannot be set to 0.0.	scenario
CHECK: When uniform production is assumed, consumption must be input.	scenario

TABLE B.1. (contd)

Error Message	Error Type
CHECK: When uniform production is assumed, total production must be input.	scenario
CHECK: xxxxxxxx exposure not selected: yyyyyyyy will not be considered. (warning only)	scenario
CHECK: xxxxxxxx transport has been selected: No inventory entered, please check input file.	scenario
CHECK: xxxxxxxx transport has not been selected: Inventory has been entered, please check input file.	scenario
CHECK: Yield cannot be 0.0 for animal product no. x.	scenario
CHECK: Yield cannot be 0.0 for food pathway x.	scenario
CHECK: Zero hours of inhalation exposure will equal zero dose.	scenario
CHECK: Zero inhalation rate will equal zero.	scenario
DUMRED Error while reading past unused data set. LUN: xxx Line yyy of zzz	program/ file
DUMRED: End of file reading past unused data set. LUN: xxx Line yyy of zzz	program/ file
EOVRQ: NUBAR is out if range.	scenario
EOVRQ: NMET is out of range.	scenario
EOVRQ: NDIST is out of range.	scenario
EXTDF: The following shield specs data rejected...	scenario
EXTDF: IGEOM xxx is out of range.	scenario
FILERR: Error code = 0 in FILERR	program
FILERR: Logical unit number = 0 in FILERR	program
FILERR: Error occurred while reading file \xxx\xxxxxxxx.xxx Assigned to LUN: yyy Message: zzzzzzzzzzzzzzzz	scenario/ file or program/ file

TABLE B.1. (contd)

Error Message		Error Type
FILERR:	Error opening file named \xxx\xxxxxxxx.xxx Assigned to LUN: yyy Message: zzzzzzzzzzzzzzzz	scenario/ file or program/ file
FILERR:	File out of order or other indexing problem \xxx\xxxxxxxx.xxx Assigned to LUN: yyy Message: zzzzzzzzzzzzzzzz	program/ file
FILERR:	Premature end-of-file encountered in \xxx\xxxxxxxx.xxx Assigned to LUN: yyy Message: zzzzzzzzzzzzzzzz	scenario/ file or program/ file
IDNUC:	There were xxxx unidentified radionuclides.	scenario
IDNUC:	Unidentified radionuclide in input xxxxxx.	scenario
INTPOL:	Error in direction in interpolation.	program
INTPOL:	MI distance outside range of chi/Q file.	scenario
ISOSUB:	SLTH = 0. Execution terminated in subroutine CYL	scenario
ISOSUB:	SLTH = 0. Execution terminated in subroutine DISC	scenario
ISOSUB:	VOLUME=0, execution terminated in subroutine ENDCYL	scenario
ISOSUB:	X=0. Execution terminated in subroutine DSCSRC	scenario
LS2:	Error return for LSODES2, ISTATE = xxx RWORK(11 to 14) aaa bbb ccc ddd IWORK(11 to 26) eee fff ggg hhh ...	program
METLIB:	Alkaline Earth organs expected.	program
METLIB:	No data for xxx; skipped.	warning
METLIB:	Too many organs: xxx.	program/ file
NRGLIB:	Energy library out of order. RMDLIB: xxxxxx ENERGY: yyyyyy	program/ file

TABLE B.1. (contd)

Error Message		Error Type
NUCTST:	Too many radionuclides in this case (Max=100): xxxx	scenario
OPNFIL:	Invalid value for IMODE: xxx	program
OPNFIL:	Invalid value for LUN: xxx	program
ORDIN:	INTDF can only handle 8-member chains.	program
REDFIL:	File titles do not match, LUN 11 and 13. Assumed to be invalid case.	scenario
REDSET:	Internal dose factors not found for xxxxxx.	warning
RLIBIN:	Decay chain xxxx has improper order. Current member is yyyy After zzzzzz.	program/ file
RLIBIN:	Improper number of radionuclides in library: xxxx.	program
SIJLIB:	Target organ index is 0 (IT,IORG(it): xxx yyy.	program
SWCAL:	DYXU = 0.0, invalid (divide by zero).	program
SWCAL:	DZXU = 0.0, invalid (divide by zero).	program
SWCAL:	The dilution calculation has failed. A value of 1E-20 will be returned for the mixing ratio.	warning
WBEDE:	Invalid master organ index ...	program
WBEDE4:	Invalid master organ index ...	program
XQCAL:	MI location selection error: Direction index: xxx Distance: yyy	scenario
XQIN:	Invalid INOPT in XQIN	program

EXHIBIT B.1. Software Change Packet

PNL SOFTWARE CHANGE PACKET — Change Packet Number [ ]

Software Package: GENII Hanford Environmental Dosimetry System

Program (indicate): APPRENTICE ENVIN ENV DOSE INTDF EXTDF DITTY

Document Title: Napier B. A., R. A. Peloquin, D. L. Strenge, and J. V. Ramsdell. 1988. Hanford Environmental Dosimetry Upgrade Project. The Hanford Environmental Radiation Dosimetry Software System. Vol I, II, and III. PNL-6584, Pacific Northwest Laboratory, Richland, WA.

CHANGE(S) AND/OR PROBLEM(S) REPORTED

(To be completed by person requesting change)

PROBLEM DOCUMENTATION INCLUDED

____ Input file that demonstrates problem
____ Error message
____ Output file annotated to demonstrate problem

Submitted by: ______________________ ____________
Change Requester Date

Approved by: ______________________ ____________
PNL GENII Designated Expert Date

Send to: B. A. Napier
Senior Research Scientist
Environmental Health Physics K3-54
Pacific Northwest Laboratory
Richland, WA 99352

WBS: 12914
QA: N/A

PNL-6584 Vol. 3
UC-600

PNL--6584-Vol.3

DE89 000482

HANFORD ENVIRONMENTAL DOSIMETRY UPGRADE PROJECT

GENII - THE HANFORD ENVIRONMENTAL RADIATION DOSIMETRY SOFTWARE SYSTEM

VOLUME 3: CODE MAINTENANCE MANUAL

B. A. Napier
R. A. Peloquin
D. L. Strenge
J. V. Ramsdell

September 1988

Prepared for
the U.S. Department of Energy
under Contract DE-AC06-76RLO 1830

Pacific Northwest Laboratory
Richland, Washington 99352

ABSTRACT

The Hanford Environmental Dosimetry Upgrade Project was undertaken to incorporate the internal dosimetry models recommended by the International Commission on Radiological Protection (ICRP) in updated versions of the environmental pathway analysis models used at Hanford. The resulting second generation of Hanford environmental dosimetry computer codes is compiled in the Hanford Environmental Dosimetry System (Generation II, or GENII). This coupled system of computer codes is intended for analysis of environmental contamination resulting from acute or chronic releases to, or initial contamination of, air, water, or soil, on through the calculation of radiation doses to individuals or populations. GENII is described in three volumes of documentation. This volume is a Code Maintenance Manual for the serious user, including code logic diagrams, global dictionary, worksheets to assist with hand calculations, and listings of the code and its associated data libraries. The first volume describes the theoretical considerations of the system. The second volume is a Users' Manual, providing code structure, users' instructions, required system configurations, and QA-related topics.

ACKNOWLEDGMENTS

This work was performed as part of the Dose Overview Project for the U. S. Department of Energy, Richland Operations Office. The authors would like to thank all those individuals who have helped make the development of this software package possible. Assisting in the developing of the project as well as the code package were the successive managers of the Dose Overview Project: Ron Kathren, the late Ed Watson, Jerry Martin, and R. Gene Schreckhise. Members of the Hanford Dose Overview Panel, including Darrell Fisher, Paul Rittman, and Janet Davis, provided the initial code capability requirements. Valuable developmental assistance was provided by S. Keith Hargrove, Mike Madison, Jaime Lara, and Phil Pohl, of the NORCUS REST and GEM programs. We especially thank Joe Soldat for extending his computer literacy as our chief test subject in code debugging.

CONTENTS OF VOLUME 3: CODE MAINTENANCE MANUAL

CONTENTS OF VOLUME 1: CONCEPTUAL REPRESENTATION

CONTENTS OF VOLUME 2: USERS' MANUAL

FIGURES - VOL. 3

TABLES - VOL. 3

EXHIBITS - VOL. 3

1.0 INTRODUCTION

At the direction of U.S. Department of Energy, The Hanford Environmental Dosimetry Upgrade Project was undertaken by Pacific Northwest Laboratory (PNL)[a] to incorporate the internal dosimetry models recommended by the International Commission on Radiological Protection (ICRP) in updated versions of the environmental pathway analysis models used at Hanford. The resulting second generation of Hanford environmental dosimetry computer codes is compiled in the Hanford Environmental Dosimetry System (Generation II, or GENII). The GENII system was developed through tasks designed to provide a state-of-the-art, technically peer-reviewed, documented set of programs for calculating radiation doses from radionuclides released to the environment.

The general requirements of the system to be designed included the capabilities for calculating radiation doses for acute releases, with options for annual dose, committed dose, and accumulated dose; for calculating the same types of doses from chronic releases; for evaluating exposure pathways including direct exposure via water (swimming, boating, and fishing), soil (surface and buried sources), air (semi-infinite cloud and finite cloud geometries), inhalation pathways, and ingestion pathways. The release scenarios to be included were acute releases to air from ground level or elevated sources, or to water; chronic releases to air from ground level or elevated sources, or to water; and initial contamination of soil or surfaces. Source term variations to be accounted for included decay of radionuclides to the start of the exposure scenario, input of total radioactivity or specified fractions, and input of measured concentrations in specified environmental media. Interfaces were to be provided for external calculations of atmospheric dispersion, geohydrology, biotic transport, and surface water transport. Target populations were to be allowed by distance and direction for individuals, populations, and for intruders into contained sources.

The Hanford Environmental Dosimetry System (GENII) is composed of seven

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(a) PNL is operated for the U.S. Department of Energy by Battelle Memorial Institute under Contract DE-AC06-76RLO 1830.

linked computer codes and their associated data libraries. These codes and their linkages are illustrated in Figure 1.1.

GENII is described in three volumes of documentation. This volume is a Code Maintenance Manual for the serious user, including code logic diagrams, global dictionary, worksheets and example hand calculations, and listings of the code and its associated data libraries. The first volume describes the theoretical considerations of the system. Included are the conceptual diagrams, mathematical representation of the solutions, and descriptions of solution techniques, where appropriate. The second volume is a Users' Manual, providing code structure, users' instructions, required system configurations, and QA-related topics.

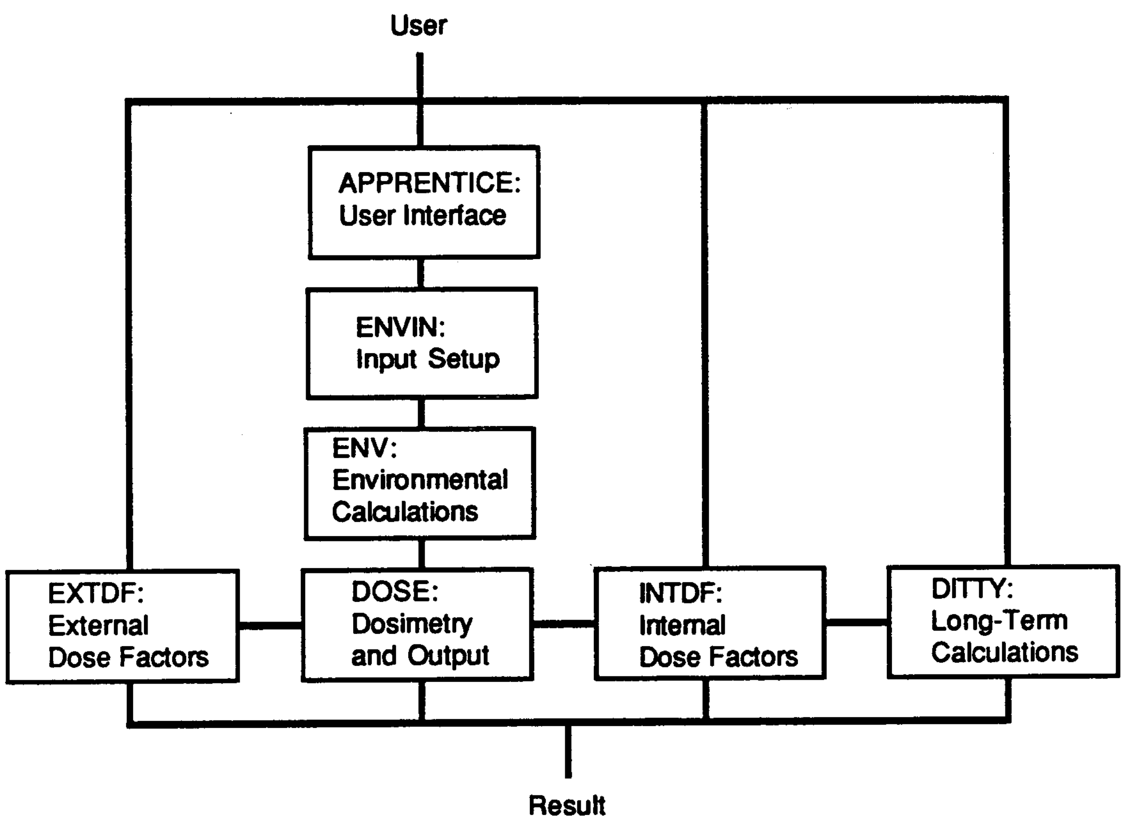

FIGURE 1.1. Current User/Computer Program Interaction In the GENII Software Package

9 1 0 4 8 0 6 5 8

2.0 CODE STRUCTURE AND LOGIC DIAGRAMS

The GENII Software Package is composed of several computer programs and data libraries. The computer programs fall into three categories: 1) user interface (i.e., interactive menu-driven program to assist the user with scenario generation), 2) internal and external dose factor generators, and 3) the environmental dosimetry programs. APPRENTICE is the user interface for the short-term environmental dosimetry programs. INTDF and EXTDF generate internal and external dose rate factors, respectively. Long-term environmental dosimetry is handled by DITTY. For maximum flexibility, the short-term environmental dosimetry portion has been divided into three interrelated but separate programs (ENVIN, ENV, and DOSE) that handle input organization and checking, environmental exposure, and dose calculations, respectively.

Two user interaction levels are defined for the GENII software package. The first, Level 0, interacts with the user interface; the second, Level 1, interacts directly with the text input files. Level 0 helps both the novice and the experienced user of the software package. Level 1 is intended for the experienced user of the software. DITTY, EXTDF, and INTDF are available to only the Level 1 user at this time.

This third volume of the documentation is intended for those who maintain and control the GENII Software Package and for Level 1 Users who wish a deeper understanding of the operation, structure, mechanics, and programming of GENII. This volume contains summaries of the code structure and logic, a global dictionary of parameters, worksheets intended for hand calculation, verification of the equations as implemented, and listings of the codes and data libraries.

Structurally, all the GENII computer programs described above are part of an integrated design/maintenance environment, with the exception of APPRENTICE. This integrated environment includes common parameter definition across all the codes, use of a pool of FORTRAN COMMON BLOCKS, and use of general purpose code modules, herein referred to as GENERAL modules. Figure 2.1 depicts the structural organization of the software package.

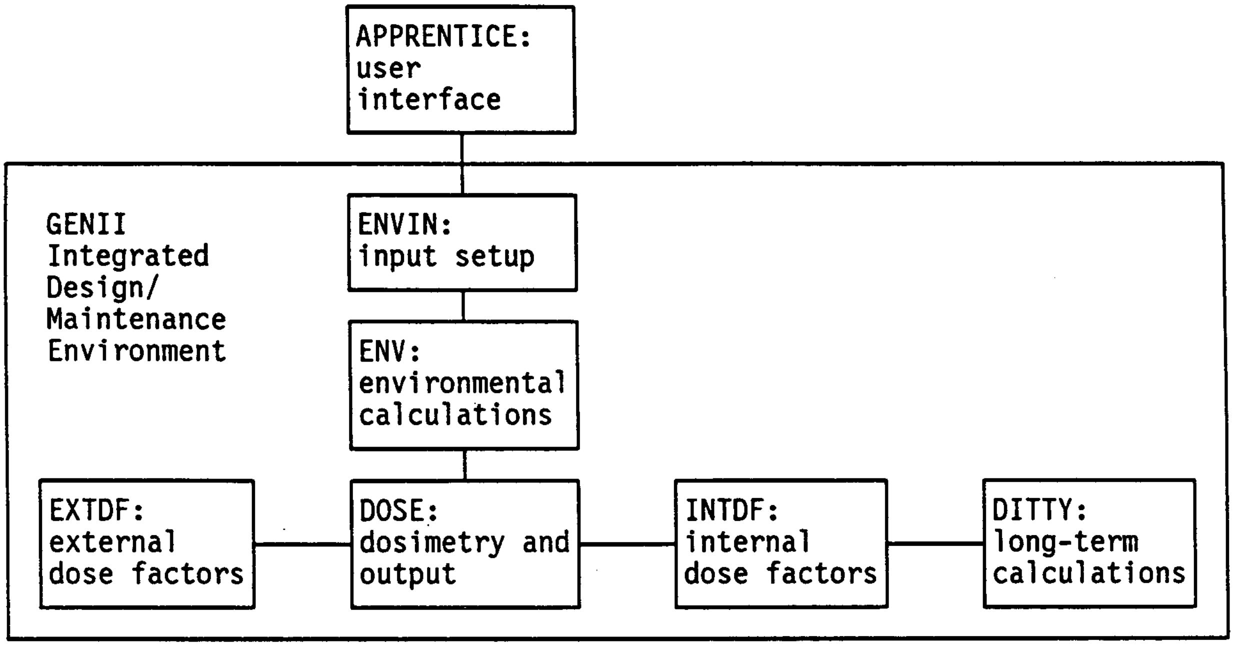

FIGURE 2.1. Structural Organization of the GENII Software Package

Structure and logic of the primary programs have been summarized in Figures 2.2 through 2.6 for computer programs ENVIN, ENV, DOSE, INTDF, and DITTY, respectively. Table 2.1 shows FORTRAN LOGICAL parameter names and parameter interrelationships of the exposure pathways as used to control exposure calculations throughout the codes. Subroutine hierarchy and usage is summarized in Table 2.2 for each of the codes and GENERAL modules. Common block usage is shown in Table 2.3.

2.1 SOFTWARE CONFIGURATION CONTROL, TESTING, AND VERIFICATION

The integrity of the GENII software system is maintained by two systems: 1) software configuration control and 2) software testing and verification. Both systems consist of numbering, documentation, and signature procedures. Each of the systems is tracked with a data base.

Software configuration control of the GENII Software Package reflects the integrated nature of the structure. When any code module or data file of the design/maintenance environment is modified, a new version number is applied to each code of the package. New versions of the entire GENII

Software Package are then released as deemed necessary by the designated GENII expert. Because APPRENTICE is outside the integrated design/maintenance environment, new versions of APPRENTICE may be released between releases of the entire package. Version numbering reflects change packet number. Each change packet contains changes relating to a particular enhancement or modification. Each version will reflect one or more specific change packet(s). This volume corresponds to the GENII Software Package as configured in Version 1.351 and APPRENTICE as configured in Version 1.357.

The GENII Software Package has been under configuration control since March 24, 1987. The developmental version of GENII was called Version 0 and contains 195 change packets. Version 1 of GENII was released on October 1, 1987 for testing. To date there have been 351 change packets to Version 1 and 24 releases.

There are 43 test and verification packets to date. Each packet contains hand calculations and/or alternate code/document comparisons for specified codes, pathways, radionuclides, etc.

Get system time and date Read file names		MAKDA2 OPNFIL
Read GENII input file		READIN
Read master radionuclide library		RLIBIN
Identify and order inventory		ORDER IDNUC
Test input parameters for ranges and option logic		CHECK XQIN
Read environmental data libraries		ENVLIB
Write input parameter report to GENII output file		RITQA
Read and check default environmental parameters		REDFLT
If Acute:	Calculate E/Q values, if requested	ACCMOD OPNFIL XQIN SIGMA PLMRIZ DRFBIV BSORT PROB HEADNG FILERR RWAKE PROFILE
Else Chronic:	Calculate Chi/Q values, if requested	CRONMOD OPNFIL XQIN SIGMA PLMRIZ FNTDRF FILERR PROFILE
Write input file for ENV		RITENV

FIGURE 2.2. Program ENVIN Logic Structure

- Get system time and date, read file names — MAKDA2, OPNFIL
- Read case-specific parameters from ENV input file — REDCAS
- Population and production file input and calculation — XQIN, XQCAL, INTPOL
- For each radionuclide chain--
  - Initialize chain parameters, read radionuclide chain data set — INITNV, REDCHA
  - If Acute:
    - For each season--
      - Calculate time-integrated media concentration — ACUTE1
      - Calculate exposure/uptake this season — EXPOSR
        - If carbon or tritum: — CANDH
        - Else: — ACUTEC, ACUTEA
      - For each subsequent year of intake
        - Calculate transport: — TRNSPT
          - Soil/waste decay, harvest removal — DKHARV
          - Deposition/removal soil — EDRNON, EDRRES, EDRCRP, EDRANM
        - Write media report — RITMED
        - Calulate exposure/uptake: — EXPOSR
          - If carbon/tritium: — CANDH
          - Else: — INHCAL, EXTCAL, CRPCAL, ANMCAL, DRKCAL, AQUCAL
      - Write exposure data set to output file — RITENV
  - Else Chronic:
    - Transport pre-calculations — BIOCAL, SWCAL, AIRCAL
    - For each year of optional decay/buildup period
      - Calculate transport through environment: — TRNSPT
        - Waste package availability — PACKAG
        - If not first year, decay soils and buried waste — DKSOIL
        - Deposition/removal to soil — EDRNON, EDRRES, EDRCRP, EDRANM
    - Manual redist. in soil, land use change — PRIOR
    - For each year of intake--
      - Calculate transport through environment: — TRNSPT
        - Waste package availability — PACKAG
        - If not first year, decay soils and buri — DKSOIL
        - Deposition/removal to soil — EDRNON, EDRRES, EDRCRP, EDRANM
      - Calculate exposure/uptake rates: — EXPOSR
        - If carbon or tritum: — CANDH
        - Else:
          - Inhalation — INHCAL
          - External exposure — EXTCAL
          - Terrestrial foods — CRPCAL
          - Animal products — ANMCAL
          - Drinking water — DRKCAL
          - Aquatic foods — AQUCAL
    - Write exposure data set to ENV output file — RITEXP

FIGURE 2.3. Program ENV Logic Structure

- Get system time and date, read file names — MAKDA2 OPNFIL
- Read input files, external dose factors — REDFIL
- If Acute:
  - For each season-- — DOSCTL
    - For each year of the dose commitment period-- — DOSCAL
      - For each radionuclide considered-- — DOSCAL
        - Read ingestion and inhalation dose factors — REDSET
        - For each organ-- — DOSCAL
          - For each selected exposure pathway-- — DOSCAL
            - Read exposure for each year of intake — DOSCAL
            - For each year of intake-- — DOSCAL
              - Calculate internal dose increments — DOSCAL
        - Calculate external dose increment for each pathway — DOSCAL
      - For each organ-- — DOSCAL
        - Determine if this year's dose to organ is maximum — DOSCAL
    - Calculate totals and set flags — TOTCAL
    - Calculate whole body effective dose equivalent — WBEDE
    - Write dose summary report — DOSSUM
    - If selected, write dose by pathway report — RITBYP
    - If selected, write dose by radionuclide report — RITBYR
    - Write dose by radionuclide report — RITEDE
- Else Chronic:
  - For each year of the dose commitment period-- — DOSCAL
    - For each radionuclide considered-- — DOSCAL
      - Read ingestion and inhalation dose factors — REDSET
      - For each organ-- — DOSCAL
        - For each selected exposure pathway-- — DOSCAL
          - Read exposure for each year of intake — DOSCAL
          - For each year of intake-- — DOSCAL
            - Calculate internal dose increments, total — DOSCAL
      - Calculate external dose increment for each pathways and accumulate totals — DOSCAL
    - For each organ-- — DOSCAL
      - Determine if this year's dose to organ is maximum — DOSCAL
  - Calculate totals and set flags — TOTCAL
  - Calculate whole body effective dose equivalent — WBEDE
  - Write dose summary report — DOSSUM
  - If selected, write dose by pathway report — RITBYP
  - If selected, write dose by radionuclide report — RITBYR
  - Write dose by radionuclide report — RITEDE

FIGURE 2.4. Program DOSE Logic Structure

Step	Routine
Get system time and date	MAKDA2
Read file names	OPNFIL
Read INTDF input file, count inventory	
Read master radionuclide library	RLIBIN
Check input radionuclide list for validity	IDNUC
Calculate lung deposition fractions	DEP
Open output and report files, print headings	
For each radionuclide in the input list--	
Identify radionuclide and find daughters	ORDIN
Read Sij factor library	SIJLIB
Read metabolic data for this radionuclide chain	METLIB
Set organ parameters	SETORG
Write input parameter report	RITINT
Calculate ingestion dose factors: Initialize organ compartments	SETPAR
For each year of the dose commitment period--	
Perform integration of contamination remaining in each organ model compartment as a result of ingestion; use specified model	LS2 GEN ALK IOD
Calculate yearly dose increment	CDECAL
Write reports	RITEND
Calculate inhalation dose factors: Initialize organ compartments	SETPAR
For each year of the dose commitment period--	
Perform integration of contamination remaining in each organ model compartment as a result of inhalation; use specified model	LS2 GEN ALK IOD
Calculate yearly dose increment	CDECAL
Write reports	RITEND
Write CDE increment data set for this radionuclide	RITINC

FIGURE 2.5. Program INTDF Logic Structure

Get system time and date	MAKDA2
Read file names	OPNFIL
Read master radionuclide library	RLIBIN
Read master radionuclide list	IDNUC
Check master radionuclide list	SETNUC
Read inhalation and ingestion dose factors	AIRLIN
Read food transfer data	FOOLIN
Read external exposure dose factors	GRDLIN
Read input file for one case	CASE2
Read bioaccumulation factors	BIOLIN
Read and set airborne release data, if considered	ACTIN
Read and set waterborne release data, if considered	ACTIN
Write input parameter report	QAPAGE
Initialize parameters	CONTRL
Calculate doses for acute release, if considered	APATHS WPATHS DOSADD
For each 70-yr time step for 10,000 years	CONTRL
Calculate concentrations from airborne pathways	APATHS
Calculate concentrations from waterborne pathways	WPATHS
Calculate dose increments this time period	DOSADD
Calculate EDE	WBEDE2 WBEDE4
Write results report	DITBYP DITBYR REPORT
Read title for next case	CASE2
Continue until end of input file	

FIGURE 2.6. Program DITTY Logic Structure

TABLE 2.1. Standardized Array Positions for Environmental Exposure Pathways

Index	Exposure Pathway	Selection Flag	Group Flag
1	Plume, external	AIREXT	
2	Inhalation uptake	INHAL	
3	Ground, external	GROUND	
4	Leafy vegetable ingestion	TDF(1)	TFOOD
5	Root vegetable ingestion	TDF(2)	TFOOD
6	Grain ingestion	TDF(3)	TFOOD
7	Fruit ingestion	TDF(4)	TFOOD
8	Beef ingestion	ANF(1)	ANFOOD
9	Poultry ingestion	ANF(2)	ANFOOD
10	Cow milk ingestion	ANF(3)	ANFOOD
11	Egg ingestion	ANF(4)	ANFOOD
12	Inadvertent soil ingestion	SLING	
13	Water ingestion/swimming	SWING	RECRE
14	Swimming, external	REC(1)	RECRE
15	Boating, external	REC(2)	RECRE
16	Shoreline, external	REC(3)	RECRE
17	Drinking water ingestion	DRINK	
18	Fish ingestion	AQF(1)	AQFOOD
19	Mollusc ingestion	AQF(2)	AQFOOD
20	Crustacea ingestion	AQF(3)	AQFOOD
21	Aquatic plants ingestion	AQF(4)	AQFOOD
22	Deep soil, external	DEEP	
23	Buried waste, external	BURWAS	

9 1 0 4 8 0 6 6 7

TABLE 2.2. Subroutine Hierarchy and Usage

ENVIN

- ENVIN
  - MAKDA2
  - OPNFIL
  - READIN
  - RLIBIN
  - ORDER
  - CHECK
  - ENVLIB
  - RITQA
  - REDFLT
  - ACCMOD
  - CRONMOD
  - RITENV
- ACCMOD
  - OPNFIL
  - XQIN
  - SIGMA
  - PLMRIZ
  - DRFBIV
  - BSORT
  - PROB
  - HEADNG
  - FILERR
  - RWAKE
  - PROFILE
- BSORT
  - none
- CHECK
  - HEADNG
  - XQIN
  - OPNFIL
  - EXIT (system)
- CRONMOD
  - OPNFIL
  - XQIN
  - SIGMA
  - PLMRIZ
  - FNTDRF
  - FILERR
  - PROFILE
- DRFBIV
  - none
- DRFSEC
  - none
- ENVLIB
  - OPNFIL
  - FILERR
- FNTDRF
  - DRFSEC
- INVMOL
  - none
- ORDER
  - IDNUC
  - EXIT (system)
- PLMRIZ
  - USTAR
- PROB
  - none
- PROFILE
  - USTAR
  - INVMOL
- READIN
  - OPNFIL
  - DUMRED
  - FILERR
- REDFLT
  - FILERR
- RITENV
  - OPNFIL
  - FILERR
- RITQA
  - OPNFIL
  - HEADNG
  - GETDAT
  - FILERR
  - SYSTEM (system)
- RWAKE
  - SIGMA
- USTAR
  - INVMOL

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TABLE 2.2. (contd)

ENV

- ENV
  - MAKDA2
  - OPNFIL
  - REDCAS
  - XQCAL
  - OPNFIL
  - HEADNG
  - INITNV
  - REDCHA
  - ACUTE1
  - EXPOSR
  - TRNSPT
  - RITMED
  - RITEXP
  - BIOCAL
  - SWCAL
  - AIRCAL
  - PRIOR
- ACUTE1
  - CHAIN
- ACUTEA
  - CHAIN
- ACUTEC
  - CHAIN
- AIRCAL
  - CHAIN
  - EXIT (system)
  - FILERR
- ANMCAL
  - CHAIN
- AQUCAL
  - CHAIN
- CANDH
  - CHAIN
- CHAIN
- CRPCAL
  - CHAIN
- DKHARV
  - CHAIN
- DRKCAL
  - CHAIN
- EDRANM
  - CHAIN
- EDRCRP
  - CHAIN
- EDRNON
  - CHAIN
- EDRRES
  - CHAIN
- EXPOSR
  - CANDH
  - ACUTEC
  - ACUTEA
  - CRPCAL
  - ANMCAL
  - DRKCAL
  - AQUCAL
  - INHCAL
  - EXTCAL
- EXTCAL
  - OPNFIL
  - HEADNG
  - CHAIN
- INHCAL
  - none
- INITNV
  - none
- INTPOL
  - EXIT
- PACKAG
  - none
- PRIOR
  - none
- REDCAS
  - OPNFIL
  - FILERR
- REDCHA
  - none
- REDIST
  - none
- RITEXP
  - FILERR
- RITMED
  - none
- SWCAL
  - CHAIN
  - EXIT (system)
- TRNSPT
  - PACKAG
  - REDIST
  - DKHARV
  - EDRNON
  - EDRRES
  - EDRCRP
  - EDRANM
- XQCAL
  - XQIN
  - OPNFIL
  - HEADNG
  - FILERR
  - EXIT

TABLE 2.2. (contd)

DOSE

- DOSE
  - MAKDA2
  - OPNFIL
  - REDFIL
  - DOSCTL
  - TOTCAL
  - DOSSUM
  - RITBYP
  - RITBYR
  - RITEDE
- DOSCAL
  - none
- DOSCTL
  - REDSET
  - DOSCAL
- DOSSUM
  - MAKDA2
  - OPNFIL
  - SUBHED
- REDFIL
  - OPNFIL
  - BIOCAL
  - EXIT (system)
  - FILERR
- REDSET
  - none
- RITBYP
  - SUBHED
- RITBYR
  - SUBHED
- RITEDE
  - SUBHED
- SUBHED
  - HEADNG
- TOTCAL
  - WBEDE
- WBEDE
  - EXIT (system)

INTDF

- INTDF
  - DIFEQ2
  - MAKDA2
  - OPNFIL
  - RLIBIN
  - IDNUC
  - DEP
  - OPNFIL
  - ORDIN
  - METLIB
  - HEADNG
  - SIJLIB
  - SETORG
  - RITINT
  - SETPAR
  - LS2
  - CDECAL
  - RITEND
  - RITINC
  - FILERR
- ALK
  - none
- CDECAL
  - none
- DEP
  - none
- DGCHAIN
  - none
- DIFEQ2
  - DGCHAIN
  - GEN
  - ALK
  - IOD
- GEN
  - IOD
- IOD
  - none
- LS2
  - LSODES2
  - DIFEQ2
- METLIB
  - OPNFIL
  - EXIT (system)
  - FILERR
- ORDIN
  - EXIT
- RITEND
  - HEADNG
- RITINC
  - none
- RITINT
  - HEADNG
  - FILERR
- SEERED
  - FILERR
- SETORG
  - none
- SETPAR
  - none
- SIJLIB
  - OPNFIL
  - SEERED
  - EXIT (system)

TABLE 2.2. (contd)

EXTDF

- EXTDF
  - OPNFIL
  - MAKDA2
  - RLIBIN
  - NRGLIB
  - HEADNG
  - BETA
  - POINT (in ISOSUB)
  - LINE (in ISOSUB)
  - SPHERE (in ISOSUB)
  - TCONE (in ISOSUB)
  - DISC (in ISOSUB)
  - CYL (in ISOSUB)
  - ENDCYL (in ISOSUB)
  - RECT (in ISOSUB)
  - ANCYL (in ISOSUB)
  - SHORT

- BETA
  - BYIELD (in ISOSUB)

- ISOSUB
  - ADJUST (in ISOSUB)

- NRGLIB
  - none

- SHORT
  - none

DITTY

- DITTY
  - MAKDA2
  - OPNFIL
  - RLIBIN
  - SETNUC
  - AIRLIN
  - FOOLIN
  - GRDLIN
  - CASE2
  - BIOLIN
  - ACTIN
  - QAPAGE
  - CONTRL
  - REPORT
  - FILERR

- ACTIN
  - OPNFIL
  - CONSET
  - EXIT (system)
  - FILERR

- AIRLIN
  - OPNFIL
  - ZEROR
  - ZEROI
  - APATHS
  - TRITUM
  - CARBON
  - BCHAIN

- BCHAIN

- BIOLIN
  - OPNFIL
  - FILERR

- BLOCK2

- CARBON
  - none

- CASE2
  - ZEROR
  - OPNFIL
  - EOVRQ
  - PMEQ
  - PMSET
  - PMINT
  - PMAC
  - FILERR

- CONSET
  - none

- CONTRL
  - APATHS
  - WPATHS
  - DOSADD

- DITBYP
  - HEADIT

- DITBYR
  - HEADIT

- DOSADD
  - ZEROR
  - WBEDE2

- EOVRQ
  - ZEROR
  - EXIT (system)
  - SIGMA

- FILLUP
  - none

TABLE 2.2. (contd)

- FOOLIN
  - OPNFIL
  - FILERR
- GRAPH
  - SETUP
  - FILLUP
  - HEADIT
- GRDLIN
  - OPNFIL
  - FILERR
- GRFIL
  - none
- HEADIT
  - FILERR
- NUCTST
  - EXIT (system)
- PMAC
  - none
- PMEQ
  - none
- PMINT
  - none
- PMSET
  - none
- QAPAGE
  - HEADIT
  - GRAPH
  - ZEROR
- REPORT
  - GRAPH
  - HEADIT
  - WBEDE4
  - DITBYR
  - DITBYP
  - OPNFIL
- SETNUC
  - ZEROI
  - NUCTST
- SETUP
  - none
- TRITUM
  - none
- WBEDE2
  - EXIT (system)
- WBEDE4
  - none
- WPATHS
  - TRITUM
  - CARBON
  - BCHAIN
  - ZEROR
- ZEROI
  - none
- ZEROR
  - none

GENERAL

- BIOCAL
  - none
- BLKORG
  - none
- BLOCKD
  - none
- DUMRED
  - none
- FILERR
  - EXIT (system)
- HEADNG
  - FILERR
- IDNUC
  - EXIT (system)
- MAKDA2
  - DATE (system)
  - TIME (system)
- OPNFIL
  - EXIT (system)
  - FILERR
- RLIBIN
  - OPNFIL
  - EXIT (system)
  - FILERR
- SIGMA
  - none
- XQIN
  - OPNFIL
  - FILERR

TABLE 2.3. COMMON BLOCK Usage

AFPPAR:
- ACUTE1
- ACUTEA
- ACUTEC
- AIRCAL
- ANMCAL
- AQUCAL
- CANDH
- CRPCAL
- EDRCRP
- EDRRES
- EXTCAL
- INHCAL
- INTPOL
- REDCAS
- REDFIL
- XQCAL
- XQIN

AIRCON:
- CASE2
- EOVRQ
- PMEQ

AIRPAR:
- ACUTE1
- ACUTEA
- ACUTEC
- AIRCAL
- BLOCKD
- EXTCAL
- INTPOL
- REDCAS
- REDCHA
- REDFIL
- XQCAL
- XQIN

ANMPAR:
- ACUTEA
- AIRCAL
- ANMCAL
- BLOCKD
- CANDH
- DKHARV
- EDRANM
- EDRNON
- INITNV
- REDCAS
- REDCHA
- XQCAL
- XQIN

AQUPAR:
- AIRCAL
- AQUCAL
- DRKCAL
- INITNV
- REDCAS
- REDCHA
- XQCAL

BIODAT:
- BIOLIN
- BLOCK2
- CARBON
- CASE2
- DITTY
- QAPAGE
- TRITUM
- WPATHS

CONC:
- ACUTE1
- ACUTEA
- ACUTEC
- AIRCAL
- ANMCAL
- AQUCAL
- CANDH
- CRPCAL
- DKHARV
- DRKCAL
- EDRANM
- EDRCRP
- EDRNON
- EDRRES
- ENV
- EXPOSR
- EXTCAL
- INHCAL
- INITNV
- PACKAG
- PRIOR
- REDCHA
- REDIST
- RITMED
- SWCAL
- TRNSPT
- XQCAL

DAY:
- HEADIT
- QAPAGE

DAYPC:
- AIRLIN
- CDECAL
- DOSSUM
- EXTDF
- HEADIT
- HEADNG
- INTDF
- MAKDA2
- OPNFIL
- QAPAGE
- REPORT
- RITEND
- RITINT

DECAY:
- ACUTE1
- ACUTEA
- ACUTEC
- BLOCK2
- CHAIN
- DGCHAIN
- DIFEQ2
- GEN
- ORDIN
- REDCHA
- RITINT
- SETPAR

DFPAR:
- BLOCKD
- DOSCAL
- DOSCTL
- REDFIL
- REDSET

DISPSN:
- BLOCK2
- CASE2
- DITTY
- EOVRQ
- QAPAGE

DKAY:
- APATHS
- BLOCK2
- DITTY
- DOSADD
- SETNUC
- WPATHS

DOSALL:
- DOSCAL
- DOSCTL
- DOSSUM
- RITBYP
- RITBYR
- RITEDE
- TOTCAL

DOSES:
- CDECAL
- RITEND
- RITINC

DOSFAC:
- AIRLIN
- DOSADD

EDCN:
- APATHS
- CONTRL
- DOSADD
- WPATHS

ENVPAR:
- REDCAS

EXPALL:
- EXPOSR
- INITNV
- RITEXP
- RITMED
- TRNSPT

EXTPAR:
- BLOCKD
- EXTCAL
- INHCAL
- REDCAS

FILES:
- BLOCK2
- BLOCKD
- FILERR
- INTDF
- OPNFIL
- REDFIL

FLAGS:
- AIRLIN
- DOSADD
- NUCTST
- QAPAGE
- REPORT
- SETNUC

FODATA:
- APATHS
- BLOCK2
- DITTY
- FOOLIN
- WPATHS

FODPAR:
- ACUTE1
- ACUTEA
- ACUTEC
- AIRCAL
- ANMCAL
- BLOCKD
- CANDH
- CRPCAL
- DKHARV
- EDRANM
- EDRCRP
- EDRNON
- EDRRES
- INITNV
- REDCAS
- REDCHA
- XQCAL
- XQIN

GRDDAT:
- DOSADD
- GRDLIN

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TABLE 2.3. (contd)

INTDFS:
- CDECAL
- INTDF
- LS2
- METLIB
- RITEND
- RITINT
- SETORG
- SETPAR

INVIN:
- DOSCAL
- DOSCTL
- IDNUC
- INTDF
- ORDIN

ISO:
- BETA
- EXTDF
- ISOSUB
- NRGLIB
- SHORT

LABELS:
- ACUTE1
- BLOCKD
- DOSE
- REDFIL
- RITBYP
- RITBYR
- RITEXP
- XQCAL

MTBPAR:
- ALK
- BLKORG
- CDECAL
- DEP
- DIFEQ2
- GEN
- INTDF
- IOD
- LS2
- METLIB
- ORDIN
- RITEND
- RITINT
- SETORG
- SETPAR
- SIJLIB

NAMLST:
- BLOCK2
- CASE2
- DITTY
- QAPAGE

NUCNAM:
- ACTIN
- AIRLIN
- APATHS
- BIOLIN
- CONTRL
- DIRBYP
- DITBYR
- FILLUP
- FOOLIN
- GRAPH
- GRDLIN
- NUCTST
- QAPAGE
- REPORT
- SETNUC
- WPATHS

OPT:
- ACUTE1
- ACUTEA
- ACUTEC
- AIRCAL
- ALK
- ANMCAL
- AQUCAL
- BIOCAL
- BLKORG
- BLOCKD
- CANDH
- CDECAL
- CRPCAL
- DIFEQ2
- DKHARV
- DOSCAL
- DOSCTL
- DOSE
- DOSSUM
- DRKCAL
- EDRANM
- EDRCRP
- EDRNON
- EDRRES
- ENV
- EXPOSR
- EXTCAL
- GEN
- INHCAL
- INITNV
- INTDF
- INTPOL
- IOD
- LS2
- METLIB
- ORDIN
- PACKAG
- PRIOR
- REDCAS
- REDCHA
- REDFIL
- REDIST
- REDSET
- REPORT
- RITBYP
- RITBYR
- RITEDE
- RITEND
- RITEXP
- RITINC
- RITINT
- RITMED
- SETORG
- SETPAR
- SIJLIB
- SUBHED
- SWCAL
- TOTCAL
- TRNSPT
- WBEDE
- WBEDE2
- WBEDE4
- XQCAL
- XQIN

OPTION:
- ACTIN
- BLOCK2
- CASE2
- CONSET
- DITTY
- QAPAGE
- REPORT

ORGID:
- AIRLIN
- QAPAGE
- REPORT
- WBEDE2
- WBEDE4

ORGMAS:
- AIRLIN
- BLKORG
- DIRBYP
- DITBYR
- DOSADD
- DOSCAL
- DOSCTL
- DOSSUM
- METLIB
- REDFIL
- REDSET
- REPORT
- RITBYP
- RITBYR
- RITEDE
- RITEND
- RITINT
- SETORG
- SIJLIB
- TOTCAL
- WBEDE
- WBEDE2
- WBEDE4

ORGPAR:
- ALK
- BLKORG
- CDECAL
- DIFEQ2
- GEN
- IOD
- METLIB
- RITEND
- RITINC
- RITINT
- SETORG
- SETPAR
- SIJLIB

PATHIN:
- APATHS
- BLOCK2
- CASE2
- DITTY
- DOSADD
- QAPAGE
- WPATHS

PLOT:
- BLOCK2
- FILLUP
- GRAPH
- SETUP

POPU:
- CASE2
- PMEQ
- QAPAGE

RAD:
- ACUTE1
- ACUTEA
- ACUTEC
- AIRCAL
- ALK
- ANMCAL
- AQUCAL
- CANDH
- CDECAL
- CRPCAL
- DIFEQ2
- DKHARV
- DRKCAL
- EDRANM
- EDRCRP
- EDRNON
- EDRRES
- ENV
- EXPOSR
- EXTCAL
- GEN
- INHCAL
- INITNV
- INTDF
- IOD
- LS2
- METLIB
- ORDIN
- PACKAG
- PRIOR
- REDCHA

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TABLE 2.3. (contd)

- REDIST
- RITEND
- RITEXP
- RITINC
- RITINT
- RITMED
- SETORG
- SETPAR
- SIJLIB
- SWCAL
- TRNSPT
- XQCAL

RADIN:
- DOSCAL
- DOSCTL
- DOSE
- DOSSUM
- REDFIL
- REDSET
- RITBYR
- RITEDE
- TOTCAL

RESULT:
- BLOCK2
- CONTRL
- DIRBYP
- DITBYR
- DOSADD
- REPORT
- WBEDE2
- WBEDE4

RMD:
- AIRLIN
- EXTDF
- IDNUC
- NRGLIB
- ORDIN
- RLIBIN
- SETNUC
- SHORT
- SIJLIB

RMD2:
- ORDIN
- RLIBIN
- SIJLIB

SEE:
- SEERED
- SIJLIB

SIJS:
- CDECAL
- RITINT
- SIJLIB

SOLPAR:
- ACUTE1
- ACUTEA
- ACUTEC
- ANMCAL
- BIOCAL
- BLOCKD
- CANDH
- CRPCAL
- DKHARV
- DOSCAL
- DOSCTL
- EDRANM
- EDRCRP
- EDRNON
- EDRRES
- ENV
- EXTCAL
- INHCAL
- INITNV
- PACKAG
- PRIOR
- REDCAS
- REDCHA
- REDFIL
- REDIST
- RITMED
- TRNSPT

SOURCE:
- BLOCK2
- DITTY
- NUCTST
- SETNUC

SWPAR:
- ACUTE1
- ACUTEA
- ACUTEC
- BLOCKD
- EXTCAL
- REDCAS
- RITMED
- SWCAL
- TRNSPT

TIMES:
- ACUTE1
- ACUTEA
- ACUTEC
- AQUCAL
- DOSCAL
- DOSCTL
- DOSE
- DOSSUM
- EDRNON
- ENV
- EXPOSR
- EXTCAL
- INHCAL
- INITNV
- INTDF
- PACKAG
- REDCAS
- REDFIL
- REDSET
- RITBYP
- RITBYR
- RITEDE
- RITEND
- RITEXP
- RITINT
- RITMED
- SUBHED
- SWCAL
- TOTCAL
- TRNSPT
- WBEDE

TIMES2:
- BLOCK2
- CASE2
- CONSET
- DIRBYP
- DITBYR
- DITTY
- GRAPH
- HEADIT
- REPORT

TITL:
- ACTIN
- AIRLIN
- BLOCK2
- CASE2
- CDECAL
- DITTY
- DOSE
- DOSSUM
- EXTDF
- HEADIT
- HEADNG
- INTDF
- OPNFIL
- QAPAGE
- REDFIL
- REPORT

VARYBL:
- ACTIN
- APATHS
- BLOCK2
- CASE2
- DITTY
- QAPAGE
- REPORT
- WPATHS

3.0 GLOBAL PARAMETER DICTIONARY AND COMMON BLOCK DEFINITION

Table 3.1 is the global parameter dictionary for the GENII Software Package. Parameters are described for all the codes in the GENII Integrated Design/Maintenance Environment with the exception of EXTDF. The EXTDF parameter dictionary is included with the EXTDF code listing in Section 5.1 of this volume. Parameter usage is summarized in Table 3.2. This table identifies the codes that use each parameter, the FORTRAN COMMON BLOCK where the parameter resides, prominent exposure pathway flags associated with the parameter, FORTRAN type, a flag indicating if the parameter is set by the user, read from a library, or calculated, the parameter indices associated with the FORTRAN DIMENSION, the code modules where the parameter is set and the code modules where the parameter is used.

TABLE 3.1. Global Parameter Dictionary

Parameter Name	Common Block	Description
AB	FODATA	Soil removal percolation constant, yr^{-1}.
ACTA	VARBYL	Activity released to air for each time increment for up to 100 radionuclides. Units are total curies released in each period to air.
ACTW	VARBYL	Activity released to water for each time increment for up to 100 radionuclides. Units are total curies released in each period to water.
ACUTE	OPT	Flag set if this is an acute exposure case, (dimensionless).
ADJ	MTBPAR	Deposition fractions into nine lung compartments for translocation classes D, W, and Y, respectively, (dimensionless).
ADJEAT	FODPAR	Ratio of total production of terrestrial foods to population consumption rate for each terrestrial food, (dimensionless) Maximum value is 1.0. Accounts for total production less than the yearly production necessary to feed the specified population.
ADJET2	ANMPAR	Ratio of total production of animal products to population consumption rate for each animal product, (dimensionless). Maximum value is 1.0. Accounts for total production less than the yearly production necessary to feed the specified population.
ADJETQ	AQUPAR	Ratio of total production of aquatic foods to population consumption rate for each aquatic food, (dimensionless).
ADRTTL	TITLES	Title of airborne release data library in DITTY.
AEDE	OPT	Set if the dose commitment (annual effective dose equivalent) is to be calculated.
AEDEQ	DOSALL	Annual effective dose equivalent, (Sv or rem).
AIR	OPT	Set if air transport is to be considered for this case. Equivalenced with TROPT(1).
AIRCN	OPT	Flag set if air concentration has been input. Used to determine source of air concentration to use for air calculations (off site or on site) and to determine validity of user's scenario.

TABLE 3.1. (contd)

Parameter Name	Common Block	Description
AIRCON	CONC	Concentration in air of each radionuclide, (Units of Activity/m^3), for each radionuclide in the current chain.
AIRCON	EDCN	Atmospheric concentrations of radionuclides from dispersion/diffusion (no resuspension), (person-ci-yr/m^3), in DITTY.
AIREXT	OPT	Set if the external exposure from air (infinite plume model) is to be considered for this case.
AL	DECAY	Radiological decay constant for each radionuclide in the current chain, yr^{-1}.
ALDAY	DECAY	Radiological decay constant for each radionuclide in the current chain, (d^{-1}).
ALOG2	OPT	Natural log of 2.0. Default value: 0.6931
ALT	RADIN	Decay constant of each radionuclide to be considered for this case, (yr^{-1}).
ANF	OPT	Flag set to consider each of the four animal food pathways, (dimensionless).
ANFOOD	OPT	Set if the animal product ingestion pathway is to be considered for this case, (dimensionless).
ANMCON	CONC	Radionuclide concentration for each animal food product, (Units of Activity/kg) for each radionuclide in the current chain.
ANMFED	ANMPAR	Flag set if concentration of animal fresh forage is known, default value is false (dimensionless).
ANMLAB	LABELS	Eight character description/label for each animal product compartment: Beef, Poultry, Cow Milk, and Eggs. Equivalenced with EXPLAB.
ANNULD	DOSALL	Yearly annual dose, (Sv or rem).
AQF	OPT	Flag set to consider each of the four aquatic food ingestion pathways, (dimensionless).

TABLE 3.1. (contd)

Parameter Name	Common Block	Description
AQFLAB	LABELS	Eight character description/label for each aquatic food compartment: Fish, Molluscs, Invertebrate, and Water Plants. Equivalenced with EXPLAB.
AQFOOD	OPT	Flag set if the aquatic food ingestion pathway is to be considered for this case, (dimensionless).
AQRLAB	LABELS	Eight character description/label for each aquatic recreation activity: Swimming, Boating, and Shoreline. Equivalenced with EXPLAB.
AQUATC	EDCN	Concentration of radionuclides in the edible portion to aquatic plants and animals, person-ci-yr/kg (or per liter H_2O). (DITTY).
AQUCON	CONC	Aquatic foods concentration, (Units of Activity/kg), for each aquatic food and radionuclide in the current chain.
AQUPOP	AQUPAR	Population ingesting aquatic food products, (person).
AQUTT	TIMES	Transit time for water release term (surface water) to reach site of aquatic foods production, (hr).
AR	DKAY	Radiological decay constant for each radionuclide, yr^{-1}.
ARF2CN	CONC	Animal-fodder-weighted decayed air concentration for each radionuclide chain member in the current chain for each animal fodder path, (Units of Activity s/m^3 yr).
ARFCON	CONC	Terrestrial-food-weighted decayed air concentration for each radionuclide chain member for each terrestrial food path, (Units of Activity s/m^3 yr).
ARPCON	CONC	Population-weighted air concentration decayed for time in transit. (Units of Activity s/m^3 yr).
ARPXCN	AIR	Average population-weighted air dose factor (Units of Activity person rem/yr Ci).
ARRAY	PLOT	Character storage array for graph.
ASSA	INTDFS	Absolute step size allowed in call to the LSODES2 Differential Equation Solver.
ATNO	RMD2	Atomic number of each radionuclide in the master radionuclide library.

TABLE 3.1. (contd)

Parameter Name	Common Block	Description
ATNUM	RAD	Atomic number of each radionuclide in the current chain.
ATOL	INTDFS	Absolute error tolerance allowed in call to LSODES2 Differential Equation Solver.
AVALSL	EXTPAR	Top soil is available for resuspension to a depth of AVALSL, (cm). Default value: 1.0 cm.
AW	RAD	Mass number, including optional metastable designation (m), for each radionuclide in the current chain.
AW	NAMES	Six character atomic weight symbol for each radionuclide in the master radionuclide library. Isomeric states are indicated by the letter M after the atomic weight.
AW2M	RMD2	Mass number including optional metastable classification for each implicit daughter in the master radionuclide library.
AWI	INVIN	Mass number (plus optional metastable specifications) for each radionuclide in the input list.
AWM	RMD	Mass number (plus optional metastable specifications) for each radionuclide in the master radionuclide data library.
AWM	NUCNAM	Six character element name for each radionuclide in the master list.
AWT	RADIN	Mass number, including optional metastable classification, for each radionuclide to be considered for this case.
AYEAR	OPT	Days in a year conversion factor. Default value: 365.0.
BAS	RADIN	Flag set if there is any input inventory in the five basic concentration categories (dimensionless).
BASIC	OPT	Flag set if user has supplied any radionuclide basic concentrations on input, (dimensionless).
BEFAIR	TIMES	Number of years that radionuclides were deposited on the site via air deposition prior to the beginning of the intake period, (yr).

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TABLE 3.1. (contd)

Parameter Name	Common Block	Description
BEFIRR	TIMES	Number of years that radionuclides were deposited by irrigation with contaminated water on the site prior to the beginning of the intake period, (yr).
BEFORE	TIMES	Number of years prior to the beginning of the intake period that the inventory was disposed (yr). Package degradation starts at this time.
BIOACF	AQUPAR	Bioaccumulation factors for each radionuclide in current chain, (Units of Activity/kg per Units of Activity/L).
BIOACF	BIODAT	Bioaccumulation factors in DITTY for: 1 - Fish 2 - Crustacea 3 - Molluscs 4 - Water Plants.
BIOACT	ENVPAR	Bioaccumulation factors for each radionuclide considered in this case, (Units of Activity/kg per Units of Activity/L).
BIOMA2	ANMPAR	Standing biomass (wet) of each animal feed or forage type. Used for air interception calculations (kg/m^2).
BIOMAS	FODPAR	Standing biomass (wet) of each terrestrial food type. Used for air interception calculations (kg/m^2).
BIOT	OPT	Set if biotic transport is to be considered for this case, (dimensionless).
BIOTTL	TITLES	Title of bioaccumulation library, (only elements 1 - 20 are title, 21 - 40 are units) in DITTY.
BONE	RAD	Bone dosimetry classification: V - volume seeker, S - surface seeker, N - none, for each radionuclide in the current chain.
BONED	RMD	Bone dosimetry classification (N-none, V-volume seeker, S-surface seeker) for each radionuclide in the master radionuclide data library.
BONET	RADIN	Bone dosimetry classification for each radionuclide considered in this case.

TABLE 3.1. (contd)

Parameter Name	Common Block	Description
BRANCH	RMD2	Branching ratio of each implicit daughter in the master radionuclide library.
BTDSET	SOLPAR	Index of biotic transport scenario to consider during the inventory decay/buildup period prior to uptake. Allowable values: 1 - arid non agricultural, 2 - humid non agricultural, 3 - agricultural.
BTNTK	SOLPAR	Flag set is biotic transport is to be considered during the intake period.
BTPRE	SOLPAR	Flag set if biotic transport is to be considered during the inventory decay /buildup period.
BUILDH	AIRPAR	Building height, (m), used in building wake model.
BUILDX	AIRPAR	Building cross-sectional area (m^2), used for building wake model.
BURWAS	OPT	Flag set if buried waste availability is considered in this case.
BVI	FODPAR	The concentration ratio for plant uptake of each plant type and radionuclide in the current chain, (Units of Activity/kg [wet weight] per Units of Activity/kg [dry soil]).
BVIT	ENVPAR	Concentration ratio for plant uptake of each plant type and radionuclide in this case, (Units of Activity/kg [wet weight] per Units of Activity/kg [dry soil]).
C14	RAD	Flag set if current radionuclide is carbon-14.
CARBON	MTBPAR	Flag set if the current element is carbon.
CASCON	RADIN	Concentration in five basic concentration and four derived concentration compartments for each radionuclide considered in this case, (Units of Activity per standard media for each compartment).

TABLE 3.1. (contd)

Parameter Name	Common Block	Description
CASQ	RADIN	Concentration in each of three source term compartments for each radionuclide considered in this case. Compartments and units are: 1 - air (Units of Activity/yr), 2 - buried waste (Units of Activity/m^3), 3 - surface water (Units of Activity/yr).
CASTTL	TITLES	Case title in DITTY.
CDE	DOSALL	Committed dose equivalent for each of the eleven components of the effective dose equivalent, (Sv or rem).
CDEING	DOSES	Ingestion committed dose equivalent for each organ, for each yearly increment, summed over the current radionuclide chain. Same as parameter DFG in module REDSET of DOSE.
CDEING	DOSALL	Dose to each organ from ingestion (rem or Sv).
CDEINH	DOSES	Inhalation committed dose equivalent for each organ considered, for each yearly increment, summed over radionuclide chain members in the current chain. Same as parameter DFH read in module REDSET of DOSE.
CDEINH	DOSALL	Dose to each organ from inhalation (rem or Sv).
CFLO	PATHIN	River flow rate in DITTY, (ft^3/s).
CHIAC	DAY	IAC output.
CHIPAT	DAY	IPATH output.
CLASS	RAD	Translocation classification for each radionuclide in the current chain. Allowable values: D,W,Y.
CLASST	RADIN	Translocation classification of each radionuclide considered in this case.
CLOCK	DAYPC	Ten character time-of-day of execution.
CONCIN	INVIN	Input concentration of radionuclide in nine compartments as ordered in the input file for each radionuclide in the input list.
CONS	FODPAR	Consumption rate of each terrestrial food, (kg/yr).

TABLE 3.1. (contd)

Parameter Name	Common Block	Description
CONS2	ANMPAR	Human consumption rate of animal products, (kg/yr).
CONSUM	ANMPAR	Animal consumption of feed and forage (kg/day). Default values: 68.0 (feed-beef), 0.12 (feed-poultry), 68.0 (feed-milk cow), 0.12 (feed-eggs), 55.0 (forage-beef), 55.0 (forage-milk cow).
CONSUM	PATHIN	Consumption rates, kg/yr, for terrestrial paths in DITTY.
CRATIO	FODATA	Concentration ratios in DITTY for: 1 - Plants, 2 - Eggs, 3 - Milk, 4 - Beef, 5 - Unused, 6 - Poultry.
CTOAIR	CONC	Initial soil deposition from air for acute exposures (Units of Activity/m^2).
CUMD	DOSALL	Cumulative dose (internal plus external), (Sv or rem).
CUMDOS	OPT	Set if the cumulative dose is to be calculated.
CUMID	DOSALL	Cumulative internal dose, (Sv or rem).
CUMIOR	DOSALL	Cumulative dose to each organ in the master organ list for each year of the dose commitment period (Rem or Sv).
CUMIYR	DOSALL	Yearly cumulative internal dose, (Sv/yr or rem/yr).
DAIT	DFPAR	Air submersion external dose factors for total body, (person Sv/yr per Bq/m^3).
DAIT	DAY	Eight character name for day of year, MMDDYY: MM - month, DD - day, YY - year.
DASHES	OPT	Line of dashes used in reports.
DAYYR	OPT	Day to year conversion, value: 365.25, (d/yr).

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TABLE 3.1. (contd)

Parameter Name	Common Block	Description
DBIT	DFPAR	External exposure conversion factor at the water surface for each radionuclide considered in this case. (person Sv/yr per Bq/m^2 L to the total body).
DCEND	TIMES	Dose calculations end after this years (yr).
DCFEXT	AIRPAR	External dose conversion factor from surface dose to effective dose equivalent.
DDIT	DFPAR	External dose factor for exposure to contaminated soil or waste with: 1 - 0.15 m, 2 - 0.5 m, 3 - 1.0 m overburden of soil (person Sv/yr per Bq/m^3).
DEBUG	OPT	Flag set for special output for debugging and testing.
DEEP	OPT	Flag set if deep soil calculations are to be performed.
DEPFR1	OPT	Fraction of deposition from air intercepted by the plant (dimensionless).
DEPFR2	OPT	Interception fraction of irrigation water onto leaves, (dimensionless). Default value: 0.25.
DEPOSIT	MTBPAR	Uptake rate of each of the first nine lung subcompartments, (Bq/d).
DERANM	OPT	Flag set if derived concentration has been input for animal products.
DERAQU	OPT	Flag set if derived concentration has been input for aquatic foods.
DERCRP	OPT	Flag set if derived concentration has been input for terrestrial plants.
DERDRK	OPT	Flag set if derived concentration has been input for drinking water.
DERIVE	OPT	Flag set if user has supplied any radionuclide derived concentrations on input, (dimensionless).
DEX1R	DOSALL	External dose by radionuclide received in the first year, used for AEDE calculation.

TABLE 3.1. (contd)

Parameter Name	Common Block	Description
DEX1V	DOSALL	External dose by exposure pathway received in the first year, used for AEDE calculation.
DFG	DFPAR	Ingestion committed dose equivalent yearly increment for each organ in the master organ list for each year of the dose commitment period.
DFG	DOSFAC	Ingestion dose factors for DITTY from chronic exposure, (Sv per 70 yr/Bq/yr for 70 yr).
DFH	DFPAR	Inhalation committed dose equivalent yearly increment for each organ in the master organ list for each year of the dose commitment period.
DFH	DOSFAC	Inhalation dose factors for DITTY from chronic exposure, (Sv per 70 yr/Bq/yr for 70 yr).
DIAM	MTBPAR	Particle size (micron), activity median atmospheric diameter of an aerosol distribution.
DIETFR	ANMPAR	Fraction of animal feed consisting of contaminated stored grain (1-4) as well as beef (5) and milk cow (6) fresh forage, (dimensionless). Total for each animal product may equal less than 1.0 to account for uncontaminated fodder.
DIST	DISPSN	Distance from the release point to the center of population ring, X: M. Must be in increasing order
DK	DECAY	Indicator of radionuclide chain members that are first and second precursors of this radionuclide in the current chain, respectively as specified in the master radionuclide library. (Dimensionless).
DK	DKAY	Fraction of first and second precursor that decay to this radionuclide, for DITTY.
DKF	RMD	Fraction of first and second precursor that decay to the current radionuclide in the master radionuclide library.
DKT	RADIN	Fraction of the first and second precursor that decay to each radionuclide considered in this case.

TABLE 3.1. (contd)

Parameter Name	Common Block	Description
DOAIR	OPT	Flag set if air deposition buildup is considered during current year of simulation. Always set on during intake period, used to control air deposition during the inventory decay/buildup period prior to the beginning of the intake period.
DOBIOT	OPT	Flag set if biotic transport is considered during current year of simulation. Always set on during intake period, used to control biotic transport during the inventory decay/buildup period prior to the beginning of the intake period.
DOIRR	OPT	Flag set if irrigation deposition buildup is considered during current year of simulation. Always set on during intake period, used to control irrigation deposition during the inventory decay/buildup period prior to the beginning of the intake period.
DOSCDR	DOSALL	Committed dose equivalent by radionuclide, (Sv or rem).
DOSCDV	DOSALL	Committed dose equivalent by environmental pathway, (Sv or rem).
DOS01	DOSALL	Internal dose for each organ in the master list summed over ingestion and inhalation contributions, radionuclides in the input list, years of the dose commitment period and all environmental exposure pathways. (If IUNIT>5, Rem, otherwise Sv).
DOS02	DOSALL	Cumulative total dose to organs, (Sv or rem).
DOS03	DOSALL	Maximum annual dose to organs, (Sv or rem).
DOSR	DOSALL	Internal dose for each organ in the master list and each radionuclide in the input list, summed over ingestion and inhalation as well as all years of the dose commitment period and all environmental exposure pathways. (If IUNIT>5, Rem, otherwise Sv).
DOSRE	DOSALL	External dose by radionuclide, (Sv or rem).
DOSRP	DOSALL	Dose to each organ by radionuclide for 1)inhalation, 2)ingestion (rem or Sv).
DOSTYP	OPT	Parameter written by ENVIN and read by ENV and DOSE, but no longer used.

TABLE 3.1. (contd)

Parameter Name	Common Block	Description
DOSV	DOSALL	Internal dose for each organ in the master list and each environmental pathway summed over ingestion and inhalation and radionuclides as well as all years of the dose commitment period (If IUNIT>5, Rem, otherwise Sv).
DOSVE	DOSALL	External dose by environmental pathway, (Sv or rem).
DOWAST	OPT	Flag set if waste package degradation is considered during current year of simulation. Always set on during intake period, used to control waste calculations during the inventory decay/buildup period prior to the beginning of the intake period.
DPVL	FODPAR	Deposition velocity of each radionuclide in the current chain, (m/s).
DPVLT	ENVPAR	Deposition velocity of each radionuclide in this case, (m/s).
DPVRES	OPT	Deposition velocity used for resuspension calculations, (m/s). Default value: 0.001.
DRFOQ	AIRPAR	Population-weighted finite plume external dose rate factor (person rem dis) / (Ci MeV).
DRFSAV	AIRPAR	Maximum individual external dose rate factors for finite plume for each of six energy groups, (rem dis/[Units of Activity] Mev).
DRINK	OPT	Flag set if the drinking water pathway is to be considered for this case, (dimensionless).
DRYFA2	ANMPAR	Dry weight to wet weight ratio for each animal feed or forage pathway, (dimensionless).
DRYFAC	FODPAR	Dry weight to wet weight ratio for each terrestrial food type, (dimensionless).
DS2CON	CONC	Radionuclide concentration in the deep soil compartment for each radionuclide for animal fodder, (Units of Activity/kg^3).
DSCON	CONC	Deep soil concentration of available contamination, (Units of Activity/m^3), for each radionuclide in the current chain for each terrestrial food path.

TABLE 3.1. (contd)

Parameter Name	Common Block	Description
DSIT	DFPAR	External dose factor for exposure to contaminated surface soil of each radionuclide considered in this case (person Sv/yr per Bq/effective m^2 to the total body). Read from file in units of Sv/yr per Bq/m^3 for a 15 cm slab and units adjusted.
DSRES	CONC	Deep soil concentration at the residential/resuspension location for each radionuclide in the current chain, (Units of Activity/m^3).
DSRES	CONC	Deep soil concentration in the residual/resuspension soil compartment for each radionuclide in the current chain.
DTOTAL	OUTORG	Total dose to each organ as a function of time in DITTY.
DUMMY	OPT	Array of zeros passed to subroutine CHAIN.
DVEL	FODATA	Deposition velocities, (m/s), in DITTY.
DWATER	ANMPAR	Animal drinking water consumption water, (L/d).
DWCF	BIODAT	Drinking water cleanup factors (the fraction passing through a water treatment plant)
DWCLEN	AQUPAR	Drinking water cleanup factor for each radionuclide in the current chain, (dimensionless).
DWCLET	ENVPAR	Drinking water cleanup factor for each radionuclide in the input list, (dimensionless).
DWCON	CONC	Drinking water concentration (Units of Activity/L).
DWFACA	ANMPAR	Fraction of animal drinking water that is contaminated, (dimensionless).
DWPOP	AQUPAR	Population drinking contaminated water, (person).
DWSRC	AQUPAR	Flag set to indicate source of drinking water: 0 - none, 1 - ground water, 2 - surface water, 3 - derived concentration.
DWTRET	AQUPAR	Logical set if drinking water is processed by water treatment plant.

TABLE 3.1. (contd)

Parameter Name	Common Block	Description
DWUSAG	AQUPAR	Drinking water consumption rate (L/yr).
EDA	GRDDAT	External dose factor for submersion in contaminated air, (rem/s per ci/m^3).
EDBCNW	EDCN	Concentration of radionuclide in the edible portion of the terrestrial plants and animals, (person ci yr/kg), from irrigation deposition.
EDBCON	EDCN	Concentration of radionuclides in the edible portion of terrestrial animals and plants from atmospheric deposition, (person ci yr/kg).
EDE	DOSALL	Effective dose equivalent, (Sv or rem).
EDEING	DOSALL	Effective dose equivalent from ingestion (rem or Sv).
EDEINH	DOSALL	Effective dose equivalent from inhalation (rem or Sv).
EDERG	DOSALL	Effective dose equivalent from ingestion by radionuclide (rem or Sv).
EDERH	DOSALL	Effective dose equivalent from inhalation by radionuclide (rem or Sv).
EDIS	AIRPAR	Energy per disintegration in each energy group for each radionuclide in the current chain, (MeV/dis).
EDS	GRDDAT	External dose factor for exposure to contaminated soil, (person Sv/yr per Bq/m^2), units adjusted on input.
EDW	GRDDAT	External dose factor for exposure to contaminated water, (person Sv/yr per Bq/L).
EFFSTK	AIRPAR	Flag set if the input stack height is to be treated as an effective stack height. This condition is true when stack height is greater than zero and stack flow, diameter and temperature are zero, and STACK is also true, (dimensionless).
EFPOP	AFPPAR	Effective food-weighted population for each terrestrial food used if FOQOPT=3 (FPRD/CONS summed over distance and direction) or effective area-weighted population if FOQOPT=2 ([fractional pop. * total pop]/total pop. summed over distance and direction).

TABLE 3.1. (contd)

Parameter Name	Common Block	Description
EFPOPA	AFPPAR	Effective food-weighted population for each animal food product used if FOQOPT=3 (FPRD/CONS summed over distance and direction) or effective area-weighted population if FOQOPT=2 ([fractional population * total population] / total population summed over distance and direction).
ELNAME	MTBPAR	Element name of each radionuclide in the current chain as read from the master radionuclide library.
ELT	RAD	Element symbol of each radionuclide in the current chain.
ELT	NAMES	Two character element name for each radionuclide in the master radionuclide data library, (DITTY).
ELT2M	RMD2	Element symbol for each implicit daughter in the master radionuclide library.
ELTI	INVIN	Element symbol of each radionuclide in the input list.
ELTM	RMD	Element symbol of each radionuclide in the master radionuclide library.
ELTM	NUCNAM	2 character element name for each radionuclide in the master list, (DITTY).
ELTT	RADIN	Element symbol for each radionuclide to be considered in this case.
EOQ	AIRCON	Normalized time-integrated air concentration for each spatial interval, (s/m3) for 10 distances and 16 sectors in DITTY.
ETEMP	AIRPAR	Effluent temperature used for atmospheric calculations, (degrees C).
EXCAMT	SOLPAR	Rate at which soil is excavated from the waste by animal burrowing activity, (m^3/m^2 yr).

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TABLE 3.1. (contd)

Parameter Name	Common Block	Description
EXCAV	SOLPAR	Fraction of soil moved by animals from each of 6 soil layers: 1 - $\leq$ 0.15 m, 2 - $>$ 0.15 m and $\leq$ 0.5 m, 3 - $>$ 0.5 m and $\leq$ 1.0 m, 4 - $>$ 1.0 m and $\leq$ 1.5 m, 5 - $>$ 1.5 m and $\leq$ 2.0 m, 6 - $>$ 2.0 m, for 1-nonagricultural arid, and 2-nonagricultural humid, and, 3-agricultural sites, (dimensionless).
EXPLAB	LABELS	The 8-character label for each exposure path as defined in BLOCKD.
EXPORT	OPT	Flag set if dose is to be calculated for food crops grown on contaminated site and exported to another location.
EXPOS	CONC	Array to store exposure rates for each exposure pathway for each radionuclide.
EXPOST	EXPALL	Environmental exposure rates for each year of the intake period, for each member of the current radionuclide chain, for each exposure pathway.
EXTD	DOSALL	External dose, (Sv or rem).
EXTDOS	DOSALL	External annual dose, (Sv or rem).
EXTIM	PATHIN	Hours/year exposure time to contaminated soil.
F	DISPSN	Joint frequency of occurrence of atmospheric conditions for up to 8 windspeeds, 7 stabilities, and 16 sectors, (dimensionless), in DITTY.
F1	MTBPAR	Fraction of material absorbed into blood from gut for each radionuclide in the current chain (dimensionless).
FETAGE	MTBPAR	Age of the fetus, (d), to use in the fetal iodine model.
FETDOS	MTBPAR	Logical flag set if fetal dose from iodine is to be calculated.
FEXTC	MTBPAR	Fraction excreted from the transfer compartment (blood and body fluids) for each radionuclide in the current chain. FEXTC + UEXTC = 1.0.

TABLE 3.1. (contd)

Parameter Name	Common Block	Description
FG2SI	MTBPAR	Switch for fraction from gut to small intestine. Set to 1.0 if F1=1.0 otherwise 0.0 (dimensionless).
FG2TC	MTBPAR	Switch for fraction from gut to the transfer compartment. Set to 1.0 if F1=1.0 otherwise 0.0, (dimensionless).
FILN	FILES	Default file names associated with logical unit numbers 1 through 50. For default values see BLOCKD.
FINITE	OPT	Set if dose from a finite plume is to be considered for this case.
FMI	ANMPAR	Transfer coefficient that relates daily intake rate by an animal to the concentration in an edible animal product, (Units of Activity/L or kg per Units of Activity/d), for four stored feed and two fresh forage compartments.
FMIT	ENVPAR	Transfer coefficient that relates daily intake rate by an animal to the concentration in an edible animal product, (Units of Activity/L or kg per Units of Activity/d), for each radionuclide in this case.
FOQ	FODPAR	Food-weighted chi/Q value, (food s/m^3).
FOQOPT	OPT	Option for specification of population for food production. Allowable values are: 0 - Use food-weighted chi/Q value, 1 - Use population-weighted chi/Q, 2 - Use uniform production, 3 - Use chi/Q and production grids.
FPRD	AFPPAR	Food production in each grid point of each terrestrial food type, (kg/yr).
FPRDA	AFPPAR	Animal product production in each grid point for each animal food product, (kg/yr).
FRACUT	ANMPAR	Fraction of animal diet that consists of fresh forage following an acute release for four seasons winter, spring, summer, and autumn (dimensionless).
FRCLOD	EXTPAR	Average fraction of time spent in cloud (hr/person hr).

TABLE 3.1. (contd)

Parameter Name	Common Block	Description
FRSIZ	EXTPAR	Source area for external dose modification factor. Used in near-field scenarios only. Effects calculation if source area is less than 1250 m^2. (m^2).
FTRTTL	TITLES	Title of transfer coefficient library, (only elements 1 - 20 are title, 21 - 60 are units). (DITTY).
GAMMAT	ENVPAR	Energy per disintegration in each energy group for each radionuclide considered in this case, (MeV/dis).
GDRTTL	TITLES	Title of external exposure D.F. library for ground and swimming exposure. (DITTY).
GROUND	OPT	Set if external exposure from soil is to be considered for this case.
GRWP	FODPAR	Growing period for each terrestrial food type (d).
GRWP	PATHIN	Growing period for food types (d) in DITTY.
GRWPA	ANMPAR	Growing period for animal feed (four types) and forage (two types), (d).
GWCON	CONC	Concentration in ground water of each radionuclide in the current chain, (Units of Activity/L).
H2	MTBPAR	Time step to use for DGCHAIN calls, (d). H2 is set to the smallest half time of any chain member but not greater than 1 day.
H3	RAD	Flag set if current radionuclide is tritium.
HARVA	ANMPAR	Radionuclide concentration removed from soil due to animal consumption/harvest of fodder for each animal product and radionuclide for surface (1) and deep (2) soil, (Units of Activity/kg).
HARVST	OPT	Flag set if the user wishes to consider radionuclide removal due to harvest removal, (dimensionless).
HARVT	FODPAR	Radionuclide concentration removed from the soil due to terrestrial food harvest for each food pathway and radionuclide for surface (1) and deep(2) soil, (Units of Activity/kg).
HIDOSE	DOSES	70-yr dose increment in DITTY.

TABLE 3.1. (contd)

Parameter Name	Common Block	Description
HL	RAD	Half-life of each radionuclide chain member (d).
HLDUP	FODPAR	Holdup time between harvest and consumption of each terrestrial food type, (d).
HLDUP2	AQUPAR	Holdup time between harvest and consumption of each aquatic food type, (d).
HLDUPA	ANMPAR	Holdup time between harvest or slaughter and consumption of each animal product, (d).
HLT	RADIN	Radiological half-life of each radionuclide to be considered in this case, (yr).
HOLDDW	AQUPAR	Holdup time between contamination of drinking water and consumption, (d).
HRBOAT	EXTPAR	Length of exposure from boating in contaminated water (hr).
HRGRD	EXTPAR	Length of exposure to contaminated ground, (hr).
HRINH	EXTPAR	Number of hours of inhalation exposure to contamination per year, (hr/yr).
HRPLUM	EXTPAR	Length of exposure to contaminated plume, (hr).
HRSHOR	EXTPAR	Length of external exposure from shoreline activities next to contaminated water, (hr).
HRSWIM	EXTPAR	Length of exposure from swimming in contaminated water, (hr).
HRYR	OPT	Number of hours in a year (hr/yr), constant. Default value: 8766.0
HS	DISPSN	Height of the stack, (m), in DITTY.
HSTART	TIMES	Beginning time step to use for evaluating the differential equations defining organ retention as presented in subroutine DIFEQ2, (d).
IAC	OPTION	Set positive to consider acute release period, (DITTY).
IAIR	OPTION	Set positive if airborne release activity data is to be read, (DITTY).

TABLE 3.1. (contd)

Parameter Name	Common Block	Description
IAN	(local)	Loop index for animal food products, $\leq$ to NAN.
ICDE	DOSALL	Index in master organ list corresponding to the organ dose in array CDE, (dimensionless).
ICH	RADIN	Number of radionuclide chains to be considered in this case $1 \leq ICH \leq 100$.
ICHN	DKAY	No. of decay chains in master list, $1 \leq ICHN \leq 100$, in DITTY.
ICL	RAD	Index of the solubility classification for each radionuclide in the current chain. Allowable values are: 1-D (days), 2-W (weeks), and 3-Y (years).
ICLASS	RADIN	Index of the translocation classification for each radionuclide: 1 - Class D, 2 - Class W, 3 - Class Y.
ICLN	DOSALL	Cross index relating each organ in the output list with the master organ list.
IDF	OPT	Control integer indicating whether: 1 - inhalation, 2 - ingestion, 3 - external, 4 - no, dose rate factors are to be used to calculate the dose from each environmental exposure pathway.
IDFTTL	TITLES	Title of inhalation/ingestion dose factor library, (DITTY).
IDIR	AIRPAR	Index of each direction, starting with 1 for wind blowing from south to north.
IEOQ	NAMLST	Controls reading/calculation of atmospheric dispersion in DITTY.
IFR	RMD	Indices of chain members that are first and second precursor of current radionuclide in master radionuclide data library.

TABLE 3.1. (contd)

Parameter Name	Common Block	Description
IFR	DECAY	IFR(1,I) gives the chain member that is the first precursor to radionuclide I, IFR(2,I) is the location of second precursor, IFR(1,I) $<$ IFR(2,I) $<$ IMEM(I). (DITTY).
IFRM	DECAY	Fraction of first and second precursor that decay to the current radionuclide as specified in the master radionuclide library, (dimensionless).
IFRM	DKAY	IFRM(1,I) gives the chain member that is the first precursor to radionuclide I. IFRM(2,I) gives second precursor. IFRM(1,I) $<$ IFRM(2,I). (DITTY).
IFRT	RADIN	Index of the chain members that are first and second precursors of each radionuclide, respectively, considered in this case.
IGRDOS	OPTION	Flag set to 1 for graph of dose to each organ in DITTY.
IGRNUC	OPTION	Flag set to 1 to graph each release of radionuclide in DITTY.
IGRPL	OPTION	Flag set to 1 to graph population dispersion factor for waterborne pathways in DITTY.
IGRPM	OPTION	Flag set to 1 to graph population dispersion factor for airborne pathways in DITTY.
IGRPOP	OPTION	Flag set to 1 to graph population distribution data in DITTY.
IGRTNU	OPTION	Flag set to 1 to graph total release of all radionuclides in DITTY.
IMOD	RAD	Model index for each radionuclide in the current chain. Allowable values: 0-General, 1-Alkaline Earth, 2-Iodine. Daughters follow parent.
IMODM	RMD	Model index for each radionuclide in the master radionuclide library. Allowable values: 0-General, 1-Alkaline Earth, 2-Iodine.
IMPORT	OPT	Logical flag set if food is imported into region to feed the population.
IN	(local)	Loop index of radionuclides in the current chain, (dimensionless).

TABLE 3.1. (contd)

Parameter Name	Common Block	Description
INDW	SOLPAR	Buried waste depth index. Used for biotic transport calculations. See parameter EXCAV for values. Allowable range: $1 \leq$ INDW ≤ 6. (Dimensionless).
INFLG	FLAGS	Control integer to indicate which master list radionuclides have no dose factors supplied, (DITTY).
INGWAT	EXTPAR	Water inadvertently ingested per hour while swimming, (L).
INHAL	OPT	Flag set if the inhalation exposure pathway is to be considered for this case, (dimensionless).
INHDF	OPT	Flag set if inhalation dose factors are being calculated this pass. (Note: there are two control loops in INTDF, one for calculating ingestion DRF's and one for calculating inhalation DRF's.)
INUC	DKAY	No. of radionuclides in master list, $1 \leq$ INUC ≤ 100, in DITTY.
IO	(local)	Loop index for organs considered for this case.
IODI	MTBPAR	Index of the age-specific fetal iodine dose factor array to use for this part of the calculation.
IOFNUC	RADIN	Number of radionuclides in each chain to be considered for this case.
IOR	DFPAR	Flag set for each organ considered for the current radionuclide.
IORG	ORGPAR	Index in master organ list of each organ considered in the current case. Associated with organ list.
IOSALT	BIODAT	Value of ISALT for previous case: comparison with ISALT determines if different bioaccumulation factors need to be read in, (DITTY).
IPA	NAMLST	Controls definition of population dispersion factor for air releases, (DITTY).
IPATH	OPTION	Input flag selects pathways to be considered, (DITTY).
IPL	NAMLST	Controls definition of population for acute waterborne releases, (DITTY).

TABLE 3.1. (contd)

Parameter Name	Common Block	Description
IPNDX	RMD2	Parent index of each implicit daughter in the master radionuclide library.
IPOP	OPTION	Selects method of determining population dispersion factor, (DITTY).
IPOPL	NAMLST	Controls definition of population for waterborne releases, (DITTY).
IRC	(local)	Index of the current recreational activity.
IRELES	AIRPAR	Release type index where: 0 - ground level release, open area, 1 - stack release (effective or plume rise), 2 - release from vent or short stack on building roof (building wake), 3 - release from building below roof (ground level, building wake).
IRES	OPT	Flag set to indicate resuspension option: 0 - no resuspension, 1 - use Mass Loading model to calculate resuspension, 2 - use Anspaugh model to calculate resuspension.
IRMD	RAD	Index of each radionuclide chain member in the master radionuclide library.
IRRSA	ANMPAR	Index defining source of irrigation water for each animal feed or forage type where: 0 - no irrigation, 1 - ground water source, 2 - surface water source, (dimensionless).
IRRSR	SOLPAR	Index defining the source of residential irrigation water: 0 - residential irrigation not considered, 1 - ground water, 2 - surface water.
IRRST	FODPAR	Index defining source of irrigation water for each terrestrial food type where: 0 - no irrigation, 1 - ground water source, 2 - surface water source, (dimensionless).

TABLE 3.1. (contd)

Parameter Name	Common Block	Description
IRTIMA	ANMPAR	Number of months per year of irrigation of each animal feed and forage type, (mo/yr).
IRTIMR	SOLPAR	Number of months per year of irrigation of residential land area, (mo/yr).
IRTIMT	FODPAR	Number of months per year of irrigation of each terrestrial food type, (mo/yr).
ISALT	OPT	Flag to indicate fresh-(0) or salt-(1) water bioaccumulation factors.
ISTAT	INTDFS	Array of status parameters returned by the LSODES2 Differential Equation Solver stored for later printing in the report.
ITF	(local)	Index of terrestrial food type, $\leq$ NFT.
ITIME	TIMES	Loop index for year of simulation, either of uptake or of the dose commitment period.
ITIMT	TIMES	Over-all time index, that starts counting from the earliest prior period.
IUNIT	OPT	Release term input units: 1-pCi, 2-pCi, 3-mCi, 4-Ci, and 5-Bq, $1 \leq$ IUNIT ≤ 5.
IWAT	OPTION	Flag set positive if waterborne release activity data is to be read in DITTY.
IYX	ORGPAR	Cross index relating the integrated retention compartment of array YWORK with each organ in the organ list.
JFIN	AIRPAR	Flag set if joint frequency data is to be used otherwise it is assumed that chi/Q grid is to be used.
KGG	OPT	Kilogram to gram conversion factor, value: 1.0E-3, (kg/g).
KGMG	OPT	Kilogram to milligram unit conversion factor, 1.0E-6 kg/mg.
LABELX	PLOT	Character x-axis label in DITTY.

TABLE 3.1. (contd)

Parameter Name	Common Block	Description
LABELY	PLOT	Character storage array for selected Y-axis label, (DITTY).
LEACHR	SOLPAR	Leaching rate constant (percolation) of radionuclides, out of the surface soil layer (top 15 cm) for each member of the current radionuclide chain (yr^{-1}).
LEACHT	ENVPAR	Leaching rate constant (percolation) of radionuclides out of the surface soil layer (top 15 cm) for each radionuclide in the input list (yr^{-1}).
LEAFRS	FODPAR	Resuspension factor unto plant leaf surfaces, (m^{-1}).
LEGEND	PLOT	Character array for radionuclide names for IGRTNUC option in DITTY.
LM2IN	OPT	Liter/m^2 to inch conversion factor, (L/m^2 in). Used to convert from irrigation rate of in/yr to L/m^2 yr.
LOIC	TIMES	Loss of institutional control occurred LOIC years prior to the beginning of the intake period, (yr).
LUA	OPTION	Select input logical file unit for airborne release activity in DITTY.
LUN	OPT	Logical unit number of the current output file.
LUW	OPTION	Select input logical file unit for waterborne release activity in DITTY.
M3CM3	OPT	Cubic meter to cubic centimeter conversion constant (m^3/cm^3). Value: 1.0E-6.
M3L	OPT	Cubic meter to liter unit conversion constant, (m^3/L). Value: 1.0E-3.
MANULR	SOLPAR	Deep soil volume/surface area mixing ratio used to account for manual redistribution of a given volume of buried contaminated waste such as from the digging of a basement or well over a defined surface area, (m).
MASMAS	ORGMAS	Mass of each organ in the master organ list, (gm).
MASORG	ORGMAS	Name of each organ in the master organ list.
MAXO	DOSALL	Index of controlling organ.

TABLE 3.1. (contd)

Parameter Name	Common Block	Description
MAXP	DOSALL	Index of controlling pathway: 1)inhalation, 2)ingestion, 3)external.
MAXR	DOSALL	Index of controlling radionuclide.
MAXTIM	DOSES	Dose integral period (70-YR period) during which the maximum dose rate occurs in DITTY.
MAXYR	DOSALL	Year of dose commitment period receiving the largest annual dose, (yr).
METHOD	OPT	Method to be used to evaluate differential equations defining organ retentions as presented in subroutine DIFEQ2. Note: only method 3 is now supported.
MEVSV	OPT	Conversion factor for changing MeV/g per transformation to Sv per Bq-d.
MIDIR	AIRPAR	Index of direction of the maximum individual, where 1 indicates wind blowing from north to south.
MIDIST	AIRPAR	Distance from air release to exposure point of maximum or average individual, (m).
MINDIS	AIRPAR	Minimum distance that can be considered (m).
MIXFLG	SWPAR	Selection flag for mixing ratio calculation: 0 - use input value, 1 - river model, 2 - lake model.
MIXR	SWPAR	Mixing ratio at each water pathway usage location (dimensionless).
MOPYR	PATHIN	The number of months per year irrigation occurs in DITTY.
MORG	ORGMAS	Number of organs in the master organ list.
MOYR	OPT	Number of months in a year conversion, (mo/yr). Value: 12.0.
NAN	OPT	Number of animal food products allowed in program. Value: 4.
NAQ	OPT	Number of aquatic food types allowed in program. Value: 4.

TABLE 3.1. (contd)

Parameter Name	Common Block	Description
NBEFORE	TIMES	Number of years in the optional radionuclide inventory decay/buildup period, (yr). Set to the greatest of BEFORE, BEFAIR, or BEFIRR.
NBONE	ORGPAR	Number of "BONE" subcompartments considered for the current radionuclide chain. Allowable values: $0 \leq \text{NBONE} \leq 4$.
NCH	RMD	Number of decay chains in the master radionuclide library.
NCH	DECAY	No. of decay chains in the master library RMDLIB, 1 <= NCH => 200. (DITTY).
NCHAIN	OPT	Number of radionuclide chains to consider for this case. Same as parameter ICH in Common Block RADIN used by ENVIN.
NCHN	RMD	Chain number that each radionuclide in the master radionuclide library is a member of.
NCHN	DECAY	Chain number for each radionuclide.
NCHST	RMD	Location in the master radionuclide library of the first member of a radionuclide chain.
NCHST	DECAY	Location in the master radionuclide list of the first member of each chain, 1 <= NCHST(I) => 300
NDAU	RMD2	Number of implicit daughters for each radionuclide in the master radionuclide library.
NDIR	AIRPAR	Number of sectors used for atmospheric calculations.
NDIST	AIRPAR	Number of distances specified in the distance array for atmospheric calculations.
NDIST	DISPSN	Number of distances considered for defining population and E/Q, $1 \geq \text{DIST} \geq 10$, in DITTY.
NEAR	OPT	Flag set on if this is a near field (i.e., narrowly-focused, single site) scenario. Default is FALSE: far-field scenario assumed (i.e., wide-scale release, multiple site). (Dimensionless).

TABLE 3.1. (contd)

Parameter Name	Common Block	Description
NEQ	INTDFS	Number of differential equations to evaluate for the current radionuclide chain.
NFLAG	RMD	Control integer to indicate if each radionuclide in the master radionuclide library was included in the input list.
NFLAG2	INVIN	Index of the position in the master radionuclide library of each radionuclide in the input list.
NFLAGC	RMD	Control integer to indicate if each of the chains in the master radionuclide library was referenced in the input list.
NIDRMD	RMD2	Number of implicit daughters included in the radionuclide master library.
NIN	INVIN	Number of radionuclide in the input list $0 < NIN \leq 100$.
NMAX	OPT	Maximum number of radionuclides that can be considered in one case. Default values: 100.
NMET	DISPSN	Number of atmospheric stability categories for definition of joint frequency data, in DITTY.
NOCOMP	ORGPAR	Total number of organ subcompartments considered for the current radionuclide chain. Allowable values: $0 \geq NOCOMP \geq 9$.
NOFN	DKAY	Number of radionuclides in each chain, $1 \leq NOFN(i) \leq 9$, in DITTY.
NOFNUC	RMD	Number of radionuclides in each chain in master radionuclide data library.
NONAG	OPT	Flag set if this calculation is for a non agricultural scenario during the radionuclide inventory decay/buildup period prior to the beginning of the intake period. Cleared at beginning of the intake period.
NONAGD	CONC	Non-agricultural deep soil compartment concentration for each radionuclide in the current chain, (Units of Activity/m^3). Used during the radionuclide inventory option decay/buildup period prior to the beginning of the intake period for biotic transport calculations.

TABLE 3.1. (contd)

Parameter Name	Common Block	Description
NONAGS	CONC	Non-agricultural surface soil compartment for each radionuclide in the current chain, (Units of Activity/m^2). Used during the radionuclide inventory optional decay/buildup period prior to the beginning of the intake period for biotic transport calculations.
NONUC	RAD	Number of radionuclides in current chain for this case $1 \leq$ NONUC ≤ 9, (dimensionless).
NORG	ORGPAR	Number of additional organs for which integrated retentions are calculated for this radionuclide chain. Associated with organ models.
NORGCM	ORGPAR	Master organ index of each organ considered for the current radionuclide chain. Used as cross-reference between the integrated retention organ compartments (YORG and YWORK) and the master organ list.
NORGCR	ORGPAR	Number of organ sub-compartments to be considered for each organ modelled.
NORGL	ORGPAR	Number of organs in the organ list for the current radionuclide chain.
NORGS	DOSALL	Number of target organs in the output list.
NOTHER	ORGPAR	Number of "OTHER" subcompartments considered for the current radionuclide chain. Allowable values: $0 \geq$ NOTHER ≥ 3.
NPATH	OPT	Number of environmental exposure pathways that can be considered.
NRE	OPT	Number of aquatic recreation pathways available. Current value: 3.
NSC	INTDFS	Number of steps to convergence allowed in call to the LSODES2 Differential Equation Solver.
NSEAS	AIRPAR	Number of seasons considered for atmospheric calculations. Default value: 1.
NSPD	AIRPAR	Number of wind speeds considered for atmospheric calculations.

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Parameter Name	Common Block	Description
NSTAB	AIRPAR	Number of stability classes considered for atmospheric calculations.
NTA	NAMLST	Number of times for which data is supplied in arrays PM1, POPT, and T, (DITTY).
NTF	OPT	Number of terrestrial food types, (dimensionless). Current value: 4.
NTIME	TIMES	Number of time period, length of dose commitment period.
NTKEND	TIMES	Intake of contamination ends after NTKEND (yr).
NTL	NAMLST	Number of times for which population data is given in arrays PL1 and TL in DITTY.
NTOD	AIRPAR	Number of time-of-days considered in atmospheric calculations.
NUBAR	DISPSN	Number of windspeed groups used for definition of joint frequency data, $1 \leq NUBAR \leq 8$.
NUCS	RMD	Number of radionuclides in the master radionuclide library.
NUCS	NUCNAM	Number of radionuclides in the master list, (DITTY).
NUCTOT	RADIN	Total number of radionuclides to be considered in this case, including daughters.
NVU	OPT	Unit conversion factors for input inventory, corresponding to IUNIT (index of input units). Default values: 1.0E-12 (pCi), 1.0E-6 (μCi), 1.0E-3 (mCi), 1.0 (Ci), 2.7E-11 (Bq).
OMAX	DOSALL	Dose to controlling organ.
ONEYR	OPT	One year, constant (yr). Value: 1.0
ORGANS	ORGPAR	Names of each organ considered in the current case.
ORGFEX	MTBPAR	Fraction excreted via urine from each organ compartment for each radionuclide in the current chain. ORGFEX + ORGUEX = 1.0.

TABLE 3.1. (contd)

Parameter Name	Common Block	Description
ORGING	ORGPAR	Multiplier apportioning "other" among all organs making up "other" by mass for ingestion (dimensionless).
ORGINH	ORGPAR	Multiplier apportioning "other" among all organs making up "other" by mass for inhalation (dimensionless).
ORGMLT	ORGPAR	Multiplier applied to the integrated quantity in the committed dose equivalent calculation usually set to 1.0. Used to select bone surface or volume and to ratio bone volume between cortical and cancellous tissue.
ORGUEX	MTBPAR	Fraction excreted via feces from each organ compartment for each radionuclide in the current chain. ORGUEX + ORGFEX = 1.0.
OUTEDE	OPT	Flag set if the user is only interested in the annual effective dose equivalent calculation, as opposed to cumulative dose calculation. Dose calculations are performed more efficiently when this flag is set.
OUTPTH	OPT	Flag set if report of organ dose by partway is desired.
OUTRAD	OPT	Flag set if report of organ dose by radionuclide is desired.
OVRBRD	SOLPAR	Depth of soil overburden of buried waste, (m).
P	OPT	Pi. Value: 3.1415926.
PACKHL	SOLPAR	Half-life of the waste form/package, (yr).
PAKADD	CONC	Waste package degradation contribution, (Units of Activity/m^3).
PATH	OPT	Exposure pathway flags, equivalenced with named pathway logicals.
PL	VARBYL	Total population for each time period, used in waterborne calculations.
PL1	NAMLST	Total population (waterborne release) for each time in array TL in DITTY.
PLTCON	CONC	Radionuclide concentration in each terrestrial food type for each radionuclide in the current chain, (Units of Activity/kg).

TABLE 3.1. (contd)

Parameter Name	Common Block	Description
PLTLAB	LABELS	Eight character description/label for each terrestrial plant food compartment: Leafy Veg, Root Veg, Grains, Fruits. Equivalenced with EXPLAB.
PM	VARBYL	Population dispersion factor, person-s/m^3 for airborne releases for each time period in DITTY.
PM1	NAMLST	Airborne population dispersion factor in DITTY.
PMA	NAMLST	Population dispersion factor for acute waterborne releases in DITTY.
PMAX	DOSALL	Dose of controlling pathway: inhalation, ingestion, or external (rem or Sv).
PODTTL	TITLES	Title of population distribution library in DITTY.
POP	AFPPAR	Population for each distance and direction.
POP	POPU	Population within each spatial interval for 10 distances and 16 direction sectors in DITTY.
POPDOS	OPT	Flag set if population dose is to be calculated for this case.
POPDOS	DOSES	The population weighted integrated dose to five organs for 100 radionuclides in DITTY.
POPIN	OPT	Total exposed population input by user. Used when population grid not used, (persons).
POPOPT	OPT	Population definition option: 1 - use population grid in file POP.IN, 2 - use population total entered this line (dimensionless).
POPT	OPT	Total population considered for inhalation and external calculations at the residential location (person).
POPT	NAMLST	Total population (airborne release) for each time in array T in DITTY.
PPL	NAMLST	Total population for acute waterborne releases in DITTY.
PRCNTI	OPT	Probability level to use for acute air exposures where 1-1%, 2-5%, 3-10%, 4-25%, 5-50% (dimensionless).

TABLE 3.1. (contd)

Parameter Name	Common Block	Description
PWT	AIRPAR	Population-weighted chi/Q values for each distance in the specified sector for acute population exposures (person s/m^3).
PWTAIR	CONC	Individual or average population-weighted air exposure for acute releases (Units of Activity s/m^3).
PWTX	AIRPAR	Population-weighted external dose rate factors for finite plume (person rem dis/(Ci MeV)).
PWTXAR	AIRPAR	Individual external dose rate factors for finite plume (person rem dis/(Ci MeV)).
Q	DFPAR	Environmental exposure rate for each radionuclide for each exposure path for each year of intake, (Units of Activity/yr).
QAIR	CONC	Air release term, (Units of Activity/yr).
QIN	INVIN	Input release term for air (Units of Activity/yr), buried waste (Units of Activity/m^3), and surface water (Units of Activity/yr) for each radionuclide in the input list.
QSW	CONC	Surface water release term, (Units of Activity/yr).
QWAS	CONC	Buried waste source term, (Units of Activity/m^3).
RA226	MTBPAR	Flag set if the current radionuclide is radium 226.
RADEDE	DOSALL	Effective Dose equivalent for each radionuclide considered in this case (rem or Sv).
REC	OPT	Flag set if each of the aquatic recreation pathways are to be considered for this case.
RECON	PATHIN	Reconcentration ratios for water concentration calculations in DITTY.
RECRE	OPT	Flag set if the aquatic recreation exposure pathway is to be considered for this case.
RECTT	TIMES	Transit time for surface water release term to reach site of aquatic recreational activities, (hr).
RELEND	TIMES	Release ends after year RELEND (yr).

TABLE 3.1. (contd)

Parameter Name	Common Block	Description
RELTRM	OPT	Flag set if user has supplied any radionuclide release terms on input, (dimensionless).
RESFAC	EXTPAR	Resuspension factor.
RESIRR	SOLPAR	Flag set if irrigation of the residential site is to be considered.
RESSOL	CONC	Residential/resuspension surface soil compartment used for external and inhalation calculations, (Units of Activity/m^2).
RF1	OPT	Fraction of plant roots in the surface soil layer, that is; in the top 15 cm (dimensionless).
RF2	OPT	Fraction of plant roots in deep soil that are exposed to potential contamination from buried contained waste (dimensionless).
RINH	EXTPAR	Human inhalation rate (cm^3/s).
RINHA	EXTPAR	Breathing rate for acute releases (cm^3/s).
RIRR	FODPAR	Irrigation water applicable rate, (in/yr), for each terrestrial food type.
RIRR	PATHIN	Irrigation rate, (L/m^2/mo) in DITTY.
RIRRA	ANMPAR	Irrigation water applicable rate for animal fodder (in/yr) for four stored feed and two fresh forage compartments.
RIRRR	SOLPAR	Irrigation water application rate for residential land area, (in/yr).
RM	PATHIN	Mixing ratio for water concentration calculation in DITTY.
RMAX	DOSALL	AEDE of controlling radionuclide (rem or Sv).
RMDTTL	TITLES	Title of RMDLIB in DITTY.
RTBLOOD	MTBPAR	Biological rate constant for the transfer compartment, (blood and body fluids) for each radionuclide in the current chain (d-1).

TABLE 3.1. (contd)

Parameter Name	Common Block	Description
RTBONE	MTBPAR	Biological rate constant of each "BONE" subcompartment considered for the current radionuclide chain, (d-1).
RTGUT	MTBPAR	Biological rate constant for each of four gut model compartments (d-1).
RTLUNG	MTBPAR	Biological rate constant for each of 12 lung/lymph compartments (d-1).
RTOL	INTDFS	Relative error tolerance allowed in call to the LSODES2 Differential Equation Solver.
RTORG	MTBPAR	Biological rate constant for each organ/tissue subcompartment (d-1).
RTOTHR	MTBPAR	Biological rate constant of each "OTHER" organ subcompartment considered for the current radionuclide chain, (d-1).
RTPACK	SOLPAR	Available waste concentration, (Units of Activity/m^3).
RTSIBL	MTBPAR	Biological rate of transfer between small intestine (SI gut subcompartment) and the transfer compartment (blood and body fluids), (d-1).
SAVINC	DOSALL	Yearly internal dose increment for the first three years of the dose commitment period. Printed in summary report. (Sv or rem).
SAVORG	DOSALL	Dose increment to each organ for the first three years of intake and dose commitment (Rem or Sv). Used for dose summary report.
SCONW	EDCN	Farm soil concentrations of radionuclides, (person ci yr/kg) in DITTY.
SEALAB	LABELS	Descriptive labels for each of the four seasons considered during an acute release: winter, spring, summer, and autumn.
SECDA	OPT	Seconds in a day conversion factor, (s/d). Default value: 8.64E4.
SECYR	OPT	Number of seconds in a year (s/yr) constant. Default value: 3.15E7

TABLE 3.1. (contd)

Parameter Name	Common Block	Description
SEDCON	CONC	Concentration, (Units of Activity/m^3), in sediment of each radionuclide in the current chain.
SEDCON	EDCN	River sediment concentrations of radionuclides, (person ci yr/m^2), in DITTY.
SFLOW	AIRPAR	Stack flow used in atmospheric calculations, (m^3/s).
SHITE	AIRPAR	Stack height used for atmospheric calculations, (m).
SHORWI	EXTPAR	Shore width factor for each shoreline type. Shoreline type (SHRTYP) is set by the user.
SHRTYP	EXTPAR	Shoreline type used to determine shore-width factor, Allowable values: 1 - river shore, 2 - lake shore, 3 - ocean site, 4 - tidal basin.
SI2I	ORGMAS	Semi-infinite to infinite dose correction factor (dimensionless). Applied to external exposure dose rate for immersion.
SIJ	SIJS	Sij factors total dose (Sv/da) rate on target organ i per Bq in source organ j, for each radionuclide in the current chain.
SINDX	ORGMAS	Source organ index of each organ in the master organ list.
SL2CON	CONC	Radionuclide concentration in the surface soil compartment by radionuclide chain member and animal product, (Units of Activity of Activity/m^2).
SLCON	EDCN	Concentration in farm soil of radionuclides from atmospheric deposition, (person ci yr/kg), in DITTY.
SLDN	OPT	Surface soil density, (kg [dry soil] per square meter). Default value: 224.0
SLING	OPT	Set if the inadvertent soil ingestion pathway is to be considered for this case, (dimensionless).

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TABLE 3.1. (contd)

Parameter Name	Common Block	Description
SOLCON	CONC	Surface soil concentration, (Units of Activity/m^2), of each radionuclide in the current chain, for each terrestrial food type.
SOLING	SOLPAR	Quantity of soil inadvertently ingested, (mg/day).
SOLUNT	OPT	Soil source units are in terms of activity per: 1 - m^2, 2 - m^3, 3 - kg, $1 \leq$ SOLUNT ≤ 3.
SPECOR	ORGPAR	Logical flag set for each organ in the master organ list that is "specified" or considered for this radionuclide chain.
SRAD	AIRPAR	Stack radius used for atmospheric calculations, (m).
SSLDN	OPT	Soil density: (1.5E3 kg/m^3).
STACK	AIRPAR	Flag set on if air release is from a stack, (dimensionless).
STORTM	ANMPAR	Storage time of animal feed, between harvest and animal consumption, (d), for four stored feed and two fresh forage compartments.
SURCM	SOLPAR	Depth of surface soil layer, (cm).
SVU	OPT	Soil source term media conversion factor, corresponding to index SOLUNT. Default values: 1.0, 0.15, 224.0.
SWACUT	CONC	Time-integrated surface water concentration for acute exposures (Units of Activity yr/L).
SWAT	OPT	Set if surface water transport is to be considered for this case.
SWCON	CONC	Concentration in surface water of each radionuclide in the current chain, (Units of Activity/L).
SWDPTH	SWPAR	Average water depth in surface water body (m).
SWDZ	SWPAR	Depth of effluent discharge point to surface water, used only for lake model (m).

TABLE 3.1. (contd)

Parameter Name	Common Block	Description
SWFLOW	SWPAR	Average river flow rate: for river model (MIXFLG=1), flow velocity (m/s), (MIXFLG=3), volumetric flow rate (m^3/s).
SWIDTH	SWPAR	Average river width, used only for river model when MIXFLG = 1, (m).
SWING	OPT	Flag set if inadvertent ingestion of water during swimming is to be considered.
SWIRR	CONC	Surface water concentration decayed for transit to irrigation site (Units of Activity/L).
SWLSX	SWPAR	Longshore distance from effluent release point to usage location for each water pathway (m).
SWOSY	SWPAR	Offshore distance to the water intake for each water pathway (m).
SWQB	SWPAR	Rate of effluent discharge of the receiving surface water body, (m^3/s).
SWTT	TIMES	Transit time for surface water release term to reach population, (hr).
T	NAMLST	Times at which airborne population data is supplied, years A.D. in DITTY.
TARGET	ORGPAR	Flag set if each organ/tissue in the organ list is a target.
TCBONE	MTBPAR	Fraction of contamination going from the transfer compartment (blood and body fluids) to each of the "BONE" compartments considered for the current radionuclide chain.
TCLASS	RMD	Translocation classification, (sometimes referred to as solubility classification), for each radionuclide in the master radionuclide library. Allowable values: D - Class D, W - Class W, Y - Class Y.
TCMULT	ORGPAR	Transfer compartment multiplier used to get correct integrated retentions in differential equations for given model compartments. Apportions transfer compartment among all compartments.

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TABLE 3.1. (contd)

Parameter Name	Common Block	Description
TCORG	MTBPAR	Fraction of material going from transfer compartment (blood and body fluids) to each organ sub-compartment for each radionuclide in the current chain (dimensionless).
TCOTHR	MTBPAR	Fraction of contamination going from the transfer compartment (blood and body fluids) to each of the "OTHER" organ subcompartments considered for the current radionuclide chain.
TCWS	SWPAR	Transfer constant from water to sediment, ($L/m^2/yr$). Default value: 36500.0
TEI	MTBPAR	Logical flag set if the tellurium-iodine model is to be used for this radionuclide chain.
TFD	OPT	Flag set to consider each of four terrestrial food pathways, (dimensionless).
TFOOD	OPT	Set if the terrestrial food crop ingestion pathway is to be considered for this case, (dimensionless).
TICKX	PLOT	Array of x-axis tick marks in DITTY.
TICKY	PLOT	Array of y-axis tick marks in DITTY.
TINDX	ORGMAS	Target organ index of each organ in the master organ list.
TITLS	TITL	Eighty-character title of each file corresponding to the filename stored in the file 'FILENAME.DAT' and associated with the logical unit number FILN.
TL	NAMLST	Times at which waterborne population data is supplied, years A.D.
TODAY	DAYPC	Ten character date of execution.
TOTEXC	SOLPAR	Total quantity of soil excavated by burrowing animals for: 1 - arid non agricultural, 2 - humid non agricultural, 3 - agricultural conditions, (m^3/m^2 yr).
TOTMAS	ORGPAR	Total mass of the human body, (gm).

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TABLE 3.1. (contd)

Parameter Name	Common Block	Description
TPOPS	AIRPAR	Total population in the specified sector for acute exposures (persons).
TPRODA	ANMPAR	Total production of each animal product. If input by user, the minimum of total production or consumption rate times population is used in calculations. If value of 0.0 input, TPRODA is set to consumption rate times the population. (kg/yr).
TPRODQ	AQUPAR	Total production of each aquatic food type. If input by user, the minimum of total production or consumption rate times population is used in calculations. If value of 0.0 input, TPRODQ is set to consumption rate times population. (kg/yr).
TPRODT	FODPAR	Total production of each terrestrial food type. If input by user, the minimum of total production or consumption rate times population is used in calculations. If value of 0.0 input, TPRODT is set to consumption rate times population. (kg/yr).
TR	RMD	Radiological half-life of each radionuclide in radionuclide master library, (d).
TRANS	FODPAR	Translocation factor from plant surfaces to edible part of the plant for each terrestrial plant type, (dimensionless).
TRANSA	ANMPAR	Translocation factor from plant surfaces to edible parts of the plant, for four stored feed and two fresh forage compartments, (dimensionless).
TRITUM	MTBPAR	Flag set if current radionuclide is tritium.
TTAIR	AIRPAR	Travel time to each distance in specified sector for acute release, population exposure (s).
TTAIR1	AIRPAR	Travel time to the specified distance for acute atmospheric releases (s).
UBAR	AFPPAR	Average windspeed for each direction, (m/s).
UBAR	DISPSN	Average windspeed for each energy group, (m/s), in DITTY.

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TABLE 3.1. (contd)

Parameter Name	Common Block	Description
UEXTC	MTBPAR	Fraction excreted from the transfer compartment (blood and body fluids) via urine for each radionuclide in the current chain. UEXTC+FEXTC=1.0.
UNIT1	OPT	Label specification for inventory input units.
UNIT2	OPT	Label specification of each transport media corresponding to indices of TROPT.
UNIT3	OPT	Label specification for soil source input units option.
UPTGUT	MTBPAR	Uptake rate to the gut model, input is to the gut (stomach) subcompartment, (Bq/d).
USAG	AQUPAR	Consumption rate of each aquatic food product, (kg/yr).
USAGE	PATHIN	Consumption or exposure rates for aquatic paths
WASDEP	SOLPAR	Thickness of buried waste, (m). Waste is assumed to be uniformly distributed.
WATCON	EDCN	Water concentrations of radionuclides, (Ci/L person yr).
WDE	DOSALL	Weighted dose equivalent for each of the eleven components of the whole body effective dose equivalent, (Sv or rem).
WRDTTL	TITLES	Title of waterborne release data library in DITTY.
WT	OPT	Weight associated with each of the 11 components of the whole body EDE, (dimensionless). Default values: 0.25, 0.15, 0.12, 0.12, 0.03, 0.03, 5 times 0.06
WTIM	OPT	Weathering half life, (d). Default value: 14.0
X	AIRPAR	Standard distances used in population, food production, and chi/Q grids, (m).
XDIV	MTBPAR	Biological half-life in pulmonary region of the lung for translocation classes D, W, and Y, respectively, (d). Default values: 0.5, 50.0, 500.0
XMLF	EXTPAR	Mass loading factor, (g/m^3), used for resuspension calculations with Mass Loading model.
XOQ	AFPPAR	Chi/Q values for each distance and direction, (s/m^3).

TABLE 3.1. (contd)

Parameter Name	Common Block	Description
XOQI	AFPPAR	Normalized air concentration for a single location, (s/m^3).
XOQOPT	OPT	Option for specification of chi/Q. Allowable values are: 0 - Use population-weighted chi/Q value, 1 - Use population and chi/Q grid, 2 - Use joint frequency data.
YBLOOD	INTDFS	Amount of each radionuclide chain member in the transfer compartment (body fluids and blood). Equivalenced with YWORK array.
YELD	FODPAR	Yield of each terrestrial food type, (kg/m^2), per year.
YELD	PATHIN	Crop yield, (kg/m^2), for the crops or forage associated with the seven 'CONSUM' pathways in DITTY.
YELDA	ANMPAR	Yield of animal fodder, (kg/m^2), for four stored feed and two fresh forage compartments.
YELDBT	SOLPAR	Total vegetative production, for arid, humid and agricultural conditions, respectively, during the optional inventory decay/buildup period, (kg[wet]/m^2 yr).
YGUT	INTDFS	Amount of each radionuclide chain member in each of four gut model subcompartments. Equivalenced with YWORK array.
YLUNG	INTDFS	Amount of each radionuclide in each of 12 lung compartments at any given time step.
YORG	INTDFS	Amount of each radionuclide chain member in each organ subcompartment. Equivalenced with YWORK array.
YOTHR	INTDFS	Amount of each radionuclide chain member in each of the "OTHER" organ subcompartments. Equivalenced with YWORK array.
YRDA	OPT	Years in a day conversion factor (yr/d). Default value: 2.74E-3.
YRHR	OPT	Year to hour conversion factor, value: 1.14E-4, (yr/hr).
YRSEC	OPT	Year to second conversion factor, value: 3.17E-8, (yr/s).

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TABLE 3.1. (contd)

Parameter Name	Common Block	Description
YWORK	INTDFS	Work array passed to the LSODES2 Differential Equation Solver.
ZERO	OPT	Constant: 0.0, (dimensionless).
ZNP	MTBPAR	Deposition fraction for the nasal-pharynx lung region, (dimensionless).
ZP	MTBPAR	Deposition fraction for the pulmonary lung region (dimensionless).
ZTB	MTBPAR	Deposition fraction for the tracheo-bronchial lung region, (dimensionless).

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TABLE 3.2. Parameter Usage

Common Block	Parameter Name	Used By	Exposure	Fortran Type	Set By	Dimensions	Set In	Used In
AFPPAR	AVEU	ENV	AIR	REAL	USER CALC	NDIR	XQIN	XQCAL AIRCAL
AFPPAR	DRFOQ	ENV	AIR	REAL	CALC	NDIR NDIST 6	CRONMO XQIN	XQCAL AIRCAL
AFPPAR	EFPOP	ENV	AIR	REAL	CALC	NTF	XQCAL	ANMCAL CRPCAL XQCAL
AFPPAR	EFPOPA	ENV	AIR	REAL	CALC	NAN	XQCAL	ANMCAL XQCAL AIRCAL
AFPPAR	FPRD	ENV	AIR	REAL	USER CALC	NDIST NDIR NTF	POPCAL XQCAL	XQPOP XQCAL AIRCAL
AFPPAR	FPRDA	ENV	AIR	REAL	USER CALC	NDIST NDIR NAN	POPCAL XQCAL	XQPOP XQCAL AIRCAL
AFPPAR	POP	ENV	AIR	REAL	USER	NDIST NDIR	XQIN	XQIN XQCAL AIRCAL
AFPPAR	XOQ	ENV	AIR	REAL	USER CALC	NDIST NDIR	CRONMO XQIN	CRONMO INTPOL XQCAL AIRCAL
AFPPAR	XOQI	ENVIN ENV	AIR	REAL	USER	1	READIN REDCAS INTPOL XQCAL	AIRCAL INTPOL RITENV XQCAL CHECK
AIRPAR	BUILDH	ENVIN ENV	AIR	REAL	USER	1	READIN REDCAS	ACCMOD
AIRPAR	BUILDX	ENVIN ENV	AIR	REAL	USER	1	READIN REDCAS	ACCMOD
AIRPAR	DRFSAV	ENVIN ENV	AIR	REAL	CALC	6	ACCMOD	

TABLE 3.2. (contd)

Common Block	Parameter Name	Used By	Expo- sure	Fortran Type	Set By	Dimen- sions	Set In	Used In
AIRPAR	EDIS	ENV	AIR	REAL	LIBR	6 NONUC	REDCHA	AIRCAL
AIRPAR	EFFSTK	ENVIN	AIR	LOGICAL	PROG	1	CHECK	CRONMO
AIRPAR	ETEMP	ENVIN	AIR	REAL	USER	1	READIN CHECK CRONMO REDCAS	RITENV CHECK CRONMO
AIRPAR	FC	ENV	AIR	REAL	PROG	6	BLOCKD	AIRCAL ACUTE1
AIRPAR	IRELES	ENVIN ENV	AIR	INTEGER	USER	1	READIN REDCAS	ACCMOD
AIRPAR	JFIN	ENVIN ENV	AIR	LOGICAL	USER	1	READIN REDCAS	CHECK XQCAL
AIRPAR	MIDIR	ENV	AIR	INTEGER	USER	1	READIN REDCAS XQCAL	RITENV CHECK INTPOL XQCAL
AIRPAR	MIDIST	ENV	AIR	REAL	USER	1	READIN XQCAL REDCAS	RITENV CHECK INTPOL XQCAL
AIRPAR	MINDIS	ENV	AIR	REAL	PROG	1	BLOCKD	CHECK
AIRPAR	NDIR	ENVIN ENV	AIR	INTEGER	PROG	1	BLOCKD	XQIN XQCAL CRONMO AIRCAL INTPOL
AIRPAR	NDIST	ENVIN ENV	AIR	INTEGER	PROG	1	BLOCKD REDFLT	CRONMO XQCAL XQIN AIRCAL INTPOL
AIRPAR	NSEAS	ENVIN	AIR	INTEGER	PROG	1	CRONMO ACCMOD	CRONMO ACCMOD
AIRPAR	NSPD	ENVIN	AIR	INTEGER	PROG	1	CRONMO ACCMOD	CRONMO ACCMOD
AIRPAR	NSTAB	ENVIN	AIR	INTEGER	PROG	1	CRONMO ACCMOD	CRONMO ACCMOD

TABLE 3.2. (contd)

Common Block	Parameter Name	Used By	Expo-sure	Fortran Type	Set By	Dimen-sions	Set In	Used In
AIRPAR	NTOD	ENVIN	AIR	INTEGER	PROG	1	CRONMO ACCMOD	CRONMO ACCMOD
AIRPAR	PMX	ENVIN ENV	AIR	REAL	CALC	6	ACCMOD	ACCMOD
AIRPAR	PWT	ENVIN ENV	AIR	REAL	CALC	NDIST	ACCMOD	ACUTE1
AIRPAR	PWTX	ENVIN ENV	AIR	REAL	CALC	NDIST 6	ACCMOD	ACUTE1
AIRPAR	SFLOW	ENV	AIR	REAL	USER	1	READIN CHECK REDCAS	RITENV CHECK ACCMOD CRONMOD
AIRPAR	SHITE	ENVIN	AIR	REAL	USER	1	READIN CHECK REDCAS	RITENV CHECK CRONMO ACCMOD
AIRPAR	SRAD	ENVIN	AIR	REAL	USER	1	CHECK REDCAS	RITENV ACCMOD CHECK CRONMO
AIRPAR	STACK	ENVIN ENV	AIR	LOGICAL	USER	1	READIN REDCAS	RITENV CHECK
AIRPAR	TPOPS	ENVIN ENV		REAL	CALC	1	ACCMOD	ACUTEC ACUTEA ACUTE1
AIRPAR	TTAIR	ENVIN ENV	AIR	REAL	CALC	NDIST	ACCMOD	ACUTE1
AIRPAR	TTAIRI	ENVIN ENV		REAL	CALC	1	ACCMOD	ACUTE1
AIRPAR	X	ENVIN ENV	AIR	REAL	PROG	NDIST	BLOCKD	CRONMO AIRCAL INTPOL ACCMOD XQCAL
ANMPAR	ADJET2	ENV	ANFOOD	REAL	CALC	NAN	XQCAL	ANMCAL XQCAL
ANMPAR	ANMFED	ENV	ANFOOD	LOGICAL	PROG	1	REDCHA	ANMCAL

TABLE 3.2. (contd)

Common Block	Parameter Name	Used By	Exposure	Fortran Type	Set By	Dimensions	Set In	Used In	
ANMPAR	BIOMA2	ENVIN ENV	ANFOOD	REAL	USER PROG	NAN+2	REDFLT	ANMCAL ACUTEA	
ANMPAR	CONS2	ENV	ANFOOD	REAL	USER	NAN	READIN REDCAS	ANMCAL RITQA RITENV	XQCAL AIRCAL
ANMPAR	CONSUM	ENV	ANFOOD	REAL	PROG	6	REDFLT BLOCKD REDCAS	ANMCAL REDFLT RITENV	
ANMPAR	DIETFR	ENV	ANFOOD	REAL	USER	NAN+2	READIN REDCAS	ANMCAL RITQA RITENV	
ANMPAR	DRYFA2	ENV	ANFOOD	REAL	USER PROG	NAN+2	REDFLT	ANMCAL ACUTEA	
ANMPAR	DWATER	ENV	ANFOOD	REAL	PROG	NAN	REDFLT REDCAS	ANMCAL REDFLT RITENV	
ANMPAR	DWFACA	ENV	ANFOOD	REAL	USER	NAN	READIN REDCAS	ANMCAL RITQA RITENV	
ANMPAR	FMI	ENV	ANFOOD	REAL	LIB	NAN+2 NONUC	REDCHA	ANMCAL	
ANMPAR	FRACUT	ENVIN ENV	ANFOOD	REAL	LIBR	4	REDFLT READIN	ACUTE1	
ANMPAR	GRWPA	ENV	ANFOOD	REAL	USER	NAN+2	READIN REDCAS	ANMCAL RITQA	RITENV CRPCAL
ANMPAR	HARVA	ENV	ANFOOD	REAL	CALC	NAN NONUC 2	ANMCAL	ANMCAL DKHARV	
ANMPAR	HLDUPA	ENV	ANFOOD	REAL	USER	NAN	READIN REDCAS	ANMCAL RITQA RITENV	
ANMPAR	IRRSA	ENVIN ENV	ANFOOD	INTEGER	USER	NAN+2	READIN REDCAS	ANMCAL READIN CHECK	RITQA RITENV EDRANM

TABLE 3.2. (contd)

Common Block	Parameter Name	Used By	Exposure	Fortran Type	Set By	Dimensions	Set In	Used In	
ANMPAR	IRTIMA	ENVIN ENV	ANFOOD	REAL	USER	NAN+2	READIN REDCAS	ANMCAL RITQA	RITENV EDRANM
ANMPAR	RIRRA	ENV	ANFOOD	REAL	USER	NAN+2	READIN REDCAS	ANMCAL RITQA	RITENV EDRANM
ANMPAR	STORTM	ENV	ANFOOD	REAL	USER	NAN+2	READIN REDCAS	ANMCAL RITQA RITENV	
ANMPAR	TPRODA	ENVIN ENV	ANFOOD	REAL	USER CALC	NAN+2	READIN CHECK XQCAL REDCAS	ANMCAL RITQA RITENV XQCAL	
ANMPAR	TRANSA	ENV	ANFOOD	REAL	USER	NAN+2	BLOCKD REDFLT REDCAS	ANMCAL REDFLT RITENV	
ANMPAR	YELDA	ENV	ANFOOD	REAL	USER	NAN+2	READIN REDCAS	ANMCAL RITQA RITENV	
AQUPAR	ADJETQ	ENV	AQFOOD	REAL	CALC	NAQ	XQCAL	AQUCAL XQCAL	
AQUPAR	AQUPOP	ENVIN ENV	AQFOOD	REAL	USER	1	READIN REDCAS XQCAL	AQUCAL RITQA RITENV XQCAL	
AQUPAR	BIOACF	ENV	AQFOOD	REAL	LIB	NAQ NONUC	REDCHA	AQUCAL	
AQUPAR	DWCLEN	ENV	DRINK	REAL	LIB	NONUC	REDCHA	DRKCAL	
AQUPAR	DWPOP	ENV ENVIN	DRINK	REAL	USER	1	READIN REDCAS XQCAL	RITQA RITENV	
AQUPAR	DWSRC	ENVIN ENV	DRINK	INTEGER	USER	1	READIN REDCAS	DRKCAL RITQA	RITENV CHECK
AQUPAR	DWTRET	ENVIN ENV	DRINK	LOGICAL	USER	1	READIN REDCAS	DRKCAL RITQA RITENV	

TABLE 3.2. (contd)

Common Block	Parameter Name	Used By	Expo-sure	Fortran Type	Set By	Dimen-sions	Set In	Used In	
AQUPAR	DWUSAG	ENVIN ENV	DRINK	REAL	USER	1	READIN REDCAS	DRKCAL RITQA RITENV	
AQUPAR	HLDUP2	ENVIN ENV	AQFOOD	REAL	USER	NAQ	READIN REDCAS	AQUCAL RITQA	RITENV CRPCAL
AQUPAR	HOLDDW	ENVIN ENV	DRINK	REAL	USER	1	READIN REDCAS	DRKCAL RITENV	
AQUPAR	TPRODQ	ENVIN ENV	AQFOOD	REAL	USER CALC	NAQ	READIN CHECK REDCAS	RITQA RITENV XQCAL	
AQUPAR	USAG	ENV	AQFOOD	REAL	USER	NAQ	READIN REDCAS	AQUCAL RITQA	RITENV RITQA
CONC	AIRCON	ENV	AIR	REAL	USER CALC	NONUC	REDCHA TRNSPT INITNV	CRPCAL ANMCAL EDRANM INHCAL	EXTCAL TRNSPT EDRRES EDRCRP
CONC	ANMCON	ENV	ANFOOD	REAL	USER CALC	NAN NONUC	ANMCAL INITNV REDCHA	ANMCAL	
CONC	AQUCON	ENV	AQFOOD	REAL	USER CALC	NAQ NONUC	REDCHA AQUCAL INITNV	AQUCAL ANMCAL	
CONC	ARF2CN	ENV	ANFOOD	REAL	CALC	NONUC NAN	TRNSPT INITNV AIRCAL	SOLCAL EDRANM ANMCAL XQCAL AIRCAL	
CONC	ARFCON	ENV	AIR	REAL	CALC	NONUC NTF	AIRCAL TRNSPT INITNV	CRPCAL XQCAL EDRCRP	
CONC	ARPCON	ENV	AIR	REAL	CALC	NONUC	AIRCAL TRNSPT INITNV	SOLCAL INHCAL EXTCAL TRNSPT AIRCAL EDRRES	

TABLE 3.2. (contd)

Common Block	Parameter Name	Used By	Exposure	Fortran Type	Set By	Dimensions	Set In	Used In
CONC	ARPXCN	ENV	AIR	REAL	CALC	NONUC 6	AIRCAL	EXTCAL
CONC	CTOAIR	ENV	AIR	REAL	CALC	NONVC	TRNACU	ACUTEA ACUTEC
CONC	DS2CON	ENV	DEEP	REAL	CALC	NONUC NAN+2	REDCHA INITNV PRIOR HARVES	SOLCAL ANMCAL EDRANM XQCAL PRIOR HARVES
CONC	DSCON	ENV	DEEP	REAL	USER CALC	NONUC NTF	REDCHA SOLCAL INITNV PRIOR HARVES EDRCRP	CRPCAL PRIOR HARVES EDRCRP
CONC	DSRES	ENV	DEEP	REAL	CALC	NONUC	PRIOR TRNSPT INITNV EDRRES	EDRRES PRIOR
CONC	DWCON	ENV	DRINK	REAL	USER CALC	NONUC	INITNV REDCHA	DRKCAL
CONC	EXPOS	ENV		REAL	CALC	NONUC NPATH	ANMCAL CRPCAL AQUCAL INHCAL DRKCAL EXTCAL INITNV	EXPOSR
CONC	GWCON	ENV	GWAT	REAL	USER CALC	NONUC	REDCHA TRNSPT INITNV	CRPCAL ANMCAL EDRANM DRKCAL TRNSPT EDRRES EDRCRP
CONC	NONAGD	ENV	NONAG	REAL	CALC	NONUC	EDRNON INITNV	PRIOR EDRNON
CONC	NONAGS	ENV	NONAG	REAL	CALC	NONUC	EDRNON INITNV	PRIOR EDRNON REDCHA

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TABLE 3.2. (contd)

Common Block	Parameter Name	Used By	Exposure	Fortran Type	Set By	Dimensions	Set In	Used In	
CONC	PAKADD	ENV	BURWAS	REAL	CALC	NONUC	PACKAG	EDRANM EDRNON PACKAG	EDRRES EDRCRP
CONC	PLTCON	ENV	TFOOD	REAL	USER CALC	NTF NONUC	CRPCAL INITNV REDCHA	CRPCAL SOLCAL	
CONC	PWTAIR	ENV	AIR	REAL	CALC	NONUC	ACUTE1	ACUTEC ACUTEA	
CONC	QAIR	ENV	AIR	REAL	USER	NONUC	INITNV REDCHA	AIRCAL ACUTE1	
CONC	QSW	ENV	SWAT	REAL	USER	NONUC	REDCHA INITNV	TRNSPT	
CONC	QWAS	ENV	BURWAS	REAL	USER	NONUC	REDCHA INITNV PACKAG	SOLCAL PACKAG	
CONC	RESSOL	ENV	GROUND	REAL	CALC	NONUC	INITNV REDCHA PRIOR EDRRES	EXTCAL INHCAL CRPCAL TRNSPT PRIOR EDRRES	
CONC	SEDCON	ENV	SWAT	REAL	USER CALC	NONUC	RECCAL EXTCAL INITNV	RECCAL EXTCAL	
CONC	SL2CON	ENV	ANFOOD	REAL	CALC	NONUC NAN+2	EDRANM INITNV REDCHA PRIOR HARVES	ANMCAL SOLCAL EDRANM PRIOR DKSOIL	
CONC	SOLCON	ENV	TFOOD	REAL	USER CALC	NONUC NTF	INITNV REDCHA PRIOR EDRCRP	CRPCAL SOLCAL PRIOR HARVES DKSOIL EDRCRP	
CONC	SWACUT	ENV	SWAT	REAL	CALC	NONUC	ACUTE1	ACUTEA	AQUCAL

TABLE 3.2. (contd)

Common Block	Parameter Name	Used By	Exposure	Fortran Type	Set By	Dimensions	Set In	Used In	
								DRKCAL	ACUTEC
CONC	SWCON	ENV	SWAT	REAL	USER CALC	NONUC	REDCHA TRNSPT INITNV	CRPCAL ANMCAL CHECK	CHECK DRKCAL TRNSPT
CONC	SWIRR	ENV	SWAT	REAL	USER	NONUC	TRNSPT	CRPCAL ANMCAL EDRANM	TRNSPT EDRRES EDRCRP
DAYPC	CLOCK			CHAR*10		1	MAKDA2	RITEND HEADNG	OPNFIL RITINT
DAYPC	TODAY			CHAR*10		1	MAKDA2	HEADNG OPNFIL RITINT	
DECAY	AL	ENV INTDF		REAL*8	CALC	NONUC	REDCHA ORDIN	CHAIN	
DECAY	ALDAY	INTDF		REAL	CALC	NONUC		DGCHAI DIFEQ2 RITINT	
DECAY	DK	ENV		INTEGER	LIB	2 NONUC	REDCHA ORDIN	CHAIN DGCHAI RITINT	
DECAY	IFRM	ENV		REAL	LIB	2 NONUC	ORDIN REDCHA	CHAIN DGCHAI	ORDIN RITINT
DECAY	NUC	ENV		INTEGER	PROG	1	ORDIN REDCHA	CHAIN DGCHAI	
DFPAR	DAIT	DOSE		REAL	LIB	NUCTOT	REDFIL	DOSCAL	
DFPAR	DBIT	DOSE		REAL	LIB	NUCTOT	REDFIL	DOSCAL	
DFPAR	DDIT	DOSE		REAL	LIB	NUCTOT 3	REDFIL	DOSCAL	
DFPAR	DFG	DOSE		REAL	CALC	MORG DCEND	REDSET	DOSCAL REDSET	
DFPAR	DFH	DOSE		REAL	CALC	MORG DCEND	REDSET	DOSCAL REDSET	

TABLE 3.2. (contd)

Common Block	Parameter Name	Used By	Expo-sure	Fortran Type	Set By	Dimen-sions	Set In	Used In
DFPAR	DSIT	ENVIN		REAL	LIB	NUCTOT	REDFIL	DOSCAL
DFPAR	IOR	DOSE		LOGICAL	PROG	NORG	SETORG	DOSCAL
DFPAR	Q	DOSE		REAL	CALC	NTKEND	DOSCAL	DOSCAL
DOSALL	AEDEQ	DOSE		REAL	CALC	1	WBEDE	DOSSUM
DOSALL	ANNULD	DOSE		REAL	CALC	DCEND	TOTCAL	DOSSUM
DOSALL	CDE	DOSE		REAL	CALC	11	WBEDE	DOSSUM WBEDE
DOSALL	CDEING	DOSE		REAL	CALC	MORG	DOSCAL	TOTCAL
DOSALL	CDEINH	DOSE		REAL	CALC	MORG	DOSCAL	TOTCAL
DOSALL	CUMD	DOSE		REAL	CALC	1	TOTCAL	DOSSUM
DOSALL	CUMID	DOSE		REAL	CALC	1	TOTCAL	DOSSUM TOTCAL
DOSALL	CUMIOR	DOSE		REAL	CALC	MORG DCEND	TOTCAL	DOSSUM
DOSALL	CUMIYR	DOSE		REAL	CALC	DCEND	DOSCAL	DOSSUM DOSCAL TOTCAL
DOSALL	DASHES	DOSE		CHAR*8	PROG	10	BLOCKD	RITBYP RITBYR
DOSALL	DEX1R	DOSE		REAL	CALC	NUCTOT	DOSCAL	DOSCAL RITBYR
DOSALL	DEX1V	DOSE		REAL	CALC	NPATH	DOSCAL	DOSCAL RITBYP
DOSALL	DOSCDR	DOSE		REAL	CALC	MORG NUCTOT	DOSCAL	RITBYR DOSCAL
DOSALL	DOSCDV	DOSE		REAL	CALC	MORG NUCTOT	DOSCAL	RITBYP DOSCAL
DOSALL	DOSO1	DOSE		REAL	CALC	MORG	DOSCAL	WBEDE TOTCAL DOSCAL RITBYP DOSSUM RITBYR

TABLE 3.2. (contd)

Common Block	Parameter Name	Used By	Exposure	Fortran Type	Set By	Dimensions	Set In	Used In	
DOSALL	DOSO2	DOSE		REAL	CALC	MORG	DOSCAL	DOSCAL TOTCAL	RITBYP RITBYR
DOSALL	DOSO3	DOSE		REAL	CALC	MORG		DOSSUM	
DOSALL	DOSR	DOSE		REAL	CALC	MORG NUCTOT	DOSCAL	RITBYR DOSCAL	
DOSALL	DOSRE	DOSE		REAL	CALC	NUCTOT	DOSCAL	RITBYR DOSCAL	
DOSALL	DOSRP	DOSE		REAL	CALC	MORG NUCTOT 2	DASCAL	TOTCAL	
DOSALL	DOSV	DOSE		REAL	CALC	MORG NPATH	DOSCAL	RITBYP DOSCAL	
DOSALL	DOSVE	DOSE		REAL	CALC	5	DOSCAL	RITBYP DOSCAL	
DOSALL	EDE	DOSE		REAL	CALC	1	WBEDE	DOSSUM WBEDE	
DOSALL	EDEING	DOSE		REAL	CALC	1	TOTCAL	DOSSUM	
DOSALL	EDEINH	DOSE		REAL	CALC	1	TOTCAL	DOSSUM	
DOSALL	EDERG	DOSE		REAL	CALC	NUCTOT	TOTCAL	RITEDE	
DOSALL	EDERH	DOSE		REAL	CALC	NUCTOT	TOTCAL	RITEDE	
DOSALL	EXTD	DOSE		REAL	CALC	1	TOTCAL	DOSSUM TOTCAL	RITBYP RITBYR
DOSALL	EXTDOS	DOSE		REAL	CALC	DCEND	DOSCAL	DOSSUM DOSCAL TOTCAL	RITBYP RITBYR WBEDE
DOSALL	ICDE	DOSE		INTEGER	CALC	11	WBEDE	DOSSUM WBEDE	
DOSALL	ICLN	DOSE		INTEGER	CALC	MORG	TOTCAL	RITBYR RITBYP DOSSUM	

TABLE 3.2. (contd)

Common Block	Parameter Name	Used By	Exposure	Fortran Type	Set By	Dimensions	Set In	Used In
DOSALL	MAXO	DOSE		INTEGER	CALC	1	DOSSUM	DOSSUM
DOSALL	MAXP	DOSE		INTEGER	CALC	1	TOTCAL	DOSSUM
DOSALL	MAXR	DOSE		INTEGER	CALC	1	TOTCAL	DOSSUM
DOSALL	MAXYR	DOSE		INTEGER	CALC	1		DOSSUM
DOSALL	NORGS	DOSE		INTEGER	CALC	1	TOTCAL	RITBYP DOSSUM RITBYR TOTCAL
DOSALL	OMAX	DOSE		REAL	CALC	1	DOSSUM	DOSSUM
DOSALL	PMAX	DOSE		REAL	CALC	1	TOTCAL	DOSSUM
DOSALL	RADEDE	DOSE		REAL	CALC	NUCTOT	TOTCAL	RITEDE
DOSALL	RMAX	DOSE		REAL	CALC	1	TOTCAL	DOSSUM
DOSALL	SAVINC	DOSE		REAL	CALC	3 3	DOSCAL	DOSSUM DOSCAL
DOSALL	SAVORG	DOSE		REAL	CALC	MORG 3 3	DOSCAL	TOTCAL
DOSALL	WDE	DOSE		REAL	CALC	11	WBEDE	DOSSUM
DOSES	CDEING	INTDF		REAL	CALC	NORGL NTIME	CDECAL	RITINC RITEND
DOSES	CDEINH	INTDF		REAL	CALC	NORGL NTIME	CDECAL	RITINC RITEND
ENVPAR	BIOACT	ENVIN	AQFOOD	REAL	LIB	NAQ NUCTOT	ENVLIB	RITENV
ENVPAR	BVIT	ENVIN	TFOOD ANFOOD	REAL	LIB	NTF NUCTOT	ENVLIB	RITENV
ENVPAR	DPVLT	ENVIN	TFOOD ANFOOD	REAL	LIB	NTF NUCTOT	ENVLIB	RITENV
ENVPAR	DWCLET	ENVIN	DRINK	REAL	LIB	NUCTOT	ENVLIB	RITENV
ENVPAR	FMIT	ENVIN	ANFOOD	REAL	LIB	NAN+2 NUCTOT	ENVLIB	RITENV

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TABLE 3.2. (contd)

Common Block	Parameter Name	Used By	Exposure	Fortran Type	Set By	Dimensions	Set In	Used In
ENVPAR	GAMMAT	ENVIN ENV	FINITE	REAL	LIB	6 NUCTOT	ENVLIB	RITENV
ENVPAR	LEACHT	ENVIN		REAL	LIB	NIN	ENVLIB	RITENV
EXPALL	EXPOST	ENV		REAL	CALC	NTKEND NONUC NPATH	EXPOSR INITNV	RITEXP
EXTPAR	AVALSL	ENV	IRES	REAL	USER	1	READIN REDCAS	RITQA RITENV INHCAL
EXTPAR	FRCLOD	ENV	ACUTE	REAL	USER	1	READIN REDCAS	ACUTE1
EXTPAR	FRSIZ	ENVIN ENV	NEAR	LOGICAL	USER	1	READIN REDCAS	EXTCAL
EXTPAR	HRBOAT	ENVIN ENV	RECRE	REAL	USER	1	READIN REDCAS	RITQA RITENV EXTCAL
EXTPAR	HRGRD	ENVIN ENV	GROUND	REAL	USER	1	READIN REDCAS	RITQA RITENV EXTCAL
EXTPAR	HRINH	ENVIN ENV	INHAL	REAL	USER	1	READIN REDCAS	INHCAL RITENV RITQA CHECK
EXTPAR	HRPLUM	ENVIN ENV	AIREXT	REAL	USER	1	READIN REDCAS	RITQA RITENV EXTCAL
EXTPAR	HRSHOR	ENVIN ENV	RECRE	REAL	USER	1	READIN REDCAS	RITQA RITENV EXTCAL
EXTPAR	HRSWIM	ENVIN ENV	RECRE	REAL	USER	1	READIN REDCAS	RITQA RITENV EXTCAL
EXTPAR	INGWAT	ENVIN ENV	SWING	REAL	USER PROG	1	REDFLT REDCAS BLOCKD	EXTCAL REDFLT RITENV

TABLE 3.2. (contd)

Common Block	Parameter Name	Used By	Expo-sure	Fortran Type	Set By	Dimen-sions	Set In	Used In	
EXTPAR	RESFAC			REAL		1	INHCAL	INHCAL	
EXTPAR	RINH	ENVIN ENV	INHAL	REAL	USER	1	READIN REDCAS	INHCAL RITQA	RITENV CHECK
EXTAR	RINHA	ENV	ACUTE	REAL	USER PROG		REDFLT	ACUTEI	
EXTPAR	SHORWI	ENV	RECRE	REAL	PROG	4	BLOCKD REDFLT REDCAS	REDFLT RITENV EXTCAL	
EXTPAR	SHRTYP	ENVIN ENV	RECRE	INTEGER	USER	1	READIN REDCAS	RITENV RITQA EXTCAL	
EXTPAR	XMLF	ENV	IRES	REAL	USER	1	READIN REDCAS	RITQA RITENV INHCAL	
FILES	FILN	ENVIN		CHAR*20	LIB	30	BLOCKD	FILERR OPNFIL	REDFLT RITQA
FODPAR	ADJEAT	ENV	TFOOD	REAL	CALC	NTF	XQCAL	CRPCAL XQCAL	
FODPAR	BIOMAS	ENVIN ENV	TFOOD	REAL	USER PROG	NTF	REDFLT	CRPCAL ACUTEC	
FODPAR	BVI	ENV	TFOOD	REAL	LIB	NTF NONUC	REDCHA	CRPCAL ANMCAL EDRANM	EDRNON EDRRES EDRCRP
FODPAR	CONS	ENVIN ENV	TFOOD	REAL	USER	NTF	READIN REDCAS	CRPCAL RITQA	RITENV XQCAL
FODPAR	DPVL	ENV		REAL	LIB	NONUC	REDCHA	CRPCAL ANMCAL EDRANM	EDRRES EDRCRP
FODPAR	DRYFAC	ENV		REAL	USER PROG	NTF	REDFLT	CRPCAL ACUTEC	
FODPAR	FOQ	ENV		REAL	CALC USER	1	READIN REDCAS	RITQA RITENV	
FODPAR	GRWP	ENVIN	TFOOD	REAL	USER	NTF	READIN	CRPCAL	

TABLE 3.2. (contd)

Common Block	Parameter Name	Used By	Exposure	Fortran Type	Set By	Dimensions	Set In	Used In	
		ENV					REDCAS	RITQA RITENV	
FODPAR	HARVT	ENV	TFOOD	REAL	CALC	NTF NONUC 2	CRPCAL	DKHARV	
FODPAR	HLDUP	ENVIN ENV	TFOOD	REAL	USER	NTF	READIN REDCAS	CRPCAL RITQA RITENV	
FODPAR	IRRST	ENVIN ENV	TFOOD	INTEGER	USER	NTF	READIN REDCAS	CRPCAL READIN RITQA	RITENV CHECK EDRCRP
FODPAR	IRTIMT	ENVIN ENV	TFOOD	REAL	USER	NTF	READIN REDCAS	CRPCAL RITQA	RITENV EDRCRP
FODPAR	LEAFRS	ENV		REAL	PROG USER	1	REDFLT BLOCKD REDCAS	CRPCAL ANMCAL REDFLT RITENV	
FODPAR	RIRR	ENV	IRR	REAL	USER	NTF	READIN REDCAS	CRPCAL RITQA	RITENV EDRCRP
FODPAR	TPRODT	ENVIN ENV	TFOOD	REAL	USER CALC	NTF	READIN CHECK XQCAL REDCAS	RITQA RITENV XQCAL AIRCAL	
FODPAR	TRANS	ENV	TFOOD	REAL	USER	NTF	BLOCKD REDFLT REDCAS	CRPCAL REDFLT RITENV	
FODPAR	YELD	ENV	TFOOD	REAL	USER	NTF	READIN REDCAS	CRPCAL RITQA RITENV	EDRANM EDRCRP
INTDFS	ASSA	INTDF		REAL*8	USER	1	INTDF	LS2 RITINT	
INTDFS	ATOL	INTDF		REAL*8	USER	1	INTDF	LS2 RITINT	
INTDFS	ISTAT	INTDF		INTEGER	PROG	6 2	LS2	RITEND	

TABLE 3.2. (contd)

Common Block	Parameter Name	Used By	Exposure	Fortran Type	Set By	Dimensions	Set In	Used In	
INTDFS	NEQ	INTDF		INTEGER	CALC	1	METLIB	LS2	
INTDFS	NSC	INTDF		INTEGER	USER	1	INTDF	LS2 RITINT	
INTDFS	RTOL	INTDF		REAL*8	USER	1	INTDF	LS2 RITINT	
INTDFS	YBLOOD	INTDF		REAL*8	CALC	NONUC	METLIB	GEN ALK IOD	
INTDFS	YGUT	INTDF		REAL*8	CALC	NONUC 4	SETPAR	DIFEQ2	
INTDFS	YLUNG	INTDF		REAL*8	CALC	NONUC 12	SETPAR	DIFEQ2	
INTDFS	YORG	INTDF		REAL*8	CALC	NONUC NOCOMP	METLIB	GEN ALK IOD	
INTDFS	YOTHR	INTDF		REAL*8	CALC	NONUC NOTHER	METLIB	GEN ALK IOD	
INTDFS	YWORK	INTDF		REAL*8	CALC		CDECAL LS2 SETPAR	CDECAL LS2 RITEND	
INVIN	AWI	ENVIN		CHAR*6	USER	NIN	READIN INTDF	INTDF IDNUC	READIN RITQA
INVIN	CONCIN	ENVIN		REAL	USER	9 NIN	READIN	ORDER RITQA	
INVIN	ELTI	ENVIN		CHAR*2	USER	NIN	READIN INTDF	INTDF IDNUC	READIN RITQA
INVIN	NFLAG2	INTDF		INTEGER	CALC	NIN	IDNUC	ORDIN	
INVIN	NIN	ENVIN		INTEGER	USER	1	READIN INTDF	INTDF IDNUC	READIN RITQA
INVIN	QIN	ENVIN		REAL	USER	3 NIN	READIN	RITENV ORDER	RITQA

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TABLE 3.2. (contd)

Common Block	Parameter Name	Used By	Expo- sure	Fortran Type	Set By	Dimen- sions	Set In	Used In
LABELS	ANMLAB	ENVIN ENV	ANFOOD	CHAR	USER	NAN	BLOCKD	RITQA RITENV
LABELS	AQFLAB	ENVIN ENV	AQFOOD	CHAR	USER	NAQ	BLOCKD	RITQA RITEXP
LABELS	AQRLAB	ENVIN ENV	RECRE	CHAR	USER	NAQRC	BLOCKD	RITQA RITEXP
LABELS	EXPLAB	ENV DOSE		CHAR*80	PROG	22	BLOCKD	RITBYP CHECK RITEXP
LABELS	PLTLAB	ENVIN ENV	TFOOD	CHAR	USER	4	BLOCKD	RITQA RITENV
LABELS	SEALAB	ENVIN ENV DOSE		CHAR*6	PROG	4	BLOCKD	DOSSUM SUBHED
MTBPAR	ADJ	INTDF		REAL	PROG	9 3	BLOCKD	SETPAR
MTBPAR	CARBON	INTDF		LOGICAL	PROGR AM	1	ORDIN	DIFEQ2 SETPAR
MTBPAR	DEPOSIT	INTDF		REAL	CALC	9	SETPAR	DIFEQ2 SETPAR
MTBPAR	DIAM	INTDF		REAL	USER	1	INTDF	
MTBPAR	ELNAME	INTDF		CHAR*14	LIB	NONUC	ORDIN	METLIB RITINT
MTBPAR	F1	ENVIN DOSE		REAL	LIB	NONUC	METLIB	RITEND RITINT SETPAR
MTBPAR	FETAGE	INTDF		REAL	USER	1	INTDF	IOD
MTBPAR	FETDOS	INTDF		LOGICAL	USER	1	INTDF	IOD INTDF
MTBPAR	FEXTC	ENVIN DOSE		REAL	LIB	NONUC	METLIB	

TABLE 3.2. (contd)

Common Block	Parameter Name	Used By	Expo-sure	Fortran Type	Set By	Dimen-sions	Set In	Used In
MTBPAR	FG2SI	INTDF		REAL	CALC	1	SETPAR	DIFEQ2
MTBPAR	FG2TC	INTDF		REAL	CALC	1	SETPAR	DIFEQ2
MTBPAR	H2	INTDF		REAL*8	CALC PROG	1	ORDIN	ORDIN
MTBPAR	IODI	INTDF		REAL	PROG	1	ORDIN	IOD ORDIN
MTBPAR	ORGFEX	INTDF		REAL	LIB	NORGCM NONUC		
MTBPAR	ORGUEX	INTDF		REAL	LIB	NORGCM NONUC		
MTBPAR	RA226	INTDF		LOGICAL	CALC	1	ORDIN	DIFEQ2
MTBPAR	RTBLOOD	INTDF		REAL	LIB	NONUC	METLIB	ALK GEN IOD RITINT
MTBPAR	RTBONE	INTDF		REAL	LIB	NBONE	METLIB	ALK GEN RITINT
MTBPAR	RTGUT	INTDF		REAL	CALC	4	SETPAR	DIFEQ2 SETPAR
MTBPAR	RTLUNG	INTDF		REAL	PROG	12	SETPAR	DIFEQ2 SETPAR
MTBPAR	RTORG	INTDF		REAL	LIB	NOCOMP	METLIB	METLIB ALK GEN IOD RITINT
MTBPAR	RTOTHR	INTDF		REAL	LIB	NOTHER	METLIB	ALK GEN IOD RITINT
MTBPAR	RTSIBL	INTDF		REAL	CALC	1	SETPAR	DIFEQ2 SETPAR
MTBPAR	TCBONE	INTDF		REAL	LIB	NBONE	METLIB	ALK GEN RITINT
MTBPAR	TCORG	INTDF		REAL	LIB	NORGCM	METLIB	METLIB

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TABLE 3.2. (contd)

Common Block	Parameter Name	Used By	Exposure	Fortran Type	Set By	Dimensions	Set In	Used In	
						NONUC		ALK GEN RITINT	
MTBPAR	TCOTHR	INTDF		REAL	LIB	NOTHER	METLIB BLOCKD	ALK GEN RITINT	
MTBPAR	TEI	INTDF		LOGICAL	PROG	1	ORDIN	DIFEQ2 IOD ORDIN	RITEND RITINT SETORG
MTBPAR	TRITUM	INTDF		LOGICAL	PROG	1	ORDIN	DIFEQ2 SETPAR	
MTBPAR	UEXTC	INTDF		REAL	LIB	NONUC			
MTBPAR	UPTGUT	INTDF		REAL	CALC	1	SETPAR	DIFEQ2	SETPAR
MTBPAR	XDIV	INTDF		REAL	PROG	3	BLOCKD	SETPAR	
MTBPAR	ZNP	INTDF		REAL	PROG	1	DEP	SETPAR	
MTBPAR	ZP	INTDF		REAL	PROG	1	DEP	SETPAR	
MTBPAR	ZTB	INTDF		REAL	PROG	1	DEP	SETPAR	
OPT	ACUTE	ENVIN ENV		LOGICAL	USER	1	READIN INTDF REDFIL REDCAS	INTDF RITINT SETPAR	ENVIN RITQA RITENV
OPT	AEDE	ENVIN DOSE		LOGICAL	USER	1	REDFIL CHECK REDCAS	RITENV	
OPT	AIR	ENVIN ENV		LOGICAL	USER		READIN REDFIL REDCAS	ENVIN RITQA RITENV CHECK EDRANM TRNSPT	XQCAL AIRCAL REDCAS EDRRES EDRCRP
OPT	AIRCN	ENVIN ENV		LOGICAL	CALC	1	CHECK REDCAS	RITENV EDRANM ANMCAL INHCAL	EXTCAL TRNSPT EDRRES EDRCRP

TABLE 3.2. (contd)

Common Block	Parameter Name	Used By	Exposure	Fortran Type	Set By	Dimensions	Set In	Used In	
OPT	ALOG2	ENV INTDF		REAL	PROG	1	BLOCKD	SOLCAL SETPAR METLIB	ANMCAL CRPCAL PACKAG
OPT	ANF	ENVIN ENV	ANFOOD	LOGICAL	USER	NAN	READIN REDCAS CHECK	ANMCAL RITQA RITENV CHECK EDRANM	XQCAL REDCAS REDCHA PRIOR DKHARV
OPT	ANFOOD	ENVIN ENV		LOGICAL	USER	1	READIN REDCAS REDFIL	EXPOSR READIN RITQA RITENV CHECK	TRNSPT XQCAL REDCAS REDCHA
OPT	AQF	ENVIN ENV	AQFOOD	LOGICAL	USER	NAN	READIN REDCAS CHECK	AQUCAL RITQA RITENV CHECK	XQCAL REDCAS REDCHA
OPT	AQFOOD	ENVIN ENV		LOGICAL	USER	1	READIN REDCAS REDFIL	EXPOSR READIN RITQA RITENV	CHECK XQCAL REDCAS
OPT	AYEAR	ENV INTDF		REAL	PROG	1	BLOCKD	INTDF	
OPT	BASIC	ENV ENVIN		LOGICAL	CALC	1	CHECK BLOCKD REDCAS	RITQA RITENV REDCHA CHECK	
OPT	BIOT	ENVIN ENV		LOGICAL	USER	1	READIN REDCAS REDFIL	READIN RITQA RITENV CHECK EDRANM EDRNON	ENV REDCAS PRIOR EDRRES EDRCRP
OPT	BURWAS	ENV		LOGICAL	USER	1	READIN REDCAS REDFIL	TRNSPT READIN RITQA RITENV	CHECK REDCAS DKSOIL

TABLE 3.2. (contd)

Common Block	Parameter Name	Used By	Exposure	Fortran Type	Set By	Dimensions	Set In	Used In
OPT	CUMDOS	ENVIN DOSE		LOGICAL	USER		REDFIL CHECK REDCAS	RITENV
OPT	DAYYR	ENV		REAL	PROG	1	BLOCKD	CRPCAL INHCAL
OPT	DEBUG	ENVIN ENV DOSE OUT		LOGICAL	USER	1	READIN INTDF REDFIL ENV REDCAS	INTDF METLIB LS2 ANMCAL RITINT SETPAR SIJLIB WBEDE READIN RITENV EDRANM CRPCAL AQUCAL INHCAL EXTCAL EDRNON INTPOL XQCAL AIRCAL ENV PRIOR DKSOIL PACKAG EDRRES EDRCRP
OPT	DEEP	ENVIN ENV		LOGICAL	PROG	1	CHECK REDCAS	EDRNON EDRRES EDRCRP EDRANM CRPCAL ANMCAL DKSOIL
OPT	DEPFR1	ENV		REAL	PROG	1	REDFLT BLOCKD REDCAS	CRPCAL ANMCAL REDFLT RITENV
OPT	DEPFR2	ENV		REAL	PROG USER	1	BLOCKD REDFLT REDCAS	CRPCAL ANMCAL REDFLT RITENV
OPT	DERANM	ENV		LOGICAL	PROG	1	REDCHA	ANMCAL
OPT	DERAQU	ENV		LOGICAL	PROG	1	REDCHA	AQUCAL
OPT	DERCRP	ENV		LOGICAL	PROG	1	REDCHA	CRPCAL
OPT	DERDRK	ENV		LOGICAL	PROG	1	REDCHA	DRKCAL
OPT	DERIVE	ENV ENVIN		LOGICAL	CALC	1	CHECK BLOCKD REDCAS	RITQA RITENV REDCHA

TABLE 3.2. (contd)

Common Block	Parameter Name	Used By	Exposure	Fortran Type	Set By	Dimensions	Set In	Used In	
OPT	DOAIR	ENV		LOGICAL	CALC	1	PRIOR TRNSPT	SOLCAL EDRANM	EDRRES EDRCRP
OPT	DOBIOT	ENV		LOGICAL	CALC	1	PRIOR TRNSPT	SOLCAL EDRANM EDRNON	EDRRES EDRCRP
OPT	DOIRR	ENV		LOGICAL	CALC	1	PRIOR TRNSPT	SOLCAL EDRRES EDRCRP	
OPT	DOSTYP	ENVIN DOSE		INTEGER	USER	1	REDFIL CHECK REDCAS	ANMCAL RITQA RITENV	CHECK CRPCAL XQCAL
OPT	DOWAST	ENV		LOGICAL	CALC	1	PRIOR TRNSPT	SOLCAL TRNSPT	PRIOR DKSOIL
OPT	DPVRES	ENV		REAL	PROG	1	REDFLT BLOCKD REDCAS	CRPCAL ANMCAL REDFLT RITENV	
OPT	DRINK	ENVIN ENV		LOGICAL	USER	1	READIN	EXPOSR READIN RITQA	CHECK REDCAS
OPT	DUMMY	ENV		REAL	PROG	NONUC	BLOCKD		
OPT	EXPORT	ENVIN ENV		LOGICAL	USER		READIN REDCAS	RITENV XQCAL	
OPT	FINITE	ENVIN ENV		LOGICAL	USER	1	READIN	DOSCAL RITQA EXTCAL	
OPT	FOQOPT	ENV		INTEGER	USER	1	READIN REDCAS	READIN RITQA RITENV	CHECL XQCAL AIRCAL
OPT	GROUND	ENVIN ENV		LOGICAL	USER	1	READIN	EXPOSR RITQA RITENV	CHECK EXTCAL REDCAS
OPT	HARVST	ENVIN ENV		LOGICAL	USER PROG	1	REDFLT	DKHARV CRPCAL	

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TABLE 3.2. (contd)

Common Block	Parameter Name	Used By	Exposure	Fortran Type	Set By	Dimensions	Set In	Used In	
								ANMCAL	
OPT	HRYR	ENV		REAL	PROG	1	BLOCKD		
OPT	IDF	DOSE		INTEGER	CALC	NPATH	BLOCKD	DOSCAL RITBYP	
OPT	IMPORT	ENVIN ENV		LOGICAL	PROG	1	READIN	XQCAL	
OPT	INHAL	ENVIN ENV		LOGICAL	USER	1	READIN	EXPOSR READIN RITQA RITENV	CHECK TRNSPT REDCAS
OPT	INHDF	INTDF		LOGICAL	PROG	1	INTDF	CDECAL DIFEQ2 LS2	RITEND SETPAT
OPT	IRES	ENVIN ENV		INTEGER	USER	1	READIN REDCAS	READIN RITQA	RITENV OMHCAL
OPT	ISALT	ENVIN		INTEGER		1	READIN REDCAS	ENVLIB RITENV CHECK	
OPT	IUNIT	ENVIN		INTEGER	USER	1	READIN REDFIL REDCAS	DOSCAL RITQA RITENV	RITEXP TRNSPT
OPT	KGG	ENV		REAL	PROG	1	BLOCKD	INHCAL	
OPT	KGMG	ENV		REAL	PROG	1	BLOCKD	CRPCAL	
OPT	LM2IN	ENV		REAL	PROG	1	BLOCKD	CRPCAL ANMCAL EDRCRP	EDRANM EDRRES
OPT	LUN	ENVIN ENV DOSE OUT			PROG	1	ENV INTDF CDECAL METLIB RITEND XQIN RITINC RITINT SIJLIB	INTDF CDECAL METLIB RITEND REDFLT XQIN RITINC RITINT SIJLIB	

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TABLE 3.2. (contd)

Common Block	Parameter Name	Used By	Exposure	Fortran Type	Set By	Dimensions	Set In	Used In
							DOSE REDFIL REDSET DOSSUM READIN RITQA ENVLIB RITENV CHECK CRONMO RITEXP TRNSPT XQCAL REDCAS REDCHA	DOSE REDFIL REDSET DOSSUM RITBYP RITBYR READIN RITQA ENVLIB RITENV CHECK CRONMO RITEXP TRNSPT XQCAL REDCAS REDCHA
OPT	M3CM3	ENV		REAL	PROG	1	BLOCKD	INHCAL
OPT	M3L	ENV		OPT	PROG	1	BLOCKD	TRNSPT
OPT	METHOD	INTDF		INTEGER	USER	1	INTDF	INTDF RITEND RITINT
OPT	MEVSV			REAL	PROG		BLOCKD	SIJLIB
OPT	MOYR	ENV		REAL	PROG	1	BLOCKD	CRPCAL ANMCAL EDRANM EDRRES EDRCRP
OPT	NAN	ENV	ANFOOD	REAL	PROG	1	BLOCKD	ANMCAL READIN RITQA RITENV CHECK EDRANM TRNSPT XQCAL AIRCAL REDCAS REDCHA PRIOR DKHARV
OPT	NAQ	ENV	AQFOOD	INTEGER	PROG	1	BLOCKD	AQUCAL READIN RITQA ENVLIB RITENV CHECK XQCAL REDCAS
OPT	NCHAIN	ENV		INTEGER	CALC	1	REDCAS REDFIL	ENV REDFIL

TABLE 3.2. (contd)

Common Block	Parameter Name	Used By	Exposure	Fortran Type	Set By	Dimensions	Set In	Used In	
								REDCAS	
OPT	NEAR	ENVIN ENV		LOGICAL	USER	1	READIN REDCAS REDFIL	RITQA RITENV CHECK REDCAS PRIOR	
OPT	NMAX	ENVIN		INTEGER	PROG	1	BLOCKD	ORDER	
OPT	NONAG	ENV ENVIN	NEAR	LOGICAL	CALC	1	CHECK REDCAS PRIOR	PRIOR RITENV CHECK REDCHA DKHARV	
OPT	NPATH	DOSE ENV		REAL	PROG	1	BLOCKD	RITEXP REDFIL DOSCAL	RITBYP EXPOSR INITNV
OPT	NRE	ENVIN		INTEGER	PROG	1	BLOCKD	CHECK	
OPT	NTF	ENV	TFOOD	INTEGER	PROG	1	BLOCKD	CRPCAL READIN RITQA ENVLIB RITENV CHECK TRNSPT	XQCAL AIRCAL REDCAS REDCHA PRIOR DKHARV EDRCRP
OPT	NVU	DOSE		REAL	PROG	5	REDFLT BLOCKD REDCAS	REDFLT DOSCAL RITENV	
OPT	ONEDOS	ENVIN DOSE		LOGICAL	USER	1	REDFIL CHECK REDCAS	RITENV	
OPT	ONEYR	ENV		REAL	PROG	1	BLOCKD	SOLCAL	
OPT	OUTEDE	DOSE		LOGICAL	USER	1	REDFIL REDCAS	DOSCAL DOSSUM	RITBYP RITBYR
OPT	OUTPTH	ENVIN OUT		LOGICAL	USER	1	READIN REDFIL REDCAS	DOSE RITENV	

TABLE 3.2. (contd)

Common Block	Parameter Name	Used By	Exposure	Fortran Type	Set By	Dimensions	Set In	Used In
OPT	OUTRAD	ENVIN OUT		LOGICAL	USER	1	READIN REDFIL REDCAS	DOSE RITENV
OPT	P	ENV		REAL	PROG	1	BLOCKD	MIXRTO XQCAL
OPT	PATH	ENV DOSE		LOGICAL	USER	NPATH	REDCAS REDFIL	REDFIL RITENV DOSCAL RITEXP RITBYP
OPT	POPDOS	ENVIN ENV		LOGICAL	USER		READIN REDCAS REDFIL	TOTCAL XQCAL RITQA AIRCAL RITENV ENV CHECK
OPT	POPIN	ENVIN ENV		INTEGER	USER	1	READIN REDCAS	XQPOP
OPT	POPOPT	ENVIN ENV		INTEGER	USER	1	READIN REDCAS	XQPOP XQCAL
OPT	POPT	ENV		REAL	USER CALC	1	XQIN XQCAL REDCAS	EXTCAL CRPCAL INHCAL XQCAL XQIN AIRCAL
OPT	PRCNTI	ENVIN		INTEGER	USER PROG	1	REDFLT	ACCMOD
OPT	REC	ENVIN ENV	RECRE	LOGICAL	USER	5	CHECK	EXTCAL
OPT	RECRE	ENVIN ENV		LOGICAL	USER	1	READIN REDCAS REDFIL	EXPOSR CHECK RITQA EXTCAL RITENV REDCAS
OPT	RELTRM	ENV ENVIN		LOGICAL	CALC	1	CHECK BLOCKD REDCAS	RITQA RITENV REDCHA CHECK
OPT	RF1	ENV		REAL	USER		READIN REDCAS CHECK	CRPCAL ANMCAL RITQA RITENV CHECK

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TABLE 3.2. (contd)

Common Block	Parameter Name	Used By	Exposure	Fortran Type	Set By	Dimensions	Set In	Used In	
OPT	RF2	ENV		REAL	USER		READIN CHECK REDCAS	CRPCAL ANMCAL RITQA RITENV CHECK	EDRANM EDRNON EDRRES EDRCRP
OPT	SECDA	INTDF		REAL	PROG	1	BLOCKD	ORDIN CDECAL RITEND	
OPT	SECYR	ENV		REAL	PROG	1	BLOCKD	SOLCAL INHCAL ANMCAL EDRANM	CRPCAL EDRRES EDRCRP
OPT	SLDN	ENV		REAL	PROG	1	REDFLT BLOCKD REDCAS	SOLCAL CRPCAL ANMCAL REDFLT RITENV INHCAL	
OPT	SLING	ENVIN ENV		LOGICAL	USER	1		RITQA CRPCAL EXPOSR	
OPT	SOLUNT	ENVIN		INTEGER	USER	1	READIN REDFIL REDCAS	ORDER RITQA	
OPT	SSLDN	ENV		REAL	BLOCK D	1	REDFLT BLOCKD REDCAS	SLNCAL ANMCAL REDFLT RITENV EDRANM EDRRES EDRCRP	CRPCAL EDRNON EDRRES EDRCRP
OPT	SVU	ENVIN		REAL	PROG	3	REDFLT BLOCKD REDCAS	ORDER REDFLT RITENV	
OPT	SWAT	ENVIN ENV		LOGICAL	USER	1	READIN REDCAS REDFIL	TRNSPT READIN RITQA RITENV	CHECK ENV REDCAS

TABLE 3.2. (contd)

Common Block	Parameter Name	Used By	Exposure	Fortran Type	Set By	Dimensions	Set In	Used In	
OPT	SWING	ENVIN ENV		LOGICAL	USER	1		CHECK	
OPT	TFD	ENVIN ENV	TFOOD	LOGICAL	USER	4	READIN REDCAS CHECK	CRPCAL RITQA RITENV CHECK XQCAL AIRCAL	REDCAS REDCHA PRIOR DKHARV EDRCRP
OPT	TFOOD	ENVIN ENV		LOGICAL	USER	1	READIN REDCAS REDFIL	EXPOSR RITQA RITENV CHECK	TRNSPT XQCAL AIRCAL REDCAS
OPT	UNIT1	ENV		CHAR*3	PROG	5	BLOCKD	RITQA RITEXP TRNSPT	
OPT	UNIT2	ENV		CHAR*2	PROG	6	BLOCKD	RITEXP	
OPT	UNIT3	ENV		CHAR*2	PROG	3	BLOCKD	RITQA	
OPT	UNITCF	ENV		REAL	PROG	1	BLOCKD		
OPT	WT	DOSE		REAL	PROG	11	BLOCKD REDCAS	DOSSUM RITENV	
OPT	WTIM	ENV		REAL	PROG	1	REDFLT BLOCKD REDCAS	CRPCAL ANMCAL REDFLT	WBEDE RITENV
OPT	XOQOPT	ENV	AIR	INTEGER	USER	1	READIN REDCAS	ENVIN RITQA RITENV	CHECK XQCAL
OPT	YRDA	ENVIN ENV		REAL	PROG	1	BLOCKD	ORDER AQUCAL ANMCAL	CRPCAL DRKCAL
OPT	YRHR	ENV		REAL	PROG	1	BLOCKD	AQUCAL INHCAL	EXTCAL TRNSPT
OPT	YRSEC	ENV		REAL	PROG	1	BLOCKD	INHCAL TRNSPT AIRCAL	

TABLE 3.2. (contd)

Common Block	Parameter Name	Used By	Exposure	Fortran Type	Set By	Dimensions	Set In	Used In	
OPT	ZERO	INTDF		REAL	PROG	1	BLOCKD	EULER DIFEQ2 LS2	
ORGMAS	MASMAS	INTDF		REAL	PROG	MORG	BLOCKD	SETORG	
ORGMAS	MASORG	ENVIN		CHAR*8	PROG	MORG	BLOCKD	METLIB RITEND SETORG DOSSUM	RITBYP RITBYR WBEDE
ORGMAS	MORG	SIJMAK		INTEGER	PROG	1	BLOCKD	SIJLIB REDSET DOSCAL	TOTCAL WBEDE
ORGMAS	SI2I	DOSE		REAL	PROG	1	BLKORG REDFIL	DOSCAL	
ORGMAS	SINDX	SIJMAK		INTEGER	PROG	MORG	BLOCKD		
ORGMAS	TINDX	SIJMAK		INTEGER	PROG	MORG	BLOCKD		
ORGPAR	IORG	INTDF SIJMAK		INTEGER	CALC	NORG	BLOCKD SIJLIB SETORG REDSET	METLIB RITEND RITINT SETORG SIJLIB	
ORGPAR	IYX	INTDF		INTEGER	CALC	NORGL	SETORG	CDECAL	
ORGPAR	NBONE	INTDF		INTEGER	CALC	1	METLIB	METLIB GEN RITINT	
ORGPAR	NOCOMP	INTDF		INTEGER	CALC	1	METLIB	METLIB GEN RITINT	
ORGPAR	NORG	ENVIN DOSE		INTEGER	CALC	1	METLIB	METLIB CDECAL GEN	RITEND RITINT SETORG
ORGPAR	NORGCM	INTDF		INTEGER	CALC	NORG	METLIB SETORG	METLIB GEN RITINT	
ORGPAR	NORGCR	ENVIN		INTEGER	CALC	1	METLIB	SETORG	

TABLE 3.2. (contd)

Common Block	Parameter Name	Used By	Exposure	Fortran Type	Set By	Dimensions	Set In	Used In	
		DOSE						RITEND RITINT	
ORGPAR	NORGL	INTDF		INTEGER	CALC	1	SETORG	CDECAL METLIB RITEND RITINC	RITINT SETORG SIJLIB
ORGPAR	NOTHER	INTDF		INTEGER	CALC	1	METLIB	METLIB GEN RITINT	
ORGPAR	ORGANS	ENVIN		CHAR*8	CALC	NORG	SETORG	RITEND RITINT	
ORGPAR	ORGING	INTDF		REAL	CALC	MORG	SETORG	CDECAL	
ORGPAR	ORGINH	INTDF		REAL	CALC	MORG	SETORG	CDECAL	
ORGPAR	ORGMLT	INTDF		REAL	CALC	NORGL	SETORG	CDECAL RITINT	
ORGPAR	SPECOR	INTDF		LOGICAL	CALC	NORGL	SETORG	CDECAL RITINT SETORG	
ORGPAR	TARGET	INTDF		LOGICAL	CALC	NORGL	SETORG	CDECAL RITINT	
ORGPAR	TCMULT			REAL	CALC	MORG	SETORG	GEN DIFEQ2	IOD ALK
ORGPAR	TOTMAS	INTDF		REAL	PROG	1	BLOCKD	SETORG	
RAD	ATNUM	INTDF		INTEGER	PROG	NONVC	IDNUC	METLIB	
RAD	AW	ENV		CHAR*6	CALC	NONUC	REDCHA ORDIN	ORDIN RITEND RITINT	SIJLIB RITEXP
RAD	BONE	ENV		CHAR*1	LIB	NONUC	REDCHA ORDIN	RITINT SETORG	
RAD	C14	ENV		LOGICAL	PROGR AM	1	REDCHA	EXPOSR	

TABLE 3.2. (contd)

Common Block	Parameter Name	Used By	Expo-sure	Fortran Type	Set By	Dimen-sions	Set In	Used In	
RAD	CLASS	ENVIN		CHAR*1	LIB	NONUC	REDCHA ORDIN	METLIB ORDIN RITEND	RITINT SETPAR
RAD	ELT	ENV		CHAR*2	CALC	NONUC	REDCHA ORDIN	ORDIN RITEND SIJLIB	
RAD	H3	ENV		LOGICAL	PROGR AM	1	REDCHA	EXPOSR	
RAD	HL	ENV		REAL	LIB	NONUC	REDCHA		
RAD	ICL	INTDF		INTEGER	PROG	NONUC	ORDIN		
RAD	IMOD	INTDF		INTEGER	LIB	NONUC	ORDIN	METLIB DIFEQ2 RITEND	RITINT SETORG
RAD	IRMD			INTEGER	PROG	NONVC	ORDIN	SIJLIB	
RAD	NONUC	ENVIN ENV		INTEGER	CALC	NONUC	ORDIN ENV	CDECAL ALK DIFEQ2 PRIOR IOD LS2 ORDIN RITEND ANMCAL XQIN RITINT SIJLIB CHECK EDRANM CRPCAL	AQUCAL RITEXP INHCAL DRKCAL EXTCAL TRNSPT EXPOSR EDRNON AIRCAL ENV REDCHA DKHARV PACKAG EDRRES EDRCRP
RADIN	ALT	ENVIN		REAL	CALC	NUCTOT	ORDER ORDIN	ORDIN RITENV	
RADIN	AWT	ENVIN		CHAR*6	PROG	NUCTOT	ORDER REDFIL	REDFIL REDSET	RITBYR RITENV
RADIN	BAS	ENVIN		LAGICAL	PROGR AM	5	CHECK	RITQA	

TABLE 3.2. (contd)

Common Block	Parameter Name	Used By	Exposure	Fortran Type	Set By	Dimensions	Set In	Used In	
RADIN	BONET	ENVIN		CHAR*1	PROG	NUCTOT	ORDER	RITENV	
RADIN	CASCON	ENVIN		REAL	CALC	5+4 NUCTOT	ORDER	ORDER RITENV CHECK	
RADIN	CASQ	ENVIN		REAL	CALC	3 NUCTOT	ORDER	RITENV CHECK	
RADIN	CLASST	ENVIN		CHAR*1	PROG	NUCTOT	ORDER	ORDER RITENV	
RADIN	DKT	ENVIN		REAL	PROG	2 NUCTOT	ORDER	RITENV	
RADIN	ELTT	ENVIN		CHAR*2	PROG	NUCTOT	ORDER REDFIL	REDSET RITBYR	ENVLIB RITENV
RADIN	HLT	ENVIN		REAL	CALC	NUCTOT	ORDER	ORDER RITENV	
RADIN	ICH	ENVIN		INTEGER	CALC	1	ORDER	RITENV	
RADIN	ICLASS	ENVIN		INTEGER	CALC	NUCTOT	ORDER REDCHA	SETPAR RITENV	
RADIN	IFRT	ENVIN		INTEGER	PROG	2 NUCTOT	ORDER	ORDER RITENV	
RADIN	IOFNUC	ENVIN		INTEGER	CALC	NUCTOT	ORDER REDFIL	RITENV	
RADIN	NUCTOT	ENVIN		INTEGER	CALC	1	ORDER REDFIL	DOSE REDFIL DOSCAL RITBYR	ORDER ENVLIB RITENV CHECK
RMD	AWM	ENVIN		CHAR*6	LIB	250	RLIBIN	IDNUC ORDER	ORDIN RLIBIN
RMD	BONED	ENVIN		CHAR*1	LIB	250	RLIBIN	ORDER ORDIN	
RMD	DKF	ENVIN		REAL	CALC	2 250	RLIBIN	ORDER ORDIN	
RMD	ELTM	ENVIN		CHAR*2	LIB	250	RLIBIN	IDNUC	RLIBIN

TABLE 3.2. (contd)

Common Block	Parameter Name	Used By	Exposure	Fortran Type	Set By	Dimensions	Set In	Used In	
								ORDER ORDIN	RITINT RITEXP
RMD	IFR	ENVIN		INTEGER	LIB	2 250	RLIBIN	ORDER ORDIN	
RMD	IMODM	INTDF		INTEGER	LIB CALC	NUCS	RLIBIN	ORDIN	
RMD	NCH	ENVIN		INTEGER	CALC	1	RLIBIN	ORDER RLIBIN	
RMD	NCHN	ENVIN		INTEGER	CALC	250	RLIBIN	IDNUC ORDIN	
RMD	NCHST	ENVIN		INTEGER	CALC	200	RLIBIN	ORDER ORDIN	
RMD	NFLAG	ENVIN		INTEGER	CALC	250	IDNUC	ORDER	
RMD	NFLAGC	ENVIN		INTEGER	CALC	200	IDNUC	ORDER	
RMD	NOFNUC	ENVIN		INTEGER	CALC	200	RLIBIN	ORDER ORDIN RLIBIN	
RMD	NUCS	ENVIN		INTEGER	CALC	1	RLIBIN	RLIBIN IDNUC	
RMD	TCLASS	ENVIN		CHAR*1	LIB	250	RLIBIN	ORDER ORDIN	
RMD	TR	ENVIN		REAL	LIB	250	RLIBIN	ORDER ORDIN	
RMD2	ATNO			INTEGER	LIB	NUCS	RLIBIN	METLIB	
RMD2	BRANCH			REAL	LIB	30	RLIBIN		
RMD2	ELT2M			CHAR*2	LIB	30	RLIBIN		
RMD2	IPNDX			INTIGER	LIB	30	RLIBIN		
RMD2	NDAU			INTEGER	LIB	NUCS	RLIBIN		
RMD2	NIDRMD			INTEGER	LIB	30	RLIBIN		

TABLE 3.2. (contd)

Common Block	Parameter Name	Used By	Exposure	Fortran Type	Set By	Dimensions	Set In	Used In	
RMD2	AW2M			CHAR*6	LIB	30	RLIBIN		
SIJS	SIJ	ENVIN DOSE		REAL	LIB	NORG NORG NONUC	SIJLIB	CDECAL RITINT SIJLIB	
SOLPAR	BTDSET	ENVIN ENV	BIOT	INTEGER	USER	1	READIN REDCAS	RITQA RITENV CHECK	BIOCAL EDRNON
SOLPAR	BTNTK	ENVIN ENV	BIOT	LOGICAL	USER	1	READIN REDCAS	SOLCAL RITQA RITENV	
SOLPAR	BTPRE	ENVIN ENV	BIOT	LOGICAL	USER	1	READIN REDCAS	RITQA RITENV PRIOR	
SOLPAR	EXCAMT	ENV	BIOT	REAL	CALC	1	BIOCAL	EDRANM EDRNON	EDRRES EDRCRP
SOLPAR	EXCAV	ENV	BIOT	REAL	PROG	6 3	BLOCKD REDFLT REDCAS	REDFLT RITENV BIOCAL	
SOLPAR	INDW	ENV	BIOT	INTEGER	CALC	1	BIOCAL	SOLCAL BIOCAL	
SOLPAR	IRRSR	ENV	GROUND	INTEGER	USER	1	READIN REDCAS	SOLCAL RITQA RITENV	CHECK EDRRES
SOLPAR	IRTIMR	ENV	GROUND	REAL	USER	1	READIN REDCAS	SOLCAL RITQA	RITENV EDRRES
SOLPAR	LEACHR	ENV		REAL	LIB	NONUC	REDCHA	SOLCAL	
SOLPAR	MANULR	ENVIN ENV	BURWAS	REAL	USER	1	READIN REDCAS	RITQA RITENV PRIOR	
SOLPAR	OVRBRD	ENVIN ENV		REAL	USER	1	READIN REDCAS	BIOCAL RITQA RITENV	
SOLPAR	PACKHL	ENVIN ENV		REAL	USER	1	READIN REDCAS	SOLCAL RITQA	

TABLE 3.2. (contd)

Common Block	Parameter Name	Used By	Exposure	Fortran Type	Set By	Dimensions	Set In	Used In	
								RITENV	
SOLPAR	RESIRR	ENVIN ENV		LOGICAL	USER	1	READIN REDCAS	EDRRES READIN RITENV	CHECK PRIOR
SOLPAR	RIRRR	ENV	GROUND	REAL	USER	1	READIN REDCAS	SOLCAL RITQA	RITENV EDRRES
SOLPAR	RTPACK	ENV	BURWAS	REAL	CALC	NONUC	PACKAG TRNSPT	PACKAG	
SOLPAR	SOLING	ENV		REAL	USER PROG	1	BLOCKD REDFLT REDCAS	REDFLT RITENV CRPCAL	
SOLPAR	SURCM	ENV		REAL	USER PROG	1	BLOCKD REDFLT	INHCAL REDFLT	
SOLPAR	TOTEXC	ENV		REAL	PROG	3	BLOCKD REDFLT REDCAS	SOLCAL REDFLT RITENV BIOCAL	
SOLPAR	WASDEP	ENV	NEAR	REAL	USER	1	READIN REDCAS	RITQA RITENV CHECK EDRANM CRPCAL	ANMCAL EDRNON EDRRES EDRCRP
SOLPAR	YELDBT	ENV	BIOT	REAL	PROG	3	BLOCKD REDFLT REDCAS	REDFLT RITENV EDRNON EDRRES	
SWPAR	MIXFLG	ENVIN	SWAT	INTEGER	USER		READIN REDCAS	SWCAL ENV READIN RITQA	RITENV CHECK REDCAS
SWPAR	MIXR	ENVIN	SWAT	REAL	USER	1	SWCAL READIN REDCAS	RITQA RITENV CHECK TRNSPT	
SWPAR	SWDPTH	ENVIN	SWAT	REAL	USER	1	READIN REDCAS	CHECK RITQA	SWCAL RITENV

TABLE 3.2. (contd)

Common Block	Parameter Name	Used By	Exposure	Fortran Type	Set By	Dimensions	Set In	Used In	
SWPAR	SWDZ	ENVIN	SWAT	REAL	USER	1	READIN REDCAS	RITENV RITQA	SWCAL
SWPAR	SWFLOW	ENVIN	SWAT	REAL	USER	1	READIN REDCAS	SWCAL RITQA RITENV	CHECK TRNSPT
SWPAR	SWIDTH	ENVIN	SWAT	REAL	USER	1	READIN REDCAS	SWCAL RITQA	RITENV CHECK
SWPAR	SWLSX	ENVIN	SWAT	REAL	USER	1	READIN REDCAS	SWCAL RITQA RITENV	
SWPAR	SWOSY	ENVIN	SWAT	REAL	USER	1	READIN REDCAS	SWCAL RITQA RITENV	
SWPAR	SWQB	ENVIN	SWAT	REAL	USER	1	READIN REDCAS	MIXTRO RITQA RITENV	
SWPAR	TCWS	ENV		REAL	PROG	1	REDFLT REDCAS	REDFLT RITENV EXTCAL	
TIMES	AQUTT	ENVIN ENV	AQFOOD	REAL	USER	NAQ	READIN REDCAS CHECK	AQUCAL RITQA RITENV CHECK	
TIMES	BEFAIR	ENV ENVIN		INTEGER	USER	1	READIN REDCAS REDFIL	PRIOR RITQA RITENV CHECK	
TIMES	BEFIRR	ENV ENVIN		INTEGER	USER	1	READIN REDCAS REDFIL	PRIOR RITQA RITENV CHECK	
TIMES	BEFORE	ENVIN ENV		REAL	CALC	1	READIN REDCAS	PRIOR RITQA RITENV CHECK	

91048 0755

TABLE 3.2. (contd)

Common Block	Parameter Name	Used By	Exposure	Fortran Type	Set By	Dimensions	Set In	Used In	
TIMES	DCEND	ENVIN DOSE		REAL	USER	1	READIN INTDF REDFIL REDCAS	INTDF RITEND RITINT REDFIL DOSCAL DOSSUM	TOTCAL RITBYP RITBYR RITQA RITENV
TIMES	HSTART	INTDF		REAL*8	USER	1	INTDF	INTDF	RITINT
TIMES	ITIME	ENV DOSE		INTEGER	CALC	1	ENV	INTDF INHCAL TRNSPT	EXPOSR ENV PRIOR
TIMES	ITIMT	ENV		INTEGER	CALC	1	PRIOR ENV	PACKAG INHCAL	ENV PRIOR
TIMES	LOIC	ENV ENVIN	NEAR	INTEGER	USER	1	READIN REDCAS	PRIOR RITQA	RITENV CHECK
TIMES	NBEFORE	ENV		INTEGER	CALC	1	PRIOR	PRIOR	
TIMES	NTIME	DOSE		INTEGER	USER	1	INTDF REDFIL ENV	INTDF RITEND RITEXP	INITNV ENV
TIMES	NTKEND	ENVIN ENV		REAL	USER	1	READIN REDFIL REDCAS	DOSCAL DOSSUM RITBYP RITBYR	RITQA RITENV ENV
TIMES	RECTT	ENVIN ENV	RECRE	REAL	USER	1	READIN REDCAS CHECK	RITENV CHECK EXTCAL	
TIMES	RELEND	ENVIN ENV		REAL	USER	1	READIN REDCAS REDFIL	DOSSUM RITBYP RITBYR RITQA	RITENV EXTCAL TRNSPT
TIMES	SWTT	ENVIN ENV	SWAT	REAL	USER	1	READIN REDCAS	RITENV CHECK TRNSPT	
TITL	TITLS	ENVIN ENV DOSE		CHAR*80	USER PROG	30	OPNFIL REDFLT REDFIL READIN	RITQA HEADNG OPNFIL	

4.0 WORKSHEETS AND HAND CALCULATIONS

A worksheet package is provided to assist the user performing hand calculations for code verification. Table 4.1 is the table of contents for the worksheet package included in Exhibit 4.1.

TABLE 4.1. GENII Environmental Dosimetry Software Package Hand Calculation Worksheets Table of Contents

TABLE 4.1. (Contd)

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Exhibit 4.1. GENII Hand Calculation Worksheets

Title:	Pathway or Organ:		Prepared by:	Date:
	Radionuclide:	Year:	Reviewed by:	Date:

SURFACE WATER CONCENTRATION

Surface Water Release Term • Mixing Ratio / Surface Water Flow Rate • Unit Conversion • Conversion Factor = Surface Water Concentration

$$\boxed{i}\ \frac{\text{UoA}}{\text{yr}} \bullet \boxed{i/c} \;/\; \boxed{i}\ \frac{m^3}{\text{sec}} \bullet 1.0\times10^{-3}\ \frac{m^3}{L} \bullet 3.17\times10^{-8}\ \frac{\text{yr}}{\text{sec}} = \boxed{c}\ \frac{\text{UoA}}{L}$$

QSW MIXR SWFLOW SWQB M3L YRSEC SWCON

MEDIA.OUT

DECAY SURFACE WATER FOR TRANSIT TIME TO IRRIGATION WITHDRAWL / RECREATIONAL SITES

$$\text{Surface Water Concentration} \bullet e^{-\left[\lambda_{decay} \bullet \text{Transit Time} \bullet \text{Unit Conversion}\right]} = \text{Decayed Surface Water Concentration}$$

$$\boxed{i/c}\ \frac{\text{UoA}}{L} \bullet e^{-\left[\boxed{c}\ \text{yr}^{-1} \bullet \boxed{i}\ \text{hr} \bullet 1.14\times10^{-4}\ \frac{\text{yr}}{\text{hr}}\right]} = \boxed{c}\ \frac{\text{UoA}}{L}$$

SWCON AL SWTT RECTT YRHR WATCON / SWIRR

MEDIA.OUT

SEDIMENT CONCENTRATION

$$\text{Decayed Surface Water Concentration} \bullet \text{Water to Sediment Transfer Factor} \bullet \frac{1.0 - e^{-\left(\lambda_{decay} \bullet 1\ \text{yr}\right)}}{\lambda_{decay}} = \text{Sediment Concentration}$$

$$\boxed{c}\ \frac{\text{UoA}}{L} \bullet \boxed{d\ \ 25295.0}\ \frac{L}{m^2\ \text{yr}} \bullet \frac{1.0 - e^{-\left[\boxed{c}\ \text{yr}^{-1} \bullet 1\ \text{yr}\right]}}{\boxed{c}\ \text{yr}^{-1}} = \boxed{c}\ \frac{\text{UoA}}{m^2}$$

WATCON AL AL SEDCON

debug

Parameter Source Legend:
i - GENII.IN
l - library value
d - DEFAULT.IN
c - calculated value

MEDIA CONCENTRATION: SURFACE WATER AND SEDIMENT
Subroutines: TRNSPT, EXTCAL

CHRONIC RELEASE

9 1 0 4 8 0 7 5 9

Exhibit 4.1. GENII Hand Calculation Worksheets

Title:	Pathway or Organ:		Prepared by:	Date:
	Radionuclide:	Year:	Reviewed by:	Date:

AIR CONCENTRATION - INFINITE PLUME (When Air Concentration Input; No Air Transport)

Air Concentration • Unit Conversion = Population-Weighted Air Concentration

$$\boxed{i/c}\ \frac{\text{UoA}}{\text{m}^3} \bullet 3.15\times10^{7}\ \frac{\text{sec}}{\text{yr}} = \boxed{c}\ \frac{\text{UoA sec}}{\text{m}^3\ \text{yr}}$$

AIRCON   SECYR   ARPCON

debug

AIR RELEASE DECAY FOR TRANSIT TIME FOR EACH DISTANCE (i) AND DIRECTION (j) - INFINTIE PLUME array)

Air Release Term • $e^{-\left[\lambda_{decay} \bullet \text{Distance} / \text{Average Wind Speed} \bullet \text{Unit Conversion}\right]}$ = Decayed Air Release Term

$$\boxed{i}\ \frac{\text{UoA}}{\text{yr}} \bullet e^{-\left[\boxed{c}\ \text{yr}^{-1} \bullet \boxed{i}\ \text{m} \ / \ \boxed{i/c}\ \frac{\text{m}}{\text{sec}} \bullet 3.17\times10^{-8}\ \frac{\text{yr}}{\text{sec}}\right]} = \boxed{c}\ \frac{\text{UoA}}{\text{yr}}$$

QAIR   AL $DIST_i$ $AVEU_j$ $DKAIR_{ij}$

debug

AIR CONCENTRATION - INFINITE PLUME (Individual, Chi/Q value input)

Air Release Term (No Decay) • Population-Weighted Chi/Q / Total Population = Average Population-weighted Air Concentration

$$\boxed{i}\ \frac{\text{UoA}}{\text{yr}} \bullet \boxed{i}\ \frac{\text{person sec}}{\text{m}^3} \ / \ \boxed{i/c}\ \text{person} = \boxed{c}\ \frac{\text{UoA sec}}{\text{m}^3\ \text{yr}}$$

QAIR   XOQI   POPT   ARPCON

debug

Parameter Source Legend:
i - GENII.IN
l - library value
d - DEFAULT.IN
c - calculated value

MEDIA CONCENTRATION: AIR
Subroutine: XQCAL, AIRCAL

CHRONIC RELEASE

Exhibit 4.1. GENII Hand Calculation Worksheets

Title:	Pathway or Organ:		Prepared by:	Date:
	Radionuclide:	Year:	Reviewed by:	Date:

AVERAGE POPULATION-WEIGHTED AIR CONCENTRATION - INFINITE PLUME

Summed Over Distance & Direction [Decayed Air Release Term • Chi/Q by Distance and Direction • Population by Distance and Direction] / Total Population For Air Paths = Average Population-Weighted Concentration

$$\sum_{i=1}^{NDIST} \sum_{j=1}^{NDIR} \left[\underset{DKAIR_{ij}}{\boxed{c}} \frac{UoA}{yr} \bullet \underset{XOQ_{ij}}{\boxed{i/c}} \frac{sec}{m^3} \bullet \underset{POP_{ij}}{\boxed{i}} \text{ person} \right] / \underset{POPT}{\boxed{c}} \text{ person} = \underset{ARPCON}{\boxed{c}} \frac{UoA\ sec}{m^3\ yr}$$

MEDIA.OUT

AVERAGE POPULATION-WEIGHTED AIR DOSE FACTOR - FINITE PLUME

Summed Over Energy Groups, Distance and Direction [Decayed Air Release Term • Dose Rate Factor For Finite Plume • Population by Distance and Direction • Energy per Disintegration • Surface Correction] = Intermediate Value

$$\sum_{k=1}^{6} \sum_{i=1}^{NDIST} \sum_{j=1}^{NDIR} \left[\underset{DKAIR_{ij}}{\boxed{c}} \frac{UoA}{yr} \bullet \underset{DRFOQ_{ijk}}{\boxed{i/c}} \frac{person\ rem\ dis}{Ci\ MeV} \bullet \underset{POP_{ij}}{\boxed{i}} \text{ person} \bullet \underset{EDIS_k}{\boxed{l}} \frac{MeV}{dis} \bullet \underset{FC_k}{\boxed{d}} \right] = \boxed{}$$

Intermediate Value / Total Population For Air Paths = Average Population-Weighted Air Dose Factor

$$\boxed{c} \ / \ \underset{POPT}{\boxed{c}} \text{ person} = \underset{ARPXCN}{\boxed{c}} \frac{UoA\ person\ rem}{yr\ Ci}$$

debug

Parameter Source Legend:
i - GENII.IN
l - library value
d - DEFAULT.IN
c - calculated value

MEDIA CONCENTRATION: AIR
Subroutine: XQCAL, AIRCAL

CHRONIC RELEASE

Exhibit 4.1. GENII Hand Calculation Worksheets

Title:	Pathway or Organ:		Prepared by:	Date:
	Radionuclide:	Year:	Reviewed by:	Date:

AIR RELEASE DECAY TO MAXIMUM INDIVIDUAL LOCATION - FINITE PLUME

$$\text{Air Release Term} \bullet e^{-\left[\lambda_{decay} \bullet \text{Specifed Distance} \,/\, \text{Average Wind Speed in Specified Sector} \bullet \text{Unit Conversion}\right]} = \text{Decayed Air Release Term}$$

$$\underset{\text{QAIR}}{\boxed{i\quad}}\ \frac{\text{UoA}}{\text{yr}} \bullet e^{-\left[\underset{\text{AL}}{\boxed{c\quad}}\ \text{yr}^{-1} \bullet \underset{\text{MIDIST}}{\boxed{i\quad}}\ \text{m} \,/\, \underset{\text{AVEU}_{(\text{midir})}}{\boxed{i/c\quad}}\ \frac{\text{m}}{\text{sec}} \bullet 3.17\text{x}10^{-8}\ \frac{\text{yr}}{\text{sec}}\right]} = \underset{\text{DKAIR}}{\boxed{c\quad}}\ \frac{\text{UoA}}{\text{yr}}$$

$\boxed{\quad}$ debug

AVERAGE OR MAXIMUM INDIVIDUAL AIR DOSE FACTOR - FINITE PLUME

$$\text{Summed Over Energy Groups} \left[\text{Decayed Air Release Term} \bullet \text{Dose Rate Factor For Finite Plume} \bullet \text{Energy per Disintegration} \bullet \text{Surface Correction}\right] = \text{Average/ Maximum Individual Air Dose Factor}$$

$$\sum_{k=1}^{6} \left[\underset{\text{DKAIR}}{\boxed{c\quad}}\ \frac{\text{UoA}}{\text{yr}} \bullet \underset{\text{DRSAV}_k}{\boxed{i/c\quad}}\ \frac{\text{person rem dis}}{\text{Ci MeV}} \bullet \underset{\text{EDIS}_k}{\boxed{l\quad}}\ \frac{\text{MeV}}{\text{dis}} \bullet \underset{\text{FC}_k}{\boxed{d\quad}}\right] = \underset{\text{ARPXCN}}{\boxed{\quad}}\ \frac{\text{UoA person rem}}{\text{yr Ci}}$$

Parameter Source Legend:
i - GENII.IN
l - library value
d - DEFAULT.IN
c - calculated value

MEDIA CONCENTRATION: AIR
Subroutine: XQCAL, AIRCAL

CHRONIC RELEASE

Title:	Pathway or Organ:		Prepared by:	Date:
	Radionuclide:	Year:	Reviewed by:	Date:

AVERAGE FOOD-WEIGHTED AIR CONCENTRATION (If FOQOPT = 0)

Air Release Term (No Decay) • Food-Weighted Chi/Q = Average Food-weighted Air Concentration

$$\underset{\text{QAIR}}{\boxed{i\quad}}\ \frac{\text{UoA}}{\text{yr}} \bullet \underset{\text{FOQ}}{\boxed{i\quad}}\ \frac{\text{sec}}{\text{m}^3} = \underset{\substack{\text{ARFCON}\\ \text{ARF2CN}}}{\boxed{c\quad}}\ \frac{\text{UoA sec}}{\text{m}^3\ \text{yr}}$$

debug

AVERAGE FOOD-WEIGHTED AIR CONCENTRATION (If FOQOPT = 1)

Average Population-weighted Air Concentration = Average Food-weighted Air Concentration

$$\underset{\text{ARPCON}}{\boxed{c\quad}}\ \frac{\text{UoA sec}}{\text{m}^3\ \text{yr}} = \underset{\substack{\text{ARFCON}\\ \text{ARF2CN}}}{\boxed{c\quad}}\ \frac{\text{UoA sec}}{\text{m}^3\ \text{yr}}$$

debug

FOOD-WEIGHTED AIR CONCENTRATION (FOQOPT = 2 or 3)

Summed Over Each Distance and Direction [Decayed Air Release Term • Chi/Q by Distance and Direction • Food Production by Distance and Direction] / Total Production = Average Food-weighted Air Concentration

$$\sum_{i=1}^{\text{NDIST}} \sum_{j=1}^{\text{NDIR}} \left[\underset{\text{DKAIR}_{ij}}{\boxed{c\quad}}\ \frac{\text{UoA}}{\text{yr}} \bullet \underset{\text{XOQ}_{ij}}{\boxed{i/c\quad}}\ \frac{\text{sec}}{\text{m}^3} \bullet \underset{\text{FPRD}_{ij}}{\boxed{i/c\quad}}\ \frac{\text{kg}}{\text{yr}} \right] \Big/ \underset{\substack{\text{TPRODT}\\ \text{TPRODA}}}{\boxed{i\quad}}\ \frac{\text{kg}}{\text{yr}} = \underset{\substack{\text{ARFCON}\\ \text{ARF2CN}}}{\boxed{c\quad}}\ \frac{\text{UoA sec}}{\text{m}^3\ \text{yr}}$$

MEDIA.OUT

Parameter Source Legend:
i - GENII.IN
l - library value
d - DEFAULT.IN
c - calculated value

MEDIA CONCENTRATION: AIR
Subroutine: XQCAL, AIRCAL

CHRONIC RELEASE

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Title:	Pathway or Organ:	Prepared by:	Date:
	Radionuclide: / Year:	Reviewed by:	Date:

WASTE PACKAGE RELEASE TERM

$$e^{-\left(\text{Ln } 2.0/\text{Package Halflife} \bullet \text{Years of Simulation} - 1\text{ yr}\right)} - e^{-\left(\text{Ln } 2.0/\text{Package Halflife} \bullet \text{Years of Simulation}\right)} = \text{Waste Package Release Term}$$

$$e^{-\left(0.693/\boxed{i}\,yr^{-1} \bullet \boxed{i}\,yr - 1.0\ yr\right)} - e^{-\left(0.693/\boxed{i}\,yr^{-1} \bullet \boxed{i}\,yr\right)} = \boxed{c}\,yr^{-1}$$

ALOG2 PACKHL ITIME ALOG2 PACKHL ITIME PACKAV

DECAY CONTAINED WASTE (After First Year)

$$\text{Contained Waste Concentration} \bullet e^{-\left(\lambda_{decay} \bullet 1\text{ yr}\right)} = \text{Decayed Contained Waste Concentration}$$

$$\boxed{i}\,\frac{UoA}{m^3} \bullet e^{-\left[\boxed{c}\,yr^{-1} \bullet 1\text{ yr}\right]} = \boxed{c}\,\frac{UoA}{m^3}$$

QWAS AL QWAS

debug

WASTE PACKAGE AVAILABILITY OF DECAYED CONTAINED WASTE

$$\text{Decayed Contained Waste Concentration} \bullet \text{Waste Package Release Term} = \text{Waste Package Degradation Rate}$$

$$\boxed{i}\,\frac{UoA}{m^3} \bullet \boxed{c}\,yr^{-1} = \boxed{c}\,\frac{UoA}{m^3 yr}$$

QWAS PACKAV RTWAST

debug

Parameter Source Legend:
i - GENII.IN
l - library value
d - DEFAULT.IN
c - calculated value

WASTE FORM DEGRADATION
Subroutine: PACKAG

CHRONIC RELASE

Exhibit 4.1. GENII Hand Calculation Worksheets

Title:	Pathway or Organ:		Prepared by:	Date:
	Radionuclide:	Year:	Reviewed by:	Date:

INTEGRATE TOTAL REMOVAL FROM CONTAINED WASTE OVER ONE YEAR

$$\text{Waste Removal Rate} \bullet \frac{1.0 - e^{-\left(\lambda_{\text{package}} \bullet 1\ \text{yr}\right)}}{\lambda\ \text{package}} = \text{Waste Package Degradation Contribution}$$

$$\underset{\text{RTWAS}}{\boxed{c}}\ \frac{\text{UoA}}{m^3\ \text{yr}} \bullet \frac{1.0 - e^{-\left[\underset{\text{PACKHL}}{\boxed{c}}\ \text{yr}^{-1} \bullet 1\ \text{yr}\right]}}{\underset{\text{PACKHL}}{\boxed{c}}\ \text{yr}^{-1}} = \underset{\text{RTWAS PAKADD}}{\boxed{}}\ \frac{\text{UoA}}{m^3}$$

debug

REMOVE AVAILABLE WASTE FROM WASTE FORM / PACKAGE

Contained Waste Concentration − Available Waste Concentration = Remaining Contained Waste Concentration

$$\underset{\text{QWAS}}{\boxed{i/c}}\ \frac{\text{UoA}}{m^3} - \underset{\text{RTWAST}}{\boxed{c}}\ \frac{\text{UoA}}{m^3} = \underset{\text{QWAS}}{\boxed{c}}\ \frac{\text{UoA}}{m^3}$$

debug

RADIOLOGICAL DECAY AND HARVEST REMOVAL OF DEEP SOIL FOR PREVIOUS YEAR

$$\left[\text{Deep Soil Concentration} \bullet e^{-\left(\lambda_{\text{decay}} \bullet 1\ \text{yr}\right)}\right] - \text{Harvest of Previous Year} = \text{Deep Soil Concentration}$$

$$\left[\underset{\text{DSCON DS2CON DSRES NONAGD}}{\boxed{i/c}}\ \frac{\text{UoA}}{m^3} \bullet e^{-\left(\underset{\text{AL}}{\boxed{c}}\ \text{yr}^{-1} \bullet 1\ \text{yr}\right)}\right] - \underset{\text{HARVT(in,itf,2) HARVA(in,ian,2)}}{\boxed{}}\ \frac{\text{UoA}}{m^3} = \underset{\text{DSCON / DS2CON DSRES / NONAGD}}{\boxed{}}\ \frac{\text{UoA}}{m^3}$$

Parameter Source Legend:
i - GENII.IN
l - library value
d - DEFAULT.IN
c - calculated value

MEDIA CONCENTRATION: BURIED WASTE AND DEEP SOIL
Subroutines: EDRANM, EDRCRP, EDRNON, EDRRES, PACKAV

CHRONIC RELEASE

Exhibit 4.1. GENII Hand Calculation Worksheets

Title:	Pathway or Organ:		Prepared by:	Date:
	Radionuclide:	Year:	Reviewed by:	Date:

DEEP SOIL CONCENTRATION AT END OF YEAR (Prior to Biotic Transport Removal)

Deep Soil Concentration + Waste Package Degradation Contribution = Deep Soil Concentration

[c] $\frac{\text{UoA}}{m^3}$ + [c] $\frac{\text{UoA}}{m^3}$ = [c] $\frac{\text{UoA}}{m^3}$

DSCON
DS2CON
DSRES
NONAGD

PAKADD

DSCON
DS2CON
DSRES
NONAGD

[MEDIA.OUT]

MANUAL REDISTRIBUTION

Surface Soil Concentration + (Deep Soil Concentration • Deep Volume/ Surface Area Dilution Factor • Surface Soil Density) = Surface Soil Concentration

[i/c] $\frac{\text{UoA}}{m^2}$ + [[1/c] $\frac{\text{UoA}}{m^3}$ • [i] m • [d 224.0] $\frac{m^3}{m^2}$] = [ ]

SOLCON
SL2CON
RESSOL

DSCON
DS2CON
DSRES

MANULR

SLDN

SOLCON
SL2CON
RESSOL

[debug]

SOIL EXCAVATED BY BIOTIC TRANSPORT

Fraction of total soil brought to surface from within the waste • Total Soil Excavated by Animals = Soil Excavated From the Waste Rate

[ ] • [ ] $\frac{m^3}{m^2\ yr}$ = [ ] $\frac{m^3}{m^2\ yr}$

EXCAV(ID,IC)

TOTEXC

EXCAMT

[debug]

Parameter Source Legend:
i - GENII.IN
l - library value
d - DEFAULT.IN
c - calculated value

MEDIA CONCENTRATION: DEEP AND SURFACE SOIL
Subroutines: EDRANM, EDRCRP, EDRNON, EDRRES

CHRONIC RELEASE

Exhibit 4.1. GENII Hand Calculation Worksheets

Title:	Pathway or Organ:		Prepared by:	Date:
	Radionuclide:	Year:	Reviewed by:	Date:

BIOTIC TRANSPORT RATE

Concentration Ratio • Fraction Roots in Deep Soil • Yield / Surface Soil Density = Intermediate Value

[l] UoA/kg (wet plant) / UoA/kg (dry soil) (BVI) • [i] (RF2) • [i/d] kg/m^2 yr (YELD, YELDA, YELDBT) / [d 1.5E3] kg/m^3 (SSLDN) = [c] m^3/m^2 yr (RTEMP)

debug

Decayed Deep Soil Concentration • (Excavated Soil + Plant Uptake) / Waste Depth = Biotic Transport Rate

[i/c] UoA/m^3 (DSCON, DS2CON, DSRES, NONAGD) • [[d] m^3/m^2 yr (EXCAMT) + [c] m^3/m^2 yr (RTEMP)] / [i] m (WASDEP) = [c] UoA/m^2 yr (RTBIO)

debug

INTEGRATE CONTRIBUTION FROM BIOTIC TRANSPORT TO DEEP SOIL

$$\text{Biotic Transport Rate} \bullet \frac{1.0 - e^{-\left[\lambda_{decay} \bullet 1\ yr\right]}}{\lambda_{decay}} = \text{Deep Soil Contribution}$$

$$[c]\ \frac{UoA}{m^3\ yr}\ (\text{RTBIO}) \bullet \frac{1.0 - e^{-\left[\,[c]\ yr^{-1}\ (\text{AL}) \bullet 1\ yr\right]}}{[c]\ yr^{-1}\ (\text{AL})} = [c]\ \frac{UoA}{m^3}\ (\text{RTAVAL})$$

debug

Parameter Source Legend:
i - GENII.IN
l - library value
d - DEFAULT.IN
c - calculated value

MEDIA CONCENTRATION: DEEP AND SURFACE SOIL
Subroutines: EDRANM, EDRCRP, EDRNON, EDRRES

CHRONIC RELEASE

9 1 0 4 8 0 7 6 7

Exhibit 4.1. GENII Hand Calculation Worksheets

Title:	Pathway or Organ:		Prepared by:	Date:
	Radionuclide:	Year:	Reviewed by:	Date:

DEEP SOIL CONCENTRATION AFTER BIOTIC TRANSPORT REMOVAL

Deep Soil Concentration − Biotic Transport Removal = Deep Soil Concentration

$$\boxed{c\quad} \frac{\text{UoA}}{m^3} - \boxed{c\quad} \frac{\text{UoA}}{m^3} = \boxed{c\quad} \frac{\text{UoA}}{m^3}$$

DSCON, DS2CON, DSRES, NONAGD − RTAVAL = DSCON, DS2CON, DSRES, NONAGD

MEDIA.OUT

RADIOLOGICAL DECAY AND HARVEST REMOVAL FROM SURFACE SOIL FOR PREVIOUS YEAR

$$\left[\text{Surface Soil Concentration} \bullet e^{-\left(\lambda_{decay} + \lambda_{weathering}\right) \bullet 1\ \text{yr}}\right] - \text{Harvest of Previous Year} = \text{Surface Soil Concentration}$$

$$\left[\boxed{i/c\quad} \frac{\text{UoA}}{m^3} \bullet e^{-\left[\left(\boxed{c\quad}\ yr^{-1} + \boxed{c\quad}\ yr^{-1}\right) \bullet 1\ yr\right]}\right] - \boxed{\quad} \frac{\text{UoA}}{m^2} = \boxed{\quad} \frac{\text{UoA}}{m^2}$$

SOLCON, SL2CON, RESSOL, NONAGS; AL; LEACHR; HARVT(in,itf,1), HARVA(in,ian,1); SOLCON, SL2CON, RESSOL, NONAGS

debug

Parameter Source Legend:
i - GENII.IN
l - library value
d - DEFAULT.IN
c - calculated value

MEDIA CONCENTRATION: DEEP AND SURFACE SOIL
Subroutines: EDRANM, EDRCRP, EDRNON, EDRRES

CHRONIC RELEASE

9 1 0 4 8 0 7 6 8

Exhibit 4.1. GENII Hand Calculation Worksheets

Title:	Pathway or Organ:		Prepared by:	Date:
	Radionuclide:	Year:	Reviewed by:	Date:

SURFACE SOIL INPUT UNITS ADJUSTMENT

Surface Soil Input Concentration • Input Units Adjustment = Surface Soil Concentration

i [ ] UoA / m³ or m² or kg • [ ] / m² = c [ ] UoA / m² yr

CASCON

SVU

0.15 m³/m²

1.0 m²/m²

224.0 kg/m²

SOLCON
SL2CON
RESSOL
NONAGS

ENV.IN

IRRIGATION DEPOSITION RATE

Water Concentration • Irrigation Rate / Unit Conversion • Unit Conversion = Irrigation Deposition Rate

i/c [ ] UoA / L • i [ ] in / yr / 12 mo / yr • 25.4 L / m² in = c [ ] UoA / m² yr

GWCON
SWIRR

RIRR
RIRRA
RIRRR

MOYR

LM2IN

RTIRR

debug

AIR DEPOSITION RATE

Average Food-weighted Decayed Air Concentration • Deposition Velocity = Air Deposition Rate

c [ ] UoA sec / m³ yr • l [ ] m / sec = c [ ] UoA / m² yr

ARFCON
ARF2CN

DPVL

RTATM

debug

Parameter Source Legend:
i - GENII.IN
l - library value
d - DEFAULT.IN
c - calculated value

MEDIA CONCENTRATION: SURFACE SOIL
Subroutines: EDRANM, EDRCRP, EDRNON, EDRRES

CHRONIC RELEASE

Exhibit 4.1. GENII Hand Calculation Worksheets

Title:	Pathway or Organ:		Prepared by:	Date:
	Radionuclide:	Year:	Reviewed by:	Date:

TOTAL ENVIRONMENTAL DEPOSITION/REMOVAL RATE TO SURFACE SOIL

Irrigation Deposition Rate + Atomospheric Deposition Rate + Biotic Transport Rate = Environmental Deposition/ Removal Rate

[c] UoA/(m^2 yr) RTIRR + [c] UoA/(m^2 yr) RTATM + [c] UoA/(m^2 yr) RTBIO = [c] UoA/(m^2 yr) RTENV

debug

ENVIRONMENTAL DEPOSITION/REMOVAL CONTRIBUTION TO SURFACE SOIL

$$\text{Environmental Deposition/Removal Rate} \bullet \frac{1.0 - e^{-\left[\left(\lambda_{decay} + \lambda_{leaching}\right) \bullet 1\ yr\right]}}{\lambda_{decay} + \lambda_{leaching}} = \text{Environmental Deposition/Removal Contribution}$$

$$\underset{RTENV}{\boxed{c}}\ \frac{UoA}{m^2\ yr} \bullet \frac{\left[1.0 - e^{-\left[\underset{AL}{\boxed{c}} + \underset{LEACHR}{\boxed{l}}\right] yr^{-1} \bullet 1\ yr}\right]}{\underset{AL}{\boxed{c}}\ yr^{-1} + \underset{LEACHR}{\boxed{l}}\ yr^{-1}} = \underset{RTENV}{\boxed{c}}\ \frac{UoA}{m^2}$$

debug

SURFACE SOIL CONCENTRATION

Surface Soil Concentration + Net Environmental Deposition/Removal Contribution = Surface Soil Concentration

[i/c] UoA/m^2 SOLCON / SL2CON RESSOL / NONAGS + [c] UoA/m^2 RTENV = [c] UoA/m^2 SOLCON / SL2CON RESSOL / NONAGS

MEDIA.OUT

Parameter Source Legend:
i - GENII.IN
l - library value
d - DEFAULT.IN
c - calculated value

MEDIA CONCENTRATION: SURFACE SOIL
Subroutines: EDRANM, EDRCRP, EDRNON, EDRRES

CHRONIC RELEASE

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Exhibit 4.1. GENII Hand Calculation Worksheets

Title:	Pathway or Organ:		Prepared by:	Date:
	Radionuclide:	Year:	Reviewed by:	Date:

AIR INTERCEPTION FRACTION

1.0 - e^-[Standing Biomass • Dry Weight/Wet Weight Ratio • Constant] = Air Interception Fraction

1.0 - e^-[d/i kg/m² (BIOMAS, BIOMA2) • d/i (DRYFAC, DRYFR2) • 2.9* / 3.6**] = c (DEPFR1)

* Leafy veg., Fruit
** Other veg., Grains

LEAF DEPOSITION RATE FROM AIR

Food-Weighted Air Concentration • Deposition Velocity • Air Interception Fraction = Intermediate Leaf Deposition Rate from Air

c UoA sec/(m³ yr) (ARFCON, ARF2CN) • l m/sec (DPVL) • d/i (DEPFR1) = c UoA/(m² yr) (LEAF1a)

debug

LEAF DEPOSITION RATE FROM RESUSPENSION

Soil Concentration • Leaf Resuspension Factor • Resuspension Deposition Velocity • Unit Conversion • Air Interception Fraction = Intermediate Leaf Deposition Rate from Resuspension

i/c UoA/m² (SOLCON, SL2CON) • d/i 1.0E-9 m⁻¹ (LEAFRS) • d/i 0.001 m/sec (DPVRES) • 3.15x10⁷ sec/yr (SECYR) • c (DEPFR1) = c UoA/(m² yr) (LEAF1b)

debug

Parameter Source Legend:
i - GENII.IN
l - library value
d - DEFAULT.IN
c - calculated value

PLANT AND ANIMAL PRODUCT CONCENTRATION
Subroutines: CRPCAL, ANMCAL

CHRONIC RELEASE

Title:	Pathway or Organ:		Prepared by:	Date:
	Radionuclide:	Year:	Reviewed by:	Date:

LEAF DEPOSITION RATE FROM IRRIGATION

Water Concentration • Irrigation Application Rate / Mo/yr of Irrigation • Unit Conversion • Unit Conversion • Irrigation Deposition Fraction = Intermediate Leaf Deposition Rate from Irrigation

i/c [ ] $\frac{UoA}{L}$	•	i [ ] $\frac{in}{season}$	/	i [ ] $\frac{mo}{season}$	•	12.0 $\frac{mo}{yr}$	•	25.4 $\frac{L}{m^2\ in}$	•	d/i 0.25	=	c [ ] $\frac{UoA}{m^2\ yr}$
GWCON SWIRR		RIRR RIRRA		IRTIMT IRTIMA IRTIMR		MOYR		LM2IN		DEPFR2		LEAF2

debug

TOTAL LEAF DEPOSITION RATE

(Sum of Deposition Rates onto Leaves) • Translocation Factor / Standing Biomass = Total Deposition Rate onto Edible Parts

$\left[\ c\ [\ ] + c\ [\ ] + c\ [\ ]\ \right] \frac{UoA}{m^2\ yr}$ • d [ ] / i [ ] $\frac{kg}{m^2}$ = c [ ] $\frac{UoA}{kg\ yr}$

LEAF1a	LEAF1b	LEAF2	TRANS TRANSA	BIOMAS BIOMA2	LEAF

debug

WEATHERING CONSTANT

Natural Log 2.0 / Weathering Half Time / Unit Conversion = Weathering Constant

0.693	/	d 14.0 d	/	$2.74 \times 10^{-3}\ \frac{yr}{d}$	=	c [ ] yr^{-1}
ALOG2		WTIM		YRDA		TENV2

debug

Parameter Source Legend:
i - GENII.IN
l - library value
d - DEFAULT.IN
c - calculated value

9 1 0 4 8 0 7 7 2

Title:	Pathway or Organ:		Prepared by:	Date:
	Radionuclide:	Year:	Reviewed by:	Date:

LEAF CONTRIBUTION

$$\text{Leaf Deposition Rate} \bullet \frac{\left[1.0-e^{-\left[\left(\lambda_{decay}+\lambda_{weathering}\right)\,\bullet\,\text{Growing Period}\,\bullet\,\text{Unit Conversion}\right]}\right]}{\lambda_{decay}+\lambda_{weathering}} = \text{Leaf Contribution}$$

$$\underset{\text{LEAF}}{\boxed{c}}\ \frac{\text{UoA}}{\text{kg yr}} \bullet \frac{\left[1.0-e^{-\left[\underset{\text{AL}}{\boxed{c}}+\underset{\text{TENV2}}{\boxed{c}}\right]\text{yr}^{-1}\bullet\underset{\text{GRWP}}{\boxed{i}}\,\text{d}\,\bullet\underset{\text{YRDA}}{2.74\text{x}10^{-3}\,\frac{\text{yr}}{\text{d}}}}\right]}{\underset{\text{AL}}{\boxed{c}}\,\text{yr}^{-1}+\underset{\text{TENV2}}{\boxed{c}}\,\text{yr}^{-1}} = \underset{\text{LEAF}}{\boxed{c}}\ \frac{\text{UoA}}{\text{kg}}$$

debug

ROOT UPTAKE FROM SURFACE SOIL

Surface Soil Concentration		Soil Density		Concentration Ratio UoA/kg (wet plant)/ UoA/kg (dry soil)		Fraction Roots in Surface Soil		Root Uptake From Surface Soil
c/i $\frac{\text{UoA}}{\text{m}^2}$	/	d 224.0 $\frac{\text{kg}}{\text{m}^2}$	•	l $\frac{\text{UoA/kg}}{\text{UoA/kg}}$	•	i	=	c $\frac{\text{UoA}}{\text{kg}}$
SOLCON SL2CON		SLDN		BVI		RF1		ROOT1
								debug

ROOT UPTAKE FROM DEEP SOIL

Deep Soil Concentration		Soil Density		Concentration Ratio UoA/kg (wet plant)/ UoA/kg (dry soil)		Fraction Roots in Deep Soil		Root Uptake From Deep Soil
c/i $\frac{\text{UoA}}{\text{m}^3}$	/	d $1.5\text{x}10^3$ $\frac{\text{kg}}{\text{m}^3}$	•	l $\frac{\text{UoA/kg}}{\text{UoA/kg}}$	•	i	=	c $\frac{\text{UoA}}{\text{kg}}$
DSCON DS2CON		SSLDN		BVI		RF2		ROOT2
								debug

Parameter Source Legend:
i - GENII.IN
l - library value
d - DEFAULT.IN
c - calculated value

PLANT AND ANIMAL PRODUCT CONCENTRATION
Subroutines: CRPCAL, ANMCAL

CHRONIC RELEASE

Exhibit 4.1. GENII Hand Calculation Worksheets

Title:	Pathway or Organ:		Prepared by:	Date:
	Radionuclide:	Year:	Reviewed by:	Date:

SAVE PLANT UPTAKE CONTRIBUTION FROM SURFACE SOIL AND HARVEST REMOVAL

[Leaf Contribution + Root Uptake From Surface Soil] • Yield • Fraction of Roots in Surface Soil = Next Year's Harvest Removal From Surface Soil

[c ___ UoA/kg (LEAF) + c ___ UoA/kg (ROOT1)] • i ___ kg/m² (YELD, YELDA) • i ___ (RF1) = ___ (HARVT(in,itf,1), HAVRA(in,ian,1))

SAVE ROOT UPTAKE FROM DEEP SOIL CONTRIBUTION AS HARVEST REMOVAL

Root Uptake From Deep Soil • Yield / Waste Thickness • Fraction of Roots in Deep Soil = Next Year's Harvest Removal From Deep Soil

___ UoA/kg (ROOT2) • ___ kg/m² (YELD) / ___ m (WASDEP) • ___ (RF2) = ___ (HARVA(in,ian,2), HARVA(in,ian,2))

TOTAL PLANT CONCENTRATION

Leaf Contribution + Surface Soil Root Contribution + Deep Soil Root Contribution = Total Plant Concentration

c ___ UoA/kg (LEAF) + c ___ UoA/kg (ROOT1) + c ___ UoA/kg (ROOT2) = c ___ UoA/kg (PLTCON)

debug

Parameter Source Legend:
i - GENII.IN
l - library value
d - DEFAULT.IN
c - calculated value

PLANT AND ANIMAL PRODUCT CONCENTRATION
Subroutines: CRPCAL, ANMCAL

CHRONIC RELEASE

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Exhibit 4.1. GENII Hand Calculation Worksheets

Title:	Pathway or Organ:		Prepared by:	Date:
	Radionuclide:	Year:	Reviewed by:	Date:

ANIMAL PRODUCT CONCENTRATION FROM EACH TYPE OF FODDER

Feed or Forage Concentration • Animal Consumption Rate • Plant/Animal Transfer Coefficient • Fraction of Diet this Fodder Type = Animal Product Concentration From Fodder

c	UoA/kg	•	d	kg/d	•	l	(UoA/kg)/(UoA/d)	•	i	=	c	UoA/kg
PLT			CONSUM			FMI			DIETFR		EDBL	

debug

ANIMAL DRINKING WATER CONTRIBUTION

Animal Drinking Water Concentration • Animal Consumption Rate • Plant/Animal Transfer Coefficient • Fraction of Water from This Source • Animal Product Contribution from Drinking Water

c	UoA/L	•	d	L/d	•	l	(UoA/L)/(UoA/d)	•	i	=	c	UoA/kg
GWCON SWIRR			DWATER			FMI			DWFACA		DW	

debug

TOTAL ANIMAL PRODUCT CONCENTRATION

Animal Product Concentration From Feed + Animal Product Concentration From Forage + Animal Product Concentration From Drinking Water = Total Animal Product Concentration

c	UoA/kg	+	c	UoA/kg	+	c	UoA/kg	=	c	UoA/kg
EDBL(1-4)			EDBL(5-8)			DW			ANMCON	

debug

Parameter Source Legend:
i - GENII.IN
l - library value
d - DEFAULT.IN
c - calculated value

PLANT AND ANIMAL PRODUCT CONCENTRATION
Subroutines: CRPCAL, ANMCAL

CHRONIC RELEASE

Exhibit 4.1. GENII Hand Calculation Worksheets

Title:	Pathway or Organ:		Prepared by:	Date:
	Radionuclide:	Year:	Reviewed by:	Date:

RESUSPENSION FACTOR - MASS LOADING MODEL

Mass Loading Factor / Surface Soil Density • Unit Conversion = Resuspension Factor

[i] $\frac{g}{m^3}$ / [d 224.0] $\frac{kg}{m^2}$ • $1.0 \times 10^{-3} \frac{kg}{g}$ = [c] m^{-1}

XMLF SLDN KGG RESFAC

[debug]

RESUSPENSION FACTOR - ANSPAUGH MODEL

Resuspension Factor at Time zero • e^- [Effective Decay Constant Controlling Availability of Material • √(Time after Deposition • Unit Conversion)] + Resuspension Factor after 17 years = Intermediate Value

$1.0 \times 10^{-4}\ m^{-1}$ • e^- [[d 0.15] d^{-} • [[i] yr • 365.25 $\frac{d}{yr}$]$^{\frac{1}{2}}$] + $1.0\times10^{-9}\ m^{-1}$ = [c] m^{-1}

ITIME

Intermediate Value • Depth of Soil Available For Resuspension / Depth of Surface Soil = Resuspension Factor

[c] m^{-1} • [i] cm / [d 15.0] cm = [c] m^{-1}

AVALSL SVRCM RESFAC

[debug]

Parameter Source Legend:
i - GENII.IN
l - library value
d - DEFAULT.IN
c - calculated value

EXPOSURE: INHALATION
Subroutines: INHCAL

CHRONIC RELEASE

Exhibit 4.1. GENII Hand Calculation Worksheets

Title:	Pathway or Organ:		Prepared by:	Date:
	Radionuclide:	Year:	Reviewed by:	Date:

INHALATION AIR CONCENTRATION

Average Population-weighted Air concentration • Unit Conversion + [Residential/Resuspension Surface Soil Concentration • Resuspension Factor] = Air Concentration For Inhalation

$$\underset{\text{ARPCON}}{\boxed{i/c}}\ \frac{\text{UoA sec}}{m^3\ \text{yr}} \bullet \underset{\text{YRSEC}}{3.17\text{x}10^{-8}}\ \frac{\text{yr}}{\text{sec}} + \left[\underset{\text{RESSOL}}{\boxed{i/c}}\ \frac{\text{UoA}}{m^2} \bullet \underset{\text{RESFAC}}{\boxed{c}}\ m^{-1} \right] = \underset{\text{INHCON}}{\boxed{c}}\ \frac{\text{UoA}}{m^3}$$

debug

INHALATION EXPOSURE FROM INFINITE PLUME

Air Concentration For Inhalation • Inhalation Rate • Unit Conversion • Unit Conversion = Intermediate Value

$$\underset{\text{INHCON}}{\boxed{i}}\ \frac{\text{UoA}}{m^3} \bullet \underset{\text{RINH}}{\boxed{d/i}}\ \frac{cm^3}{\text{sec}} \bullet \underset{\text{M3CM3}}{1.0\text{x}10^{-6}}\ \frac{m^3}{cm^3} \bullet \underset{\text{SECYR}}{3.15\text{x}10^{7}}\ \frac{\text{sec}}{\text{yr}} = \boxed{c}\ \frac{\text{UoA}}{\text{yr}}$$

Intermediate Vaue • Exposure Duration • Unit Conversion • Population Exposed to Air = Inhalation Exposure

$$\boxed{c}\ \frac{\text{UoA}}{\text{yr}} \bullet \underset{\text{HRINH}}{\boxed{i}}\ \frac{\text{hr}}{\text{person yr}} \bullet \underset{\text{YRHR}}{1.14\text{x}10^{-4}}\ \frac{\text{yr}}{\text{hr}} \bullet \underset{\text{POPT}}{\boxed{i/c}}\ \text{person} = \underset{\text{EXPOS}}{\boxed{c}}\ \frac{\text{UoA}}{\text{yr}}$$

ENV.OUT

Parameter Source Legend:
i - GENII.IN
l - library value
d - DEFAULT.IN
c - calculated value

EXPOSURE: INHALATION
Subroutines: INHCAL

CHRONIC RELEASE

Exhibit 4.1. GENII Hand Calculation Worksheets

Title:	Pathway or Organ:		Prepared by:	Date:
	Radionuclide:	Year:	Reviewed by:	Date:

EXTERNAL EXPOSURE FROM INFINITE PLUME

Population-weighted Air Concentration • Unit Conversion • Duration Exposure • Unit Conversion • Exposed Population = External Exposure Rate from Infinite Plume

$$\underset{\text{ARPCON}}{\boxed{c\quad}}\ \frac{\text{UoA sec}}{\text{m3 yr}} \bullet \underset{\text{YRSEC}}{3.17\times10^{-8}}\ \frac{\text{yr}}{\text{sec}} \bullet \underset{\text{HRIPL}}{\boxed{i\quad}}\ \frac{\text{hr}}{\text{person yr}} \bullet \underset{\text{YRHR}}{1.14\times10^{-4}}\ \frac{\text{yr}}{\text{hr}} \bullet \underset{\text{POPT}}{\boxed{c/i\quad}}\ \text{per-son} = \underset{\text{EXPOS}}{\boxed{c\quad}}\ \frac{\text{UoA}}{\text{m}^3}$$

ENV.OUT

EXTERNAL EXPOSURE FROM FINITE PLUME

Population-weighted Air Dose Factor • Duration of Exposure • Unit Conversion = Intermediate Value

$$\underset{\text{ARPXCN}}{\boxed{c\quad}}\ \frac{\text{UoA person rem}}{\text{yr Ci}} \bullet \underset{\text{HRFPL}}{\boxed{i\quad}}\ \frac{\text{hr}}{\text{person yr}} \bullet \underset{\text{YRHR}}{1.14\times10^{-4}}\ \frac{\text{yr}}{\text{hr}} = \boxed{c\quad}$$

Intermediate Value • Exposed Population = External Exposure Rate from Finite Plume

$$\boxed{c\quad} \bullet \underset{\text{POPT}}{\boxed{c\quad}}\ \text{person} = \underset{\text{EXPOS}}{\boxed{c\quad}}\ \frac{\text{UoA person rem}}{\text{yr Ci}}$$

ENV.OUT

Parameter Source Legend:
i - GENII.IN
l - library value
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c - calculated value

EXPOSURE: EXTERNAL
Subroutines: EXTCAL

CHRONIC RELEASE

Exhibit 4.1. GENII Hand Calculation Worksheets

Title:	Pathway or Organ:	Prepared by:	Date:
	Radionuclide: / Year:	Reviewed by:	Date:

EXTERNAL EXPOSURE FACTOR FROM THE SURFACE SOIL

Residential/ Resuspension Surface Soil Concentration • Duration of Exposure • Unit Conversion • Exposed Population = External Exposure Factor from Surface Soil

[c/i] $\frac{\text{UoA}}{\text{m}^2}$ • [i] $\frac{\text{hr}}{\text{person yr}}$ • 1.14×10^{-4} $\frac{\text{yr}}{\text{hr}}$ • [i/c] person = [c] $\frac{\text{UoA}}{\text{m}^2}$

RESSOL HRGRD YRHR POPT EXPOS

ENV.OUT

EXTERNAL EXPOSURE FACTOR FROM THE DEEP SOIL

Residential/ Resuspension Deep Soil Concentration • Duration of Exposure • Unit Conversion • Exposed Population = External Exposure Factor from Deep Soil

[c/i] $\frac{\text{UoA}}{\text{m}^3}$ • [i] $\frac{\text{hr}}{\text{person yr}}$ • 1.14×10^{-4} $\frac{\text{yr}}{\text{hr}}$ • [i/c] person = [c] $\frac{\text{UoA}}{\text{m}^3}$

DSRES HRGRD YRHR POPT EXPOS

ENV.OUT

EXTERNAL EXPOSURE FACTOR FROM CONTAINED BURIED WASTE

Contained Buried Waste Concentration • Duration of Exposure • Unit Conversion • Exposed Population = External Exposure Factor from Buried Waste

[c/i] $\frac{\text{UoA}}{\text{m}^3}$ • [i] $\frac{\text{hr}}{\text{person yr}}$ • 1.14×10^{-4} $\frac{\text{yr}}{\text{hr}}$ • [i/c] person = [c] $\frac{\text{UoA}}{\text{m}^3}$

QWAS HRGRD YRHR POPT EXPOS

ENV.OUT

Parameter Source Legend:
i - GENII.IN
l - library value
d - DEFAULT.IN
c - calculated value

EXPOSURE: EXTERNAL
Subroutines: EXTCAL

CHRONIC RELEASE

Exhibit 4.1. GENII Hand Calculation Worksheets

Title:	Pathway or Organ:		Prepared by:	Date:
	Radionuclide:	Year:	Reviewed by:	Date:

EXTERNAL EXPOSURE FACTOR FROM SWIMMING

Decayed Surface Water Concentration • Duration Of Exposure • Unit Conversion • Exposed Population = External Exposure Factor from Swimming

$$\boxed{c}\ \frac{\text{UoA}}{\text{L}} \bullet \boxed{i}\ \frac{\text{hr}}{\text{person yr}} \bullet 1.14\text{x}10^{-4}\ \frac{\text{yr}}{\text{hr}} \bullet \boxed{i}\ \text{person} = \boxed{c}\ \frac{\text{UoA}}{\text{L}}$$

WATCON • HRSWIM • YRHR • POPT = EXPOS

ENV.OUT

EXTERNAL EXPOSURE FACTOR FROM BOATING

Decayed Surface Water Concentration • Duration Of Exposure • Unit Conversion • Exposed Population = External Exposure Factor from Boating Exposure

$$\boxed{c}\ \frac{\text{UoA}}{\text{L}} \bullet \boxed{i}\ \frac{\text{hr}}{\text{person yr}} \bullet 1.14\text{x}10^{-4}\ \frac{\text{yr}}{\text{hr}} \bullet \boxed{i}\ \text{person} = \boxed{c}\ \frac{\text{UoA}}{\text{L}}$$

WATCON • HRBOAT • YRHR • POPT = EXPOS

ENV.OUT

EXTERNAL EXPOSURE FACTOR FROM FISHING AND SHORELINE ACTIVITIES

Sediment Concentration • Duration of Exposure • Unit Conversion • Shore Width Factor • Exposed Population = External Exposure Factor from Shoreline Activities

$$\boxed{c}\ \frac{\text{UoA}}{\text{m}^2} \bullet \boxed{i}\ \frac{\text{hr}}{\text{person yr}} \bullet 1.14\text{x}10^{-4}\ \frac{\text{yr}}{\text{hr}} \bullet \boxed{i/d} \bullet \boxed{i}\ \text{person} = \boxed{c}\ \frac{\text{UoA}}{\text{m}^2}$$

SEDCON • HRSHOR • YRHR • SHORWI (SHRTYP) • POPT = EXPOS

ENV.OUT

Parameter Source Legend:
i - GENII.IN
l - library value
d - DEFAULT.IN
c - calculated value

EXPOSURE: EXTERNAL
Subroutines: EXTCAL

CHRONIC RELEASE

<u>Exhibit 4.1.</u> GENII Hand Calculation Worksheets

Title:	Pathway or Organ:		Prepared by:	Date:
	Radionuclide:	Year:	Reviewed by:	Date:

DRINKING WATER CONCENTRATION

Water Concentration • Drinking Water Clean Up Factor • $e^{-\left[\lambda_{decay} \,\bullet\, \text{Hold Up/Transit Time} \,\bullet\, \text{Unit Conversion}\right]}$ = Intermediate Value

[i/c] $\frac{UoA}{L}$ • [l] • $e^{-\left[[c]\ yr^{-1} \,\bullet\, [i]\ d \,\bullet\, 2.74\times10^{-3}\ \frac{yr}{d} \right]}$ = [c] $\frac{UoA}{L}$

SWCON
GWCON
DWCON

DWCLEN

AL

HOLDDW

YRDA

EXPOSURE FROM INGESTION OF DRINKING WATER

Intermediate Value • Consumption Rate • Drinking Water Population = Drinking Water Exposure

[c] $\frac{UoA}{L}$ • [i] $\frac{L}{\text{person yr}}$ • [i] person = [c] $\frac{UoA}{yr}$

DWUSAG

DWPOP

EXPOS

ENV.OUT

AQUATIC FOODS EXPORT ADJUSTMENT FACTOR (If Food is Not Exported)

Total Production / Population Ingesting Aquatic Foods / Consumption Rate = Export Adjustment Factor

[i/c] $\frac{kg}{yr}$ / [c] person / [i] $\frac{kg}{\text{person yr}}$ = [c]

TPRODQ

AQUPOP

USAG2

ADJETQ

GENII.OUT

Parameter Source Legend:
i - GENII.IN
l - library value
d - DEFAULT.IN
c - calculated value

9104807 81

Exhibit 4.1. GENII Hand Calculation Worksheets

Title:	Pathway or Organ:		Prepared by:	Date:
	Radionuclide:	Year:	Reviewed by:	Date:

AQUATIC FOOD CONCENTRATION

Surface Water Concentration • e - [λ decay • Transit Time • Unit Conversion] • Bioaccumulation Factor = Intermediate Aquatic Food Concentration

[i/c] $\frac{UoA}{L}$ (SWCON) • e - [[c] yr^{-1} (AL) • [i] hr (AQUTT) • $1.14x10^{-4}$ $\frac{yr}{hr}$ (YRHR)] • [l] $\frac{UoA/kg}{UoA/L}$ (BIOACF) = [c] $\frac{UoA}{kg}$ (AQUCON)

debug

DECAY AQUATIC FOODS FOR HARVEST / CONSUMPTION HOLDUP TIME

Aquatic Food Concentration • e - [λ decay • Holdup Time • Unit Conversion] = Decayed Aquatic Food Concentration

[c] $\frac{UoA}{kg}$ (AQUCON) • e - [[c] yr^{-1} (AL) • [i] d (HLDUP2) • $2.74x10^{-3}$ $\frac{yr}{d}$] = [c] $\frac{UoA}{kg}$ (AQUCON)

EXPOSURE FROM CONSUMPTION OF AQUATIC FOODS

Decayed Aquatic Food Concentration • Consumption Rate • Population Ingesting Aquatic Foods • Production/Consumption Adjustment = Aquatic Food Exposure

[c] $\frac{UoA}{kg}$ (AQUCON) • [i] $\frac{kg}{yr}$ (USAG2) • [i] person (AQUPOP) • [c] (ADJETQ) = [c] $\frac{UoA}{yr}$ (EXPOS)

ENV.OUT

Parameter Source Legend:
i - GENII.IN
l - library value
d - DEFAULT.IN
c - calculated value

EXPOSURE: AQUATIC FOOD INGESTION
Subroutines: AQUCAL

CHRONIC RELEASE

Exhibit 4.1. GENII Hand Calculation Worksheets

Title:	Pathway or Organ:		Prepared by:	Date:
	Radionuclide:	Year:	Reviewed by:	Date:

DECAY FOR HOLDUP BETWEEN HARVEST AND CONSUMPTION OF TERRESTRIAL FOODS AND ANIMAL PRODUCTS

Food Concentration • $e^{-\left(\lambda_{decay} \,\bullet\, \text{Holdup Period} \,\bullet\, \text{Unit Conversion}\right)}$ = Food Concentration

$$\underset{\text{PLTCON, ANMCON}}{\boxed{c}}\ \frac{\text{UoA}}{\text{kg}} \bullet e^{-\left[\underset{\text{AL}}{\boxed{c}}\ \text{yr}^{-1} \bullet \underset{\text{HLDUP, HLDUPA}}{\boxed{i}}\ \text{d} \bullet \underset{\text{YRDA}}{2.74\text{E-}3\ \frac{\text{yr}}{\text{d}}}\right]} = \underset{\text{PLTCON, ANMCON}}{\boxed{c}}\ \frac{\text{UoA}}{\text{kg}}$$

EFFECTIVE POPULATION FOR TERRESTRIAL FOODS AND ANIMAL PRODUCTS (When Food Production Grid Used)

Summed Over Each Distance and Direction [Food Production In each Grid / Consumption of Food Product per Person] = Effective Population For Terrestrial Foods And Animal Products

$$\sum_{i=1}^{\text{NDIST}} \sum_{j=1}^{\text{NDIR}} \left[\underset{\text{FPRD ij}}{\boxed{i/c}}\ \frac{\text{kg}}{\text{yr}} \Big/ \underset{\text{CONS, CONS2}}{\boxed{i}}\ \frac{\text{kg}}{\text{yr person}} \right] = \underset{\text{EFPOP, EFPOPA}}{\boxed{c}}\ \text{person}$$

GENII.OUT

EXPORT/IMPORT ADJUSTMENT FACTOR FOR TERRESTRIAL FOODS AND ANIMAL PRODUCTS

Total Production / Effective Population / Consumption Rate = Export Adjustment Factor

$$\underset{\text{TPRODT, TPRODA}}{\boxed{i/c}}\ \frac{\text{kg}}{\text{yr}} \Big/ \underset{\text{EFPOP, EFPOPA, POPT, TPOPS}}{\boxed{c}}\ \text{person} \Big/ \underset{\text{CONS, CONS2}}{\boxed{i}}\ \frac{\text{kg}}{\text{person yr}} = \underset{\text{ADJEAT, ADJET2}}{\boxed{c}}$$

debug

Parameter Source Legend:
i - GENII.IN
l - library value
d - DEFAULT.IN
c - calculated value

EXPOSURE: TERRESTRIAL FOOD AND ANIMAL PRODUCT INGESTION
Subroutines: CRPCAL, ANMCAL

CHRONIC RELEASE

Exhibit 4.1. GENII Hand Calculation Worksheets

Title:	Pathway or Organ:	Prepared by:	Date:
	Radionuclide: / Year:	Reviewed by:	Date:

HUMAN UPTAKE RATE FROM TERRESTRIAL FOODS AND ANIMAL PRODUCTS

Food Concentration • Human Consumption Rate • Effective Population • Export Adjustment = Human Uptake Rate from Consumption of Foods

Food Concentration		Human Consumption Rate		Effective Population		Export Adjustment		Human Uptake Rate
c [ ] UoA/kg	•	i [ ] kg/(person yr)	•	c [ ] person	•	c [ ]	=	c [ ] UoA/yr
PLTCON ANMCON		CONS CONSA		EFPOP EFPOPA		ADJEAT ADJET2		EXPOS [ ] ENV.OUT

EXPOSURE FROM INADVERTENT INGESTION OF SOIL

Residential/Surface Soil Concentration • Quantity of Soil Ingested / Surface Soil Density • Unit Conversion = Intermediate Value

Residential/Surface Soil Concentration		Quantity of Soil Ingested		Surface Soil Density		Unit Conversion		Intermediate Value
i/c [ ] UoA/m^2	•	d 410.0 mg/(person d)	/	d 224.0 kg/m^2	•	1.0×10^{-6} kg/mg	=	c [ ] UoA/(person d)
RESSOL		SOLING		SLDN		KGMG		

Intermediate Value • Unit Conversion • Exposed Population = Inadvertent Soil Ingestion Exposure

Intermediate Value		Unit Conversion		Exposed Population		Inadvertent Soil Ingestion Exposure
c [ ] UoA/(person d)	•	362.25 d/yr	•	i [ ] person	=	c [ ] UoA/yr
		DAYR		POPT		EXPOS [ ] ENV.OUT

INTERNAL EXPOSURE FACTOR FROM INADVERTENT INGESTION OF SWIMMING WATER

Decayed Surface Water Concentration • Duration Of Exposure • Ingestion Rate • Exposed Population = Internal Exposure Factor from Ingestion Of Swimming Water

Decayed Surface Water Concentration		Duration Of Exposure		Ingestion Rate		Exposed Population		Internal Exposure Factor
c [ ] UoA/L	•	i [ ] hr/(person yr)	•	d 0.10 L/hr	•	i [ ] person	=	c [ ] UoA/L
WATCON		HRSWIM		INGWAT		POPT		EXPOS [ ] ENV.OUT

Parameter Source Legend:
i - GENII.IN
l - library value
d - DEFAULT.IN
c - calculated value

EXPOSURE: TERRESTRIAL FOOD AND ANIMAL PRODUCT INGESTION
Subroutines: CRPCAL, ANMCAL

CHRONIC RELEASE

Exhibit 4.1. GENII Hand Calculation Worksheets

Title:	Pathway or Organ:		Prepared by:	Date:
	Radionuclide:	Year:	Reviewed by:	Date:

SURFACE WATER CONCENTRATION FROM ACUTE RELEASE

Surface Water Release Term • Mixing Ratio / Surface Water Flow Rate • Unit Conversion • Conversion Factor = Time-Integrated Surface Water Concentration

$$\boxed{i}\ \text{UoA} \bullet \boxed{i/c} \ / \ \boxed{i}\ \frac{m^3}{sec} \bullet 1.0\times10^{-3}\ \frac{m^3}{L} \bullet 3.17\times10^{-8}\ \frac{yr}{sec} = \boxed{c}\ \frac{\text{UoA yr}}{L}$$

QSW MIXR SWFLOW M3L YRSEC WATCON

DECAY SURFACE WATER FOR TRANSIT TIME TO IRRIGATION WITHDRAWAL / AQUATIC FOOD HARVEST LOCATION - ACUTE RELEASE

Time-Integrated Surface Water Concentration • e $-\left[\lambda\ \text{decay} \bullet \text{Transit Time} \bullet \text{Unit Conversion}\right]$ = Time-Integrated Decayed Surface Water Concentration

$$\boxed{c}\ \frac{\text{UoA yr}}{L} \bullet e^{-\left[\boxed{c}\ yr^{-1} \bullet \boxed{i}\ hr \bullet 1.14\times10^{-4}\ \frac{yr}{hr}\right]} = \boxed{c}\ \frac{\text{UoA yr}}{L}$$

SWACUT AL SWTT AQUTT YRHR WATCON SWDK

MEDIA.OUT

DECAY SURFACE WATER FOR TRANSIT TIME TO DRINKING WATER WITHDRAWAL LOCATION - ACUTE RELEASE

Time-Integrated Surface Water Concentration • e $-\left[\lambda\ \text{decay} \bullet \text{Transit/Hold-up TIme} \bullet \text{Unit Conversion}\right]$ = Time-Integrated Decayed Drinking Water Concentration

$$\boxed{c}\ \frac{\text{UoA yr}}{L} \bullet e^{-\left[\boxed{c}\ yr^{-1} \bullet \boxed{i}\ d \bullet 2.74\times10^{3}\ \frac{yr}{d}\right]} = \boxed{c}\ \frac{\text{UoA yr}}{L}$$

SWACUT AL HOLDDW YRDA WATCON

debug

Parameter Source Legend:
i - GENII.IN
l - library value
d - DEFAULT.IN
c - calculated value

MEDIA CONCENTRATION: SURFACE WATER
Subroutine: ACUTE1, ACUTEC, ACUTEA, DRKCAL, AQUCAL

ACUTE RELEASE

Exhibit 4.1. GENII Hand Calculation Worksheets

Title:	Pathway or Organ:		Prepared by:	Date:
	Radionuclide:	Year:	Reviewed by:	Date:

ACUTE AIR RELEASE DECAY FOR TRANSIT TIME FOR EACH DISTANCE (i) IN SPECIFIED DIRECTION

Acute Air Release Term • e^− [λ decay • Travel Time to Distance • Unit Conversion] = Decayed Acute Air Release Term

$$\underset{\text{QAIR}}{\boxed{i}}\ \frac{\text{UoA}}{\text{yr}} \bullet e^{-\left[\underset{\text{AL}}{\boxed{c}}\ \text{yr}^{-1} \bullet \underset{\text{TTAIRI, TTAIR}_i}{\boxed{i}}\ \text{sec} \bullet \underset{\text{YRSEC}}{3.17\times10^{-8}\ \frac{\text{yr}}{\text{sec}}}\right]} = \underset{\text{DKAIRA}_i}{\boxed{c}}\ \text{UoA}$$

debug

AVERAGE OR MAXIMUM INDIVIDUAL AIR CONCENTRATION AT DISTANCE (i) FROM ACUTE RELEASE - INFINITE PLUME

Decayed Air Release Term • E/Q = Individual Acute Air Exposure

$$\underset{\text{DKAIRAi, QAIR}}{\boxed{c}}\ \text{UoA} \bullet \underset{\text{XOQI}}{\boxed{i/c}}\ \frac{\text{sec}}{\text{m}^3} = \underset{\text{PWTAIR}}{\boxed{c}}\ \frac{\text{UoA sec}}{\text{m}^3}$$

MEDIA.OUT

AVERAGE POPULATION-WEIGHTED AIR CONCENTRATION FROM ACUTE RELEASE - INFINITE PLUME (Population, XOQOPT=3)

Summed Over Each Distance In Sector [Decayed Air Release Term • Population-Weighted E/Q by Distance] / Total Population In Sector = Average Population-Weighted Air Exposure

$$\sum_{i=1}^{\text{NDIST}} \left[\underset{\text{DKAIRA}_i}{\boxed{c}}\ \text{UoA} \bullet \underset{\text{PWT}_i}{\boxed{i/c}}\ \frac{\text{person sec}}{\text{m}^3}\right] / \underset{\text{TPOPS}}{\boxed{c}}\ \text{person} = \underset{\text{PWTAIR}}{\boxed{c}}\ \frac{\text{UoA sec}}{\text{m}^3}$$

MEDIA.OUT

Parameter Source Legend:
i - GENII.IN
l - library value
d - DEFAULT.IN
c - calculated value

MEDIA CONCENTRATION: AIR
Subroutine: ACUTE1

ACUTE RELEASE

9 1 0 4 8 0 7 8 6

Exhibit 4.1. GENII Hand Calculation Worksheets

Title:	Pathway or Organ:		Prepared by:	Date:
	Radionuclide:	Year:	Reviewed by:	Date:

INDIVIDUAL DOSE FACTOR AT DISTANCE (i) FROM ACUTE RELEASE - FINITE PLUME

Summed Over Energy Groups [Air Release Term • External Dose Rate Factor For Finite Plume • Energy per Disintegration • Surface Dose Correction] = Individual Acute Air Exposure

$$\sum_{k=1}^{6}\left[\underset{DKAIRA_i}{\boxed{c}}\ \text{UoA}\cdot\underset{DRFSAV_k}{\boxed{i/c}}\ \frac{\text{rem dis}}{\text{Ci MeV}}\cdot\underset{EDIS_k}{\boxed{l}}\ \frac{\text{MeV}}{\text{dis}}\cdot\underset{FC_k}{\boxed{}}\right.=\underset{PWTXAR}{\boxed{c}}\ \frac{\text{UoA rem}}{\text{Ci}}$$

debug

AVERAGE POPULATION-WEIGHTED SUBMERSION DOSE COEFFICIENTS FROM ACUTE RELEASE - FINITE PLUME

Summed Over Each Distance In Sector and Energy Group [Decayed Air Release Term • Population-weighted Dose Rate Factor by Distance and Energy • Energy per Disintegration • Surface Dose Correction] = Intermediate Value

$$\sum_{k=1}^{6}\sum_{i=1}^{NDIST}\left[\underset{DKAIRA_i}{\boxed{c}}\ \text{UoA}\cdot\underset{PWTX_i}{\boxed{i/c}}\ \frac{\text{person rem dis}}{\text{Ci MeV}}\cdot\underset{EDIS}{\boxed{l}}\ \frac{\text{MeV}}{\text{dis}}\cdot\underset{FC}{\boxed{}}\right]=\boxed{c}$$

Intermediate Value / Total Population In Sector = Average Population-Weighted Air Exposure

$$\boxed{c}\ /\ \underset{TPOPS}{\boxed{c}}\ \text{person}=\underset{PWTXAR}{\boxed{c}}\ \frac{\text{UoA rem}}{\text{Ci}}$$

debug

Parameter Source Legend:
i - GENII.IN
l - library value
d - DEFAULT.IN
c - calculated value

MEDIA CONCENTRATION: AIR
Subroutine: ACUTE1

ACUTE RELEASE

Exhibit 4.1. GENII Hand Calculation Worksheets

Title:	Pathway or Organ:	Prepared by:	Date:
	Radionuclide: / Year:	Reviewed by:	Date:

ACUTE SOIL DEPOSITION FROM AIR

Air Concentration • Deposition Velocity = Initial Soil Deposition From Air

$$\boxed{c} \ \frac{\text{UoA sec}}{m^3} \bullet \boxed{i} \ \frac{m}{\text{sec}} = \boxed{c} \ \frac{\text{UoA}}{m^2}$$

PWTAIR   DPVL   CTØAIR

debug

IRRIGATION DEPOSITION RATE ONTO SOIL FROM AN ACUTE RELEASE

Water Concentration • Irrigation Application Rate • Unit Conversion = Initial Soil Deposition From Irrigation

$$\boxed{i/c} \ \frac{\text{UoA yr}}{L} \bullet \boxed{i} \ \frac{\text{in}}{\text{yr}} \bullet 25.4 \frac{L}{m^2 \text{ in}} = \boxed{c} \ \frac{\text{UoA}}{m^2}$$

WATCON   RIRR RIRRA RIRRR   LM2IN   CTØIRR

TOTAL SURFACE ACUTE DEPOSITION

Initial Deposition From Air + Initial Deposition From Irrigation = Initial Surface Soil Deposition*

$$\boxed{i/c} \ \frac{\text{UoA}}{m^2} + \boxed{i} \ \frac{\text{UoA}}{m^2} = \boxed{c} \ \frac{\text{UoA}}{m^2}$$

CTØAIR   CTØIRR   SOLCON SL2CON RESSOL

MEDIA.OUT

*Winter: Contamination is from air only

Parameter Source Legend:
- i - GENII.IN
- l - library value
- d - DEFAULT.IN
- c - calculated value
- p - program constant

Exhibit 4.1. GENII Hand Calculation Worksheets

Title:	Pathway or Organ:		Prepared by:	Date:
	Radionuclide:	Year:	Reviewed by:	Date:

AVERAGE RESIDENTIAL SURFACE SOIL CONCENTRATION - ACUTE RELEASE

$$\text{Initial Surface Soil Deposition} \bullet \frac{1.0 - e^{-\left(\lambda_{decay} \bullet 1\ yr\right)}}{\lambda_{decay}} = \text{Residential Surface Soil Concentration}$$

$$\underbrace{\boxed{c\quad}}_{RESSOL}\ \frac{UoA}{m^2} \bullet \frac{1.0 - e^{-\left[\underbrace{\boxed{c\quad}}_{AL}\ yr^{-1} \bullet 1\ yr\right]}}{\underbrace{\boxed{c\quad}}_{AL}\ yr^{-1}} = \underbrace{\boxed{c\quad}}_{RESSOL}\ \frac{UoA}{m^2}$$

DECAY SOILS TO TIME OF HARVEST - ACUTE RELEASE

$$\text{Surface Soil Concentration* (Food Production)} \bullet e^{-\left(\lambda_{decay} \bullet \text{Time to Harvest**}\right)} = \text{Decayed Surface Soil Concentration}$$

$$\underbrace{\boxed{i\quad}}_{\substack{SOLCON\\SL2CON}}\ \frac{UoA}{m^2} \bullet e^{-\left[\underbrace{\boxed{c\quad}}_{AL}\ yr^{-1} \bullet \underbrace{\boxed{p\quad}}_{TIMHAR^{**}}\ yr\right]} = \underbrace{\boxed{c\quad}}_{SOLHAR}\ \frac{UoA}{m^2}$$

* Winter: Contamination is from air only

** Winter: 6 mo
Spring: 3 mo
Summer: 1 mo

Parameter Source Legend:
i - GENII.IN
l - library value
d - DEFAULT.IN
c - calculated value
p - program constant

Exhibit 4.1. GENII Hand Calculation Worksheets

Title:	Pathway or Organ:		Prepared by:	Date:
	Radionuclide:	Year:	Reviewed by:	Date:

PLANT CONCENTRATION FROM ROOT UPTAKE - ACUTE RELEASE (LEAFY VEGETABLES / FRESH FORAGE) SPRING AND SUMMER

Surface Soil Concentration / Soil Density • Concentration Ratio UoA/kg (wet plant)/ UoA/kg (dry soil) • Fraction Roots in Surface Soil • Dry Weight/ Wet Weight Ratio = Intermediate Value

$$\boxed{c/i}\ \frac{\text{UoA}}{\text{m}^2} \;/\; \boxed{d/i\ \ 224.0}\ \frac{\text{kg}}{\text{m}^2} \;\bullet\; \boxed{l}\ \frac{\text{UoA/kg}}{\text{UoA/kg}} \;\bullet\; \boxed{i} \;\bullet\; \boxed{d/i} \;=\; \boxed{}$$

SOLCON SL2CON — SLDN — BVI — RF1 — DRYFAC DRYFA2

Intermediate Value
$$\bullet\ \frac{1.0 - e^{-\left(\lambda_{decay}\ \bullet\ 1\ \text{yr}\right)}}{\lambda_{decay}} =$$
Time-Integrated Plant Concentration From Root Uptake

$$\boxed{c}\ \frac{\text{UoA}}{\text{kg}} \;\bullet\; \frac{1.0 - e^{-\left[\boxed{c}_{\,AL}\ \text{yr}^{-1}\ \bullet\ 1.0\ \text{yr}\right]}}{\boxed{c}_{\,AL}\ \text{yr}^{-1}} = \boxed{c}\ \frac{\text{UoA yr}}{\text{kg}}$$

AL — AL — ROOTCN

PLANT CONCENTRATION FROM ROOT UPTAKE FOR OTHER SEASONS AND OTHER FOODS - ACUTE RELEASE

Decayed Surface Soil Concentration / Soil Density • Concentration Ratio UoA/kg (wet plant)/ UoA/kg (dry soil) • Fraction Roots in Surface Soil • Dry Weight/ Wet Weight Ratio = Root Uptake From Surface Soil

$$\boxed{c/i}\ \frac{\text{UoA}}{\text{m}^2} \;/\; \boxed{d/i\ \ 224.0}\ \frac{\text{kg}}{\text{m}^2} \;\bullet\; \boxed{l}\ \frac{\text{UoA/kg}}{\text{UoA/kg}} \;\bullet\; \boxed{i} \;\bullet\; \boxed{d/i} \;=\; \boxed{}\ \frac{\text{UoA}}{\text{kg}}$$

SOLHAR — SLDN — BVI — RF1 — DRYFAC — ROOTCN

debug

Note: No Root Uptake in Autumn

Parameter Source Legend:
i - GENII.IN
l - library value
d - DEFAULT.IN
c - calculated value
p - program constant

PLANT AND ANIMAL PRODUCT CONCENTRATION
Subroutine: ACUTEA ACUTEC

ACUTE RELEASE

Exhibit 4.1. GENII Hand Calculation Worksheets

Title:	Pathway or Organ:		Prepared by:	Date:
	Radionuclide:	Year:	Reviewed by:	Date:

TIME-INTEGRATED LEAF CONTRIBUTION FROM ACUTE AIR DEPOSITION (EXCEPT WINTER)

Initial Soil Deposition From Air	•	Air Interception Fraction*	/	Standing Biomass	•	Translocation Factor	=	Intermediate Value
c [ ] UoA/m²	•	c [ ]	/	d/i [ ] kg/m²	•	d/i [ ]	=	c [ ] UoA/kg
CT0AIR		DEPFR1*		BIOMAS BIOMA2		TRANS TRANSA		CBARA

* Use worksheet in chronic release section

TIME-INTEGRATED LEAF CONTRIBUTION FROM IRRIGATION (EXCEPT WINTER)

Initial Soil Deposition From Water	•	Irrigation Interception Fraction	/	Standing Biomass	•	Translocation Factor	=	Intermediate Value
c [ ] UoA/m²	•	d/i [ ]	/	d/i [ ] kg/m²	•	d/i [ ]	=	c [ ] UoA/kg
CT0IRR		DEPFR2		BIOMAS BIOMA2		TRANS TRANSA		CBARI

TOTAL LEAF CONCENTRATION - ACUTE RELEASE

Air Contribution	+	Irrigation Contribution	=	Total Leaf Concentration
c [ ] UoA/kg	+	c [ ] UoA/kg	=	c [ ] UoA/kg
CBARA		CBARI		LEAFCN

Parameter Source Legend:
i - GENII.IN
l - library value
d - DEFAULT.IN
c - calculated value
p - program constant

PLANT AND ANIMAL PRODUCT CONCENTRATION
Subroutine: ACUTEA ACUTEC

ACUTE RELEASE

Exhibit 4.1. GENII Hand Calculation Worksheets

Title:	Pathway or Organ:	Prepared by:	Date:
	Radionuclide: / Year:	Reviewed by:	Date:

LEAFY VEGETABLES / FRESH FORAGE (SPRING, SUMMER, AND FALL)

$$\text{Leaf Concentration} \bullet \frac{1.0 - e^{-(\lambda_{decay} + \lambda_{weathering}^{*}) \bullet 12\ mo}}{\lambda_{decay} + \lambda_{weathering}^{*}} = \text{Time-Integrated Plant Contribution From Air Deposition onto Leaves}$$

$$\underset{LEAFCN}{\boxed{c}}\ \frac{UoA}{kg} \bullet \frac{1.0 - e^{-\left[\underset{AL}{\boxed{c}} + \underset{TENV2^{*}}{\boxed{\ }}\right] yr^{-1} \bullet 1.0\ yr}}{\underset{AL}{\boxed{c}}\ yr^{-1} + \underset{TENV2^{*}}{\boxed{\ }}\ yr^{-1}} = \underset{CBARA}{\boxed{c}}\ \frac{UoA\ yr}{kg}$$

* No weathering in autumn, set to 0.0

OTHER VEGETABLES, FRUIT AND GRAIN (SUMMER)

$$\text{Leaf Contribution} \bullet e^{-(\lambda_{decay} + \lambda_{weathering}) \bullet 1\ mo} = \text{Leaf Contribution}$$

$$\underset{LEAFCN}{\boxed{i}}\ \frac{UoA}{kg} \bullet e^{-\left[\underset{AL}{\boxed{c}} + \underset{TENV\ TENV2}{\boxed{\ }}\ yr^{-1}\right] \bullet 0.083\ yr} = \underset{LEAFCN}{\boxed{c}}\ \frac{UoA}{kg}$$

TOTAL TERRESTRIAL FOOD CONTRIBUTION - ACUTE RELEASE

$$\left[\text{Leaf Contribution} + \text{Surface Soil Root Contribution}\right] = \text{Total Forage Contribution}$$

$$\left[\underset{LEAFCN}{\boxed{c}}\ \frac{UoA}{kg} + \underset{ROOTCN}{\boxed{c}}\ \frac{UoA}{kg}\right] = \underset{FOODCN}{\boxed{c}}\ \frac{UoA}{kg}$$

debug

Parameter Source Legend:
i - GENII.IN
l - library value
d - DEFAULT.IN
c - calculated value
p - program constant

PLANT AND ANIMAL PRODUCT CONCENTRATION
Subroutine: ACUTEA ACUTEC

ACUTE RELEASE

Exhibit 4.1. GENII Hand Calculation Worksheets

Title:	Pathway or Organ:		Prepared by:	Date:
	Radionuclide:	Year:	Reviewed by:	Date:

TOTAL FORAGE CONCENTRATION - ACUTE RELEASE

[Leaf Contribution + Surface Soil Root Contribution] • Animal Diet Forage Fraction = Total Forage Contribution

$$\left[\boxed{c\quad} \frac{UoA}{kg}_{\text{LEAFCN}} + \boxed{c\quad} \frac{UoA}{kg}_{\text{ROOTCN}} \right] \bullet \boxed{\quad}_{\text{FRACUT}} = \boxed{c\quad} \frac{UoA}{kg}_{\text{FORAGE}}$$

debug

TOTAL STORED FEED CONCENTRATION - ACUTE RELEASE

[Leaf Contribution + Surface Soil Root Contribution] • Animal Diet Stored Feed Fraction = Intermediate Value

$$\left[\boxed{c\quad} \frac{UoA}{kg}_{\text{LEAFCN}} + \boxed{c\quad} \frac{UoA}{kg}_{\text{ROOTCN}} \right] \bullet \left[1.0 - \boxed{\quad}_{\text{FRACUT}} \right] = \boxed{c\quad} \frac{UoA}{kg}$$

$$\text{Intermediate Value} \bullet \frac{1.0 - e^{-\left(\lambda_{decay} \bullet 12\ \text{mo}\right)}}{\lambda_{decay}} = \text{Time-Integrated Grain Concentration}$$

$$\boxed{c\quad} \frac{UoA}{kg} \bullet \frac{1.0 - e^{-\left[\boxed{c\quad}_{\text{AL}}\ yr^{-1} \bullet 1.0\ yr\right]}}{\boxed{c\quad}_{\text{AL}}\ yr^{-1}} = \boxed{c\quad} \frac{UoA\ yr}{kg}_{\text{GRAIN}}$$

Parameter Source Legend:
i - GENII.IN
l - library value
d - DEFAULT.IN
c - calculated value
p - program constant

PLANT AND ANIMAL PRODUCT CONCENTRATION
Subroutine: ACUTEA ACUTEC

ACUTE RELEASE

Exhibit 4.1. GENII Hand Calculation Worksheets

Title:	Pathway or Organ:	Prepared by:	Date:
	Radionuclide: / Year:	Reviewed by:	Date:

ANIMAL CONSUMPTION OF DRINKING WATER - ACUTE RELEASE

Time-Integrated Decayed Surface Water Concentration • Animal Drinking Water Consumption Rate • Fraction Water from This Source = Animal Drinking Water Factor

$$\boxed{c}\ \frac{\text{UoA yr}}{\text{L}} \bullet \boxed{d/i}\ \frac{\text{L}}{\text{d}} \bullet \boxed{i} = \boxed{c}\ \frac{\text{UoA yr}}{\text{d}}$$

WATCON • DWATER • DWFACA = DW

ANIMAL INTAKE - ACUTE DEPOSITION

[Time-Integrated Forage Concentration • Animal Consumption Rate] + [Time-Integrated Stored Feed Concentration • Animal Consumption Rate] + Animal Drinking Water Contribution = Animal Feed and Forage Contribution

$$\left[\boxed{}\ \frac{\text{UoA yr}}{\text{kg}} \bullet \boxed{}\ \frac{\text{kg}}{\text{d}}\right] + \left[\boxed{}\ \frac{\text{UoA yr}}{\text{kg}} \bullet \boxed{}\ \frac{\text{kg}}{\text{d}}\right] + \boxed{}\ \frac{\text{UoA yr}}{\text{d}} = \boxed{}\ \frac{\text{UoA yr}}{\text{d}}$$

FORAGE • CONSUM + GRAIN • CONSUM + DW = ANIMCN

ANIMAL PRODUCT CONCENTRATION - ACUTE DEPOSITION

• Plant/Animal Transfer Coefficient = Time-Integrated Animal Product Concentration

$$\boxed{}\ \frac{\text{UoA yr}}{\text{d}} \bullet \boxed{l}\ \frac{\text{UoA/kg}}{\text{UoA/d}} = \boxed{c}\ \frac{\text{UoA yr}}{\text{kg}}$$

ANIMCN • FMI = ANIMCN

DECAY FOR HOLDUP BETWEEN HARVEST AND CONSUMPTION OF TERRESTRIAL FOODS AND ANIMAL PRODUCTS - ACUTE RELEASE

Food Concentration • $e^{-(\lambda_{decay}}$ • Holdup Period • Unit Conversion) = Food Concentration

$$\boxed{c}\ \frac{\text{UoA}}{\text{kg}} \bullet e^{-\left[\boxed{c}\ \text{yr}^{-1} \bullet \boxed{i}\ \text{d} \bullet 2.74\text{E-3}\ \frac{\text{yr}}{\text{d}}\right]} = \boxed{c}\ \frac{\text{UoA}}{\text{kg}}$$

FOODCN / ANIMCN • AL • HLDUP / HLDUPA • YRDA = FOODCN / ANIMCN

Parameter Source Legend:
i - GENII.IN
l - library value
d - DEFAULT.IN
c - calculated value
p - program constant

PLANT AND ANIMAL PRODUCT CONCENTRATION
Subroutine: ACUTEA ACUTEC

ACUTE RELEASE

Exhibit 4.1. GENII Hand Calculation Worksheets

Title:	Pathway or Organ:		Prepared by:	Date:
	Radionuclide:	Year:	Reviewed by:	Date:

HUMAN CONSUMPTION INTEGRAL (LEAFY VEGETABLES IN WINTER, OTHERS ALWAYS)

$$\text{Terrestrial Food Contribution} \bullet \frac{1.0 - e^{-\left(\lambda_{decay} \bullet 12\ mo\right)}}{\lambda_{decay}} = \text{Time-Integrated Food Concentration}$$

$$\underset{\text{FOODCN}}{\boxed{c}}\ \frac{UoA}{kg} \bullet \frac{1.0 - e^{-\left[\underset{\text{AL}}{\boxed{c}}\ yr^{-1} \bullet 1.0\ yr\right]}}{\underset{\text{AL}}{\boxed{c}}\ yr^{-1}} = \underset{\text{FOODCN}}{\boxed{c}}\ \frac{UoA\ yr}{kg}$$

HUMAN UPTAKE RATE FROM TERRESTRIAL FOODS AND ANIMAL PRODUCTS - ACUTE RELEASE

Food Concentration • Human Consumption Rate • Effective Population • Export Adjustment = Human Uptake Rate from Consumption of Foods

$$\underset{\text{FOODCN ANIMCN}}{\boxed{c}}\ \frac{UoA}{kg} \bullet \underset{\text{CONS CONS2}}{\boxed{i}}\ \frac{kg}{person\ yr} \bullet \underset{\text{EFPOP EFPOPA}}{\boxed{c}}\ person \bullet \underset{\text{ADJEAT ADJET2}}{\boxed{c}} = \underset{\text{EXPOS}}{\boxed{c}}\ \frac{UoA}{yr}$$

ENV.OUT

EXTERNAL EXPOSURE FROM INFINITE PLUME - ACUTE RELEASE

Population-weighted Air Concentration • Unit Conversion • Average Fraction of Time Submersed in Cloud • Exposed Population In Sector = Exposure Rate from Infinite Plume

$$\underset{\text{PWTAIR}}{\boxed{c}}\ \frac{UoA\ sec}{m3} \bullet \underset{\text{YRSEC}}{3.17\text{x}10^{-8}\ \frac{yr}{sec}} \bullet \underset{\text{FRCLOD}}{\boxed{i}}\ \frac{hr}{person\ hr} \bullet \underset{\text{TPOPS}}{\boxed{i/c}}\ person = \underset{\text{EXPOS}}{\boxed{c}}\ \frac{UoA\ in\ 1st\ yr}{m^3}$$

ENV.OUT

Parameter Source Legend:
i - GENII.IN
l - library value
d - DEFAULT.IN
c - calculated value

EXPOSURE: TERRESTRIAL FOOD AND ANIMAL PRODUCT INGESTION
Subroutines: ACUTEC, ACUTEA

ACUTE RELEASE

9 1 0 4 8 0 7 9 5

Exhibit 4.1. GENII Hand Calculation Worksheets

Title:	Pathway or Organ:		Prepared by:	Date:
	Radionuclide:	Year:	Reviewed by:	Date:

EXTERNAL EXPOSURE FROM FINITE PLUME - ACUTE RELEASE

Average Population-Weighted Air Exposure • Average Fraction of Time Spent in Cloud • Exposed Population In Sector = External Exposure From Finite Plume

[c] $\frac{\text{UoA rem}}{\text{Ci}}$ • [i] $\frac{\text{hr}}{\text{person hr}}$ • [i/c] person = [c] $\frac{\text{UoA rem}}{\text{Ci}}$

PWTXAR • HRFPL • TPOPS = EXPOS

ENV.OUT

EXTERNAL EXPOSURE FACTOR FROM THE SURFACE SOIL - ACUTE RELEASE

Residential/Resuspension Surface Soil Concentration • Duration of Exposure • Unit Conversion • Exposed Population in Sector = External Exposure Factor from Surface Soil

[c/i] $\frac{\text{UoA yr}}{\text{m}^2}$ • [i] $\frac{\text{hr}}{\text{person yr}}$ • $1.14\times10^{-4}\ \frac{\text{yr}}{\text{hr}}$ • [i/c] person = [c] $\frac{\text{UoA yr}}{\text{m}^2}$

RESSOL • HRGRD • YRHR • TPOPS = EXPOS

ENV.OUT

EXPOSURE FROM INGESTION OF DRINKING WATER - ACUTE RELEASE

Time-Integrated Decayed Surface Water Concentration • Drinking Water Clean Up Factor • Drinking Water Consumption Rate • Drinking Water Population = Drinking Water Exposure

[c] $\frac{\text{UoA yr}}{\text{L}}$ • [l] • [i] $\frac{\text{L}}{\text{person yr}}$ • [i] person = [c] UoA

WATCON • DWCLEN • DWUSAG • DWPOP = EXPOS

ENV.OUT

Parameter Source Legend:
i - GENII.IN
l - library value
d - DEFAULT.IN
c - calculated value

EXPOSURE: EXTERNAL
Subroutines: EXTCAL

CHRONIC RELEASE

Exhibit 4.1. GENII Hand Calculation Worksheets

Title:	Pathway or Organ:		Prepared by:	Date:
	Radionuclide:	Year:	Reviewed by:	Date:

INHALATION EXPOSURE (ACUTE PORTION) - ACUTE RELEASE

Average Population-Weighted Air Exposure • Acute Exposure Breathing Rate • Unit Conversion • Average Fraction of Time Spent in Cloud • Exposed Population In Sector = Inhalation Exposure (Acute Portion)

$$\underset{\text{PWTAIR}}{\boxed{c\quad}}\ \frac{\text{UoA sec}}{\text{m}^3} \bullet \underset{\text{RINHA}}{\boxed{d/i\quad}}\ \frac{\text{cm}^3}{\text{sec}} \bullet \underset{\text{MCM}}{1.0\text{x}10^{-6}\ \frac{\text{m}^3}{\text{cm}^3}} \bullet \underset{\text{FRCLOD}}{\boxed{i\quad}}\ \frac{\text{hr}}{\text{person hr}} \bullet \underset{\text{TPOPS}}{\boxed{i/c\quad}}\ \text{per-son} = \underset{\text{ACUTEP}}{\boxed{c\quad}}\ \text{UoA}$$

INHALATION EXPOSURE (CHRONIC PORTION) - ACUTE RELEASE

Residential/ Resuspension Surface Soil Concentration • Resuspension Factor • Chronic Breathing Rate • Unit Conversion • Unit Conversion = Intermediate Value

$$\underset{\text{RESSOL}}{\boxed{i/c\quad}}\ \frac{\text{UoA yr}}{\text{m}^2} \bullet \underset{\text{RESFAC}}{\boxed{c\quad}}\ \text{m}^{-1} \bullet \underset{\text{RINH}}{\boxed{d/i\quad}}\ \frac{\text{cm}^3}{\text{sec}} \bullet \underset{\text{MC3M3}}{1.0\text{x}10^{-6}\ \frac{\text{m}^3}{\text{cm}^3}} \bullet \underset{\text{SECYR}}{3.15\text{x}10^{7}\ \frac{\text{sec}}{\text{yr}}} = \boxed{c\quad}\ \text{UoA}$$

Intermediate Vaue • Exposure Duration • Unit Conversion • Exposed Population In Sector = Inhalation Exposure (Chronic Portion)

$$\boxed{c\quad}\ \text{UoA} \bullet \underset{\text{HRINH}}{\boxed{i\quad}}\ \frac{\text{hr}}{\text{person yr}} \bullet \underset{\text{YRHR}}{1.14\text{x}10^{-4}\ \frac{\text{yr}}{\text{hr}}} \bullet \underset{\text{TPOPS}}{\boxed{i/c\quad}}\ \text{person} = \underset{\text{CHRONP}}{\boxed{c\quad}}\ \text{UoA}$$

TOTAL INHALATION EXPOSURE FROM AN ACUTE RELEASE

Inhalation Exposure (Acute) + Inhalation Exposure (Chronic) = Total Inhalation Exposure

$$\underset{\text{ACUTEP}}{\boxed{c\quad}}\ \text{UoA} + \underset{\text{CHRONP}}{\boxed{\quad}}\ \text{UoA} = \underset{\text{EXPOS}}{\boxed{\quad}}\ \text{UoA in 1st year}$$

ENV.OUT

Parameter Source Legend:
i - GENII.IN
l - library value
d - DEFAULT.IN
c - calculated value

EXPSOURE: Inhalation
Subroutine: INHCAL

ACUTE RELEASE

Exhibit 4.1. GENII Hand Calculation Worksheets

Title:	Pathway or Organ:		Prepared by:	Date:
	Radionuclide:	Year:	Reviewed by:	Date:

INTERNAL DOSE INCREMENT FOR EACH INGESTION PATHWAY

Uptake/ Exposure Rate • Dose Rate Factor • Unit Conversion Factor = Internal Dose Increment in Sieverts • Unit Conversion = Internal Dose Increment In Rem

INHALATION:

EXPOS		DFH		NVU		DOSINC			DOSINC
$\square \frac{\text{UoA}}{\text{yr}}$	•	$\square \frac{\text{person Sv}}{\text{Bq}}$	•	$\square \frac{\text{Bq}}{\text{UoA}}$	=	$\square$ Sv	•	$100.0 \frac{\text{rem}}{\text{Sv}}$ =	$\square \frac{\text{person rem}}{\text{yr}}$

TERRESTRIAL FOOD INGESTION:

EXPOS		DFG		NVU		DOSINC			DOSINC
$\square \frac{\text{UoA}}{\text{yr}}$	•	$\square \frac{\text{person Sv}}{\text{Bq}}$	•	$\square \frac{\text{Bq}}{\text{UoA}}$	=	$\square$ Sv	•	$100.0 \frac{\text{rem}}{\text{Sv}}$ =	$\square \frac{\text{person rem}}{\text{yr}}$

ANIMAL PRODUCT INGESTION:

EXPOS		DFG		NVU		DOSINC			DOSINC
$\square \frac{\text{UoA}}{\text{yr}}$	•	$\square \frac{\text{person Sv}}{\text{Bq}}$	•	$\square \frac{\text{Bq}}{\text{UoA}}$	=	$\square$ Sv	•	$100.0 \frac{\text{rem}}{\text{Sv}}$ =	$\square \frac{\text{person rem}}{\text{yr}}$

INADVERTENT SOIL INGESTION:

EXPOS		DFG		NVU		DOSINC			DOSINC
$\square \frac{\text{UoA}}{\text{yr}}$	•	$\square \frac{\text{person Sv}}{\text{Bq}}$	•	$\square \frac{\text{Bq}}{\text{UoA}}$	=	$\square$ Sv	•	$100.0 \frac{\text{rem}}{\text{Sv}}$ =	$\square \frac{\text{person rem}}{\text{yr}}$

INADVERTENT SWIMMING WATER INGESTION:

EXPOS		DFG		NVU		DOSINC			DOSINC
$\square \frac{\text{UoA}}{\text{yr}}$	•	$\square \frac{\text{person Sv}}{\text{Bq}}$	•	$\square \frac{\text{Bq}}{\text{UoA}}$	=	$\square$ Sv	•	$100.0 \frac{\text{rem}}{\text{Sv}}$ =	$\square \frac{\text{person rem}}{\text{yr}}$

DRINKING WATER INGESTION:

EXPOS		DFG		NVU		DOSINC			
$\square \frac{\text{UoA}}{\text{yr}}$	•	$\square \frac{\text{person Sv}}{\text{Bq}}$	•	$\square \frac{\text{Bq}}{\text{UoA}}$	=	$\square$ Sv	•	$100.0 \frac{\text{rem}}{\text{Sv}}$ =	$\square \frac{\text{person rem}}{\text{yr}}$

AQUATIC FOOD INGESTION:

EXPOS		DFG		NVU		DOSINC			
$\square \frac{\text{UoA}}{\text{yr}}$	•	$\square \frac{\text{person Sv}}{\text{Bq}}$	•	$\square \frac{\text{Bq}}{\text{UoA}}$	=	$\square$ Sv	•	$100.0 \frac{\text{rem}}{\text{Sv}}$ =	$\square \frac{\text{person rem}}{\text{yr}}$

If input units = pCi, then NVU = 0.037 Bq/UoA
If input units = uCi, then NVU = 3.7E+4 Bq/UoA
If input units = mCi, then NVU = 3.7E+7 Bq/UoA
If input units = Ci, then NVU = 3.7E+10 Bq/UoA
If input units = Bq, then NVU = 1.0 Bq/UoA

DOSE

Exhibit 4.1. GENII Hand Calculation Worksheets

Title:	Pathway or Organ:		Prepared by:	Date:
	Radionuclide:	Year:	Reviewed by:	Date:

EXTERNAL DOSE INCREMENT FOR EACH EXTERNAL EXPOSURE PATHWAY

Uptake/ Exposure Rate • Dose Rate Factor • Unit Conversion = External Dose Increment in Sieverts • Unit Conversion = External Dose Increment In Rem

INFINITE PLUME

[ ] $\frac{\text{UoA}}{\text{m}^3}$ • [ ] DAIT $\frac{\text{person Sv/yr}}{\text{Bq/m}^3}$ • [ ] NVU $\frac{\text{Bq}}{\text{UoA}}$ = [ ] DOSINC Sv • 100.0 $\frac{\text{rem}}{\text{Sv}}$ = [ ] DOSINC $\frac{\text{person rem}}{\text{yr}}$

FINITE PLUME

[ ] $\frac{\text{UoA person rem}}{\text{Ci yr}}$ • [ ] NVU $\frac{\text{Bq}}{\text{UoA}}$ • 2.7×10^{-11} $\frac{\text{Ci}}{\text{Bq}}$ = [ ] DOSINC $\frac{\text{person rem}}{\text{yr}}$

SURFACE SOIL

[ ] $\frac{\text{UoA}}{\text{m}^2}$ • [ ] DSIT $\frac{\text{person Sv/yr}}{\text{Bq/m}^3}$ /0.15 $\frac{\text{m}^3}{\text{m}^2}$ • [ ] NVU $\frac{\text{Bq}}{\text{UoA}}$ = [ ] DOSINC Sv • 100.0 $\frac{\text{rem}}{\text{Sv}}$ = [ ] DOSINC $\frac{\text{person rem}}{\text{yr}}$

DEEP SOIL

[ ] $\frac{\text{UoA}}{\text{m}^3}$ • [ ] DDIT(1) $\frac{\text{person Sv/yr}}{\text{Bq/m}^3}$ • [ ] NVU $\frac{\text{Bq}}{\text{UoA}}$ = [ ] DOSINC Sv • 100.0 $\frac{\text{rem}}{\text{Sv}}$ = [ ] DOSINC $\frac{\text{person rem}}{\text{yr}}$

CONTAINED BURIED WASTE

[ ] $\frac{\text{UoA}}{\text{m}^3}$ • [ ] DDIT(1,2,or3) $\frac{\text{person Sv/yr}}{\text{Bq/m}^3}$ • [ ] NVU $\frac{\text{Bq}}{\text{UoA}}$ = [ ] DOSINC Sv • 100.0 $\frac{\text{rem}}{\text{Sv}}$ = [ ] DOSINC $\frac{\text{person rem}}{\text{yr}}$

SWIMMING

[ ] $\frac{\text{UoA}}{\text{L}}$ • 2.0[(a)] • [ ] DBIT $\frac{\text{person Sv/yr}}{\text{Bq/L}}$ • [ ] NVU $\frac{\text{Bq}}{\text{UoA}}$ = [ ] DOSINC Sv • 100.0 $\frac{\text{rem}}{\text{Sv}}$ = [ ] DOSINC $\frac{\text{person rem}}{\text{yr}}$

BOATING

[ ] $\frac{\text{UoA}}{\text{L}}$ • [ ] DBIT $\frac{\text{person Sv/yr}}{\text{Bq/L}}$ • [ ] NVU $\frac{\text{Bq}}{\text{UoA}}$ = [ ] DOSINC Sv • 100.0 $\frac{\text{rem}}{\text{Sv}}$ = [ ] DOSINC $\frac{\text{person rem}}{\text{yr}}$

FISHING AND SHORELINE ACTVITIES

[ ] EXPOS $\frac{\text{UoA}}{\text{L}}$ • [ ] DSIT $\frac{\text{person Sv/yr}}{\text{Bq/m}^2}$ • [ ] NVU $\frac{\text{Bq}}{\text{UoA}}$ = [ ] DOSINC Sv • 100.0 $\frac{\text{rem}}{\text{Sv}}$ = [ ] DOSINC $\frac{\text{person rem}}{\text{yr}}$

(a) Correction factor for semi-infinite to infinite

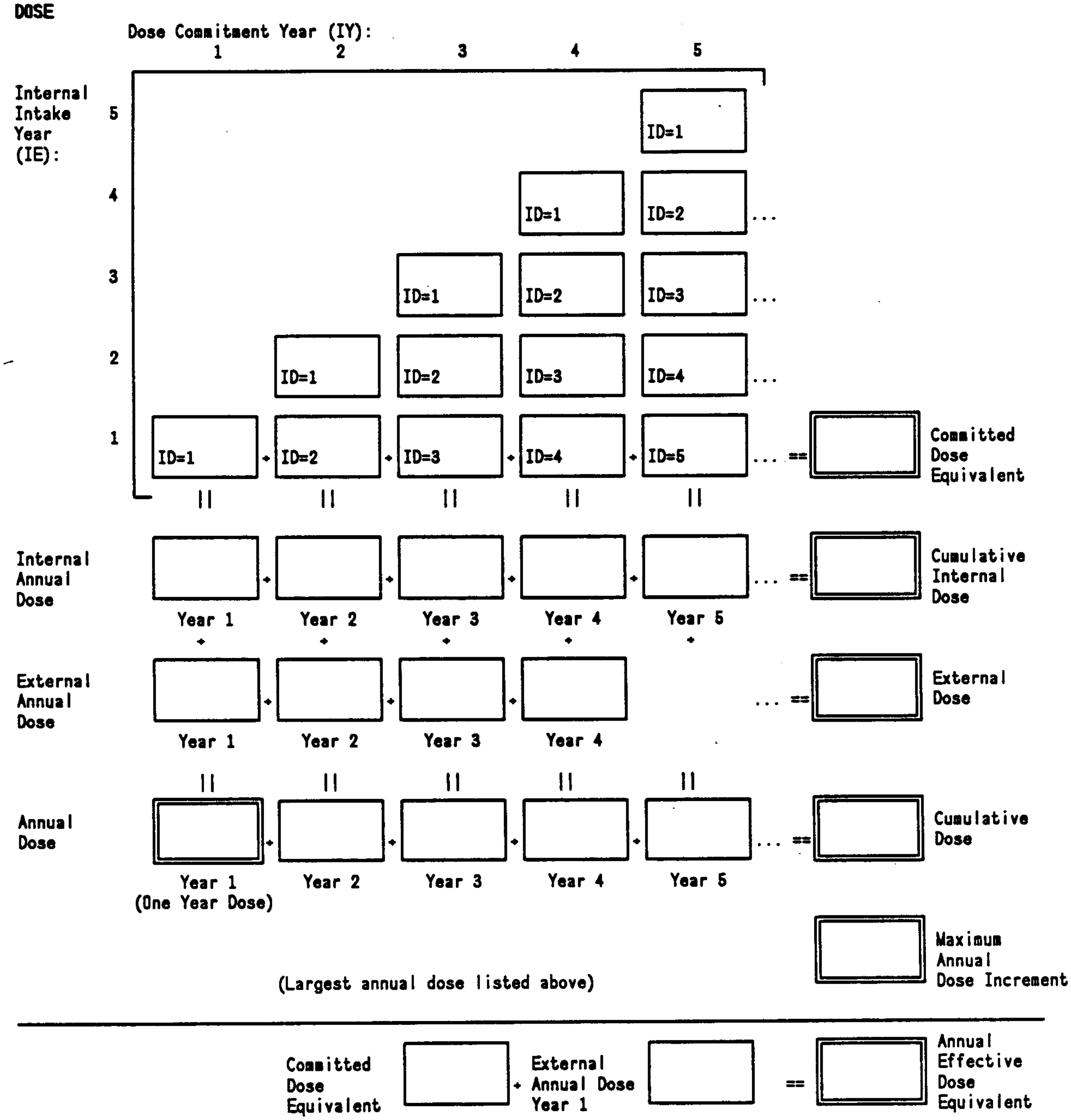
If input units = pCi, then NVU = 0.037 Bq/UoA
If input units = uCi, then NVU = 3.7E+4 Bq/UoA
If input units = mCi, then NVU = 3.7E+7 Bq/UoA
If input units = Ci, then NVU = 3.7E+10 Bq/UoA
If input units = Bq, then NVU = 1.0 Bq/UoA

DOSE

Exhibit 4.1. GENII Hand Calculation Worksheets

Title:	Pathway or Organ:		Prepared by:	Date:
	Radionuclide:	Year:	Reviewed by:	Date:

DOSE



DOSE

If input units = pCi, then NVU = 0.037 Bq/UoA
If input units = uCi, then NVU = 3.7E+4 Bq/UoA
If input units = mCi, then NVU = 3.7E+7 Bq/UoA
If input units = Ci, then NVU = 3.7E+10 Bq/UoA
If input units = Bq, then NVU = 1.0 Bq/UoA

5.0 LISTINGS

This section consists of listings of all computer codes, data libraries, and support data files. All computer codes are listed in Section 5.1. Following are listing of all data files, ordered by external file assignments as contained in the file named FILENAME.DAT, in Section 5.2.

5.1 CODE LISTINGS

Table 5.1 is a table of contents for the programs listed in this section. Listings of two utility codes are included in addition to listings of APPRENTICE and the six codes in the GENII Integrated Design/Maintenance Environment. GENERAL modules, COMMON BLOCKS, and the text of the APPRENTICE help screens are also included.

TABLE 5.1. Code Listings Table of Contents

APPRENTICE

Program title: APPRENTICE - A module of the GENII environmental dosimetry software package.

Prepared for: U. S. Department of Energy under Contract DE-AC06-76RLO 1830

Contact: Bruce Napier
Pacific Northwest Laboratory
Richland WA 99352
(509) 375-3916

Code developers: R. A. Peloquin and B. A. Napier
Pacific Northwest Laboratory
Richland WA 99352

--- Program Information ---

Problem description: To provide interactive input to the major modules of the GENII system.

Results format: The output of APPRENTICE is an output file that can be used as GENII.IN.

Computer: This version is for the IBM PC/AT.

Programming language: Compiled BASIC using FINALLY (c) and FINALLY Modules (c).

Machine requirements: IBM PC/AT with a minimum of 512 Kbytes random access memory and 1 20-Mbyte fixed disk drive.

Reference: B. A. Napier, R. A. Peloquin, D. L. Strenge, and J. V. Ramsdell. 1988. "GENII - The Hanford Environmental Radiation Dosimetry Software

```
'                           System." PNL-6584, Volumes 1, 2, and 3.
'                           Pacific Northwest Laboratory, Richland, WA
'                           99352
'
'------------------------------------------------------------------
'
'     APPRENTICE
'
'     User interface control module with pull-down menus and pop-up
'     help screens for GENII
'
'     Control Module of Program APPRENTICE of the GENII Software Package
'     Pacific Northwest Laboratory Environmental Dosimetry System
'
'     Last Modification: 1-Sep-88  RAP
'     Reviewed and Approved: 14-Sept-88  BA Napier
'
'------------------------------------------------------------------
'
'     This program uses FINALLY (c) and FINALLY MODULES (c) libraries,
'     (Copyright 1986 Komputererk Inc., Pittsburgh, PA).
'
'     Call msmenu.1 (z.i$, z.h$, iopt(), cmd$(), zh.ch, ich)
'
'     z.i$       - Initialization flag: if length <> 0 then initialize arrays,
'                  display banner and exit, if length=0 then make normal
'                  entry to menu (input)
'     z.h$       - Menu description goes to the right of the menu list (input)
'     iopt()     - Number of options (commands) in each menu; iopt(1) for
'                  main menu commands (the number of sub-menus), iopt(n) for
'                  each sub-menu (input).  OPTION BASE 1. (input)
'     jopt()     - Default or currently selected option in each submenu
'     cmd$(i,j)  - Command titles; where i is the menu number (1 for the
'                  main menu) and j is the command number 1 to iopt(i). (input)
'     iman       - Starting command in main menu to be highlighted; 1 is
'                  default for first entry, 0 will highlight the last entry
'                  (wrap). (Input)
'     imenu      - Index of current menu
'     isub       - Starting command of the iman sub-menu to be highlighted.
'                  0 is the default for no sub-menu to appear. (Input)
'     nmenu      - Number of menus available
'     nopt       - number of options in main menu, also number of submenus
'
'------------------------------------------------------------------

      DEFINT i-n
      COMMON /errors/ nerr%
'      OPTION BASE 1
      KEY OFF
```

```
        DIM iopd(6), iopt(6), cmd$(5,5), jopt(5)
        DIM iopd2(5), iopt2(5), cmd2$(5,13), jtrans(5), jinv(12)
        DIM iopd3(5), iopt3(5), cmd3$(5,11), jexp(10), jrpt(4)
        DIM iopd4(6), iopt4(6), cmd4$(6,5), jtf(5), jan(5), jaq(5)
        DIM jflag(20), jrad(300), rmd$(300)
        DIM ipage1(1300), ipage2(1300)

'       Error handling for invalid numbers--
        ON ERROR GOTO errhand

        x= FRE("")
'       j$="Free string space: "+STR$(x) : CALL messag(j$)

'       Initialize parameters--

        CALL init ( iopd%(),  iopt%(), cmd$(),  jopt%(),_
                iopd2%(), iopt2(), cmd2$(), jtrans%(), jinv%(),_
                iopd3%(), iopt3(), cmd3$(), jexp%(),_
                iopd4%(), iopt4(), cmd4$(), jtf%(), jan%(), jaq%(),_
                z.h$ )

        ON KEY ( 2) GOSUB updater
        ON KEY ( 3) GOSUB switchr
        ON KEY (11) GOSUB moveu
        ON KEY (12) GOSUB movel
        ON KEY (13) GOSUB mover
        ON KEY (14) GOSUB moved
        ON KEY (10) GOSUB doner
        KEY 2, "Select"
        KEY 3, "Page"
        KEY 4, ""  : KEY 5, "" : KEY 6, "" : KEY 7, "" : KEY 8, "" : KEY 9, ""
        KEY 10, "End"

'       Rad input page parameters,;must be here because of function keys--
        ib1 = 3 : ib2 = 8 : ib3 = 23 : ib4 = 68

        nmenu = 12                                         'number of menus
        imenu = 1                                      'start with first menu
        jrpt(1) = 1                               'set AEDE only report as default

'       Set up first help screen library--
        GOSUB help1

'---- Display introduction, read master radionuclide library -----------

        CLS
        CALL helpmenu.1 (-1, 1, ibuf, 1, 1, ilr, ilc, h$, iherr)
        CALL helpmenu.1 (-1, 2, ibuf, iur, iuc, ilr, ilc, h$, iherr)
        LOCATE 14,10 : PRINT "GENII Version 1.357"
        LOCATE 3,60 : PRINT "Please wait, ";
```

```
        LOCATE 4,60 : PRINT "loading files...";

'       Read master radionuclide library--
        CALL menu5 (7, imenu, jopt(), jinv(), jexp(),_
                    nirmd, jrad(), rmd$(), cmd2$(),_
                    ir, ic, icur, ib1, ib2, ib3, ib4, _
                    idle, notdone, ipage1(), ipage2(), z.h$)

        CALL helpmenu.1 (-1, 3, ibuf, iur, iuc, ilr, ilc, h$, iherr)

'       Read parameter file--
        CALL params (0, 0, 7, par$, jflag()) 'read parameter file

        CALL music2
        LOCATE 3,60 : PRINT "Press any key";
        LOCATE 4,60 : PRINT "to continue...   ";

waitb:
        z$=INKEY$ : IF z$="" THEN GOTO waitb

        CALL tblank (14,10,14,20)
        CALL helpmenu.1 (0, 3, ibuf, iur, iuc, ilr, ilc, h$, iherr)
        CALL helpmenu.1 (0, 2, ibuf, iur, iuc, ilr, ilc, h$, iherr)
        CALL helpmenu.1 (0, 1, ibuf, 1, 1, ilr, ilc, h$, iherr)
        CALL tblank (3,60,4,79)

        CALL helpmenu.1 (-1, 4, ibuf, iur, iuc, ilr, ilc, h$, iherr)
        LOCATE 24,10
        PRINT "If you wish instruction on using APPRENTICE, press H;";
        LOCATE 25,24 :PRINT "otherwise, any other key.";

waitc:
        z$=INKEY$ : IF z$="" THEN GOTO waitc
        CALL helpmenu.1 (0, 4, ibuf, iur, iuc, ilr, ilc, h$, iherr)
        CALL tblank (24,1,25,79)

        IF z$ = "H" OR z$ = "h" THEN
          FOR i = 1 TO 3
            CALL helpmenu.1 (-1, 4+i, ibuf, iur, iuc, ilr, ilc, h$, iherr)
            CALL waita
          NEXT i
          FOR i = 3 TO 1 STEP -1
            CALL helpmenu.1 (0, 4+i, ibuf, iur, iuc, ilr, ilc, h$, iherr)
          NEXT i
        END IF

        CALL genbox

'---- Primary control loop -------------------------------------------
```

```
      iold = 0 : idir = 1

main:

'      Check if change of help screen library is necessary--
       IF imenu < 6 AND ihelp=2 THEN GOSUB help1
       IF imenu => 6 AND ihelp=1 THEN GOSUB help2

       IF imenu = 0 THEN
      imenu = 12

       ELSEIF imenu > nmenu THEN
      GOTO done

       ELSEIF imenu = 1 THEN
      CALL menu1 (iopd(), iopt%(), cmd$(), jopt%(), imenu%, z.h$ )

       ELSEIF imenu = 2 THEN

'        Set no. of transport options for far-field scenario (move to menu2)--
         IF jopt(1) = 2 THEN
           iopt2(3) = 3 : jtrans(3) = 0 : jtrans(4) = 0
         ELSE
           iopt2(3) = iopd2(3)
         END IF

      CALL menu2 (iopd2(), iopt2(), cmd2$(), jtrans(), imenu, z.h$, _
                      jinv(), jexp(), jopt())

       ELSEIF imenu = 3 THEN
      CALL menu3 (iopd3(), iopt3(), cmd3$(), jexp(), jrpt(), imenu, z.h$ )
         CALL tblank (2,1,24,80) : CALL genbox

       ELSEIF imenu = 4 THEN

         IF jexp(7)=1 OR jexp(8)=1 OR jexp(9)=1 THEN
           CALL tblank (2,1,24,80) : CALL genbox
        CALL menu4 (iopd4(), iopt4(), cmd4$(), jtf(), jan(), jaq(), _
                        jexp(), imenu, z.h$)
         END IF
         CALL tblank (2,1,24,80) : CALL genbox

       ELSEIF imenu = 5 THEN
         CALL menu5 (0, imenu, jopt(), jinv(), jexp(),_
                      nirmd, jrad(), rmd$(), cmd2$(), _
                      ir, ic, icur, ib1, ib2, ib3, ib4, _
                      idle, notdone, ipage1(), ipage2(), z.h$)
         CALL tblank (2,1,24,80) : CALL genbox

       ELSEIF imenu = 6 THEN     'air and water transport
```

```
  IF jtrans(1)=1 OR jtrans(2)=1 THEN
    CALL menu7 (imenu, jopt(), jtrans(), jexp(), z.h$)
    CALL tblank (2,1,24,80) : CALL genbox
  END IF

ELSEIF imenu = 7 THEN    'waste form degradation & biotic transport

  IF jtrans(3)=1 OR jtrans(4)=1 THEN
    CALL menu8 (imenu, jopt(), jtrans(), z.h$)
    CALL tblank (2,1,24,80) : CALL genbox
  END IF

ELSEIF imenu = 8 THEN     'times, near and far-field

  CALL menu6 (imenu, jopt(), jtrans(), jinv(), jexp(), z.h$)
  CALL tblank (2,1,24,80) : CALL genbox

ELSEIF imenu = 9 THEN

  IF jexp(1)=1 OR jexp(2)=1 OR jexp(3)=1 OR jexp(4)=1 OR jexp(5)=1 THEN
    CALL menu9 (imenu, jopt(), jtrans(), jinv(), jexp(), z.h$)
    CALL tblank (2,1,24,80) : CALL genbox
  END IF

ELSEIF imenu = 10 THEN

  IF jexp(6)=1 OR jexp(7)=1 OR jexp(8)=1 OR jexp(9)=1 THEN
    CALL menu10 (imenu, jopt(), jtrans(), jinv(), jexp(), z.h$)
    CALL tblank (2,1,24,80) : CALL genbox
  END IF

ELSEIF imenu = 11 THEN

  IF jexp(7)=1 OR jexp(8)=1 OR jexp(9)=1 THEN
    CALL menu11 (imenu, jopt(), jtrans(), jinv(), jexp(), _
                 jaq(), jtf(), jan(), z.h$)
    CALL tblank (2,1,24,80) : CALL genbox
  END IF

ELSEIF imenu = 12 THEN

  CALL menu12 (imenu, jopt(), jtrans(), jinv(), jexp(), _
               jaq(), jtf(), jan(), jrpt(), _
               jrad(), rmd$(), nirmd,
               cmd$(), cmd2$(), cmd3$(), z.h$)
  IF imenu = 1 THEN CALL tblank (2,1,24,80) : CALL genbox

END IF
```

```
IF iold < imenu THEN
  idir = 1
ELSEIF iold > imenu THEN
  idir = -1
ELSE
  IF idir = 1 THEN
    imenu = imenu + 1
  ELSEIF idir = -1 THEN
    imenu = imenu - 1
    IF imenu = 3 THEN CALL tblank (3,1,25,79) : CALL genbox
  END IF
 END IF
 iold = imenu

GOTO main

'     Error handing--
errl:
      GOTO done

done:

      PRINT "APPRENTICE execution completed."
      END

'---- Set up first help screen library --------------------------------

help1:

      h$ = "\genii\aprhelp1.dat"
      CALL helpmenu.1 (+1, nhelp, ibuf, iur, iul, ilr, ilc, h$, iherr)
      IF iherr <> 0 THEN CALL messag ("Error "+STR$(iherr)+" with "+h$)
      ihelp = 1
      RETURN

'---- Set up second help screen library --------------------------------

help2:
      h$ = "\genii\aprhelp2.dat"
      CALL helpmenu.1 (+1, nhelp, ibuf, iur, iul, ilr, ilc, h$, iherr)
      IF iherr <> 0 THEN CALL messag ("Error "+STR$(iherr)+" with "+h$)
      ihelp = 2
      RETURN

'---- Inventory input subs ------------------------------------------

updater:

      CALL keystop
      GOSUB getpos
```

```
        IF jrad(i) = 0 THEN
          CALL intense (1)
          jrad(i) = 1
        ELSE
          jrad(i) = 0
        END IF

        LOCATE ir, ic : GOSUB prtrmd : CALL intense (0) : CALL keystart
        RETURN

switchr:

        CALL keystop
        LOCATE ir, ic : CALL reverse (0) : GOSUB prtrmd
        IF icur = 1 THEN
          CALL textsave (ib1,ib2,ib3,ib4,ipage1(),ierr)
          icur = 2
        ELSE
         CALL textsave (ib1,ib2,ib3,ib4,ipage2(),ierr)
          icur = 1
        END IF
        CALL tblank (ib1,ib2,ib3,ib4)
        idle = 0 : CALL keystart
        RETURN

doner:
        notdone = 0 : idle = 0
        CALL keystop : KEY OFF

        IF icur = 1 THEN
          CALL textsave (ib1,ib2,ib3,ib4,ipage1(),ierr)
        ELSE
          CALL textsave (ib1,ib2,ib3,ib4,ipage2(),ierr)
        END IF
        CALL tblank (2,1,25,80) : CALL reverse (0)
        RETURN

mover:
        CALL keystop
        GOSUB prtrmd : ic = ic + 10
        IF ic > ib4 THEN ic = ib2+3 : ir = ir + 1
        IF ir > ib3 THEN CALL music : ir = ir - 1
        LOCATE ir, ic : CALL reverse (1) : GOSUB prtrmd : CALL reverse (0)
        CALL keystart
        RETURN

movel:
        CALL keystop
        GOSUB prtrmd : ic = ic - 10
```

```
        IF ic < ib2 THEN ic = 61 : ir = ir - 1
        IF ir < ib1 THEN CALL music : ir = ir + 1
        LOCATE ir, ic : CALL reverse (1) : GOSUB prtrmd : CALL reverse (0)
        CALL keystart
        RETURN

moveu:
        CALL keystop
        GOSUB prtrmd : ir = ir - 1
        IF ir < ib1 THEN ir = ib3 : ic = ic - 10
        IF ic < ib2 THEN  CALL music : ic = ic + 1
        LOCATE ir, ic : CALL reverse (1) : GOSUB prtrmd : CALL reverse (0)
        CALL keystart
        RETURN

moved:
        CALL keystop
        GOSUB prtrmd : ir = ir + 1
        IF ir > ib3 THEN ir = ib1 : ic = ic + 10
        IF ic > ib4 THEN CALL music : ic = ic - 10
        LOCATE ir, ic : CALL reverse (1) : GOSUB prtrmd : CALL reverse (0)
        CALL keystart
        RETURN

prtrmd:
        GOSUB getpos : IF jrad(i) = 1 THEN CALL intense (1)
        LOCATE ir, ic : PRINT rmd$(i); : CALL intense (0)
        LOCATE ir, ic ,1
        RETURN

getpos:
'       ic = POS(0) : ir = CSRLIN
        i = (ic/10) - 1 : i = i * 21 + ir - 2
        IF icur = 2 THEN i = i + 126
        RETURN

'---- Error handing for invalid numbers ------------------------------

errhand:

        nerr = err
        CALL messag ("Error:"+STR$(nerr))
        IF nerr = 5 THEN
          CALL messag ("Illegal number, reenter")
          RESUME NEXT
        ELSEIF nerr = 6 THEN
          CALL messag ("Number too large, reenter")
          RESUME NEXT
        ELSEIF nerr = 76 THEN
          CALL messag ("Path not found")
```

```
      RESUME NEXT
    ELSEIF  nerr = 75 THEN
      CALL messag ("Path/file access error")
      RESUME NEXT
    ELSEIF nerr = 67 THEN
      CALL messag ("Too many files")
      RESUME NEXT
    ELSEIF nerr = 64 THEN
      CALL messag ("Bad file name")
      RESUME NEXT
    ELSEIF nerr = 55 THEN
      CALL messag ("File already open")
      RESUME NEXT
    ELSEIF nerr = 53 THEN
      CALL messag ("File not found")
      RESUME NEXT
    ELSEIF nerr = 58 THEN
      CALL messag ("File already exists")
      RESUME NEXT
    ELSE
      ERROR nerr
      ON ERROR GOTO 0
    END IF
    RETURN

'------------------------------------------------------------------------
'
    SUB genbox STATIC
'
'   Subprogram for APPRENTICE of the GENII Software Package
'   Pacific Northwest Laboratory Environmental Dosimetry System
'
'   Last Modification: 1-Jan-88 RAP
'   Reviewed and Approved: 14-Sept-88  BA Napier
'
    DEFINT i-n
    DIM iboxs(120)

    ibox = ibox + 1
    IF ibox =1 THEN
      CALL tborder.1 (1,2,63,8,79)
      LOCATE 3,65 : PRINT "GENII:"
      LOCATE 4,65 : PRINT "Hanford"
      LOCATE 5,65 : PRINT "Environmental"
      LOCATE 6,65 : PRINT "Dosimetry"
      LOCATE 7,65 : PRINT "System"
      CALL textsave (2,63,8,79,iboxs(),ierr)
    ELSE
      CALL textrstr (2,63,8,79,iboxs(),ierr)
    END IF
```


9 1 0 4 8 0 8 1 1

```
        EXIT SUB
'------------------------------------------------------------------------
        END SUB
'------------------------------------------------------------------------
'
        SUB waita STATIC
'
'       Subprogram for APPRENTICE of the GENII Software Package
'       Pacific Northwest Laboratory Environmental Dosimetry System
'
'       Last Modification: 22-Nov-87 RAP
'       Reviewed and Approved: 14-Sept-88  BA Napier
'
        LOCATE 25,26 : PRINT "Press any key to continue...";

waitk:

        z$=INKEY$
        IF z$="" THEN GOTO waitk

        CALL tblank (25,1,25,79)

        EXIT SUB
'------------------------------------------------------------------------
        END SUB

'------------------------------------------------------------------------

        SUB messag (j$) STATIC

'       Subprogram for APPRENTICE of the GENII Software Package
'       Pacific Northwest Laboratory Environmental Dosimetry System
'
'       Last Modification: 6-Mar-88 RAP
'       Reviewed and Approved: 14-Sept-88  BA Napier
'
        DEFINT i-n
        DIM isave(80)

        CALL textsave (24,1,24,80,isave(),ierr)
        CALL music
        LOCATE 24
        CALL tcenter.1 (1, 80, j$)
        PRINT j$;
        CALL waita
        CALL textrstr (24,1,24,80,isave(),ierr)

        EXIT SUB
'------------------------------------------------------------------------
```

9 1 0 4 8 0 8 1 2

```
END SUB

'-------------------------------------------------------------------

SUB messag2 (j$) STATIC

'     Subprogram for APPRENTICE of the GENII Software Package
'     Pacific Northwest Laboratory Environmental Dosimetry System
'
'     Last Modification: 6-Mar-88 RAP
'     Reviewed and Approved: 14-Sept-88  BA Napier
'

DEFINT i-n
DIM isave(80)
CALL textsave (24,1,24,80,isave(),ierr)
CALL music2
LOCATE 24
CALL tcenter.1 (1, 80, j$)
PRINT j$;
CALL waita
CALL textrstr (24,1,24,80,isave(),ierr)

EXIT SUB
'-------------------------------------------------------------------
END SUB

'-------------------------------------------------------------------
'
SUB music STATIC
'
'     Subprogram for APPRENTICE of the GENII Software Package
'     Pacific Northwest Laboratory Environmental Dosimetry System
'
'     Last Modification: 29-Nov-87 RAP
'     Reviewed and Approved: 14-Sept-88  BA Napier
'

listen$ = "mb T240 o1 L8 ms c o0 G3"
PLAY "X" + VARPTR$(listen$)

EXIT SUB
'-------------------------------------------------------------------
END SUB
'-------------------------------------------------------------------
'
SUB music2 STATIC
'
'     Subprogram for APPRENTICE of the GENII Software Package
'     Pacific Northwest Laboratory Environmental Dosimetry System
'
'     Last Modification: 1-Jan-88 RAP
```

```
'       Reviewed and Approved: 14-Sept-88  BA Napier
'
        listen$ = "mb T240 o1 L8 ms G3"
        PLAY "X" + VARPTR$(listen$)

        EXIT SUB
'-------------------------------------------------------------------------
        END SUB
'-------------------------------------------------------------------------
'
        SUB strip (array$(2)) STATIC
'
'       Subprogram for APPRENTICE of the GENII Software Package
'       Pacific Northwest Laboratory Environmental Dosimetry System
'
'       Last Modification: 7-Jul-88 RAP
'       Reviewed and Approved: 14-Sept-88  BA Napier
'
        DEFINT i-n

        istop1 = UBOUND (array$,1)
        istop2 = UBOUND (array$,2)

        FOR i = 1 TO istop1
          FOR j = 1 to istop2
            IF i = 1 THEN
'             CALL strplead.1 (array$(i,j),array$(i,j))
            ELSE
              CALL stripper.1 (array$(i,j),array$(i,j))
            END IF
          NEXT j
        NEXT i

        EXIT SUB
'-------------------------------------------------------------------------
        END SUB

'-------------------------------------------------------------------------
'
        SUB keystart STATIC
'
'       Subprogram for APPRENTICE of the GENII Software Package
'       Pacific Northwest Laboratory Environmental Dosimetry System
'
'       Last Modification: 6-Mar-88 RAP
'       Reviewed and Approved: 14-Sept-88  BA Napier
'
        DEFINT i-n

        KEY (2) ON
```

9 1 0 4 8 0 8 1 4

```
        KEY (3) ON
        KEY (10) ON
        KEY (11) ON
        KEY(12) ON
        KEY(13) ON
        KEY(14) ON

        EXIT SUB
'----------------------------------------------------------------------
        END SUB
'----------------------------------------------------------------------
'
        SUB keystop STATIC
'
'       Subprogram for APPRENTICE of the GENII Software Package
'       Pacific Northwest Laboratory Environmental Dosimetry System
'
'       Last Modification: 6-Mar-88 RAP
'       Reviewed and Approved: 14-Sept-88  BA Napier
'
        DEFINT i-n

        KEY (2) OFF
        KEY (3) OFF
        KEY (10) OFF
        KEY (11) OFF
        KEY(12) OFF
        KEY(13) OFF
        KEY(14) OFF

        EXIT SUB
'----------------------------------------------------------------------
        END SUB
```

```
'---------------------------------------------------------------------
'
      SUB init ( iopd%(1),  iopt%(1),  cmd$(2), jopt%(1),_
              iopd2%(1), iopt2%(1), cmd2$(2), jtrans%(1), jinv%(1),_
              iopd3%(1), iopt3%(1), cmd3$(2), jexp%(1),_
              iopd4%(1), iopt4%(1), cmd4$(2), jtf%(1), jan%(1), jaq%(1),_
              z.h$ ) STATIC
'
'     User interface control module which is the initialization
'     part of the \GENII\APPRENTICE program.
'
'     Module of Program APPRENTICE of the GENII Software Package
'     Pacific Northwest Laboratory Environmental Dosimetry System
'
'     Last Modification: 7-Jul-88  RAP
'     Reviewed and Approved: 14-Sept-88  BA Napier
'
'---- Initialization ---------------------------------------------------


      DEFINT i-n

'     Find out what kind of hardware is being used and set screen --
      SCREEN 0,0

'     Initialize Menu 1--

      z.h$ = " |  GENII's APPRENTICE"

      iopd(1) = 5   :  cmd$(1,1) = "Scenario "
      iopd(2) = 3   :  cmd$(2,1) =     "Help....F1"
                       cmd$(2,2) =     "Far-field "
                 cmd$(2,3) =     "Near-field"    : jopt(1) = 2
                 cmd$(1,2) = "Dose to  "
      iopd(3) = 3   :  cmd$(3,1) =     "Help....F1"
                 cmd$(3,2) =     "Population"
                 cmd$(3,3) =     "Individual"    : jopt(2) = 3
                 cmd$(1,3) = "Release  "
      iopd(4) = 3   :  cmd$(4,1) =     "Help....F1"
                 cmd$(4,2) =     "Chronic"
                 cmd$(4,3) =     "Acute  "       : jopt(3) = 2

                       cmd$(1,4) = "Individual Type "
      iopd(5) = 3   :  cmd$(5,1) =     "Help............F1"
                       cmd$(5,2) =     "Average Individual" : jopt(4) = 2
                 cmd$(5,3) =     "Maximum Individual"

      iopd(6) = 0   :  cmd$(1,5) = "Next"
```


9 1 0 4 8 0 8 1 6

```
'     Initialize Menu 2--

      iopd2(1) = 4
      iopd2(2) = 0 :cmd2$(1,1) = "Previous Menu "
                    cmd2$(1,2) = "Transport "
      iopd2(3) = 5 :cmd2$(3,1) =    "Help................F1"
              cmd2$(3,2) =    "Air                     "
              cmd2$(3,3) =    "Surface Water           "
              cmd2$(3,4) =    "Biotic Transport        "
              cmd2$(3,5) =    "Waste Form Degradation"

                    cmd2$(1,3) = "Inventory Location "
      iopd2(4) =13 :cmd2$(4,1) =    "Help...........F1"
              cmd2$(4,2) =    "Air ->            "
                    cmd2$(4,3) =    "Surface Water -> "
                    cmd2$(4,4) =    "Buried Waste ->  "
                    cmd2$(4,5) =    "Air              "
                    cmd2$(4,6) =    "Surface soil     "
                    cmd2$(4,7) =    "Deep Soil        "
                    cmd2$(4,8) =    "Ground Water     "
                    cmd2$(4,9) =    "Surface Water    "
                    cmd2$(4,10)=    "Terrestrial Foods"
                    cmd2$(4,11)=    "Animal Products  "
                    cmd2$(4,12)=    "Drinking Water   "
                    cmd2$(4,13)=    "Aquatic Foods    "

      iopd2(5) = 0 :cmd2$(1,4) = "Next"


'     initialize menu 3--

      iopd3(1) = 4
      iopd3(2) = 0 :cmd3$(1,1) = "Previous Menu "
                    cmd3$(1,2) = "Exposure "
      iopd3(3) = 11:cmd3$(3,1) =    "Help.....................F1"
              cmd3$(3,2) =    "External: Finite plume      "
              cmd3$(3,3) =    "External: Infinite plume    "
              cmd3$(3,4) =    "External: Ground            "
              cmd3$(3,5) =    "External: Recreation        "
              cmd3$(3,6) =    "Inhalation                  "
              cmd3$(3,7) =    "Ingestion: Drinking water   "
              cmd3$(3,8) =    "Ingestion: Aquatic food     "
              cmd3$(3,9) =    "Ingestion: Terrestrial food"
              cmd3$(3,10)=    "Ingestion: Animal product  "
              cmd3$(3,11)=    "Inadvertent soil ingestion "

      iopd3(4) = 5 :cmd3$(1,3) = "Report "
                    cmd3$(4,1) =    "Help.........F1"
                    cmd3$(4,2) =    "AEDE Only      "
                    cmd3$(4,3) =    "By Radionuclide"
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                   cmd3$(4,4) =   "By Pathway      "
                   cmd3$(4,5) =   "Screen Debug    "
      iopd3(5) = 0 :cmd3$(1,4) = "Next"

'     Initialize menu 4--

      iopd4(1) = 5
      iopd4(2) = 0 : cmd4$(1,1) = "Previous Menu "
                     cmd4$(1,2) = "Aquatic Foods "
      iopd4(3) = 5 : cmd4$(3,1) =    "Help........F1"
               cmd4$(3,2) =    "Fish            "
               cmd4$(3,3) =    "Mollusc         "
               cmd4$(3,4) =    "Crustacae       "
               cmd4$(3,5) =    "Aquatic plants"
               cmd4$(1,3) = "Terrestrial Foods "
      iopd4(4) = 5 : cmd4$(4,1) =    "Help..........F1"
                     cmd4$(4,2) =    "Leafy Vegetables"
               cmd4$(4,3) =    "Other Vegetables"
               cmd4$(4,4) =    "Fruit           "
               cmd4$(4,5) =    "Cereal          "
               cmd4$(1,4) = "Animal Products "
      iopd4(5) = 5 : cmd4$(5,1) =    "Help......F1"
               cmd4$(5,2) =    "Meat          "
               cmd4$(5,3) =    "Poultry       "
               cmd4$(5,4) =    "Milk          "
               cmd4$(5,5) =    "Eggs          "
      iopd4(6) = 0 : cmd4$(1,5) = "Next"


      FOR i = 1 TO 5
        iopt(i) = iopd(i)
        iopt2(i) = iopd2(i)
        iopt3(i) = iopd3(i)
        iopt4(i) = iopd4(i)
      NEXT i
        iopt(6) = iopd(6)
        iopt4(6) = iopd4(6)

      EXIT SUB
'-------------------------------------------------------------------------
      END SUB
```

```
'-----------------------------------------------------------------------
'
      SUB MENU1 (iopd%(1), iopt%(1), cmd$(2), jopt%(1), imenu%, z.h$ )_
               STATIC
'
'     Subprogram for APPRENTICE of the GENII Software Package
'     Pacific Northwest Laboratory Environmental Dosimetry System
'
'     Last Modification: 8-Jul-88 RAP
'     Reviewed and Approved: 14-Sept-88  BA Napier
'
'---- Menu 1 Setup and Control -----------------------------------------

      DEFINT i-n
      ir = 8 : ir2 = 5 : ic = 3 : ic2 = 6

      GOSUB setup

'     Initialize Menu 1 --

      iman = 1 : isub = 0
      CALL strip (cmd$())
      z.i$ = "i"
      CALL msmenu.1 (z.i$, z.h$, iopt(), cmd$(), iman, isub)
      z.i$ = ""


'     Menu 1 Control Loop--

loop1:

      CALL msmenu.1 (z.i$, z.h$, iopt(), cmd$(), iman, isub)
      CALL strip (cmd$())

      IF iman = iopt(1) THEN
     imenu = imenu + 1
     GOTO next1

      ELSEIF iman = 0 AND isub = 0 THEN
     imenu = 0
     GOTO next1

      ELSEIF isub=1 THEN

        IF iman = 1 THEN
          CALL helpmenu.1 (-1, 8, ibuf, iur, iul, ilr, ilc, h$, iherr)
          CALL waita
          CALL helpmenu.1 (0, 8, ibuf, iur, iul, ilr, ilc, h$, iherr)
          CALL helpmenu.1 (-1, 9, ibuf, iur, iul, ilr, ilc, h$, iherr)
          FOR i = 1 TO 4
```


9 1 0 4 8 0 8 1 9

```
        CALL helpmenu.1 (-1, 9+i, ibuf, iur, iul, ilr, ilc, h$, iherr)
        CALL waita
        CALL helpmenu.1 (0, 9+i, ibuf, iur, iul, ilr, ilc, h$, iherr)
      NEXT i
      CALL helpmenu.1 (0, 9, ibuf, iur, iul, ilr, ilc, h$, iherr)
      CALL helpmenu.1 (-1, 14, ibuf, iur, iul, ilr, ilc, h$, iherr)
      FOR i = 1 TO 4
        CALL helpmenu.1 (-1, 14+i, ibuf, iur, iul, ilr, ilc, h$, iherr)
        CALL waita
        CALL helpmenu.1 (0, 14+i, ibuf, iur, iul, ilr, ilc, h$, iherr)
      NEXT i
      CALL helpmenu.1 (0, 14, ibuf, iur, iul, ilr, ilc, h$, iherr)

    ELSEIF iman = 2 THEN
      CALL helpmenu.1 (-1, 28, ibuf, iur, iul, ilr, ilc, h$, iherr)
      CALL waita
      CALL helpmenu.1 (0, 28, ibuf, iur, iul, ilr, ilc, h$, iherr)

    ELSEIF iman = 3 THEN
      CALL helpmenu.1 (-1, 29, ibuf, iur, iul, ilr, ilc, h$, iherr)
      CALL waita
      CALL helpmenu.1 (0, 29, ibuf, iur, iul, ilr, ilc, h$, iherr)

    ELSEIF iman = 4 THEN
      CALL helpmenu.1 (-1, 30, ibuf, iur, iul, ilr, ilc, h$, iherr)
      CALL waita
      CALL helpmenu.1 (-1, 31, ibuf, iur, iul, ilr, ilc, h$, iherr)
      CALL waita
      CALL helpmenu.1 (0, 31, ibuf, iur, iul, ilr, ilc, h$, iherr)
      CALL helpmenu.1 (0, 30, ibuf, iur, iul, ilr, ilc, h$, iherr)

    END IF

  ELSEIF iman = 4 THEN
    jopt(4) = isub
    GOSUB defind

  ELSEIF iman = 2 AND isub = 2 AND jopt(1)=3 THEN
    CALL messag (_
    "Cannot calculate population dose in near-field scenario.")

  ELSE
 jopt(iman) = isub
    ir = 5 + iman*3 + isub
    LOCATE ir, ic2 : CALL intense (1) : PRINT cmd$(iman+1,isub);
    IF isub = 2 THEN isub = 3 : ir = ir + 1 ELSE isub = 2 : ir = ir - 1
    LOCATE ir,ic2 : CALL intense (0) : PRINT cmd$(iman+1,isub);
 iman = iman+1 : IF jopt(iman)=2 THEN isub = 3 ELSE isub = 2

    jopt(4) = 2 : IF jopt(1) = 3 THEN jopt(4) = 3
```

```
        GOSUB defind

      END IF

      GOTO loop1

nextl:

      CALL params (1, jopt(4), 5, par$, jopt())

      IF jopt(1)=3 AND jopt(2)=2 THEN
        CALL messag (_
        "Cannot calculate population dose in near-field scenario.")
        iman = 2 : isub = 1 : GOTO loop1
      END IF

      EXIT SUB

'---- Set up Screen boxes ---------------------------------------------
setup:

'     Set up scenario box--
      CALL tborder.1 (1,9,1,18,20)

      FOR i = 1 TO iopt(1)-2
        IF MID$(cmd$(1,i),1,1 ) = " " THEN cmd$(1,i) = MID$(cmd$(1,i),2)
     ir = ir + 1 : LOCATE ir, ic : PRINT cmd$(1,i);
     ir = ir + 1 : LOCATE ir, ic2 : IF jopt(i)=2 THEN CALL intense (1)
        IF MID$(cmd$(2,i),1,1 ) = " " THEN cmd$(2,i) = MID$(cmd$(2,i),2)
     PRINT cmd$(i+1,2); : CALL intense (0)
     ir = ir + 1 : LOCATE ir, ic2 : IF jopt(i)=3 THEN CALL intense (1)
        IF MID$(cmd$(3,i),1,1 ) = " " THEN cmd$(3,i) = MID$(cmd$(3,i),2)
     PRINT cmd$(i+1,3); : CALL intense (0)

      NEXT i

'     Set up default box--
      CALL tborder.1 (1,5,1,8,20)

      LOCATE ir2, ic : PRINT cmd$(1,4);
      GOSUB defind

      RETURN

'---- Default individual ----------------------------------------------
defind:

      LOCATE ir2+1, ic2 : IF jopt(4)=2 THEN CALL intense (1)
     PRINT "Average Ind."; : CALL intense (0)
      LOCATE ir2+2, ic2 : IF jopt(4)=3 THEN CALL intense (1)
```


9 1 0 4 8 0 8 2 1

```
    PRINT "Maximum Ind."; : CALL intense (0)
     RETURN

'----------------------------------------------------------------------
     END SUB
```

9 1 0 4 8 0 8 2 2

```
'-----------------------------------------------------------------------
'
     SUB MENU2 (iopd2%(1), iopt2%(1), cmd2$(2), jtrans%(1), imenu%, _
                z.h$, jinv%(1), jexp%(1), jopt%(1) ) STATIC
'
'    Menu 2 Setup and Control (Transport and Inventory Location)
'
'    Subprogram for APPRENTICE of the GENII Software Package
'    Pacific Northwest Laboratory Environmental Dosimetry System
'
'    Last Modification: 8-Jul-88 RAP
'    Reviewed and Approved: 14-Sept-88  BA Napier
'
'-----------------------------------------------------------------------

     DEFINT i-n

     irbl = 7 : icl = 25 : irb2  = 11 : ic2 = 58
     IF jopt(1)=2 THEN jtrans(3)=0 : jtrans(4)=0
     GOSUB trnbox : GOSUB invbox

'    Initialize Menu 2 --
     iman = 2 : isub = 2

     CALL strip (cmd2$())
     z.i$ = "i"
     CALL msmenu.1 (z.i$, z.h$, iopt2(), cmd2$(), iman, isub)
     z.i$ = ""


'    Menu 2 Control Loop--
loop2:

     CALL msmenu.1 (z.i$, z.h$, iopt2(), cmd2$(), iman, isub)
     CALL strip (cmd2$())

     IF iman = iopt2(1) THEN
    imenu = imenu + 1
    GOTO next2

     ELSEIF iman = 1 THEN
    imenu = imenu - 1
       GOTO next2

     ELSEIF iman = 0 AND isub = 0 THEN
    imenu = 0
    GOTO next2

     ELSEIF isub = 1 THEN
```

```
    IF iman = 2 THEN
      CALL helpmenu.1 (-1, 19, ibuf, iur, iul, ilr, ilc, h$, iherr)
      CALL waita
      CALL helpmenu.1 (0, 19, ibuf, iur, iul, ilr, ilc, h$, iherr)

    ELSEIF iman = 3 THEN
      CALL helpmenu.1 (-1, 20, ibuf, iur, iul, ilr, ilc, h$, iherr)
      CALL waita
      FOR i = 1 TO 3
        CALL helpmenu.1 (-1, 20+i, ibuf, iur, iul, ilr, ilc, h$, iherr)
        CALL waita
      NEXT i
      FOR i = 3 TO 1 STEP -1
        CALL helpmenu.1 (0, 20+i, ibuf, iur, iul, ilr, ilc, h$, iherr)
      NEXT i
      CALL helpmenu.1 (0, 20, ibuf, iur, iul, ilr, ilc, h$, iherr)
    END IF

  ELSEIF iman=2 THEN                                    'transport menu update

    ir = irb1 + isub - 1 : LOCATE ir, ic1

    IF jtrans(isub-1) = 0 THEN                          'select and print RV

      CALL intense (1) : PRINT cmd2$(iman+1,isub); : CALL intense (0)
      jtrans(isub-1) = 1
      IF isub-1=3 THEN
        jtrans(4) = 1
        LOCATE irb1+4, ic1
        CALL intense (1) : PRINT cmd2$(iman+1,5); : CALL intense (0)
      END IF
      IF isub-1 < 4 THEN jinv(isub-1) = 1
      IF isub-1 = 4 THEN jinv(3) = 1

    ELSE

   PRINT cmd2$(iman+1,isub);
   jtrans(isub-1) = 0
      IF isub-1 < 4 THEN jinv(isub-1) = 0
      IF isub-1 = 4 THEN jinv(3) = 0

    END IF

    IF isub-1 < 5 THEN GOSUB invbox
 isub = isub+1
 IF isub > iopt2(3) THEN iman = iman+1

  ELSEIF iman=3 THEN                                    'inventory location

   ir = irb2 + isub - 1 : LOCATE ir, ic2
```

```
IF jinv(isub-1) = 0 THEN
     IF isub-1 = 3 AND jopt(1) = 2 THEN                    'far-field
       CALL messag ("Buried waste not allowed in far-field scenario")
     ELSEIF isub-1 = 4 AND jtrans(1) THEN
       GOSUB errmes2
     ELSEIF isub-1 = 8 AND jtrans(2) THEN
       GOSUB errmes2
     ELSE
    CALL intense (1) : PRINT cmd2$(iman+1,isub); : CALL intense (0)
    jinv(isub-1) = 1
       IF isub-1 = 9 THEN
         jexp(8) = 1
       ELSEIF isub-1 = 10 THEN
         jexp(9) = 1
       ELSEIF isub-1 = 11 THEN
         jexp(6) = 1
       ELSEIF isub-1 = 12 THEN
         jexp(7) = 1
       END IF
       IF isub-1 = 1 AND jtrans(1) = 0 THEN               'air transport
         jtrans(1) = 1 : GOSUB trnbox
       ELSEIF isub-1= 2 AND jtrans(2) = 0 THEN 'surface water transport
         jtrans(2) = 1 : GOSUB trnbox
       ELSEIF isub-1 = 3 AND jtrans(4) = 0 THEN           'buried waste
         jtrans(4) = 1 : GOSUB trnbox
       END IF
     END IF
ELSE
  PRINT cmd2$(iman+1,isub);
  jinv(isub-1) = 0
     IF isub-1 = 9 THEN
       jexp(8) = 0
     ELSEIF isub-1 = 10 THEN
       jexp(9) = 0
     ELSEIF isub-1 = 11 THEN
       jexp(6) = 0
     ELSEIF isub-1 = 12 THEN
       jexp(7) = 0
     END IF
END IF

isub = isub+1
IF isub > iopt2(4) THEN iman = iman+1

END IF
GOTO loop2

next2:
```


9 1 0 4 8 0 8 2 5

```
        IF jopt(3)=3 THEN
          IF jtrans(1)=0 AND jtrans(2)=0 THEN
            CALL messag ("Transport must be specified for acute release.")
            iman = 2 : isub = 1 : GOTO loop2
          END IF
        END IF

        EXIT SUB

'---- Set up transport status box ------------------------------------
trnbox:

        CALL tborder.1 (1,7,22,12,54)
        LOCATE irb1,ic1-1 : PRINT cmd2$(1,2);
        ir = irb1

        FOR i = 2 TO iopt2(3)
       ir = ir + 1 : LOCATE ir, ic1 : IF jtrans(i-1)=1 THEN CALL intense (1)
       PRINT cmd2$(3,i); : IF jtrans(i-1) THEN CALL intense (0)
        NEXT i

        RETURN

'---- Set up inventory location status box ---------------------------
invbox:

        CALL tborder.1 (1,11,56,24,77)
        LOCATE irb2,ic2-1 : PRINT cmd2$(1,3);
        ir = irb2

        FOR i = 2 TO iopt2(4)
       ir = ir + 1 : LOCATE ir, ic2 : IF jinv(i-1)=1 THEN CALL intense (1)
       PRINT cmd2$(4,i); : IF jinv(i-1) THEN CALL intense (0)
        NEXT i
        RETURN

'---- Option incompatibility ------------------------------------------

errmes2:
        CALL messag (_
        "Cannot consider both transport and basic concentration.")
        RETURN

'----------------------------------------------------------------------
        END SUB
```

```
'-------------------------------------------------------------------
'
      SUB MENU3 ( iopd3%(1), iopt3%(1), cmd3$(2), jexp%(1), jrpt%(1),_
                 imenu%, z.h$ ) STATIC
'
'     Menu 3 Setup and Control (Exposure and Report)
'
'     Subprogram for APPRENTICE of the GENII Software Package
'     Pacific Northwest Laboratory Environmental Dosimetry System
'
'     Last Modification: 7-Jul-88 RAP
'     Reviewed and Approved: 14-Sept-88  BA Napier
'
'-------------------------------------------------------------------

      DEFINT i-n
      irb = 13 : icb = 25 : irb2 = 19 : ic2 = 4
      GOSUB setup

'     Initialize Menu 3 --
      iman = 2 : isub = 3

      CALL strip (cmd3$())
      z.i$ = "i"
      CALL msmenu.1 (z.i$, z.h$, iopt3(), cmd3$(), iman, isub)
      z.i$ = ""


'     Menu 3 Control Loop--

loop3:

      CALL msmenu.1 (z.i$, z.h$, iopt3(), cmd3$(), iman, isub)
      CALL strip (cmd3$())

      IF iman = iopt3(1) THEN
      imenu = imenu + 1
      GOTO next3

      ELSEIF iman = 1 THEN
      imenu = imenu - 1
        GOTO next3

      ELSEIF iman = 0 AND isub = 0 THEN
      imenu = 0
      GOTO next3

      ELSEIF isub = 1 THEN
```

9 1 0 4 8 0 8 2 7

```
        IF iman = 2 THEN
          CALL helpmenu.1 (-1, 24, ibuf, iur, iul, ilr, ilc, h$, iherr)
          CALL waita
          CALL helpmenu.1 (0, 24, ibuf, iur, iul, ilr, ilc, h$, iherr)
          iman = 2 : isub = 3

        ELSEIF iman = 3 THEN
          CALL helpmenu.1 (-1, 32, ibuf, iur, iul, ilr, ilc, h$, iherr)
          CALL waita
          CALL helpmenu.1 (0, 32, ibuf, iur, iul, ilr, ilc, h$, iherr)
        END IF

      ELSEIF iman = 2 THEN

        ir = irb + isub - 1 : LOCATE ir,icb
        IF jexp(isub-1)=0 THEN
            CALL intense (1) : PRINT cmd3$(iman+1,isub); : CALL intense(0)
       jexp(isub-1)=1
          IF isub-1 < 3 THEN GOSUB chkfin
        ELSE
       PRINT cmd3$(iman+1,isub);
       jexp(isub-1)=0
        END IF

        isub = isub+1
        IF isub > iopt3(3) THEN isub = 2 : iman = iman + 1

      ELSEIF iman = 3 THEN

        ir = irb2 + isub - 1 : LOCATE ir,ic2
        IF jrpt(isub-1)=0 THEN
          CALL intense (1) : PRINT cmd3$(iman+1,isub); : CALL intense (0)
          jrpt(isub-1)=1
        ELSE
          PRINT cmd3$(iman+1,isub)1
          jrpt(isub-1)=0
        END IF

        isub = isub+1
        IF isub > iopt3(4) THEN isub = 0 : iman = iman+ 1

      END IF
      GOTO loop3

next3:

      EXIT SUB

'---- Set up exposure and report status boxes -------------------------
```

```
setup:

      CALL tborder.1 (1,13,22,24,54)
      LOCATE 13,24 : PRINT cmd3$(1,2);
      ir = irb

      FOR i = 2 TO iopt3(3)
     ir = ir + 1 : LOCATE ir, icb : IF jexp(i-1)=1 THEN CALL intense (1)
     PRINT cmd3$(3,i); : IF jexp(i-1)=1 THEN CALL intense (0)
      NEXT i

      CALL tborder.1 (1,19,1,24,20)
      LOCATE 19,3 : PRINT cmd3$(1,3);
      ir = irb2

      FOR i = 2 TO iopt3(4)
     ir = ir + 1 : LOCATE ir, ic2 : IF jrpt(i-1)=1 THEN CALL intense (1)
     PRINT cmd3$(4,i); : IF jrpt(i-1)=1 THEN CALL intense (0)
      NEXT i
      RETURN

'---- Check for finite / infinite plume incompatibility ---------------

chkfin:

      IF jexp(1) = 1 AND jexp(2) = 1 THEN
        IF isub = 3 THEN                               'infinite last selected
          jexp(1) = 0
          ir = irb + 1 : LOCATE ir,icb
            PRINT cmd3$(iman+1,isub-1);
        ELSE                                           'finite last selected
          jexp(2) = 0
          ir = irb + 2 : LOCATE ir,icb
            PRINT cmd3$(iman+1,isub+1);
        END IF
      END IF

      RETURN

'----------------------------------------------------------------------
      END SUB
```

9 1 0 4 8 0 8 2 9

```
'-----------------------------------------------------------------------
'
      SUB MENU4 ( iopd4%(1), iopt4%(1), cmd4$(2), jtf%(1), jan%(1), _
                jaq%(1), jexp%(1), imenu%, z.h$ ) STATIC
'
'     Menu 4 Setup and Control
'
'     Subprogram for APPRENTICE of the GENII Software Package
'     Pacific Northwest Laboratory Environmental Dosimetry System
'
'     Last Modification: 26-Jul-88 RAP
'     Reviewed and Approved: 14-Sept-88  BA Napier
'
'-----------------------------------------------------------------------

      DEFINT i-n
      ifirst = ifirst + 1

      iopt4(3) = iopd4(3)
      iopt4(4) = iopd4(4)
      iopt4(5) = iopd4(5)

      iman = 5 : isub = 0
      IF jexp(9) = 0 THEN iopt4(5) = 0 ELSE iman = 4
      IF jexp(8) = 0 THEN iopt4(4) = 0 ELSE iman = 3
      IF jexp(7) = 0 THEN iopt4(3) = 0 ELSE iman = 2
      IF iman < 5 THEN isub = 2

      GOSUB setup

      CALL strip (cmd4$())
      z.i$ = "i"
      CALL msmenu.1 (z.i$, z.h$, iopt4(), cmd4$(), iman, isub)
      z.i$ = ""

'     Menu 4 Control Loop--

loop4:

      IF iman < iopt4(1) THEN
        IF iopt4(iman+1)=0 AND iman < iopt4(1) THEN iman = iman+1 : GOTO loop4
      END IF
      IF isub > 0 AND iopt4(iman+1) = 0 THEN isub = 0

      CALL msmenu.1 (z.i$, z.h$, iopt4(), cmd4$(), iman, isub)
      CALL strip (cmd4$())

      IF iman = iopt4(1) THEN
     imenu = imenu + 1
     GOTO next4
```

```
 ELSEIF iman = 1 THEN
imenu = imenu - 1
   GOTO next4

 ELSEIF iman = 0 AND isub = 0 THEN
imenu = 0
GOTO next4

 ELSEIF isub = 1 THEN
   IF iman = 2 THEN
     CALL helpmenu.1 (-1, 34, ibuf, iur, iul, ilr, ilc, h$, iherr)
  CALL waita
  CALL helpmenu.1 (0, 34, ibuf, iur, iul, ilr, ilc, h$, iherr)
   ELSEIF iman = 3 THEN
     CALL helpmenu.1 (-1, 35, ibuf, iur, iul, ilr, ilc, h$, iherr)
  CALL waita
  CALL helpmenu.1 (0, 35, ibuf, iur, iul, ilr, ilc, h$, iherr)
   ELSEIF iman = 4 THEN
     CALL helpmenu.1 (-1, 36, ibuf, iur, iul, ilr, ilc, h$, iherr)
  CALL waita
  CALL helpmenu.1 (0, 36, ibuf, iur, iul, ilr, ilc, h$, iherr)
   END IF

 ELSEIF iman=2 THEN

   IF isub=0 THEN iman = iman + 1 : GOTO loop4
ic = 4 : ir = 13 + isub : LOCATE ir,ic
   IF jaq(isub-1)=0 THEN
     CALL intense (1) : PRINT cmd4$(iman+1,isub); : CALL intense (0)
     jaq(isub-1)=1
   ELSE
     PRINT cmd4$(iman+1,isub);
     jaq(isub-1)=0
   END IF
   isub = isub+1 : IF isub>5 THEN isub = 2 : iman = iman+1

   ELSEIF iman=3 THEN

   IF isub=0 THEN iman = iman + 1 : GOTO loop4
   ic = 29 : ir = 13 + isub : LOCATE ir,ic
 IF jtf(isub-1)=0 THEN
  CALL intense (1) : PRINT cmd4$(iman+1,isub); : CALL intense (0)
     jtf(isub-1)=1
   ELSE
     PRINT cmd4$(iman+1,isub);
     jtf(isub-1)=0
   END IF
   isub = isub+1 : IF isub>5 THEN isub = 2 : iman = iman+1
```

```
        ELSEIF iman=4 THEN

          IF isub=0 THEN iman = iman + 1 : GOTO loop4
          ic = 54 : ir = 13 + isub : LOCATE ir,ic
          IF jan(isub-1)=0 THEN
            CALL intense (1) : PRINT cmd4$(iman+1,isub); : CALL intense (0)
         jan(isub-1)=1
       ELSE
         PRINT cmd4$(iman+1,isub);
         jan(isub-1)=0
       END IF
          isub = isub+1 : IF isub>5 THEN isub = 2 : iman = iman+1

        END IF

        GOTO loop4

next4:
        GOSUB check
        CALL tblank (10,1,24,80)
        EXIT SUB

'---- Set up status page ---------------------------------------------------

setup:

        CALL tblank (10,1,24,80)

        IF jexp(7) THEN                      'aquatic foods selected
          CALL tborder.1 (1,13,1,20,23)
          ir = 14 : ic = 4
          FOR i = 2 TO iopt4(3)
         ir = ir + 1
         LOCATE ir, ic : IF jaq(i-1) = 1 THEN CALL intense (1)
            PRINT cmd4$(3,i); : CALL intense (0)
          NEXT i
          CALL tborder.1 (1,10,1,12,23)
          LOCATE 11,ic : PRINT cmd4$(1,2);
        END IF

        IF jexp(8) THEN                        'terrestrial foods selected
          CALL tborder.1(1,13,26,20,48)
          ir = 14 : ic = 29
          FOR i = 2 TO iopt4(4)
         ir = ir + 1
         LOCATE ir, ic : IF jtf(i-1) = 1 THEN CALL intense(1)
            PRINT cmd4$(4,i); : CALL intense (0)
          NEXT i
          CALL tborder.1 (1,10,26,12,48)
          LOCATE 11,ic : PRINT cmd4$(1,3);
```

```
        END IF

        IF jexp(9) THEN                        'animal products selected
          CALL tborder.1 (1,13,51,20,73)
          ir = 14 : ic = 54
          FOR i = 2 TO iopt4(5)
         ir = ir + 1
         LOCATE ir,ic : IF jan(i-1) = 1 THEN CALL intense (1)
            PRINT cmd4$(5,i); : CALL intense (0)
          NEXT i
          CALL tborder.1 (1,10,51,12,73)
          LOCATE 11,ic : PRINT cmd4$(1,4);
        END IF

        RETURN

'---- Ensured that food types have been selected ----------------------

check:
        IF jexp(7) > 0 THEN
          icnt = 0
          FOR i = 1 TO 4
            IF jaq(i)>0 THEN icnt = icnt + 1
          NEXT i
          IF icnt = 0 THEN
            j$ = "Select aquatic food types now." : CALL messag (j$)
            iman = 4 : isub = 2 : GOTO loop4
          END IF
        END IF

        IF jexp(8) > 0 THEN
          icnt = 0
          FOR i = 1 TO 4
            IF jtf(i)>0 THEN icnt = icnt + 1
          NEXT i
          IF icnt = 0 THEN
            j$ = "Select terrestrial food types now." : CALL messag (j$)
            iman = 2 : isub = 2 : GOTO loop4
          END IF
        END IF

        IF jexp(9) > 0 THEN
          icnt = 0
          FOR i = 1 TO 4
            IF jan(i)>0 THEN icnt = icnt + 1
          NEXT i
          IF icnt = 0 THEN
            j$ = "Select animal products now." : CALL messag (j$)
            iman = 3 : isub = 2 : GOTO loop4
          END IF
```

```
END IF

RETURN

'---------------------------------------------------------------
END SUB
```

9 1 0 4 8 0 8 3 4

```
'-----------------------------------------------------------------------
'
    SUB MENU5 (i5flag%, imenu%, jopt%(1), jinv%(1), jexp%(1),_
               nirmd%, jrad%(1), rmd$(1), cmd2$(2),_
               ir%, ic%, icur%, ib1%, ib2%, ib3%, ib4%,_
               idle%, notdone%, ipage1%(1), ipage2%(1), z.h$ ) STATIC
'
'   Menu 5 Setup and Control (Radiological inventory)
'
'   Subprogram for APPRENTICE of the GENII Software Package
'   Pacific Northwest Laboratory Environmental Dosimetry System
'
'   Last Modification: 11-Jul-88 RAP
'   Reviewed and Approved: 14-Sept-88  BA Napier
'
'-----------------------------------------------------------------------
'
'   Argument list:
'     I5flag   - Flag set to:
'                  0 - process menu 5
'                  7 - read master radionuclide library
'                  8 - write inventory portion of output file
'
'-----------------------------------------------------------------------

    DEFINT i-n

    ifirst = ifirst + 1
    IF ifirst=1 THEN

      DIM iopd5(5), iopt5(5), cmd5$(4,6), rad$(8)
      DIM jrow(300), jcol(300)
      DIM irmd(100), iloc(3), icloc(3), q(3,300), locunt$(12)
      DIM jflag(20), jinvold(12), dir$(10)

      icheck = 0 : iold = 0 : mor3 = 0

      iopd5%(1) = 4
      iopd5%(2) = 0 : cmd5$(1,1) = "Previous Menu "
                      cmd5$(1,2) = "Activity Units"
      iopd5%(3) = 6 : cmd5$(3,1) =    "Help...F1"
                      cmd5$(3,2) =    "pCi"
                      cmd5$(3,3) =    "uCi"
                      cmd5$(3,4) =    "mCi"
                      cmd5$(3,5) =    "Ci "
                      cmd5$(3,6) =    "Bq"
                 cmd5$(1,3) = "Inventory      "
      iopd5%(4) = 6 : cmd5$(4,1) =    "Help...................F1"
                  cmd5$(4,2) =    "Select Radionuclides"
                      cmd5$(4,3) =    "Input Inventory Quantities"
```


9 1 0 4 8 0 8 3 5

```
                cmd5$(4,4) =    "Display Inventory"
                cmd5$(4,5) =    "Add / Delete Radionuclides"
                cmd5$(4,6) =    "Change Quantities"
          iopd5%(5) = 0 : cmd5$(1,4) = "Next"

          FOR i = 1 TO 5 : iopt5(i) = iopd5(i) : NEXT i

'         Initialize location units --
          locunt$(1) = "/yr" : locunt$(2) = "/yr" : locunt$(3) = "/m3"
          locunt$(4) = "/m3" : locunt$(6) = "/m3"
          locunt$(7) = "/L" : locunt$(8) = "/L" : locunt$(9) = "/kg"
          locunt$(10) = "kg" : locunt$(11) = "/L" : locunt$(12) = "/kg"

      END IF

'---- Main process loop -----------------------------------------------

      IF i5flag = 0 THEN

'       Process menu 5--
        GOTO menu5

      ELSEIF i5flag = 7 THEN

'       Read master radionuclide library--
        GOSUB redrmd

      ELSEIF i5flag = 8 THEN

'       Write inventory portion of output file--
        GOSUB ritinv

      END IF
      EXIT SUB

'---- Menu 5 (inventory) control ---------------------------------------

menu5:

      iman = 2 : isub = 5
      z.i$ = "i"
      CALL msmenu.1 (z.i$, z.h$, iopt5(), cmd5$(), iman, isub)
      z.i$ = ""
      first1 = 0 : first2 = 0
      IF iunit > 0 THEN GOSUB prtunt

'     Menu 5 Control Loop--
loop5:
      CALL msmenu.1 (z.i$, z.h$, iopt5(), cmd5$(), iman, isub)
```


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```
 IF iman = iopt5(1) THEN
imenu = imenu + 1
GOTO next5

 ELSEIF isub = 1 THEN
   IF iman = 2 THEN
     CALL helpmenu.1 (-1, 33, ibuf, iur, iul, ilr, ilc, h$, iherr)
     CALL waita
     CALL helpmenu.1 (0, 33, ibuf, iur, iul, ilr, ilc, h$, iherr)
   ELSEIF iman = 3 THEN
     CALL helpmenu.1 (-1, 25, ibuf, iur, iul, ilr, ilc, h$, iherr)
     CALL waita
     CALL helpmenu.1 (0, 25, ibuf, iur, iul, ilr, ilc, h$, iherr)
   END IF

 ELSEIF iman = 1 THEN
   IF jexp(7)=0 AND jexp(8)=0 AND jexp(9)=0 THEN
     imenu=imenu - 2
   ELSE
  imenu = imenu - 1
   END IF
   GOTO next5

 ELSEIF iman = 0 AND isub = 0 THEN
imenu = 0
GOTO next5

 ELSEIF iman = 2 THEN
   iunit = isub-1
   GOSUB prtunt
   IF jinv(5) = 1 THEN GOSUB getsoil
   iman = 3 : isub=2

 ELSEIF iman = 3 THEN

   IF iunit = 0 THEN
     j$ = "Enter activity units first." : CALL messag (j$)
     iman = 2 : isub=2
   ELSE
     GOSUB radin
     isub = isub + 1
     IF isub > iopt5(iman+1) THEN iman = iman + 1 : isub = 0

   END IF

 END IF
 GOTO loop5

next5:
```

```
        IF icheck > 0 THEN GOSUB chkold
        IF iold=1 THEN
          CALL messag ("Note: inventory locations have been changed.")
          IF jinv(5)=1 AND iunit=0 THEN GOSUB getsoil : GOSUB prtunt
          iman = 3 : isub = 4 : GOSUB setold : GOTO loop5
        END IF
        GOSUB setold

        KEY OFF
        EXIT SUB

'---- Display selected units ------------------------------------------

prtunt:

        LOCATE 10,69 : CALL intense (1)
        PRINT "Units: "; cmd5$(3,iunit+1);
        CALL intense (0)
        RETURN

'---- Get soil source parameter ----------------------------------------

getsoil:

        CALL params (1, 41, 1, par$, jflag())
        CALL tblank (10,1,24,79)
        iunit2 = VAL (par$)

        IF iunit2 = 1 THEN
          locunt$(5) = "/m2"
        ELSEIF iunit2 = 2 THEN
          locunt$(5) = "/m3"
        ELSEIF iunit2 = 3 THEN
          locunt$(5) = "/kg"
        END IF

        RETURN

'---- Set previous inventory location for next time -------------------

setold:
        FOR i = 1 TO 12 : jinvold(i) = jinv(i) : NEXT i
        icheck = icheck + 1
        iold = 0
        RETURN

'---- Check if changes made to inventory location since last here ------

chkold:
```

```
      iold = 0
      FOR i = 1 TO 12
        IF jinv(i) <> jinvold(i) THEN iold = 1
      NEXT i
      RETURN

'---- Inventory control ----------------------------------------------

radin:

      irl = 5 : icl = 10
      icloc(1) = 23 : icloc(2) = 41 : icloc(3) = 59

      IF isub = 1 THEN

     CALL helpmenu.1 (-1, 25, ibuf, iur, iul, ilr, ilc, h$, iherr)
     CALL waita
     CALL helpmenu.1 (0, 25, ibuf, iur, iul, ilr, ilc, h$, iherr)

      ELSEIF isub = 2 OR isub = 5 THEN

        KEY ON
        icur = 1 : notdone = 1

        WHILE notdone = 1

          IF icur = 1 THEN
            ifirst1 = ifirst1 + 1
            GOSUB displa1
          ELSEIF icur = 2 THEN
            ifirst2 = ifirst2 + 1
            GOSUB displa2
          END IF

          ir = ib1 : ic = ib2 + 3
          CALL reverse (1) : GOSUB prtrmd : CALL reverse (0)

          idle = 1 : CALL keystart
          WHILE idle = 1 : WEND
          CALL keystop : LOCATE ,,0                   'turn off cursor

        WEND

        KEY OFF : firstr = 2

      ELSEIF isub > 2 AND firstr < 2 THEN

        j$ =  "Select radionuclides first." : CALL messag (j$)
        isub = 2
```

```
        ELSEIF isub = 3 OR isub = 4 OR isub = 6 THEN

          GOSUB chkinv

          IF nloc > 0 THEN

            nopass = 1
            WHILE nopass > 0

              IF nopass = 1 THEN
                istart = 1
              ELSE
                istart = istop + 1
              END IF

              istop = istart + 18
              IF istop > nirmd THEN istop = nirmd

              GOSUB prtinv
              IF isub=4 THEN CALL waita
              IF isub=3 OR isub = 6 THEN GOSUB inputq

              IF istop = nirmd THEN nopass = 0 ELSE nopass = nopass + 1

              CALL tblank (2,1,24,80)

            WEND

          END IF
        END IF
        RETURN

'---- Establish list of selected radionuclides, check locations --------

chkinv:
        nirmd = 0
        FOR i = 1 TO nrmd
          IF jrad(i) THEN
            nirmd = nirmd + 1
            irmd(nirmd) = i
          END IF
        NEXT i

'       Check for inventory location--
        nloc = 0
        FOR i = 1 TO 12
          IF jinv(i) = 1 THEN
            nloc = nloc + 1
            IF nloc < 4 THEN iloc(nloc) = i
          END IF
```

```
      NEXT i

      IF nloc = 0 THEN
        j$ = "Inventory location must be specified first." : CALL messag (j$)
        imenu = 2 : GOTO next5

      mor3 = mor3 + 1
      ELSEIF nloc > 3 AND mor3 = 1 THEN
        CALL messag (_
        "WARNING: Only first 3 locations can be entered in APRENTICE.")
        CALL messag ("WARNING: Remember to add others to input file")
        nloc = 3

      END IF
      RETURN

'---- Input and test inventory quantity -------------------------------

inputq:

      j = 1 : i = istart
      ir = irl : ir2 = istop - istart + irl

loopi:
      rnum = (q(j,irmd(i)))
      IF rnum > 0.0 THEN in$ = STR$ (rnum) ELSE in$ = SPACE$(8)

      CALL innum (in$, 2, rnum, ir, icloc(j), nflag)
      q(j,irmd(i)) = rnum : narrow = nflag

      IF narrow = -1 THEN
        IF i > istart THEN
          i = i - 1 : ir = ir - 1
        ELSEIF j > 1 THEN
          j = j - 1 : i = istop : ir = ir2
        END IF
      ELSE
        IF i < istop THEN
          i = i + 1 : ir = ir + 1
        ELSEIF j < nloc THEN
          j = j + 1 : i = istart : ir = irl
        ELSE
          RETURN
        END IF
      END IF
      GOTO loopi

      RETURN

'---- Print page of inventory on screen --------------------------------
```

```
prtinv:

       CALL reverse (0)
       ir = irl
       FOR i = istart TO istop
         LOCATE ir, icl : PRINT rmd$(irmd(i));
         ir = ir + 1
       NEXT i

       FOR j = 1 TO nloc

         ir = irl
         LOCATE 3, icloc(j)+1 : PRINT cmd2$(4,iloc(j)+1);
         LOCATE 4, icloc(j) : PRINT cmd5$(3,iunit+1);
         IF jopt(3) <> 3 THEN PRINT locunt$(iloc(j));
         FOR i = istart TO istop
           LOCATE ir,icloc(j) : PRINT USING " ##.#^^^^"; q(j,irmd(i))
           ir = ir + 1
         NEXT i

       NEXT j
       RETURN


'---- Inventory input subs -------------------------------------------

displa1:

       IF ifirst1 = 1 THEN
         CALL tblank (2,7,24,69)
         CALL tborder.1 (2,2,7,24,69)
         FOR i = 1 TO nhalf
           LOCATE jrow(i), jcol(i)
           IF jrad(i) = 1 THEN CALL intense (1)
           PRINT rmd$(i); : CALL intense (0)
         NEXT i
       ELSE
         CALL textrstr (ib1,ib2,ib3,ib4,ipage1(),ierr)
       END IF
       RETURN

displa2:

       IF ifirst2 = 1 THEN
         FOR i = nhalf+1 TO nrmd
           LOCATE jrow(i), jcol(i)
           IF jrad(i) = 1 THEN CALL intense (1)
           PRINT rmd$(i); : CALL intense (0)
         NEXT i
```

```
      ELSE
        CALL textrstr (ib1,ib2,ib3,ib4,ipage2(),ierr)
      END IF
      RETURN

prtrmd:
      GOSUB getpos : IF jrad(i) = 1 THEN CALL intense (1)
      LOCATE ir, ic, 1 : PRINT rmd$(i); : CALL intense (0)
      RETURN

getpos:
      i = (ic/10) - 1 : i = i * 21 + ir - 2
      IF icur = 2 THEN i = i + 126
      RETURN


'---- Read radionuclide master library --------------------------------

redrmd:

      CALL getdir.2 ("filename.dat", dir$(), idir)
      IF idir = 0 THEN
        OPEN "I", #1, "\genii\filename.dat"
      ELSE
        OPEN "I", #1, "filename.dat"
      END IF

      LINE INPUT #1, dum$ : LINE INPUT #1, dum$
      LINE INPUT #1, fil$
      CLOSE (1)
      fil$ = MID$ (fil$, 11)
      OPEN "I", #1, fil$
      LINE INPUT #1, dum$

      i = 1
      ir = ib1 : ic = ib2+3

'     Temporary fix until another page needed--
      WHILE NOT EOF(1) AND i < 253

        LINE INPUT #1, l$
        rmd$(i) = MID$(l$,1,6)
'       CALL strptral.1 (rmd$(i), rmd$(i))

'       Set row and column indices--
        IF ir > ib3 THEN
          ic = ic + 10 : ir = ib1
          IF ic > 61 THEN ir = ib1 : ic = ib2+3 : nhalf = i - 1
        END IF
        jrow(i) = ir : jcol(i) = ic
```

```
    ir = ir + 1

    i = i + 1

  WEND

  nrmd = i - 1
  CLOSE (1)

  RETURN

'------------------------------------------------------------------------

ritinv:

  LINE INPUT #1, l$ : MID$(l$,1,5) = STR$(iunit) : PRINT #2, l$
  LINE INPUT #1, l$ : MID$(l$,1,5) = STR$(iunit2) : PRINT #2, l$
  LINE INPUT #1, l$ : PRINT #2, l$

  FOR i = 1 TO 8 : LINE INPUT #1, l$ : PRINT #2, l$ : NEXT i

  iset = 0
  FOR i = 1 TO 8
    IF jinv(i) = 1 THEN iset = 1
  NEXT i

  IF iset = 1 THEN
    FOR i = 1 TO nirmd                        'print first inventory set

      PRINT #2, USING "     \       \"; rmd$(irmd(i));

      FOR k = 1 TO 8
        ifound = 0
        FOR j = 1 TO nloc
          IF iloc(j) = k THEN
            ifound = 1
            PRINT #2, USING "##.#^^^^"; q(j,irmd(i));
          END IF
        NEXT j
        IF ifound = 0 THEN PRINT #2, SPACE$(8);
      NEXT k
      PRINT #2, " "

    NEXT i
    PRINT #2, " "
  END IF

loop1:                                     'Skip until next heading found
  LINE INPUT #1, l$ : IF MID$(l$,6,1) <> "-" THEN GOTO loop1
```

```
      PRINT #2, l$
      FOR i = 1 TO 6 : LINE INPUT #1, l$ : PRINT #2, l$ : NEXT i


      iset = 0
      FOR i = 9 TO 12
        IF jinv(i) = 1 THEN iset = 1
      NEXT i

      IF iset = 1 THEN
        FOR i = 1 TO nirmd                          'print second inventory set

          PRINT #2, USING "     \       \"; rmd$(irmd(i));

          FOR k = 9 TO 12
            ifound = 0
            FOR j = 1 TO nloc
              IF iloc(j) = k THEN
                ifound = 1
                PRINT #2, USING "##.#^^^^"; q(j,irmd(i));
              END IF
            NEXT j
            IF ifound = 0 THEN PRINT #2, SPACE$(8);
          NEXT k
          PRINT #2, " "

        NEXT i
        PRINT #2, " "
      END IF

loop2:                                          'Skip until next heading found
      LINE INPUT #1, l$ : IF MID$(l$,6,1) <> "#" THEN GOTO loop2

      PRINT #2, CHR$(13)
      PRINT #2, l$
      RETURN

'----------------------------------------------------------------------
      END SUB
```

```
'--------------------------------------------------------------------
'
      SUB MENU6 ( imenu%, jopt%(1), jtrans%(1), _
                 jinv%(1), jexp%(1), z.h$ ) STATIC
'
'     Menu 6 Setup and Control (Times, near and far field)
'
'     Subprogram for APPRENTICE of the GENII Software Package
'     Pacific Northwest Laboratory Environmental Dosimetry System
'
'     Last Modification: 30-Aug-88 RAP
'     Reviewed and Approved: 14-Sept-88  BA Napier
'
'--------------------------------------------------------------------

      DEFINT i-n

      ifirst = ifirst + 1
      IF ifirst = 1 THEN

        x = FRE("")

        DIM iopd6(6), iopt6(6), cmd6$(5,5), jflag(20)

        iopd6(1) = 5
        iopd6(2) = 0 : cmd6$(1,1) = "Previous Menu "
                       cmd6$(1,2) = "Times   "
        iopd6(3) = 2 : cmd6$(3,1) =    "Help....F1"
                       cmd6$(3,2) =    "Input     "
                       cmd6$(1,3) = "Far-field "
        iopd6(4) = 4 : cmd6$(4,1) =    "Help..................F1"
                  cmd6$(4,2) =    "Sum population grid file"
                  cmd6$(4,3) =    "Input population total  "
                  cmd6$(4,4) =    "Input                   "
                  cmd6$(1,4) = "Near-field "
        iopd6(5) = 2 : cmd6$(5,1) =    "Help....F1"
                  cmd6$(5,2) =    "Input     "
        iopd6(6) = 0 : cmd6$(1,5) = "Next"

        FOR i = 1 TO 5 : iopt6(i) = iopd6(i) : NEXT i

      END IF

'     Initialize Menu 6 --

      iman = 2 : isub = 2
      IF jtrans(1)=1 THEN
     cmd6$(4,2) =    "Use population grid file"
      ELSE
```


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```
cmd6$(4,2) =    "Sum population grid file"
 END IF

 CALL params (1, 175, 6, par$, jflag())
 ixoq = VAL (par$)

 IF jopt(1) = 3 THEN      'near-field
   iopt6(4) = 0
   iopt6(5) = iopd6(5)

 ELSEIF jopt(1) = 2 THEN  'far-field
   iopt6(5) = 0

   IF jopt(2) = 3 THEN 'individual
     iopt6(4) = 0

   ELSEIF jtrans(1)=1 AND ixoq>1 THEN  'population file to be used
     iopt6(4) = 0
     CALL params (1, 174, 8, "1", jflag())  'set population

   ELSEIF jtrans(1)=0 AND jtrans(2)=1 THEN  'water only
     iopt6(4) = iopd6(4)
  cmd6$(4,2) = "unused                      " : isub = 3

   ELSE
     iopt6(4) = iopd6(4)
   END IF
 ELSE
   CALL messag ("jopt not set.")
 END IF


 CALL strip (cmd6$())
 z.i$ = "i"
 CALL msmenu.1 (z.i$, z.h$, iopt6(), cmd6$(), iman, isub)
 z.i$ = ""

'    Menu 6 Control Loop--

loop6:

 IF iman < iopt6(1) AND iopt6(iman+1)=0  THEN iman = iman+1 : GOTO loop6
 IF isub > 0 AND iopt6(iman+1) = 0 THEN isub = 0

 CALL msmenu.1 (z.i$, z.h$, iopt6(), cmd6$(), iman, isub)
 CALL strip (cmd6$())

 IF iman = iopt6(1) THEN
imenu = imenu + 1
GOTO next6
```


9 1 0 4 8 0 8 4 7

```
 ELSEIF iman = 1 THEN
   imenu = imenu - 1
   GOTO next6

 ELSEIF iman = 0 AND isub = 0 THEN
imenu = 0
GOTO next6

 ELSEIF iman = 2 THEN  'times

   IF isub = 1 THEN
     CALL helpmenu.1 (-1, 16, ibuf, iur, iul, ilr, ilc, h$, iherr)
     CALL waita
  CALL helpmenu.1 (0, 16, ibuf, iur, iul, ilr, ilc, h$, iherr)
     isub = isub + 1

   ELSEIF isub = 2 THEN

     CALL params (2,1,1,par$,jflag())

     IF jopt(3)=2 AND (jtrans(1)=1 OR jtrans(2)=1) THEN
       CALL params (1,3,0,par$,jflag())
     END IF

     IF jopt(3)=2 AND jtrans(1)=1 THEN
       CALL params (1,4,0,par$, jflag())
     END IF
     IF jopt(3)=2 AND jtrans(1)=2 THEN
       CALL params (1,5,0,par$, jflag())
     END IF

     IF jopt(3)=2 THEN
       IF jtrans(3)=1 OR jtrans(4)=1 OR jinv(4)=1 OR jinv(5)=1 THEN
         CALL params (1,6,0,par$, jflag())
       END IF
       IF jtrans(3)=1 THEN
         CALL params (1,7,0,par$, jflag())
       END IF
     END IF

     CALL tblank (10, 1, 24, 80)
     iman = iman + 1

   END IF

 ELSEIF iman = 3 THEN  'far-field

   IF iopt6(4) = 0 THEN
     iman = iman + 1 : isub = 0 : GOTO loop6
```

```
 ELSEIF isub = 1 THEN
   CALL helpmenu.1 (-1, 17, ibuf, iur, iul, ilr, ilc, h$, iherr)
   CALL waita
CALL helpmenu.1 (0, 17, ibuf, iur, iul, ilr, ilc, h$, iherr)
   isub = isub + 1

 ELSEIF isub = 2 THEN
   IF jtrans(1)=0 AND jtrans(2)=1 THEN  'water only, over write
     jpop = 2 : isub = 4
   ELSE
     jpop = 1 : isub=0 : iman = 5
   END IF

 ELSEIF isub = 3 THEN
   jpop = 2 : isub = isub+1

 ELSEIF isub = 4 THEN
   CALL params (1, 39, 1, par$,jflag()) : isub = 0 : iman = 5
 END IF

 par$ = STR$(jpop)
 CALL params (1, 174, 8, par$, jflag())

ELSEIF iman = 4 THEN  'near-field

  IF iopt6(5) = 0 THEN
    iman = iman + 1 : isub = 0 : GOTO loop6

  ELSEIF isub = 1 THEN
    CALL helpmenu.1 (-1, 18, ibuf, iur, iul, ilr, ilc, h$, iherr)
    CALL waita
    CALL helpmenu.1 (-1, 19, ibuf, iur, iul, ilr, ilc, h$, iherr)
    CALL waita
    CALL helpmenu.1 (-1, 20, ibuf, iur, iul, ilr, ilc, h$, iherr)
    CALL waita
 CALL helpmenu.1 (0, 20, ibuf, iur, iul, ilr, ilc, h$, iherr)
 CALL helpmenu.1 (0, 19, ibuf, iur, iul, ilr, ilc, h$, iherr)
 CALL helpmenu.1 (0, 18, ibuf, iur, iul, ilr, ilc, h$, iherr)

  ELSEIF isub = 2 THEN

    IF jexp(8)=1 OR jexp(9)=1 OR jtrans(3)=1 THEN
      CALL params (1,8,1,par$,jflag())
      IF jtrans(4)=1 OR jinv(6)=1 THEN CALL params (1,9,0,par$,jflag())
    END IF

    CALL params (1,10,0,par$,jflag())
    IF jtrans(4)=0 AND jinv(6)=1 THEN CALL params (1,35,0,par$,jflag())
```

```
          IF jexp(3)=1 THEN            'get source size for external dose mod.
            CALL params (1,179,0,par$,jflag())
            IF par$="T" THEN
              CALL params (1,180,0,par$,jflag())
            ELSE
              CALL params (1,180,8,"1250",jflag())
            END IF
          ELSE
            CALL params (1,180,8,"1250",jflag())
          END IF

          CALL tblank (10,1,24,80) : isub = 0 : iman = 5

        END IF

      END IF
      GOTO loop6

next6:

      EXIT SUB
'-----------------------------------------------------------------------
       END SUB
```


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```
'-------------------------------------------------------------------
'
     SUB MENU7 ( imenu%, jopt%(1), jtrans%(1), jexp%(1), z.h$ ) _
             STATIC
'
'    Air and surface water transport selection and input control.
'
'    Module of Program APRENTIC of the GENII Software Package
'    Pacific Northwest Laboratory Environmental Dosimetry System
'
'    Last Modification: 31-Aug-88  RAP
'
'------------------------------------------------------------------------
'
'    icheck   - flag set if iold is not the same as inew indicating
'               that the user has modified previous options which
'               effect this menu
'    inew     - index of current option combination selection
'               (population/individual, chronic/acute)
'    iold     - index of previous option combination selection last
'               time in this menu, see inew
'    iset     - flag set when user changes chi/q option while in this
'               menu, checked on exit to ensure that input parameters
'               have been updated
'
'------------------------------------------------------------------------

     DEFINT i-n

     inew = 0
     icheck = 0
     iset = 0

     first = first + 1
     IF first = 1 THEN

       DIM iopd7(5), iopt7(5), cmd7$(4,6), imi$(5), ipop$(5), _
           iai$(4), iap$(4), jflag(20)

'      Initialize Chronic Maximum Individual Menu --
       imi$(1) =    "Help.................F1"
    imi$(2) =    "Use chi/Q value"
    imi$(3) =    "Select MI dist. & dir."
    imi$(4) =    "Specify MI dist. & dir."
       imi$(5) =    "Input"

'      Initialize Chronic Population Menu --
       ipop$(1) =    "Help............................F1"
    ipop$(2) =    "Use population-weighted chi/Q value"
    ipop$(3) =    "Calculate from chi/Q & pop. grids"
```


9 1 0 4 8 0 8 5 1

```
ipop$(4) =    "Calculate from joint freq. & pop."
   ipop$(5) =    "Input"

'      Initialize Acute Individual Menu--
       iai$(1) =    "Help..................F1"
    iai$(2) =    "Use E/Q value"
    iai$(3) =    "Specify ind. dist. & dir."
    iai$(4) =    "Input"

'      Initialize Acute Population Menu--
       iap$(1) =    "Help.............F1"
    iap$(2) =    "Use E/Q value"
    iap$(3) =    "Specify direction"
    iap$(4) =    "Input"


'      Initialize Transport Menu--

       iopd7(1) = 4
       iopd7(2) = 0 : cmd7$(1,1) = "Previous Menu "
                    : cmd7$(1,2) = "Air Transport "
       iopd7(4) = 5 : cmd7$(1,3) = "Surface Water Transport"
                      cmd7$(4,1) = "Help................. F1"
       iopd7(5) = 0 : cmd7$(1,4) = " Next"
       FOR i = 1 TO 5 : iopt7(i) = iopd7(i) : NEXT i

       iold = 0

     END IF

'    Initialize Air Transport Menu --

     IF jtrans(1) = 1 THEN

       iman = 2

       IF jopt(3) = 2 THEN                              'chronic pop and mi

         IF jopt(2) = 2 THEN
           FOR i = 1 TO 5 : cmd7$(3,i) = ipop$(i) : NEXT i
           inew = 1
         ELSE
           FOR i = 1 TO 5 : cmd7$(3,i) = imi$(i) : NEXT i
           inew = 2
         END IF
         iopt7(3) = 5

       ELSE                                              'acute pop and mi
```


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```
    IF jopt(2) = 2 THEN
      FOR i = 1 TO 4 : cmd7$(3,i) = iap$(i) : NEXT i
      inew = 3
    ELSE
      FOR i = 1 TO 4 : cmd7$(3,i) = iai$(i) : NEXT i
      inew = 4
    END IF
    iopt7(3) = 4
  END IF

ELSE
  iopt7(3) = 0
END IF

IF jtrans(2) = 1 THEN                                        'surface water
  IF jopt(3) = 3 THEN                                              'acute
    iopt7(4) = 2
    cmd7$(4,2) = "Input"
    CALL params (1, 178, 8, "1", jflag())         'set mixing ratio flag
  ELSE                                                           'chronic
    iopt7(4) = iopd7(4)
    cmd7$(4,2) = "Enter Mixing Ratio Value"
    cmd7$(4,3) = "Use River MR Model"
    cmd7$(4,4) = "Use Lake MR Model"
    cmd7$(4,5) = "Input"
  END IF
  IF iman = 0 THEN iman = 3
ELSE
  iopt7(4) = 0
END IF

isub = 2
CALL strip (cmd7$())
z.i$ = "i"
CALL msmenu.1 (z.i$, z.h$, iopt7(), cmd7$(), iman, isub)
z.i$ = ""

iset = 0
IF iold <> inew THEN
  jair = 0
  icheck = 1
END IF

'     Transport Control Loop--

loop7:

IF iopt7(iman+1) < iopt7(1) THEN
  IF iopt7(iman+1)=0 AND iman < iopt7(1) THEN iman = iman+1 : GOTO loop7
END IF
```

```
IF isub > 0 AND iopt7(iman+1) = 0 THEN isub = 0

CALL msmenu.1 (z.i$, z.h$, iopt7(), cmd7$(), iman, isub)
CALL strip (cmd7$())

IF iman = iopt7(1) THEN
  imenu = imenu + 1
GOTO next7

ELSEIF iman = 1 THEN
  imenu = imenu - 1
  GOTO next7

ELSEIF iman = 0 AND isub = 0 THEN
  imenu = 0
  GOTO next7

ELSEIF iman = 2 THEN

  IF iopt7(3) = 0 THEN
    iman = iman + 1 : isub = 2 : GOTO loop7

  ELSEIF isub = 1 THEN

    GOSUB airhlp

    IF jopt(3) = 2 THEN 'chronic
      IF jopt(2) = 3 THEN 'individual
        FOR ih = 1 TO 4
          CALL helpmenu.1 (-1, ih, ibuf,iur,iul,ilr,ilc,h$,iherr)
          CALL waita
        NEXT ih
        FOR ih = 4 to 1 STEP -1
          CALL helpmenu.1 (0, ih, ibuf, iur, iul, ilr, ilc, h$, iherr)
        NEXT ih
      ELSE
        FOR ih = 1 TO 4
          CALL helpmenu.1 (-1, 4+ih, ibuf,iur,iul,ilr,ilc,h$,iherr)
          CALL waita
        NEXT ih
        FOR ih = 4 to 1 STEP -1
          CALL helpmenu.1 (0, 4+ih, ibuf, iur, iul, ilr, ilc, h$, iherr)
        NEXT ih
      END IF
    ELSE 'acute
      IF jopt(2) = 3 THEN 'individual
        FOR ih = 1 TO 3
          CALL helpmenu.1 (-1, 8+ih, ibuf,iur,iul,ilr,ilc,h$,iherr)
          CALL waita
        NEXT ih
```

```
        FOR ih = 3 to 1 STEP -1
          CALL helpmenu.1 (0, 8+ih, ibuf, iur, iul, ilr, ilc, h$, iherr)
        NEXT ih
      ELSE
        CALL helpmenu.1 (-1, 12, ibuf,iur,iul,ilr,ilc,h$,iherr)
        CALL waita
        CALL helpmenu.1 (-1, 13, ibuf,iur,iul,ilr,ilc,h$,iherr)
        CALL waita
        CALL helpmenu.1 (-1, 11, ibuf,iur,iul,ilr,ilc,h$,iherr)
        CALL waita
        CALL helpmenu.1 (0, 11, ibuf, iur, iul, ilr, ilc, h$, iherr)
        CALL helpmenu.1 (0, 13, ibuf, iur, iul, ilr, ilc, h$, iherr)
        CALL helpmenu.1 (0, 12, ibuf, iur, iul, ilr, ilc, h$, iherr)
      END IF
    END IF

  ELSEIF isub > 1 AND isub < iopt7(3) THEN      'set chi/Q input option

    jair = isub - 1
    IF jexp(1)=1 AND jair=1 THEN
      CALL messag ("Option not allowed with finite plume model.")
      isub = isub + 1
    ELSE
      LOCATE 9,10 : CALL intense (1)
      PRINT cmd7$(iman+1,isub); : CALL intense (0)
      isub = iopt7(3)
      iset = 1

'     set j/f flag off if Chi/Qor E/Q value input--
      IF jair=1 THEN CALL params (1, 16, 8, "F", jflag())

      IF icheck = 1 THEN icheck = 0
    END IF

  ELSEIF jair = 0 THEN                                'set option first
    CALL messag ("Enter option first.")

  ELSE
'   Input air parameters--
    iset = 0
    IF jopt(3) = 2 THEN
      IF jopt(2) = 2 THEN

'       Chronic population--

        IF jair=1 THEN par$ = "1" ELSE par$ = "0"
        CALL params (1, 175, 8, par$, jflag())

        IF jair = 1 THEN
          CALL params (1, 13, 1, par$, jflag())
```

```
    ELSEIF jair = 2 THEN
      CALL params (1, 16, 8, "F", jflag())
    ELSEIF jair = 3 THEN
      CALL params (1, 16, 8, "T", jflag())
    END IF

    iman = iman + 1 : isub = 0

  ELSEIF jopt(2) = 3 THEN

    Chronic individual--
    par$ = STR$(jair)
    CALL params (1, 175, 8, par$, jflag())

    IF jair = 1 THEN
      CALL params (1, 11, 1, par$, jflag())
    ELSEIF jair = 2 THEN
      CALL params (1, 16, 1, par$, jflag())
    ELSEIF jair = 3 THEN
      GOSUB sector
      CALL params (2, 14, 1, par$, jflag())
    END IF

  END IF

  IF jair ◇ 1 THEN

    Get stack parameters chronic release--
    CALL params (1, 17, 0, par$, jflag())

    IF par$ = "T" THEN
      CALL params (1, 18, 0, par$, jflag())
      IF par$ = "F" THEN
        CALL params (4, 19, 1, par$, jflag())
      ELSE
        CALL params (1, 19, 1, par$, jflag())
      END IF
    END IF

  END IF

  iman = iman + 1

ELSE

  IF jopt(2) = 2 THEN

    Acute population--

    IF jair = 1 THEN
```

```
      CALL params (1, 175, 8, "1", jflag())
      CALL params (1, 40, 1, par$, jflag())
    ELSEIF jair = 2 THEN
      CALL params (1, 175, 8, "3", jflag())
      GOSUB sector
      CALL params (1, 185, 1, par$, jflag())
      CALL params (1, 14, 8, par$, jflag())
      CALL params (1, 16, 8, "T", jflag())
    END IF

  ELSEIF jopt(2) = 3 THEN

'   Acute individual--

    IF jair = 1 THEN
      CALL params (1, 175, 8, "1", jflag())
      CALL params (1, 12, 1, par$, jflag())
    ELSEIF jair = 2 THEN
      CALL params (1, 175, 8, "3", jflag())
      GOSUB sector
      CALL params (2, 14, 1, par$, jflag())
      CALL params (1, 16, 8, "T", jflag())
    END IF

  END IF

  IF jair ◇ 1 THEN

'   Get stack parameters acute release--
    CALL params (1, 17, 0, par$, jflag())

    IF par$ = "T" THEN                                 'elevated release
      CALL params (1, 18, 0, par$, jflag())
      IF par$ = "T" THEN                         'effective stack height
        CALL params (1, 19, 0, par$, jflag())
        CALL params (1, 181, 8, "1", jflag())
      ELSE
        CALL params (1, 184, 0, par$, jflag())
        IF par$ = "T" THEN                      'use building wake model
          CALL params (3, 19, 0, par$, jflag())
          CALL params (2, 182, 0, par$, jflag())
          CALL params (1, 181, 8, "2", jflag())
        ELSE                                        'use plume rise model
          CALL params (4, 19, 1, par$, jflag())
          CALL params (1, 181, 8, "1", jflag())
        END IF
      END IF
    ELSE                                            'ground level release
      CALL params (1, 184, 0, par$, jflag())
      IF par$ = "T" THEN                        'use building wake model
```

```
          CALL params (1, 20, 0, par$, jflag())
          CALL params (1, 182, 0, par$, jflag())
          CALL params (1, 181, 8, "3", jflag())
        ELSE                                       'ground level, open
          CALL params (1, 181, 8, "0", jflag())
        END IF

      END IF

    END IF
    iman = iman + 1
  END IF

END IF

ELSEIF iman = 3 THEN                                 'surface water transport

  IF iopt7(4) = 0 THEN
    iman = iman + 1 : isub = 2 : GOTO loop7

  ELSEIF isub = 1 THEN
    IF jopt(3) = 2 THEN 'chronic
      CALL helpmenu.1 (-1, 14, ibuf,iur,iul,ilr,ilc,h$,iherr)
      CALL waita
      CALL helpmenu.1 (0, 14, ibuf, iur, iul, ilr, ilc, h$, iherr)
    ELSE 'acute
      CALL helpmenu.1 (-1, 15, ibuf,iur,iul,ilr,ilc,h$,iherr)
      CALL waita
      CALL helpmenu.1 (0, 15, ibuf, iur, iul, ilr, ilc, h$, iherr)
    END IF

  ELSEIF jopt(3) = 3 THEN                                        'acute
    CALL params (2, 23, 1, par$, jflag())
    CALL params (1, 26, 0, par$, jflag())

  ELSEIF isub > 1 AND isub < iopt7(4) THEN        'set mixing ratio flag

    jsw = isub - 2
    LOCATE 9,10 : CALL intense (1)
    PRINT cmd7$(iman+1,isub); : CALL intense (0)
    CALL params (1, 178, 8, STR$(jsw), jflag())
    isub = iopt7(4)

  ELSE                                     'input surface water parameters

    IF jsw = 0 THEN CALL params (1, 23, 1, par$, jflag())
    IF jsw = 0 THEN
      CALL params (1, 24, 1, par$, jflag())
    ELSEIF jsw = 1 OR jsw = 2 THEN
      CALL params (1, 25, 1, par$, jflag())
```

```
            END IF
            CALL params (1, 26, 0, par$, jflag())
            IF jsw > 0 THEN CALL params (4, 27, 0, par$, jflag())
            IF jsw = 1 THEN CALL params (1, 31, 0, par$, jflag())
            IF jsw = 2 THEN CALL params (1, 32, 0, par$, jflag())
            iman = iman + 1 : isub = 2

          END IF

        END IF
        GOTO loop7

next7:
        GOSUB check
        iold = inew
        EXIT SUB

'---- check options for validity ----------------------------------------

check:

        IF iold > 0 AND icheck = 1 THEN
          CALL messag ("Previous option changes require your attention here.")
          iman = 2 : isub = 1 : GOTO loop7
        END IF

        IF iset = 1 THEN    'air option changed but parameters not input
          CALL messag ("Input air parameters now.")
          iman = 2 : isub = iopt7(3) : GOTO loop7
        END IF

'       Check for finite plume - chi/Q option incompatibility--
        IF jexp(1)=1 AND jair=1 THEN
          CALL messag ("Invalid air transport option for finite plume.")
          iman = 2 : isub = 1 : GOTO loop7
        END IF

        RETURN

'---- sector index display -------------------------------------------

sector:

        LOCATE 3, 3 : PRINT "Wind toward:";
        LOCATE 4, 5 : PRINT "1-S      5-W      9-N      13-E";
        LOCATE 5, 5 : PRINT "2-SSW    6-WNW    10-NNE   14-ESE";
        LOCATE 6, 5 : PRINT "3-SW     7-NW     11-NE    15-SE";
        LOCATE 7, 5 : PRINT "4-WSW    8-NNW    12-ENE   16-SSE";
        RETURN
```

```
'---- general air transport help screens -------------------------------

airhlp:

      CALL helpmenu.1 (-1, 33, ibuf,iur,iul,ilr,ilc,h$,iherr)
      CALL waita
      CALL helpmenu.1 (-1, 34, ibuf,iur,iul,ilr,ilc,h$,iherr)
      CALL helpmenu.1 (-1, 35, ibuf,iur,iul,ilr,ilc,h$,iherr)
      CALL waita
      CALL helpmenu.1 (0, 35, ibuf,iur,iul,ilr,ilc,h$,iherr)
      CALL helpmenu.1 (0, 34, ibuf,iur,iul,ilr,ilc,h$,iherr)
      CALL helpmenu.1 (0, 33, ibuf,iur,iul,ilr,ilc,h$,iherr)
      CALL helpmenu.1 (-1, 36, ibuf,iur,iul,ilr,ilc,h$,iherr)
      CALL waita
      CALL helpmenu.1 (0, 36, ibuf,iur,iul,ilr,ilc,h$,iherr)
      CALL helpmenu.1 (-1, 32, ibuf,iur,iul,ilr,ilc,h$,iherr)
      CALL waita
      CALL helpmenu.1 (0, 32, ibuf,iur,iul,ilr,ilc,h$,iherr)

      RETURN

'-----------------------------------------------------------------------
      END SUB
```

```
'-----------------------------------------------------------------------
'
     SUB MENU8 ( imenu%, jopt%(1), jtrans%(1), z.h$ ) STATIC
'
'    Menu 8 Setup and Control (Waste form availablility and
'    Biotic transport)
'
'    Subprogram for APPRENTICE of the GENII Software Package
'    Pacific Northwest Laboratory Environmental Dosimetry System
'
'    Last Modification: 11-Jul-88 RAP
'    Reviewed and Approved: 14-Sept-88  BA Napier
'
'-----------------------------------------------------------------------

     DEFINT i-n

     ifirst = ifirst + 1
     IF ifirst = 1 THEN

       DIM iopd8%(5), iopt8%(5), cmd8$(4,4), jflag(20)

       iopd8%(1) = 4
       iopd8%(2) = 0 : cmd8$(1,1) = "Previous Menu "
                       cmd8$(1,2) = "Waste Form Availability"
       iopd8%(3) = 2 : cmd8$(3,1) =    "Help...........F1"
                       cmd8$(3,2) =    "Input"
                  cmd8$(1,3) = "Biotic Transport"
       iopd8%(4) = 2 : cmd8$(4,1) =    "Help.....F1"
                  cmd8$(4,2) =    "Input"
       iopd8%(5) = 0 : cmd8$(1,4) = "Next"

       FOR i = 1 TO 5 : iopt8(i) = iopd8(i) : NEXT i

     END IF

'    Initialize Menu 8 --

     IF jtrans(4) = 0 THEN iopt8(3) = 0 ELSE iopt8(3) = iopd8(3)
     IF jtrans(3) = 0 THEN iopt8(4) = 0 ELSE iopt8(4) = iopd8(4)
     IF iopt8(3) = 0 THEN iman = 3 ELSE iman = 2
     isub = 2

     CALL strip (cmd8$())
     z.i$ = "i"
     CALL msmenu.1 (z.i$, z.h$, iopt8(), cmd8$(), iman, isub)
     z.i$ = ""

'    Menu 8 Control Loop--
```

```
loop8:

      IF iopt8(iman+1)=0 AND iman < iopt8(1) THEN iman = iman+1 : GOTO loop8
      IF isub > 0 AND iopt8(iman+1) = 0 THEN isub = 0

      CALL msmenu.1 (z.i$, z.h$, iopt8(), cmd8$(), iman, isub)
      CALL strip (cmd8$())

      IF iman = iopt8(1) THEN
     imenu = imenu + 1
     GOTO next8

      ELSEIF iman = 1 THEN
        imenu = imenu - 1
        GOTO next8

      ELSEIF iman = 0 AND isub = 0 THEN
     imenu = 0
     GOTO next8

      ELSEIF iman = 2 THEN

        IF iopt8(3) = 0 THEN
          iman = iman + 1 : isub = 2 : GOTO loop8

        ELSEIF isub = 1 THEN
          CALL helpmenu.1 (-1, 37, ibuf, iur, iul, ilr, ilc, h$, iherr)
          CALL waita
       CALL helpmenu.1 (0, 37, ibuf, iur, iul, ilr, ilc, h$, iherr)

        ELSEIF isub = 2 THEN
          CALL params (3, 33, 1, par$, jflag())
          iman = iman + 1 : isub = 2
        END IF

      ELSEIF iman = 3 THEN

        IF iopt8(4) = 0 THEN
          iman = iman + 1 : isub = 2 : GOTO loop8

        ELSEIF isub = 1 THEN
          CALL helpmenu.1 (-1, 38, ibuf, iur, iul, ilr, ilc, h$, iherr)
          CALL waita
       CALL helpmenu.1 (0, 38, ibuf, iur, iul, ilr, ilc, h$, iherr)
        ELSEIF isub = 2 THEN
          CALL params (3, 36, 1, par$, jflag())
          isub = 2 : iman = 4
        END IF

      END IF
```

```
        GOTO loop8
next8:
        EXIT SUB
'---------------------------------------------------------------------
         END SUB
```

```
'------------------------------------------------------------------------
'
      SUB MENU9 ( imenu%, jopt%(1), jtrans%(1), jinv%(1), _
                  jexp%(1), z.h$ ) STATIC
'
'     Menu 9 Setup and Control (External exposure and inhalation)
'
'     Subprogram for APPRENTICE of the GENII Software Package
'     Pacific Northwest Laboratory Environmental Dosimetry System
'
'     Last Modification: 11-Jul-88 RAP
'     Reviewed and Approved: 14-Sept-88  BA Napier
'
'------------------------------------------------------------------------

      DEFINT i-n

      ifirst = ifirst + 1
      IF ifirst = 1 THEN

        DIM iopd9%(5), iopt9%(5), cmd9$(4,4), jflag(20)

        iopd9%(1) = 4
        iopd9%(2) = 0 : cmd9$(1,1) = "Previous Menu "
                        cmd9$(1,2) = "External Exposure"
        iopd9%(3) = 2 : cmd9$(3,1) =    "Help..........F1"
                        cmd9$(3,2) =    "Input"
                   cmd9$(1,3) = "Inhalation"
        iopd9%(4) = 2 : cmd9$(4,1) =    "Help.....F1"
                   cmd9$(4,2) =    "Input"
        iopd9%(5) = 0 : cmd9$(1,4) = "Next"

        FOR i = 1 TO 5 : iopt9(i) = iopd9(i) : NEXT i

      END IF

'     Initialize Menu 9 --

      IF jexp(1)=0 AND jexp(2)=0 AND jexp(3)=0 AND jexp(4)=0 THEN
        iopt9(3) = 0
      ELSE
        iopt9(3) = iopd9(3)
      END IF
      IF jexp(5) = 0 THEN iopt9(4) = 0 ELSE iopt9(4) = iopd9(4)
      isub = 2 : iman = 2 : IF iopt9(3) = 0 THEN iman = 3

      CALL strip (cmd9$())
      z.i$ = "i"
      CALL msmenu.1 (z.i$, z.h$, iopt9(), cmd9$(), iman, isub)
      z.i$ = ""
```

9 1 0 4 8 0 8 6 4

```
'     Menu 9 Control Loop--

loop9:

      IF iopt9(iman+1)=0 AND iman < iopt9(1) THEN iman = iman+1 : GOTO loop9
      IF isub > 0 AND iopt9(iman+1) = 0 THEN isub = 0

      CALL msmenu.1 (z.i$, z.h$, iopt9(), cmd9$(), iman, isub)
      CALL strip (cmd9$())

      IF iman = iopt9(1) THEN
     imenu = imenu + 1
     GOTO next9

      ELSEIF iman = 1 THEN
        imenu = imenu - 1
        GOTO next9

      ELSEIF iman = 0 AND isub = 0 THEN
     imenu = 0
     GOTO next9

      ELSEIF iman = 2 THEN  'external

        IF iopt9(3) = 0 THEN
          iman = iman + 1 : isub = 0 : GOTO loop9

        ELSEIF isub = 1 THEN
          IF jopt(3)=2 THEN 'chronic
            CALL helpmenu.1 (-1, 21, ibuf, iur, iul, ilr, ilc, h$, iherr)
            CALL waita
         CALL helpmenu.1 (0, 21, ibuf, iur, iul, ilr, ilc, h$, iherr)
          ELSE 'acute
            CALL helpmenu.1 (-1, 22, ibuf, iur, iul, ilr, ilc, h$, iherr)
            CALL waita
         CALL helpmenu.1 (0, 22, ibuf, iur, iul, ilr, ilc, h$, iherr)
          END IF

        ELSEIF isub = 2 THEN

          IF jexp(1)=1 OR jexp(2)=1 THEN
            IF jopt(3) = 3 THEN
'             Acute release--
              CALL params (1, 54, 0, par$, jflag())
            ELSE
'             Chronic release--
              CALL params (1, 42, 0, par$, jflag())
            END IF
          END IF
```

```
' Ground exposure--
  IF jexp(3)=1 THEN

    CALL params (1, 44, 1, par$, jflag())

' Irrigation of ground--
    IF jinv(2)=1 OR jinv(7)=1 OR jinv(8)=1 THEN
      CALL params (1, 50, 0, par$, jflag())
      IF par$ = "T" THEN
        IF jinv(7)=1 THEN
          CALL params (1, 51, 8, "1", jflag())
        ELSEIF jinv(2)=1 OR jinv(8)=1 THEN
          CALL params (1, 51, 8, "2", jflag())
        ELSE
          CALL params (1, 51, 0, par$, jflag())
        END IF
        CALL params (2, 52, 0, par$, jflag())
      END IF
    END IF
  END IF

' Aquatic recreation

  IF jexp(4)=1 THEN
    IF jopt(3)=2 THEN CALL params (2, 45, 1, par$, jflag())
    CALL params (2, 47, 0, par$, jflag())
  END IF
  IF jexp(4)=1 AND jinv(2)=1 THEN
    CALL params (1, 49, 0, par$, jflag())
  END IF

  iman = iman + 1 : isub = 2

END IF

ELSEIF iman = 3 THEN 'inhalation

  IF iopt9(4) = 0 THEN
    iman = iman + 1 : isub = 0 : GOTO loop9

  ELSEIF isub = 1 THEN
    CALL helpmenu.1 (-1, 23, ibuf, iur, iul, ilr, ilc, h$, iherr)
    CALL waita
 CALL helpmenu.1 (0, 23, ibuf, iur, iul, ilr, ilc, h$, iherr)

  ELSEIF isub = 2 THEN

    CALL params (2, 55, 1, par$, jflag())
    iresp = VAL (par$)
```

```
            IF iresp=1 THEN CALL params (1, 57, 0, par$, jflag())
            IF iresp=2 THEN CALL params (1, 58, 0, par$, jflag())
            IF jopt(3)=3 AND jexp(2)=0 THEN  'acute, no external; get plume fr.
              CALL params (1, 54, 0, par$, jflag())
            END IF
            iman = 4 : isub = 0

          END IF

        END IF
        GOTO loop9

next9:

        EXIT SUB
'-----------------------------------------------------------------------
          END SUB
```

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```
'-----------------------------------------------------------------
'
      SUB MENU10 ( imenu%, jopt%(1), jtrans%(1), jinv%(1), _
                 jexp%(1), z.h$ ) STATIC
'
'     Menu 10 Setup and Control (Ingestion population and drinking
'     water)
'
'     Subprogram for APPRENTICE of the GENII Software Package
'     Pacific Northwest Laboratory Environmental Dosimetry System
'
'     Last Modification: 29-Aug-88 RAP
'     Reviewed and Approved: 14-Sept-88  BA Napier
'
'-----------------------------------------------------------------

      DEFINT i-n

      ifirst = ifirst + 1
      IF ifirst = 1 THEN

        DIM iopd10%(5), iopt10%(5), cmd10$(4,4), jflag(20)

        iopd10%(1) = 4
        iopd10%(2) = 0 : cmd10$(1,1) = "Previous Menu "
                         cmd10$(1,2) = "Ingestion Population"
        iopd10%(3) = 2 : cmd10$(3,1) =    "Help..........F1"
                         cmd10$(3,2) =    "Input            "
                         cmd10$(1,3) = "Drinking Water"
        iopd10%(4) = 2 : cmd10$(4,1) =    "Help.....F1"
                   cmd10$(4,2) =    "Input       "
        iopd10%(5) = 0 : cmd10$(1,4) = "Next"

        FOR i = 1 TO 5 : iopt10(i) = iopd10(i) : NEXT i

      END IF

'     Initialize Menu 10 --

'     Air ingestion population--
      IF jtrans(1)=0 THEN 'not air case
        iopt10(3) = 0
      ELSEIF jopt(3)=3 THEN 'acute
        iopt10(3) = 0
        CALL params (1, 176, 8, "1", jflag())
      ELSE
        iopt10(3) = iopd10(3)
      END IF

'     Drinking water--
```


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```
        IF jexp(6)=0 THEN iopt10(4) = 0 ELSE iopt10(4) = iopd10(4)

        isub = 2 : iman = 2

        CALL strip (cmd10$())
        z.i$ = "i"
        CALL msmenu.1 (z.i$, z.h$, iopt10(), cmd10$(), iman, isub)
        z.i$ = ""

'       Menu 10 Control Loop--

loop10:

        IF iopt10(iman+1)=0 AND iman < iopt10(1) THEN iman = iman+1 : GOTO loop10
        IF isub > 0 AND iopt10(iman+1) = 0 THEN isub = 0

        CALL msmenu.1 (z.i$, z.h$, iopt10(), cmd10$(), iman, isub)
        CALL strip (cmd10$())

        IF iman = iopt10(1) THEN
       imenu = imenu + 1
       GOTO next10

        ELSEIF iman = 1 THEN
          imenu = imenu - 1
          GOTO next10

        ELSEIF iman = 0 AND isub = 0 THEN
       imenu = 0
       GOTO next10

        ELSEIF iman = 2 THEN 'ingestion population

          IF isub = 1 THEN
            CALL helpmenu.1 (-1, 24, ibuf, iur, iul, ilr, ilc, h$, iherr)
            CALL waita
            CALL helpmenu.1 (-1, 25, ibuf, iur, iul, ilr, ilc, h$, iherr)
            CALL waita
            CALL helpmenu.1 (-1, 26, ibuf, iur, iul, ilr, ilc, h$, iherr)
            CALL waita
         CALL helpmenu.1 (0, 26, ibuf, iur, iul, ilr, ilc, h$, iherr)
         CALL helpmenu.1 (0, 25, ibuf, iur, iul, ilr, ilc, h$, iherr)
         CALL helpmenu.1 (0, 24, ibuf, iur, iul, ilr, ilc, h$, iherr)
            isub = isub + 1

          ELSEIF isub = 2 THEN

            IF jinv(1)=1 THEN GOSUB atmprd
            IF ifoq=0 THEN CALL params (1, 177, 1, par$, jflag())
            IF jexp(7)=1 THEN CALL params (1, 59, 1, par$, jflag())
```


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```
      IF jexp(6)=1 THEN CALL params (1, 60, 0, par$, jflag())
      IF jexp(7)=1 OR jexp(8)=1 OR jexp(9)=1 THEN
        CALL params (1, 61, 1, par$, jflag())
        IF par$ = "F" THEN
          CALL params (1, 67, 0, par$, jflag())
          IF par$ = "F" THEN
            j$ = "It is assumed that food production = food consumption."
            CALL messag2 (j$)
          END IF
        END IF
      END IF

    END IF
    iman = iman + 1 : isub = 2

  ELSEIF iman = 3 THEN                          'drinking water

    IF iopt10(4) = 0 THEN
      iman = iman + 1 : isub = 0 : GOTO loop10

    ELSEIF isub = 1 THEN
      CALL helpmenu.1 (-1, 27, ibuf, iur, iul, ilr, ilc, h$, iherr)
      CALL waita
   CALL helpmenu.1 (0, 27, ibuf, iur, iul, ilr, ilc, h$, iherr)
      isub = isub + 1

    ELSEIF isub = 2 THEN

      IF jinv(11) = 1 THEN                     'derived concentration
        CALL params (1, 62, 8, "3", jflag())
      ELSEIF jinv(7) AND (jinv(8) OR jinv(2)) THEN
        CALL params (1, 62, 1, par$, jflag())
      ELSEIF jinv(7) = 1 THEN                  'ground water
        CALL params (1, 62, 8, "1", jflag())
      ELSEIF jinv(8) = 1 OR jinv(2) = 1 THEN   'surface water
        CALL params (1, 62, 8, "2", jflag())
      END IF

      CALL params (3, 63, 1, par$, jflag())
      iman = 4 : isub = 0

    END IF

  END IF
  GOTO loop10

next10:

  EXIT SUB
```


9 1 0 4 8 0 8 7 0

```
'-----------------------------------------------------------------------

atmprd:

      CALL tblank (10,1,24,80)
      LOCATE 12, 3
      PRINT "Atmospheric production definition (select option):";
      LOCATE 14,3
      PRINT "  0 - Use food-weighted chi/Q value";
      LOCATE 15,3
      PRINT "  1 - Use chi/Q value entered under Air Transport";
      LOCATE 16,3
      PRINT "  2 - Use uniform production";
      LOCATE 17,3
      PRINT "  3 - Use chi/Q grid and food production grid";
      LOCATE 19,3
      PRINT "Enter selected option:";

      isetfq = isetfq + 1
      IF isetfq = 1 THEN
        CALL params (1, 176, 6, par$, jflag())
        ifoq = VAL(par$)
      END IF

      inopt=1
      WHILE inopt=1

        in$ = STR$ (ifoq)
        CALL stripper.1 (in$, in$)
        CALL innum (in$,1,rnum,19,27,iarrow)
        IF rnum < 4 THEN inopt = 0 ELSE CALL music

      WEND
      CALL tblank (10,1,25,80)

      ifoq = INT (rnum)
      par$ = STR$(ifoq)
      CALL params (1, 176, 8, par$, jflag())

      RETURN

'-----------------------------------------------------------------------
       END SUB
```

```
'----------------------------------------------------------------
'
     SUB MENU11 ( imenu%, jopt%(1), jtrans%(1), jinv%(1), _
                  jexp%(1), jaq%(1), jtf%(1), jan%(1), z.h$ ) STATIC
'
'    Menu 11 Setup and Control (aquatic foods, terrestrial foods, and
'    animal product input control)
'
'    Subprogram for APPRENTICE of the GENII Software Package
'    Pacific Northwest Laboratory Environmental Dosimetry System
'
'    Last Modification: 30-Aug-88 RAP
'    Reviewed and Approved: 14-Sept-88  BA Napier
'
'----------------------------------------------------------------

     DEFINT i-n

     ifirst = ifirst + 1
     IF ifirst = 1 THEN

       DIM iopd11%(6), iopt11%(6), cmd11$(5,5), jflag(20)

       iopd11%(1) = 5
       iopd11%(2) = 0 : cmd11$(1,1) = "Previous Menu "
                        cmd11$(1,2) = "Aquatic Foods"
       iopd11%(3) = 2 : cmd11$(3,1) =    "Help......F1"
                        cmd11$(3,2) =    "Input        "
                        cmd11$(1,3) = "Terrestrial Foods"
       iopd11%(4) = 2 : cmd11$(4,1) =    "Help........F1"
                 cmd11$(4,2) =    "Input       "
                        cmd11$(1,4) = "Animal Products"
       iopd11%(5) = 2 : cmd11$(5,1) =    "Help........F1"
                 cmd11$(5,2) =    "Input       "
       iopd11%(6) = 0 : cmd11$(1,5) = "Next"

       FOR i = 1 TO 6 : iopt11(i) = iopd11(i) : NEXT i

     END IF

'    Initialize Menu 11 --

     IF jexp(7)=0 THEN iopt11(3) = 0 ELSE iopt11(3) = iopd11(3)
     IF jexp(8)=0 THEN iopt11(4) = 0 ELSE iopt11(4) = iopd11(4)
     IF jexp(9)=0 THEN iopt11(5) = 0 ELSE iopt11(5) = iopd11(5)

'    Get export and import flags--
     iport = 0
     CALL params (1, 61, 6, par$, jflag())
     IF par$="T" THEN
```

```
  iport = 1
ELSE
  CALL params (1, 67, 6, par$, jflag())
  IF par$ = "T" THEN
    iport = 1
  END IF
END IF

'     Get number of years of intake--
      CALL params (1, 1, 6, par$, jflag())
      ntkend = VAL(par$)

      isub = 2 : iman = 2

      CALL strip (cmd11$())
      z.i$ = "i"
      CALL msmenu.1 (z.i$, z.h$, iopt11(), cmd11$(), iman, isub)
      z.i$ = ""

'     Menu 11 Control Loop--

loop11:

      IF iopt11(iman+1)=0 AND iman < iopt11(1) THEN iman = iman+1 : GOTO loop11
      IF isub > 0 AND iopt11(iman+1) = 0 THEN isub = 0

      CALL msmenu.1 (z.i$, z.h$, iopt11(), cmd11$(), iman, isub)
      CALL strip (cmd11$())

      IF iman = iopt11(1) THEN
     imenu = imenu + 1
     GOTO next11

      ELSEIF iman = 1 THEN
        imenu = imenu - 1
        GOTO next11

      ELSEIF iman = 0 AND isub = 0 THEN
     imenu = 0
     GOTO next11

      ELSEIF iman = 2 THEN                                      'aquatic foods

        IF isub = 1 THEN
          CALL helpmenu.1 (-1, 28, ibuf, iur, iul, ilr, ilc, h$, iherr)
          CALL waita
       CALL helpmenu.1 (0, 28, ibuf, iur, iul, ilr, ilc, h$, iherr)

        ELSEIF isub = 2 THEN
          CALL params (1, 66, 1, par$, jflag())
```

```
'       save isalt for output
        FOR i = 1 TO 4
          IF jaq(i) > 0 THEN
            ip = 68 + (i-1) * 4
'           Transit time--
            CALL params (1, ip, 1, par$, jflag())
            IF iport=1 THEN CALL params (1, ip+1, 0, par$, jflag())
'           Holdup and consumption--
            CALL params (2, ip+2, 0, par$, jflag())
          END IF
        NEXT i

      END IF
      iman = iman + 1 : isub = 2

    ELSEIF iman = 3 THEN                                  'terrestrial foods

      IF ioptl1(4) = 0 THEN
        iman = iman + 1 : isub = 2 : GOTO loop11

      ELSEIF isub = 1 THEN
        CALL helpmenu.1 (-1, 29, ibuf, iur, iul, ilr, ilc, h$, iherr)
        CALL waita
     CALL helpmenu.1 (0, 29, ibuf, iur, iul, ilr, ilc, h$, iherr)

      ELSEIF isub = 2 THEN

        FOR i = 1 TO 4
          IF jtf(i) > 0 THEN
            ip = 84  + (i-1) * 8
            CALL params (1, ip, 1, par$, jflag())
            ip = ip + 1
            GOSUB irrig
            CALL params (1, ip, 0, par$, jflag()) : ip = ip + 1
            IF iport=1 THEN CALL params (1, ip, 0, par$, jflag())
            ip = ip + 1
            CALL params (2, ip, 0, par$, jflag())
          END IF
        NEXT i
      END IF

      iman = iman + 1 : isub = 2

    ELSEIF iman = 4 THEN                                  'animal products

      IF ioptl1(5) = 0 THEN
        iman = iman + 1 : isub = 2 : GOTO loop11

      ELSEIF isub = 1 THEN
        CALL helpmenu.1 (-1, 30, ibuf, iur, iul, ilr, ilc, h$, iherr)
```

```
    CALL waita
  CALL helpmenu.1 (0, 30, ibuf, iur, iul, ilr, ilc, h$, iherr)

   ELSEIF isub = 2 THEN

    FOR i = 1 TO 4
      IF jan(i) > 0 THEN

        IF i = 1 THEN
          ip = 116
        ELSEIF i = 2 THEN
          ip = 134
        ELSEIF i = 3 THEN
          ip = 145
        ELSEIF i = 4 THEN
          ip = 163
        END IF

'       Holdup, consumption, and total production--
        CALL params (2, ip, 1, par$, jflag()) : ip = ip + 2
        IF iport=1 THEN CALL params (1, ip, 0, par$, jflag())
        ip = ip + 1

'       Contaminated drinking water--
        IF jinv(2) OR jinv(7) OR jinv(8) THEN
          CALL params (1, ip, 0, par$, jflag())
        END IF
        ip = ip + 1

'       Fraction of animal diet consisting of contaminated stored feed--

        IF jopt(3)=3 AND ntkend > 1 THEN
          CALL messag ("Diet fraction is for years 2 to "+STR$(ntkend))
        END IF

        IF jopt(3)=2 OR (jopt(3)=3 AND ntkend > 1) THEN
          CALL params (1, ip, 0, par$, jflag())
        END IF
        ip = ip + 1

'       Stored feed: growing time, irrigation, yield, and storage--
        IF VAL(par$) > 0.0  OR jopt(3)=3 THEN
          CALL params (1, ip, 0, par$, jflag()) : ip = ip + 1
          GOSUB irrig
          CALL params (1, ip, 0, par$, jflag()) : ip = ip + 1
          IF jopt(3)=2 THEN CALL params (1, ip, 0, par$, jflag())
          ip = ip + 1
        ELSE
          ip = ip + 6
        END IF
```

```
                IF i=1 OR i=3 THEN

'                 Fraction of animal diet consisting of contaminated fresh feed--

                  IF jopt(3)=3 AND ntkend > 1 THEN
                    CALL messag ("Diet fraction is for years 2 to "+STR$(ntkend))
                  END IF

                  par$ = ""
                  IF jopt(3)=2 OR (jopt(3)=3 AND ntkend > 1) THEN
                    CALL params (1, ip, 0, par$, jflag())
                  END IF
                  ip = ip + 1

'                 Fresh forage: growing time, irrigation, yield, and storage--
                  IF VAL(par$) > 0.0 OR jopt(3)=3 THEN
                    CALL params (1, ip, 0, par$, jflag()) : ip = ip + 1
                    GOSUB irrig
                    CALL params (2, ip, 0, par$, jflag()) : ip = ip + 2
                  END IF
                END IF

              END IF
            NEXT i
            iman = iman + 1 : isub = 2

          END IF
        END IF
        GOTO loop11

next11:
        EXIT SUB

'---- Irrigation input ---------------------------------------------------

irrig:
        irr = 0
        IF (jinv(2)=1 OR jinv(8)=1) AND jinv(7)=1 THEN

'         Both surface and ground water--
          CALL params (1, ip, 0, par$, jflag()) : irr = 1

        ELSEIF jinv(7)=1 THEN                                 'ground water
          CALL params (1, ip, 8, "1", jflag()) : irr = 1

        ELSEIF jinv(2)=1 OR jinv(8)=1 THEN                    'surface water
          CALL params (1, ip, 8, "2", jflag()) : irr = 1

        ELSE
```


9 1 0 4 8 0 8 7 6

```
  CALL params (1, ip, 8, "0", jflag())

END IF

ip = ip + 1
IF irr=1 THEN CALL params (2, ip, 0, par$, jflag())
ip = ip + 2
RETURN

'-----------------------------------------------------------------------
END SUB
```


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```
      COMMON SHARED /errors/ nerr%
'-----------------------------------------------------------------------
'
      SUB MENU12 ( imenu%, jopt%(1), jtrans%(1), jinv%(1), _
                   jexp%(1), jaq%(1), jtf%(1), jan%(1), jrpt%(1), _
                   jrad%(1), rmd$(1), nirmd%, _
                   cmd$(2), cmd2$(2), cmd3$(2), z.h$ ) STATIC
'
'     Menu 12 Setup and Control (File management)
'
'     Subprogram for APPRENTICE of the GENII Software Package
'     Pacific Northwest Laboratory Environmental Dosimetry System
'
'     Last Modification: 30-Aug-88 RAP
'     Reviewed and Approved: 14-Sept-88  BA Napier
'
'-----------------------------------------------------------------------

      DEFINT i-n

      ifirst = ifirst + 1
      IF ifirst = 1 THEN

        x = FRE("")
        DIM dir$(34), idum2(1), tab$(2)

        DIM iopd12%(5), iopt12%(5), cmd12$(3,5), jflag(20)

        iopd12%(1) = 4
        iopd12%(2) = 0 : cmd12$(1,1) = "Previous Menu "
                         cmd12$(1,2) = "Files  "
        iopd12%(3) = 5 : cmd12$(3,1) =    "Help.........F1"
                         cmd12$(3,2) =    "Filenames"
                         cmd12$(3,3) =    "Title"
                         cmd12$(3,4) =    "Write File"
                         cmd12$(3,5) =    "File Management"

        iopd12%(4) = 0 : cmd12$(1,3) = "Next Scenario"
        iopd12%(5) = 0 : cmd12$(1,4) = "Quit"

        FOR i = 1 TO 5 : iopt12(i) = iopd12(i) : NEXT i

      END IF

'     Initialize Menu 12 --

'     Free up string space--
      x = FRE (" ")
'     j$ = "Free string space: "+STR$(x) : CALL messag(j$)
```

```
        iman = 2 : isub = 2

        CALL strip (cmd12$())
        z.i$ = "i"
        CALL msmenu.1 (z.i$, z.h$, iopt12(), cmd12$(), iman, isub)
        z.i$ = ""

   '    Menu 12 Control Loop--

loop12:

   '     IF isub > 0 AND iopt12(iman) = 0 THEN isub = 0

        CALL msmenu.1 (z.i$, z.h$, iopt12(), cmd12$(), iman, isub)
        CALL strip (cmd12$())

        IF iman = iopt12(1) THEN

          IF irit = 0 THEN
            CALL messag ("You have not saved this scenario.")
          ELSE
            LOCATE 10,10 : PRINT "You have created ";iscen;" input files.";
            LOCATE 12,10
            PRINT "To execute, after quitting, type:";
            i = INSTR (bat$,".")
            LOCATE 14,20 : CALL intense (1) : PRINT MID$(bat$,1,i-1);
            CALL intense (0)
            CALL waita
          END IF

          LOCATE 24,22 : PRINT "Are you sure you wish to quit (N/Y)?  ";
          valu$ = "N" : CALL inlog (valu$, 24,70)
          CALL tblank (24,1,24,80)

          IF valu$ = "T" THEN
         imenu = imenu + 1
            GOTO next12
          END IF

         ELSEIF iman = 1 THEN
          imenu = imenu - 1
          GOTO next12

         ELSEIF iman = 0 AND isub = 0 THEN
        imenu = 0
        GOTO next12

         ELSEIF iman = 2 THEN

           IF isub = 1 THEN
```

```
      CALL helpmenu.1 (-1, 31, ibuf, iur, iul, ilr, ilc, h$, iherr)
      CALL waita
   CALL helpmenu.1 (0, 31, ibuf, iur, iul, ilr, ilc, h$, iherr)
      isub = isub + 1

    ELSEIF isub = 2 THEN   'input filenames

      CALL getdir.2 ("*.in", dir$(), idir)
      IF idir < 0 THEN
        CALL messag ("Too many files to display. Use File Management.")

      ELSEIF idir > 0 THEN                          'display directory
        GOSUB disdir

      END IF

'     CALL driveget.1 (dr$, idr)
      CALL getsub (0, sub$)

getfil:
      ir = 24 : LOCATE ir,10
      PRINT "Enter filename prefix for this scenario:  ";
      CALL inchar (prefix$, 2, 8, ir, 60)

'     Construct complete filename--

      CALL stripper.1 (prefix$, prefix$)
      pre$ = sub$+"\"+prefix$
      filn$ = pre$ + ".in"
      chk$ = prefix$+".BAT"

      CALL getdir.2 (filn$, dir$(), idir)
      IF idir = 0 THEN
        CALL getdir.2 (chk$, dir$(), idir)
      END IF

      IF idir > 0 THEN
        CALL tblank (ir,1,ir,59)
        CALL messag ("File already exists.")
        GOTO getfil
      ELSE
        IF LEN(prefix$) > 0 THEN inam = 1
      END IF

      CALL tblank (2,1,24,79) : CALL genbox
      GOSUB extfil 'see if additional filenames needed

      LOCATE 24,10 : PRINT "Do you wish to print output file (N/Y)?";
      IF iprnt = 1 THEN valu$ = "Y" ELSE valu$ = "N"
      CALL inlog (valu$, 24, 60)
```

```
          IF valu$ = "F" THEN iprnt = 0 ELSE iprnt = 1
          CALL tblank (24,1,24,79)
          isub = isub + 1

        ELSEIF isub = 3 THEN   'input title

          LOCATE 10,10,1 : PRINT "Enter a title to identify this scenario ";
          CALL inchar (titl$, 0, 70, 12, 10 )
          CALL tblank (10,1,12,79)
          isub = isub + 1

        ELSEIF isub = 4 THEN   'write input files

'         Check for option incompatibilities--
          GOSUB chk

          iscen = iscen + 1

'         Write batch commands--

          IF iscen = 1 THEN

            IF inam = 0 THEN
              CALL messag ("Enter filename first.")
              iman = 2 : isub = 2 : iscen = 0 : GOTO loop12
            END IF

            bat$ = prefix$+".BAT"
            nerr = 0 : OPEN "O", #3, bat$
            IF nerr > 0 THEN GOTO getfil
            GOSUB intro
            GOSUB ritbat
            CLOSE (3)

          ELSEIF iscen = 2 THEN

getbat:
            ir = 24 : LOCATE ir,10
            PRINT "Enter filename prefix for this batch file:  ";
            CALL inchar (in$, 2, 8, ir, 60)
            CALL tblank (24,1,24,79)

'           Construct complete batch file name--

            CALL stripper.1 (in$, in$)
            lin = LEN(in$) : IF lin=0 GOTO getbat
            in$ = in$+".BAT"
            CALL getdir.2 (in$, dir$(), idir)

            IF idir > 0 AND in$ <> bat$ THEN
```

```
      CALL messag ("File already exists.")
      i = INSTR (in$,".") : IF i > 0 THEN in$ = MID$(IN$,1,i-1)
      GOTO getbat

    ELSEIF idir=0 AND in$ <> bat$ THEN

      nerr = 0: NAME bat$ AS in$
      IF nerr > 0 THEN
        CALL messag ("File not found.")
        GOTO getbat
      END IF

    END IF

    bat$ = sub$+"\"+in$
    nerr = 0 : OPEN "A", #3, bat$
    IF nerr > 0 THEN
      CALL messag ("Error with file.")
      GOTO getbat
    END IF
    GOSUB ritbat
    CLOSE (3)

  ELSE

    nerr = 0 : OPEN "A", #3, bat$
    IF nerr > 0 THEN
      CALL messag ("Error with file.")
      GOTO getbat
    END IF

    GOSUB ritbat
    CLOSE (3)

  END IF

  GOSUB ritfil
  CALL tblank (24,1,24,80)

  iman = 4 : isub = 0

ELSEIF isub = 5 THEN   'directory management

  search$ = sub$+"\*.in"
  LOCATE 12,10 : PRINT "Please wait..."
  CALL dirmngr (search$, ier)
  CALL tblank (2,1,25,79) : CALL genbox
  IF ier > 0 THEN j$=STR$(ier) : CALL messag (j$)

END IF
```

```
      ELSEIF iman = 3  THEN 'create another scenario

        imenu = 1
        CALL tblank (10,1,24,79)
        GOTO next12

      END IF
      GOTO loop12

next12:

      EXIT SUB

'---------------------------------------------------------------------
extfil:

'     Get XOQOPT value from file--
      CALL params (1, 175, 6, par$, jflag())
      jair = VAL (par$)

'     Check population file--
      icheck = 0

      IF jopt(2)=2 THEN  'population case

        IF jtrans(1)=1 THEN
          IF jair<>1 THEN icheck = 1
        ELSE
          CALL params (1, 174, 6, par$, jflag())
          jpop = VAL (par$)
          IF jpop =1 THEN icheck = 1
        END IF

      ELSE  'individual select location
        IF jtrans(1)=1 AND jair=2 THEN icheck = 1
      END IF

      IF icheck=1 THEN
        x$ = "population" : exfil$ = popfil$ : exnam$ = popnam$
        GOSUB exfil : popfil$ = exfil$ : popnam$ = exnam$
      END IF

'     Check chi/q and joint frequency files--
      IF jtrans(1) = 1 THEN

        IF jair <> 1  THEN
          CALL params (1, 16, 6, par$, jflag())
          IF par$="F" THEN
            x$ = "chi/Q" : exfil$ = chifil$ :exnam$ = chinam$
```

```
          GOSUB exfil : chifil$ = exfil$ : chinam$ = exnam$
          jfreq = 0
        ELSE
          x$ = "joint frequency" : exfil$ = jffil$ : exnam$ = jfnam$
          GOSUB exfil : jffil$ = exfil$ : jfnam$ = exnam$
          jfreq = 1
        END IF
      END IF

    END IF
    RETURN

'--------------------------------------------------------------------------
chk:

'   Make sure that inventory has been entered
    IF nirmd=0 THEN
      j$ = "Inventory must be specified." : CALL messag (j$)
      imenu = 5 : GOTO next12
    END IF

'   Check that exposure has been specified--
    ifound = 0
    FOR i = 1 TO 10
      IF jexp(i) = 1 THEN ifound = 1
    NEXT i
    IF ifound = 0 THEN
      j$ = "Exposure must be specified" : CALL messag (j$)
      imenu = 3 : GOTO next12
    END IF

'   Load flag array--
    jflag(1)=jaq(1)
    jflag(2)=jaq(2)
    jflag(3)=jaq(3)
    jflag(4)=jaq(4)

    jflag(5)=jtf(1)
    jflag(6)=jtf(2)
    jflag(7)=jtf(3)
    jflag(8)=jtf(4)

    jflag(9)=jan(1)
    jflag(10)=jan(2)
    jflag(11)=jan(3)
    jflag(12)=jan(4)

    jflag(13) = jopt(3)
    jflag(14) = jopt(2)
    jflag(15) = jopt(1)
```

```
        RETURN

'---- Write batch file introduction ------------------------------------

intro:
        r$ = "rem " : p$ = STRING$(14,32)
        PRINT #3, "CLS"
        PRINT #3, r$
        PRINT #3, r$
        PRINT #3, r$
        PRINT #3, r$
        PRINT #3, r$; p$; "GENII"
        PRINT #3, r$; p$; "Hanford Environmental Dosimetry Software System"
        PRINT #3, r$
        PRINT #3, r$; p$; "Pacific Northwest Laboratory"
        PRINT #3, r$; p$; "Richland WA"
        PRINT #3, r$
        PRINT #3, r$; p$; "Contact:  Bruce Napier (509) 375-3896"
        PRINT #3, r$

        RETURN

'---- Write batch file for this scenario ------------------------------

ritbat:
        i$ = STR$(iscen) : CALL stripper.1 (i$, i$)
        e$ = " if errorlevel 1 goto stop"+i$
        s$ = ":stop"+i$
        d$ = " \genii\"

        CALL stripper.1 (jffil$, jffil$)
        CALL stripper.1 (chifil$, chifil$)
        CALL stripper.1 (popfil$, popfil$)
        CALL stripper.1 (foodprod$,foodprod$)

        PRINT #3, " echo off"
        PRINT #3, " erase ";d$;"genii.in"
        PRINT #3, " erase ";d$;"pop.in"
        PRINT #3, " erase ";d$;"jointfre.in"
        PRINT #3, " erase ";d$;"chiq.in"
        PRINT #3, " erase ";d$;"foodprod.in"
        PRINT #3, " erase ";d$;"env.in"
        PRINT #3, " erase ";d$;"genii.out"
        PRINT #3, " erase ";d$;"env.out"
        PRINT #3, " erase ";d$;"genii2.out"
        PRINT #3, " erase ";d$;"dose.out"

        IF jair <> 1  THEN
          IF jfreq=1 THEN
```

```
      PRINT #3, " copy ";jffil$;  d$; "jointfre.in"
    ELSE
      PRINT #3, " copy ";chifil$; d$; "chiq.in"
    END IF
  END IF

  IF icheck = 1 THEN PRINT #3, " copy ";popfil$; d$; "pop.in"
  IF jfoq=3  THEN PRINT #3, " copy ";foqfil$; d$; "foodprod.in"

  PRINT #3, "echo on"
  PRINT #3, " copy ";filn$;d$;"genii.in"
  PRINT #3, d$;"envin"
  PRINT #3, e$
  PRINT #3, d$;"env"
  PRINT #3, e$
  PRINT #3, d$;"dose"
  PRINT #3, e$
  PRINT #3, r$
  PRINT #3, " copy";d$;"genii.out+";d$;"genii2.out+";_
            d$;"dose.out ";pre$;".out"
  IF iprnt=1 THEN PRINT #3, " copy ";pre$;".out prn"
  PRINT #3, r$
  PRINT #3, s$
  RETURN

'---- Open and write input file ----------------------------------------

ritfil:
  LOCATE 24,10 : PRINT "Please wait, writing file...";

  OPEN "I", #1, "\genii\apprenti.dat"
  nerr = 0 : OPEN "O", #2, filn$
  IF nerr > 0 THEN
    CALL messag ("Error with .dat file")
    GOTO getfil
  END IF
  irit = irit + 1 : inam = 0

  LINE INPUT #1, l$ : PRINT #2, l$
  LINE INPUT #1, l$

  PRINT #2, "Title: "; titl$

  LINE INPUT #1, l$ : PRINT #2, SPACE$(7); filn$; TAB(49);
  PRINT #2, "Created on "; DATE$; " at ";MID$(TIME$,1,5)

  LINE INPUT #1, l$ : PRINT #2, l$

'     Write options--
  CALL ritin (jopt(), jtrans(), jinv(), jexp(), _
```


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```
                  jaq(), jtf(), jan(), jrpt(), cmd$())

'     Write inventory--
      CALL menu5 (8, imenu, jopt(), jinv(), jexp(),_
                  nirmd, jrad(), rmd$(), cmd2$(),_
                  ir, ic, icur, ib1, ib2, ib3, ib4,
                  idum, idum, idum2(), idum2(), z.h$)

'     Write parameters--
      CALL params (0, 0, 9, par$, jflag())
      CLOSE (2)
      CLOSE (1)

      RETURN

'---- Get extra input file name, check title -------------------------

 exfil:
      CALL tblank (10,1,24,79)
      LOCATE 10,10
      PRINT "Have you prepared ";x$;" input file (Y/N)?";
      valu$ = "Y" : CALL inlog (valu$, 10, 60)

      IF valu$ = "F" THEN

        LOCATE 12,10
        PRINT "Be sure to create file and add file name to batch file.";
        CALL waita

      ELSE

        CALL driveget.1 (dr$, idum)
        CALL getsub (0, sub$)
        LOCATE 12,10
        PRINT "Is file located in ";dr$;":";sub$;" (Y/N)";
        valu$ = "Y" : CALL inlog (valu$, 12, 60)

        IF valu$ = "F" THEN
          LOCATE 14,10
          PRINT "Enter complete file name including drive and path:";
          CALL inchar (exfil$, 1, 60, 15, 10)
        ELSE
          LOCATE 14,10
          PRINT "Enter ";x$;" file name (e.g., myfile.in):";
          CALL inchar (exnam$, 1, 12, 14, 60)
          CALL stripper.1 (exnam$, exnam$)
          exfil$ = dr$+":"+sub$+"\"+exnam$
        END IF

        CALL getdir.2 (exfil$, tab$(), idir)
```


9 1 0 4 8 0 8 8 7

```
      IF idir > 0 THEN

        OPEN "I", #1, exfil$ : LINE INPUT #1, extl$ : CLOSE (1)
        LOCATE 16, 10 : CALL reverse (1)
        PRINT MID$(extl$,1,60); : CALL reverse (0)
        LOCATE 17,10 : PRINT "Is this the correct file (Y/N)?";
        valu$ = "Y" : CALL inlog (valu$, 17, 60)
        IF valu$ = "F" THEN GOTO exfil

      ELSEIF idir = 0 THEN
        CALL messag ("File not found.")
        GOTO exfil

      ELSE
        CALL messag ("Please reenter.")

      END IF

    END IF
    CALL tblank (10,1,24,80)

    RETURN

'---- Display list of input files in this subdirectory ----------------

disdir:

    LOCATE 3,10 : PRINT "Input files in current directory:"
    nmax = 17
    IF idir > nmax THEN nloop = 2 ELSE nloop = 1

    FOR iloop = 1 TO nloop

      IF iloop = 1 THEN
        IF idir > nmax THEN imax = nmax ELSE imax = idir
        istart = 1
      ELSE
        istart = nmax + 1
        imax = idir
      END IF

      CALL tblank (5,1,23,60) : ir = 5
      FOR i = istart TO imax
        ipnt = INSTR (dir$(i)," ")
        LOCATE ir, 10 : PRINT MID$(dir$(i),1,ipnt);
        LOCATE ir, 40 : PRINT MID$(dir$(i),ipnt+2);
        ir = ir + 1
      NEXT i
      CALL waita
```

```
    NEXT iloop
    RETURN
'-----------------------------------------------------------------------
    END SUB
```

9 1 0 4 8 0 8 8 9

```
'-----------------------------------------------------------------------
'
    SUB RITIN ( jopt%(1), jtrans%(1), jinv%(1),
                jexp%(1), jaq%(1), jtf%(1), jan%(1), jrpt%(1),_
                cmd$(2)) STATIC
'
'   Write option portion of output file
'
'   Subprogram for APPRENTICE of the GENII Software Package
'   Pacific Northwest Laboratory Environmental Dosimetry System
'
'   Last Modification: 28-Jan-88 RAP
'   Reviewed and Approved: 14-Sept-88  BA Napier
'
'-----------------------------------------------------------------------

    DEFINT i-n

    LINE INPUT #1, l$
    IF jopt(1) = 3 THEN MID$(l$,1,1) = "T" ELSE MID$(l$,1,1) = "F"
    PRINT #2, l$

    LINE INPUT #1, l$
    IF jopt(2) = 2 THEN MID$(l$,1,1) = "T" ELSE MID$(l$,1,1) = "F"
    PRINT #2, l$

    LINE INPUT #1, l$
    IF jopt(3) = 3 THEN MID$(l$,1,1) = "T" ELSE MID$(l$,1,1) = "F"
    PRINT #2, l$

    LINE INPUT #1, l$ : MID$(l$,6,18) = cmd$(5,jopt(4)) : PRINT #2, l$
    LINE INPUT #1, l$ : PRINT #2, l$
    LINE INPUT #1, l$ : PRINT #2, l$

    LINE INPUT #1, l$
    IF jtrans(1) = 1 THEN MID$(l$,1,1) = "T" ELSE MID$(l$,1,1) = "F"
    IF jexp(1) = 1 THEN MID$(l$,41,1) = "T" ELSE MID$(l$,41,1) = "F"
    PRINT #2, l$

    LINE INPUT #1, l$
    IF jtrans(2) = 1 THEN MID$(l$,1,1) = "T" ELSE MID$(l$,1,1) = "F"
    IF jexp(2) = 1 THEN MID$(l$,41,1) = "T" ELSE MID$(l$,41,1) = "F"
    PRINT #2, l$

    LINE INPUT #1, l$
    IF jtrans(3) = 1 THEN MID$(l$,1,1) = "T" ELSE MID$(l$,1,1) = "F"
    IF jexp(3) = 1 THEN MID$(l$,41,1) = "T" ELSE MID$(l$,41,1) = "F"
    PRINT #2, l$

    LINE INPUT #1, l$
```

```
IF jtrans(4) = 1 THEN MID$(1$,1,1) = "T" ELSE MID$(1$,1,1) = "F"
IF jexp(4) = 1 THEN MID$(1$,41,1) = "T" ELSE MID$(1$,41,1) = "F"
PRINT #2, 1$

LINE INPUT #1, 1$
IF jexp(5) = 1 THEN MID$(1$,41,1) = "T" ELSE MID$(1$,41,1) = "F"
PRINT #2, 1$

LINE INPUT #1, 1$
IF jexp(6) = 1 THEN MID$(1$,41,1) = "T" ELSE MID$(1$,41,1) = "F"
PRINT #2, 1$

LINE INPUT #1, 1$
IF jrpt(1) = 1 THEN MID$(1$,1,1) = "T" ELSE MID$(1$,1,1) = "F"
IF jexp(7) = 1 THEN MID$(1$,41,1) = "T" ELSE MID$(1$,41,1) = "F"
PRINT #2, 1$

LINE INPUT #1, 1$
IF jrpt(2) = 1 THEN MID$(1$,1,1) = "T" ELSE MID$(1$,1,1) = "F"
IF jexp(8) = 1 THEN MID$(1$,41,1) = "T" ELSE MID$(1$,41,1) = "F"
PRINT #2, 1$

LINE INPUT #1, 1$
IF jrpt(3) = 1 THEN MID$(1$,1,1) = "T" ELSE MID$(1$,1,1) = "F"
IF jexp(9) = 1 THEN MID$(1$,41,1) = "T" ELSE MID$(1$,41,1) = "F"
PRINT #2, 1$

LINE INPUT #1, 1$
IF jrpt(4) = 1 THEN MID$(1$,1,1) = "T" ELSE MID$(1$,1,1) = "F"
IF jexp(10) = 1 THEN MID$(1$,41,1) = "T" ELSE MID$(1$,41,1) = "F"
PRINT #2, 1$

LINE INPUT #1, 1$ : PRINT #2, 1$
LINE INPUT #1, 1$ : PRINT #2, 1$
LINE INPUT #1, 1$ : PRINT #2, 1$

EXIT SUB

'-------------------------------------------------------------------
END SUB
```

```
'-------------------------------------------------------------------
'
'     SUB ritpar (new$(1), rval(1), jflag%(1)) STATIC
'
'     Write parameters to GENII input file.
'
'     Module of Program APPRENTICE of the GENII Software Package
'     Pacific Northwest Laboratory Environmental Dosimetry System
'
'     Last Modification: 1-Sep-88  RAP
'     Reviewed and Approved: 14-Sept-88  BA Napier
'
'-------------------------------------------------------------------
'
      DEFINT i-n

'     Time--
      LINE INPUT #1, l$ : PRINT #2, l$
      FOR i = 1 TO 5
        LINE INPUT #1, l$ : MID$(l$,1,5) = new$(i) : PRINT #2, l$
      NEXT i
      FOR i = 1 TO 3 : LINE INPUT #1, l$ : PRINT #2, l$ : NEXT i

'     Far field--
      LINE INPUT #1, l$ : MID$(l$,1,10) = new$(174) : PRINT #2, l$
      LINE INPUT #1, l$ : MID$(l$,1,10) = new$(39) : PRINT #2, l$

      FOR i = 1 TO 4 : LINE INPUT #1, l$ : PRINT #2, l$ : NEXT i

'     Near field--
      FOR i = 1 TO 5
        LINE INPUT #1, l$ : MID$(l$,1,10) = new$(5+i) : PRINT #2, l$
      NEXT i
      LINE INPUT #1, l$ : MID$(l$,1,10) = new$(180) : PRINT #2, l$
      FOR i = 1 TO 2 : LINE INPUT #1, l$ : PRINT #2, l$ : NEXT i

'     Air transport--
      LINE INPUT #1, l$ : MID$(l$,47,10) = new$(181) : PRINT #2, l$
      LINE INPUT #1, l$ : MID$(l$,1,10) = new$(175)
      MID$(l$,47,10) = new$(17) :  PRINT #2, l$

      LINE INPUT #1, l$ : MID$(l$,47,10) = new$(19) : PRINT #2, l$
      LINE INPUT #1, l$ : MID$(l$,47,10) = new$(20) : PRINT #2, l$

'     Chi/Q, PM, E/Q--
      LINE INPUT #1, l$
      IF jflag(13)=2 THEN          'chronic
        IF jflag(14)=3 THEN
          MID$(l$,1,10) = new$(11)   'individual
        ELSE
```


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```
    MID$(1$,1,10) = new$(12)    'population
  END IF
ELSE                            'acute
  IF jflag(14)=3 THEN
    MID$(1$,1,10) = new$(12)     'individual
  ELSE
    MID$(1$,1,10) = new$(40)    'population
  END IF
END IF

MID$(1$,47,10) = new$(21) :  PRINT #2, 1$

LINE INPUT #1, 1$ : MID$(1$,1,10) = new$(14)
MID$(1$,47,10) = new$(22) : PRINT #2, 1$

LINE INPUT #1, 1$ : MID$(1$,1,10) = new$(15)
  MID$(1$,47,10) = new$(182) : PRINT #2, 1$
LINE INPUT #1, 1$ : MID$(1$,1,10) = new$(16)
  MID$(1$,47,10) = new$(183) : PRINT #2, 1$
FOR i = 1 TO 2 : LINE INPUT #1, 1$ : PRINT #2, 1$ : NEXT i

'       Surface water transport
LINE INPUT #1, 1$ : MID$(1$,1,10) = new$(178) : PRINT #2, 1$
LINE INPUT #1, 1$ : MID$(1$,1,10) = new$(23) : PRINT #2, 1$
jsw = VAL (new$(178))
IF jsw > 0 and jsw <3 THEN
  LINE INPUT #1, 1$ : MID$(1$,1,10) = new$(25) : PRINT #2, 1$
ELSE
  LINE INPUT #1, 1$ : MID$(1$,1,10) = new$(24) : PRINT #2, 1$
END IF
LINE INPUT #1, 1$ : MID$(1$,1,10) = new$(26) : PRINT #2, 1$

LINE INPUT #1, 1$ : PRINT #2, 1$
FOR i = 1 TO 6
  LINE INPUT #1, 1$ : MID$(1$,1,10) = new$(26+i) : PRINT #2, 1$
NEXT i
FOR i = 1 TO 2 : LINE INPUT #1, 1$ : PRINT #2, 1$ : NEXT i

'       Waste form availability and biotic transport--
FOR i = 1 TO 3
  LINE INPUT #1, 1$ : MID$(1$,1,10) = new$(32+i) : PRINT #2, 1$
NEXT i
FOR i = 1 TO 2 : LINE INPUT #1, 1$ : PRINT #2, 1$ : NEXT i
FOR i = 1 TO 3
  LINE INPUT #1, 1$ : MID$(1$,1,10) = new$(35+i) : PRINT #2, 1$
NEXT i
FOR i = 1 TO 6 : LINE INPUT #1, 1$ : PRINT #2, 1$ : NEXT i

'       External exposure--
```

```
LINE INPUT #1, l$ : MID$(l$,1,10) = new$(42)
MID$(l$,43,9) = new$(50) :  PRINT #2, l$

LINE INPUT #1, l$ : MID$(l$,1,10) = new$(44)
MID$(l$,43,9) = new$(51) :  PRINT #2, l$

LINE INPUT #1, l$ : MID$(l$,1,10) = new$(45) :  PRINT #2, l$

LINE INPUT #1, l$ : MID$(l$,1,10) = new$(46)
MID$(l$,43,9) = new$(52) :  PRINT #2, l$

LINE INPUT #1, l$ : MID$(l$,1,10) = new$(47)
MID$(l$,43,9) = new$(53) :  PRINT #2, l$

LINE INPUT #1, l$ : MID$(l$,1,10) = new$(48) : PRINT #2, l$
LINE INPUT #1, l$ : MID$(l$,1,10) = new$(49) : PRINT #2, l$
LINE INPUT #1, l$ : MID$(l$,1,10) = new$(54) : PRINT #2, l$
FOR i = 1 TO 2 : LINE INPUT #1, l$ : PRINT #2, l$ : NEXT i

'     Inhalation--
LINE INPUT #1, l$ : MID$(l$,1,10) = new$(55) : PRINT #2, l$
LINE INPUT #1, l$ : MID$(l$,1,10) = new$(56) : PRINT #2, l$

LINE INPUT #1, l$
IF rval(56) = 1.0 THEN
  MID$(l$,1,10) = new$(57)
ELSEIF rval(56) = 2.0 THEN
  MID$(l$,1,10) = new$(58)
ELSE
  MID$(l$,1,1) = "0"
END IF
PRINT #2, l$
FOR i = 1 TO 2 : LINE INPUT #1, l$ : PRINT #2, l$ : NEXT i

'     Ingestion population--
LINE INPUT #1, l$ : MID$(l$,1,10) = new$(176) : PRINT #2, l$
LINE INPUT #1, l$ : MID$(l$,1,10) = new$(177) : PRINT #2, l$
FOR i = 1 TO 3 : LINE INPUT #1, l$ : PRINT #2, l$ : NEXT i
FOR i = 1 TO 3
  LINE INPUT #1, l$ : MID$(l$,1,10) = new$(58+i) : PRINT #2, l$
NEXT i
FOR i = 1 TO 5 : LINE INPUT #1, l$ : PRINT #2, l$ : NEXT i

'     Aquatic foods--
LINE INPUT #1, l$ : MID$(l$,1,10) = new$(66) : PRINT #2, l$
FOR i = 1 TO 5 : LINE INPUT #1, l$ : PRINT #2, l$ : NEXT i

FOR i = 1 TO 4
  ip = 67 + 4 * (i-1)
  LINE INPUT #1, l$
```

```
    IF jflag(i)=1 THEN MID$(l$,12,1) = "T" ELSE MID$(l$,12,1) = "F"
    MID$(l$,55,6) = new$(61+i)
    PRINT #2, MID$(l$,1,21);
    PRINT #2, USING " ##.##"; rval(ip+1);
    PRINT #2, USING " ##.#^^^^"; rval(ip+2);
    PRINT #2, USING " ####.##"; rval(ip+3);
    PRINT #2, USING " ####.#"; rval(ip+4);
    PRINT #2, MID$(l$,52,79)
  NEXT i
  FOR i = 1 TO 7 : LINE INPUT #1, l$ : PRINT #2, l$ : NEXT i

'   Terrestrial foods--

  FOR i = 1 TO 4
    ip = 83 + 8 * (i-1)
    LINE INPUT #1, l$
    IF jflag(4+i)=1 THEN MID$(l$,12,1) = "T" ELSE MID$(l$,12,1) = "F"
    PRINT #2, MID$(l$,1,21);
    PRINT #2, USING " ##.##"; rval(ip+1);
    irr = INT(rval(ip+2))
    PRINT #2, USING " ##"; irr;
    IF irr > 0 THEN x = rval(ip+3) ELSE x = 0.0
    PRINT #2, USING " ###.#"; x;
    IF irr > 0 THEN x = rval(ip+4) ELSE x = 0.0
    PRINT #2, USING " ###.#"; x;
    PRINT #2, USING " #####.#"; rval(ip+5);
    PRINT #2, USING "  ##.#^^^^"; rval(ip+6);
    PRINT #2, USING " #####.#"; rval(ip+7);
    PRINT #2, USING " ######.#"; rval(ip+8)
  NEXT i
  FOR i = 1 TO 8 : LINE INPUT #1, l$ : PRINT #2, l$ : NEXT i

'   Animal products--
  FOR i = 1 TO 4

    IF i = 1 THEN
      ip = 115
    ELSEIF i = 2 THEN
      ip = 133
    ELSEIF i = 3 THEN
      ip = 144
    ELSEIF i = 4 THEN
      ip = 162
    END IF

    LINE INPUT #1, l$
    IF jflag(8+i)=1 THEN MID$(l$,1,1) = "T" ELSE MID$(l$,1,1) = "F"
    PRINT #2, MID$(l$,1,10);
    PRINT #2, USING " ####.#"; rval(ip+2);
    PRINT #2, USING " ###.#"; rval(ip+1);
```

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```
        PRINT #2, USING " ###.##"; rval(ip+3);
        PRINT #2, USING "  ###.##"; rval(ip+4);

'       Set diet fraction to zero if acute, one year of intake--
        IF jflag(13)=3 AND rval(1) > 1 THEN x = rval(ip+5) ELSE x = 0.0

        PRINT #2, USING " ##.##"; x;
        PRINT #2, USING " ###.#"; rval(ip+6);
        irr = INT (rval(ip+7))
        PRINT #2, USING "  #"; irr;
        IF irr > 0 THEN x = rval(ip+8) ELSE x = 0.0
        PRINT #2, USING " ###.#"; x;
        IF irr > 0 THEN x = rval(ip+9) ELSE x = 0.0
        PRINT #2, USING " ##.##"; x;
        PRINT #2, USING "  ##.##"; rval(ip+10);
        PRINT #2, USING " ###.#"; rval(ip+11)

      NEXT i
      LINE INPUT #1, l$ : PRINT #2, l$

      FOR i = 1 TO 2
        IF i = 1 THEN ip = 126 ELSE ip = 155
        LINE INPUT #1, l$
        PRINT #2, MID$(l$,1,38);

'       Set diet fraction to zero if acute, one year of intake--
        IF jflag(13)=3 AND rval(1) > 1 THEN x = rval(ip+1) ELSE x = 0.0

        PRINT #2, USING " ##.##"; x;
        PRINT #2, USING " ###.#"; rval(ip+2);
        PRINT #2, USING "  #"; rval(ip+3);
        PRINT #2, USING " ###.#"; rval(ip+4);
        PRINT #2, USING " ##.##"; rval(ip+5);
        PRINT #2, USING "  ##.##"; rval(ip+6);
        PRINT #2, USING " ###.#"; rval(ip+7)
      NEXT i

      LINE INPUT #1, l$ : PRINT #2, l$
      LINE INPUT #1, l$ : PRINT #2, l$

      EXIT SUB
'------------------------------------------------------------------------
      END SUB
```

```
'-------------------------------------------------------------------
'
'     SUB params (np%, ipstart%, iflag%, par$, jflag%(1)) STATIC
'
'     Parameter input and checking handler.
'
'     Module of Program APPRENTICE of the GENII Software Package
'     Pacific Northwest Laboratory Environmental Dosimetry System
'
'     Last Modification: 1-Sep-88  RAP
'     Reviewed and Approved: 14-Sept-88  BA Napier
'
'-------------------------------------------------------------------
'
'     Parameter file (each data set consists of the following):
'       Record 1 - blank line
'       Record 2 - parameter index
'                - number of lines of descriptive information (1-2)
'                - parameter type flag;
'                    0 - logical
'                    1 - integer
'                    2 - real
'       Record 3 - default parameter value (maximum individual)
'       Record 4 - default parameter value (population)
'       Record 5 - reasonable minimum value
'                - reasonable maximum value
'       Record 6 - first line of descriptiion
'       Record 7 - (optional) second line of description
'
'     Argument list:
'       Np       - number of consecutive parameters (by parameter index)
'                  to input this call (input)
'       Istart   - beginning parameter index (input)
'       Iflag    - Flag set to:
'                    0 - display parameter in next position on screen
'                    1 - if data input area of screen (rows 10 through 24
'                        are to be cleared prior to inputting the current
'                        parameter (input)
'                    5 - set idos value; maximum individual or average
'                        individual default values
'                    6 - not input, return parameter value in par$
'                    7 - read parameter file
'                    8 - not parameter input; set parameter to par$
'                    9 - write output file
'       Par$     - last input parameter returned to calling module
'       Jflag()  - Flags necessary to write file are in array positions as
'                  follows:
'                    1-4 - jaq
'                    5-8 - jtf
'                    9-12 - jan
```

```
'                    13 - jopt(3) acute or chronic
'
'       Idos      - dose type; either 2-average individual  or 3-maximum
'                    individual
'
'-----------------------------------------------------------------------
'

     DEFINT i-n

     ifirst = ifirst + 1 : nmx = 185
     IF ifirst = 1 THEN
       DIM nld(nmx), ityp(nmx), rmin(nmx), rmax(nmx), rval(nmx), iset(nmx)
       DIM desc$(2,nmx), defmi(nmx), defpop(nmx), new$(nmx)
     END IF

'---- Process requested parameters ------------------------------------

'    Check if valid indices passed--
     icheck = ipstart + np - 1
     IF icheck > nmx THEN
       CALL messag ("Invalid index in PARAMS: "+STR$(icheck))
       EXIT SUB
     END IF

     IF iflag = 5 THEN                                    'set default type
       idos = ipstart
       EXIT SUB

     ELSEIF iflag = 6 THEN                            'return requested value
       IF ityp(ipstart) > 0 THEN
         IF iset(ipstart) = 0 THEN
           IF idos = 2 THEN                                       'population
             new$(ipstart) = STR$(defpop(ipstart))
             iset(ipstart) = idos
           ELSE
             new$(ipstart) = STR$(defmi(ipstart))
             iset(ipstart) = idos
           END IF
         END IF
       END IF
       par$ = new$(ipstart)
       EXIT SUB

     ELSEIF iflag = 7 THEN
       GOSUB redpar                                    'read parameter file
       EXIT SUB

     ELSEIF iflag = 9 THEN
       CALL ritpar (new$(), rval(), jflag())         'write output file
       EXIT SUB
```

```
ELSEIF iflag = 8  THEN              'set parameter value and return
  new$(ipstart) = par$
  rval(ipstart) = VAL (par$)
  iset(ipstart) = 1
  EXIT SUB

ELSEIF iflag = 1 THEN                                 'clear screen
  ir = 9
  CALL tblank (1,ir+2,1,24,80)
END IF

istop = ipstart + np - 1
FOR ip = ipstart TO istop

  IF ityp(ip) > 0 THEN
    IF iset(ip) <> idos THEN
      IF idos = 2 THEN                                   'population
        new$(ip) = STR$(defpop(ip)) : iset(ip) = idos
      ELSE
        new$(ip) = STR$(defmi(ip)) : iset(ip) = idos
      END IF
    END IF
  END IF

ir = ir+2 : IF ir > 22 THEN ir = 11 : CALL tblank (1,ir-2,1,24,80)
  IF ir < 11 THEN ir = 11
  LOCATE ir, icl : PRINT desc$(1,ip);
  IF nld(ip) > 1 THEN ir = ir+1 LOCATE ir, icl+2 : PRINT desc$(2,ip);

  IF ityp(ip) > 0 THEN                              'input number

    nogood = 1
    WHILE nogood = 1                'loop until valid number input

      CALL innum (new$(ip), ityp(ip), rnum!, ir, 60, iarrow)
      nogood = 0
      IF ityp(ip) = 1 THEN                           'integer
        IF rnum > 32767.0 THEN
          GOSUB outran : nogood = 1
        ELSE
          inum = INT (rnum)
          IF inum < INT(rmin(ip)) OR inum > INT(rmax(ip)) THEN
            GOSUB outran : nogood = 1
          END IF
        END IF
      ELSE                                           'real
        IF rnum < rmin(ip) OR rnum > rmax(ip) THEN
          GOSUB outran : nogood = 1
        END IF
```

```
            END IF

            IF nogood = 0 THEN
              rval(ip) = rnum
              par$ = new$(ip)
            END IF

          WEND

        ELSEIF ityp(ip) = 0 THEN                              'logical input

          valu$ = new$(ip)
          CALL inlog (valu$, ir, 60)
          new$(ip) = valu$
          par$ = valu$

        END IF

      NEXT ip

      EXIT SUB

'---- Out of range error handling ---------------------------------------

outran:
      CALL music : LOCATE 24,10
      PRINT "Number outside reasonable range of";
      PRINT rmin(ip);" to ";rmax(ip);
      CALL waita : CALL tblank (24,1,24,80)
      RETURN

'---- Read parameter file, dimension arrays, set constants -------------

redpar:
      ic1 = 10 : ic2 = 60

      OPEN "I", #1, "\GENII\PARAMS.DAT"
      LINE INPUT #1, dum$
      WHILE NOT EOF(1)
        LINE INPUT #1, dum$
        INPUT #1, i, nld(i), ityp(i)
        IF ityp(i) = 0 THEN
          INPUT #1, new$(i)
          iset(i) = 1
        ELSE
          INPUT #1, defmi(i)
          INPUT #1, defpop(i)
          INPUT #1, rmin(i), rmax(i)
          new$(i) = "0"
        END IF
```

```
        FOR j = 1 TO nld(i)
          LINE INPUT #1, desc$(j,i)
        NEXT j
        IF i = nmx THEN GOTO redend
      WEND

redend:
      CLOSE (1)
      RETURN

'------------------------------------------------------------------------
      END SUB
```

```
'------------------------------------------------------------------
'
      SUB INNUM  (a$, nflag%, buf!, ir%, icl%, iflag%) STATIC

'     Input number and check for validity, reprint number as integer
'     or in E-format, return valid number
'
'     Module of Program APPRENTICE of the GENII Software Package
'     Pacific Northwest Laboratory Environmental Dosimetry System
'
'     Last Modification: 11-Jul-88  RAP
'     Reviewed and Approved: 14-Sept-88  BA Napier
'
'------------------------------------------------------------------
'
'     a$        - input number string
'     nflag     - flag indicating number type: 0-integer, 1-real on input
'     iflag     - flag indicating if up or down arrow indicated on return
'     buf       - number returned to calling program
'
'------------------------------------------------------------------

      DEFINT i - n
      num$ = "1234567890-+.Ee " : t$ = CHR$(13) : ilen = 8
      buf$ = SPACE$ (ilen)
      iflag = 0

      insrt = 0
      LOCATE 9,69 : CALL reverse(1) : PRINT "Insert Off" : CALL reverse(0)
      jlen = LEN (a$) : IF jlen > ilen THEN jlen = ilen
      CALL stripper.1 (a$, a$)
      MID$ (buf$,1,jlen) = a$

start:

      ic = icl + 1
      LOCATE ir, ic, 1 : CALL reverse (1) : PRINT buf$; : LOCATE ir,ic

      istop = 0 : ipnt = 1
      WHILE istop = 0

        ityp = 1 : CALL inkey.1 (ityp, iscan, c$)
'        CALL messag (STR$(ityp)+" "+STR$(iscan)+" "+c$)

        IF ityp = 0 THEN     'insert toggle
           IF iscan = 82 THEN
             IF insrt = 0 THEN
               insrt = 1 : LOCATE 9,69 : PRINT "Insert On "
             ELSE
               insrt = 0 : LOCATE 9,69 : PRINT "Insert Off"
```

```
    END IF
   ELSEIF iscan = 83  THEN  'delete
    buf$ = MID$(buf$,1,ipnt-1)+ MID$(buf$,ipnt+1)+" "
    LOCATE ir,icl+1,1 : PRINT buf$; : LOCATE ir,ic,1
   END IF

ELSEIF ityp = -6 THEN                               'cursor keys

  IF iscan = 75 THEN                                'backwards
    ipnt = ipnt - 1 : IF ipnt = 0 THEN ipnt = 1
  ELSEIF iscan = 77 THEN                            'forwards
    ipnt = ipnt + 1 : IF ipnt > ilen THEN ipnt = ilen
  ELSEIF iscan = 72 THEN
    istop = 1 : iflag = -1
  ELSEIF iscan = 80 THEN
    istop = 1 : iflag = 1
  END IF
  ic = icl + ipnt : LOCATE ir,ic,1

ELSEIF ityp = -7 THEN

  IF iscan = 8 THEN

    ipnt = ipnt - 1
    IF ipnt > 0 THEN
      MID$ (buf$,ipnt,1) = " "
      ic = icl + ipnt : LOCATE ir,ic,1 : PRINT " ";
      ic = icl + ipnt : LOCATE ir,ic,1
    ELSE
      ipnt = 1
    END IF

  ELSEIF iscan = 13 THEN
    istop = 1

  END IF

ELSEIF ityp > 31 THEN

  ichk = INSTR (num$, c$)
  IF ichk > 0 THEN
    IF insrt=1 THEN
      CALL strins.1 (ipnt, c$, buf$)
      jlen = LEN(buf$)
      IF jlen > ilen THEN buf$ = MID$(buf$,1,ilen)
    ELSE
      MID$ (buf$,ipnt,1) = c$
    END IF
    ic = icl + ipnt : LOCATE ir,ic,1 : PRINT MID$(buf$,ipnt);
    ipnt = ipnt+1 : IF ipnt > ilen THEN ipnt = ilen
```

```
      ic = icl + ipnt : LOCATE ir,ic,1
    END IF

  END IF

WEND

'       Check number for validity--

CALL caseuppr.1 (buf$, buf$)
ilen = LEN (buf$)
CALL cntocr (buf$, "E", ne, ip)
CALL cntocr (buf$, "-", ndash, idash)
CALL cntocr (buf$, "+", nplus, iplus)
CALL cntocr (buf$, ".", ndec, idec)


IF ne > 1 OR ndash > 1 OR nplus > 1 OR ndec > 1 THEN GOTO errl
IF ndash > 0 AND nplus > 0 THEN GOTO errl
IF ne > 0 THEN IF ip=1 OR ip=ilen THEN GOTO errl
IF ndash > 0 THEN IF idash=1 OR idash=ilen THEN GOTO errl
IF nplus > 0 THEN IF iplus=1 OR iplus=ilen THEN GOTO errl
IF ndec > 1 THEN GOTO errl

IF ne = 0 AND (ndash > 0 OR nplus > 0) THEN     'add E for Lahey FORTRAN
  IF ndash > 0 THEN CALL strins.1 (idash, "E", buf$)
  IF nplus > 0 THEN CALL strins.1 (iplus, "E", buf$)
  ne = 1
END IF

'       Add decimal to real numbers--
IF nflag = 2 AND ndec = 0 THEN
  IF ne = 1 THEN
    ie = INSTR (buf$,"E")
    CALL strins.1 (ie, ".0", buf$)
  ELSE
    CALL stripper.1 (buf$, buf$)
    buf$ = buf$+".0"
  END IF
END IF

'       Check size of exponent--
IF ne = 1 THEN
  ie = INSTR (buf$, "E")
  IF ndash = 1 THEN ex$ = MID$ (buf$, ie+2) ELSE ex$ = MID$ (buf$, ie+1)
  ex = VAL (ex$)
  IF ex > 30 THEN
    CALL reverse (0)
    CALL messag ("Exponent out of range.")
    GOTO start
```

```
          END IF
        END IF

        buf = VAL (buf$) : LOCATE ir, icl+1 : CALL reverse (0)
        IF nflag = 2 THEN
          PRINT USING "##.#^^^^"; buf
        ELSE
          PRINT USING "########"; buf
        END IF

        a$ = buf$
        LOCATE 9,69 : PRINT  "          "
        CALL reverse (0)
        EXIT SUB

errl:
        CALL reverse (0)
        CALL messag ("Invalid number, reenter.")
        GOTO start

'------------------------------------------------------------------------
        END SUB

        SUB cntocr (spec$, find$, ncount%, iposit%) STATIC

        DEFINT i-n
        ncount = 0
        iposit = 0

        ipos = 1
        WHILE ipos > 0
          ipos = INSTR (ipos, spec$, find$)
          IF ipos > 0 THEN ncount = ncount + 1 : iposit = ipos : ipos=ipos+1
        WEND

        EXIT SUB
'------------------------------------------------------------------------
        END SUB
```

```
'-----------------------------------------------------------------
'
     SUB INLOG  (valu$, ir%, icl%) STATIC

'    Input logical and check for validity, reprint
'
'    Module of Program APPRENTICE of the GENII Software Package
'    Pacific Northwest Laboratory Environmental Dosimetry System
'
'    Last Modification: 7-Jan-88  RAP
'    Reviewed and Approved: 14-Sept-88  BA Napier
'
'-----------------------------------------------------------------
'
'    valu$    - input number string
'
'-----------------------------------------------------------------

     DEFINT i - n
     ok$ = "tTfFYyNn" : t$ = CHR$(13) : ilen = 1
     buf$ = SPACE$ (ilen)


     CALL stripper.1 (valu$, valu$)
     CALL caseuppr.1 (valu$)
     IF valu$ = "T" THEN valu$ = "Y"
     IF valu$ = "F" THEN valu$ = "N"

start:

     ic = icl + 1
     LOCATE ir, ic, 1 : CALL reverse (1) : PRINT valu$; : LOCATE ir,ic

     istop = 0 : ipnt = 1
     WHILE istop = 0

       ityp = 1 : CALL inkey.1 (ityp, iscan, c$)

       IF iscan = 13 THEN
         istop = 1

       ELSE
         n = INSTR (ok$, c$)
         IF n > 0 THEN istop = 1

'        Check character for validity--
         CALL caseuppr.1 (c$)
         valu$ = c$

       END IF
```

```
WEND

LOCATE ir, icl+1 : CALL reverse (0) : PRINT valu$;

IF valu$ = "Y" THEN valu$ = "T"
IF valu$ = "N" THEN valu$ = "F"

EXIT SUB

'-----------------------------------------------------------------------
END SUB
```

```
'--------------------------------------------------------------------
'
     SUB inchar (varbl$, iflag%, ilen%, ir%, icl%) STATIC
'
'    Input character string of specified length
'
'    Module of Program APPRENTICE of the GENII Software Package
'    Pacific Northwest Laboratory Environmental Dosimetry System
'
'    Last Modification: 23-Mar-88  RAP
'    Reviewed and Approved: 14-Sept-88  BA Napier
'
'--------------------------------------------------------------------
'
'    varbl$    - input string default value, returned string
'    iflag     - flag indicating type of input:
'                  0 - spaces allowed
'                  1 - file name including path and drive
'                  2 - file name prefix
'
'--------------------------------------------------------------------

     DEFINT i - n
     a1$ = "abcdefghijklmnopqrstuvwxyzABCDEFGHIJKLMNOPQRSTUVWXYZ"
     a2$ = "1234567890-_"
     a3$ = ".\:"
     a4$ = " *!$?+=@#;/"
     t$ = CHR$(13)
     buf$ = SPACE$ (ilen)

     IF iflag = 0 THEN
       a$ = a1$ + a2$ + a3$ + a4$
     ELSEIF iflag = 1 THEN
       a$ = a1$ + a2$ + a3$
     ELSEIF iflag = 2 THEN
       a$ = a1$ + a2$
     END IF

     insrt = 0
     LOCATE 9,69 : CALL reverse(1) : PRINT "Insert Off" : CALL reverse(0)
     jlen = LEN (varbl$) : IF jlen > ilen THEN jlen = ilen
     MID$ (buf$,1,jlen) = varbl$

start:

     ic = icl + 1
     LOCATE ir, ic, 1 : CALL reverse (1) : PRINT buf$; : LOCATE ir,ic

     istop = 0 : ipnt = 1
     WHILE istop = 0
```

```
ityp = 1 : CALL inkey.1 (ityp, iscan, c$)

IF ityp = 0 THEN      'insert toggle
   IF iscan = 82 THEN
     IF insrt = 0 THEN
       insrt = 1 : LOCATE 9,69 : PRINT "Insert On "
     ELSE
       insrt = 0 : LOCATE 9,69 : PRINT "Insert Off"
     END IF
   ELSEIF iscan = 83  THEN  'delete
     buf$ = MID$(buf$,1,ipnt-1)+ MID$(buf$,ipnt+1)+" "
     LOCATE ir,icl+1,1 : PRINT buf$; : LOCATE ir,ic,1
   END IF

ELSEIF ityp = -6 THEN

  IF iscan = 75 THEN
    ipnt = ipnt - 1 : IF ipnt = 0 THEN ipnt = 1
  ELSEIF iscan = 77 THEN
    ipnt = ipnt + 1 : IF ipnt > ilen THEN ipnt = ilen
  END IF
  ic = icl + ipnt : LOCATE ir,ic,1

ELSEIF ityp = -7 THEN

  IF iscan = 8 THEN

    ipnt = ipnt - 1
    IF ipnt > 0 THEN
      MID$ (buf$,ipnt,1) = " "
      ic = icl + ipnt : LOCATE ir,ic,1 : PRINT " ";
      ic = icl + ipnt : LOCATE ir,ic,1
    ELSE
      ipnt = 1
    END IF

  ELSEIF iscan = 13 THEN
    istop = 1

  END IF

ELSEIF ityp > 31 THEN

  ichk = INSTR (a$, c$)
  IF ichk > 0 THEN
    IF insrt=1 THEN
      CALL strins.1 (ipnt, c$, buf$)
      jlen = LEN(buf$)
      IF jlen > ilen THEN buf$ = MID$(buf$,1,ilen)
```

```
        ELSE
          MID$ (buf$,ipnt,1) = c$
        END IF
        ic = icl + ipnt : LOCATE ir,ic,1 : PRINT MID$(buf$,ipnt);
        ipnt = ipnt+1 : IF ipnt > ilen THEN ipnt = ilen
        ic = icl + ipnt : LOCATE ir,ic,1
      ELSE
        CALL music
      END IF

    END IF

  WEND

  LOCATE ir, icl+1 : CALL reverse (0)
  PRINT buf$;" ";
  varbl$ = buf$
  LOCATE 9,69 : PRINT  "          "

  EXIT SUB
'--------------------------------$------------------------------------
  END SUB
```

```
'-----------------------------------------------------------------------
'
    SUB intense (iflag%) STATIC
'
'   Subprogram for APPRENTICE of the GENII Software Package
'   Pacific Northwest Laboratory Environmental Dosimetry System
'
'   Last Modification: 31-Jan-88 RAP
'   Reviewed and Approved: 14-Sept-88  BA Napier
'
    DEFINT i-n

'   CALL reverse (iflag%)
    IF iflag = 1 THEN
      COLOR 0, 7, 0
    ELSE
      COLOR 7, 0, 0
    END IF

    EXIT SUB
'-----------------------------------------------------------------------
    END SUB
```

APPRENTICE HELP SCREEN TEXT

Screen: Titl.1 APRHELP1: 1

(First title screen - GENII)

Screen: Titl.2 APRHELP1: 2

Napier, B. A., R. A. Peloquin, D. L. Strenge, and J. V. Ramsdell. 1988. HANFORD ENVIRONMENTAL DOSIMETRY UPGRADE PROJECT. GENII -THE HANFORD ENVIRONMENTAL RADIATION DOSIMETRY SOFTWARE SYSTEM. VOL 1: Conceptual Representation, VOL 2: Users Manual, VOL 3: Code Maintenance Manual. PNL-6584. Pacific Northwest Laboratory. Richland. WA.

Screen: Titl.3 APRHELP1: 3

(Third title screen - Hanford Environmental Dosimetry System)

Screen: Intro.1 APRHELP1: 4

Pacific Northwest Laboratory has developed and documented a comphrehensive set of codes (i.e., environmental pathway models and associated computer programs for estimating potential radiation doses to humans from radionuclides in the environment. These codes address both routine and accidential releases of radionuclides to air or water as well as other situations, (e.g., resideual contamination from spills or decommissioning operations). Internal radiation dose calculations are performed using methods recommended by the International Commission of Radiation Protection (ICRP) as described in ICRP Publications No. 26 (ICRP 1977) and No. 30 (ICRP 1979). The codes are based on existing Hanford models and codes, using updated formulations and transfer coefficients.

Screen: How.1 APRHELP1: 5

How to use APPRENTICE:

1 - Use left and right arrows on numeric keypad to move to another menu. There are 12 main menus in APPRENTICE. You will see only those menus that are appropriate for the scenario under construction.

2 - Use down arrow on numeric keypad to pull a menu down.

3 - Use return key to select an item.

4 - Assistance is available throughout APRENTICE by accessing pop-up help screens. Use the F1 key or select Help from the menu.

9104809 12

Screen: How.2 APREHELP1: 6

5 - APPRENTICE attempts to assist you with scenario construction in the following way:

a) APPRENTICE checks for option incompatibilities and alerts you when these are discovered.

b) Only questions pertinent to the current scenario are asked.

c) Default values are provided for all variables. You may select between maximum individual and average individual parameters.

d) All input variables are checked against reasonable bounds.

Screen: How.3 APRHELP1: 7

6 - When you are ready, APPRENTICE will request a filename for storing your scenario. A GENII input file will be created with a file extension of ".IN". An execution file will be created with a ".BAT" extension.

7 - Multiple input files can be created in an APPRENTICE execution. Simply select "Next Scenario" after you have selected "Write file" on the final menu. APPRENTICE will return you to the first menu. All variable selections from the previous scenario remain in effect unless changed. A single execution file will be generated for processing the series of scenarios.

8 - To exit APPRENTICE quickly, without saving your scenario; press the Esc key several times until the final menu appears.

Screen: Scen.1 APRHELP1: 8

A "scenario" is a conceptual model of patterns if human activity corresponding to actions, events, and processes that result in radiation exposure to individuals or groups.

A "far-field" scenario is one defined to determine the impacts of a particular release of radioactive material into a wide environment, such as doses from releases from a stack in individuals or populations downwind.

In a "near-field" scenario, interest is focused on the doses an individual could receive at a particular location as a result of initial contamination or external sources, i.e., buried waste or contaminated soil.

In a near-field scenario, contamination levels in specific environmental media may be known. A far-field scenario can be characterized as coming in to a receptor. Of dource, the two types are not mutually exclusive - some doses to individuals from remote sources can be calculated as either far- or near-field with the same result. Specific examples of common types of far-field and near-field scenarios are given on the following screens.

Screen: Far.1 APREHELP1: 9

Far-Field Scenarios

Screen: Far.2 APRHELP1: 10

CHRONIC ATMOSPHERIC RELEASE: Prospective or retrospective doses to individuals or populations at specified distances and directions from the source, via submersion, inhalation and deposition groundshine and food pathways. This class of scenario is commonly used for showing compliance to regulations for emmission sources.

Screen: Far.3 APRHELP1: 11

ACUTE ATMOSPHERIC RELEASES: Prospective or retrospective doses to individuals or populations at specified distances and directions from an acute release via submersion, inhalation, deposition groundshine and food pathways. This class of scenario is often used in Safety Analysis Reports (SARs) or Environmental Impact Statements (EISs).

Screen: Far.4 APRHELP1: 12

CHRONIC SURFACE WATER RELEASES: Prospective or retrospective doses to individuals and populations at specified distances downstream of a release point via swimming, boating, shoreline, drinking water, aquatic foods, irrigated terrestrial foods and animal products, soil contaminated via irrigation, and other pathways associated with liquid releases. This class of calculation is also often encountered in showing compliance with regulations.

Screen: Far.5 APRHELP1: 13

ACUTE SURFACE WATER RELEASES:
Prospective or retrospective doses to individuals and populations at specified distances downstream of a release point via swimming, boating, shoreline, drinking water, aquatic foods, irrigated terrestrial foods and animal products, soil contaminated via irrigation, and other pathways associated with acute liquid releases. This class of calculations is also associated with SARs and EISs.

APPRENTICE HELP SCREEN TEXT

Screen: Near.1 APRHELP1: 14

Near-Field Scenarios

Screen: Near.2 APRHELP1: 15

INITIAL SURFACE CONTAMINATION: Individual doses resulting from contact with contamiated soil or surfaces via direct contact, resuspension, or crop uptake. Calculations of this nature can be used to analyze the impacts of spills or remdial actions.

Screen: Near.3 APRHELP1: 16

INITIAL SUBSURFACE CONTAMINATION: Individual doses resulting from contact with contaminated soil or surfaces via direct contact, resuspension, or crop uptake. The surface soil may be contaminated via manual redistribution of the material or through biotic transport. Calculations of this nature can be used to analyze the impacts of waste management options. Often a time delay may be included to account for radioactive decay of the source.

Screen: Near.4 APRHELP1: 17

GROUNDWATER CONTAMINATION: Prospective or retrospective doses to individuals and populations from a given water concentration via irrigation, and other pathways associated with liquid releases. This class of calculations is also often encountered when showing compliance with regulations.

Screen: Near.5 APRHELP1: 18

CUMULATIVE EFFECTS: Prospective calculations combining initial soil contamination with additional contributions from an external atmospheric or liquid source. This type of calulation is representative of how near-field and far-field calculations can conceptually be combined.

Screen: Tran.1 APRHELP1: 19

TRANSPORT. In most calculations, the known quantity is generally the release quantity. This may take the form of activity, or activity per unit time, released into the transport media of air or surface water, or in the case of buried waste, into soil via waste package degradation and biotic transport. These are converted via approproate models to concentrations in the corresponding media.

APPRENTICE HELP SCREEN TEXT

Screen: Inv.1 APRHELP1: 20

INVENTORY LOCATION. Air --> signifies air transport, Surface Water --> signifies surface water transport. If the basic media concentration is known, it may be input and the transport step omitted. If derived concentrations are known, they may be entered and the earlier processes overridden. See Figure 2.1 in VOl. 1 of the documentation.

Screen: Tran.2 (release terms) APRHELP1: 21

Screen: Tran.3 (rad in env.) APRHELP1: 22

Screen: Tran.4 (derived) APRHELP1: 23

Screen: Exp.1 APRHELP1: 24

EXPOSURE. The potential routes through which people may be exposed to radionuclides or radiation are called "exposure pathways". The general pathways can be thought of as external exposure, inhalation, and ingestion. The pathways are chosen depending on the ways people can be exposed for a given circumstance. In this way, ans appropriate collection of defined pathways can also be considered to be a definition of an "exposure scenario". Because a conceptualization of the types of exposure must be made before the pathways can be fully defined, "scenarios" are usually defined before the parameters are selected for the "pathways".

Screen: Rad.1 APRHELP1: 25

Select radionuclides by using the arrow keys on the numeric key pad to move the reverse video box to cover the name and then press the F2 key. The F2 key is a toggle; it can also be used to deselect radionuclides.

There are two pages of radionuclide names; use the F3 key to switch between the two pages.

When you have identified all radionuclides in your inventory, press the F10 key to continue.

After the radionuclides have been selected, you will be asked to enter the quantity for each specified location. After completing entry of the inventory, you may make corrections to the quantities or select additional radionuclides.

APPRENTICE HELP SCREEN TEXT

Screen: Air.1 APRHELP1: 26

Warning: GENII will not include a decay correction when this mode is selected. See Help.

Screen: Air.2 APRHELP1: 27

The user may either input a chi/Q value or request that one be calculated. When a chi/q value is input, no decay correction is made by GENII. The user should calculate a decay correction by made for each radionuclide (if transit time is known) and the input release term reduced accordingly.

Screen: Dose.1 APRHELP1: 28

Scenarios may be constructed to calculate either doses to representative members of critical groups (individuals) or collective doses to regional populations or subpopulations. Note that individual doses may be calculated for either near-field or far-field scenarios, but that population doses are only defined for far-field scenarios (because locally-measured or locally-predicted values cannot be representative over wide areas).

Screen: Rel.1 APRHELP1: 29

For scenarios involving release of radioactive materials into the environment, the input may be either of short duration (a matter of minutes to a few days), or continuous or routine (such that annual average parameters are appropriate). Note that scenarios involving exposure to pre-existing soil, vegetation, or groundwater contamination must be treated as chronic.

Screen: Itype.1 APRHELP1: 30

Two sets of recommended default parameters are provided to ease data entry. The "Average Individual" set is representative of the population average exposure and dietary habits and should be used for most population dose calculations. The "Maximum Individuals" set provides upper bound parameters you may override. All default parameters, however they provide an adequate basis for most generic calculations.

Screen: Itype.2 APRHELP1: 31

If you find that you are regularly resetting particular parameters, it is possible to revise the default parameter file. See the User's Manual for instructions.

Screen: Rep.1 APREHELP1: 32

Various levels of detail are available in the output report. The Annual Effective Dose Equivalent (AEDE) is the committed dose from one year of exposure. If this option is not selected, cumulative doses from continued exposure (for the number of years you specify in the TIMES Menu) will also be calculated and reported. Additional information can be requested on AEDE and cumulative dose-by-radionuclide or dose-by-exposure-pathway. Note that all of these options result in an increased number of pages of output.

For users interested in the intermediate workings of the code, selected information can be displayed on the screen during calculations. This information is cryptic, fast-scrolling, and slows the calculations. Interpretation requires use of the code listings provided in Volume 3 of PNL-6584.

Screen: Rad.2 33

GENII requires information on the source of radioactivity in order to continue. You have the option of using either S.I. units or the various multiples of conventional units. Note that if you are entering source term information for more than one environmental medium, the units used must be consistent within a single case.

Screen: Food.1 APRHELP1: 34

Select the aquatic food pathways to be considered. Information on production and consumption of each food type selected will be required in later menus.

Screen: Food.2 APRHELP1: 35

Select terrestrial food crop types to be considered. Information on production and consumption of each food type selected will be required in later menus.

Screen: Food.3 APRHELP1: 36

Select animal products to be considered. Information on the food and water the animals consume and the production and human consumption of each food type will be required in later menus.

Screen: Waste.1 APRHELP1: 37

For near-field scenarios involving either "Buried Waste" or "Deep Soil", an estimate of the thickness of the contaminated zone is required for the harvest removal model. Additionally, the depth to the top of this zone is required by the animal portion of soil the animals might move. "Buried Waste" acts as an additional compartment, that feeds "Deep Soil" at a rate determined by the waste decomposition half-life.

Screen: Biot.1 APRHELP1: 38

Biotic transport may result in radionuclides reaching surface soil from "Buried Waste" or "Deep Soil" both during the period following waste disposal and loss of institutional control but before the initial time of human exposure via this scenario (the "Years since LOIC" of a previous input screen), as well as continue during the exposure period. Three possibilities are provided for the conditions existing at the site prior to the start of this scenario's exposure. The parameters that describe these conditions are simplifications of those used in Mckenzie et al (1982 and 1983).

Screen: Air.3 APRHELP2: 1

There are three options, of increasing complexity, available to determine the annual average atmospheric dispersion values to be used in the chronic individual calculation.

The simplest (for GENII) is to directly input a precalculated chi/Q, in sec/m^3.

Screen: Air.4 APRHELP1: 2

The next in complexity is for the user to specify the location of the individual, in terms of distance and direction from the source, and have GENII compute the chi/Q for that location. This option requires that the user also have available one of two data sets: either a grid of precalculated chi/Q values or a set of joint frequency data for the source location. (See the User's Manual for the format of these external data files). If you chose to use the joint frequency data option, you will also be prompted to enter data on the characteristics of the source (including whether or not it is an elevated or ground level release, and whether or not to calculate plume rise. Note that each of these options has specific data requirements).

Screen: Air.5 APRHELP2: 3

Finally, if either a chi/Q grid or joint frequency file is available, you may instead direct GENII to search and find (select) the location of the maximally exposed individual via the air pathway. These options require data as described above for the specific MI, plus they require a population grid - so that GENII does not assume an MI location where nobody lives.

Screen: Air.6 APRHELP2: 4

UPON SELECTION OF THE METHOD, HIT "INPUT" TO CONTINUE DATA ENTRY.

Screen: Air.7 APRHELP2: 5

There are three options, of increasing complexity, available to determine the annual average atmospheric dispersion values to be used in the chronic population calculation.

The simplest (for GENII) is for the user to directly input a precalculated population-weighted chi/Q value (in person - sec/m^3).

Screen: Air.8 APRHELP2: 6

The next in complexity is for the user to provide both a grid of precalculated chi/Q values and a matching grid of population, and allow GENII to cross-multiply the two to create a population-weighted chi/Q.

Screen: Air.9 APRHELP2: 7

The third option requires the user to supply a joint frequency distribution in place of the chi/Q grid, and allow the code to create the chi/Q grid (see the User's Manual for the format of the chi/Q and joint frequency files). If you chose to use the joint frequency input option, you will also be prompted to enter the data on the characteristics of the source (including whether or not it is an elevated or groundlevel release, and whether or not to calculate plume rise).

Screen: Air.10 APRHELP2: 8

Note that each of these options has specific data requirements.

Note that you cannot request the "FINITE PLUME" submersion model without using one of the joint frequency options.

Upon selection of the method desired, hit "INPUT" to continue entering the data required for that option.

Screen: Air.11 APRHELP2: 9

There are two options for determining the time-integrated air concentration for the acute individual exposure.

The first is through input of a precalculated E/Q, in sec/m^3.

Screen: Air.12 APRHELP2: 10

The second is to specify the distance and direction of the individual from the release point. This option requires that the user provide either a grid of precalculated E/Q values or a set of joint frequency data for the source location. (See the User's Manual for the format of these external files). If you choose to use the joint frequency option, the code will calculate the E/Q which is not exceeded more than 5% of the time for the specified location (i.e., the 95th percentile E/Q). For this option you will also be prompted to enter data on the source characteristics (including whether or not it is an elevated or groundlevel release, whether or not to use the plume rise model, whether or not to use the building wake model).

Screen: Air.13 APRHELP2: 11

Note that each of these options has specific data requirements.

Note that you cannot request the "FINITE PLUME" submersion model without using one of the joint frequency options.

Upon selection of the method, hit "INPUT" to continue entering the data required for that option.

Screen: Air.14 APRHELP2: 12

There are two options for determining the population-weighted, time-integrated air concentration for acute population exposures.

The simplest is through user input of a precalculated population-weighted E/Q (in person - sec/m^3).

Screen: Air.15 APRHELP2: 13

The second option is to specify the direction from the source for which the calculation is desired. This option requires that the user provide either a grid of precalculated E/Q values or a set of joint frequency data for the source location (see the User's Manual for the format of these external files), as well as a population grid file. If you choose the joint frequency option, the code will calculate the population-weighted E/Q which is not exceeded more than 5% of the time for the specified direction (i.e., the 95th percentile population-weighted E/Q). For this option you will also be prompted to enter data on the source characteristics (including whether or not it is an elevated or groundlevel release, whether or not to use the plume rise model, and whether or not to consider the building wake model).

Screen: Swat.1 APRHELP2: 14

Three options are available to determine the surface water concentrations from chronic releases, a simple dilution volume model and more complex models of river and lake dispersion. The dilution volume model requires only input of the annual average flow of the receiving water body (i.e., river), and allows adjustment by a multiplicative input mixing ratio. The river and lake models generate mixing ratios, and from them water concentrations, as functions of flow velocity, water depth, effluent discharge rate, longshore and offshore distance, and other parameters.

Upon selection of the method, hit "INPUT" to continue entering the data required for that option.

Screen: Swat.2 APRHELP2: 15

Because of the nature of the acute model for surface water transport, only one model is available to determine time-integrated water concentrations. Required input is the average flow of the receiving water body and a multiplicative mixing ratio (usually 1.0 unless otherwise known). The entire source is assumed to be carried off by the river/lake flow.

Screen: Time.1 APRHELP2: 16

The time step available for GENII simulations is integer years. Within this constraint, scenarios may be constructed by defining the length of time a person is exposed (intake ends), the period for which the dose commitment is calculated (dose calc. ends), the length of time during which the individual(s) is/are exposed that the active radionuclide release continues, and the length of time prior to the beginning of the exposure that deposition via air or water occurred (for determining soil accumulation).

Screen: Far.6 APRHELP2: 17

To calculate population doses, you will be asked to input consumption/exposure parameters for an average individual in the population. GENII will then use these average parameters times the number of people to calculate collective dose. The code can either figure a total population for you by summing from a grid you must provide, or you can simply enter the total.

If you know the total consumption values (for instance, 100,000 kg of vegetables) and don't really care about how many people it feeds, put in a population of 1 and enter the other values later when asked.

Screen: Near.6 APRHELP1: 18

You will be asked questions pertinent to the development of the near-field scenario under construction. If you have selected "Buried Waste or Deep Soil" as a source, radioactive decay of the source from the quantity initially disposed, and release from waste packages to soil, can be calculated by entering the appropriate decay time. If "Burial Transport" has been requested, the length of time that the biota have had contact with the waste (assumed to start at the time of loss of institutional control) can be entered.

Screen: Near.7 APRHELP2: 19

A two-compartment model of plant roots is allowed: vegetation uptake is assumed to be proportional to the fraction of roots contacting 1) the mixed surface soil layer, and 2) the layer of contaminated buried soil. (These two layers can be separated by a third, clean layer).
These root fractions are used in the regular plant concentration model, the harvest removal model, and the plant portion of the biotic transport model.

Screen: Near.8 APRHELP2: 20

For scenarios involving physical disruption that mixes deeply buried waste (in Ci/m^3) with surface soil (in Ci/m^2), a "Manual Redistribution" factor is available. (A handy factor to remember is that throughout GENII, 1 Ci/m^3 = 0.15 Ci/m^2).

Screen: Ext.1 APRHELP2: 21

The "EXTERNAL EXPOSURE" parameters help define the time during which the individuals or populations are exposed to sources of direct radiation exposure from contaminated air, soil, water, or sediments. GENII uses fairly simple exposure geometries - shielding corrections for buildings, etc. are not included. If desired, simple reductions for shielding may be incorporated by reducing the time assumed for exposure.

Screen: Ext.2 APRHELP2: 22

The "EXTERNAL EXPOSURE" parameters help define the fraction of time the individuals or populations are exposed to source of direct radiation exposure from contaminated air, soil, water, or sediments. For exposure to an acute air concentration, the fraction of the time of plume passage that the person(s) is exposed is input. For exposures to soil and sediment following acute deposition the exposure is modeled as chronic to a decaying source. Note that, if swimming and boating have been selected, certain assumptions have been "hard-wired" into the code (100% exposure for maximum individual, 0% exposure for populations), so no inputs are requested.

Screen: Inh.1 APRHELP2: 23

GENII considers two sources for inhalation exposure: plumes from acute or chronic sources and resuspension from soil contamination. Exposure to plumes may be characterized through the time spent at a location within the plume, in hours/year for chronic exposure or fraction of plume passage time for acute releases. Two models describing resuspension are available if desired. The Mass Loading model relates the local air concentration to the local soil concentration by assuming that dust in the air has the same concentrations as the soil. The Anspaugh model is a time-dependent function relating surface activity to air concentration. GENII uses a fraction of the upper soil compartment to represent the surface activity.

Screen: Ing.1 APRHELP2: 24

A common assumption in the older Hanford environmental codes was that food crops are produced and eaten where the people live. While not a bad assumption for individuals, this can lead to inaccuracies when the people live on one side of a source and the crops are grown on the other, or when not enough food is grown to support the entire population. GENII allows several options, of increasing complexity, to deal with food production.

Screen: Ing.2 APRHELP2: 25

The user may input a precalculated normalized food-production-weighted chi/Q value (option 0), analogous to a population-weighted chi/Q.

You may select to use the same distribution as used for the population, essentially assuming that the field and people are co-located (option 1).

If you know how much food is produced, but not necessarily where, you may assume the crops are grown uniformly throughout the 80-km grid (option 2).

Finally, if you know the actual food production distribution, prepared as a file of values in kg/yr for each of the 10 x 16 grid points for each food type, this may be used with the chi/Q grid input or calculated for the population (option 3).

Screen: Ing.3 APRHELP2: 26

Note that with options 2 and 3, the potential for doses to people outside the region may be considered via crop export, if desired.

Note: Only the option assuming co-location of crops and population (option 1) is currently available for acute releases. Model development for the other options is as yet incomplete.

Screen: Drink.1 APRHELP2: 27

Because GENII allows simultaneous consideration of several sources of contamination (surface water and ground water), you need to indicate which source is to be used for drinking. You will also need to indicate whether the drinking water is treated through a water treatment facility: if so, reductions in concentration for filtration/cleanup will be calculated. The travel time of the water through the distribution system is also input, to allow calculation of decay of short-lived nuclides.

Screen: Aqu.1 APRHELP2: 28

For each of the aquatic food types you have selected, several parameters must be entered. These include travel time of the radionuclides in the water to the point where the fish/etc. is caught, and the time between harvest and consumption. These allow for proper accounting of decay for short-lived nuclides. Individual aquatic food consumption rates are also input here. Suggested default values are provided, but all may be overridden.

Screen: Tfood.1 APRHELP2: 29

For each of the terrestrial food types you have selected, several parameters must be entered. These help define the conditions under which the crops are grown, such as the length of the growing season and the yield of the crop, as well as the conditions of irrigation if you have selected surface water. Individual food consumption rates are also input here. Recommended default values are provided, but all may be overridden.

Note: Growing time is only used for the years after the release in acute cases. If you are only looking at dose commitment from the first year of exposure, whatever value you enter will be ignored.

Screen: Anfood.1 APRHELP2: 30

For each of the animal products you have selected, several parameters must be entered to define the conditions under which the products are produced. This includes not only how much of each product are consumed by humans, but also the conditions for the foods that the animals themselves eat. Some animals are allowed two food sources (fresh forage and stored feed), so information on growing period, yield, irrigation rates, etc. must be provided for these as well.

Suggested default parameters are provided for all values, but these may be overridden if desired.

Screen: Files.1 APRHELP2: 31

The GENII package functions as a coupled set of programs that transfer data via input/output files. A normal run consists of one or more input files (created by APPRENTICE) controlled by a batch file (a *.BAT file also created by APPRENTICE). You will be asked to provide a File name for each scenario you create in a run. If you create only one scenario, APPRENTICE will give the batch file the same name as the input file, otherwise, you will also be prompted for a batch file name. The "File Management" option is a handy "window" out of APPRENTICE to your system to look at or manipulate files anywhere on your system. (It is particularly useful if you forget the names of your joint frequency, chi/Q, or population files!) You can search any directory using the "search string" option, copy or delete existing files, and view the first 8 lines of any file to see what's in it. When you are finished with a scenario, you must use the WRITE FILE option to save your input before continuing with another scenario or quitting APPRENTICE.

```
C-----------------------------------------------------------------------
C
C     Program title:                    ENVIN - A module of the GENII
C                                       environmental dosimetry software
C                                       package.
C
C     Prepared for:                     U. S. Department of Energy under
C                                       Contract DE-AC06-76RLO 1830
C
C
C     Contact:                          Bruce Napier
C                                       Pacific Northwest Laboratory
C                                       Richland WA 99352
C                                       (509) 375-3916
C
C     Code developers:                  B. A. Napier, R. A. Peloquin,
C                                       D. L. Strenge, and J. V. Ramsdell
C                                       Pacific Northwest Laboratory
C                                       Richland WA  99352
C
C
C     This code was prepared for an agency of the United States
C     Government.  Neither the United States Government or any agency
C     thereof, or any of their employees, make any warranty, expressed
C     or implied, or assumes any legal liability or responsibility for
C     any third party's use, or the results of such use, of any portion
C     of this program or represents that its use by such third party
C     would not infringe privately onwed rights.
C
C
C--- Program Information ------------------------------------------------
C
C     Problem description:       To perform input checking, data library
C                                reading, and to prepare atmospheric
C                                dispersion estimates if required for
C                                near-field and far-field short-term
C                                scenarios.
C
C     Results format:            The output of ENVIN is a data transfer file
C                                called ENV.IN used as input to the following
C                                program of the package, ENV.  A separate QA
C                                report is prepared describing the case being
C                                calculated, and a third file describing the
C                                results of the atmospheric dispersion
C                                calculation may be prepared if needed.
C
C     Computer:                  This version is for the IBM PC/AT.
C
C     Programming language:      FORTRAN compiled using Lahey(tm)
```

```
C                                 FORTRAN Compiler.
C
C    Machine requirements:        IBM PC/AT with a minimum of 640 k-bytes
C                                 random access memory and 1 20-Mbyte fixed
C                                 disk drive.
C
C
C    Reference:                   B. A. Napier, R. A. Peloquin, D. L. Strenge,
C                                 and J. V. Ramsdell. 1988. "GENII - The
C                                 Hanford Environmental Radiation Dosimetry
C                                 Software System."  PNL-6584, Volumes 1, 2,
C                                 and 3.  Pacific Northwest Laboratory,
C                                 Richland, WA  99352
C
C
C-----------------------------------------------------------------------
C
      PROGRAM ENVIN
C
C     This module controls reading of the input files and data libraries;
C     checks input for validity; organizes radionuclides into chains;
C     writes input files for ENV and DOSE; and writes a report of input
C     parameters.
C
C     Module of Program ENVIN of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 6-Jan-88  RAP
C     Reviewed and Approved:  12-Sept-88  BA Napier
C
C-------------------------------------------------------------------

      INCLUDE 'OPT.CMN'
      INCLUDE 'AIRPAR.CMN'

C     Get system time and date--
      CALL MAKDA2

C     Read file names--
      CALL OPNFIL (3,0,1)

C     Read input file--
      CALL READIN

C     Read master radionuclide library--
      CALL RLIBIN

C     Identify and order inventory--
      CALL ORDER
```

```
C     Identify and order inventory--
      CALL ORDER

C     Test input parameters for ranges and option logic--
      CALL CHECK

C     Read environmental libraries--
      CALL ENVLIB

C     Write input parameter report--
      CALL RITQA

C     Read and check default parameter file--
      CALL REDFLT

C     Generate chi/Q values if requested--
      IF (AIR .AND. XOQOPT .NE. 1 .AND. JFIN) THEN
        IF (ACUTE) THEN
          CALL ACCMOD
        ELSE
          CALL CRONMOD
        ENDIF
      ENDIF

C     Close report file--
      CLOSE (6)

C     Write input file for ENV--
      CALL RITENV

      STOP
C-----------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------
C
      SUBROUTINE ACCMOD
C
C     This model computes E/Q for accidental releases for a single
C     location.  This module computes centerline E/Q using a Gaussian
C     plume model.  The code is based of the diffusion model described
C     in Section 4.3 of Volume 1.
C
C     Written by J.V. Ramsdell (December 3, 1986)
C     Module of Program ENVIN of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 6-Jul-88  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-----------------------------------------------------------------
C
C     AIRT()    - Average air temperature (C) by season and time of day
C     DOQ()     - Normalized deposition estimates for the 1, 5, 10, 25,
C                 and 50 % probability levels.  These values are printed
C                 in the GENII output report.
C     DV        - Deposition velocity
C     EOQR()    - Normalized air exposures for the 1, 5, 10, 25, and 50 %
C                 probability levels.  These values are printed in the
C                 GENII output report; the 95% value is stored in
C                 parameter EOQ for use in ENV.
C     JFDHT     - Height for which joint frequency data is
C                 representative, m
C     JFREQ()   - Joint probability distribution wind weed, direction,
C                 and stability by season and time of day
C     MAXC      - The maximum number of E/Q values.
C     MIXLAY()  - Average mixing layer thickness by season and time of
C                 day
C     NC        - The number of E/Q values to be sorted--
C     TEMP      - Intermediate value, tested before call to EXP function
C     UBAR()    - Mid points of the wind speed ranges
C     TS()      - The matrix of E/Q, frequency, and wind speeds; sorted
C                 in descending order by E/Q after sort.
C     TSX()     - The matrix of E/Q, frequency, and wind speeds; sorted
C                 in descending order by E/Q after sort, for six energy
C                 groups for finite plume calculations.
C     ZO        - Surface roughness length in meters
C
C-----------------------------------------------------------------

      INCLUDE 'AFPPAR.CMN'
      INCLUDE 'AIRPAR.CMN'
      INCLUDE 'OPT.CMN'
```

ENVIN

```
      INTEGER MIXLAY(1,1)
      REAL JFREQ(1,1,9,7,16), JF, UBAR(9), PM, RHT,
     .     DRF(5,6), DRFS(6), EOQR(5), DOQ(5), TTIME(5), EPROB(5),
     .     POSIT(2,10), AIRT(1,1), SZ(7), SY(7), TS(3,63), TSX(3,63,6),
     .     ZO, JFDHT, OHT

      DATA AIRT/ 15.0 /, MIXLAY/ 1000 /, ZO /0.03/, OHT /0.0/

C     The second dimension of TS must >= NSPD * NSTAB * NTOD * NSEAS--
      MAXC = 63

      DV = 0.01

C---- Read in joint frequency data -------------------------------------

      LUN = 23
C     CALL OPNFIL (1,0,LUN)
      CALL OPNFIL (4,0,LUN)
      READ (LUN,'(A8)') DUM
      READ (LUN,*) NSPD, NSTAB, NSEAS, NTOD, JFDHT
      READ (LUN,*) (UBAR(I), I=1, NSPD)

      DO 41 I = 1, NSPD
        DO 31 J = 1, NSTAB
          READ (LUN,*,END=99,ERR=98) (JFREQ(1,1,I,J,K),K=1,NDIR)
          DO 33 K = 1, NDIR
            JFREQ(1,1,I,J,K) = JFREQ(1,1,I,J,K) / 100.0
   33     CONTINUE
   31   CONTINUE
   41 CONTINUE

      CLOSE(LUN)

C---- If population dose, read in population, set no. of locations ----

      IF (POPDOS) THEN
        CALL XQIN (2)
        MPOSIT = NDIST

      ELSEIF (XOQOPT .EQ. 2) THEN
C       MI location is to be selected--
        CALL XQIN (4)
        MPOSIT = NDIST

      ELSE
C       MI location is specified--
        MPOSIT = 1
```

```
      ENDIF

C---- Receptor loop, only 1 is used in GENII --------------------------

      TPOPS = 0.0

      DO 700  M = 1,MPOSIT

C       Determine location, transport sector--
        IF (POPDOS) THEN
          POSIT(2,M) = X(M)
        ELSE
          POSIT(2,M) = MIDIST
        ENDIF

        POSIT(1,M) = REAL (MIDIR)
        ID = POSIT(1,M)

C       Convert to wind direction sector--
        ID = ID + 8
        IF( ID .GT. 16) ID = ID - 16

C       Set XOQ counter to 0--
        NC = 0

C       Next loop is stability--
        DO 400 IST = 1,NSTAB

          CALL SIGMA( POSIT(2,M), IST, SZ(IST), SY(IST) )

C         Loop on wind speed--
          DO 300 IU = 1,NSPD

C           Compute release height wind--
            IF( SHITE .EQ. 0.0 .AND. JFDHT .LE. 15.0) THEN
              RSPD = UBAR(IU)

            ELSEIF (SHITE .EQ. JFDHT) THEN
              RSPD = UBAR(IU)

            ELSE

C             Compute release height wind using diabatic wind profile;
C             See Panofsky and Dutton (1984) Section 6.5--

              RSPD = PROFILE (JFDHT, Z0, UBAR(IU), IST, SHITE)

            ENDIF
```

```
C            Loop on seasons, only one in GENII--
             DO 200 ISEAS = 1,NSEAS

C              Loop on time of day, only one in GENII--
               DO 100 IT = 1,NTOD

                 JF = JFREQ(IT,ISEAS,IU,IST,ID)

C                Skip computations if joint frequency is zero--
                 IF (JF .GT. 0.0 ) THEN

                   RHT = SHITE

                   IF (IRELES .LT. 2) THEN
C                    Point source equations--

                     IF( SZ(IST) .GE. 1.32 * MIXLAY(ISEAS,IT) ) THEN

C                      Uniform concentration distribution in the vertical--
                       GZ = 1.0

C                      Compute ground-level exposure--
                       EUOQG = 1.0
     +                       / ( SQRT(2*P) * SY(IST) * MIXLAY(ISEAS,IT))

                     ELSE

C                      Non-uniform vertical concentration distribution;
C                      compute ground-level exposure--

                       EUOQG = 1.0 / ( 2*P * SY(IST) * SZ(IST) )
                       PRISE = 0.0
                       IF (SHITE .GT. 0.0 .AND. .NOT. EFFSTK)
     .                   CALL PLMRIZ (ZO, SRAD, SHITE, SFLOW, ETEMP,
     .                                AIRT(ISEAS,IT), RSPD, IST,
     .                                MIXLAY(ISEAS,IT), PRISE)

C                      Compute effective release height--
                       RHT = SHITE + PRISE

C                      Compute G(Z)--

                       GZ = 0.0
                       DO 50  N1 = 1,5

                         N = -3 + N1
                         TEMP = -0.5 * (( 2.0 * REAL(N) *
     .                          MIXLAY(ISEAS,IT) -RHT) / SZ(IST) )**2
                         IF (ABS(TEMP) .LT. 20.0) THEN
```

```
                      GZ = GZ + 2.0 * EXP(TEMP)
                    ENDIF

   50             CONTINUE
                ENDIF

              ELSE
C               Building wake model-

                IF (JFDHT .EQ. 10) THEN
                  SPD10 = UBAR(IU)
                ELSE
                  SPD10 = PROFILE (JFDHT, ZO, UBAR(IU), IST, 10.0)
                ENDIF

                IF (SRAD .GT. 0.0 .AND. SFLOW .GT. 0.0) THEN
                  WO = SFLOW / (P * SRAD**2)
                ELSE
                  WO = 0.0
                ENDIF

                WEOQ = RWAKE (BUILDX, BUILDH, SHITE, WO, SFLOW,
     .                 POSIT(2,M), OHT, SPD10, RSPD, IST, SY(IST),
     .                 SZ(IST), MIXLAY(ISEAS,IT), P)

              ENDIF

C             Evaluate finite plume dose rate factors--
              IF (FINITE) THEN
                CALL DRFBIV (RHT, SY(IST), SZ(IST), RSPD, DRFS)
              ENDIF

C             Increment class counter--
              NC = NC + 1

C             Save current DRF values for finite plume--
              IF (FINITE) THEN
                DO 60 IE = 1, 6
                  TSX(1,NC,IE) = DRFS(IE) / RSPD
                  TSX(2,NC,IE) = JF
                  TSX(3,NC,IE) = POSIT(2,M) / RSPD
   60           CONTINUE
              ENDIF

C             Compute E/Q--
              IF (IRELES .LE. 1) THEN
                TS(1,NC) = EUOQG / RSPD * GZ
              ELSE
                TS(1,NC) = WEOQ
```

```
                    ENDIF
C                   Corresponding probability--
                    TS(2,NC) = JF

C                   And travel time--
                    TS(3,NC) = POSIT(2,M) / RSPD

                  ENDIF
  100           CONTINUE
  200         CONTINUE
  300       CONTINUE
  400     CONTINUE

          IF (FINITE) THEN
            DO 450 IE = 1, 6
              CALL BSORT (MAXC, NC, TSX(1,1,IE))
              CALL PROB (MAXC, NC, TSX(1,1,IE), EPROB, DRF(1,IE), TTIME)
              DRFSAV(IE) = DRF(PRCNTI,IE)
  450       CONTINUE
          ENDIF

C         Travel time for last energy group is used--
          CALL BSORT (MAXC, NC, TS)
          CALL PROB (MAXC, NC, TS, EPROB, EOQR, TTIME)

C         Compute deposition--
          DO 500  IP = 1,5
            DOQ(IP) = DV * EOQR(IP)
  500     CONTINUE

C         Calculate population-weighted E/Q, save travel time, sector pop.--
          IF (POPDOS) THEN
            IF (FINITE) THEN
              DO 550 IE = 1, 6
                PWTX(M,IE) = DRF(PRCNTI,IE) * POP(M,MIDIR)
  550         CONTINUE
            ENDIF

            PWT(M) = EOQR(PRCNTI) * POP(M,MIDIR)

            TTAIR(M) = TTIME(PRCNTI)
            TPOPS = TPOPS + POP(M,MIDIR)
          ELSE
            XOQI = EOQR(PRCNTI)
            TTAIRI = TTIME(PRCNTI)
            TPOPS = 1.0
          ENDIF
```

```
C       Write results to GENII output file--

        LUN = 6
        IF (FINITE) THEN
          IF (M .EQ. 1) THEN
            CALL HEADNG (LUN)
            WRITE (LUN,11) INT(POSIT(1,M)), EPROB(PRCNTI)
            WRITE (LUN,10)
          ENDIF
          IF (POPDOS) THEN
            WRITE(LUN,12) POSIT(2,M), TTIME(PRCNTI),
     .                    (PWTX(M,IE), IE=1,6)
          ELSE
            WRITE(LUN,12) POSIT(2,M), TTIME(PRCNTI),
     .                    (DRFSAV(IE), IE=1,6)
          ENDIF
        ELSE
          IF (M .EQ. 1) THEN
            CALL HEADNG (LUN)
            WRITE (LUN,5) INT(POSIT(1,M))
          ENDIF
          WRITE (LUN,4) POSIT(2,M)
          DO 600 IP = 1,5
            IF (POPDOS .AND. IP .EQ. PRCNTI) THEN
              WRITE(LUN,6) EPROB(IP),EOQR(IP),DOQ(IP),TTIME(IP), PWT(M)
            ELSE
              WRITE(LUN,6) EPROB(IP),EOQR(IP),DOQ(IP),TTIME(IP)
            ENDIF
  600     CONTINUE
        ENDIF

  700 CONTINUE

C       Calculation for population-weighted E/Q--

        IF (POPDOS) THEN

          IF (FINITE) THEN
            DO 720 IE = 1, 6
              PMX(IE) = 0.0
              DO 715 I =1, NDIST
                PMX(IE) = PMX(IE) + PWTX(I,IE)
  715         CONTINUE
  720       CONTINUE
            WRITE (LUN,9) (PMX(IE),IE=1,6)
          ENDIF

          PM = 0.0
          DO 216 I = 1, NDIST
```

```
          PM = PM + PWT(I)
 216    CONTINUE
        WRITE (LUN,8) PM

        XOQI = PM

      ENDIF

      CLOSE (LUN)

      RETURN

C---- Error Messages ----------------------------------------------------

   98 CALL FILERR (2, LUN, 'In ACCMOD')
   99 CALL FILERR (3, LUN, 'In ACCMOD')

C---- Format Statements -------------------------------------------------

    1 FORMAT (9(F7.5,1X))
    2 FORMAT (/7X,10(5X,I2,2X))
    3 FORMAT (T20,3X,0PF4.0,10(1X,1PE8.2))
    4 FORMAT (' Distance:',F9.1)
    5 FORMAT (/T20,'                                              ',
     .'Population-'/
     .T20,'                                       Travel ',
     .'    Weighted'/
     .T20,' Probability      E/Q        DOQ      Time   ',
     .'       E/Q'/
     .T20,'                (sec/m3)     (m2)     (sec) ',
     .' (person-sec/m3)'/' Sector index:',I2)
    6 FORMAT (T20,4X,F6.4,2(1PE12.1),0PF10.0,1PE12.1)
    8 FORMAT (///' Population-weighted E/Q: ',T68,1PE8.1)
    9 FORMAT (/' Population-weighted DRFs :',/19X, 1P,6(E8.1, 1X))
   10 FORMAT (//'           Travel    Energy   Energy   Energy    ',
     .        'Energy   Energy   Energy'/,
     .        ' Distance  Time       0.15      0.4      0.75     ',
     .        '1.25     1.75     2.25'/,
     .        '    (m)     (sec)     (MeV)    (MeV)    (MeV)     ',
     .        '(MeV)    (MeV)    (MeV)'/)
   11 FORMAT (//' Sector Index: ',I2/' Probability: ',1PE8.1)
   12 FORMAT (' ',F7.0,2X, F6.0,3X, 1P,6(E8.1,1X))

C-----------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------------
C
      SUBROUTINE BSORT (MAXC, NC, TS2)
C
C     Sort E/Q estimates into descending order so that the probability
C     of exceeding the E/Q value can be estimated.  The sort is made
C     on E/Q but the frequency and release height wind speed are moved
C     along with the E/Q values.
C
C     Module of Program ENVIN of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 15-Dec-87  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-------------------------------------------------------------------------
C
C     MAXC      - The maximum number of E/Q values
C     NC        - Number of E/Q values to be sorted
C     TS2       - Matrix of E/Q, frequency and wind speeds on input,
C          sorted in descending order by E/Q on output
C
C-------------------------------------------------------------------------

      DIMENSION TS2(3,MAXC), TEMP(3)

      DO 301  N1 = 1,NC-1
        DO 201 N2 = N1+1,NC

          IF( TS2(1,N1) .LT. TS2(1,N2) ) THEN

            DO 101 I = 1,3
              TEMP(I) = TS2(I,N1)
              TS2(I,N1) = TS2(I,N2)
              TS2(I,N2) = TEMP(I)
  101       CONTINUE

          ENDIF

  201   CONTINUE
  301 CONTINUE

      RETURN
C-----------------------------------------------------------------------------

      END
```

```
C-----------------------------------------------------------------------
C
      SUBROUTINE CHECK
C
C     This module checks input parameters for validity.  Relationships
C     between dependent parameters are also checked.  Flags are also
C     set for improved program control.
C
C     Module of Program ENVIN of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 12-Aug-88  RAP
C     Reviewed and Approved: 12-Sept-88 BA Napier
C
C-----------------------------------------------------------------------
C
C     CHK       - Logical set or cleared to check parameter interactions
C     IPRIOR    - Logical set if any prior years are considered in this
C                 scenario
C     ISTOP     - Logical set true if any error conditions are
C                   discovered
C     ISTOP2    - Temporary logical variable
C     STORE     - Logical flag set if acute and storage times specified
C
C-----------------------------------------------------------------------

      INCLUDE 'AFPPAR.CMN'
      INCLUDE 'ANMPAR.CMN'
      INCLUDE 'AQUPAR.CMN'
      INCLUDE 'CONC.CMN'
      INCLUDE 'EXTPAR.CMN'
      INCLUDE 'FODPAR.CMN'
      INCLUDE 'LABELS.CMN'
      INCLUDE 'OPT.CMN'
      INCLUDE 'RAD.CMN'
      INCLUDE 'RADIN.CMN'
      INCLUDE 'SOLPAR.CMN'
      INCLUDE 'SWPAR.CMN'
      INCLUDE 'AIRPAR.CMN'
      INCLUDE 'TIMES.CMN'

      LOGICAL ISTOP, ISTOP2, ISTOP3, ISTOP4, CHK, STORE, IPRIOR
      DATA ISTOP /.FALSE./, ISTOP2 /.FALSE./

C---- Clear screen and print heading ---------------------------------

      CALL HEADNG (0)

C---- Clear option flags not in use as precaution, alert user if no
```

```
C     selection has been made within a group ------------------------

      ISTOP2 = .FALSE.
      ISTOP3 = .FALSE.
      ISTOP4 = .FALSE.
      IMPORT = .FALSE.

      IF (TFOOD) THEN
        CHK = .TRUE.
        DO 151 ITF = 1, NTF
          IF (TFD(ITF)) THEN
            CHK = .FALSE.
            IF (ISALT .AND. IRRST(ITF).EQ.2) ISTOP2 = .TRUE.
            IF (FOQOPT .EQ. 2) THEN
              IF (TPRODT(ITF) .EQ. 0.0) ISTOP3 = .TRUE.
              IF (CONS(ITF) .EQ. 0.0) ISTOP4 = .TRUE.
            ELSEIF (FOQOPT .EQ. 3) THEN
              TPRODT(ITF) = 0.0
            ENDIF
            IF (TPRODT(ITF) .GT. 0.0) IMPORT = .TRUE.
          ENDIF
  151   CONTINUE
        IF (CHK) THEN
          WRITE (*,159) 'terrestrial food'
          ISTOP = .TRUE.
        ENDIF
      ELSE
        DO 141 ITF = 1, NTF
          IF (TFD(ITF)) THEN
            WRITE (*,149) 'Terrestrial food', EXPLAB(ITF+3)
            TFD(ITF) = .FALSE.
          ENDIF
  141   CONTINUE
      ENDIF


      STORE = .FALSE.
      IF (ANFOOD) THEN
        CHK = .TRUE.
        DO 152 IAN = 1, NAN
          IF (ANF(IAN)) THEN
            CHK = .FALSE.

            IF (ISALT .AND. IRRSA(IAN) .EQ. 2) ISTOP2 = .TRUE.

            IF (FOQOPT .EQ. 2) THEN
              IF (TPRODA(IAN) .EQ. 0.0) ISTOP3 = .TRUE.
              IF (CONS2(IAN) .EQ. 0.0) ISTOP4 = .TRUE.
            ELSEIF (FOQOPT .EQ. 3) THEN
```


9 1 0 4 8 0 9 4 1

```
          TPRODA(IAN) = 0.0
        ENDIF
        IF (TPRODA(IAN) .GT. 0.0) IMPORT = .TRUE.

        IF (ACUTE) THEN
          IF (STORTM(IAN) .GT. 0.0) THEN
            STORTM(IAN) = 0.0
            STORE = .TRUE.
          ENDIF
          IF (IAN .EQ. 1 .AND. STORTM(5) .GT. 0.0) THEN
            STORTM(5) = 0.0
            STORE = .TRUE.
          ELSEIF (IAN .EQ. 3 .AND. STORTM(6) .GT. 0.0) THEN
            STORTM(6) = 0.0
            STORE = .TRUE.
          ENDIF
        ENDIF

      ENDIF
152   CONTINUE
      IF (CHK) THEN
        WRITE (*,159) 'animal food products'
        ISTOP = .TRUE.
      ENDIF
    ELSE
      DO 142 IAN = 1, NAN
        IF (ANF(IAN)) THEN
          WRITE (*,149) 'Animal food product', EXPLAB(IAN+7)
          ANF(IAN) = .FALSE.
        ENDIF
142   CONTINUE
    ENDIF

    IF (STORE) WRITE (*,*) 'Animal food storage times not input to',
   .                       ' acute scenario, defaults used.'

    IF (RECRE) THEN
      DO 153 IRC = 1, NRE
        REC(IRC) = .TRUE.
153   CONTINUE
      SWING = .TRUE.
    ELSE
      DO 143 IRC = 1, NRE
        REC(IRC) = .FALSE.
143   CONTINUE
      SWING = .FALSE.
    ENDIF

    IF (AQFOOD) THEN
```

```
          CHK = .TRUE.
          DO 154 IAQ = 1, NAQ
            IF (AQF(IAQ)) THEN
              CHK = .FALSE.
              IF (FOQOPT .EQ. 3) TPRODQ(IAQ) = 0.0
            ENDIF
            IF (TPRODQ(IAQ) .GT. 0.0) IMPORT = .TRUE.
  154     CONTINUE
          IF (CHK) THEN
            WRITE (*,159) 'aquatic foods'
            ISTOP = .TRUE.
          ENDIF
        ELSE
          DO 144 IAQ = 1, NAQ
            IF (AQF(IAQ)) THEN
              WRITE (*,149) 'Aquatic foods', EXPLAB(IAQ+17)
              AQF(IAQ) = .FALSE.
            ENDIF
  144     CONTINUE
        ENDIF

        IF (ISALT .AND. DRINK .AND. DWSRC .EQ. 1) ISTOP2 = .TRUE.
        IF (ISALT .AND. RESIRR .AND. IRRSR .EQ. 2) ISTOP2 = .TRUE.

        IF (ISTOP2) THEN
          ISTOP = .TRUE.
          WRITE (*,*) 'Cannot drink or irrigate with salt water'
        ENDIF

        IF (ISTOP3) THEN
          ISTOP = .TRUE.
          WRITE (*,'(2A)') 'When uniform production is assumed, total',
     .      ' production must be input.'
        ENDIF

        IF (ISTOP4) THEN
          ISTOP = .TRUE.
          WRITE (*,'(2A)') 'When uniform production is assumed, ',
     .      'consumption must be input.'
        ENDIF

        IF (EXPORT) THEN
          IF (IMPORT) THEN
            IMPORT = .FALSE.
          ELSE
            WRITE (*,'(A)') 'Production not specified for export.'
            ISTOP = .TRUE.
          ENDIF
        ENDIF
```

```
  159 FORMAT (' No ',A,' exposure paths have been selected:'/
     .        '  Please check input file.' )

  149 FORMAT (' ',A,' exposure not selected:'/
     .        '  ',A,' will not be considered.')

C---- Set dose type and check interactions --------------------------

      ONEDOS = .TRUE.
      AEDE = .TRUE.
      CUMDOS = .TRUE.
      MAXDOS = .TRUE.

      IF (NEAR) THEN
        IF (POPDOS) THEN
          Write (*,'(2A)') 'Cannot calculate population dose for near',
     .                     ' field scenario'
          ISTOP = .TRUE.
        ENDIF
      ELSE
        IF (POPDOS) MAXDOS = .FALSE.
      ENDIF

C---- Check for exposure incompatibilities --------------------------

      IF (FINITE .AND. AIREXT) THEN
        ISTOP = .TRUE.
        WRITE (*,*) 'Finite and infinite cloud exposures cannot be ',
     .              ' considered in one scenario.'
      ENDIF

C---- Check if any prior times considered ---------------------------

      IPRIOR = .FALSE.
      IF (BEFAIR .GT. 0.0 .OR. BEFIRR .GT. 0.0) THEN
        IPRIOR = .TRUE.
      ELSEIF (NEAR) THEN
        IF (BEFORE .GT. 0.0 .OR. LOIC .GT. 0.0) IPRIOR = .TRUE.
      ENDIF

C---- Check and total population ------------------------------------

      IF (.NOT. POPDOS) THEN
        TPOPS = 1
        POPT = 1
        DWPOP = 1
        AQUPOP = 1
```

```
      ENDIF

      IF (.NOT. NEAR .AND. POPDOS) THEN

        IF (POPOPT .EQ. 1) THEN
C         Open population file, read title and total--
          LUN  = 27
          CALL XQIN (2)
          CLOSE (LUN)

        ELSEIF (POPOPT .EQ. 2) THEN
          POPT = POPIN

        ELSE
          WRITE (*,*) 'Invalid population definition option: ',POPOPT
          ISTOP = .TRUE.
        ENDIF

        IF (DWPOP .EQ. 0) DWPOP = POPT
        IF (AQUPOP .EQ. 0) AQUPOP = POPT

      ENDIF

C---- Check air transport parameter interactions ----------------------

      IF (AIR) THEN

        IF (POPDOS) THEN
C         Population--

          IF (XOQOPT .EQ. 1) THEN
C           Value should be input--

            IF (XOQI .EQ. 0.0) THEN
              WRITE (*,'(2A)')
     .        ' Population-weighted chi/Q value must be ',
     .        ' entered when air transport option = 1.'
              ISTOP = .TRUE.
            ENDIF

          ELSEIF (ACUTE) THEN
C           Select direction only valid option--
            IF (XOQOPT .NE. 3) THEN
              WRITE (*,*) 'Invalid E/Q input option for acute  release'
              ISTOP = .TRUE.
            ENDIF

          ELSEIF (XOQOPT .EQ. 0) THEN
C           Chi/Q will be calculated--
```

```
        IF (POPOPT .EQ. 2) THEN
          WRITE (*,'(2A)') ' Population grid must be used with ',
     .                     ' air transport option = 0.'
          ISTOP = .TRUE.
        ENDIF

      ELSE
        WRITE (*,*)
     .  'Air transport option cannot be 2 or 3 for population.'
        ISTOP = .TRUE.
      ENDIF

    ELSE
C     Individual--

      IF (XOQOPT .EQ. 1) THEN
C       Value will be input--
        IF (XOQI .EQ. 0.0) THEN
          WRITE (*,'(2A)') 'Chi/Q value must be entered when ',
     .                    ' air transport option = 1.'
          ISTOP = .TRUE.
        ENDIF

      ELSEIF (ACUTE) THEN
C       Select direction only valid option--
        IF (XOQOPT .NE. 3) THEN
          WRITE (*,*) 'Invalid E/Q input option for acute  release'
          ISTOP = .TRUE.
        ENDIF

      ELSEIF (XOQOPT .EQ. 2) THEN
        IF (POPOPT .EQ. 2) THEN
          WRITE (*,'(2A)') ' Population grid must be used with ',
     .                     ' air transport option = 2.'
          ISTOP = .TRUE.
        ENDIF

      ELSEIF (XOQOPT .EQ. 3) THEN
        IF (MIDIST .EQ. 0.0 .OR. MIDIR .EQ. 0) THEN
          WRITE (*,37) MIDIST, MIDIR
          ISTOP = .TRUE.
        ENDIF

      ELSE
        WRITE (*,*) 'Invalid air transport option for individual.'
        ISTOP = .TRUE.
      ENDIF
    ENDIF
```

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```
      IF (TFOOD .OR. ANFOOD) THEN
        IF (FOQOPT .GT. 3) THEN
          WRITE (*,'(2A)') ' Invalid atmospheric production ',
     .                     ' definition for ingestion population'
          ISTOP = .TRUE.
        ENDIF
      ENDIF
    ENDIF

    IF (XOQOPT .EQ. 1 .AND. FINITE) THEN
      WRITE (*,'(2A)') ' Finite plume cannot be considered ',
     .                 ' when chi/Q value entered.'
      ISTOP = .TRUE.
    ENDIF

    IF (.NOT. STACK) THEN
      IF (SHITE .NE. 0.0) THEN
        SHITE = 0.0
        IF (AIR) WRITE (*,*)
     .    'Not stack release, stack height set to 0.0'
      ENDIF
      IF (SFLOW .NE. 0.0) THEN
        SFLOW = 0.0
        IF (AIR) WRITE (*,*)
     .    'Not stack release, stack flow rate set to 0.0'
      ENDIF
      IF (SRAD .NE. 0.0) THEN
        SRAD = 0.0
        IF (AIR) WRITE (*,*)
     .    'Not stack release, stack radius set to 0.0'
      ENDIF
      IF (ETEMP .NE. 0.0) THEN
        ETEMP = 0.0
        IF (AIR) WRITE (*,*)
     .    'Not stack release, effluent temp. set to 0.0'
      ENDIF
      EFFSTK = .FALSE.
    ELSE
      IF (SFLOW.EQ.0.0 .AND. SRAD.EQ.0.0 .AND. ETEMP.EQ.0.0) THEN
        EFFSTK = .TRUE.
      ELSE
        EFFSTK = .FALSE.
        IF (SRAD .EQ. 0.0) THEN
          WRITE (*,*) 'Stack radius cannot be zero.'
          ISTOP = .TRUE.
        ENDIF
        IF (.NOT. JFIN) THEN
          DO 115 IS = 1, 16
            IF (AVEU(IS) .EQ. 0.0) THEN
```


9 1 0 4 8 0 9 4 7

```
              WRITE (*,*) 'Average wind speed cannot be zero, sector',
     .                    IS
              ISTOP = .TRUE.
            ENDIF
  115     CONTINUE
        ENDIF
      ENDIF
    ENDIF

   37 FORMAT (/' Maximum individual distance and direction must be ',
     .         'entered when air transport option = 3.'//
     .         '    MI distance: ',1PE8.2,0P,/
     .         '    MI direction index (where 1 is S->N):',I8)


C---- Set inventory flags ------------------------------------------

      RELTRM = .FALSE.
      BASIC = .FALSE.
      DERIVE = .FALSE.
      AIRCN = .FALSE.

C     Set release term flag, check inventory against transport selection--
      DO 12 J = 1, 3

        CHK = .FALSE.
        DO 10 IN = 1, NUCTOT
          IF (CASQ(J,IN) .GT. 0.0) THEN
            RELTRM = .TRUE.
            CHK = .TRUE.
          ENDIF
   10   CONTINUE

        IF (J .EQ. 1) THEN
          IF (CHK .AND. .NOT. AIR) THEN
            WRITE (*,19) 'Air'
            ISTOP = .TRUE.
          ELSEIF (.NOT. CHK .AND. AIR) THEN
            WRITE (*,119) 'Air'
            ISTOP = .TRUE.
          ENDIF

        ELSEIF (J .EQ. 2) THEN
          IF (CHK .AND. .NOT. SWAT) THEN
            WRITE (*,19) 'Surface water'
            ISTOP = .TRUE.
          ELSEIF (.NOT. CHK .AND. SWAT) THEN
            WRITE (*,119) 'Surface water'
            ISTOP = .TRUE.
```

```
          ENDIF

        ELSEIF (J .EQ. 3) THEN
          IF (CHK .AND. .NOT. BURWAS) THEN
            WRITE (*,19) 'Buried waste'
            ISTOP = .TRUE.
          ELSEIF (.NOT. CHK .AND. BURWAS) THEN
            WRITE (*,119) 'Buried waste'
            ISTOP = .TRUE.
          ENDIF
        ENDIF

   12 CONTINUE

C     Set basic concentration flag, check inventory against transport
C     selection--

      DO 14 J = 1, 5
        BAS(J) = .FALSE.
        DO 15 IN = 1, NUCTOT
          IF (CASCON(J,IN) .GT. 0.0) THEN
            BASIC = .TRUE.
            BAS(J) = .TRUE.
          ENDIF
   15   CONTINUE

        IF (J .EQ. 1) THEN
C         Set air concentration flag--
          IF (BAS(J)) AIRCN = .TRUE.
          IF (BAS(J) .AND. AIR) THEN
            WRITE (*,20) J, 'Air'
            ISTOP = .TRUE.
          ENDIF
        ELSEIF (J .EQ. 5) THEN
          IF (BAS(J) .AND. SWAT) THEN
            WRITE (*,20) J, 'Surface water'
            ISTOP = .TRUE.
          ENDIF
        ENDIF

        IF (BAS(J) .AND. AIR) THEN
          WRITE (*,'(2A)') ' Air transport cannot be considered with ',
     .                     ' basic concentrations.'
          ISTOP = .TRUE.
        ENDIF

   14 CONTINUE

      IF (AIRCN .AND. FINITE) THEN
```

```
          WRITE (*,*)
     .      'Cannot consider finite plume with input air concentration.'
          ISTOP = .TRUE.
        ENDIF

C       Set derived concentration flag, check against basic concentration
C       input and transport flags--

        DO 16 J = 6, 9

          CHK = .FALSE.
          DO 17 IN = 1, NUCTOT
            IF (CASCON(J,IN) .GT. 0.0) THEN
              DERIVE = .TRUE.
              CHK = .TRUE.
            ENDIF
   17     CONTINUE

          IF (J .LT. 8) THEN
            IF (CHK .AND. (BASIC .OR. RELTRM)) THEN
              WRITE (*,21) J
              ISTOP = .TRUE.
            ENDIF

            IF (CHK .AND. J .EQ. 6) THEN
C             Terrestrial foods--
              DO 301 ITF = 1, NTF
                GRWP(ITF) = 0.0
                IRRST(ITF) = 0.0
                RIRR(ITF) = 0.0
                IRTIMT(ITF) = 0.0
                YELD(ITF) = 0.0
                HLDUP(ITF) = 0.0
  301         CONTINUE

            ELSEIF (CHK .AND. J .EQ. 7) THEN
C             Animal products--
              DO 302 IAN = 1, NAN+2
                GRWPA(IAN) = 0.0
                IRRSA(IAN) = 0.0
                RIRRA(IAN) = 0.0
                IRTIMA(IAN) = 0.0
                YELDA(IAN) = 0.0
                DWFACA(IAN) = 0.0
                DIETFR(IAN) = 0.0
                STORTM(IAN) = 0.0
  302         CONTINUE
              DO 303 IAN = 1, NAN
                HLDUPA(IAN) = 0.0
```

```
303       CONTINUE
        ENDIF

      ELSEIF (J. EQ. 8) THEN
        IF (CHK .AND. .NOT. DRINK) THEN
          WRITE (*,*) ' Drinking water exposure flag should be set.'
          ISTOP =. TRUE.
        ENDIF
        IF (CHK .AND. (DWSRC .NE. 3)) THEN
          WRITE (*,*) ' Drinking water source flag incorrect.'
          ISTOP = .TRUE.
        ENDIF

        IF (CHK) HOLDDW = 0.0

      ELSEIF (J .EQ. 9) THEN
        IF (CHK .AND. (SWAT .OR. BAS(4))) THEN
          WRITE (*,21) J
          ISTOP = .TRUE.
        ENDIF

        IF (CHK) THEN
          DO 304 IAQ = 1, NAQ
            AQUTT(IAQ) = 0.0
            HLDUP2(IAQ) = 0.0
304       CONTINUE
        ENDIF

      ENDIF

 16 CONTINUE

      IF (DRINK .AND. DWSRC .EQ. 3 .AND. .NOT. DERIVE) THEN
        ISTOP = .TRUE.
        WRITE (*,*) 'Drinking water is from water system;'
        WRITE (*,*) ' however, no derived conc. has been entered'.
      ENDIF


 19 FORMAT (/' ',A,' tranport has not been selected:'/
     .       '  Inventory has been entered, please check input file.')

119 FORMAT (/' ',A,' tranport has been selected:'/
     .       '  No inventory entered, please check input file.')

 20 FORMAT (/' Basic concentration may not be input for path ',I1,/
     .       '  when ',A,' transport selected.')
```

```
   21 FORMAT (/' Derived concentration may not be input for path ', I1,
     .        /'  when transport or basic concentrations are input.')

C---- Check for near/far field scenario incompatiblitlities -----------

      NONAG = .FALSE.
      IF (NEAR .AND. BIOT .AND. (BTDSET .LT. 3)) NONAG = .TRUE.
      IF (NONAG .AND. (BEFAIR .GT. 0 .OR. BEFIRR .GT. 0)) THEN
        WRITE (*,'(2A)') ' Cannot consider irrigation or air ',
     .         'deposition during a non-agricultural scenario.'
        ISTOP = .TRUE.
      ENDIF

      DEEP = .FALSE.
      IF (NEAR) THEN

        IF (BURWAS) DEEP = .TRUE.
        IF (BIOT) DEEP = .TRUE.
        IF (MANULR .GT. 0.0) DEEP = .TRUE.
        IF (RF2 .GT. 0.0) DEEP = .TRUE.
        IF (BAS(3)) DEEP = .TRUE.

        IF (DEEP) THEN

          WRITE (*,*) 'Deep soil is considered.'
          IF (BURWAS .AND. WASDEP .EQ. 0.0) THEN
            ISTOP = .TRUE.
            WRITE (*,*) 'Waste depth cannot be zero.'
          ENDIF

C         Set exposure flags for external dose--
          IF (GROUND) PATH(22) = .TRUE.
          IF (GROUND .AND. BURWAS) PATH(23) = .TRUE.

        ENDIF

      ELSE
C       Far-field scenario--

        IF (BURWAS) THEN
          ISTOP = .TRUE.
          WRITE (*,*)
     .      'Waste degradation incompatible with far-field scenario.'
        ENDIF

      ENDIF

C---- Check time imcompatibilities ------------------------------------
```

```
      IF (NEAR .AND. (LOIC .GT. BEFORE)) THEN
        WRITE (*,*) 'Loss of institutional control occurred before',
     .               ' waste was stored. Invalid.'
        ISTOP = .TRUE.
      ENDIF

C---- Distances check ---------------------------------------------------

      IF (NDIST .GT. 10) THEN
        WRITE (*,*)
     .    'Maximum number of distances that can be considered is 10'
        WRITE (*,*) 'Input value for NDIST is ',NDIST
        ISTOP = .TRUE.
      ENDIF

      IF (X(1) .LT. MINDIS) THEN
        WRITE (*,*) 'Minimum distance cannot be less than ',MINDIS
        ISTOP = .TRUE.
      ENDIF

C---- Divide-by-zero checks ---------------------------------------------

      IF (BURWAS .AND. WASDEP .EQ. 0.0) THEN
        WRITE (*,*) 'Waste thickness cannot be set to 0.0'
        ISTOP = .TRUE.
      ENDIF

      IF (SWAT) THEN
        IF (MIXFLG .EQ. 0) THEN

          ISTOP2 = .FALSE.
          DO 28 IN = 1, NONUC
            IF (SWCON(IN) .EQ. 0.0) ISTOP2 = .TRUE.
   28     CONTINUE
          IF (ISTOP2 .AND. SWFLOW .EQ. 0.0) THEN
            WRITE (*,*) 'Surface water flow rate cannot = 0.0'
            ISTOP = .TRUE.
          ENDIF

        ELSEIF (MIXFLG .EQ. 2) THEN
          IF (SWDPTH .EQ. 0 .OR. SWFLOW .EQ. 0) THEN
            WRITE (*,*) 'Surface water depth and flow rate cannot = 0.0'
            ISTOP = .TRUE.
          ENDIF

        ELSE
          IF (SWDPTH .EQ. 0 .OR. SWIDTH .EQ. 0 .OR. SWFLOW .EQ. 0) THEN
            WRITE (*,'(2A)') 'Surface water width, depth, or flow rate',
     .                       ' cannot = 0.0'
```

```
            ISTOP = .TRUE.
          ENDIF
        ENDIF

      ENDIF

C---- Inhalation -----------------------------------------------------

      IF (INHAL) THEN
        IF (HRINH .LE. 0.0) WRITE (*,*)
     .  ' Zero hours of inhalation exposure will equal zero dose'
        IF (RINH .LE. 0.0) WRITE (*,*)
     .  ' Zero inhalation rate will equal zero dose'
      ENDIF

C---- Check parameter limits, divide by zero -------------------------

      IF (GROUND) THEN
        IF (IRRSR .LT. 0 .OR. IRRSR .GT. 2) THEN
          WRITE (*,*) 'Invalid residential irrigation source index'
          ISTOP = .TRUE.
        ENDIF
      ENDIF

      IF (TFOOD) THEN
        DO 101 ITF = 1, NTF
          IF (TFD(ITF)) THEN

            IF (IRRST(ITF).LT.0 .OR. IRRST(ITF).GT.2) THEN
              WRITE (*,*) 'Invalid terrestrial food no: ',ITF,
     .                    ' irrigation source index'
              ISTOP = .TRUE.
            ENDIF

            IF (YELD(ITF) .EQ. 0.0) THEN
              WRITE (*,*) 'Yield cannot be 0.0 for food pathway',
     .                    ITF
              ISTOP = .TRUE.
            ENDIF

          ENDIF
  101   CONTINUE
      ENDIF

      IF (ANFOOD) THEN
        DO 102 IAN = 1, NAN
          IF (ANF(IAN)) THEN
```

```
         IF (IRRSA(IAN).LT.0 .OR. IRRSA(IAN).GT.2) THEN
           WRITE (*,*) 'Invalid animal product no: ',IAN,
     .                 ' irrigation source index'
           ISTOP = .TRUE.
         ENDIF

         IF (DIETFR(IAN) .GT. 0.0 .AND. YELDA(IAN) .EQ. 0.0) THEN
           WRITE (*,213) IAN
           ISTOP = .TRUE.
         ENDIF

         IF (IAN .EQ. 1) THEN
           IF (DIETFR(5) .GT. 0.0 .AND. YELDA(5) .EQ. 0.0) THEN
             WRITE (*,213) IAN
             ISTOP = .TRUE.
           ENDIF
         ENDIF

         IF (IAN .EQ. 3) THEN
           IF (DIETFR(6) .GT. 0.0 .AND. YELDA(6) .EQ. 0.0) THEN
             WRITE (*,213) IAN
             ISTOP = .TRUE.
           ENDIF
         ENDIF

       ENDIF
  102  CONTINUE
      ENDIF

  213 FORMAT ('Yield should not be 0.0 for animal product no. ',I2)

C---- Read library titles for modules processed after RITQA call -------

C     Open default parameter file to store title--
      CALL OPNFIL (4,0,22)
      CLOSE (22)

C     Dose factor titles for QA--
      CALL OPNFIL (4, 0, 37)
      CLOSE (37)
      CALL OPNFIL (4, 0, 10)
      CLOSE (10)

      IF ((POPDOS .AND. POPOPT .EQ. 1) .OR.
     .   (.NOT. POPDOS .AND. AIR .AND. XOQOPT .EQ. 2)) THEN
        CALL OPNFIL (4,0,27)
        CLOSE (27)
      ENDIF
```

```
      IF (AIR) THEN
        IF (JFIN .AND. XOQOPT .NE. 1) THEN
C         Open joint frequency data file and read title--
          CALL OPNFIL (4,0,23)
          CLOSE (23)
        ELSE
          IF (POPDOS  .AND. .NOT. ACUTE .AND. XOQOPT .EQ. 2) THEN
C           Open Chi/Q input files and read title--
            CALL OPNFIL (4,0,24)
            CLOSE (24)
          ENDIF
        ENDIF

C       Open food production grid input file and read title--
        IF ((TFOOD .OR. ANFOOD) .AND. FOQOPT .EQ. 3) THEN
          CALL OPNFIL (4,0,24)
          CLOSE (24)
          CALL OPNFIL (4,0,29)
          CLOSE (29)
        ENDIF

      ENDIF

C---- Stop if necessary ------------------------------------------------

      IF (ISTOP) THEN

        WRITE (*,114)
  114   FORMAT (//' ENV input file not written.'/
     .          ' Correct mistakes and rerun ENVIN '//)

C       Set system errorlevel flag--
        CALL EXIT (1)

      ENDIF

      RETURN

C-----------------------------------------------------------------------
      END
```


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```
C-------------------------------------------------------------------
C
      SUBROUTINE CRONMOD
C
C     This model computes long-term average X/Q using a sector-averaged
C     Gaussian plume model.  The code is based of the diffusion model
C     described in Section 4.3.
C
C     Written by J.V. Ramsdell (December 3, 1986)
C     Module of Program ENVIN of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 23-Mar-88  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-------------------------------------------------------------------
C
C     AIRT()     - Average air temperature (C) by season and time of day
C     DOQ()      - Normalized deposition by direction and distance
C     DV         - Deposition velocity
C     EUFF()     - Effective wind spped by direction, read into program
C                  ENV as parameter UBAR()
C     IDIR()     - wind direction sectors; 1 = NNE, etc.
C     JFDHT      - Height for which joint frequency data is
C                  representative, m
C     JFREQ()    - Joint probability distribution wind weed, direction,
C                  and stability by season and time of day
C     MIXLAY()   - Average mixing layer thickness by season and time of
C                  day
C     NDIST2     - Number of distances to use in this subroutine
C     STAB       - Stability class index
C     SZTEMP     - SZ(IST,IX)
C     TEMP       - Intermediate value, tested before call to EXP function
C     WSECTOR    - Descriptive sector label
C     UBAR()     - Mid points of the wind speed ranges
C     XOQ()      - Normalized average air concnetration by direction
C                  and distance
C     ZO         - Surface roughness length, m
C
C-------------------------------------------------------------------

      INCLUDE 'AFPPAR.CMN'
      INCLUDE 'AIRPAR.CMN'
      INCLUDE 'OPT.CMN'

      INTEGER STAB, MIXLAY(1,1), NDIST2

      REAL DOQ(16,10), DRFS(6),
     +     UBAR(9), AIRT(1,1),
```

```
     +    SZ(7,10), SY(7,10),
     +    UEFF(16), PDIR(16),
     +    JFREQ(1,1,9,7,16), JFQ, TEMP, RMIX, Z0, JFDHT

      DATA AIRT/ 15.0 /, MIXLAY/ 1000 /, Z0 /0.03/
      DV = 0.01

C---- Read in joint frequency data ------------------------------------

      LUN = 23
C     CALL OPNFIL (1,0,LUN)
      CALL OPNFIL (4,0,LUN)
      READ (LUN,'(A8)') DUM
      READ (LUN,*) NSPD, NSTAB, NSEAS, NTOD, JFDHT
      READ (LUN,*) (UBAR(I), I=1, NSPD)

       DO 41 I = 1, NSPD
        DO 31 J = 1, NSTAB
           READ (LUN,*,END=99,ERR=98) (JFREQ(1,1,I,J,K),K=1,NDIR)
           DO 33 K = 1, NDIR
             JFREQ(1,1,I,J,K) = JFREQ(1,1,I,J,K) / 100.0
   33      CONTINUE
   31   CONTINUE
   41 CONTINUE

      CLOSE(LUN)

C---- Set up for individual case ---------------------------------------

      IF (POPDOS) THEN
        ISTART = 1
        ISTOP = NDIR
        NDIST2 = NDIST

      ELSEIF (XOQOPT .EQ. 2) THEN
C       MI location is to be selected--
        CALL XQIN (4)
        ISTART = 1
        ISTOP = NDIR
        NDIST2 = NDIST

      ELSE
C       MI location is specified--
        NDIST2 = 1
        X(1) = MIDIST
        ISTART = MIDIR
        ISTOP = MIDIR

      ENDIF
```

```
C---- Compute sigmas for fixed distances ------------------------------

      DO 20  ID = 1,NDIST2
        DO 10 STAB = 1,NSTAB
         CALL SIGMA(X(ID), STAB,SZ(STAB,ID), SY(STAB,ID))
   10   CONTINUE
   20 CONTINUE

C---- Compute XOQ, outer loop is distance -----------------------------
      DO 500  IX = 1,NDIST2

C       For each stability--
        DO 400 IST = 1,NSTAB

          SZTEMP = SZ(IST,IX)

C         And each wind speed--
          DO 300 IU = 1,NSPD

C           Compute release height wind--
            IF( SHITE .EQ. 0.0 .AND. JFDHT .LE. 15.0) THEN
              RSPD = UBAR(IU)

            ELSEIF (JFDHT .EQ. SHITE) THEN
              RSPD = UBAR(IU)

            ELSE

C             Compute release height wind using diabatic wind profile,
C             see Panofsky and Dutton (1984) Section 6.5

              RSPD = PROFILE( JFDHT, Z0, UBAR(IU), IST, SHITE)

            ENDIF

C           For each season--
            DO 200 ISEAS = 1,NSEAS

C             And time of day--
              DO 100 IT = 1,NTOD

                RMIX = REAL (MIXLAY(ISEAS,IT))

                IF (SZTEMP .GE. 1.32 * RMIX) THEN
C                 Uniform concentration distribution in the vertical--
                  GZ = 1.0

C                 Compute ground-level XU/Q--
```

```
            XUOQG = 2.5465 / ( X(IX) * RMIX )

          ELSE
C           Non-uniform vertical concentration distribution--

C           Compute ground-level concentration--
            XUOQG = 1.0159 / ( X(IX) * SZTEMP )

            PRISE = 0.0
            IF(SHITE .GT. 0.0 .AND. .NOT. EFFSTK) THEN
              CALL PLMRIZ (ZO, SRAD, SHITE, SFLOW, ETEMP,
     .                     AIRT(ISEAS,IT), RSPD, IST, RMIX, PRISE)
            ENDIF

C           Compute effective release height--
            RHT = SHITE + PRISE

C           Compute G(Z)--
            GZ = 0.0
            DO 50  N1 = 1,5
              N = -3 + N1
              TEMP = -0.5 * ( (2.0 * REAL(N) * RMIX - RHT)
     +             / SZTEMP )**2
              IF (ABS(TEMP) .LT. 20.0) GZ = GZ + 2.0 * DEXP (TEMP)
   50       CONTINUE

          ENDIF

          IF (FINITE) CALL FNTDRF (RHT, X(IX), SZTEMP, DRFS)

C         Compute X/Q--
          DO 60 ID = ISTART, ISTOP

            JFQ = JFREQ(IT,ISEAS,IU,IST,ID)

C           Skip if JFREQ = 0.0--
            IF(JFQ .GT. 0.0 ) THEN

              XOQ(IX,ID) = XOQ(IX,ID) + XUOQG / RSPD * GZ * JFQ

              IF (FINITE) THEN

                DO 55 IE = 1, 6
                  DRFOQ(ID,IX,IE) = DRFOQ(ID,IX,IE) +
     .                              DRFS(IE) * JFQ / RSPD
   55           CONTINUE
              ENDIF
```

```
C                  Compute sums to permit determination of effective speed--

                   IF( IX .EQ. 1 ) THEN
                     UEFF(ID) = UEFF(ID) + JFQ * RSPD
                     PDIR(ID) = PDIR(ID) + JFQ
                   ENDIF
                 ENDIF

  60           CONTINUE

 100         CONTINUE
 200       CONTINUE
 300     CONTINUE
 400   CONTINUE
 500 CONTINUE

C---- Save MI finite DRF factors ----------------------------------------

      IF (.NOT. POPDOS .AND. XOQOPT .NE. 2) THEN
        DO 502 IE = 1, 6
          DRFSAV(IE) = DRFOQ (MIDIR, 1, IE)
 502    CONTINUE
      ENDIF

C---- Compute deposition (Note: this is not used in GENII)--------------

      DO 551  ID = ISTART, ISTOP
        DO 550  IX = 1,NDIST2
          DOQ(ID,IX) = DV * XOQ(IX,ID)
 550    CONTINUE
 551  CONTINUE

C---- Compute effective wind speed for each direction -----------------

      DO 600 ID = ISTART, ISTOP
        UEFF(ID) = UEFF(ID) / PDIR(ID)
 600  CONTINUE


C---- Write XOQ data set for first eight directions, followed by 9-16----

      IF (POPDOS .OR. XOQOPT .EQ. 2) THEN
        LUN = 24
        CALL OPNFIL (2,3,LUN)
        IEND = (NDIR + 1) / 2

C       Write direction index, average wind speed--
        WRITE (LUN,2) (IDIR(ID), ID=1,IEND)
        WRITE (LUN,5) (UEFF(ID), ID=1,IEND)
```

```
C       Write distance, XOQ--
        DO 610  IX = 1,NDIST
          WRITE(LUN,3) X(IX), (XOQ(IX,ID), ID = 1,IEND)
  610   CONTINUE

C       Repeat--
        WRITE (LUN,2) (IDIR(ID), ID=IEND+1,NDIR)
        WRITE (LUN,5) (UEFF(ID), ID=IEND+1,NDIR)
        DO 620  IX = 1,NDIST
          WRITE (LUN,3) X(IX),(XOQ(IX,ID),ID = IEND+1,NDIR)
  620   CONTINUE

C---- WRITE DRFOQ data set if finite cloud ------------------------------

        IF (FINITE) THEN
          DO 632 IE = 1, 6

            WRITE (LUN,6) IE, (IDIR(ID), ID=1,IEND)
            DO 634  IX = 1,NDIST
              WRITE(LUN,3) X(IX), (DRFOQ(ID,IX,IE), ID = 1,IEND)
  634       CONTINUE

C           Repeat--
            WRITE (LUN,6) IE, (IDIR(ID), ID=IEND+1,NDIR)
            DO 636  IX = 1,NDIST
              WRITE (LUN,3) X(IX), (DRFOQ(ID,IX,IE), ID = IEND+1,NDIR)
  636       CONTINUE

  632     CONTINUE
        ENDIF

C---- Write DOQ data set for first eight directions, followed by 9-16 -----

        WRITE(LUN,2) (IDIR(ID), ID=1,IEND)
        DO 630  IX = 1,NDIST
          WRITE (LUN,3) X(IX),(DOQ(ID,IX), ID=1,IEND)
  630   CONTINUE
        WRITE (LUN,2) (IDIR(ID), ID=IEND+1,NDIR)
        DO 640  IX = 1,NDIST
          WRITE (LUN,3) X(IX),(DOQ(ID,IX), ID=IEND+1, NDIR)
  640   CONTINUE

C---- MI location specified ---------------------------------------------

      ELSE
        XOQI = XOQ(NDIST2, MIDIR)
        MIUBAR = UEFF(MIDIR)
      ENDIF
```

```
      CLOSE(LUN)
      RETURN

C---- Error Messages -----------------------------------------------

   98 CALL FILERR (2, LUN, 'In CRONMOD')
   99 CALL FILERR (3, LUN, 'In CRONMOD')

C---- Format Statements --------------------------------------------

    1 FORMAT (9(F7.5,1X))
    2 FORMAT (/7X,10(5X,I2,2X))
    3 FORMAT (1X,0PF6.0,10(1X,1PE8.2))
    4 FORMAT (1X,I2,3X,7F10.1)
    5 FORMAT (1X,'EFF SPD',10(F8.1,1X))
    6 FORMAT (/I2,5X,10(5X,I2,2X))

C-------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------
C
      SUBROUTINE DRFBIV (H, SY, SZ, U, DRF)
C
C     This subroutine evaluates the bivariate plume external dose rate
C     factors.
C
C     Module of Program ENVIN of the GENII Sotware Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modifcation:  7-Dec-87  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-----------------------------------------------------------------------

      INCLUDE 'OPT.CMN'

      DIMENSION DRF(6),FK(6),DRFS(6)
      DIMENSION A1(6),A2(6),B1(6),B2(6),C(6),D(6),E(6),F(6)

      DATA FK/0.506,0.508,0.508,0.508,0.507,0.505/
      DATA TWO/2./

      DATA A1/.007062, .007915, .008279, .007696, .006964, .005852/
      DATA A2/0.1651,  0.1514,  0.08769, 0.07532, 0.06136, 0.04238/
      DATA B1/0.9623,  0.9222,  0.8839,  0.8854,  0.8941,  0.9038 /
      DATA B2/0.2779,  0.2813,  0.3713,  0.3900,  0.4215,  0.4740 /
      DATA C/-.1964417,-.1885449,-.1861016,-.1860144,-.1866018,-.18710/
      DATA D/0.3163679,0.2904088,0.2840850,0.2840079,0.284138,0.28418/
      DATA E/0.3857797,0.4192123,0.4252199,0.4253229,0.4257164,0.42610/
      DATA F/2.8172996,2.8136234,2.805253,2.804869,2.8039112,2.803050/

      TWOPI = TWO * P

C     Evaluate median standard deviation--

      SYZ = SQRT (SY * SZ)

C     Loop over energy groups (6)
      DO 100 IE = 1,6

C       If median sigma is greater than 600, use semi-infinite form--

        DRFS(IE) = FK(IE) / (TWOPI*SY*SZ*U)
        IF (SYZ .GE. 600.) THEN
          DRF(IE) = DRFS(IE)
          GO TO 90
        ELSE
```

```
C         Finite plume form--

          IF (SYZ .LE. 100.) THEN
            RZ = A1(IE) * SYZ**B1(IE)
          ELSE
            RZ = A2(IE) * SYZ**B2(IE)
            IF(RZ.GT.1.) RZ = 1.
          ENDIF

          DRF(IE) = FK(IE) * RZ / (TWOPI * SY * SZ * U)
          IF (H .LE. 1.) GO TO 90
          YZ = SY / SZ
          HZ = H / SZ

          IF(HZ.LE.10.) THEN
            HST = 1. - D(IE) * HZ**E(IE)
          ELSE
            HST = F(IE) / HZ
          ENDIF

          PO = C(IE) * EXP(-0.015 * SZ)
          HE = H * HST * YZ**PO
          IF (HE.LE.0.) HE = 0.
          DRF(IE) = DRF(IE) * EXP(-HE * HE / (TWO * SZ * SZ))

        ENDIF
  90  CONTINUE
 100  CONTINUE

      RETURN
C-----------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------
C
      SUBROUTINE DRFSEC(XIN,IH,SZIN,DRFS)
C
C     This subroutine evaluates finite-plume sector-averaged external
C     dose rate factors, for one distance, release height, Sz value,
C     and for six energy groups.
C
C     Module of Program ENVIN of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 12-Nov-87  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
      DIMENSION DRFS(6)
      REAL AK(6),X1(6),X2(6),X3(6),X4(6),X5(6)
      REAL AA(6,5),HX1(6,5),HX2(6,5),HX3(6,5),HX4(6,5),HX5(6,5),
     .     HX6(6,5),HX7(6,5),HX8(6,5),HX9(6,5),DX(6,5)
      REAL SZMIN(5),SZMAX(5),SZTST(5),SZXX(5)
      DIMENSION FKINF(6)

C     Data statements for ground level releases.

      DATA FKINF/.506,.508,.508,.508,.507,.505/
      DATA AK/.00400, .00380, .00380, .00360, .00342, .00342/
      DATA X1/.2154,  .2056,  .1763,  .1763,  .1745,  .1500 /
      DATA X2/1.232, 1.328,  1.246,  1.246,  1.207,  1.0385 /
      DATA X3/-.1732,-.2005, -.1961, -.1961, -.1888,- .1609 /
      DATA X4/-.1374,.0005606,.1066, .1066,  .07537, .05711/
      DATA X5/ .191,  .199,   .182,   .182,   .182,   .182  /

C     Data statements for elevated releases.

      DATA AA/
     .     0.1909,   0.1995,   0.1930,   0.1897,   0.1888,   0.1916,
     .     0.1904,   0.1947,   0.1947,   0.1908,   0.1908,   0.1927,
     .     0.1909,   0.1974,   0.1905,   0.1875,   0.1897,   0.1914,
     .     0.1900,   0.1971,   0.1902,   0.1873,   0.1893,   0.1914,
     .     0.1897,   0.1968,   0.1899,   0.1870,   0.1890,   0.1911/
      DATA HX1/
     .-.0079836, -.0068464, -.0052439, -.0051147, -.0048566, -.0043104,
     .-.002566,  -.002611,  -.002612,  -.002612,  -.0025281, -.001543,
     .-.0003225, -.0004380, -.0003760, -.0003687, -.0003970, -.0004192,
     .-.0000072393,         -.0000218405,         -.0000287361,
     .-.0000315728,         -.000055851,          -.000055851,
     .-2.7815702E-7,        -2.179202E-6,         -5.79535E-6,
     .-7.382326E-6,          -1.12916E-5,         -1.99375E-5/
```

```
 DATA HX2/
. .0020302, .0017336, .0013365, .0012986, .0012306, .0010886,
. .0006260, .0006320, .0006176, .0006642,.00060655, .0003799,
. .00007903,.0001071,.000091789,.0000901,.00009696,.00010234,
. .0000017612, .000005309, .0000069799,.0000076741,.0000135817,
. .0000135817,
. 6.71701113E-8,5.25722E-7,1.39556E-6,1.78079E-6,2.72453E-6,
. 4.815094E-6/
 DATA HX3/
. 1.10853,  1.12874,  1.16066,  1.15024,  1.14787,  1.14342,
. 1.2196,   1.200,    1.200,    1.200,    1.1124,   1.167,
. 1.51233,  1.43132,  1.42964,  1.41711,  1.3893,   1.35022,
. 2.193499, 1.95538,  1.86565,  1.832157, 1.679025, 1.679025,
. 2.76218724,2.337204,2.109784, 2.045505, 1.950043, 1.811961/
 DATA HX4/
. 1.06496,  1.05508,  1.03420,  1.0384,   1.03637,  1.036195,
. 1.243,    1.244,    1.244,    1.244,    1.3268,   1.3207,
. 1.36939,  1.37817,  1.3972,   1.3934,   1.38817,  1.37466,
. 1.48126,  1.45935,  1.48287,  1.457285, 1.416737, 1.416737,
. 1.50715482, 1.462071, 1.4591397,1.430768, 1.410792, 1.376726/
 DATA HX5/
. -.00014497,  -.000120429,-.000107396,-.000102495,-.000089844,
. -.0000729814,
. -.0001404,   -.00009759, -.00009817, -1.E-8,     -.0000285,
. -.00008758,
. -.000060141,  .000016914, .00006756, .000113459,  .00015535,
.  .00023030,
. -.0000100728, .000094251, .000178964,.000241717,  .000401386,
.  .000401386,
. 2.31697304E-5,   1.41925E-4, 2.52501E-4,3.34745E-4, 4.020886E-4,
. 5.244587E-4/
 DATA HX6/
. -2.2101,  -2.2101,  -2.2827,  -2.33404, -2.411,   -2.411,
. -2.51,    -2.51,    -2.622,   -2.622,   -2.622,   -2.6173,
. -2.83872, -2.83001, -2.86357, -2.87222, -2.88118, -2.90774,
. -3.20158, -3.19662, -3.17113, -3.12888, -2.819186, -2.819186,
. -4.11710167, -4.002866,-3.882893,-3.809661,-3.688744, -3.434422/
 DATA HX7/
. -.6205,  -.6205,  -.6205,  -.6205,  -.6205,  -.6205,
. -.568,   -.568,   -.568,   -.568,   -.568,   -.5843,
. -.53759, -.53616, -.54130, -.54504, -.54449, -.54523,
. -.49928, -.49664, -.51172, -.52408, -.58410, -.58410,
. -.3576202, -.37317, -.40363, -.42112, -.44262, -.49152/
 DATA HX8/
. 0.1525,  0.10602, 0.10084, 0.08425, 0.07891, 0.0587,
. 6*0.,    0.950, 5*0., 6*0., 6*0./
 DATA HX9/
. 0.2761,  0.3231,  0.32880, 0.3470,  0.3607,  0.3877,
. 24*0./
```

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```
      DATA DX/
     . 900.,  1000.,  950.,  1200.,  1150.,  1500.,
     . 6*0., 250., 17*0./
      DATA SZMIN/5., 15., 30., 53., 60./
      DATA SZMAX/400.,300.,400.,500.,500./
      DATA SZTST/80.,100.,150.,150.,150./
      DATA SZXX/20.,30.,30.,40.,40./

C---- Start of calculations -------------------------------------------

      W = 0.392699*XIN
      X=XIN
      SZ=SZIN
      IF(IH.EQ.0) THEN

C       Evaluate DRF values for ground level releases (<10 meters)--

        IF(SZ.GT.200.) THEN
          DO 10 IE=1,6
            DRFS(IE)=X5(IE)/(SZ*W)
 10       CONTINUE
        ELSE
          ALZ=ALOG(SZ)
          ALX=ALOG(X)
          DO 20 IE=1,6
            IF(X.LT.900.) THEN
              CW=X4(IE) + X1(IE) * ALX + X3(IE) * ALZ
            ELSE
              IF(SZ.LT.8.05) THEN
                CW=1.
              ELSE
                CW= X2(IE) + X3(IE) * ALZ
              ENDIF
            ENDIF
            IF(CW.GT.1.0) CW = 1.0
            IF(CW.LT.0.) CW = 0.1
            DRFS(IE) = CW * AK(IE) / W
  20      CONTINUE
        ENDIF
      ELSE

C     Evaluate DRF values for elevated releases, loop on energy group--

      DO 30 IE=1,6
        IF(SZ.LT.SZMIN(IH)) SZ=SZMIN(IH)
          DRFN= FKINF(IE)*.398942/(W*SZ)
          XXX=X
          IF(SZ.LT.SZTST(IH)) THEN
            IF(XXX.GT.2000.) XXX = 2000.
```


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```
            EF=HX1(IE,IH)+HX2(IE,IH)*ALOG(XXX)
            IF(SZ.GE.SZXX(IH).AND.XXX.GT.400.)EF=EF*(HX4(IE,IH)+
     *           HX5(IE,IH)*XXX)
            DRFS(IE)=DRFN*SZ**HX3(IE,IH)*EF
          ELSE
            IF(SZ.LT.SZMAX(IH)) THEN
              IF(XXX.GT.DX(IE,IH)) THEN
                EG=EXP(HX6(IE,IH)+HX7(IE,IH)*ALOG(SZ))
              ELSE
                EG=HX8(IE,IH)*(XXX**HX9(IE,IH))*EXP(HX6(IE,IH)+
     *             HX7(IE,IH)*ALOG(SZ))
              ENDIF
              DRFS(IE)=DRFN*SZ*EG
            ELSE
              DRFS(IE)=AA(IE,IH)/(W*SZ)
            ENDIF
          ENDIF
 30   CONTINUE
      ENDIF

      RETURN
C-----------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------
---
C
      SUBROUTINE ENVLIB
C
C     This subroutine handles reading of environmental data libraries and
C     storing of parameter values for radionuclides considered in this
C     case.
C
C     Module of ENVIN of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Version of 4-Aug-88  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-------------------------------------------------------------------
C
C     A         - Input mass number
C     BIOAC1()  - Input bioaccumulation factor
C     DUM       - Character input dummy variable
C     DWIN      - Input drinking water cleanup factor
C     E         - Input element symbol
C     FTRC()    - Input food transfer factor
C     GAMMA()   - Input energy per disintegration
C     IOFF      - Column offset to select fresh or salt water
C                 bioaccumulation factors
C     LECHIN    - Input leaching rate
C     NC        - Index of the current radionuclide considered for this
C                 case
C
C-------------------------------------------------------------------

      INCLUDE 'RADIN.CMN'
      INCLUDE 'ENVPAR.CMN'
      INCLUDE 'OPT.CMN'

      REAL BIOAC1(8), FTRC(8), DWIN, LECHIN, GAMMA(6)
      INTEGER IOFF, NC
      CHARACTER E*2, A*6, DUM*8
      DATA IOFF /0/

C---- Read food transfer coefficients------------------------------------
C

      NC=1
      IFLG1=0

  120 CONTINUE
      LUN = 8
```

```
      CLOSE (LUN)
      CALL OPNFIL (4,0,LUN)

      READ (LUN,1000,ERR=98,END=99) DUM
      READ (LUN,1000,ERR=98,END=99) DUM

  121 CONTINUE

        READ (LUN,1000,ERR=98,END=123) E, DVEL, (FTRC(I),I=1,8),
     .                                 LECHIN

        IF (E .EQ. ELTT(NC)) THEN
          DPVLT(NC) = DVEL
          LEACHT(NC) = LECHIN
          DO 127 ITF = 1, NTF
            BVIT(ITF,NC) = FTRC(ITF)
  127     CONTINUE
          FMIT(1,NC) = FTRC(5)
          FMIT(2,NC) = FTRC(6)
          FMIT(3,NC) = FTRC(7)
          FMIT(4,NC) = FTRC(8)
          FMIT(5,NC) = FTRC(5)
          FMIT(6,NC) = FTRC(7)
          NC = NC+1
          IFLG1 = 0
          IF (NC .GT. NUCTOT) GOTO 125
        ENDIF
        GOTO 121

  123   CONTINUE
        IF (IFLG1 .EQ. 0) THEN
          IFLG1 = 1
        ELSE
C         No information this radionuclide
          IFLG1 = 0
          NC = NC + 1
        ENDIF
C
      IF (NC .LE. NUCTOT) GOTO 120
  125 CLOSE (LUN)
C
C
C---- Read bioaccumulation factor library-------------------------------
C

      IF (ISALT) THEN
        IOFF = 0
      ELSE
        IOFF = 4
```

```
      ENDIF

      NC=1
      IFLG1=0

  140 CONTINUE
      LUN = 9
      CLOSE (LUN)
      CALL OPNFIL (4,0,LUN)
      READ (LUN,1000,ERR=98,END=99) DUM

  141 CONTINUE

        READ (LUN,1010,ERR=98,END=143) E, (BIOAC1(I),I=1,8), DWIN

        IF (E .EQ. ELTT(NC)) THEN
          DO 144 IAQ = 1, NAQ
            BIOACT(IAQ,NC) = BIOAC1(IAQ+IOFF)
  144     CONTINUE
          DWCLET(NC) = DWIN
          NC = NC+1
          IFLG1 = 0
          IF (NC .GT. NUCTOT) GOTO 145
        ENDIF
        GOTO 141

  143   CONTINUE
          IF (IFLG1 .EQ. 0) THEN
          IFLG1 = 1
        ELSE
C         No information this radionuclide
          IFLG1 = 0
          NC = NC + 1
        ENDIF

      IF (NC .LE. NUCTOT) GOTO 140
  145 CLOSE (LUN)

C---- Read gamma energies by group -----------------------------------

      NC=1
      IFLG1=0

  160 CONTINUE
      LUN = 38
      CLOSE (LUN)
      CALL OPNFIL (4,0,LUN)

  161 CONTINUE
```

```
      READ (LUN,1020,ERR=98,END=163) E, A, (GAMMA(I),I=1,6)

      IF (E .EQ. ELTT(NC) .AND. A .EQ. AWT(NC)) THEN
        DO 167 I = 1, 6
          GAMMAT(I,NC) = GAMMA(I)
 167    CONTINUE

        NC = NC+1
        IFLG1 = 0
        IF (NC .GT. NUCTOT) GOTO 165
      ENDIF
      GOTO 161

 163  CONTINUE
      IF (IFLG1 .EQ. 0) THEN
        IFLG1 = 1
      ELSE
C       No information this radionuclide
        IFLG1 = 0
        NC = NC + 1
      ENDIF
C
      IF (NC .LE. NUCTOT) GOTO 160
  165 CLOSE (LUN)
C

      RETURN

C---- Error Messages ---------------------------------------------------

   98 CALL FILERR (2, LUN, 'In ENVLIB')
   99 CALL FILERR (3, LUN, 'In ENVLIB')

C---- Format Statements ------------------------------------------------

 1000 FORMAT (A2,1X, 10E8.0)
 1010 FORMAT (A2,8F9.1,F6.1)
 1020 FORMAT (1X, A2, A6, 2X, 6F8.0)

C----------------------------------------------------------------------
      END
```

```
C-------------------------------------------------------------------
C
      SUBROUTINE FNTDRF(HT,X,SZ,DRFS)
C
C      This subroutine controls calculation and interpolation of DRF
C      values for sector averaged dispersion.
C
C     Module of Program ENVIN of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 12-Nov-87  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-------------------------------------------------------------------

      DIMENSION DRFS(6)
      DIMENSION HTAB(6),HTLOG(6),DRF1(6),DRF2(6)

      DATA HTAB/10.,50.,100.,150.,200.,250./
      DATA HTLOG/2.30258509,3.91202301,4.60517019,5.010635294,
     .           5.29831737,5.52146092/

C----- If release height is <= 10 meters, then use ground level equation.

      IF(HT.LE.HTAB(1)) THEN
        IH=0
        CALL DRFSEC(X,IH,SZ,DRFS)
      ELSE

C---- Release height is elevated; determine if interpolation is needed.

        DO 50 JH=2,6
          IF(HT.EQ.HTAB(JH)) THEN

C             Interpolation is not needed, calculate DRFS and return.

            IH=JH-1
            CALL DRFSEC(X,IH,SZ,DRFS)
            GO TO 100
          ENDIF
 50     CONTINUE
C
C       Interpolation is needed.
C
        DO 70 JH=2,6
          IF(HT.LT.HTAB(JH)) THEN
            IH1 = JH-2
            IH2 = JH-1
            CALL DRFSEC(X,IH1,SZ,DRF1)
```

```
            CALL DRFSEC(X,IH2,SZ,DRF2)
            HLOG = ALOG(HT)
            DO 60 IE=1,6
              ALD1 = ALOG(DRF1(IE))
              ALD2 = ALOG(DRF2(IE))
              DR = ALD1 + (HLOG-HTLOG(JH-1))*
     .               (ALD2-ALD1)/(HTLOG(JH)-HTLOG(JH-1))
              DRFS(IE)=EXP(DR)
 60         CONTINUE
          GO TO 100
          ENDIF
 70     CONTINUE

C---- HT is greater than 250 m, reset to 250 meters.

        IH=5
        CALL DRFSEC(X,IH,SZ,DRFS)
      ENDIF

 100  RETURN
C-----------------------------------------------------------------------
      END
```


9 1 0 4 8 0 9 7 5

```
C------------------------------------------------------------------------
C
      REAL FUNCTION INVMOL (IST, Z0)
C
C     Function to compute the inverse of the Monin-Obukhov length.  The
C     Monin-Obukhov length is a scale length in the atmospheric
C     boundary layer.  Golder (boundary layer meteorology 3:47-58)
C     has related 1/Monin-Obukhov length to the surface roughness
C     length and stability class.  This function estimates 1/L on the
C     basis of Golder's paper.
C
C     Written by J. V. Ramsdell from program by J.G. Droppo
C     Module of Program ENVIN of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 10-Feb-88  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C------------------------------------------------------------------------
C
C     IST      - Atmospheric stability class
C     Z0       - Surface roughness length, m
C
C------------------------------------------------------------------------

       DIMENSION SLOPE(7), CONST(7)

       DATA SLOPE/.0130,.0109,.00869,.00174,-.00239,-.00673,-.0130/
       DATA CONST/-.131,-.0831,-.0450,-.00741,.0138,.0368,.0781/

       INVMOL = SLOPE(IST) * ALOG( Z0*100.) + CONST(IST)

      RETURN
C------------------------------------------------------------------------
      END
```


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```
C-----------------------------------------------------------------------------
C
      SUBROUTINE ORDER
C
C     This module reorders the input inventory to follow order of the
C     master radionuclide library.
C
C     Module of Program ENVIN of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 11-Apr-88  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C     IL       - Loop index of the master radionuclide library
C     IN       - Loop index of the list of radionuclides to be considered
C                for this case
C
C-----------------------------------------------------------------------

      INCLUDE 'RMD.CMN'
      INCLUDE 'RADIN.CMN'
      INCLUDE 'INVIN.CMN'
      INCLUDE 'OPT.CMN'

C     Check input radionclide list for validity.
      CALL IDNUC

      IN=0
      ICHN=0

      DO 20 IC=1,NCH

C       If this chain is not used, skip--
        IF (NFLAGC(IC) .EQ.1) THEN

          ICHN = ICHN+1
          NCN = NOFNUC(IC)
          IOFNUC(ICHN) = NCN
          N1 = NCHST(IC)
          N2 = N1+NCN-1
          IONE = 0
          I = 0

C         Loop on all nuclides in active chain (IM = IMEM)--

          IM = 0
```


9 1 0 4 8 0 9 7 7

```
      DO 15 IL=N1,N2

        IM = IM + 1
        IF (IONE .EQ. 0) THEN
          IF (NFLAG(IL) .EQ. 0) THEN
            I = IM
          ELSE
            IONE = 1
          ENDIF
        ENDIF

        IF (IONE .EQ. 1) THEN
          IN=IN+1
C
          Include nuclide IL in array position IN--

          ELTT(IN) = ELTM(IL)
          AWT(IN) = AWM(IL)
          HLT(IN) = TR(IL) * YRDA
          ALT(IN) = 0.693 / HLT(IN)
          IFRT(1,IN) = MAX (0,IFR(1,IL)-I)
          IFRT(2,IN) = MAX (0,IFR(2,IL)-I)
          IF (IFRT(1,IN) .GT. 0) DKT(1,IN) = DKF(1,IL)
          IF (IFRT(2,IN) .GT. 0) DKT(2,IN) = DKF(2,IL)
          BONET(IN) = BONED(IL)
          CLASST(IN) = TCLASS(IL)

          IF (CLASST(IN) .EQ. 'D') THEN
            ICLASS(IN) = 1
          ELSEIF (CLASST(IN) .EQ. 'W') THEN
            ICLASS(IN) = 2
          ELSE
            ICLASS(IN) = 3
          ENDIF

          IF (NFLAG(IL) .NE. 0) THEN
C
            Correct units on source term and transfer--
            K = NFLAG(IL)
            DO 110 J = 1, 9
              CASCON(J,IN) = CONCIN(J,K)
              IF (J .EQ. 2) CASCON(J,IN) = CASCON(J,IN)*SVU(SOLUNT)
  110       CONTINUE
            DO 111 J = 1,3
              CASQ(J,IN) = QIN(J,K)
  111       CONTINUE

          ENDIF
        ENDIF
```

```
   15     CONTINUE
          IOFNUC(ICHN) = NCN-I
C
        ENDIF
   20 CONTINUE
C
      NUCTOT = IN
      ICH = ICHN

C---- Error Messages -----------------------------------------------

      IF (NUCTOT .LE. 0) THEN
        WRITE (*,300)
  300   FORMAT (' ORDER: No inventory.')
        CALL EXIT (1)

      ELSEIF (NUCTOT .GT. NMAX) THEN
        WRITE (*,301) NUCTOT,NMAX
  301   FORMAT (' No. of radionuclides (including daughters) = ',I3/
     .          ' Maximum allowed = ',I4)
        CALL EXIT (1)
      ENDIF
C
C-----------------------------------------------------------------------

      RETURN
      END
```

```
C-----------------------------------------------------------------------
C
      SUBROUTINE PLMRIZ (Z0, SRAD, SHGHT, SFLOW, ETEMP, ATEMP, RSPD,
     .                   STAB, LAYER, PRISE)
C
C     Subroutine to calculate final plume rise given atmospheric and
C     effluent release conditions.  Subroutine should be called only if
C     the release is from a defined stack.  Plume rise computations
C     are made on the basis of information in Briggs (1984).
C
C     Written by Athey, G.F., J.V. Ramsdell, C.S. Glantz  (Created: June
C       1983 for MESOI, revised: December 1986 for GENII)
C     Module of Program ENVIN of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 10-Feb-88  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C     ATEMP    - Air temperature (C)
C     SPEED    - Surface wind ppeed (m/s)
C     RSPD     - Release height wind speed
C     STAB     - Stability class
C     LAYER    - Mixing layer thickness (m)
C     PRISE    - Calculated plume rise, (m)
C     FM       - Momentum flux
C     FB       - Bouyancy flux
C     ATEMPK   - ATEMP in degrees Kelvin
C     ETEMPK   - ETEMP in degrees Kelvin
C     RM       - Momentum rise
C     RB1      - Bouyancy rise
C
C-----------------------------------------------------------------------
C

      INTEGER STAB
      REAL LAYER

      REAL C(3)
      DATA C/ 0.049, 0.27, 0.49 /
      PI = 3.14159

      PRMAX = (LAYER - SHGHT) / 2.

      IF (SHGHT .GE. LAYER .OR. SFLOW .LE. 0.0) THEN
C       If stack height greater than of equal to mixed depth, no plume rise--
```

```
          PRISE = 0.0

        ELSE
C         Compute momentum and buoyancy fluxes--

          WO =  SFLOW / ( PI * SRAD**2 )
          ETEMPK = ETEMP + 273.16
          ATEMPK = ATEMP + 273.16

C         Momentum flux--
          FM = (ATEMPK / ETEMPK) * WO * SFLOW / PI

C         Buoyancy flux--
          FB = 9.8 * (1 - ATEMPK/ETEMPK) * WO * SRAD**2
          IF(FB .LT. 0.0) FB = 0.0

C         Obtain USTAR
          USTR = USTAR (SHGHT, Z0, RSPD, STAB)

C         Compute momentum rise ... rise limited by turbulence--
          RM = 0.9 *  SQRT( ( RSPD / USTR ) * FM ) /
     +          ( RSPD * ( 0.4 + 1.2 / (WO/RSPD) ) )

C         Compute buoyancy rise for near neutral conditions--
          RB1 = 1.54 * ( FB / ( RSPD * USTR**2 ) )**(2./3.) *
     +           SHGHT**(1./3.)

          IF(STAB .LE. 4) THEN

            RB = RB1

          ELSE

C           Stable atmospheric conditions (P-G classes E-G)--
            IS = STAB-4
            S = C(IS) / ATEMPK

C           Compute buoyancy rise for stable conditions--
            IF( RSPD .GE. 1.0 ) THEN
              RB2 = 2.6 * ( FB / (RSPD * S) )**(1./3.)
            ELSE
              RB2 = 5.3 * ( FB / S**1.5 )**0.25 - 6.0 * SRAD
            ENDIF

            RB = AMIN1(RB1,RB2)

          ENDIF
```

```
C       Compute plume rise--
        PRISE = RM + RB
        IF( PRISE .GT. PRMAX) PRISE = PRMAX

      ENDIF
      RETURN

C-----------------------------------------------------------------------
      END
```


9 1 0 4 8 0 9 8 2

```
C-----------------------------------------------------------------------
C
      SUBROUTINE PROB (MAXC, NC, TS2, EPROB, EOQ, TTIME)
C
C     This module estimates probability of exceeding E/Q.  The subroutine
C     takes the probabilities associated with the sorted (largest first)
C     E/Q values and generates a cumulative distribution of the
C     probability that E/Q will be less than the given value.  It is
C     assumed that each E/Q represents the mid point of a range with
C     50% probability of being exceeded for the set of atmospheric
C     conditions.  THe cumulative distribution is then used to estimate
C     the values of E/Q that have 1, 5, 10, 25, and 50% probability of
C     being exceeded assuming that the transport is in the direction
C     to take material from the source to the receptor.  E/Q values
C     are determined by linear interpolation.  The travel time for each
C     E/Q is the lower value of travel times associated with the E/Q
C     values used for interpolation.
C

C     Written by J. V. Ramsdell (December 11, 1986)
C     Module of Program ENVIN of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 15-Dec-87  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-----------------------------------------------------------------
C
C     MAXC      - The maximum number of E/Q values
C     NC        - Number of classes with frequency = 0
C     TS2       - Matrix of sorted E/Qs, frequencies, and travel times
C     EOQR()    - E/Q values for the five probability levels (output)
C     TTIME()   - Travel time for each E/Q  (output)
C
C-----------------------------------------------------------------

      DIMENSION TS2(3,MAXC), EPROB(5), EOQ(5), TTIME(5), PR(5)

      DATA PR/ 0.01, 0.05, 0.10, 0.25, 0.50 /

C     Generate cumulative distribution--

      P1 = TS2(2,1) / 2.0
      TS2(2,1) = P1

      DO 100  N = 2,NC
        P2 = TS2(2,N) / 2.0
        TS2(2,N) = TS2(2,N-1) + P1 + P2
```

```
        P1 = P2
  100 CONTINUE

      TOTAL = TS2(2,NC) + P1

C     Normalize for wind direction frequency--
      DO 200  N = 1,NC
        TS2(2,N) = TS2(2,N) / TOTAL
  200 CONTINUE

C     Determine E/Q values--

C     Initial check for frequency < 0.01--
      IF( TS2(2,1) .LT. 0.01 ) THEN

C       Normal search--

        I = 1
        DO 400  N = 1,NC-1
          N1 = N + 1

  300     CONTINUE

          IF( TS2(2,N) .LE. PR(I) .AND. TS2(2,N1) .GT. PR(I) ) THEN

C           Compute E/Q and select travel time

            EPROB(I) = PR(I)
            EOQ(I) = TS2(1,N1) + ( TS2(1,N) - TS2(1,N1) )
     +               * ( PR(I) - TS2(2,N1) ) / ( TS2(2,N) - TS2(2,N1) )
            TTIME(I) = AMIN1( TS2(3,N), TS2(3,N1) )

C           Increment i (select next probability level)--
            I = I + 1
            IF( I .GT. 5 ) THEN
              RETURN
            ELSE
              GOTO 300
            ENDIF

          ENDIF
  400   CONTINUE
      ELSE

C       The largest E/Q value has a frequency > 0.01--

        I = 1

  500   CONTINUE
```

```
        IF( TS2(2,1) .GT. PR(I) ) THEN
          EOQ(I) = TS2(1,1)
       EPROB(I) = TS2(2,1)
          TTIME(I) = TS2(3,1)
          I = I + 1
          GOTO 500
        ENDIF

C       Resume normal search--

        DO 700  N = 1,NC-1
          N1 = N + 1

  600     CONTINUE

          IF( TS2(2,N) .LE. PR(I) .AND. TS2(2,N1) .GT. PR(I) ) THEN

C           Compute E/Q and select travel time

            EPROB(I) = PR(I)
            EOQ(I) = TS2(1,N1) + ( TS2(1,N) - TS2(1,N1) )
     +               * ( PR(I) - TS2(2,N1) ) / ( TS2(2,N) - TS2(2,N1) )
            TTIME(I) = AMIN1( TS2(3,N), TS2(3,N1) )

C           Increment i (select next probability level)
            I = I + 1
            IF( I .GT. 5 ) THEN
              RETURN
            ELSE
              GOTO 600
            ENDIF

          ENDIF
  700   CONTINUE
       ENDIF

       RETURN
C-----------------------------------------------------------------------

       END
```

```
C-----------------------------------------------------------------------------
C
      FUNCTION PROFILE (HT, Z0, SPD, IST, HGHT)
C
C     This module computes release height winds from 10 m winds using
C     diabatic wind profile, see Panofsky and Dutton (1984), Section 6.5,
C     from a surface wind measurement.  The profile used is determined
C     by the atmospheric stability class.  The profile uses the height
C     of measurement of the surface wind, which is assumed to be 10 m,
C     and a surface roughness length, which is assumed to be 0.03 m.
C     Revised to compute wind speed directly using similarity relation-
C     ships to estimate USTAR first.
C
C     Written by J. V. RAMSDELL  (December 12, 1986), Revised on
C     February 5, 1988.
C     Module of Program ENVIN of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 10-Feb-87  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C     HGHT      - Release height, m
C     HT        - Wind measurement height, m
C     INVMOL    - 1/Monin-Obukhov length used in diabatic wind profiles
C     IST       - Atmospheric stability class
C     SPD       - Surface wind speed, m/sec
C     Z0        - Surface roughness length, m
C
C-----------------------------------------------------------------------

      REAL INVMOL, MOLINV

      PI = 3.14159
      X = 0.0
      USTAR1 = USTAR (HT, Z0, SPD, IST)
      MOLINV = INVMOL (IST, Z0)

      IF (IST .LE. 3) THEN

C       Unstable conditons--

        X = (1.0 - 16.0 * HGHT *  MOLINV ) **0.25
        PSI = ALOG( (0.5+X*X/2) * (0.5+X/2)**2 ) - 2*ATAN(Y) + PI/2

      ELSEIF (IST .GE. 5) THEN
```

```
C       Stable conditions--
        PSI = -5.0 * HGHT * MOLINV

      ELSE

C       Neutral conditions--
        PSI = 0.0

      ENDIF

      WIND = USTAR1 / 0.4 * (ALOG (HGHT / Z0) - PSI)
      PROFILE = WIND

      RETURN

C----------------------------------------------------------------------
      END
```

9 1 0 4 8 0 9 8 7

```
C-----------------------------------------------------------------------
C
      SUBROUTINE READIN
C
C     Read primary input file.
C
C     Module of Program ENVIN of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 8-Jul-88  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C     CTEMP() - Temporary character array for input
C     E       - Input element symbol
C     A       - Input mass number
C     I       - Radionuclide loop index
C     J       - Input concentration loop index
C     LTEMP   - Temporary LOGICAL input parameter
C     LUN     - Logical unit device index
C     RTEMP() - Temporary REAL input parameter
C
C-----------------------------------------------------------------------

      INCLUDE 'AFPPAR.CMN'
      INCLUDE 'AIRPAR.CMN'
      INCLUDE 'ANMPAR.CMN'
      INCLUDE 'AQUPAR.CMN'
      INCLUDE 'EXTPAR.CMN'
      INCLUDE 'FODPAR.CMN'
      INCLUDE 'FILES.CMN'
      INCLUDE 'INVIN.CMN'
      INCLUDE 'OPT.CMN'
      INCLUDE 'SOLPAR.CMN'
      INCLUDE 'SWPAR.CMN'
      INCLUDE 'TIMES.CMN'
      INCLUDE 'TITL.CMN'

      CHARACTER DUM*8, E*2, A*6, CTEMP(4)*8, CTEMP2(4)*10
      REAL RTEMP(5)
      LOGICAL LTEMP

C     Open file for workspace--
      CALL OPNFIL (2,0,7)

      LUN  = 5
      CALL OPNFIL (1,0,LUN)
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```
      READ (LUN,1,ERR=98,END=99) DUM
      READ (LUN,'(7X,A73)') TITLS(5)
      READ (LUN,'(7X,A30)') INFILN
      READ (LUN,1) DUM

C---- Read input options -------------------------------------------

      READ (LUN,2) NEAR
      READ (LUN,2) POPDOS
      READ (LUN,2) ACUTE
      READ (LUN,111) DUM, DUM, DUM

      READ (LUN,3) AIR, FINITE
      READ (LUN,3) SWAT, AIREXT
      READ (LUN,3) BIOT, GROUND
      READ (LUN,3) BURWAS, RECRE
      READ (LUN,*) INHAL
      READ (LUN,5) DRINK
      READ (LUN,3) OUTEDE, AQFOOD
      READ (LUN,3) OUTRAD, TFOOD
      READ (LUN,3) OUTPTH, ANFOOD
      READ (LUN,3) DEBUG, SLING
      READ (LUN,111) DUM, DUM, DUM

C---- Read inventory -----------------------------------------------

      READ (LUN,*) IUNIT
      READ (LUN,*) SOLUNT
      IF (SOLUNT .LT. 1) SOLUNT = 1
      CALL DUMRED (LUN,9)

C     Read first set of inventories--
      I = 1
  100 CONTINUE
        READ (LUN,20) ELTI(I)
        IF (ELTI(I) .EQ. '  ' .OR. ELTI(I) .EQ. '--') GOTO 101
        BACKSPACE (LUN)
        READ (LUN,20) ELTI(I), AWI(I), (QIN(J,I),J=1,3),
     .                         (CONCIN(J,I), J=1,5)
        I = I + 1
      GOTO 100

C     Read second set of inventories--

  101 CONTINUE
      IF (ELTI(I) .EQ. '  ') CALL DUMRED (LUN,7)
      IF (ELTI(I) .EQ. '--') CALL DUMRED (LUN,6)
      NIN = I - 1
  102 CONTINUE
```

```
      I = 0
C     Check if this radionuclide has already been entered--
      READ (LUN,20) E
      IF (E .EQ. '  ' .OR. E .EQ. '##') GOTO 103
      BACKSPACE (LUN)
      READ (LUN,20) E, A, (RTEMP(J),J=1,4)

      DO 104 IN = 1, NIN
        IF (E .EQ. ELTI(IN) .AND. A .EQ. AWI(IN)) I = IN
  104 CONTINUE

C     This is a new radionuclide--
      IF (I .EQ. 0) THEN
        NIN = NIN + 1
        I = NIN
        ELTI(I) = E
        AWI(I) = A
      ENDIF

C     Transfer input concentrations into proper arrays--

      DO 105 J = 1, 4
        CONCIN(J+5,I) = RTEMP(J)
  105 CONTINUE

     GOTO 102
  103 CONTINUE

     IF (E .EQ. '  ') THEN
       READ (LUN,11) DUM, DUM
     ELSE
       READ (LUN,1) DUM
     ENDIF

C---- Read times ---------------------------------------------------------

     READ (LUN,*) NTKEND
     READ (LUN,*) DCEND
     READ (LUN,*) RELEND
     READ (LUN,*) BEFAIR
     READ (LUN,*) BEFIRR
     READ (LUN,111) DUM,DUM,DUM

C---- Read population options -------------------------------------------

     READ (LUN,*) POPOPT
     READ (LUN,*) POPIN
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```
      READ (LUN,1111) DUM,DUM,DUM,DUM

C---- Read near-field parameters -------------------------------------

      READ (LUN,*) BEFORE
      READ (LUN,*) LOIC
      READ (LUN,*) RF1
      READ (LUN,*) RF2
      READ (LUN,*) MANULR
      READ (LUN,'(A8)') DUM
      IF (DUM .EQ. '        ') DUM = '0       '
      WRITE (7,*) DUM
      BACKSPACE 7
      READ (7,*) FRSIZ
      READ (LUN,11) DUM, DUM

C---- Read air transport parameters ------------------------------------

      READ (LUN,4) DUM
      IF (DUM .EQ. '        ') DUM = '0       '
      WRITE (7,'(A8)') DUM
      BACKSPACE 7
      READ (7,*) IRELES

      READ (LUN,6) DUM, STACK
      WRITE (7,'(A8)') DUM
      BACKSPACE 7
      READ (7,*) XOQOPT

      READ (LUN,7) SHITE
      READ (LUN,7) SFLOW

      READ (LUN,9) DUM, SRAD
      WRITE (7,'(A8)') DUM
      BACKSPACE 7
      READ (7,*) XOQI

      READ (LUN,9) DUM, ETEMP
      WRITE (7,'(A8)') DUM
      BACKSPACE 7
      READ (7,*) MIDIR

      READ (LUN,10) MIDIST, BUILDX

      READ (LUN,12) JFIN, DUM
      IF (DUM .EQ. ' chi/Q g') THEN
        BUILDH = 0.0
      ELSE
        WRITE (7,*) DUM
```

```
      BACKSPACE 7
      READ (7,*) BUILDH
    ENDIF

    READ (LUN,11) DUM, DUM

C---- Read surface water transport values -----------------------------

    IF (SWAT) THEN
      READ (LUN,*) MIXFLG
      READ (LUN,*) MIXR
      READ (LUN,*) SWFLOW
      READ (LUN,*) SWTT
      IF (MIXFLG .GT. 0) THEN
        READ (LUN,1) DUM
        READ (LUN,*) SWQB
        READ (LUN,*) SWLSX
        READ (LUN,*) SWOSY
        READ (LUN,*) SWDPTH
        READ (LUN,*) SWIDTH
        READ (LUN,*) SWDZ
        READ (LUN,11) DUM, DUM
      ELSE
        CALL DUMRED (LUN,9)
      ENDIF
    ELSE
      CALL DUMRED (LUN,13)
    ENDIF

C---- Read waste form availability values -----------------------------

    READ (LUN,*) PACKHL
    READ (LUN,*) WASDEP
    READ (LUN,*) OVRBRD
    READ (LUN,11) DUM,DUM

C---- Read biotic transport values ------------------------------------

    IF (BIOT) THEN
      READ (LUN,*) BTPRE
      READ (LUN,*) BTNTK
      READ (LUN,*) BTDSET
      CALL DUMRED (LUN,6)
    ELSE
      CALL DUMRED (LUN,9)
    ENDIF

C---- Read external exposure values ------------------------------------
```

9 1 0 4 8 0 9 9 2

```
      READ (LUN,25) RTEMP(1), CTEMP2(1)
      READ (LUN,25) RTEMP(2), CTEMP2(2)
      READ (LUN,*) HRSWIM
      READ (LUN,25) RTEMP(3), CTEMP2(3)
      READ (LUN,25) RTEMP(4), CTEMP2(4)
      READ (LUN,*) SHRTYP
      READ (LUN,*) RECTT
      READ (LUN,*) FRCLOD

      WRITE (7,*) RTEMP(1)
      BACKSPACE 7
      READ (7,*) HRPLUM
      WRITE (7,*) RTEMP(2)
      BACKSPACE 7
      READ (7,*) HRGRD
      WRITE (7,*) RTEMP(3)
      BACKSPACE 7
      READ (7,*) HRBOAT
      WRITE (7,*) RTEMP(4)
      BACKSPACE 7
      READ (7,*) HRSHOR

      WRITE (7,'(A)') CTEMP2(1)
      BACKSPACE 7
      READ (7,*) RESIRR

      IF (RESIRR) THEN
        WRITE (7,'(A)') CTEMP2(2)
        BACKSPACE 7
        READ (7,*) IRRSR
        WRITE (7,'(A)') CTEMP2(3)
        BACKSPACE 7
        READ (7,*) RIRRR
        WRITE (7,'(A)') CTEMP2(4)
        BACKSPACE 7
        READ (7,*) IRTIMR
      ELSE
        IRRSR = 0
      ENDIF

      READ (LUN,11) DUM, DUM

C---- Read inhalation values ------------------------------------------

      IF (INHAL) THEN
        READ (LUN,*) HRINH
        READ (LUN,*) IRES
        READ (LUN,*) RTEMP(1)
        IF (IRES .EQ. 1) THEN
```

```
      XMLF = RTEMP(1)
    ELSEIF (IRES .EQ. 2) THEN
      AVALSL = RTEMP(1)
    ENDIF
    READ (LUN,11) DUM, DUM
  ELSE
    CALL DUMRED (LUN, 5)
  ENDIF

C---- Read ingestion population values --------------------------------

      READ (LUN,*) FOQOPT
      IF (FOQOPT .EQ. 0) THEN
        READ (LUN,*) FOQ
      ELSE
        READ (LUN,1) DUM
      ENDIF
      READ (LUN,111) DUM, DUM, DUM
      READ (LUN,*) AQUPOP
      READ (LUN,*) DWPOP
      READ (LUN,*) EXPORT
      CALL DUMRED (LUN,5)

C---- Read aquatic foods / drinking water values ----------------------

      IF (AQFOOD .OR. DRINK) THEN

        READ (LUN,*) ISALT
        CALL DUMRED (LUN,5)

        DO 110 IAQ = 1, NAQ
          READ (LUN,21) AQF(IAQ), AQUTT(IAQ), TPRODQ(IAQ), HLDUP2(IAQ),
                        USAG(IAQ), CTEMP(IAQ)
  110   CONTINUE

        IF (DRINK) THEN

          WRITE (7,'(A8)') CTEMP(1)
          BACKSPACE 7
          READ (7,*) DWSRC

          WRITE (7,'(A8)') CTEMP(2)
          BACKSPACE 7
          READ (7,*) DWTRET

          WRITE (7,'(A8)') CTEMP(3)
          BACKSPACE 7
          READ (7,*) HOLDDW
```

```
          WRITE (7,'(A8)') CTEMP(4)
          BACKSPACE 7
          READ (7,*) DWUSAG

        ENDIF

        CALL DUMRED (LUN,7)

      ELSE
        CALL DUMRED (LUN, 17)
      ENDIF

C---- Read terrestrial food values -------------------------------------

      IF (TFOOD) THEN
        DO 120 ITF = 1, NTF
          READ (LUN,22) TFD(ITF), GRWP(ITF),
     .                  IRRST(ITF), RIRR(ITF), DUM,
     .                  YELD(ITF), TPRODT(ITF), HLDUP(ITF), CONS(ITF)

          IF (IRRST(ITF) .GT. 0) THEN
            IF (DUM .EQ. '       ') THEN
              IRTIMT(ITF) = 0
            ELSE
              WRITE (7,'(A7)') DUM
              BACKSPACE 7
              READ (7,*) IRTIMT(ITF)
            ENDIF
          ENDIF

  120   CONTINUE
        CALL DUMRED (LUN,8)
      ELSE
        CALL DUMRED (LUN,12)
      ENDIF

C---- Read animal product values ------------------------------------

      IF (ANFOOD) THEN

        DO 130 IAN = 1, NAN
          READ (LUN,23) ANF(IAN), CONS2(IAN), HLDUPA(IAN), TPRODA(IAN),
     .      DWFACA(IAN), DIETFR(IAN),
     .      GRWPA(IAN), IRRSA(IAN), RIRRA(IAN),
     .      IRTIMA(IAN), YELDA(IAN), STORTM(IAN)
  130   CONTINUE

        READ (LUN,1) DUM
```

```
      DO 132 I = 5,6
        READ (LUN,24) DIETFR(I), GRWPA(I), IRRSA(I), RIRRA(I),
     .                IRTIMA(I), YELDA(I), STORTM(I)
132   CONTINUE
    ENDIF

    CLOSE (7)
    CLOSE (LUN)
    RETURN

C---- Error Messages ---------------------------------------------

   98 CALL FILERR (3, LUN, 'In READIN')
   99 CALL FILERR (2, LUN, 'In READIN')


C---- Format Statements -------------------------------------------

    1 FORMAT (A8)
   11 FORMAT (A10/A10)
  111 FORMAT (A10/A10/A10)
 1111 FORMAT (A10/A10/A10/A10)
11111 FORMAT (A10/A10/A10/A10/A10)

    2 FORMAT (L5)
    3 FORMAT (BN, L5, T39, L5)
    4 FORMAT (BN, T47, A8)
    5 FORMAT (BN, T39, L5)
    6 FORMAT (BN, A8, T47, L8)
    7 FORMAT (BN, T47, F8.0)
    8 FORMAT (BN, T53, A8)
    9 FORMAT (BN, A8, T47, F8.0)
   10 FORMAT (BN, F10.3, T47, F8.0)
   12 FORMAT (BN, L10, T47, A8)
   20 FORMAT (5X, A2, A6, 8E8.1)

   21 FORMAT (11X, L3, 8X, F5.1, E9.1, F8.1, F7.1, 2X, A8)

   22 FORMAT (11X, L3, 7X, F6.1, 2X, I1, F6.1, A7, 1X, F7.1, 2X, E8.2,
     .        2X, F6.1, 3X, F6.1)

   23 FORMAT (L3, 8X, E6.1, F6.2, E7.2, F8.1, F6.2, F6.2, I3, F6.2,
     .        F6.2, F7.2, F6.2)

   24 FORMAT (38X, F6.2, F6.2, I3, F6.2, F6.2, F7.2, F6.2)
   25 FORMAT (E10.2, 31X, A10)

C-----------------------------------------------------------------
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END

9 1 0 4 8 0 9 9 7

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C-----------------------------------------------------------------------
C
      SUBROUTINE REDFLT
C
C     Read default parameter file and check values.  If different from
C     value specified in BLOCK DATA, write message to output file and
C     update parameter value.  REDFLT reads from LUN2 and writes to the
C     output file specified by parameter LUN in common block GENRL which
C     should be set by the calling module.
C
C     Module of Program ENVIN of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 4-Aug-88  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C     LUN2   - Logical unit number of the input file
C     LTEMP  - Temporary LOGICAL input parameter
C     TEMP() - Temporary REAL input parameter array
C     RTEMP  - Temporary REAL input parameter
C
C-----------------------------------------------------------------------

      INCLUDE 'AIRPAR.CMN'
      INCLUDE 'ANMPAR.CMN'
      INCLUDE 'EXTPAR.CMN'
      INCLUDE 'FILES.CMN'
      INCLUDE 'FODPAR.CMN'
      INCLUDE 'OPT.CMN'
      INCLUDE 'SOLPAR.CMN'
      INCLUDE 'SWPAR.CMN'
      INCLUDE 'TITL.CMN'

      CHARACTER*8 DUM
      REAL RTEMP, TEMP(10)
      INTEGER LUN2, ITEMP
      LOGICAL LTEMP

      LUN2  = 22
      OPEN (LUN2, FILE=FILN(LUN2), STATUS='OLD', IOSTAT=IOS)
      IF (IOS .NE. 0) GOTO 97

      READ (LUN2,1,ERR=98,END=99) DUM
      READ (LUN2,11,ERR=98,END=99) DUM, DUM

C---- Read inventory parameters -----------------------------------------
```

```
      READ (LUN2,*,ERR=98,END=99) (TEMP(I), I=1,5)
      DO 100 I = 1, 5
        IF (TEMP(I) .NE. NVU(I)) THEN
          WRITE (LUN,10) NVU(I), TEMP(I), 'NVU(n)'
          NVU(I) = TEMP(I)
        ENDIF
  100 CONTINUE

      READ (LUN2,*) (TEMP(I), I=1,3)
      DO 110 I = 1, 3
        IF (TEMP(I) .NE. SVU(I)) THEN
          WRITE (LUN,10) SVU(I), TEMP(I), 'SVU(n)'
          SVU(I) = TEMP(I)
        ENDIF
  110 CONTINUE


C---- Read environmental parameters ------------------------------------

      READ (LUN2,11) DUM, DUM
      READ (LUN2,*) ITEMP
      IF (ITEMP .NE. PRCNTI) THEN
        WRITE (LUN,30) PRCNTI, ITEMP, 'PRCNTI'
        PRCNTI = ITEMP
      ENDIF

      READ (LUN2,*) RTEMP
      IF (RTEMP .NE. DPVRES) THEN
        WRITE (LUN,10) DPVRES, RTEMP, 'DPVRES'
        DPVRES = RTEMP
      ENDIF

      READ (LUN2,*) RTEMP
      IF (RTEMP .NE. LEAFRS) THEN
        WRITE (LUN,10) LEAFRS, RTEMP, 'LEAFRS'
        LEAFRS = RTEMP
      ENDIF

      READ (LUN2,*) TEMP
      DO 134 I = 1, 4
        IF (TEMP(I) .NE. BIOMAS(I)) THEN
          WRITE (LUN,10) BIOMAS(I), TEMP(I), 'BIOMAS(n)'
          BIOMAS(I) = TEMP(I)
        ENDIF
  134 CONTINUE
      DO 135 I = 1, 6
        IF (TEMP(I+4) .NE. BIOMA2(I)) THEN
          WRITE (LUN,10) BIOMA2(I), TEMP(I+4), 'BIOMA2(n)'
          BIOMA2(I) = TEMP(I+4)
```


9 1 0 4 8 0 9 9 9

```
      ENDIF
  135 CONTINUE

      READ (LUN2,*) RTEMP
      IF (RTEMP .NE. DEPFR2) THEN
        WRITE (LUN,10) DEPFR2, RTEMP, 'DEPFR2'
        DEPFR2 = RTEMP
      ENDIF

      READ (LUN2,*) RTEMP
      IF (RTEMP .NE. SURCM) THEN
        WRITE (LUN,10) SURCM, RTEMP, 'SURCM'
        SURCM = RTEMP
      ENDIF

      READ (LUN2,*) RTEMP
      IF (RTEMP .NE. SLDN) THEN
        WRITE (LUN,10) SLDN, RTEMP, 'SLDN'
        SLDN = RTEMP
      ENDIF

      READ (LUN2,*) RTEMP
      IF (RTEMP .NE. SSLDN) THEN
        WRITE (LUN,10) SSLDN, RTEMP, 'SSLDN'
        SSLDN = RTEMP
      ENDIF

      READ (LUN2,*) LTEMP
      IF ((LTEMP .AND. .NOT. HARVST) .OR.
     .    (.NOT. LTEMP .AND. HARVST)) THEN
        WRITE (LUN,20) HARVST, LTEMP, 'HARVST'
        HARVST = LTEMP
      ENDIF

      READ (LUN2,*) RTEMP
      IF (RTEMP .NE. SOLING) THEN
        WRITE (LUN,10) SSLDN, RTEMP, 'SOLING'
        SOLING = RTEMP
      ENDIF

      READ (LUN2,*) RTEMP
      IF (RTEMP .NE. WTIM) THEN
        WRITE (LUN,10) WTIM, RTEMP, 'WTIM'
        WTIM = RTEMP
      ENDIF

      READ (LUN2,*) (TEMP(I), I=1,4)
      DO 131 I = 1, 4
        IF (TEMP(I) .NE. TRANS(I)) THEN
```

```
        WRITE (LUN,10) TRANS(I), TEMP(I), 'TRANS(n)'
        TRANS(I) = TEMP(I)
      ENDIF
131 CONTINUE

    READ (LUN2,*) (TEMP(I), I=1,6)
    DO 121 I = 1, 6
      IF (TEMP(I) .NE. TRANSA(I)) THEN
        WRITE (LUN,10) TRANSA(I), TEMP(I), 'TRANSA(n)'
        TRANSA(I) = TEMP(I)
      ENDIF
121 CONTINUE

    READ (LUN2,*) (TEMP(I), I=1,6)
    DO 120 I = 1, 6
      IF (TEMP(I) .NE. CONSUM(I)) THEN
        WRITE (LUN,10) CONSUM(I), TEMP(I), 'CONSUM(n)'
        CONSUM(I) = TEMP(I)
      ENDIF
120 CONTINUE

    READ (LUN2,*) (TEMP(I), I=1,4)
    DO 130 I = 1, 4
      IF (TEMP(I) .NE. DWATER(I)) THEN
        WRITE (LUN,10) DWATER(I), TEMP(I), 'DWATER(n)'
        DWATER(I) = TEMP(I)
      ENDIF
130 CONTINUE

    READ (LUN2,*) (TEMP(I), I=1,4)
    DO 132 I = 1, 4
      IF (TEMP(I) .NE. FRACUT(I)) THEN
        WRITE (LUN,10) FRACUT(I), TEMP(I), 'FRACUT(n)'
        FRACUT(I) = TEMP(I)
      ENDIF
132 CONTINUE

     READ (LUN2,*) (TEMP(I), I=1,4)
    DO 140 I = 1, 4
      IF (TEMP(I) .NE. SHORWI(I)) THEN
        WRITE (LUN,10) SHORWI(I), TEMP(I), 'SHORWI(n)'
        SHORWI(I) = TEMP(I)
      ENDIF
140 CONTINUE

    READ (LUN2,*) RTEMP
    IF (RTEMP .NE. INGWAT) THEN
      WRITE (LUN,10) INGWAT, RTEMP, 'INGWAT'
      INGWAT = RTEMP
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      ENDIF

      READ (LUN2,*) RTEMP
      IF (RTEMP .NE. TCWS) THEN
        WRITE (LUN,10) TCWS, RTEMP, 'TCWS'
        TCWS = RTEMP
      ENDIF

      READ (LUN2,*) (TEMP(I), I=1,3)
      DO 150 I = 1, 3
        IF (TEMP(I) .NE. YELDBT(I)) THEN
          WRITE (LUN,10) YELDBT(I), TEMP(I), 'YELDBT(n)'
          YELDBT(I) = TEMP(I)
        ENDIF
  150 CONTINUE

      READ (LUN2,*) (TEMP(I), I=1,3)
      DO 160 I = 1, 3
        IF (TEMP(I) .NE. TOTEXC(I)) THEN
          WRITE (LUN,10) TOTEXC(I), TEMP(I), 'TOTEXC(n)'
          TOTEXC(I) = TEMP(I)
        ENDIF
  160 CONTINUE

      DO 170 J = 1,3
        READ (LUN2,*) (TEMP(I), I=1,6)
        DO 172 I = 1, 6
          IF (TEMP(I) .NE. EXCAV(I,J)) THEN
            WRITE (LUN,10) EXCAV(I,J), TEMP(I), 'EXCAV(n)'
            EXCAV(I,J) = TEMP(I)
          ENDIF
  172   CONTINUE
  170 CONTINUE

      READ (LUN2,*) RTEMP
      IF (RTEMP .NE. RINH) THEN
        WRITE (LUN,10) RINH, RTEMP, 'RINH'
        RINH = RTEMP
      ENDIF

      READ (LUN2,*) RTEMP
      IF (RTEMP .NE. RINHA) THEN
        WRITE (LUN,10) RINHA, RTEMP, 'RINHA'
        RINHA = RTEMP
      ENDIF

      READ (LUN2,*) ITEMP
      IF (ITEMP .NE. NDIST) THEN
        WRITE (LUN,30) NDIST, ITEMP, 'NDIST'
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        NDIST = ITEMP
      ENDIF

      READ (LUN2,*) (TEMP(I), I=1,10)
      DO 180 I = 1, 10
        IF (TEMP(I) .NE. X(I)) THEN
          WRITE (LUN,40) X(I), TEMP(I), 'Distance ', I
          X(I) = TEMP(I)
        ENDIF
  180 CONTINUE

      READ (LUN2,*) (TEMP(I), I=1,10)
      DO 182 I = 1, 4
        IF (TEMP(I) .NE. DRYFAC(I)) THEN
          WRITE (LUN,40) X(I), TEMP(I), 'DRYFAC ', I
          DRYFAC(I) = TEMP(I)
        ENDIF
  182 CONTINUE

      DO 184 I = 1, 6
        IF (TEMP(I+4) .NE. DRYFA2(I)) THEN
          WRITE (LUN,40) X(I), TEMP(I+4), 'DRYFA2 ', I
          DRYFA2(I) = TEMP(I+4)
        ENDIF
  184 CONTINUE

      RETURN

C---- Error Messages ---------------------------------------------------

   97 CALL FILERR (1, LUN2, 'In REDFLT')
   98 CALL FILERR (3, LUN2, 'In REDFLT')
   99 CALL FILERR (2, LUN2, 'In REDFLT')


C---- Format Statements ------------------------------------------------

    1 FORMAT (A8)
   10 FORMAT (' Default value changed from ',1P,E9.1,' to ',E9.1,
     .          ' for parameter ',A10)
   20 FORMAT (' Default value changed from ',L8,' to ',L8,
     .          ' for parameter ',A10)
   30 FORMAT (' Default value changed from ',I8,' to ',I8,
     .          ' for parameter ',A10)
   40 FORMAT (' Default value changed from ',1P,E9.1,' to ',E9.1,
     .          ' for ',A10,I2)
   11 FORMAT (A10/A10)
  111 FORMAT (A10/A10/A10)
 1111 FORMAT (A10/A10/A10/A10)
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11111 FORMAT (A10/A10/A10/A10/A10)
C-----------------------------------------------------------------------
      END
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C-------------------------------------------------------------------
C
      SUBROUTINE RITENV
C
C     Write ENV and DOSE programs input file.
C
C     Module of Program ENVIN of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 3-Aug-88  BAN
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C---------------------------------------------------------------------
C
C     I      - Radionuclide loop index
C     J      - Input concentration loop index
C
C----------------------------------------------------------------------

      INCLUDE 'AFPPAR.CMN'
      INCLUDE 'AIRPAR.CMN'
      INCLUDE 'ANMPAR.CMN'
      INCLUDE 'AQUPAR.CMN'
      INCLUDE 'DECAY.CMN'
      INCLUDE 'ENVPAR.CMN'
      INCLUDE 'EXTPAR.CMN'
      INCLUDE 'FODPAR.CMN'
      INCLUDE 'OPT.CMN'
      INCLUDE 'LABELS.CMN'
      INCLUDE 'RADIN.CMN'
      INCLUDE 'SOLPAR.CMN'
      INCLUDE 'SWPAR.CMN'
      INCLUDE 'TIMES.CMN'

      LUN = 11
      CALL OPNFIL (2,3,LUN)

C---- Write input options and general parameters ----------------------

      WRITE (LUN,11) OUTEDE, OUTRAD, OUTPTH, DEBUG,
     .               NEAR, POPDOS, ACUTE, ONEDOS, AEDE, MAXDOS, CUMDOS,
     .               DOSTYP, RELTRM, BASIC, DERIVE, AIRCN, DEEP,
     .               FINITE
   11 FORMAT (11L3,I3,6L3,T60,'Reports, options...')

      WRITE (LUN,74) ICH, IUNIT, SOLUNT, NUCTOT, POPOPT, POPT
   74 FORMAT (5I3,1PE10.3,T60,'No of chains...')
      WRITE (LUN,83) (IOFNUC(I),I=1,ICH)
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   83 FORMAT (25I3)
      WRITE (LUN,72) (ELTT(IN), AWT(IN),IN=1,NUCTOT)
   72 FORMAT (9(A2,A6)/)
      WRITE (LUN,10) AIR, SWAT, BIOT, BURWAS
   10 FORMAT (4L3,T60, 'Transport modes')

      WRITE (LUN,12) PATH, RECRE, AQFOOD, TFOOD, ANFOOD
   12 FORMAT (28L2,T60,'Exposure paths')

      WRITE (LUN,13) NTKEND, DCEND, RELEND, BEFAIR, BEFIRR
   13 FORMAT(1P,3E9.2,0P,2I9,T60,'Time periods')

      IF (NEAR) WRITE (LUN,14) BEFORE, LOIC, RF1, RF2, MANULR, FRSIZ
   14 FORMAT (1P,E9.2,0P,I9,1P,4E9.2, T60,'Near field')

      WRITE (LUN,114) NDIST, (X(I),I=1,NDIST)
  114 FORMAT (I9,1P,5E9.2,T60,'Distances'/5E9.2)

C---- Write air transport parameters ----------------------------------

      IF (AIR) THEN
        WRITE (LUN,15) STACK, XOQOPT, SHITE, SFLOW, XOQI, SRAD,
     .                 ETEMP, MIDIST, MIDIR, EFFSTK, JFIN, TTAIRI,
     .                 MIUBAR, IRELES, BUILDX, BUILDH
        WRITE (LUN, 16) TPOPS, (TTAIR(I),I=1,NDIST)

        IF (.NOT. POPDOS) THEN
          IF (FINITE) WRITE (LUN,16) (DRFSAV(J), J=1,6)

        ELSEIF (XOQOPT .GT. 1) THEN
          IF (FINITE) THEN
            WRITE (LUN,16) ((PWTX(I,J),J=1,6), I=1,NDIST)
          ENDIF
          WRITE (LUN,16) (PWT(I),I=1,NDIST)
        ENDIF

      ENDIF

   15 FORMAT (L9,I9,1P,4E9.2,T60,'Air transport'/2E9.2,0P,I9,2L9,1PE9.2,
     .        /E9.2,0P,I9,1P,2E9.2)
   16 FORMAT (6E9.2)

C---- Write surface water transport values ------------------------------

      IF (SWAT) THEN
        WRITE (LUN,18) MIXFLG, MIXR, SWFLOW, SWTT
        IF (MIXFLG .GT. 0) WRITE (LUN,17)
     .                     SWQB, SWLSX, SWOSY, SWDPTH, SWIDTH, SWDZ
      ENDIF
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   18 FORMAT (I9,1P,3E9.2,T60,'Surface water')
   17 FORMAT (1P,6E9.2)

C---- Write waste form availability parameters -------------------------

      IF (BURWAS .OR. BIOT .OR. DEEP)
     .  WRITE (LUN,19) PACKHL, WASDEP, OVRBRD
   19 FORMAT (1P,3E9.2,T60,'Waste availability')

C---- Write biotic transport values -----------------------------------

      IF (BIOT) WRITE (LUN,20) BTPRE, BTNTK, BTDSET, NONAG
   20 FORMAT (2L9,I9,L9,T60,'Biotic transport')

C---- Write external exposure values ----------------------------------

      WRITE (LUN,30) HRPLUM, FRCLOD
   30 FORMAT (1P,2E9.2,T60,'External')
      IF (GROUND) WRITE (LUN,31) HRGRD, RESIRR, IRRSR, RIRRR, IRTIMR
   31 FORMAT (1P,E9.2,0P,L9,I9,1P,2E9.2,T60,'Ground External')
      IF (RECRE) WRITE (LUN,32) HRSWIM, HRBOAT, HRSHOR, SHRTYP, RECTT
   32 FORMAT (1P,3E9.2,0P,I9,1P,E9.2, T60,'Recreation')

C---- Write inhalation values -----------------------------------------

      IF (INHAL) THEN
        WRITE (LUN,24) HRINH, IRES, AVALSL, XMLF
   24   FORMAT (1PE9.2,0PI9,1P,2E9.2,T60,'Inhalation')
      ENDIF

C---- Write ingestion population values -------------------------------

      WRITE (LUN,23) FOQOPT, FOQ, AQUPOP, DWPOP, EXPORT
   23 FORMAT (I9,1P,3E9.2,L9,T60,'Ingestion population')

C---- Write drinking water values -------------------------------------

      IF (DRINK) WRITE (LUN,22)  DWUSAG, DWSRC, DWTRET, HOLDDW
   22 FORMAT (1P,E9.2,0P,I9,L9,1P,E9.2,T60,'Drinking water')

C---- Write aquatic foods values --------------------------------------

      IF (AQFOOD) THEN
        WRITE (LUN,60) (AQF(IAQ),IAQ=1,NAQ), ISALT
   60   FORMAT (5L3,T60,'Aquatic foods')
        DO 110 IAQ = 1, NAQ
          IF (AQF(IAQ)) WRITE (LUN,61)
     .                   AQUTT(IAQ), TPRODQ(IAQ),
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     .                 HLDUP2(IAQ), USAG(IAQ), AQFLAB(IAQ)
 110   CONTINUE
      ENDIF
  61 FORMAT (1P, 4E9.2, T60, A8)

C---- Write terrestrial food values -----------------------------------

      IF (TFOOD) THEN
        WRITE (LUN,64) (TFD(ITF),ITF=1,NTF)
  64    FORMAT (4L3,T60,'Terrestrial food')
        DO 120 ITF = 1, NTF
          IF (TFD(ITF)) WRITE (LUN,65) GRWP(ITF),
     .                  IRRST(ITF), RIRR(ITF), IRTIMT(ITF),
     .                  YELD(ITF), TPRODT(ITF), HLDUP(ITF), CONS(ITF),
     .                  PLTLAB(ITF)
 120   CONTINUE
      ENDIF
  65 FORMAT (F6.1, 2X, I1, F6.1, F7.1, 1X, F7.1, 2X, E8.2,
     .       2X, F6.1, 1X, 1P, E8.2, T60, A8)

C---- Write animal product values ------------------------------------

      IF (ANFOOD) THEN
        WRITE (LUN,70) (ANF(IAN),IAN=1,NAN)
  70    FORMAT (4L3,T60,'Animal Products')
        DO 130 IAN = 1, NAN
          IF (ANF(IAN)) THEN
            WRITE (LUN,71) CONS2(IAN), HLDUPA(IAN), TPRODA(IAN),
     .        DWFACA(IAN), ANMLAB(IAN)
            WRITE (LUN,73)
     .        DIETFR(IAN), GRWPA(IAN), IRRSA(IAN), RIRRA(IAN),
     .        IRTIMA(IAN), YELDA(IAN), STORTM(IAN), ANMLAB(IAN)
          ENDIF
 130    CONTINUE
        IF (ANF(1)) WRITE (LUN,73)
     .    DIETFR(5), GRWPA(5), IRRSA(5), RIRRA(5),
     .    IRTIMA(5), YELDA(5), STORTM(5), ANMLAB(1)
        IF (ANF(3)) WRITE (LUN,73)
     .    DIETFR(6), GRWPA(6), IRRSA(6), RIRRA(6),
     .    IRTIMA(6), YELDA(6), STORTM(6), ANMLAB(3)
      ENDIF

  71 FORMAT (1P4E9.2, T70, A8)
  73 FORMAT (1P2E9.2, OPI9, 1P4E9.2, T70, A8)

C---- Write default parameter values ---------------------------------

      WRITE (LUN, 67) PRCNTI, HARVST,
     .                NVU, SVU, DPVRES, LEAFRS, DEPFR1, DEPFR2, SURCM,
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     .                  SLDN, SSLDN, SOLING, WTIM, TRANS, TRANSA, CONSUM,
     .                  DWATER, FRACUT, SHORWI, INGWAT, TCWS, YELDBT,
     .                  TOTEXC, EXCAV, RINH, RINHA, BIOMAS, BIOMA2,
     .                  DRYFAC, DRYFA2

   67 FORMAT (I9,L9,1P,4E9.2 / 50(6E9.2/))

C---- Write inventory parameters ------------------------------------

      I = 0
      DO 101 K1 = 1, ICH
        WRITE (LUN,82) K1
   82   FORMAT (T60,'Chain No.:',I3)
        DO 100 K2 = 1, IOFNUC(K1)
          I = I + 1
          WRITE (LUN,75) ELTT(I), AWT(I), BONET(I), CLASST(I),
     .                   ICLASS(I)

          IF (RELTRM) WRITE (LUN,41) (CASQ(J,I),J=1,3)
          IF (BASIC) WRITE (LUN,42) (CASCON(J,I), J=1,5)
          IF (DERIVE) WRITE (LUN,43) (CASCON(J,I), J=6,9)

          WRITE (LUN,76) HLT(I), ALT(I), IFRT(1,I), IFRT(2,I), DKT(1,I),
     .                   DKT(2,I)
          WRITE (LUN,77) DPVLT(I), LEACHT(I), (BVIT(J,I),J=1,NTF)
          WRITE (LUN,78) (FMIT(J,I), J=1,6), 'FMIT'
          WRITE (LUN,79) (BIOACT(J,I),J=1,NAN), DWCLET(I)
          IF (FINITE) WRITE (LUN,78) (GAMMAT(J,I), J=1,6), 'EDIS'
  100   CONTINUE
  101 CONTINUE

   41 FORMAT (3E9.2, T60, 'Release terms')
   42 FORMAT (5E9.2, T60, 'Basic concentration')
   43 FORMAT (4E9.2, T60, 'Derived concentration')

   75 FORMAT (' ',A2, A6, 2A3, I3)
   76 FORMAT (1P,2E9.2,0P, 2I9, 1P,2E9.2,T60,'HLT, ALT, IFRT, DKT')
   77 FORMAT (1P,6E9.2,T60,'DPVLT, LEACHT, BVIT')
   78 FORMAT (1P,6E9.2,T60,A4)
   79 FORMAT (1P,5E9.2,T60,'BIOACT, DWCLET')

      RETURN

C---- Error Messages ------------------------------------------------

   98 CALL FILERR (2, LUN, 'In RITENV')

C-------------------------------------------------------------------
      END
```

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C-------------------------------------------------------------------
C
      SUBROUTINE RITQA
C
C     Write input parameters report.
C
C     Module of Program ENVIN of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification:  18-Aug-88  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-------------------------------------------------------------------
C
C     I         - Radionuclide loop index
C     J         - Input concentration loop index
C     LUN       - Logical unit device number
C     FOQLAB()  - Descriptions of each FOQ input option
C     FILDAT    - Character string containing date of file generation
C
C-------------------------------------------------------------------

      INCLUDE 'AFPPAR.CMN'
      INCLUDE 'AIRPAR.CMN'
      INCLUDE 'ANMPAR.CMN'
      INCLUDE 'AQUPAR.CMN'
      INCLUDE 'ENVPAR.CMN'
      INCLUDE 'EXTPAR.CMN'
      INCLUDE 'FILES.CMN'
      INCLUDE 'FODPAR.CMN'
      INCLUDE 'INVIN.CMN'
      INCLUDE 'LABELS.CMN'
      INCLUDE 'OPT.CMN'
      INCLUDE 'RADIN.CMN'
      INCLUDE 'SOLPAR.CMN'
      INCLUDE 'SWPAR.CMN'
      INCLUDE 'TIMES.CMN'
      INCLUDE 'TITL.CMN'

      CHARACTER FOQLAB(4)*35, ADIR(16)*3, FILDAT*8
      DATA FOQLAB /'0 - Use food-weighted chi/Q',
     .            '1 - Use population-weighted chi/Q',
     .            '2 - Use uniform distribution',
     .            '3 - Use chi/Q and production grids'/
      DATA ADIR /'S  ','SSW','SW ','WSW','W  ','WNW','NW ','NNW',
     .          'N  ','NNE','NE ','ENE','E  ','ESE','SE ','SSE'/

      LUN = 6
      CALL OPNFIL (2,0,LUN)
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      CALL HEADNG (LUN)

C---- Write input options ----------------------------------------------

      WRITE (LUN,*,ERR=98) ' '

      IF (NEAR) THEN
        WRITE (LUN,2)
      ELSE
        WRITE (LUN,3)
      ENDIF

      IF (ACUTE) THEN
        WRITE (LUN,'(T12,A)') 'Release is acute'
      ELSE
        WRITE (LUN,'(T12,A)') 'Release is chronic'
      ENDIF

      IF (POPDOS) THEN
        IF (INHAL .OR. GROUND .OR. RECRE .OR. AIREXT .OR. FINITE
     .      .OR. SLING) THEN
          WRITE (LUN,5) POPT
        ELSE
          WRITE (LUN,'(T12,A)') 'Population dose'
        ENDIF
      ELSE
        WRITE (LUN,'(T12,A)') 'Individual dose'
      ENDIF

      IF (AIR .OR. SWAT .OR. BIOT .OR. BURWAS) THEN
        WRITE (LUN,4) 'TRANSPORT MODES ARE CONSIDERED'
        IF (AIR) WRITE (LUN,1) 'Air'
        IF (SWAT) WRITE (LUN,1) 'Surface Water'
        IF (BIOT) WRITE (LUN,1) 'Biotic Transport'
        IF (BURWAS) WRITE (LUN,1) 'Waste Form Degradation'
      ENDIF

      WRITE (LUN,4) 'EXPOSURE PATHS ARE CONSIDERED:'

      IF (FINITE) THEN
        WRITE (LUN,1) 'Finite plume, external'
      ENDIF
      IF (AIREXT) THEN
        WRITE (LUN,1) 'Infinite plume, external'
      ENDIF

      IF (GROUND) WRITE (LUN,1) 'Ground, external'
      IF (RECRE) WRITE (LUN,1) 'Recreation, external'
      IF (INHAL) WRITE (LUN,1) 'Inhalation uptake'
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      IF (DRINK) WRITE (LUN,1) 'Drinking water ingestion'
      IF (AQFOOD) WRITE (LUN,1) 'Aquatic foods ingestion'
      IF (TFOOD) WRITE (LUN,1) 'Terrestrial foods ingestion'
      IF (ANFOOD) WRITE (LUN,1) 'Animal product ingestion'
      IF (SLING) WRITE (LUN,1) 'Inadvertent soil ingestion'

      WRITE (LUN,4) 'TIMES ARE USED:'
      WRITE (LUN,322) NTKEND
      WRITE (LUN,22) DCEND
      IF (RELTRM .AND. .NOT. ACUTE .AND. (AIR .OR. SWAT))
     .   WRITE (LUN,122) RELEND
      IF (BEFAIR .GT. 0.0) WRITE (LUN,23) BEFAIR
      IF (BEFIRR .GT. 0.0) WRITE (LUN,24) BEFIRR
  322 FORMAT (T17,'Intake ends after (yr):           ',F7.1)
   22 FORMAT (T17,'Dose calculations ends after (yr): ',F7.1)
  122 FORMAT (T17,'Release ends after (yr):          ',F7.1/)
   23 FORMAT (T12,I7,' years of air deposition prior ',
     .'to the intake period')
   24 FORMAT (T12,I7,' years of irrigation water ',
     .'deposition prior to the intake period')

    1 FORMAT (' ',T17, A)
    2 FORMAT (T12,'This is a near field (narrowly-focused, ',
     .        'single site) scenario.')
    3 FORMAT (T12,'This is a far-field (wide-scale release, ',
     .        'multiple site) scenario.')
    4 FORMAT (/T12,'THE FOLLOWING ',A)
    5 FORMAT (T12,'Dose to exposed population of ',1PE10.3)

C---- Write titles of files used for this case ----------------------

      WRITE (LUN,16)
      CALL GETDAT (5, FILDAT)
      WRITE (LUN,117) INFILN, FILDAT
      CALL GETDAT (22, FILDAT)
      WRITE (LUN,117) TITLS(22) (1:68), FILDAT
      CALL GETDAT (2, FILDAT)
      WRITE (LUN,117) TITLS(2) (1:68), FILDAT

      IF (TFOOD .OR. ANFOOD) THEN
        CALL GETDAT (8, FILDAT)
        WRITE (LUN,117) TITLS(8) (1:68), FILDAT
      ENDIF
      IF (AQFOOD .OR. DRINK) THEN
        CALL GETDAT (9, FILDAT)
        WRITE (LUN,117) TITLS(9) (1:68), FILDAT
      ENDIF
      CALL GETDAT (10, FILDAT)
      WRITE (LUN,117) TITLS(10) (1:68), FILDAT
```

9 1 0 4 8 1 0 1 2

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      CALL GETDAT (37, FILDAT)
      WRITE (LUN,117) TITLS(37) (1:68), FILDAT

      IF (POPDOS .AND. POPOPT .EQ. 1) THEN
        WRITE (LUN,17) TITLS(27)
      ELSEIF (.NOT. POPDOS .AND. AIR .AND. XOQOPT .EQ. 2) THEN
        WRITE (LUN,17) TITLS(27)
      ENDIF
      IF (AIR .AND. XOQOPT .NE. 1 .AND. JFIN) WRITE (LUN,17) TITLS(23)
      IF (AIR .AND.
     .  ((XOQOPT .NE. 1 .AND. .NOT. JFIN) .OR. FOQOPT .EQ. 3))
     .  WRITE (LUN,17) TITLS(24)
      IF ((TFOOD .OR. ANFOOD) .AND. FOQOPT .EQ. 3)
     .  WRITE (LUN,17) TITLS(29)

   16 FORMAT (/10('='),' FILENAMES AND TITLES OF FILES/LIBRARIES USED ',
     .          23('=')/)
   17 FORMAT (' ',A78)
  117 FORMAT (' ',A68,'  ',A8)
   18 FORMAT (' Input file name: ',A30)

C---- Write inventory report -----------------------------------------

      WRITE (LUN,85)
      IF (BASIC) WRITE (LUN,19) SOLUNT

      IF (RELTRM) THEN
        WRITE (LUN,13) UNIT1(IUNIT), UNIT1(IUNIT), UNIT1(IUNIT)
        DO 100 I = 1, NIN
          WRITE (LUN,12) ELTI(I), AWI(I), (QIN(J,I),J=1,3)
  100   CONTINUE
      ENDIF

      IF (BASIC) THEN
        WRITE (LUN,14) UNIT1(IUNIT), UNIT1(IUNIT), UNIT3(SOLUNT),
     .                 UNIT1(IUNIT), UNIT1(IUNIT), UNIT1(IUNIT)
        DO 101 I = 1, NIN
          WRITE (LUN,12) ELTI(I), AWI(I), (CONCIN(J,I), J=1,5)
  101   CONTINUE
      ENDIF

      IF (DERIVE) THEN
        WRITE (LUN,15) UNIT1(IUNIT), UNIT1(IUNIT), UNIT1(IUNIT),
     .                 UNIT1(IUNIT)
        DO 102 I = 1, NIN
          WRITE (LUN,12) ELTI(I), AWI(I), (CONCIN(J,I), J=6,9)
  102   CONTINUE
      ENDIF
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19 FORMAT(' ',I2,T12,'Surface soil input unit: (1-m2, 2-m3, 3-kg)')

12 FORMAT (' ',T12,A2, A6, 1P, 9E8.1)

13 FORMAT (/,
  .T12,'-------- ----Release Terms------'/
  .T12,'Release          Surface Buried'/
  .T12,'Radio-    Air    Water   Source'/
  .T12,'nuclide  ',A3,'/yr  ',A3,'/yr  ',A3,'/m3'/
  .T12,'-------- ------- ------- -------')

14 FORMAT (/,
  .T12,'-------- ----------Basic Concentrations---------'/
  .T12,'Release          Surface Deep    Ground  Surface'/
  .T12,'Radio-    Air    Soil    Soil    Water   Water  '/
  .T12,'nuclide  ',A3,'/L    ',A3,'/',A2,'  ',A3,'/m3  ',A3,'/L    ',
  .    A3,'/L  '/
  .T12,'-------- ------- ------- ------- ------- -------')

15 FORMAT (/,
  .T12,'-------- ----Derived Concentrations-----'/
  .T12,'Release  Terres. Animal  Drink   Aquatic'/
  .T12,'Radio-   Plant   Product Water   Food   '/
  .T12,'nuclide  ',A3,'/kg  ',A3,'/kg  ',A3,'/L    ',A3,'/kg '/
  .T12,'-------- ------- ------- ------- -------')

C---- Write near-field parameters ------------------------------------

      IF (NEAR) WRITE (LUN,20) BEFORE, LOIC, RF1, RF2, MANULR
      IF (NEAR .AND. GROUND .AND. FRSIZ .GT. 0.0)
  .     WRITE (LUN,201) FRSIZ

20 FORMAT (/,10('='),' NEAR-FIELD PARAMETERS ', 46('=')/,
  .F7.1,T12,'Inventory disposed n years prior to beginning of ',
  .'intake period'/
  .I7,T12,'LOIC occurred n years prior to beginning of intake ',
  .'period'/,1P,
  .E7.1,T12,'Fraction of roots in upper soil (top 15 cm)'/
  .E7.1,T12,'Fraction of roots in deep soil'/
  .E7.1,T12,'Manual redistribution: deep soil/surface soil ',
  .'dilution factor')

201 FORMAT (F7.1,T12,
  .'Source area for external dose modification factor (m2)')

C---- Write air transport values -------------------------------------

      IF (AIR) THEN
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      WRITE (LUN,211)
      IF (XOQOPT .NE. 1) THEN
        IF (JFIN) THEN
          WRITE (LUN,220)
        ELSE
          WRITE (LUN,221)
        ENDIF
      ENDIF

      IF (ACUTE) THEN
        IF (XOQOPT .EQ. 1) THEN
          IF (POPDOS) THEN
            WRITE (LUN,222) XOQI
          ELSE
            WRITE (LUN,223) XOQI
          ENDIF
        ELSEIF (XOQOPT .EQ. 3) THEN
          IF (POPDOS) THEN
            WRITE (LUN,224) MIDIR, ADIR(MIDIR)
          ELSE
            WRITE (LUN,219) MIDIST, MIDIR, ADIR(MIDIR)
          ENDIF
        ENDIF

      ELSE
C       Chronic--
        IF (XOQOPT .EQ. 1) THEN
          IF (POPDOS) THEN
            WRITE (LUN,217) XOQI
          ELSE
            WRITE (LUN,216) XOQI
          ENDIF
        ELSEIF (XOQOPT .EQ. 2) THEN
          WRITE (LUN,215)
        ELSEIF (XOQOPT .EQ. 3) THEN
          WRITE (LUN,219) MIDIST, MIDIR, ADIR(MIDIR)
        ENDIF
      ENDIF

      IF (XOQOPT .NE. 1) THEN
        IF (EFFSTK) THEN
          WRITE (LUN,212) SHITE
        ELSEIF (SHITE .EQ. 0.0) THEN
          WRITE (LUN,213)
        ELSE
          WRITE (LUN,214) SHITE, SFLOW, SRAD, ETEMP
        ENDIF
      ENDIF
```


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      ENDIF

      IF (IRELES .GT. 1) THEN
        WRITE (LUN,225)
        IF (IRELES .EQ. 2) THEN
          WRITE (LUN,226)
        ELSE
          WRITE (LUN,227)
        ENDIF
        WRITE (LUN,228) BUILDX, BUILDH
      ENDIF

  211 FORMAT (/10('='),' AIR TRANSPORT ',54('='))
  212 FORMAT (1PE7.1,T12,'Effective stack height (m)')
  213 FORMAT (T12,'Ground level release.')
  214 FORMAT (1PE7.1,T12,'Stack height (m)'/
     .          E7.1,T12,'Stack flow (m3/s)'/
     .          E7.1,T12,'Stack radius (m)'/
     .          E7.1,T12,'Effluent temperaure (degrees C)')
  215 FORMAT (T12,'MI distance, direction, and chi/Q will be selected ',
     .          'by the program.')
  216 FORMAT (1PE7.1,T12,'Input chi/Q value (s/m3)')
  217 FORMAT (1PE7.1,T12,
     .          'Input population-weighted chi/Q value (s/m3)')
  219 FORMAT (1PE7.1,T12,'Maximum individual distance from release ',
     .          'point (m)'/
     .          E7.1,T12,'Maximum individual sector index (Wind Toward ',
     .          A3,')')
  220 FORMAT (T12,'Joint frequency data input.')
  221 FORMAT (T12,'Chi/Q data input.')
  222 FORMAT (1PE7.1,T12,
     .          'Input population-weighted E/Q value (s/m3)')
  223 FORMAT (1PE7.1,T12,'Input E/Q value (s/m3)')
  224 FORMAT (1PE7.1,T12,'Sector index (Wind Toward ',A3,')')
  225 FORMAT (T12,'Building Wake Model used.')
  226 FORMAT (T12,'Release from vent or short stack on building roof')
  227 FORMAT (T12,'Release from Building Below Roof')
  228 FORMAT (1PE7.1,T12,'Building cross-sectional area (m2)'/
     .          E7.1,T12,'Building height (m)')

C---- Write surface water transport values ----------------------------

      IF (SWAT) THEN
        WRITE (LUN,40) MIXFLG, SWTT
        WRITE (LUN,43) SWFLOW
        IF (MIXFLG .EQ. 0) THEN
          WRITE (LUN,41) MIXR
        ELSE
```

9 1 0 4 8 1 0 1 6

```
      WRITE (LUN,42) SWQB, SWLSX, SWOSY, SWDPTH
    ENDIF
    IF (MIXFLG .EQ. 1) WRITE (LUN,44) SWIDTH
    IF (MIXFLG .EQ. 2) WRITE (LUN,45) SWDZ
  ENDIF

40 FORMAT (/10('='),' SURFACE WATER TRANSPORT ',44('=')/,
  . ' ',I7,T12,'Mixing ratio model:',
  . '  0-use value, 1-river, 2-lake, 3-river flow'/,1P,
  . ' ',E7.1,T12,'Transit time to irrigation withdrawl ',
  . 'location (h)')
41 FORMAT (' ',1PE7.1,T12,'Mixing ratio, dimensionless')
42 FORMAT (' ',E7.1,T12,'Rate of effluent discharge to receiving ',
  . 'water body (m3/s)'/
  . ' ',E7.1,T12,'Longshore distance from release point to ',
  . 'usage location (m)'/
  . ' ',E7.1,T12,'Offshore distance to the water intake (m)'/
  . ' ',E7.1,T12,'Average water depth in surface water body (m)')
43 FORMAT (' ',1PE7.1,T12,'Average water flow rate for: MIXFLG=1,2 ',
  . '(m/s), MIXFLG=0,3 (m3/s)')
44 FORMAT (' ',E7.1,T12,'Average river width (m)')
45 FORMAT (' ',E7.1,T12,'Depth of effluent discharge point to ',
  . 'surface water (m)')

C---- Write waste form availability values ----------------------------

      IF (BURWAS .OR. BIOT .OR. DEEP)
     .  WRITE (LUN,21) PACKHL, WASDEP, OVRBRD
21 FORMAT (/10('='),' WASTE FORM AVAILABILITY ',43('=')/,1P,
  .E7.1, T12,'Waste form/package half life, yr'/
  .E7.1,T12,'Thickness of buried waste, m'/
  .E7.1,T12,'Depth of soil overburden, m')


C---- Write biotic transport values ------------------------------------

      IF (BIOT) THEN
        WRITE (LUN,46)
        IF (BTPRE) WRITE (LUN,47)
        IF (BTNTK) WRITE (LUN,48)
        WRITE (LUN,49) BTDSET
      ENDIF

46 FORMAT (/10('='),' BIOTIC TRANSPORT OF BURIED SOURCE ',33('='))
47 FORMAT (' ',T12,'Is considered during inventory decay/buildup ',
  . 'period.')
48 FORMAT (' ',T12,'Is considered during intake period.')
49 FORMAT (
  . ' ',I7,T12,'Pre-Intake conditions: 1-Arid Non Ag,2-Humid Non Ag',
```

9 1 0 4 8 1 0 1 7

```
     , ' 3-Agriculture')

C---- Write external exposure values ----------------------------------

      IF (GROUND .OR. AIREXT .OR. FINITE .OR. RECRE) THEN

        WRITE (LUN,80)
        IF (AIREXT .OR. FINITE) THEN
          IF (ACUTE) THEN
            WRITE (LUN,81) FRCLOD
          ELSE
            WRITE (LUN,82) HRPLUM
          ENDIF
        ENDIF

        IF (GROUND) THEN
          WRITE (LUN,83) HRGRD
          IF (SWAT .OR. BAS(4) .OR. BAS(5)) THEN
            IF (IRRSR .GT. 0) THEN
              WRITE (LUN,86) IRRSR, RIRRR, IRTIMR
            ELSE
              WRITE (LUN,'(T12,A)')
     .          'Residential irrigation not considered.'
            ENDIF
          ENDIF
        ENDIF

        IF (RECRE) THEN
          WRITE (LUN,84) HRSWIM, HRBOAT, HRSHOR, SHRTYP
          IF (SWAT) WRITE (LUN,87) RECTT
        ENDIF

      ENDIF

   80 FORMAT (/10('='),' EXTERNAL EXPOSURE ',50('='))
   81 FORMAT (' ',1PE7.1,T12,'Fraction of time spent in cloud')
   82 FORMAT (' ',1PE7.1,T12,'Hours of exposure to plume')
   83 FORMAT (' ',1PE7.1,T12,'Hours of exposure to ground ',
     . 'contamination')
   84 FORMAT (' ',1P,E7.1,T12,'Hours of exposure from swimming'/
     . ' ',E7.1,T12,'Hours of exposure from boating'/
     . ' ',E7.1,T12,'Hours of exposure from shoreline activities'/
     . ' ',0P,I7,T12,'Shoreline type: 1-river, 2-lake, 3-ocean, ',
     . '4-tidal basin')
   86 FORMAT (' ',I7,T12,'Residential irrigation source ',
     . '1-ground water, ', '2-surface water'/
     .' ',1PE7.1,T12,'Residential irrigation application rate (in/yr)'/
     .' ',E7.1,T12,'Residential irrigation duration (mo/yr)')
   87 FORMAT (' ',1PE7.1,T12,'Surface water transit time to ',
```

```
     .'recreational site (h)')

C---- Write inhalation values ------------------------------------------

      IF (INHAL) THEN
        WRITE (LUN,59) HRINH
        IF (IRES .GT. 0) THEN
          WRITE (LUN,30) IRES
          IF (IRES .EQ. 2) THEN
            WRITE (LUN, 31) AVALSL
          ELSEIF (IRES .EQ. 1) THEN
            WRITE (LUN, 32) XMLF
          ENDIF
        ELSE
          WRITE (LUN,'(T12,A)') 'Resuspension not considered'
        ENDIF
      ENDIF

   59 FORMAT (/10('='),' INHALATION ',57('=')/, 1P,
     . ' ',E7.1,T12,'Hours of exposure to contamination per year')
   30 FORMAT (' ',I7, T12,'Resuspension model:  1-Mass Loading, ',
     . '2-Anspaugh')
   31 FORMAT (' ',1P, E7.1, T12,'Top soil available (cm)')
   32 FORMAT (' ',1P, E7.1, T12, 'Mass loading factor (g/m3)')


C---- Write ingestion population values ------------------------------

      IF ((AIR .AND. (TFOOD .OR. ANFOOD)) .OR.
     .    (POPDOS .AND. (AQFOOD .OR. DRINK))) WRITE (LUN,57)
      IF (AIR .AND. (TFOOD. OR. ANFOOD)) THEN
        WRITE (LUN,53) FOQOPT, FOQLAB(FOQOPT+1)
        IF (FOQOPT .EQ. 0) WRITE (LUN,54) FOQ
      ENDIF

      IF (POPDOS) THEN
        IF (AQFOOD) WRITE (LUN,55) AQUPOP
        IF (DRINK) WRITE (LUN,56) DWPOP
        IF (TFOOD .OR. ANFOOD .OR. AQFOOD) THEN
          IF (EXPORT) THEN
            WRITE (LUN,'(T12,A)')
     .      'Dose from food exported out of region considered.'
          ELSEIF (IMPORT) THEN
            WRITE (LUN,'(T12,A)')
     .      'Uncontaminated food imported into region considered.'
          ELSE
            WRITE (LUN,'(T12,A)')
     .      'Food production in region assumed to equal consumption.'
```

```
          ENDIF
        ENDIF
      ENDIF

   53 FORMAT (' ',I7,T12,'Atmospheric production definition: ',A35)
   54 FORMAT (' ',1PE7.1,T12,'Food-weighted chi/Q (food s/m3)')
   55 FORMAT (' ',1PE7.1,T12,'Population ingesting aquatic foods ',
     .         '(person)')
   56 FORMAT (' ',1PE7.1,T12,'Population ingesting drinking water ',
     .         '(person)')
   57 FORMAT (/10('='),' INGESTION POPULATION ',46('='))

C---- Write drinking water values ------------------------------------

      IF (DRINK) WRITE (LUN,52) DWUSAG, DWSRC, DWTRET, HOLDDW

   52 FORMAT (/10('='),' DRINKING WATER SOURCE/IRRIGATION ',34('='),1P,/
     . ' ',E7.1,T12,'Drinking water consumption rate (l/yr)'/ 0P,
     . ' ',I7,T12,'Drinking water source: 1-ground, 2-surface, ',
     . ' 3-system '/,
     . ' ',L7, T12,'Drinking water treatment: T/F'/
     . ' ',F7.1,T12,'Drinking water transit/holdup time (d)')

C---- Write aquatic foods values ----------------------------------------

      IF (AQFOOD) THEN
        WRITE (LUN, 60)
        DO 110 IAQ = 1, NAQ
          IF (AQF(IAQ)) THEN
            IF (EXPORT .OR. IMPORT) THEN
              WRITE (LUN,61) AQFLAB(IAQ), AQUTT(IAQ), TPRODQ(IAQ),
     .                   HLDUP2(IAQ), USAG(IAQ)
            ELSE
              WRITE (LUN,161) AQFLAB(IAQ), AQUTT(IAQ),
     .                   HLDUP2(IAQ), USAG(IAQ)
            ENDIF
          ENDIF
  110   CONTINUE
      ENDIF

   60 FORMAT (/10('='),' AQUATIC FOODS INGESTION ', 43('=')//
     .        T12,'          TRAN-     PROD-     ----CONSUMPTION----'/
     .        T12,'FOOD      SIT       UCTION    HOLDUP    RATE'/
     .        T12,'TYPE      h          kg/yr    d         kg/yr'/
     .        T12,'-------- --------- --------- --------- ---------')

   61 FORMAT (11X, A8, 1P, 4E10.2)
  161 FORMAT (11X, A8, 1P, E10.2, 10X, 2E10.2)
```


9 1 0 4 8 1 0 2 0

```
C---- Write terrestrial food values ------------------------------------

      IF (TFOOD) THEN
        WRITE (LUN,64)
        DO 120 ITF = 1, NTF
          IF (TFD(ITF)) THEN
            IF (EXPORT .OR. IMPORT) THEN
              WRITE (LUN,65) PLTLAB(ITF), GRWP(ITF),
     .          IRRST(ITF), RIRR(ITF), IRTIMT(ITF),
     .          YELD(ITF), TPRODT(ITF), HLDUP(ITF), CONS(ITF)
            ELSE
              WRITE (LUN,165) PLTLAB(ITF), GRWP(ITF),
     .          IRRST(ITF), RIRR(ITF), IRTIMT(ITF),
     .          YELD(ITF), HLDUP(ITF), CONS(ITF)
            ENDIF
          ENDIF
  120   CONTINUE
      ENDIF

   64 FORMAT (/10('='),' TERRESTRIAL FOOD INGESTION ',40('='),//
     .T12,'         GROW   --IRRIGATION--            PROD-     ',
     .    '--CONSUMPTION--'/
     .T12,'FOOD     TIME   S RATE   TIME    YIELD   UCTION     ',
     .    'HOLDUP   RATE'/
     .T12,'TYPE     d      * in/yr  mo/yr   kg/m2   kg/yr      ',
     .    'd        kg/yr'/
     .T12,'-------- -----  - -----  -----   -----   -------    ',
     .    '------   ------')

   65 FORMAT (11X,A8, F6.1, 2X, I1, F6.1, F7.1, 1X, F7.1, 2X, 1P, E8.2,
     .          0P, 2X, F6.1, 1PE9.1)
  165 FORMAT (11X,A8, F6.1, 2X, I1, F6.1, F7.1, 1X, F7.1, 2X,
     .          10X, F6.1, 1PE9.1)

C---- Write animal product values ---------------------------------------

      IF (ANFOOD) THEN
        WRITE (LUN, 70)
        DO 130 IAN = 1, NAN
          IF (ANF(IAN)) THEN
            IF (ACUTE .AND. NTKEND .EQ. 1) THEN
              IF (EXPORT .OR. IMPORT) THEN
                WRITE (LUN,75) ANMLAB(IAN), CONS2(IAN), HLDUPA(IAN),
     .            TPRODA(IAN), DWFACA(IAN), GRWPA(IAN), IRRSA(IAN),
     .            RIRRA(IAN), IRTIMA(IAN), YELDA(IAN), STORTM(IAN)
              ELSE
                WRITE (LUN,175) ANMLAB(IAN), CONS2(IAN), HLDUPA(IAN),
     .            DWFACA(IAN), GRWPA(IAN), IRRSA(IAN),
     .            RIRRA(IAN), IRTIMA(IAN), YELDA(IAN), STORTM(IAN)
```


9 1 0 4 8 1 0 2 1

```
          ENDIF
        ELSE
          IF (EXPORT .OR. IMPORT) THEN
            WRITE (LUN,71) ANMLAB(IAN), CONS2(IAN), HLDUPA(IAN),
     .        TPRODA(IAN), DWFACA(IAN), DIETFR(IAN), GRWPA(IAN),
     .        IRRSA(IAN), RIRRA(IAN), IRTIMA(IAN),
     .        YELDA(IAN), STORTM(IAN)
          ELSE
            WRITE (LUN,171) ANMLAB(IAN), CONS2(IAN), HLDUPA(IAN),
     .        DWFACA(IAN), DIETFR(IAN), GRWPA(IAN), IRRSA(IAN),
     .        RIRRA(IAN), IRTIMA(IAN), YELDA(IAN), STORTM(IAN)
          ENDIF
        ENDIF
      ENDIF
130   CONTINUE

      IF (ANF(1) .OR. ANF(3)) WRITE (LUN,72)

      IF (ACUTE .AND. NTKEND .EQ. 1) THEN
        IF (ANF(1)) WRITE (LUN,77) ANMLAB(1),
     .              GRWPA(5), IRRSA(5), RIRRA(5),
     .              IRTIMA(5), YELDA(5), STORTM(5)
        IF (ANF(3)) WRITE (LUN,77) ANMLAB(3),
     .              GRWPA(6), IRRSA(6), RIRRA(6),
     .              IRTIMA(6), YELDA(6), STORTM(6)
      ELSE
        IF (ANF(1)) WRITE (LUN,73) ANMLAB(1),
     .              DIETFR(5), GRWPA(5), IRRSA(5), RIRRA(5),
     .              IRTIMA(5), YELDA(5), STORTM(5)
        IF (ANF(3)) WRITE (LUN,73) ANMLAB(3),
     .              DIETFR(6), GRWPA(6), IRRSA(6), RIRRA(6),
     .              IRTIMA(6), YELDA(6), STORTM(6)
      ENDIF
    ENDIF

    IF (ACUTE .AND. NTKEND .GT. 1) THEN
      WRITE (LUN,*) ' '
      WRITE (LUN,*)
   .  ' Note: Animal diet fraction for years 2 through ',NTKEND
    ENDIF

 70 FORMAT (/10('='),' ANIMAL FOOD INGESTION ',45('='),//
   . '             ---HUMAN---- TOTAL   DRINK   ',
   . '-------------STORED FEED-------------- '/
   . '             CONSUMPTION  PROD-   WATER   ',
   . 'DIET  GROW  -IRRIGATION--       STOR- '/
   . 'FOOD         RATE  HOLDUP UCTION  CONTAM  ',
   . 'FRAC- TIME  S RATE  TIME   YIELD AGE   '/
   . 'TYPE         kg/yr    d    kg/yr  FRACT.  ',
```

```
     . 'TION    d     * in/yr mo/yr  kg/m3 d      '/
     . '--------   ------ ----- ------ -------   ',
     . '----  ----  - ----- -----  ----- ----- '/)

   72 FORMAT (/T41,'-------------FRESH FORAGE-------------')
   71 FORMAT (A8, 2X, 1PE7.1, OPF6.1, 1PE7.1, OPF8.2,
     .            OPF6.1, F6.2, I3, F6.1, F6.1, F7.2, F6.1)
  171 FORMAT (A8, 2X, 1PE7.1, OPF6.1, 7X, F8.2,
     .            OPF6.1, F6.2, I3, F6.1, F6.1, F7.2, F6.1)
   73 FORMAT (A8, 30X, F6.2, F6.1, I3, F6.1, F6.1, F7.2, F6.1)

   75 FORMAT (A8, 2X, 1PE7.1, OPF6.1, 1PE7.1, OPF8.2,
     .            F6.2, 6X, I3, F6.1, F6.1, F7.2, F6.1)
  175 FORMAT (A8, 2X, 1PE7.1, OPF6.1, 7X, F8.2,
     .            6X, F6.2, I3, F6.1, F6.1, F7.2, F6.1)
   77 FORMAT (A8, 36X, F6.2, I3, F6.1, F6.1, F7.2, F6.1)

C---- Signature lines ---------------------------------------------

      WRITE (LUN,85)
   85 FORMAT (/79('='))
      WRITE(LUN,89)
   89 FORMAT(///,'Input prepared by:  _______________________________',
     .          '            Date:  ______________',//
     .        'Input checked by:  _______________________________',
     .          '            Date:  ______________'//)
      WRITE (LUN,85)

      RETURN

C---- Error Messages ----------------------------------------------

   98 CALL FILERR (2, LUN, 'In RITQA')

C-----------------------------------------------------------------
      END
C-----------------------------------------------------------------
C
      SUBROUTINE GETDAT (IFIL, FILDAT)
C
C     This module queries the system for and returns the creation date
C     of the file listed in FILN(IFIL).  The work buffer file (Lun 6)
C     is utilized for this operation.
C
C     Module of Program ENVIN of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification:  29-Mar-88  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
```

```
C
C-----------------------------------------------------------------------
C
C     CMND      - Constructed command sent to DOS
C     FILDAT    - File creation date read from work buffer file and
C                 returned to calling program
C     IFIL      - Logical unit number of the current file
C     ILUN      - Logical unit number of the work buffer file
C     L         - File directory line read from work buffer file
C
C-----------------------------------------------------------------------

      INCLUDE 'FILES.CMN'

      CHARACTER FILDAT*8, CMND*70, DUM*1, L*60
      INTEGER IFIL, ILUN
      ILUN = 7

      CMND = '
      WRITE (CMND (1:4), '(A)') 'dir '
      WRITE (CMND (5:), '(A)') FILN(IFIL)
      WRITE (CMND (25:27), '(A)') ' > '
      WRITE (CMND (28:), '(A)') FILN(ILUN)

      CALL SYSTEM (CMND)

      CALL OPNFIL (1, 0, ILUN)
      READ (ILUN, '(A1/A1/A1/A1)') DUM, DUM, DUM, DUM
      READ (ILUN, '(A)') L
      FILDAT = L(24:31)
      CLOSE (ILUN)

      RETURN
C-----------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------
C
      FUNCTION RWAKE( AREA,CHT,RHT,WO,FO,DIST,OHT,U10,RHU,IST,
     +                SIGMAY,SIGMAZ,LAYER,PI)

C     This function computes diffusion estimates for releases made in
C     Building wakes. The function RWAKE estimates normalized
C     concentrations (X/Q) resulting from releases made in building
C     wakes.  The function is an implementation of the building wake
C     diffusion model developed for the U.S. Nuclear Regulatory
C     Commisssion by J. V. Ramsdell.  The model was developed using
C     building wake diffusion data obtained in experiments conducted
C     at 7 reactors.
C
C     Written by J.V. Ramsdell (July 10, 1987, January 30, 1988)
C     Module of Program ENVIN of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification:  2-Aug-88 RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C     AREA     - Building area (m2), input
C     CHT      - Building height (m), input
C     DIST     - Horizontal distance to receptor (m), input
C     FO       - Flow (m3/s), input
C     IST      - Diffusion class, input
C     LAYER    - Mixing layer depth, input
C     OHT      - Receptor height (m), input
C     RHT      - Release height (m), input
C     RHU      - Release height wind speed, input
C     SIGMAY   - Horizontal diffusion coefficient, input
C     SIGMAZ   - Vertical diffusion coefficient, input
C     U10      - Wind speed at 10 m (m/s), input
C     WO       - Effluent vertical velocity (m/s), input
C     WMOD     - Normalized concentration (s/m^3), output
C
C-----------------------------------------------------------------------

C     Wake model constants--
      CO = 150.
      CX = -1.2
      CU = 0.68
      CA = -1.2

C     Compute denominator of Gaussian plume model--
      PLUMED = PI * SIGMAY * SIGMAZ * U10
```


9 1 0 4 8 1 0 2 5

```
C     Compute limiting distance for wake enhancement to diffusion rate--
      CL = SQRT( AREA )

C     Compute 'stretched string distance'
      XS = DIST + ABS( RHT - OHT )

C     Limit XS to wake enhancement limiting distance--
      XSL = AMIN1( XS, 20.0*CL )

C     Compute building surface release X/Q--
      BMOD = CO * U10**CU * SQRT( FLOAT( IST ) ) * AREA**CA * XSL**CX

C     Compute composite wake X/Q--
      ARG = (LAYER / SIGMAZ)**2

      IF(ARG .LT. 0.758 ) THEN
        WXOQ = 1.0 / ( SQRT( 2*PI ) * SIGMAY * LAYER * U10 )
      ELSEIF (ARG .GT. 10.0) THEN
        GZ = 2.0
        WXOQ = 0.5 * GZ / ( FO + PLUMED + 1.0 / BMOD )
      ELSE
        GZ = 2.0 + 4*EXP(-2*ARG) + 4*EXP(-8*ARG)
        WXOQ = 0.5 * GZ / ( FO + PLUMED + 1.0 / BMOD )
      ENDIF

      IF( WO .GT. 0.0 .AND. RHT .GE. CHT ) THEN
C       NRC XOQDOQ Split-H Model--

C       Compute X/Q from elevated plume--
        IF( ARG .LT. 0.758 ) THEN
          EMOD = 1.0 / ( SQRT( 2*PI ) * SIGMAY * LAYER * RHU )
        ELSE
          WSIGZ = SIGMAZ
          IF(IST .GT. 4)  CALL SIGMA( DIST,4,WSIGZ,WSIGY)
          PLUMED = 2*PI * SIGMAY * SIGMAZ * RHU

          GZ = 2*EXP(-0.5*(RHT/WSIGZ)**2 )

          ARG1 = -0.5*((2*LAYER-RHT)/SIGMAZ)**2
          IF (-ARG1 .LT. 30.0) GZ = GZ + 2*EXP(ARG1)

          ARG2 = -0.5*((2*LAYER+RHT)/WSIGZ)**2
          IF (-ARG2 .LT. 30.0) GZ = GZ + 2*EXP(ARG2)

          ARG3 = -0.5*((4*LAYER-RHT)/SIGMAZ)**2
          IF (-ARG3 .LT. 30.0) GZ = GZ + 2*EXP(ARG3)

          ARG4 = -0.5*((4*LAYER+RHT)/WSIGZ)**2
          IF (-ARG4 .LT. 30.0) GZ = GZ + 2*EXP(ARG4)
```

```
              EMOD = GZ / PLUMED

              WR = WO / RHU

              IF( WR .GT. 1.0 ) THEN
C               Compute fraction of time plume is in wake--

                IF( WR .LE. 1.5 ) THEN
                  WF = 2.58 - 1.58 * WR
                ELSE IF( WR .LT. 5.0 ) THEN
                  WF = 0.3 - 0.06 * WR
                ELSE
                  WF = 0.0
                ENDIF

C               Combine wake and elevated plume concentrations--
                RWAKE = ( 1.0 - WF ) * EMOD + WF * WXOQ

              ELSE

C               Plume is in wake 100% of the time--
                RWAKE = WXOQ

              ENDIF
            ENDIF

          ELSE
C           Plume is entrained in wake--
            RWAKE = WXOQ
          ENDIF

          RETURN
C-----------------------------------------------------------------------
          END
```


9 1 0 4 8 1 0 2 7

```
C-----------------------------------------------------------------------
C
      FUNCTION USTAR (HT, ZO, SPD, IST)
C
C     Function to compute USTAR from wind speed.  The function uses
C     an observed wind, its measurement height, and the surface
C     roughness length along with diabatic wind profile  -- see
C     Panofsky and Dutton (1984) Section 6.5 -- to estimate USTAR.
C     The specific profile used is determined by the atmospheric
C     class.
C
C     Written by J. V. Ramsdell
C     Module of Program ENVIN of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 19-Feb-88  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C     HT        - Measurement height, m
C     INVMOL    - 1/Monin-Obukov length used in diabatic wind profiles
C     IST       - Atmospheric stability class
C     SPD       - Wind speed, m/sec
C     ZO        - Surface roughness length, m
C
C-----------------------------------------------------------------------

      REAL INVMOL, MOLINV
      PI = 3.14159
      MOLINV = INVMOL( IST, ZO )

      IF (HT .LT. 1.0) THEN
        HTA = 10.0
      ELSE
        HTA = HT
      ENDIF

      IF (IST .LE. 3) THEN
C       Unstable conditions--

        X = (1 - 16 * HTA * MOLINV )**0.25
        PSI = ALOG( (0.5+X*X/2) * (0.5+X/2)**2 ) - 2*ATAN(X) + PI/2

      ELSEIF (IST .GE. 5) THEN
C       Stable conditions--

        PSI = -5 * HTA * MOLINV
```

```
      ELSE
C       Neutral conditions--

        PSI = 0.0

      ENDIF
      USTAR = 0.4 * SPD / ( ALOG( HTA/Z0 ) - PSI )

      RETURN
C-----------------------------------------------------------------------
      END
```

9 1 0 4 8 1 0 2 9

```
C-----------------------------------------------------------------------
C
C    Program title:                      ENV - A module of the GENII
C                                        environmental dosimetry software
C                                        package.
C
C    Prepared for:                       U. S. Department of Energy under
C                                        Contract DE-AC06-76RLO 1830
C
C
C    Contact:                            Bruce Napier
C                                        Pacific Northwest Laboratory
C                                        Richland WA 99352
C                                        (509) 375-3916
C
C    Code developers:                    B. A. Napier, R. A. Peloquin,
C                                        D. L. Strenge, and J. V. Ramsdell
C                                        Pacific Northwest Laboratory
C                                        Richland WA  99352
C
C
C    This code was prepared for an agency of the United States
C    Government.  Neither the United States Government or any agency
C    thereof, or any of their employees, make any warranty, expressed
C    or implied, or assumes any legal liability or responsibility for
C    any third party's use, or the results of such use, of any portion
C    of this program or represents that its use by such third party
C    would not infringe privately onwed rights.
C
C
C--- Program Information -----------------------------------------------
C
C    Problem description:        To perform environmental transport and
C                                exposure calculations for individuals
C                                or population groups, acute or chronic,
C                                as required for near-field and
C                                far-field short-term scenarios.
C
C    Results format:             The output of ENV is a data transfer file
C                                called ENV.OUT used as input to the following

C                                program of the package, DOSE.  A separate
C                                report is prepared describing the media
C                                concentrations calculated.
C
C    Computer:                   This version is for the IBM PC/AT.
C
C    Programming language:       FORTRAN compiled using Lahey(tm)
C                                FORTRAN Compiler.
```

```
C
C   Machine requirements:      IBM PC/AT with a minimum of 640 Kbytes
C                              random access memory and 1 20-Mbyte fixed
C                              disk drive.
C
C
C   Reference:                 B. A. Napier, R. A. Peloquin, D. L. Strenge,
C                              and J. V. Ramsdell. 1988. "GENII - The
C                              Hanford Environmental Radiation Dosimetry
C                              Software System."  PNL-6584, Volumes 1, 2,
C                              and 3.  Pacific Northwest Laboratory,
C                              Richland, WA 99352
C
C
C-----------------------------------------------------------------------------
C
      PROGRAM ENV
C
C     This module controls reading of the input files, initializing
C     parameters, and indexing of the radionuclide chain and time step
C     loops.
C
C     Module of Program ENV of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 19-Aug-88  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C--------------------------------------------------------------------------
C
C     IC        - Index of the current radionuclide chain
C     IP        - Index of the current exposure pathway
C     INCHAN()  - Number of radionuclides in each chain
C     QAIRAV()  - Air term saved for other seasons of acute release
C     QSWSV()   - Surface water release term saved for other seasons
C                 of acute release
C
C--------------------------------------------------------------------------

      INCLUDE 'CONC.CMN'
      INCLUDE 'OPT.CMN'
      INCLUDE 'RAD.CMN'
      INCLUDE 'SOLPAR.CMN'
      INCLUDE 'TIMES.CMN'

      INTEGER INCHAN(70), IBEFOR, YRTOGO
      REAL TYR, QAIRSV(9), QSWSV(9)
      LOGICAL SAVBUG
```


9 1 0 4 8 1 0 3 1

```
C     Get system date and time, read file names--
      CALL MAKDA2
      CALL OPNFIL (3,0,1)

C     Read case-specific parameters from the input file--
      CALL REDCAS (INCHAN)

C     Calculate population and production parameters--
      CALL XQCAL

C     Open outputs file and write heading information--
      CALL OPNFIL (2,1,13)
      LUN = 21
      CALL OPNFIL (2,0,LUN)
      CALL HEADNG (LUN)

C     Open temporary files for acute case--
      CALL OPNFIL (8,0,7)
      CALL OPNFIL (8,0,49)
      CALL OPNFIL (8,0,50)

C     For each radionuclide chain--
      DO 100 IC = 1, NCHAIN

C       Initialize chain parameters and read a radionuclide chain data set--
        NONUC = INCHAN(IC)
        CALL INITNV
        CALL REDCHA
        SAVBUG = DEBUG

C------ Acute calculation ---------------------------------------------

        IF (ACUTE) THEN

C         Clear non-agricultual and skip flags--
          DOAIR = .TRUE.
          DOIRR = .TRUE.
          DOBIOT = .TRUE.
          DOWAST = .TRUE.
          NONAG = .FALSE.

          DEBUG = SAVBUG
          NTIME = INT (NTKEND)

          NSEAS = 1
          IF (TFOOD .OR. ANFOOD) NSEAS = 4

C         Save release term--
```

```
          DO 211 IN = 1, NONUC
            QAIRSV(IN) = QAIR(IN)
            QSWSV(IN) = QSW(IN)
  211     CONTINUE

C         Assumed prospective, do four seasons, starting with winter
C         if terrestrial food or animal product consumption is considered--

          DO 210 ISEAS = 1, NSEAS

            DO 213 IN = 1, NONUC
              QAIR(IN) = QAIRSV(IN)
              QSW(IN) = QSWSV(IN)
  213       CONTINUE

            ITIME = 1
            ITIMT = 1
            CALL ACUTE1 (ISEAS)
            CALL EXPOSR (ISEAS)

            DO 212 IN = 1, NONUC
              QAIR(IN) = 0.0
              QSW(IN) = 0.0
              PWTAIR(IN) = 0.0
              PWTXAR(IN) = 0.0
              DO 216 IP = 1, NPATH
                EXPOS(IN,IP) = 0.0
  216         CONTINUE
  212       CONTINUE

            DO 214 ITIME = 2, NTIME

C             Increment over-all time index--
              ITIMT = ITIMT + 1
              TYR = FLOAT (ITIME)
              IF (DEBUG) WRITE (*,1) ITIME, ITIMT,
     .                          (ELT(IN),AW(IN), IN=1,NONUC)
              IF (ITIME .GT. 2) DEBUG = .FALSE.

C             Initialize exposures--
              DO 312 IN = 1, NONUC
                DO 314 IP = 1, NPATH
                  EXPOS(IN,IP) = 0.0
  314           CONTINUE
  312         CONTINUE

C             Calculate transport--
              CALL TRNSPT (.TRUE.)
              CALL RITMED (.TRUE.)
```

```
C              Calculate exposure--
               CALL EXPOSR (0)

  214        CONTINUE

C            Write exposure data set to file--
             CALL RITEXP (ISEAS, INCHAN)

  210      CONTINUE

         ELSE

C-------- Chronic exposure ------------------------------------------

C          Do transport pre-calculations--
           IF (BIOT .OR. DEEP .OR. BURWAS) CALL BIOCAL
           IF (SWAT) CALL SWCAL
           IF (AIR .OR. AIRCN) CALL AIRCAL

C          Determine number of years of prior decay/building--
           IBEFOR = INT (BEFORE)
           NBEFORE = MAX (IBEFOR, BEFAIR, BEFIRR)

C          Non-agricultural conditions considered only for biotic transport--
           IF (BEFAIR .GT. 0 .OR. BEFIRR .GT. 0) NONAG = .FALSE.

C          For each year of the decay/buildup period--
           DO 102 ITIME = 1, NBEFORE

C            Increment over-all time index, years-to-go--
             ITIMT = ITIMT + 1
             YRTOGO = NBEFORE - ITIME + 1

             IF (ITIME .GT. 3) DEBUG = .FALSE.
             IF (DEBUG) WRITE (*,2) ITIME, (ELT(IN),AW(IN),IN=1,NONUC)

C            Clear skip flags if calculations are to be performed--
             IF (BIOT .AND. BTPRE .AND. LOIC .GE. YRTOGO) DOBIOT=.TRUE.
             IF (BEFORE .GE. YRTOGO) DOWAST = .TRUE.
             IF (BEFAIR .GE. YRTOGO) DOAIR = .TRUE.
             IF (BEFIRR .GE. YRTOGO) DOIRR = .TRUE.

             CALL TRNSPT (.FALSE.)

  102      CONTINUE

C          Land use change from nonag to ag--
           CALL PRIOR
```

```
C         Clear non-agricultual and skip flags--
          DOAIR = .TRUE.
          DOIRR = .TRUE.
          DOBIOT = .TRUE.
          DOWAST = .TRUE.
          NONAG = .FALSE.

          DEBUG = SAVBUG
          NTIME = INT (NTKEND)
          DO 200 ITIME = 1, NTIME

C           Increment over-all time index--
            ITIMT = ITIMT + 1
            TYR = FLOAT (ITIME)
            IF (DEBUG) WRITE (*,1) ITIME, ITIMT,
                                (ELT(IN),AW(IN), IN=1,NONUC)
            IF (ITIME .GT. 2) DEBUG = .FALSE.

            IF (TYR .GT. RELEND) THEN

              IF (SWAT) THEN
C               Surface water release has ended--
                DO 140 IN = 1, NONUC
                  SWCON(IN) = 0.0
                  SWIRR(IN) = 0.0
  140           CONTINUE
              ENDIF

              IF (AIR) THEN
C               Air release has ended--
                DO 141 IN = 1, NONUC
                  ARPCON(IN) = 0.0
                  DO 144 ITF = 1, NTF
                    ARFCON(IN,ITF) = 0.0
  144             CONTINUE
                  DO 146 IAN = 1, NAN+2
                    ARF2CN(IN,IAN) = 0.0
  146             CONTINUE
  141           CONTINUE
              ENDIF
            ENDIF

C           Initialize exposures--
            DO 316 IN = 1, NONUC
              DO 318 IP = 1, NPATH
                EXPOS(IN,IP) = 0.0
  318         CONTINUE
  316       CONTINUE
```

```
C            Calculate transport--
             CALL TRNSPT (.TRUE.)

C            Calculate exposure--
             CALL EXPOSR (0)

C            Write media report--
             CALL RITMED (.TRUE.)

  200      CONTINUE

C          Write exposure data set to file--
           CALL RITEXP (0, INCHAN)

         ENDIF

  100 CONTINUE

C       Write additional seasons to output file--
        IF (ACUTE .AND. NSEAS .GT. 1) CALL RITEXP (0, INCHAN)

      STOP

C---- Format Statements ----------------------------------------------

    1 FORMAT (' Release Year:',I4, ' Over-all year:',I4, 4X,
     .          9(A2,A6,1X))
    2 FORMAT (' Yr: ',I3, 2X, 9(A2,A6, 1X))

C-------------------------------------------------------------------
      END
```


9 1 0 4 8 1 0 3 6

```
C-------------------------------------------------------------------
C
      SUBROUTINE ACUTE1 (ISEAS)
C
C     This subroutine calculates transport through air and surface
C     water from an acute release as well as inhalation and external
C     exposure.
C
C     Module of Program ENV of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 13-Jun-88  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-------------------------------------------------------------------
C
C     CTOIRR() - Initial concentration in surface soil from irrigation
C                for each radionuclide in the current chain, UoA/m2
C     DAL      - Double precision temporary variable
C     DKAIRA() - Air concentration decayed for travel time to each
C                distance in the specified sector for population dose,
C                UoA
C     DNTGRL   - Double precision temporary varaible
C     FIRST()  - Flag set if this is first time through subroutine, for
C                report printing
C     WATCON() - Time-integrated surface water concentration decayed
C                for travel time to  irrigation-withdrawal location,
C                UoA yr/L
C-------------------------------------------------------------------

      INCLUDE 'AFPPAR.CMN'
      INCLUDE 'AIRPAR.CMN'
      INCLUDE 'CONC.CMN'
      INCLUDE 'DECAY.CMN'
      INCLUDE 'FODPAR.CMN'
      INCLUDE 'LABELS.CMN'
      INCLUDE 'OPT.CMN'
      INCLUDE 'RAD.CMN'
      INCLUDE 'SOLPAR.CMN'
      INCLUDE 'SWPAR.CMN'
      INCLUDE 'TIMES.CMN'

      REAL T, DKAIRA(9,10), CTOIRR(9), WATCON(9)
      REAL*8 DAL, DNTGRL
      LOGICAL FIRST
      DATA FIRST /.TRUE./

C     Atmospheric deposition--
      IF (AIR) THEN
```

```
        IF (XOQOPT .NE. 1) THEN
C         XOQOPT=0, a or b--

          IF (POPDOS) THEN
C           Decay for travel time to each distance in specified sector--
            DO 321 I = 1, NDIST
              T = TTAIR(I) * YRSEC
              CALL CHAIN (T, DUMMY, QAIR, DKAIRA(1,I), 0)
              IF (DEBUG) THEN
                WRITE (*,*) 'Decayed air at distance', X(I),':',
     .                      (DKAIRA(IN,I),IN=1,NONUC)
              ENDIF
  321       CONTINUE
          ELSE
C           XOQOPT = 3--
C           Maximum or average individual, decay to specified location--
            T = TTAIRI * YRSEC
            CALL CHAIN (T, DUMMY, QAIR, DKAIRA(1,1), 0)
            IF (DEBUG) THEN
               WRITE (*,*) 'Decayed air at distance', MIDIST,':',
     .                     (DKAIRA(I,1),I=1,NONUC)
            ENDIF
          ENDIF

          IF (FINITE) THEN

            IF (POPDOS) THEN
C             Calculate population-weighted submersion dose coefficients--
              DO 424 IN = 1, NONUC
                PWTXAR(IN) = 0.0
                DO 422 I = 1, NDIST
                  DO 423 K = 1, 6
                    PWTXAR(IN) = PWTXAR(IN) + DKAIRA(IN,I) * PWTX(I,K)
     .                           * EDIS(K,IN) * FC(K)
  423             CONTINUE
  422           CONTINUE
                PWTXAR(IN) = PWTXAR(IN) / POPT
  424         CONTINUE

            ELSE
C             Maximum or average individual submersion dose coefficients--
              DO 430 IN = 1, NONUC
                PWTXAR(IN) = 0.0
                DO 432 K = 1, 6
                  PWTXAR(IN) = PWTXAR(IN) + DKAIRA(IN,1) * DRFSAV(K)
     .                         * EDIS(K,IN) * FC(K)
 432            CONTINUE
 430          CONTINUE
```

```
            ENDIF

            IF (DEBUG) WRITE (*,*) 'PWTXAR:',(PWTXAR(I),I=1,NONUC)
          ENDIF
        ENDIF

C       Infinite plume--
        IF (XOQOPT .EQ. 1) THEN
C         No decay--
          DO 312 IN = 1, NONUC
            PWTAIR(IN) = QAIR(IN) * XOQI
            CTOAIR(IN) = PWTAIR(IN) * DPVL(IN)
  312     CONTINUE

        ELSE
          IF (POPDOS) THEN
C           Calculate average population-weighted air concentration--
            DO 324 IN = 1, NONUC
              PWTAIR(IN) = 0.0
              DO 322 I = 1, NDIST
                PWTAIR(IN) = PWTAIR(IN) + DKAIRA(IN,I) * PWT(I)
  322         CONTINUE
              PWTAIR(IN) = PWTAIR(IN) / POPT
              CTOAIR(IN) = PWTAIR(IN) * DPVL(IN)
  324       CONTINUE

            IF (DEBUG) WRITE (*,*) 'CTOAIR:',(CTOAIR(I),I=1,NONUC)

          ELSE
C           Maximum or average individual--
            DO 300 IN = 1, NONUC
              PWTAIR(IN) = DKAIRA(IN,1) * XOQI
              CTOAIR(IN) = PWTAIR(IN) * DPVL(IN)
  300       CONTINUE

            IF (DEBUG) WRITE (*,*) 'CTOAIR:',(CTOAIR(I),I=1,NONUC)
          ENDIF
        ENDIF

      ELSE
C       Air release not considered--
        DO 326 IN = 1, NONUC
          PWTXAR(IN) = 0.0
          PWTAIR(IN) = 0.0
          CTOAIR(IN) = 0.0
  326   CONTINUE
      ENDIF

C     Surface water time-integrated concentration--
```

9 1 0 4 8 1 0 3 9

```
      IF (SWAT) THEN

        DO 302 IN = 1, NONUC
          SWACUT(IN) = QSW(IN) * MIXR / SWFLOW * M3L * YRSEC
  302   CONTINUE

        IF (DOIRR) THEN
C         Decay for transit time to withdrawal site--
          T = SWTT * YRHR
          CALL CHAIN (T, DUMMY, SWACUT, WATCON, 0)
        ELSE
          DO 304 IN = 1, NONUC
            WATCON(IN) = 0.0
  304     CONTINUE
        ENDIF

      ELSE
        DO 306 IN = 1, NONUC
          SWACUT(IN) = 0.0
          WATCON(IN) = 0.0
  306   CONTINUE
      ENDIF

C     Residential soil concentration--
      DO 307 IN  = 1, NONUC

C       Irrigation contribution--
        IF (SWAT .AND. ISEAS .GT. 1) THEN
          CTOIRR(IN) = WATCON(IN) * RIRRR * LM2IN
        ELSE
          CTOIRR(IN) = 0.0
        ENDIF

C       Get average soil concentration--
        DAL = DBLE (AL(IN))
        IF (DAL .GT. 50.0D0) THEN
          DNTGRL = 1.0D0 / DAL
        ELSE
          DNTGRL = (1.0D0 - DEXP(-DAL)) / DAL
        ENDIF
        RESSOL(IN) = (CTOAIR(IN) + CTOIRR(IN)) * DNTGRL

  307 CONTINUE

C---- Print media report -------------------------------------------------

      LUN = 21
      IF (FIRST) THEN
        WRITE (LUN, 12) UNIT1(IUNIT), UNIT1(IUNIT), UNIT1(IUNIT)
```

```
      FIRST = .FALSE.
    ENDIF

    DO 132 IN = 1, NONUC
      WRITE (LUN,14) ELT(IN), AW(IN), SEALAB(ISEAS), PWTAIR(IN),
   .                 RESSOL(IN), SWACUT(IN)
132 CONTINUE

C---- Format Statements -------------------------------------------------

 10 FORMAT (' Year: ',I4,'      Media for Acute Release')

 12 FORMAT (//
   .      '                    ------Residential------'/
   .      '                    Average                  Time'/
   .      '                    Population-              Integrated'/
   .      ' Radio-    Season   Weighted     Surface     Surface'/
   .      ' nuclide   or Year  Air          Soil        Water'/
   .      '                    ',
   .      A3,' sec/m3    ',A3,'/m2    ',A3,' yr/L'/
   .      ' --------  -------  -----------  ----------  -----------')

 14 FORMAT (' ', A2, A6, A8, 1P, 6 (4X, E8.1E2))

    RETURN
C-----------------------------------------------------------------------
    END
```


9 1 0 4 8 1 0 4 1

```
C-----------------------------------------------------------------------
C
      SUBROUTINE ACUTEA (ISEAS)
C
C     This subroutine calculates exposure through ingestion of
C     animal products from an acute release for a given season.
C
C     Module of Program ENV of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 29-Aug-88  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C     ANIMCN    - Animal product concentration from forage, feed, and
C                 drinking water, UoA-yr/kg and UoA/kg
C     CBARA()   - Time integrated forage concentration from air for each
C                 radionuclide in the current chain, UoA-yr/kg
C     CBARI()   - Time-integrated forage concentration from irrigation
C                 for each radionuclide in the current chain, UoA-yr/kg
C     CTOIRR() - Initial concentration in the surface soil from
C                 irrigation for each radionuclide in the current
C                 chain, UoA/m2
C     DW        - Time-integrated animal product concentration resulting
C                 from ingestion of drinking water, UoA-yr/kg
C     FORAGE() - Time-integrated animal product concentration from
C                 consumption of fresh forage of beef,(5), and milk
C                 cows,(6), UoA-yr/kg, for each radionuclide in the
C                 current chain
C     GRAIN()   - Animal product concentration from ingestion of grain,
C                 UoA/kg
C     ISEAS     - Index of the current season, where 1=winter, 2=spring,
C                 3=summer, 4=autumn
C     LEAFCN() - Concentration in plant from leaf uptake for grains,
C                 for each radionuclide in the current chain, UoA/kg
C     LEAFDK    - Time to decay leaves of grains, yr
C     PWTAIR() - Average population-weighted air concnetration for each
C                 radionuclide in the current chain, UoA-sec/m3
C     ROOTCN() - Concentration in grains from root uptake for each radio-
C                 nuclide in the current chain, UoA/kg
C     SOLHAR() - Surface soil concentration at time of harvest, UoA/m2
C     TENV2     - Weathering constant, yr-1
C     TIMHAR    - Time to harvest, yr
C     WATCON() - Time-integrated surface water concentration decayed for
C                 transit time to irrigation-withdrawal location, UoA yr/L

C
C-----------------------------------------------------------------------
```

```
      INCLUDE 'AFPPAR.CMN'
      INCLUDE 'AIRPAR.CMN'
      INCLUDE 'ANMPAR.CMN'
      INCLUDE 'CONC.CMN'
      INCLUDE 'DECAY.CMN'
      INCLUDE 'FODPAR.CMN'
      INCLUDE 'OPT.CMN'
      INCLUDE 'RAD.CMN'
      INCLUDE 'SOLPAR.CMN'
      INCLUDE 'SWPAR.CMN'
      INCLUDE 'TIMES.CMN'

      REAL TIMHAR, LEAFDK, TENV2, TENV(9), SOLHAR(9),
     .     CTOIRR(9), CBARA(9), CBARI(9), WATCON(9),
     .     ROOTCN(9), LEAFCN(9), FORAGE(9,6), DW, GRAIN(9), FR
      INTEGER ISEAS

C---- Set parameters based on season ----------------------------------

      IF (ISEAS .EQ. 1) THEN
C       Winter

        DOIRR = .FALSE.
        TIMHAR = 0.50
        LEAFDK = 0.0
        TENV2 = ALOG2 / WTIM / YRDA

      ELSEIF (ISEAS .EQ. 2) THEN
C       Spring

        DOIRR = .TRUE.
        TIMHAR = 0.25
        LEAFDK = 0.0
        TENV2 = ALOG2 / WTIM / YRDA

      ELSEIF (ISEAS .EQ. 3) THEN
C       Summer

        DOIRR = .TRUE.
        TIMHAR = 0.083
        LEAFDK = 30.0 * YRDA
        TENV2 = ALOG2 / WTIM / YRDA

      ELSEIF (ISEAS .EQ. 4) THEN
C       Autumn

        DOIRR = .TRUE.
        TIMHAR = 0.0
```

```
          LEAFDK = 0.0
          TENV2 = 0.0

        ENDIF

C       Weathering constant changes by season--
        DO 100 IN = 1, NONUC
          TENV(IN) = TENV2
  100   CONTINUE

C       Irrigation deposition--
        IF (SWAT .AND. DOIRR) THEN
          T = SWTT * YRHR
          CALL CHAIN (T, DUMMY, SWACUT, WATCON, 0)
        ENDIF

C---- First do fresh forage ------------------------------------------

        DO 400 IAN = 5, 6
          IF ((IAN.EQ.5 .AND. ANF(1)) .OR. (IAN.EQ.6 .AND. ANF(3))) THEN

            DO 320 IN = 1, NONUC

C             Irrigation deposition--
              IF (SWAT .AND. DOIRR) THEN
                CTOIRR(IN) = WATCON(IN) * RIRRA(IAN) * LM2IN
              ELSE
                CTOIRR(IN) = 0.0
              ENDIF

C             Set surface soil concentration--
              SL2CON(IN,IAN) = CTOAIR(IN) + CTOIRR(IN)

  320       CONTINUE

            IF (ISEAS .EQ. 1) THEN
C             Winter, decay soil to harvest time--
              CALL CHAIN (TIMHAR, DUMMY, SL2CON(1,IAN), SOLHAR, 0)
              DO 322 IN = 1, NONUC
                ROOTCN(IN) = SOLHAR(IN) / SLDN
     .                       * BVI(3,IN) * DRYFA2(IAN) * RF1
  322         CONTINUE

            ELSEIF (ISEAS .EQ. 4) THEN
C             Autumn, no root uptake--
              DO 325 IN = 1, NONUC
                ROOTCN(IN) = 0.0
  325         CONTINUE
```

```
          ELSE
C           Spring or summer--
            DO 326 IN = 1, NONUC
              ROOTCN(IN) = SL2CON(IN,IAN) / SLDN
     .                       * BVI(3,IN) * DRYFA2(IAN) * RF1
  326       CONTINUE
            CALL CHAIN ((1.0), DUMMY, ROOTCN, ROOTCN, 1)

        ENDIF

          IF (ISEAS .GT. 1) THEN
C         Fresh forage leaves,  except for winter--

            DEPFR1 = 1.0 - EXP (-2.9 * BIOMA2(IAN) * DRYFA2(IAN))

            DO 340 IN = 1, NONUC
              CBARA(IN) = CTOAIR(IN) * DEPFR1
              CBARI(IN) = CTOIRR(IN) * DEPFR2
              IF (BIOMA2(IAN) .GT. 0.0) THEN
                LEAFCN(IN) = (CBARA(IN) + CBARI(IN)) * TRANSA(IAN)
     .                       / BIOMA2(IAN)
              ELSE
                LEAFCN(IN) = 0.0
              ENDIF
  340       CONTINUE

            IF (ISEAS .EQ. 4) THEN
              CALL CHAIN ((1.0), DUMMY, LEAFCN, LEAFCN, 1)
            ELSE
              CALL CHAIN ((1.0), TENV, LEAFCN, LEAFCN, 1)
            ENDIF

          ENDIF

          DO 342  IN = 1, NONUC
            FORAGE(IN,IAN) = (LEAFCN(IN) + ROOTCN(IN)) * FRACUT(ISEAS)
  342     CONTINUE

        ENDIF
  400 CONTINUE


      DO 310 IAN = 1, NAN
        IF (ANF(IAN)) THEN

C-------- Next do stored feed and grain --------------------------------

          DO 324 IN = 1, NONUC
```


9 1 0 4 8 1 0 4 5

```
          IF (SWAT .AND. DOIRR) THEN
            CTOIRR(IN) = WATCON(IN) * RIRRA(IAN) * LM2IN
          ELSE
            CTOIRR(IN) = 0.0
          ENDIF
  324   CONTINUE

C       Set surface soil concentration--
        DO 330 IN = 1, NONUC
          SL2CON(IN,IAN) = CTOAIR(IN) + CTOIRR(IN)
  330   CONTINUE

C       Decay soil to harvest time--
        CALL CHAIN (TIMHAR, DUMMY, SL2CON(1,IAN), SOLHAR, 0)

C       Root uptake--
        DO 350 IN = 1, NONUC
          IF (ISEAS .LT. 4) THEN
            ROOTCN(IN) = SOLHAR(IN) / SLDN * BVI(3,IN) * RF1
          ELSE
            ROOTCN(IN) = 0.0
          ENDIF
  350   CONTINUE

        DO 354 IN = 1, NONUC
          LEAFCN(IN) = 0.0
  354   CONTINUE

        IF (ISEAS .GT. 2) THEN
C         Leaf uptake, summer and autumn--

          DEPFR1 = 1.0 - EXP (-2.9 * BIOMA2(IAN) * DRYFA2(IAN))

          DO 352 IN = 1, NONUC
            IF (BIOMA2(IAN) .GT. 0.0)
     .        LEAFCN(IN) = (CTOAIR(IN) * DEPFR1 + CTOIRR(IN) * DEPFR2)
     .                     * TRANSA(IAN) / BIOMA2(IAN)
  352     CONTINUE

          IF (ISEAS .EQ. 3)
     .      CALL CHAIN (LEAFDK, TENV, LEAFCN, LEAFCN, 0)

        ENDIF

C       Set fraction of animal diet consisting of grain--
        IF (IAN .EQ. 1 .OR. IAN .EQ. 3) THEN
          FR = 1.0 - FRACUT(ISEAS)
        ELSE
```

```
          FR = 1.0
        ENDIF

        DO 356 IN = 1, NONUC
          GRAIN(IN) = (ROOTCN(IN) + LEAFCN(IN)) * FR
356     CONTINUE
        CALL CHAIN ((1.0), DUMMY, GRAIN, GRAIN, 1)

C-------- Total --------------------------------------------------------

        DO 358 IN = 1, NONUC

C           Animal consumption of drinking water--
            DW = WATCON(IN) * DWATER(IAN) * DWFACA(IAN)

C           Total animal product concentration--
            ANIMCN = GRAIN(IN) * CONSUM(IAN) + DW
            IF (IAN .EQ. 1) ANIMCN = ANIMCN + FORAGE(IN,5) * CONSUM(5)
            IF (IAN .EQ. 3) ANIMCN = ANIMCN + FORAGE(IN,6) * CONSUM(6)
            ANIMCN = ANIMCN * FMI(IAN,IN)

C           Holdup between harvest and consumption--
            T = HLDUPA(IAN) * YRDA
            CALL CHAIN (T, DUMMY, ANIMCN, ANIMCN, 0)

C           Human consumption of animal products--
            EXPOS(IN,7+IAN) = ANIMCN * CONS2(IAN) * EFPOPA(IAN)
                             * ADJET2(IAN)

358     CONTINUE
      ENDIF
310 CONTINUE

    RETURN
C-----------------------------------------------------------------------
    END
```


9 1 0 4 8 1 0 4 7

```
C-----------------------------------------------------------------------
C
      SUBROUTINE ACUTEC (ISEAS)
C
C     This subroutine calculates exposure through ingestion of
C     terrestrial foods from an acute release for a given season.
C
C     Module of Program ENV of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 17-Aug-88  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C     CBARA()  - Time integrated plant concentration from air for each
C                radionuclide in the current chain, UoA-yr/kg
C     CBARI()  - Time-integrated plant concentration from irrigation
C                for each radionuclide in the current chain, UoA-yr/kg
C     CTOIRR() - Initial concentration in the surface soil from
C                irrigation for each radionuclide in the current
C                chain, UoA/m2
C     FOODCN() - Concentration in food, UoA yr/kg
C     ISEAS    - Index of the current season, where 1=winter, 2=spring,
C                3=summer, 4=autumn
C     LEAFCN() - Concentration in plant from leaf uptake for grains,
C                fruits, and root vegetables for each radionuclide in
C                the current chain, UoA/kg
C     LEAFDK   - Time to decay leaves of grains, fruits, and root
C                vegetables, yr
C     ROOTCN() - Concentration in plant from root uptake for each radio-
C                nuclide in the current chain, UoA/kg
C     SOLHAR() - Surface soil concentration at time of harvest, UoA/m2
C     T        - Time in adjusted units for CHAIN calls
C     TENV2    - Weathering constant, yr-1
C     TIMHAR   - Time to harvest, yr
C     WATCON() - Time-integrated surface water concentration decayed for
C                transit to irrigation-withdrawal location, UoA yr/L
C
C-----------------------------------------------------------------------

      INCLUDE 'AFPPAR.CMN'
      INCLUDE 'AIRPAR.CMN'
      INCLUDE 'CONC.CMN'
      INCLUDE 'DECAY.CMN'
      INCLUDE 'FODPAR.CMN'
      INCLUDE 'OPT.CMN'
      INCLUDE 'RAD.CMN'
      INCLUDE 'SOLPAR.CMN'
```

```
      INCLUDE 'SWPAR.CMN'
      INCLUDE 'TIMES.CMN'

      REAL TIMHAR, LEAFDK, TENV2, TENV(9), SOLHAR(9),
     .     CTOIRR(9), CBARA(9), CBARI(9), WATCON(9),
     .     ROOTCN(9), LEAFCN(9), FOODCN(9)
      INTEGER ISEAS

C---- Set parameters based on season ---------------------------------

      IF (ISEAS .EQ. 1) THEN
C       Winter

        DOIRR = .FALSE.
        TIMHAR = 0.50
        LEAFDK = 0.0
        TENV2 = ALOG2 / WTIM / YRDA

      ELSEIF (ISEAS .EQ. 2) THEN
C       Spring

        DOIRR = .TRUE.
        TIMHAR = 0.25
        LEAFDK = 0.0
        TENV2 = ALOG2 / WTIM / YRDA

      ELSEIF (ISEAS .EQ. 3) THEN
C       Summer

        DOIRR = .TRUE.
        TIMHAR = 0.083
        LEAFDK = 30.0 * YRDA
        TENV2 = ALOG2 / WTIM / YRDA

      ELSEIF (ISEAS .EQ. 4) THEN
C       Autumn

        DOIRR = .TRUE.
        TIMHAR = 0.0
        LEAFDK = 0.0
        TENV2 = 0.0

      ENDIF

C     Weathering constant changes by season
      DO 100 IN = 1, NONUC
        TENV(IN) = TENV2
  100 CONTINUE
```

```
C     For each terrestrial food pathway--
      DO 310 ITF = 1, NTF
        IF (TFD(ITF)) THEN

C           Irrigation deposition--
            IF (SWAT .AND. DOIRR) THEN

              T = SWTT * YRHR
              CALL CHAIN (T, DUMMY, SWACUT, WATCON, 0)

              DO 320 IN = 1, NONUC
                CTOIRR(IN) = WATCON(IN) * RIRR(ITF) * LM2IN
  320         CONTINUE
            ELSE
              DO 328 IN = 1, NONUC
                CTOIRR(IN) = 0.0
  328         CONTINUE
            ENDIF

C           Set surface soil concentration--
            DO 330 IN = 1, NONUC
              SOLCON(IN,ITF) = CTOAIR(IN) + CTOIRR(IN)
  330       CONTINUE

C           Plant concentration from root uptake, except autumn--
            IF (ISEAS .EQ. 4) THEN

C             Autumn, no root uptake--
              DO 351 IN = 1, NONUC
                ROOTCN(IN) = 0.0
  351         CONTINUE

            ELSEIF (ITF .EQ. 1 .AND. (ISEAS.EQ.2 .OR. ISEAS.EQ.3)) THEN

C             Leafy vegetables, spring and summer--
              DO 353 IN = 1, NONUC
                ROOTCN(IN) = SOLCON(IN,ITF) / SLDN
     .                       * BVI(ITF,IN) * DRYFAC(ITF) * RF1
  353         CONTINUE
              CALL CHAIN ((1.0), DUMMY, ROOTCN, ROOTCN, 1)

            ELSE

C             Decay soil to harvest time--
              CALL CHAIN (TIMHAR, DUMMY, SOLCON(1,ITF), SOLHAR, 0)
              DO 350 IN = 1, NONUC
                ROOTCN(IN) = SOLHAR(IN) / SLDN
     .                       * BVI(ITF,IN) * DRYFAC(ITF) * RF1
  350         CONTINUE
```

```
          ENDIF

          IF (ITF .EQ. 1) THEN
C           Leaf uptake, leafy vegetables--

            DEPFR1 = 1.0 - EXP (-2.9 * BIOMAS(ITF) * DRYFAC(ITF))

            DO 340 IN = 1, NONUC
              IF (ISEAS .EQ. 1) THEN
C               Winter--
                LEAFCN(IN) = 0.0
              ELSE
                CBARA(IN) = CTOAIR(IN) * DEPFR1
                CBARI(IN) = CTOIRR(IN) * DEPFR2
                LEAFCN(IN) = (CBARA(IN) + CBARI(IN))
     .                       * TRANS(ITF) / BIOMAS(ITF)
              ENDIF
  340       CONTINUE

            IF (ISEAS .EQ. 4) THEN
C             Autumn--
              CALL CHAIN ((1.0), DUMMY, LEAFCN, LEAFCN, 1)
            ELSEIF (ISEAS .EQ. 2 .OR. ISEAS .EQ. 3) THEN
C             Spring or Summer--
              CALL CHAIN ((1.0), TENV, LEAFCN, LEAFCN, 1)
            ENDIF


          ELSE
C           Leaves of grain, fruits, root vegetables--

            IF (ISEAS .GT. 2) THEN

              IF (ITF .EQ. 4) THEN
                DEPFR1 = 1.0 - EXP (-2.9 * BIOMAS(ITF) * DRYFAC(ITF))
              ELSE
                DEPFR1 = 1.0 - EXP (-3.6 * BIOMAS(ITF) * DRYFAC(ITF))
              ENDIF

              DO 352 IN = 1, NONUC
                LEAFCN(IN) = (CTOAIR(IN) * DEPFR1 +
     .                        CTOIRR(IN) * DEPFR2)
     .                        / BIOMAS(ITF) * TRANS(ITF)
  352         CONTINUE

              IF (ISEAS .EQ. 3)
     .          CALL CHAIN (LEAFDK, TENV, LEAFCN, LEAFCN, 0)
```

```
            ELSE
              DO 354 IN = 1, NONUC
                LEAFCN(IN) = 0.0
 354          CONTINUE
            ENDIF

          ENDIF

C         Total food concentration--
          DO 360 IN = 1, NONUC
            FOODCN(IN) = ROOTCN(IN) + LEAFCN(IN)
 360      CONTINUE


C         Holdup between harvest and consumption--
          T = HLDUP(ITF) * YRDA
          CALL CHAIN (T, DUMMY, FOODCN, FOODCN, 0)

C         Human Consumption Integral (Leafy in Winter, all others always)
          IF (ITF .GT. 1 .OR. ISEAS .EQ. 1)
     .     CALL CHAIN ((1.0), DUMMY, FOODCN, FOODCN, 1)

          DO 362 IN = 1, NONUC
C           Human uptake from foods--
            EXPOS(IN,ITF+3) = FOODCN(IN) * CONS(ITF) * EFPOP(ITF) *
     .                        ADJEAT(ITF)
 362      CONTINUE

        ENDIF
 310  CONTINUE

      RETURN
C-----------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------
C
      SUBROUTINE AIRCAL
C
C     This module calculates average population-weighted and average
C     food-weighted air concentrations.
C
C     Module of Program ENV of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 11-Apr-88  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C     AFRAC    - Fraction of grid area in current sector
C     AREAT    - Total area in grid
C     DKAIR() -  Air source term decayed for transit, for the current
C                exposure pathway, distance and direction
C     RTEMP()  - Temporary input and calculation array (infinite plume)
C     RXTEMP() - Temporary input and calculation array (finite plume)
C     T        - Time in years passed to CHAIN
C
C-----------------------------------------------------------------------

      INCLUDE 'AIRPAR.CMN'
      INCLUDE 'AFPPAR.CMN'
      INCLUDE 'ANMPAR.CMN'
      INCLUDE 'AQUPAR.CMN'
      INCLUDE 'CONC.CMN'
      INCLUDE 'FODPAR.CMN'
      INCLUDE 'OPT.CMN'
      INCLUDE 'RAD.CMN'

      CHARACTER DUM*8
      REAL RTEMP(9), RXTEMP(9), DKAIR(9)

C---- Air concentrations -----------------------------------------------

      IF (AIRCN) THEN

C       Air concnetration was input--
        DO 103 IN = 1, NONUC
          ARPCON(IN) = AIRCON(IN) * SECYR
  103   CONTINUE

      ELSEIF (XOQOPT .EQ. 1) THEN

C       Chi/Q value was input, no decay in transit--
```

```
         DO 102 IN = 1, NONUC
           ARPCON(IN) = QAIR(IN) * XOQI / POPT
  102    CONTINUE

        ELSEIF (POPDOS) THEN

C        Population dose, joint frequency data or Chi/Q array enetered--

         DO 101 IN = 1, NONUC
           RTEMP(IN) = 0.0
           IF (FINITE) RXTEMP(IN) = 0.0
  101    CONTINUE

C        Sum over each distance and direction--
         DO 100 IX = 1, NDIST
           DO 110 ID = 1, NDIR

C              Calculate decay in transit--
               T = X(IX) / AVEU(ID) * YRSEC
               CALL CHAIN (T, DUMMY, QAIR, DKAIR, 0)

C              Multiply by chi/Q and population; accumulate total--
               DO 120 IN = 1, NONUC

                 IF (FINITE) THEN
                   DO 115 IE = 1, 6
                     RXTEMP(IN) = RXTEMP(IN) + DKAIR(IN) *
     .                            DRFOQ(ID,IX,IE) * POP(IX,ID) *
     .                            EDIS(IE,IN) * FC(IE)
  115              CONTINUE
                 ENDIF

                 RTEMP(IN) = RTEMP(IN) +
     .                       DKAIR(IN) * XOQ(IX,ID) * POP(IX,ID)

  120          CONTINUE

  110      CONTINUE
  100    CONTINUE

         DO 130 IN = 1, NONUC
C          Divide by total population for air paths--

           IF (FINITE) THEN
             ARPXCN(IN) = RXTEMP(IN) / POPT
           ENDIF

           ARPCON(IN) = RTEMP(IN) / POPT
```

```
 130   CONTINUE

      ELSE
C       Individual at specified or determined location--

        DO 104 IN = 1, NONUC

C         Calculate decay in transit--
          IF (XOQOPT .EQ. 3) THEN
            T = MIDIST / MIUBAR * YRSEC
          ELSEIF (XOQOPT .EQ. 2) THEN
            T = MIDIST / AVEU(MIDIR) * YRSEC
          ELSE
            GOTO 92
          ENDIF
          CALL CHAIN (T, DUMMY, QAIR, DKAIR, 0)

          IF (FINITE) THEN
            ARPXCN(IN) = 0.0
            DO 107 IE = 1, 6
              ARPXCN(IN) = ARPXCN(IN) + DKAIR(IN) * DRFSAV(IE)
                           * EDIS(IE,IN) * FC(IE)
 107        CONTINUE
          ENDIF

C         Infinite plume, selected Chi/Q stored in XOQI--
          ARPCON(IN) = DKAIR(IN) * XOQI

 104   CONTINUE

      ENDIF

      IF (DEBUG) THEN
        IF (FINITE) THEN
          WRITE (*,*) 'Air (ARPXCN):',ARPXCN(1)
        ENDIF
        WRITE (*,*) 'Air (ARPCON):', ARPCON(1)
      ENDIF

C---- Terrestrial foods air concentrations------------------------------

      IF (TFOOD) THEN
        DO 140 ITF = 1, NTF
          IF (TFD(ITF)) THEN

            IF (FOQOPT .EQ. 0) THEN

C             Food-weighted chi/Q was input--
              DO 144 IN = 1, NONUC
```


9 1 0 4 8 1 0 5 5

```
               ARFCON(IN,ITF) = QAIR(IN) * FOQ
  144        CONTINUE

           ELSEIF (FOQOPT .EQ. 1) THEN

C            Set food-weighted air to pop-weighted air--
             DO 142 IN = 1, NONUC
               ARFCON(IN,ITF) = ARPCON(IN)
  142        CONTINUE

           ELSEIF (FOQOPT .GT. 1) THEN

C            Calculate air concentrations--
             DO 413 IN = 1, NONUC
               RTEMP(IN) = 0.0
  413        CONTINUE

             DO 412 ID = 1, NDIR
               DO 414 IX = 1, NDIST

C                Calculate decay in transit--
                 T = X(IX) / AVEU(ID) * YRSEC
                 CALL CHAIN (T, DUMMY, QAIR, DKAIR, 0)

C                Multiply by chi/Q and effective pop; accumulate total--
                 DO 454 IN = 1, NONUC
                   RTEMP(IN) = RTEMP(IN) + DKAIR(IN) * XOQ(IX,ID)
                               * FPRD(IX,ID,ITF)
  454            CONTINUE
  414          CONTINUE
  412        CONTINUE


             DO 458 IN = 1, NONUC
               ARFCON(IN,ITF) = RTEMP(IN) / TPRODT(ITF)
  458        CONTINUE

           ENDIF
         ENDIF
  140  CONTINUE
     ENDIF

C---- Animal product-weighted air concentrations ----------------------

     IF (ANFOOD) THEN
       DO 150 IAN = 1, NAN
         IF (ANF(IAN)) THEN

           IF (FOQOPT .EQ. 0) THEN
```

```
C           Food-weighted chi/Q was input--
            DO 154 IN = 1, NONUC
              ARF2CN(IN,IAN) = QAIR(IN) * FOQ
              IF (IAN .EQ. 1) ARF2CN(IN,5) = ARF2CN(IN,1)
              IF (IAN .EQ. 3) ARF2CN(IN,6) = ARF2CN(IN,3)
  154       CONTINUE

          ELSEIF (FOQOPT .EQ. 1) THEN

C           Set food-weighted air to pop-weighted--
            DO 152 IN = 1, NONUC
              ARF2CN(IN,IAN) = ARPCON(IN)
              IF (IAN .EQ. 1) ARF2CN(IN,5) = ARF2CN(IN,1)
              IF (IAN .EQ. 3) ARF2CN(IN,6) = ARF2CN(IN,3)
  152       CONTINUE

          ELSEIF (FOQOPT .GT. 1) THEN
C           Calculate air concentrations--

            DO 415 IN = 1, NONUC
              RTEMP(IN) = 0.0
  415       CONTINUE

            DO 442 ID = 1, NDIR

              DO 444 IX = 1, NDIST

C               Calculate decay in transit--
                T = X(IX) / AVEU(ID) * YRSEC
                CALL CHAIN (T, DUMMY, QAIR, DKAIR, 0)

C               Multiply by chi/Q and effective pop; accumulate total--
                DO 464 IN = 1, NONUC
                  RTEMP(IN) = RTEMP(IN) + DKAIR(IN) * XOQ(IX,ID)
                              * FPRDA(IX,ID,IAN) / CONS2(IAN)
  464           CONTINUE
  444         CONTINUE
  442       CONTINUE


C           Calculate animal food-weighted air concentration--
            DO 468 IN = 1, NONUC
              ARF2CN(IN,IAN) = RTEMP(IN) / EFPOPA(IAN)
              IF (IAN .EQ. 1) ARF2CN(IN,5) = ARF2CN(IN,1)
              IF (IAN .EQ. 3) ARF2CN(IN,6) = ARF2CN(IN,3)
  468       CONTINUE

          ENDIF
```

```
          ENDIF
  150   CONTINUE
      ENDIF

      RETURN

C---- Error Conditions ---------------------------------------------------

   92 WRITE (*,*) 'XOQOPT invalid in AIRCAL: ',XOQOPT
      CALL EXIT (1)

   99 CALL FILERR (2, LUN, 'In AIRCAL')

C-----------------------------------------------------------------------
      END
```

```
C-------------------------------------------------------------------
C
      SUBROUTINE ANMCAL
C
C     This subroutine calculates uptake rate from comsumption of
C     animal products.
C
C     Module of Program ENV of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 17-Aug-88  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-------------------------------------------------------------------
C
C     Internal parameters:
C
C     ANFLAG    - option flag for each of the feed and fodder types
C     DW        - animal drinking water contribution, UoA/L
C     EDBL()    - Concentration in animals from the six feed categories
C     IBV       - index of BVI value to use, either (1) fresh, (4) stored;
C                 soil-to-plant transfer factor for feed and forage
C     LEAF()    - Total leaf concentration, each radionuclide, UoA/kg
C     LEAF1a    - Leaf concentration from air, UoA/kg
C     LEAF1b    - Leaf concentration from resuspension, UoA/kg
C     LEAF2     - Leaf concentration from irrigation, UoA/kg
C     PLT()     - Plant concentration for each feed and fodder type, UoA/kg

C     ROOT1     - Root uptake contribution from surface soil, UoA/kg
C     ROOT2     - Root uptake contribution from deep soil, UoA/kg
C     T         - decay/integral time, sec
C     TENV      - Weathering time constant (-) for each radionuclide
C     WATCON()  - water concentration used for each radionuclide in the,
C                 current chain, either ground water or surface water
C
C     Assumptions:
C
C     1) Animals drink irrigation water if irrigation is considered,
C        otherwise animals assumed to drink surface water
C
C-------------------------------------------------------------------
C
      INCLUDE 'OPT.CMN'
      INCLUDE 'CONC.CMN'
      INCLUDE 'RAD.CMN'
      INCLUDE 'FODPAR.CMN'
      INCLUDE 'ANMPAR.CMN'
      INCLUDE 'AFPPAR.CMN'
      INCLUDE 'SOLPAR.CMN'
```

```
      REAL TENV(9), LEAF(9), PLT(9,6), EDBL(9,6), DW, LEAF1A, LEAF1B,
     .     LEAF2, ROOT1, ROOT2, WATCON(9)
      INTEGER IBV
      LOGICAL ANFLG

      IF (.NOT. DERANM .OR. ANMFED) THEN

C       Calculate weathering constant--
        TENV2 = ALOG2 / WTIM / YRDA

C       Move fresh forage concentration into PLT--
        IF (ANMFED) THEN
          DO 112 IN = 1, NONUC
            PLT(IN,5) = ANMCON(IN,1)
            PLT(IN,6) = ANMCON(IN,3)
            ANMCON(IN,1) = 0.0
            ANMCON(IN,3) = 0.0
  112     CONTINUE
        ENDIF

C       For each animal feed and fodder pathway--
        DO 100 IAN = 1, NAN+2

C         Set option flag/concentration ratio index for feed or forage--
          IF (IAN .LT. 5) THEN
            ANFLG = ANF(IAN)
            IBV = 4
          ELSEIF (IAN .EQ. 5) THEN
            ANFLG = ANF(1)
            IBV = 1
          ELSE
            ANFLG = ANF(3)
            IBV = 1
          ENDIF

C         Set water source for irrigation and drinking water, drinking
C         water defaults to surface water if no irrigation--
          DO 114 IN = 1, NONUC
            IF (IRRSA(IAN) .EQ. 1) THEN
              WATCON(IN) = GWCON(IN)
            ELSE
              WATCON(IN) = SWIRR(IN)
            ENDIF
  114     CONTINUE

          IF (ANFLG) THEN
            IF (.NOT. ANMFED) THEN
```

```
                    DEPFR1 = 1.0 - EXP (-2.9 * BIOMA2(IAN) * DRYFA2(IAN))
C                   Calculate contribution from deposition onto leaves--
                    DO 110 IN = 1, NONUC

                      PLT(IN,IAN) = 0.0
                      EDBL(IN,IAN) = 0.0

C                     Calculate leaf deposition rate from air--
                      LEAF1A = ARF2CN(IN,IAN) * DPVL(IN) * DEPFR1

C                     Calculate leaf deposition from resuspension--
                      LEAF1B = SL2CON(IN,IAN) * LEAFRS * DPVRES * SECYR
     .                         * DEPFR1

C                     Calculate leaf deposition rate from irrigation--
                      LEAF2 = 0.0
                      IF (IRRSA(IAN) .GT. 0) THEN
                        IF (IRTIMA(IAN) .GT. 0.0)
     .                    LEAF2 = WATCON(IN) * RIRRA(IAN) * LM2IN /
     o                            IRTIMA(IAN) * MOYR * DEPFR2
                      ENDIF

C                     Calculate total leaf deposition rate--
                      LEAF(IN) = 0.0
                      IF (BIOMA2(IAN) .GT. 0.0)
     .                  LEAF(IN) = (LEAF1A + LEAF1B + LEAF2) * TRANSA(IAN)
     o                             / BIOMA2(IAN)

                      IF (DEBUG .AND. IN .EQ. 1)
     .                  WRITE (*,1) IAN, LEAF1A, LEAF1B, LEAF2, LEAF(1)

C                     Set weathering constant for each radionuclide--
                      TENV(IN) = TENV2

  110               CONTINUE

C                   Apply weathering correction (accumulation & decay) to leaves--
                    T = GRWPA(IAN) * YRDA
                    IF (T .GT. 0.0) CALL CHAIN (T, TENV, LEAF, LEAF, 1)

C                   Calculate root contribution and fodder concentration--
                    DO 120 IN = 1, NONUC

C                     Calculate root uptake contribution (surface and deep soil)--
                      ROOT1 = SL2CON(IN,IAN) / SLDN
     .                        * BVI(IBV,IN) * DRYFA2(IAN) * RF1
                      ROOT2 = 0.0
                      IF (DEEP)
```

```
     .              ROOT2 = DS2CON(IN,IAN) / SSLDN
     .                      * BVI(IBV,IN) * DRYFA2(IAN) * RF2

C                 Save uptake from soil for next year's harvest removal--
                  IF (HARVST) THEN
                    HARVA(IN,IAN,1) = (LEAF(IN) + ROOT1) * YELDA(IAN)
                    IF (DEEP .AND. RF2 .GT. 0.0) THEN
                      HARVA(IN,IAN,2) = ROOT2 * YELDA(IAN) / WASDEP
                    ELSE
                      HARVA(IN,IAN,2) = 0.0
                    ENDIF
                  ENDIF

C                 Total plant concentration for each food and fodder--
                  PLT(IN,IAN) = LEAF(IN) + ROOT1 + ROOT2

                  IF (DEBUG .AND. IN .EQ. 1) WRITE (*,2)
     .              IAN,LEAF(1),ROOT1,ROOT2,PLT(1,IAN)

  120           CONTINUE
              ENDIF

C---------- Decay for holdup between feed harvest and animal consumption--

              T = 1.0
              CALL CHAIN (T, DUMMY, HARVA(1,IAN,1), HARVA(1,IAN,1), 0)
              IF (DEEP)
     .          CALL CHAIN (T, DUMMY, HARVA(1,IAN,2), HARVA(1,IAN,2), 0)

              T = STORTM(IAN) * YRDA
              IF (T .GT. 0.0)
     .          CALL CHAIN (T, DUMMY, PLT(1,IAN), PLT(1,IAN), 0)

C---------- Calculate animal product concentration ----------------------
              DO 130 IN = 1, NONUC

C               Animal product concentration for each type of fodder--
                EDBL(IN,IAN) = PLT(IN,IAN) * FMI(IAN,IN) * CONSUM(IAN) *
     .                         DIETFR(IAN)

C               Calculate animal drinking water contribution--
                DW = 0.0
                IF (IAN .LT. 5) DW = WATCON(IN) *
     .            FMI(IAN,IN) * DWATER(IAN) * DWFACA(IAN)

                IF (DEBUG .AND. IN .EQ. 1) WRITE (*,*)
     .            'EDBL/DW:',EDBL(IN,IAN),DW

C               Add stored feed, fresh forage, and drink water contributions--
```

```
         IF (IAN .LT. 5) THEN
           ANMCON(IN,IAN) = EDBL(IN,IAN) + DW
         ELSEIF (IAN .EQ. 5) THEN
           ANMCON(IN,1) = ANMCON(IN,1) + EDBL(IN,IAN)
         ELSEIF (IAN .EQ. 6) THEN
           ANMCON(IN,3) = ANMCON(IN,3) + EDBL(IN,IAN)
         ENDIF

  130       CONTINUE
          ENDIF
  100   CONTINUE
      ENDIF

C---- For each animal product ------------------------------------------
      DO 200 IAN = 1, NAN
        IF (ANF(IAN)) THEN

          IF (DEBUG) WRITE (*,*) 'ANMCON:', ANMCON(1,IAN)

C         Holdup between slaughter/harvest and human consumption--
          IF (.NOT. DERANM) THEN
            T = HLDUPA(IAN) * YRDA
            CALL CHAIN (T, DUMMY, ANMCON(1,IAN), ANMCON(1,IAN), 0)
          ENDIF

C         Human uptake from contaminated animal products--
          DO 210 IN = 1, NONUC
            EXPOS(IN,7+IAN) = ANMCON(IN,IAN) * CONS2(IAN) * EFPOPA(IAN)
                              * ADJET2(IAN)
  210     CONTINUE

        ENDIF
  200 CONTINUE

      RETURN

C---- Format Statements ------------------------------------------------

    1 FORMAT (' ANM: (1A/1B/2/LEAF):',I2,1P,4E10.2)
    2 FORMAT (' ANM: (LEAF/ROOT1/ROOT2/PLT):',I2,1P,4E10.2)

C-----------------------------------------------------------------------
      END
```

```
C-------------------------------------------------------------------
C
      SUBROUTINE AQUCAL
C
C     This subroutine calculates human uptake rate from consumption of
C     aquatic food.
C
C     Module of Program ENV of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 13-Jan-88 RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-------------------------------------------------------------------
C
C     SWDK()    - Surface water concentration, decayed for transit,
C                 UoA/L
C     TYR       - Decay time in years
C
C-------------------------------------------------------------------

      INCLUDE 'CONC.CMN'
      INCLUDE 'RAD.CMN'
      INCLUDE 'AQUPAR.CMN'
      INCLUDE 'OPT.CMN'
      INCLUDE 'AFPPAR.CMN'
      INCLUDE 'TIMES.CMN'

      REAL SWDK(9), TYR

      DO 100 IAQ = 1, NAQ
        IF (AQF(IAQ)) THEN

          IF (.NOT. DERAQU) THEN

C           Decay surface water for time in transit--
            TYR = AQUTT(IAQ) * YRHR
            IF (ACUTE) THEN
              CALL CHAIN (TYR, DUMMY, SWACUT, SWDK, 0)
            ELSE
              CALL CHAIN (TYR, DUMMY, SWCON, SWDK, 0)
            ENDIF

C           Calculate aquatic foods concentrations--
            DO 110 IN = 1, NONUC
              AQUCON(IN,IAQ) = SWDK(IN) * BIOACF(IAQ,IN)
  110       CONTINUE

            IF (DEBUG) WRITE (*,*) 'IAN, SWDK, AQUCON:',
```

```
     .         IAQ, SWDK(1), AQUCON(1,IAQ)

             ENDIF

C            Decay for holdup time--
             IF (.NOT. DERAQU) THEN
               T = HLDUP2(IAQ) * YRDA
               CALL CHAIN ( T, DUMMY, AQUCON(1,IAQ), AQUCON(1,IAQ), 0)
             ENDIF

C            Exposure from consumption of aquatic foods--
             DO 120 IN = 1, NONUC
               EXPOS(IN,17+IAQ) = AQUCON(IN,IAQ)
     .                            * USAG(IAQ) * AQUPOP * ADJETQ(IAQ)
  120        CONTINUE
           ENDIF

  100 CONTINUE
      RETURN

C-----------------------------------------------------------------------
      END
```


9 1 0 4 8 1 0 6 5

```
C-----------------------------------------------------------------------
C
      SUBROUTINE CANDH
C
C     This module calculates environmental concentrations of C-14 and
C     H-3 using simplified specific-activity models for acute and chronic
C     exposures.
C
C     Module of Program ENV of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification:  30-Aug-88 RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C     AIRBOX()  - air concentration for each radionuclide in the
C                 current chain, set based on whether acute or chronic
C                 exposure
C     ANFLAG    - option flag for each of the feed and fodder types
C     ANMFR     - fraction of animal diet for the current animal feed
C                 type, set based on whether acute or chronic exposure
C     DW1()     - Intake via drinking water, used for tritium
C     DW2()     - Concentration in drinking water, used for tritium
C     EDBL()    - Concentration in animals from the six feed categories,
C                 used for carbon
C     EDBL1()   - Intake via food, used for tritium
C     EDBL2()   - Concentration in food, used for tritium
C     LEAF()    - Total leaf concentration, each radionuclide, UoA/kg
C     LEAF1a    - Leaf concentration from air, UoA/kg
C     LEAF2     - Leaf concentration from irrigation, UoA/kg
C     WATCON()  - Water concentration used for each radionuclide in the
C                 current chain, either ground water or surface water
C
C     Assumptions:
C
C     1) Animals drink irrigation water if irrigation is considered,
C        otherwise animals assumed to drink surface water
C
C-----------------------------------------------------------------------

      INCLUDE 'OPT.CMN'
      INCLUDE 'RAD.CMN'
      INCLUDE 'CONC.CMN'
      INCLUDE 'FODPAR.CMN'
      INCLUDE 'ANMPAR.CMN'
      INCLUDE 'AFPPAR.CMN'
      INCLUDE 'SOLPAR.CMN'
```

```
      REAL LEAF(9), EDBL(9,6), LEAF1A, LEAF2, WATCON(9), AIRBOX(9),
     .     EDBL1(6), EDBL2(6), DW1(4), DW2(4), ANMFR,
     .     C(6), C0, C1, C2, C3,
     .     H(6), H1, H2, H33,
     .     W(6), W1, W2, W3
      LOGICAL ANFLG

      DATA C /0.24, 0.20, 0.07, 0.15, 0.24, 0.07/
      DATA C0 /2.0E-5/
      DATA C1 /1.6E-4/
      DATA C2 /0.09/
      DATA C3 /0.4/

      DATA H / 0.094, 0.087, 0.083, 0.092, 0.094, 0.083/
      DATA H1 /9.0/
      DATA H2 /0.008/
      DATA H33 /0.0625/

      DATA W / 0.60, 0.70, 0.88, 0.75, 0.60, 0.88/
      DATA W1 /0.80/
      DATA W2 /0.12/
      DATA W3 /0.80/

      DATA Z1 /0.1/, Z2 /0.03/

      DATA SKG /0.01/
      DATA PKG /0.1/
      DATA RMV /1.25/

      IF (H3) THEN
        W1M = W1 / H1 + (1.0 - W1) * H33
        W2M = W2 / H1 + (1.0 - W2) * H33
        W3M = W3 / H1 + (1.0 - W3) * H33
      ENDIF


C-----------------------------------------------------------------

C     Process each selected terrestrial food type--

      IF (TFOOD) THEN
        DO 101 ITF = 1, NTF
          IF (TFD(ITF)) THEN
            IF (.NOT. DERCRP) THEN

C             Set media conpartments--

              IF (ACUTE) THEN
```

```
            DO 122 IN = 1, NONUC

              IF (C14) THEN
                AIRBOX(IN) = PWTAIR(IN) / 3600.0
                             * 2.0 / (GRWP(ITF) * 24.0)
              ELSEIF (H3) THEN
                AIRBOX(IN) = PWTAIR(IN) / 3600.0
              ENDIF

              IF (IRRST(ITF) .EQ. 2) THEN
                WATCON(IN) = SWACUT(IN) / 3600.0
              ELSE
                WATCON(IN) = 0.0
              ENDIF

122         CONTINUE

          ELSE

            DO 123 IN = 1, NONUC

              AIRBOX(IN) = ARFCON(IN,ITF) * YRSEC

              IF (IRRST(ITF) .EQ. 2) THEN
                WATCON(IN) = SWIRR(IN)
              ELSEIF (IRRST(ITF) .EQ. 1) THEN
                WATCON(IN) = GWCON(IN)
              ELSE
                WATCON(IN) = 0.0
              ENDIF
123         CONTINUE

          ENDIF

          DO 111 IN = 1, NONUC
C           Calculate leaf concentration--
            IF (C14) THEN
              LEAF1A = AIRBOX(IN) / C1
            ELSEIF (H3) THEN
              LEAF1A = AIRBOX(IN) * H1 / H2
            ENDIF

C           Calculate leaf concentration from irrigation--
            LEAF2 = 0.0
            IF (IRTIMT(ITF) .GT. 0.0) THEN

              IF (C14) THEN
                LEAF2 = WATCON(IN) * RIRR(ITF) * LM2IN /
                        IRTIMT(ITF) * MOYR * PKG * RMV
```

```
                    / SLDN / SKG

              ELSEIF (H3) THEN
                LEAF2 = WATCON(IN) * H1

              ENDIF
            ENDIF

C           Calculate total leaf and plant concentrations --

            LEAF(IN) = LEAF1A + LEAF2

            IF (ITF .EQ. 3) THEN
              IF (C14) THEN
                PLTCON(IN,ITF) = LEAF(IN) * C3
              ELSEIF (H3) THEN
                PLTCON(IN,ITF) = LEAF(IN) * W1M
              ENDIF

            ELSE
              IF (C14) THEN
                PLTCON(IN,ITF) = LEAF(IN) * C2
              ELSEIF (H3) THEN
                PLTCON(IN,ITF) = LEAF(IN) * W2M
              ENDIF
            ENDIF

  111     CONTINUE

C         Decay for holdup time between harvest and consumption--
          T = HLDUP(ITF) * YRDA
          CALL CHAIN (T, DUMMY, PLTCON(1,ITF), PLTCON(1,ITF), 0)

        ENDIF

C       Calculate human uptake from crops ---
        DO 131 IN = 1, NONUC
          EXPOS(IN,3+ITF) = PLTCON(IN,ITF) * CONS(ITF)
                          * EFPOP(ITF) * ADJEAT(ITF)
  131   CONTINUE

      ENDIF
  101 CONTINUE
    ENDIF

C---- Process each selected animal pathway ----------------------------
C
    IF (ANFOOD) THEN
      IF (.NOT. DERANM .OR. ANMFED) THEN
```

```
          IF (ANMFED) THEN
            DO 112 IN = 1, NONUC
              ANMCON(IN,1) = 0.0
              ANMCON(IN,3) = 0.0
  112       CONTINUE
          ENDIF

C         For each animal feed and fodder pathway--
          DO 100 IAN = 1, NAN+2

C           Set option flag/concentration ratio index for feed or forage--
            IF (IAN .LT. 5) THEN
              ANFLG = ANF(IAN)
            ELSEIF (IAN .EQ. 5) THEN
              ANFLG = ANF(1)
            ELSE
              ANFLG = ANF(3)
            ENDIF

C           Set media conpartments--

            IF (ACUTE) THEN

              DO 132 IN = 1, NONUC

                IF (C14) THEN
                  AIRBOX(IN) = PWTAIR(IN) / 3600.0
                               * 2.0 / (GRWPA(IAN) * 24.0)
                ELSEIF (H3) THEN
                  AIRBOX(IN) = PWTAIR(IN) / 3600.0
                END IF

                IF (IRRSA(IAN) .EQ. 2) THEN
                  WATCON(IN) = SWACUT(IN) / 3600.0
                ELSE
                  WATCON(IN) = 0.0
                ENDIF

  132         CONTINUE

C             Set acute diet fraction for autumn--
              IF (IAN .EQ. 1) THEN
                ANMFR = 1.0 - FRACUT(4)
              ELSEIF (IAN .EQ. 2) THEN
                ANMFR = 1.0
              ELSEIF (IAN .EQ. 3) THEN
                ANMFR = 1.0 - FRACUT(4)
              ELSEIF (IAN .EQ. 4) THEN
```

```
                ANMFR = 1.0
              ELSE
                ANMFR = FRACUT(4)
              ENDIF

            ELSE

C             Chronic--

              DO 133 IN = 1, NONUC

                AIRBOX(IN) = ARF2CN(IN,IAN) * YRSEC

                IF (IRRSA(IAN) .EQ. 2) THEN
                  WATCON(IN) = SWIRR(IN)
                ELSEIF (IRRSA(IAN) .EQ. 1) THEN
                  WATCON(IN) = GWCON(IN)
                ELSE
                  WATCON(IN) = 0.0
                ENDIF

  133         CONTINUE

C             Set chronic exposure animal diet fraction--
              ANMFR = DIETFR(IAN)

            ENDIF

            IF (ANFLG) THEN
              IF (.NOT. ANMFED) THEN

C               Calculate contribution from deposition onto leaves--
                DO 110 IN = 1, NONUC

C                 Calculate leaf deposition rate from air--
                  IF (C14) THEN
                    LEAF1A = AIRBOX(IN) / C1
                  ELSEIF (H3) THEN
                    LEAF1A = AIRBOX(IN) * H1 / H2
                  ENDIF

C                 Calculate leaf deposition rate from irrigation--
                  LEAF2 = 0.0
                  IF (IRRSA(IAN) .GT. 0.0 .AND. IRTIMA(IAN) .GT. 0.0)
     .            THEN

                    IF (C14) THEN
                      LEAF2 = WATCON(IN) * RIRRA(IAN) * LM2IN /
     .                        IRTIMA(IAN) * MOYR * PKG * RMV
```

```
                         / SLDN / SKG

                 ELSEIF (H3) THEN
                   LEAF2 = WATCON(IN) * H1

                 ENDIF
               ENDIF

C              Calculate total plant concentration--
               LEAF(IN) = LEAF1A + LEAF2

               IF (C14) THEN
                 EDBL(IN,IAN) = LEAF(IN) * C(IAN) * ANMFR

               ELSEIF (H3) THEN

                 WXM = W3M
                 IF (IAN .LT. 5) WXM = W2M

                 EDBL1(IAN) = LEAF(IN) * CONSUM(IAN) * WXM * ANMFR
                 EDBL2(IAN) = CONSUM(IAN) * WXM * ANMFR

C                Calculate animal drinking water contribution--
                 IF (IAN .LT. 5) THEN
                   DW1(IAN) = WATCON(IN) * DWATER(IAN) * DWFACA(IAN)
                   DW2(IAN) = DWATER(IAN) * DWFACA(IAN) / H1
                 ENDIF

               ENDIF
  110        CONTINUE
           ENDIF

         ENDIF
  100  CONTINUE
     ENDIF

C    Add stored feed, fresh forage, and drinking water contributions--

     IF (C14) THEN
       ANMCON(1,1) = EDBL(1,1) + EDBL(1,5)
       ANMCON(1,2) = EDBL(1,2)
       ANMCON(1,3) = EDBL(1,3) + EDBL(1,6)
       ANMCON(1,4) = EDBL(1,4)

     ELSEIF (H3) THEN

C      Meat--
       RTEMP = (EDBL2(1) + EDBL2(5) + DW2(1))
       IF (RTEMP .GT. 0.0) THEN
```

```
            ANMCON(1,1) = (EDBL1(1) + EDBL1(5) + DW1(1)) / RTEMP *
     .                    (W(1) / H1  +  (1.0 - W(1)) * H(1))
          ELSE
            ANMCON(1,1) = 0.0
          ENDIF
C
          Poultry--
          RTEMP = (EDBL2(2) + DW2(2))
          IF (RTEMP .GT. 0.0) THEN
            ANMCON(1,2) = (EDBL1(2) + DW1(2)) / RTEMP *
     .                    (W(2) / H1  +  (1.0 - W(2)) * H(2))
          ELSE
            ANMCON(1,2) = 0.0
          ENDIF
C
          Milk--
          RTEMP = (EDBL2(3) + EDBL2(6) + DW2(3))
          IF (RTEMP .GT. 0.0) THEN
            ANMCON(1,3) = (EDBL1(3) + EDBL1(6) + DW1(3)) / RTEMP *
     .                    (W(3) / H1  +  (1.0 - W(3)) * H(3))
          ELSE
            ANMCON(1,3) = 0.0
          ENDIF
C
          Eggs--
          RTEMP = (EDBL2(4) + DW2(4))
          IF (RTEMP .GT. 0.0) THEN
            ANMCON(1,4) = (EDBL1(4) + DW1(4)) / RTEMP *
     .                    (W(4) / H1  +  (1.0 - W(4)) * H(4))
          ELSE
            ANMCON(1,4) = 0.0
          ENDIF

        ENDIF

        DO 200 IAN = 1, NAN
          IF (ANF(IAN)) THEN
C
            Holdup between slaughter/harvest and human consumption--
            IF (.NOT. DERANM) THEN
              T = HLDUPA(IAN) * YRDA
              CALL CHAIN (T, DUMMY, ANMCON(1,IAN), ANMCON(1,IAN), 0)
            ENDIF
C
            Human uptake from contaminated animal products--
            DO 210 IN = 1, NONUC
              EXPOS(IN,7+IAN) = ANMCON(IN,IAN) * CONS2(IAN) *
     .                          EFPOPA(IAN) * ADJET2(IAN)
```

```
 210        CONTINUE

          ENDIF
 200    CONTINUE
        ENDIF

        RETURN
C-----------------------------------------------------------------------
        END
```

9 1 0 4 8 1 0 7 4

```
C-----------------------------------------------------------------------
C
      SUBROUTINE CHAIN (T, AB, AM, AO, INTGRL)
C
C
C     This subroutine calculates radioactive decay and buildup for a
C     chain of radionuclides for a given time period, allowing for
C     nonradiological removal to a sink, or the time integral of the
C     activity
C
C     Module of Program ENV of the GENII Software Package
C     Pacific Northwest Laboratory Envoronmental Dosimetry System
C
C     Last modification:  6-Nov-87  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C     T              - Time over which decay is to be considered.  Units of
C                    T must be compatible with the units of the decay con-
C                    stants, AL
C     AB()         - Sum of the non radiological removal constants in units
C                    compatible with T
C     AM()         - Initial quantity of each radionuclide (Ci)
C     AO()         - Final activity (or time integral) of each radionuclide
C     INTRGL       - Control integer set > 0 to calculate time integral
C                    of activity, otherwise calculate decay
C
C-----------------------------------------------------------------------

      INCLUDE 'DECAY.CMN'

      REAL*8 A(45), SUMPR, ASUM, AMD(9), EXPO(9), ABD(9)
      REAL*8 ARG, TERM
      DIMENSION AM(9), AO(9), AB(9)


C     Divide by lambda--
      DO 113 IJK = 1, 9
        EXPO(IJK) = 0.0D0
        ABD(IJK) = DBLE (AB(IJK) + AL(IJK))
        IF (AL(IJK) .NE. 0.0) AMD(IJK) = DBLE (AM(IJK) / AL(IJK))
  113 CONTINUE
C
C     INITIALIZE COEFFICIENT ARRAY TO ZERO--

      N2N = NUC * (NUC-1) / 2 + NUC
C
```

```
C      CALL ZEROR (N2N, A)

      DO 100 IJK = 1, N2N
        A(IJK) = 0.0D0
  100 CONTINUE
C

C     DO LOOP ON CHAIN MEMBERS,  MAX = NUC--

      DO 5 J = 1, NUC

C

C       CALCULATE EXPONENTIAL FOR CURRENT NUCLIDE--

        ARG=-ABD(J) * T

C

        IF (INTGRL .GT. 0)    THEN
          IF (ARG .GT. 0.0) THEN
            WRITE (*,111) ARG
  111       FORMAT (' ERROR IN EXMO OF ACHAIN, POS ARG= '
     .                1PE10.3)
          ELSE
C           FORM IS:  (1 - DEXP (ARG) ) / AB   FOR INTGRL > 0

            IF (-ARG .GT. 50.0) THEN
              EXPO(J) = 1.0D0 / ABD(J)
            ELSEIF (-ARG .GT. 0.001) THEN
              EXPO(J) = (1.0D0 - DEXP(ARG)) / ABD(J)
            ELSE
              FX = -(DLOG10(-ARG))
              I = 10 - IFIX(FX)
              IF (I .LT. 2)  I=2
              TERM = - ARG
              EXPO(J) = -ARG / ABD(J)
              DO 13 IT = 2,I
                TERM = (TERM*ARG) / DBLE(IT)
                EXPO(J) = EXPO(J) + TERM / ABD(J)
  13          CONTINUE
            ENDIF
          ENDIF
        ELSE

C         FORM IS EXP(ARG) FOR INTGRL = 0

          IF (-ARG .GT. 50.0) THEN
            EXPO(J) = 0.0D0
```

```
          ELSE
            EXPO(J) = DEXP (ARG)

          ENDIF
        ENDIF
C
C       SET STARTING INDEX FOR TERM ARRAY A--

        JJ = J * (J-1) / 2

C

C       SET CHAIN POSITION MINUS ONE--

        J1 = J - 1

C

        IF(J1 .GT. 0)   THEN

C

          IMAX = MIN0 (J1, 2)

          DO 3 M = 1, J1

            DO 2 L = M, J1

              DO 1 I = 1, IMAX

C

                IF (IFRM(I,J) .EQ. L)    THEN

                  A(M+JJ) = A(M+JJ) + DK(I,J) * AL(L) * A(M+L * (L-1)/2)

                ENDIF

C

    1         CONTINUE

    2       CONTINUE

C

            A(M+JJ) = A(M+JJ) / (ABD(J) - ABD(M))
```

```
C
   3     CONTINUE
C
        ENDIF
C
C
        ASUM = 0.0D0
        IF (J1 .EQ. 0) GO TO 11
          DO 12 IRAP = 1, J1
            JK = JJ + IRAP
            ASUM = ASUM + A(JK)
  12      CONTINUE
  11    CONTINUE

        A(J+JJ) = AMD(J) - ASUM

        SUMPR = 0.0D0
        J2 = J
        DO 8884 IN = 1, J2
          JK = JJ + IN
          SUMPR = SUMPR + EXPO(IN) * A(JK)
 8884   CONTINUE

C       Multiply by lambda, return to single precision--
        AO(J) = SNGL (SUMPR * AL(J))

C

    5 CONTINUE

      RETURN

C-------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------
C
      SUBROUTINE CRPCAL
C
C     This subroutine calculates human uptake rate from consumption of
C     terrestrial foods.
C
C     Module of Program ENV of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification:  17-Aug-88 RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C     LEAF1a     - Intermediate leaf deposition rate from air  (UoA/m2 yr)
C     LEAF1b     - Intermediate leaf depostion rate from resuspension,
C                  (UoA/m2 yr)
C     LEAF2      - Intermediate leaf deposition rate from irrigation,
C                  (UoA/M2 yr)
C     TENV       - Weathering constant, yr-1
C     WATCON     - water concentration used for the current radionuclide,
C                  either ground water or surface water (UoA/L)
C
C-----------------------------------------------------------------------
C
      INCLUDE 'AFPPAR.CMN'
      INCLUDE 'CONC.CMN'
      INCLUDE 'FODPAR.CMN'
      INCLUDE 'OPT.CMN'
      INCLUDE 'RAD.CMN'
      INCLUDE 'SOLPAR.CMN'

      REAL TENV(9), LEAF(9), LEAF1A, LEAF1B, LEAF2, WATCON

C---- Calculate weathering constant ------------------------------------

      TENV2 =  ALOG2 / WTIM / YRDA
      IF (DEBUG) WRITE (*,*) 'Weathering (TENV2): ', TENV2

C     Process each selected terrestrial food type--
      DO 100 ITF = 1, NTF
        IF (TFD(ITF)) THEN
          IF (.NOT. DERCRP) THEN

C---------- Calculate contribution from leaves -------------------------

            IF (ITF .EQ. 2 .OR. ITF .EQ. 3) THEN
              DEPFR1 = 1.0 - EXP (-3.6 * BIOMAS(ITF) * DRYFAC(ITF))
```

```
          ELSE
            DEPFR1 = 1.0 - EXP (-2.9 * BIOMAS(ITF) * DRYFAC(ITF))
          ENDIF

          DO 110 IN = 1, NONUC

C           Calculate leaf deposition rate from air--
            LEAF1A = ARFCON(IN,ITF) * DPVL(IN) * DEPFR1

C           Calculate leaf depositon rate from resuspension--
            LEAF1B = SOLCON(IN,ITF) * LEAFRS * DPVRES * SECYR * DEPFR1

C           Calculate leaf deposition rate from irrigation--
            LEAF2 = 0.0
            IF (IRRST(ITF) .GT. 0) THEN
              IF (IRRST(ITF) .EQ. 1) THEN
                WATCON = GWCON(IN)
              ELSE
                WATCON = SWIRR(IN)
              ENDIF
              IF (IRTIMT(ITF) .GT. 0.0) THEN
                LEAF2 = WATCON * RIRR(ITF) * LM2IN / IRTIMT(ITF)
     .                  * MOYR * DEPFR2
              ENDIF
            ENDIF

C           Calculate total leaf deposition rate --
            LEAF(IN) = 0.0
            IF (BIOMAS(ITF) .GT. 0.0)
     .        LEAF(IN) = (LEAF1a + LEAF1b + LEAF2)
     .                   * TRANS(ITF) / BIOMAS(ITF)

            IF (DEBUG .AND. IN .EQ. 1) WRITE (*,*)
     .        'LEAF1a/LEAF1b/LEAF2/LEAF:',LEAF1A,LEAF1B,LEAF2,LEAF(1)

C         ---- Set weathering constant for each radionuclide ---------
            TENV(IN) = TENV2

  110     CONTINUE

C         Apply weathering correction (accumulation & decay) to leaves--
          T = GRWP(ITF) * YRDA
          CALL CHAIN (T, TENV, LEAF, LEAF, 1)
C         LEAF() now in concentration units

C---------- Calculate root contribution and plant concentration --------
          DO 120 IN = 1, NONUC

C           Calculate root uptake contribution (surface & deep soil)--
```

```
              ROOT1 = SOLCON(IN,ITF) / SLDN
     .                * BVI(ITF,IN) * DRYFAC(ITF) * RF1
              ROOT2 = 0.0
              IF (DEEP)
     .          ROOT2 = DSCON(IN,ITF) / SSLDN
     .                  * BVI(ITF,IN) * DRYFAC(ITF)* RF2

C             Save uptake from soil for next year's harvest removal--
              IF (HARVST) THEN
                HARVT(IN,ITF,1) = (LEAF(IN) + ROOT1) * YELD(ITF)
                IF (DEEP .AND. RF2 .GT. 0.0) THEN
                  HARVT(IN,ITF,2) = ROOT2 * YELD(ITF) / WASDEP
                ELSE
                  HARVT(IN,ITF,2) = 0.0
                ENDIF
              ENDIF

C             Calculate total plant concentration--
              PLTCON(IN,ITF) = LEAF(IN) + ROOT1 + ROOT2

              IF (DEBUG .AND. IN .EQ. 1) WRITE (*,*)
     .          'LEAF/ROOT1/ROOT2/PLTCON:',
     .          ITF, LEAF(1),ROOT1,ROOT2, PLTCON(1,ITF)
  120       CONTINUE

C---------- Decay for holdup time between harvest and consumption ------

            T = 1.0
            CALL CHAIN (T, DUMMY, HARVT(1,ITF,1), HARVT(1,ITF,1), 0)
            IF (DEEP)
     .        CALL CHAIN (T, DUMMY, HARVT(1,ITF,2), HARVT(1,ITF,2), 0)

            T = HLDUP(ITF) * YRDA

          ENDIF

C-------- Calculate human uptake from crops ----------------------------

          DO 130 IN = 1, NONUC
            EXPOS(IN,3+ITF) = PLTCON(IN,ITF) * CONS(ITF)
     .                        * EFPOP(ITF) * ADJEAT(ITF)
  130     CONTINUE

        ENDIF
  100 CONTINUE

      RETURN

C-----------------------------------------------------------------------
```

END

```
C-----------------------------------------------------------------------
C
      SUBROUTINE DKHARV
C
C     This subroutine calculates radionuclide decay in the surface
C     soil (top 15 cm), deep soil (available for uptake), and the waste
C     form compartments for a single radionuclide decay chain.  In
C     addition,  this subroutine calculates harvest removal of radio-
C     nuclides in the surface and deep soil compartments for both
C     terrestrial foods and animal product pathways.  This subroutine
C     is used for both near-field and far-field scenarios.
C
C     Module of Program ENV of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 12-Aug-88  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-----------------------------------------------------------------------

      INCLUDE 'SOLPAR.CMN'
      INCLUDE 'OPT.CMN'
      INCLUDE 'CONC.CMN'
      INCLUDE 'RAD.CMN'
      INCLUDE 'FODPAR.CMN'
      INCLUDE 'ANMPAR.CMN'

      LOGICAL ANFLG

      IF (DOWAST .AND. BURWAS) THEN
C       Decay contained waste for previous year--
        TEMP = QWAS(1)
        CALL CHAIN (ONEYR, LEACHR, QWAS, QWAS, 0)
        IF (DEBUG) WRITE (*,*) 'QWAS before/after decay:',
     .    TEMP, QWAS(1)
      ENDIF

      IF (NONAG) THEN

C       Decay non-agricultural soil compartments--
        CALL CHAIN (ONEYR, LEACHR, NONAGS, NONAGS, 0)
        IF (DEEP) CALL CHAIN (ONEYR, DUMMY, NONAGD, NONAGD, 0)

      ELSE

C       Residential/resuspension soil compartments--
        CALL CHAIN (ONEYR, LEACHR, RESSOL, RESSOL, 0)
        IF (DEEP) CALL CHAIN (ONEYR, DUMMY, DSRES, DSRES, 0)
```


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```
C       For terrestrial foods soil compartment--
        IF (TFOOD) THEN
          DO 130 ITF = 1, NTF
            IF (TFD(ITF)) THEN

C             Decay soils for previous year--
              TEMP = SOLCON(1,ITF)
              CALL CHAIN (ONEYR, LEACHR, SOLCON(1,ITF), SOLCON(1,ITF),0)
              IF (DEEP) CALL CHAIN
     .          (ONEYR, DUMMY, DSCON(1,ITF), DSCON(1,ITF), 0)

C             Harvest removal--
              IF (HARVST) THEN
                DO 120 IN = 1, NONUC
                  SOLCON(IN,ITF) = SOLCON(IN,ITF) - HARVT(IN,ITF,1)
                  IF (DEEP) DSCON(IN,ITF) =
     .              DSCON(IN,ITF) - HARVT(IN,ITF,2)
  120           CONTINUE
              ENDIF

              IF (DEBUG) WRITE (*,*)
     .          'Crop soil before/after decay & harvest, HARVT:',
     .           ITF, TEMP, SOLCON(1,ITF),HARVT(1,ITF,1)

            ENDIF
  130     CONTINUE
        ENDIF

C       For animal product soil compartment--
        IF (ANFOOD) THEN
          DO 132 IAN = 1, NAN+2

            IF (IAN .LT. 5) THEN
              ANFLG = ANF(IAN)
            ELSEIF (IAN .EQ. 5) THEN
              ANFLG = ANF(1)
            ELSE
              ANFLG = ANF(3)
            ENDIF

            IF (ANFLG) THEN

C             Decay soils for previous year--
              TEMP = SL2CON(1,IAN)
              CALL CHAIN (ONEYR, LEACHR, SL2CON(1,IAN), SL2CON(1,IAN),0)
              IF (DEEP) CALL CHAIN
     .          (ONEYR, DUMMY, DS2CON(1,IAN), DS2CON(1,IAN), 0)

C             Harvest removal--
```


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```
          IF (HARVST) THEN
            DO 122 IN = 1, NONUC
              SL2CON(IN,IAN) = SL2CON(IN,IAN) - HARVA(IN,IAN,1)
              IF (DEEP) DS2CON(IN,IAN) =
     .          DS2CON(IN,IAN) - HARVA(IN,IAN,2)
 122        CONTINUE
          ENDIF

          IF (DEBUG) WRITE (*,*)
     .      'Anm soil before/after decay & harvest, HARVA:',
     .       IAN, TEMP, SL2CON(1,IAN), HARVA(1,IAN,1)

        ENDIF
 132  CONTINUE
      ENDIF
    ENDIF

    RETURN
C-----------------------------------------------------------------------
    END
```

```
C-----------------------------------------------------------------------
C
      SUBROUTINE DRKCAL
C
C
C     This subroutine calculates drinking water uptake rates--
C
C     Module of Program ENV of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 13-Jan-88 RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C     WATCON()  - Drinking water concentration, units of activity/L
C     TYR       - Decay time in years
C
C-----------------------------------------------------------------------

      INCLUDE 'AQUPAR.CMN'
      INCLUDE 'CONC.CMN'
      INCLUDE 'OPT.CMN'
      INCLUDE 'RAD.CMN'

      REAL WATCON(9), TYR

      IF (.NOT. DERDRK) THEN

        DO 100 IN = 1, NONUC

C         Determine drinking water source--
          IF (ACUTE) THEN
            WATCON(IN) = SWACUT(IN)
          ELSEIF (DWSRC .EQ. 1) THEN
            WATCON(IN) = GWCON(IN)
          ELSEIF (DWSRC .EQ. 2) THEN
            WATCON(IN) = SWCON(IN)
          ELSEIF (DWSRC .EQ. 3) THEN
            WATCON(IN) = DWCON(IN)
          ELSE
            WATCON(IN) = 0.0
          ENDIF

C         Apply drinking water cleanup factor--
          IF (DWTRET .AND. DWSRC .NE. 3)
     .      WATCON(IN) = WATCON(IN) * DWCLEN(IN)

  100   CONTINUE
```

```
C       Transit time and holdup until consumption--
        TYR = HOLDDW * YRDA
        CALL CHAIN (TYR, DUMMY, WATCON, WATCON, 0)

      ELSE

        DO 210 IN = 1, NONUC
          WATCON(IN) = DWCON(IN)
  210   CONTINUE

      ENDIF

C     Calculate exposure from consumption of drinking water--
      DO 200 IN = 1, NONUC
        EXPOS(IN,17) = WATCON(IN) * DWUSAG * DWPOP
  200 CONTINUE

      RETURN
C-----------------------------------------------------------------------
      END
```

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```
C-----------------------------------------------------------------------
C
      SUBROUTINE EDRANM
C
C     This subroutine calculates radionuclide concentrations in the
C     surface soil (top 15 cm) and deep soil (available for uptake)
C     for the animal foods pathways for a single radionuclide decay
C     chain.  This subroutine is used for both near-field and far-field
C     scenarios.  Processes considered: irrigation deposition, atmospheric
C     deposition, leaching, and biotic transport.
C
C     Module of Program ENV of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 14-Jan-88  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C     ANFLG    - Option flag for each of the animal fodder types
C     IBV      - Index of BVI value to use, either 1-fresh, 4-stored;
C                soil-to-plant transfer factor for fodder, corresponds
C                to leafy vegetables and grains of terrestrial plants
C     RTATM    - Atmospheric removal rate, UoA/m2-yr
C     RTBIO()  - Biotic transport removal rate, UoA/m2-yr
C     RTIRR    - Irrigation removal rate, UoA/m2-yr
C     WATCON   - Irrigation water concentration of current radionuclide
C                chain member, UoA/l
C
C-----------------------------------------------------------------------

      INCLUDE 'ANMPAR.CMN'
      INCLUDE 'CONC.CMN'
      INCLUDE 'FODPAR.CMN'
      INCLUDE 'OPT.CMN'
      INCLUDE 'RAD.CMN'
      INCLUDE 'SOLPAR.CMN'

      REAL RTIRR, RTATM, RTBIO(9), WATCON
      LOGICAL ANFLG
      INTEGER IBV

      DO 410 IAN = 1, NAN+2

C       Set option ratio, concentration ratio index for grass or grain--
        IF (IAN .LT. 5) THEN
          ANFLG = ANF(IAN)
          IBV = 4
        ELSEIF (IAN .EQ. 5) THEN
```

```
          ANFLG = ANF(1)
          IBV = 1
        ELSE
          ANFLG = ANF(3)
          IBV = 1
        ENDIF

        IF (ANFLG) THEN
          DO 400 IN = 1, NONUC

C             Irrigation deposition--
              RTIRR = 0.0
              IF (IRRSA(IAN) .GT. 0) THEN
                IF (IRRSA(IAN) .EQ. 1) THEN
                  WATCON = GWCON(IN)
                ELSE
                  WATCON = SWIRR(IN)
                ENDIF
                RTIRR = WATCON * RIRRA(IAN) * LM2IN
              ENDIF

C             Atmospheric deposition--
              RTATM = 0.0
              IF (DOAIR) RTATM = ARF2CN(IN,IAN) * DPVL(IN)

C             Biotic transport--
              RTBIO(IN) = 0.0
              IF (BIOT .AND. DOBIOT) THEN
                RTEMP = BVI(IBV,IN) * RF2 * YELDA(IAN) / SSLDN
                RTBIO(IN) = DS2CON(IN,IAN) * (EXCAMT + RTEMP) / WASDEP
                IF (DEBUG .AND. IN .EQ. 1) WRITE (*,*)
     .            'RTEMP, RTBIO:',RTEMP, RTBIO(1)
              ENDIF

C             Sum environmental rates--
              RTENV(IN) = RTIRR + RTATM + RTBIO(IN)
              RTAVAL(IN) = RTBIO(IN)

  400       CONTINUE

            IF (DEBUG) WRITE (*,*)
     .        'Anm soil:(RTIRR/RTATM/RTBIO):',
     .        RTIRR, RTATM, RTBIO(1)


C           ---- Integrate over one year -------------------------------

C           Total deposition/removal contributions to surface soil--
            CALL CHAIN (ONEYR, LEACHR, RTENV, RTENV, 1)
```

```
C           Calculate total change in available waste--
            IF (DEEP) CALL CHAIN (ONEYR, DUMMY, RTAVAL, RTAVAL, 1)

C           ---- Add total integrations to soil and waste concentrations --

            DO 420 IN = 1, NONUC
              SL2CON(IN,IAN) = SL2CON(IN,IAN) + RTENV(IN)
              IF (DEEP) DS2CON(IN,IAN) = DS2CON(IN,IAN) - RTAVAL(IN)
  420       CONTINUE

            IF (DEBUG) THEN
              WRITE (*,*) 'Anm soil:',IAN,SL2CON(1,IAN)
              IF (DEEP) WRITE (*,*) ' and deep:',DS2CON(1,IAN)
            ENDIF

          ENDIF
  410 CONTINUE

      RETURN
C-----------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------
C
      SUBROUTINE EDRCRP
C
C     This subroutine calculates radionuclide concentrations in the
C     surface soil (top 15 cm) and deep soil (available for uptake)
C     compartments for the terrestrial food pathways for a single
C     radionuclide decay chain.  This subroutine is used for both
C     near-field and far-field scenarios. Processes considered:
C     irrigation deposition, atmospheric deposition, leaching,
C     and biotic transport
C
C     Module of Program ENV of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 14-Jan-88  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C     RTATM    - Atmospheric removal rate, UoA/m2-yr
C     RTBIO()  - Biotic transport removal rate, UoA/m2-yr
C     RTIRR    - Irrigation removal rate, UoA/m2-yr
C     WATCON   - Irrigation water concentration of current radionuclide
C                  chain member, UoA/l
C
C-----------------------------------------------------------------------

      INCLUDE 'AFPPAR.CMN'
      INCLUDE 'CONC.CMN'
      INCLUDE 'FODPAR.CMN'
      INCLUDE 'OPT.CMN'
      INCLUDE 'RAD.CMN'
      INCLUDE 'SOLPAR.CMN'

      REAL RTIRR, RTATM, RTBIO(9), WATCON

      DO 310 ITF = 1, NTF
        IF (TFD(ITF)) THEN

          DO 300 IN = 1, NONUC

C           Irrigation deposition--

            RTIRR = 0.0
            IF (IRRST(ITF) .GT. 0 .AND. DOIRR) THEN
              IF (IRRST(ITF) .EQ. 1) THEN
                WATCON = GWCON(IN)
              ELSE
```


9 1 0 4 8 1 0 9 1

```
            WATCON = SWIRR(IN)
          ENDIF
          RTIRR = WATCON * RIRR(ITF) * LM2IN
        ENDIF

C       Atmospheric deposition--

        RTATM = 0.0
        IF (DOAIR) RTATM = ARFCON(IN,ITF) * DPVL(IN)

C       Biotic transport--
        RTBIO(IN) = 0.0
        IF (BIOT .AND. DOBIOT) THEN
          RTEMP = BVI(ITF,IN) * RF2 * YELD(ITF) / SSLDN
          RTBIO(IN) = DSCON(IN,ITF) * (EXCAMT + RTEMP) / WASDEP
          IF (DEBUG .AND. IN .EQ. 1) WRITE (*,*)
     .      'RTEMP, RTBIO:',RTEMP, RTBIO(1)
        ENDIF

C       Sum environmental deposition/contribution rates--
        RTENV(IN) = RTIRR + RTATM + RTBIO(IN)
        RTAVAL(IN) = RTBIO(IN)

        IF (DEBUG .AND. IN .EQ. 1) WRITE (*,*)
     .    'Crop soil:(RTIRR/RTATM/RTBIO):',
     .    RTIRR, RTATM, RTBIO(1)

  300 CONTINUE

C     ---- Integrate over one year -------------------------------

      RTEMP = RTENV(1)
C     Environmental deposition/removal contributions to surface soil--
      CALL CHAIN (ONEYR, LEACHR, RTENV, RTENV, 1)
      IF (DEBUG) WRITE (*,*) 'RTENV before/after integration:',
     .  RTEMP, RTENV(1)

C     Calculate net rate of change in deep soil--
      IF (DEEP) CALL CHAIN (ONEYR, DUMMY, RTAVAL, RTAVAL, 1)

C     ---- Add total integrations to soil and waste concentrations --

      DO 320 IN = 1, NONUC
        SOLCON(IN,ITF) = SOLCON(IN,ITF) + RTENV(IN)
        IF (DEEP) DSCON(IN,ITF) = DSCON(IN,ITF) - RTAVAL(IN)
  320 CONTINUE

      IF (DEBUG) THEN
        WRITE (*,*) 'Crop soil:',ITF, SOLCON(1,ITF)
```

```
          IF (DEEP) WRITE (*,*) ' and deep:', DSCON(1,ITF)
        ENDIF

      ENDIF
310 CONTINUE

    RETURN
C-----------------------------------------------------------------------
    END
```

9 1 0 4 8 1 0 9 3

```
C-----------------------------------------------------------------------
C
      SUBROUTINE EDRNON
C
C     This subroutine calculates radionuclide concentrations in the
C     surface soil (top 15 cm), deep soil (available for uptake)
C     and the waste form compartments for a single radionuclide decay
C     chain for non agricultual scenarios during the option inventory
C     decay/buildup period.  This subroutine is used for near-field
C     scenarios, Processes considered: leaching and biotic transport.
C
C     Module of Program ENV of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 6-Sep-87  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C     RTBIO()  - Biotic transport removal rate, UoA/m2-yr
C
C-----------------------------------------------------------------------

      INCLUDE 'SOLPAR.CMN'
      INCLUDE 'OPT.CMN'
      INCLUDE 'CONC.CMN'
      INCLUDE 'TIMES.CMN'
      INCLUDE 'RAD.CMN'
      INCLUDE 'FODPAR.CMN'
      INCLUDE 'ANMPAR.CMN'

      REAL RTBIO(9)

      DO 320 IN = 1, NONUC

C       Non-agricultural biotic transport scenario--
        RTBIO(IN) = 0.0
        IF (BIOT .AND. DOBIOT) THEN

          RTEMP = BVI(1,IN) * RF2 * YELDBT(BTDSET) / SSLDN
          RTBIO(IN) = NONAGD(IN) * (EXCAMT + RTEMP) / WASDEP

          IF (DEBUG .AND. IN.EQ.1) WRITE (*,*)
     .      'RTEMP, RTBIO:',RTEMP, RTBIO(1)
        ENDIF
        RTAVAL(IN) = RTBIO(IN)

  320 CONTINUE
```

```
      IF (DEBUG .AND. DEEP)
     . WRITE (*,*) 'Non-ag biotic transport rate:',RTAVAL(1)

C     ---- Integrate over one year ---------------------------------

C     Environmental deposition/removal contributions to surface soil--
      CALL CHAIN (ONEYR, LEACHR, RTBIO, RTBIO, 1)

C     Calculate removal from deep soil due to biotic transport--
      IF (DEEP) CALL CHAIN (ONEYR, DUMMY, RTAVAL, RTAVAL, 1)

      IF (DEBUG) THEN
        WRITE (*,*) 'Add to non-agr surface soil:',RTBIO(1),
     .    '  Subtract from deep:',RTAVAL(1)
      ENDIF

C     ---- Add total integrations to soil and waste concentrations --

      DO 520 IN = 1, NONUC
        NONAGS(IN) = NONAGS(IN) + RTBIO(IN)
        IF (DEEP) NONAGD(IN) = NONAGD(IN) - RTAVAL(IN)
  520 CONTINUE

      IF (DEBUG) WRITE (*,*)
     . 'Non-agr soil:',NONAGS(1),' and deep:',NONAGD(1)

      RETURN
C-----------------------------------------------------------------
      END
```

9 1 0 4 8 1 0 9 5

```
C-----------------------------------------------------------------------
C
      SUBROUTINE EDRRES
C
C     This subroutine calculates radionuclide depositon/removal to
C     residential/resuspension soil for a single radionuclide decay chain.
C     This subroutine is used for both near-field and far-field
C     scenarios.
C
C     Module of Program ENV of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 14-Jan-88  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C     RTATM     - Atmospheric removal rate, UoA/m2-yr
C     RTBIO()   - Biotic transport removal rate, UoA/m2-yr
C     RTENV()   - Total environmental removal rate, UoA/m2-yr, for each
C                 member of the current radionuclide chain
C     RTIRR     - Irrigation removal rate, UoA/m2-yr
C                 chain member, UoA/L
C     WATCON    - Irrigation water concentration, source may be either
C                 ground or surface water, UoA/L
C
C-----------------------------------------------------------------------

      INCLUDE 'AFPPAR.CMN'
      INCLUDE 'CONC.CMN'
      INCLUDE 'FODPAR.CMN'
      INCLUDE 'OPT.CMN'
      INCLUDE 'RAD.CMN'
      INCLUDE 'SOLPAR.CMN'

      REAL RTIRR, RTATM, RTBIO(9), WATCON

      DO 500 IN = 1, NONUC

C       Irrigation deposition--

        RTIRR = 0.0
        IF (RESIRR .AND. DOIRR) THEN
          IF (IRRSR .EQ. 1) THEN
            WATCON = GWCON(IN)
          ELSE
            WATCON = SWIRR(IN)
          ENDIF
          RTIRR = WATCON * RIRRR * LM2IN
```

```
      ENDIF

C     Atmospheric deposition--

      RTATM = 0.0
      IF (DOAIR) RTATM = ARPCON(IN) * DPVL(IN)

C     Biotic transport--
      RTBIO(IN) = 0.0
      IF (BIOT .AND. DOBIOT) THEN
        RTEMP = BVI(1,IN) * RF2 * YELDBT(3) / SSLDN
        RTBIO(IN) = DSRES(IN) * (EXCAMT + RTEMP) / WASDEP
        IF (DEBUG .AND. IN .EQ. 1) WRITE (*,*)
     .    'RTEMP, RTBIO: ',RTEMP, RTBIO(1)
      ENDIF

C     Sum environmental deposition/contribution rates--
      RTENV(IN) = RTIRR + RTATM + RTBIO(IN)
      RTAVAL(IN) = RTBIO(IN)

      IF (DEBUG .AND. IN .EQ. 1) WRITE (*,*)
     .  'Res soil:(RTIRR/RTATM/RTBIO):',
     .  RTIRR, RTATM, RTBIO(1)

  500 CONTINUE

C     Integrate over one year--
C     Environmental deposition/removal contributions to soils--

      CALL CHAIN (ONEYR, LEACHR, RTENV, RTENV, 1)
      IF (DEEP) CALL CHAIN (ONEYR, DUMMY, RTAVAL, RTAVAL, 1)

C     Add total integrations to residential soils--
      DO 520 IN = 1, NONUC
        RESSOL(IN) = RESSOL(IN) + RTENV(IN)
        IF (DEEP) DSRES(IN) = DSRES(IN) - RTAVAL(IN)
  520 CONTINUE

      RETURN
C-----------------------------------------------------------------------
      END
```


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```
C-----------------------------------------------------------------------
C
      SUBROUTINE EXPOSR (ISEAS)
C
C     This module controls environmental exposure calculations for a
C     radionuclide chain.
C
C     Module of Program ENV of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification:  30-Aug-88  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C     ISEAS    - Season index for acute cases
C
C-----------------------------------------------------------------------

      INCLUDE 'CONC.CMN'
      INCLUDE 'EXPALL.CMN'
      INCLUDE 'OPT.CMN'
      INCLUDE 'RAD.CMN'
      INCLUDE 'TIMES.CMN'

      IF (ACUTE .AND. ITIMT .EQ. 1) THEN

C       Food uptake from acute release--
        IF (C14 .OR. H3) THEN
          IF (ISEAS .EQ. 4) CALL CANDH
        ELSE
          IF (TFOOD) CALL ACUTEC (ISEAS)
          IF (ANFOOD) CALL ACUTEA (ISEAS)
        ENDIF

      ELSE

C       Calculate uptake rate from terrestrial foods, animal products--
        IF (C14 .OR. H3) THEN
          CALL CANDH
        ELSE
          IF (TFOOD) CALL CRPCAL
          IF (ANFOOD) CALL ANMCAL
        ENDIF
      ENDIF

C     Calculate uptake from drinking water--
      IF (DRINK) CALL DRKCAL
```

```
C     Calculate uptake from aquatic food ingestion--
      IF (AQFOOD) CALL AQUCAL

C     Calculate inhalation rate--
      IF (INHAL) CALL INHCAL

C     Calculate external exposure rates and inadvertent soil ingestion--
      IF (AIREXT .OR. FINITE .OR. GROUND .OR. SLING .OR. RECRE)
     .  CALL EXTCAL

C     Transfer to exposure rate array--
      DO 201 IP = 1, NPATH
        DO 202 IN = 1, NONUC
          EXPOST(ITIME,IN,IP) = EXPOS(IN,IP)
  202   CONTINUE
  201 CONTINUE

      RETURN
C-----------------------------------------------------------------------
      END
```

```
C------------------------------------------------------------------
C
      SUBROUTINE EXTCAL
C
C     This subroutine controls calculation of external dose as well
C     as dose from inadvertent ingestion of soil.  Exposure from
C     infinite and finite plumes are calculated.
C
C     The surface water is decayed for time in transit and then
C     external exposure rates are calculated for contaminated soil
C     at the residential site and for recreational activities.
C     Internal exposure from inadvertent ingestion of swimming
C     water in also calculated.
C
C     Module of Program ENV of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 2-Aug-88 RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C------------------------------------------------------------------
C
C     T          - Length of time sediment is exposed to contaminated
C                  water also transit time to recreational site, yr
C     WATCON()   - Surface water concentration decayed for time in
C                  transit to site, UoA/L
C     AREAEX     - Source area external dose modification factor,
C                  dimensionless
C     HECTAR     - Hectare to m2 correction factor, m2.
C     FIRST      - Logical cleared after first pass of logic.
C
C------------------------------------------------------------------
C
      INCLUDE 'AFPPAR.CMN'
      INCLUDE 'AIRPAR.CMN'
      INCLUDE 'CONC.CMN'
      INCLUDE 'EXTPAR.CMN'
      INCLUDE 'OPT.CMN'
      INCLUDE 'RAD.CMN'
      INCLUDE 'SOLPAR.CMN'
      INCLUDE 'SWPAR.CMN'
      INCLUDE 'TIMES.CMN'

      REAL T, WATCON(9), AREAEX, HECTAR
      LOGICAL FIRST
      DATA HECTAR /10000.0/, FIRST /.TRUE./

C---- Calculate exposure from plumes ---------------------------------
```

9 1 0 4 8 1 1 0 0

```
      IF (ACUTE) THEN

        IF (ITIMT .EQ. 1) THEN
          DO 404 IN = 1, NONUC

            IF (FINITE) THEN
              EXPOS(IN,1) = PWTXAR(IN) * FRCLOD * POPT
            ELSEIF (AIREXT) THEN
              EXPOS(IN,1) = PWTAIR(IN) * YRSEC * FRCLOD * POPT
            ENDIF

  404     CONTINUE
        ENDIF

      ELSE
C       Chronic--

        IF (FINITE) THEN
C         Finite plume--

          DO 80 IN = 1, NONUC
            EXPOS(IN,1) = ARPXCN(IN) * HRPLUM * YRHR * POPT
   80     CONTINUE

        ELSEIF (AIREXT) THEN
C         Infinite plume--
          DO 130 IN = 1, NONUC
            EXPOS(IN,1) = ARPCON(IN) * YRSEC * HRPLUM * YRHR * POPT
  130     CONTINUE

        ENDIF
      ENDIF

C---- Calculate exposure from contaminated soil -----------------------

      IF (GROUND) THEN

        IF (FIRST) THEN
          IF (FRSIZ .GE. 1250.0 .OR. FRSIZ .EQ. 0.0) THEN
            AREAEX = 1.0
          ELSEIF (FRSIZ .GE. 500.0) THEN
            AREAEX = 2.7 * FRSIZ / HECTAR + 0.67
          ELSEIF (FRSIZ .GE. 100.0) THEN
            AREAEX = 6.5 * FRSIZ / HECTAR + 0.48
          ELSEIF (FRSIZ .GE. 25.0) THEN
            AREAEX = 20.0 * FRSIZ / HECTAR + 0.35
          ELSE
            AREAEX = 160.0 * FRSIZ / HECTAR
          ENDIF
```

```
            LUN = 28
            CALL OPNFIL (5, 0, LUN)
            CALL HEADNG (LUN)
            WRITE (LUN, *)
     .        'Source area external dose modification factor: ', AREAEX
            FIRST = .FALSE.
            CLOSE (LUN)

          ENDIF

          DO 120 IN = 1, NONUC
            IF (ACUTE) THEN
              EXPOS(IN,3) = RESSOL(IN) * HRGRD * YRHR * POPT
            ELSE
              EXPOS(IN,3) = RESSOL(IN) * HRGRD * YRHR * POPT * AREAEX
              IF (DEEP) EXPOS(IN,22) = DSRES(IN) * HRGRD * YRHR * POPT *
     .                                 AREAEX
              IF (BURWAS) EXPOS(IN,23) = QWAS(IN) * HRGRD * YRHR * POPT *
     .                                   AREAEX
            ENDIF
  120     CONTINUE

        ENDIF

C---- Calculate exposure from recreational activities -----------------

        IF (RECRE) THEN
          IF (ACUTE) THEN

C           Decay surface water for time in transit to recreational site--
            T = RECTT * YRHR
            CALL CHAIN (T, DUMMY, SWACUT, WATCON, 0)

C           Calculate sediment concentration--

            IF (T .LE. RELEND) THEN
              DO 101 IN = 1, NONUC
                SEDCON(IN) = WATCON(IN) * TCWS
  101         CONTINUE
            ELSE
              CALL CHAIN (1.0, DUMMY, SEDCON, SEDCON, 0)
            ENDIF
            IF (DEBUG) WRITE (*,*) 'WATCON, SEDCON: ',WATCON(1), SEDCON(1)

C           Calculate exposure rates--
            IF (.NOT. POPDOS) THEN
               DO 112 IN = 1, NONUC
```


9 1 0 4 8 1 1 0 2

```
C             Swimming exposure--
              IF (REC(1)) THEN
                EXPOS(IN,14) = WATCON(IN)
C               Inadvertent swimming water ingestion--
                EXPOS(IN,13) = WATCON(IN)
              ENDIF

C             Boating exposure--
              IF (REC(2)) EXPOS(IN,15) = WATCON(IN)

C             Fishing and shoreline exposure--
              IF (REC(3)) EXPOS(IN,16) = SEDCON(IN) * SHORWI(SHRTYP) *
     .                                   HRSHOR * YRHR * POPT

  112       CONTINUE
          ENDIF

        ELSE
C         Chronic exposure--

C         Decay surface water for time in transit to recreational site--
          T = RECTT * YRHR
          CALL CHAIN (T, DUMMY, SWCON, WATCON, 0)

C         Calculate sediment concentration--

          IF (T .LE. RELEND) THEN
            CALL CHAIN (1.0, DUMMY, WATCON, SEDCON, 1)
            DO 100 IN = 1, NONUC
              SEDCON(IN) = SEDCON(IN) * TCWS
  100       CONTINUE
          ELSE
            CALL CHAIN (1.0, DUMMY, SEDCON, SEDCON, 0)
          ENDIF
          IF (DEBUG) WRITE (*,*) 'WATCON, SEDCON: ',WATCON(1), SEDCON(1)

C         Calculate exposure rates--
          DO 110 IN = 1, NONUC

C           Swimming exposure--
            IF (REC(1)) THEN
              EXPOS(IN,14) = WATCON(IN) * HRSWIM * YRHR * POPT

C             Inadvertent swimming water ingestion--
              EXPOS(IN,13) = WATCON(IN) * HRSWIM * INGWAT * POPT

            ENDIF
```

```
C           Boating exposure--
            IF (REC(2))
     .        EXPOS(IN,15) = WATCON(IN) * HRBOAT * YRHR * POPT

C           Fishing and shoreline exposure--
            IF (REC(3)) EXPOS(IN,16) = SEDCON(IN) * SHORWI(SHRTYP) *
     .                                 HRSHOR * YRHR * POPT

  110     CONTINUE

        ENDIF
      ENDIF

C---- Calculate exposure from soil ingestion---------------------------

      IF (SLING) THEN
        DO 132 IN = 1, NONUC
          EXPOS(IN,12) = RESSOL(IN) * SOLING / SLDN * KGMG
          EXPOS(IN,12) = EXPOS(IN,12) * DAYYR * POPT
  132   CONTINUE
      ENDIF

      RETURN
C----------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------
C
      SUBROUTINE INHCAL
C
C     This subroutine calculates inhalation exposure rates--
C
C     Module of ENV of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 6-Apr-88 RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C     1.0E-4    - Resuspension factor at time=0, (m-1), Anspaugh model
C     1.0E-9    - Resuspension factor at time=17 yr, (m-1), Anspaugh model
C     INHCON()  - Air concentration to use for inhalation calculations,
C                 includes resuspension contribution
C     T         - Real ITIME (d)
C
C-----------------------------------------------------------------------

      INCLUDE 'AFPPAR.CMN'
      INCLUDE 'CONC.CMN'
      INCLUDE 'EXTPAR.CMN'
      INCLUDE 'OPT.CMN'
      INCLUDE 'RAD.CMN'
      INCLUDE 'SOLPAR.CMN'
      INCLUDE 'TIMES.CMN'

      REAL INHCON(9), T

C---- Calculate resuspension factor ------------------------------------

      IF (IRES .EQ. 1) THEN

C       Use Mass Loading Model; calculate only once--
        IF (ITIMT .EQ. 1 .OR. ITIME .EQ. 1) THEN
          RESFAC = XMLF / SLDN * KGG
        ENDIF

      ELSEIF (IRES .EQ. 2) THEN

C       Use Anspaugh Model--
        IF (ITIMT .LE. 25) THEN
          T = SQRT (FLOAT (ITIMT) * DAYYR)
          RESFAC = (1.0E-4 * EXP (- 0.15 * T) + 1.0E-9)
     .             * AVALSL / SURCM
        ELSE
```

```
          RESFAC = 1.0E-9 * AVALSL / SURCM
        ENDIF

      ELSE
        RESFAC = 0
      ENDIF

      IF (DEBUG) WRITE (*,*) 'Resuspension factor:',RESFAC

C---- Calculate first year acute inhalation ----------------------------
      IF (ACUTE .AND. ITIMT .EQ. 1) THEN

        DO 402 IN = 1, NONUC

C         Acute portion of exposure--
          ACUTEP = PWTAIR(IN) * RINHA * M3CM3 * FRCLOD * POPT

C         Chronic portion of exposure--
          CHRONP = RESSOL(IN) * RESFAC * HRINH * RINH * M3CM3 * YRHR *
     .             SECYR * POPT

          IF (DEBUG) WRITE (*,*) 'Acute inhalation (ACUTEP, CHRONP)',
     .      ACUTEP, CHRONP

          EXPOS(IN,2) = ACUTEP + CHRONP

  402   CONTINUE

      ELSE
C---- Chronic exposure ------------------------------------------------

C       Air concentration includes resuspension contribution--

        DO 200 IN = 1, NONUC
          INHCON(IN) = (ARPCON(IN) * YRSEC) + (RESSOL(IN) * RESFAC)
          IF (DEBUG) WRITE (*,*) 'Inhalation air:', INHCON(IN)
  200   CONTINUE

        DO 100 IN = 1, NONUC
          EXPOS(IN,2) = INHCON(IN) * HRINH * RINH * YRHR *
     .                  M3CM3 * SECYR * POPT
  100   CONTINUE
      ENDIF

      RETURN
C----------------------------------------------------------------------
      END
```


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```
C-----------------------------------------------------------------------
C
      SUBROUTINE INITNV
C
C     This module initializes parameter values for each radionuclide
C     chain.
C
C     Module of Program ENV of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification:  12-Aug-88  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-------------------------------------------------------------------

      INCLUDE 'ANMPAR.CMN'
      INCLUDE 'AQUPAR.CMN'
      INCLUDE 'CONC.CMN'
      INCLUDE 'EXPALL.CMN'
      INCLUDE 'FODPAR.CMN'
      INCLUDE 'OPT.CMN'
      INCLUDE 'RAD.CMN'
      INCLUDE 'SOLPAR.CMN'
      INCLUDE 'TIMES.CMN'

      DO 200 IN = 1, 9
        QAIR(IN) = 0.0
        QSW(IN) = 0.0
        QWAS(IN) = 0.0
        NONAGS(IN) = 0.0
        RESSOL(IN) = 0.0
        NONAGD(IN) = 0.0
        DSRES(IN) = 0.0
        GWCON(IN) = 0.0
        SWCON(IN) = 0.0
        AIRCON(IN) = 0.0
        ARPCON(IN) = 0.0
        SEDCON(IN) = 0.0
        DWCON(IN) = 0.0
        RTAVAL(IN) = 0.0
        PAKADD(IN) = 0.0
        RTENV(IN) = 0.0

        DO 202 I = 1, 4
          SOLCON(IN,I) = 0.0
          DSCON(IN,I) = 0.0
          ARFCON(IN,I) = 0.0
          AQUCON(IN,I) = 0.0
          PLTCON(IN,I) = 0.0
```


91048 1107

```
           ANMCON(IN,I) = 0.0
           HARVT(IN,I,1) = 0.0
           HARVT(IN,I,2) = 0.0
  202    CONTINUE

         DO 204 I = 1, 6
           ARF2CN(IN,I) = 0.0
           SL2CON(IN,I) = 0.0
           DS2CON(IN,I) = 0.0
           HARVA(IN,I,1) = 0.0
           HARVA(IN,I,2) = 0.0
  204    CONTINUE

         DO 102 IP = 1, NPATH
           EXPOS(IN,IP) = 0.0
           DO 104 IY = 1, NTIME
             EXPOST(IY,IN,IP) = 0.0
  104      CONTINUE
  102    CONTINUE

  200 CONTINUE

C     Eating adjustment factor--
      DO 300 I = 1, 4
        ADJEAT(I) = 1.0
        ADJET2(I) = 1.0
        ADJETQ(I) = 1.0
  300 CONTINUE

C     Set over-all time index (covers both prior and release periods)--
      ITIMT = 0

C     Initialize transport skip flags--
      DOAIR = .FALSE.
      DOIRR = .FALSE.
      DOBIOT = .FALSE.
      DOWAST = .FALSE.

C     Initialize derived concentration input flags--
      DERCRP = .FALSE.
      DERANM = .FALSE.
      DERAQU = .FALSE.
      DERDRK = .FALSE.

      RETURN
C-----------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------
C
      SUBROUTINE INTPOL
C
C     This module interpolates between two chi/q values at specified
C     distances.
C
C     Module of Program ENV of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 11-Apr-88  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-----------------------------------------------------------------------

      INCLUDE 'AIRPAR.CMN'
      INCLUDE 'AFPPAR.CMN'
      INCLUDE 'OPT.CMN'

C     Find direction--
      IDR = 0
      DO 111 I = 1, NDIR
        IF (MIDIR .EQ. IDIR(I)) IDR = I
  111 CONTINUE
      IF (IDR .LT. 1 .OR. IDR .GT. 16) GOTO 91

C     Find distance brackette--
      IDS = 0
      DO 114 I = 1, NDIST
        IF (MIDIST .GT. X(I)) IDS = I
  114 CONTINUE
      IF (IDS .LT. 1 .OR. IDS .EQ. NDIST) GOTO 92


C     Calculate distance offset--

      DISDIF = (X(IDS+1) - X(IDS))
      IF (DISDIF .GT. 0.0) THEN
        DISDIF = (MIDIST - X(IDS)) / DISDIF
      ELSE
        DISDIF = 0.0
      ENDIF


      XOQI = (XOQ(IDS+1,IDR) - XOQ(IDS,IDR)) * DISDIF
      XOQI = XOQI + XOQ(IDS,IDR)


      IF (DEBUG) THEN
```

```
      WRITE (*,*) ' Interpolation: '
      WRITE (*,*) '   X(IDS)   X(IDS+1)   MIDIST'
      WRITE (*,*) X(IDS), X(IDS+1), MIDIST
      WRITE (*,*) '   XOQ(IDS,IDR)  XOQ(IDS+1,IDR), XOQI'
      WRITE (*,*) XOQ(IDS,IDR), XOQ(IDS+1,IDR), XOQI
    ENDIF

    RETURN

C---- Error Messages ---------------------------------------------------

 91 WRITE (*,*) ' Error in direction in interpolation in INTPOL'
    CALL EXIT (1)

 92 WRITE (*,*) 'MI distance outside range of chi/Q file in INTPOL'
    CALL EXIT (1)

C----------------------------------------------------------------------
    END
```

```
C-----------------------------------------------------------------------
C
      SUBROUTINE PACKAG
C
C     This subroutine calculates radionuclide release for packaging
C     for a single radionuclide decay chain.  This subroutine is used
C     for near-field.
C
C     Module of Program ENV of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 23-Mar-88  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C     DAL      - Double precision temporary variable
C     DNTGRL   - 1.0 - e(-lambda package half life * T) / lambda
C     RTWAST() - Waste removal rate, UoA/m3 yr
C     TYR      - REAL ITIMT, over-all time index; includes prior period
C
C-----------------------------------------------------------------------

      INCLUDE 'CONC.CMN'
      INCLUDE 'OPT.CMN'
      INCLUDE 'RAD.CMN'
      INCLUDE 'SOLPAR.CMN'
      INCLUDE 'TIMES.CMN'

      REAL RTWAST(9), TYR
      REAL*8 DAL, DNTGRL

      TYR = FLOAT (ITIMT)

C     Calculate package decay integral term--
      DAL = DBLE (PACKHL)
      IF (DAL .GT. 50.0D0) THEN
        DNTGRL = 1.0D0 / DAL
      ELSE
        DNTGRL = (1.0D0 - DEXP(-DAL * ONEYR)) / DAL
      ENDIF

C     Waste package availability over one year--
      DO 350 IN = 1, NONUC
        RTWAST(IN) = QWAS(IN) * DNTGRL
  350 CONTINUE


C     Remove waste degradation contribution from waste, and add
```

```
C     to deep soil--

      DO 360 IN = 1, NONUC

        QWAS(IN) = QWAS(IN) - RTWAST(IN)
        PAKADD(IN) = RTWAST(IN)

        IF (NONAG) THEN
C         Non-agricultural scenario--
          NONAGD(IN) = NONAGD(IN) + PAKADD(IN)

        ELSE
C         Agricutural/residential scenario--

          DSRES(IN) = DSRES(IN) + PAKADD(IN)

          DO 361 ITF = 1, NTF
            DSCON(IN,ITF) = DSCON(IN,ITF) + PAKADD(IN)
  361     CONTINUE

          DO 362 IAN = 1, NAN+2
            DS2CON(IN,IAN) = DS2CON(IN,IAN) + PAKADD(IN)
  362     CONTINUE

        ENDIF

  360 CONTINUE

      IF (DEBUG) THEN
        WRITE (*,*) 'Waste after degradation:',QWAS(1)
        WRITE (*,*) 'Available waste:',PAKADD(1)
      ENDIF

      RETURN
C-----------------------------------------------------------------------
      END
```


9 1 0 4 8 1 1 1 2

```
C-------------------------------------------------------------------------
C
      SUBROUTINE PRIOR
C
C     This subroutine calculates radionuclide decay and buildup prior
C     to the intake period.
C
C     Module of Program ENV of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 29-Dec-87 RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-------------------------------------------------------------------------
C
C     IBEFOR   - Integer of BEFORE, yr
C     YRTOGO   - Number of years remaining in inventory decay/buildup
C                period, yr
C
C-------------------------------------------------------------------------

      INCLUDE 'CONC.CMN'
      INCLUDE 'OPT.CMN'
      INCLUDE 'RAD.CMN'
      INCLUDE 'SOLPAR.CMN'

C     If non-agricultural scenario, redistribute into food pathway
C     and residential soil compartments, and clear flag--

      IF (NONAG) THEN

C       Residential/resuspension soil--
        DO 124 IN = 1, NONUC
          RESSOL(IN) = NONAGS(IN)
          DSRES(IN) = NONAGD(IN)
  124   CONTINUE

C       Terrestrial foods soil--
        IF (TFOOD) THEN
          DO 120 ITF = 1, NTF
            DO 122 IN = 1, NONUC
              IF (TFD(ITF)) THEN
                SOLCON(IN,ITF) = NONAGS(IN)
                DSCON(IN,ITF) = NONAGD(IN)
              ENDIF
  122       CONTINUE
  120     CONTINUE
        ENDIF
```

```
C       Animal fodder soil--
        IF (ANFOOD) THEN
          DO 130 IAN = 1, NAN
            DO 132 IN = 1, NONUC
              IF (ANF(IAN)) THEN
                SL2CON(IN,IAN) = NONAGS(IN)
                DS2CON(IN,IAN) = NONAGD(IN)
              ENDIF
  132       CONTINUE
  130     CONTINUE
        ENDIF

      ENDIF

      RETURN
C-----------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------
C
      SUBROUTINE REDCAS (INCHAN)
C
C     This module reads the ENV program input file.
C
C     Module of Program ENV of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 19-Aug-88  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C     I         - Radionuclide loop index
C     INCHAN()  - Number of radionuclides in each chain, passed to ENV
C     J         - Input concentration loop index
C
C-----------------------------------------------------------------------

      INCLUDE 'AFPPAR.CMN'
      INCLUDE 'AIRPAR.CMN'
      INCLUDE 'ANMPAR.CMN'
      INCLUDE 'AQUPAR.CMN'
      INCLUDE 'ENVPAR.CMN'
      INCLUDE 'EXTPAR.CMN'
      INCLUDE 'FODPAR.CMN'
      INCLUDE 'OPT.CMN'
      INCLUDE 'SOLPAR.CMN'
      INCLUDE 'SWPAR.CMN'
      INCLUDE 'TIMES.CMN'

      INTEGER INCHAN(70), NUCTOT, ITEMP
      CHARACTER DUM*1, ELTT(100)*2, AWT(100)*6

      LUN = 11
      CALL OPNFIL (4,0,LUN)

C---- Set default conditions ------------------------------------------

C     Far-field root fractions (sur/deep)--
      RF1 = 1.0
      RF2 = 0.0

C---- Read input options and general parameters -----------------------

      READ (LUN,'(A)',ERR=98,END=99) DUM
      READ (LUN,*) OUTEDE, OUTRAD, OUTPTH, DEBUG,
     .             NEAR, POPDOS, ACUTE, ONEDOS, AEDE, MAXDOS, CUMDOS,
```


9 1 0 4 8 1 1 1 5

```
     .              DOSTYP, RELTRM, BASIC, DERIVE, AIRCN, DEEP,
     .              FINITE

      READ (LUN,*) NCHAIN, IUNIT, SOLUNT, NUCTOT, POPOPT, POPT
      READ (LUN,*) (INCHAN(I),I=1,NCHAIN)
      READ (LUN,72) (ELTT(IN), AWT(IN),IN=1,NUCTOT)
   72 FORMAT (9(A2,A6)/)

      READ (LUN,*) AIR, SWAT, BIOT, BURWAS
      READ (LUN,*) PATH, RECRE, AQFOOD, TFOOD, ANFOOD
      READ (LUN,*) NTKEND, DCEND, RELEND, BEFAIR, BEFIRR
      IF (NEAR) READ (LUN,*) BEFORE, LOIC, RF1, RF2, MANULR, FRSIZ

      READ (LUN,*) NDIST
      BACKSPACE (LUN)
      IF (NDIST .GT. 5) THEN
        READ (LUN,*) ITEMP, (X(I),I=1,5)
        READ (LUN,*) (X(I),I=6,NDIST)
      ELSE
        READ (LUN,*) ITEMP, (X(I),I=1,NDIST)
        READ (LUN,'(A)') DUM
      ENDIF

C---- Read air transport values -----------------------------------------

      IF (AIR) THEN
        READ (LUN,*) STACK, XOQOPT, SHITE, SFLOW, XOQI, SRAD
        READ (LUN,*) ETEMP, MIDIST, MIDIR, EFFSTK, JFIN, TTAIRI
        READ (LUN,*) MIUBAR, IRELES, BUILDX, BUILDH
        READ (LUN,*) TPOPS, (TTAIR(I),I=1,NDIST)
        IF (.NOT. POPDOS) THEN
          IF (FINITE) READ (LUN,*) (DRFSAV(J),J=1,6)
        ELSEIF (XOQOPT .GT. 1) THEN
          IF (FINITE) THEN
            READ (LUN,*) ((PWTX(I,J), J=1,6), I=1,10)
          ENDIF
          READ (LUN,*)  (PWT(I),I=1,NDIST)
        ENDIF
      ENDIF

C---- Read surface water transport values -------------------------------

      IF (SWAT) THEN
        READ (LUN,*) MIXFLG, MIXR, SWFLOW, SWTT
        IF (MIXFLG .GT. 0) READ (LUN,*)
     .                        SWQB, SWLSX, SWOSY, SWDPTH, SWIDTH, SWDZ
      ENDIF

C---- Read waste availability values ------------------------------------
```

```
      IF (BURWAS .OR. BIOT .OR. DEEP) READ (LUN,*)
     .  PACKHL, WASDEP, OVRBRD

C---- Read biotic transport values ------------------------------------

      IF (BIOT) READ (LUN,*) BTPRE, BTNTK, BTDSET, NONAG

C---- Read external exposure values ------------------------------------

      READ (LUN,*) HRPLUM, FRCLOD
      IF (GROUND) READ (LUN,*) HRGRD, RESIRR, IRRSR, RIRRR, IRTIMR
      IF (RECRE) READ (LUN,*) HRSWIM, HRBOAT, HRSHOR, SHRTYP, RECTT

C---- Read inhalation values --------------------------------------------

      IF (INHAL) READ (LUN,*) HRINH, IRES, AVALSL, XMLF

C---- Read ingestion population values ---------------------------------

      READ (LUN,*) FOQOPT, FOQ, AQUPOP, DWPOP, EXPORT

C---- Read drinking water values ----------------------------------------

      IF (DRINK) READ (LUN,*) DWUSAG, DWSRC, DWTRET, HOLDDW

C---- Read aquatic foods values -----------------------------------------

      IF (AQFOOD) THEN
        READ (LUN,*) (AQF(IAQ),IAQ=1,NAQ), ISALT
        DO 110 IAQ = 1, NAQ
          IF (AQF(IAQ)) READ (LUN,*)
     .                    AQUTT(IAQ), TPRODQ(IAQ),
     .                    HLDUP2(IAQ), USAG(IAQ)
  110   CONTINUE
      ENDIF

C---- Read terrestrial food values --------------------------------------

      IF (TFOOD) THEN
        READ (LUN,*) (TFD(ITF),ITF=1,NTF)
        DO 120 ITF = 1, NTF
          IF (TFD(ITF)) READ (LUN,*) GRWP(ITF),
     .                    IRRST(ITF), RIRR(ITF), IRTIMT(ITF),
     .                    YELD(ITF), TPRODT(ITF), HLDUP(ITF), CONS(ITF)
  120   CONTINUE
      ENDIF
```

```
C---- Read animal product values ------------------------------------

      IF (ANFOOD) THEN
        READ (LUN,*) (ANF(IAN),IAN=1,NAN)
        DO 130 IAN = 1, NAN
          IF (ANF(IAN)) THEN
            READ (LUN,*)
     .        CONS2(IAN), HLDUPA(IAN), TPRODA(IAN), DWFACA(IAN)
            READ (LUN,*) DIETFR(IAN), GRWPA(IAN), IRRSA(IAN),
     .        RIRRA(IAN), IRTIMA(IAN), YELDA(IAN), STORTM(IAN)
          ENDIF
  130   CONTINUE
        IF (ANF(1)) READ (LUN,*)
     .    DIETFR(5), GRWPA(5), IRRSA(5), RIRRA(5),
     .    IRTIMA(5), YELDA(5), STORTM(5)
        IF (ANF(3)) READ (LUN,*)
     .    DIETFR(6), GRWPA(6), IRRSA(6), RIRRA(6),
     .    IRTIMA(6), YELDA(6), STORTM(6)
      ENDIF

C---- Read default parameter values ----------------------------------

      READ (LUN,*) PRCNTI, HARVST,
     .             NVU, SVU, DPVRES, LEAFRS, DEPFR1, DEPFR2, SURCM,
     .             SLDN, SSLDN, SOLING, WTIM, TRANS, TRANSA, CONSUM,
     .             DWATER, FRACUT, SHORWI, INGWAT, TCWS, YELDBT,
     .             TOTEXC, EXCAV, RINH, RINHA, BIOMAS, BIOMA2,
     .             DRYFAC, DRYFA2

      RETURN

C---- Error Messages -------------------------------------------------

   98 CALL FILERR (3, LUN, 'In REDCAS')
   99 CALL FILERR (2, LUN, 'In REDCAS')

C--------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------
C
      SUBROUTINE REDIST
C
C     This subroutine calculates surface soil concentration due to
C     manual redistribution of the deep soil to the surface (e.g.,
C     excavation for a basement or foundation).  This redistribution
C     occurs in the first year of the exposure period.
C
C     Module of Program ENV of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 22-Mar-88 RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
      INCLUDE 'RAD.CMN'
      INCLUDE 'CONC.CMN'
      INCLUDE 'SOLPAR.CMN'
      INCLUDE 'OPT.CMN'

      DO 172 IN = 1, NONUC

C       Residential/resuspension soil--
        RESSOL(IN) = RESSOL(IN) + DSRES(IN) * MANULR

C       Terrestrial food pathway--
        DO 170 ITF = 1, NTF
          IF (TFD(ITF)) SOLCON(IN,ITF) = SOLCON(IN,ITF) +
     .                                   DSCON(IN,ITF) * MANULR
  170   CONTINUE

C       Animal food pathway--
        DO 174 IAN = 1, NAN
          IF (ANF(IAN)) SL2CON(IN,IAN) = SL2CON(IN,IAN) +
     .                                   DS2CON(IN,IAN) * MANULR
          IF (ANF(IAN) .AND. IAN .EQ. 1) SL2CON(IN,5) = SL2CON(IN,5) +
     .                                   DS2CON(IN,5) * MANULR
          IF (ANF(IAN) .AND. IAN .EQ. 3) SL2CON(IN,6) = SL2CON(IN,6) +
     .                                   DS2CON(IN,6) * MANULR
  174   CONTINUE

  172 CONTINUE

      RETURN
C-----------------------------------------------------------------------
      END
```

```
C-------------------------------------------------------------------
C
      SUBROUTINE REDCHA
C
C     Read radionuclide-specific information for a chain from the
C     ENV program input file and set radionuclide-specific flags and
C     derived concentration flags.
C
C     Module of Program ENV of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 6-Apr-88  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C--------------------------------------------------------------------
C
C     ANI    - Input animal product concentration
C     AQU    - Input aquatic foods concentration
C     DUM    - CHARACTER dummy input variable
C     PLT    - Input terrestrial plant concentration
C     SOL    - Input surface soil concentration
C     SOL2   - Input deep soil concentration
C
C--------------------------------------------------------------------

      INCLUDE 'AIRPAR.CMN'
      INCLUDE 'ANMPAR.CMN'
      INCLUDE 'AQUPAR.CMN'
      INCLUDE 'CONC.CMN'
      INCLUDE 'DECAY.CMN'
      INCLUDE 'FODPAR.CMN'
      INCLUDE 'OPT.CMN'
      INCLUDE 'RAD.CMN'
      INCLUDE 'SOLPAR.CMN'

      CHARACTER DUM*1
      REAL PLT, ANI, AQU, SOL, SOL2

      LUN = 11
      READ (LUN,'(A)') DUM

C     Set number of radiouclides into DECAY common block--
      NUC = NONUC

      DO 100 I = 1, NONUC

        READ (LUN,1000) ELT(I), AW(I), BONE(I),
     .                             CLASS(I), ICL(I)
```

```
      IF (RELTRM) READ (LUN,*) QAIR(I), QSW(I), QWAS(I)
      IF (BASIC) READ (LUN,*) AIRCON(I), SOL,
     .                        SOL2, GWCON(I), SWCON(I)
      IF (DERIVE) READ (LUN,*) PLT, ANI, DWCON(I), AQU

      READ (LUN,*) HL(I), AL(I), IFRM(1,I), IFRM(2,I), DK(1,I),
     .             DK(2,I)
      READ (LUN,*) DPVL(I), LEACHR(I), (BVI(J,I),J=1,NTF)
      READ (LUN,*) (FMI(J,I), J=1,6)
      READ (LUN,*) (BIOACF(J,I),J=1,NAN), DWCLEN(I)
      IF (FINITE) READ (LUN,*) (EDIS(J,I), J=1,6)

      IF (BASIC) THEN

C       Set irrigation surface water--
        SWIRR(I) = SWCON(I)

        IF (NONAG) THEN

C         Set non agricultural soil--
          NONAGS(I) = SOL

        ELSE

C         Set soil concentration for each food pathway--
          DO 112 ITF = 1, NTF
            IF (TFD(ITF)) THEN
              SOLCON(I,ITF) = SOL
              DSCON(I,ITF) = SOL2
            ENDIF
  112     CONTINUE
          DO 114 IAN = 1, NAN+2
              SL2CON(I,IAN) = SOL
              DS2CON(I,IAN) = SOL2
  114     CONTINUE

C         Set residential soil--
          RESSOL(I) = SOL
          DSRES(I) = SOL2
        ENDIF

      ENDIF

      ANMFED = .FALSE.
      IF (DERIVE) THEN

C       Set derived concentration flags--
        IF (PLT .GT. 0.0) DERCRP = .TRUE.
        IF (ANI .GT. 0.0) DERANM = .TRUE.
```

```
          IF (AQU .GT. 0.0) DERAQU = .TRUE.
          IF (DWCON(I) .GT. 0.0) DERDRK = .TRUE.

C         Set each plant, animal, and aquatic food concentration to input--
          DO 110 J = 1, 4

            IF (TFOOD) THEN
              IF (TFD(J)) PLTCON(I,J) = PLT
            ELSEIF (DERCRP .AND. ANFOOD) THEN
              ANMFED = .TRUE.
              IF (ANF(J)) ANMCON(I,J) = PLT
            ELSEIF (ANFOOD) THEN
              IF (ANF(J)) ANMCON(I,J) = ANI
            ENDIF

            IF (AQF(J)) AQUCON(I,J) = AQU

  110     CONTINUE

        ENDIF

  100 CONTINUE

C     Set radionuclide-specific flags--
      C14 = .FALSE.
      H3 = .FALSE.
      IF (ELT(1) .EQ. 'C ') C14 = .TRUE.
      IF (ELT(1) .EQ. 'H ') H3 = .TRUE.

      RETURN

C---- Format Statements -----------------------------------------------

 1000 FORMAT (1X,A2,A6,2X,A1,2X,A1,2X,I3)

C---------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------
C
      SUBROUTINE RITEXP (ISEAS, INCHAN)
C
C     This subroutine writes data sets of exposure rates to the inter-
C     mediate output file that will be read by DOSE.  Media
C     concentrations are also written to a file.
C
C     Module of Program ENV of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 6-Apr-88  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-------------------------------------------------------------------
C
C     FIRST    - Logical cleared after first call to this subroutine
C
C-------------------------------------------------------------------

      INCLUDE 'EXPALL.CMN'
      INCLUDE 'LABELS.CMN'
      INCLUDE 'OPT.CMN'
      INCLUDE 'RAD.CMN'
      INCLUDE 'TIMES.CMN'

      INTEGER INCHAN(70)
      LOGICAL FIRST
      DATA FIRST /.TRUE./

      LUN = 13
      IF (FIRST) THEN

        DO 120 IP = 1, NPATH
          IF (IP .EQ. 1 .AND. FINITE) THEN
              WRITE (LUN,'(5A)') 'Finite ',EXPLAB(IP), ': ',
     .                           UNIT1(IUNIT),' person rem/Ci yr'

          ELSEIF (PATH(IP)) THEN
              WRITE (LUN,'(5A)') EXPLAB(IP), ': ',
     .                           UNIT1(IUNIT),'/',UNIT2(IP)
          ENDIF

  120   CONTINUE
        FIRST = .FALSE.

      ENDIF

C---- Set time loop termination ------------------------------------
```

```
      NT = NTIME
      IF (ACUTE .AND. NT .EQ. 0) NT = 1

C---- Write additional seasons to output file -------------------------

      IF (ACUTE .AND. ISEAS .EQ. 0) THEN

        DO 130 IS = 2, 4

          IF (IS .EQ. 2) THEN
            LUN2 = 7
          ELSEIF (IS .EQ. 3) THEN
            LUN2 = 49
          ELSEIF (IS .EQ. 4) THEN
            LUN2 = 50
          ENDIF

          REWIND (LUN2)

          DO 140 IC = 1, NCHAIN
            DO 142 IN = 1, INCHAN(IC)

              READ (LUN2) ELT(IN), AW(IN), SEALAB(IS)
              DO 150 IP = 1, NPATH
                IF (PATH(IP) .OR. (IP .EQ. 1 .AND. FINITE)) THEN
                  READ (LUN2) EXPLAB(IP),
     .                        (EXPOST(IT,IN,IP), IT=1, NT)
                ENDIF
  150         CONTINUE

              WRITE (LUN,1000) ELT(IN), AW(IN), SEALAB(IS)

              DO 160 IP = 1, NPATH
                IF (PATH(IP) .OR. (IP .EQ. 1 .AND. FINITE)) THEN
                  WRITE (LUN,1010) EXPLAB(IP),
     .                        (EXPOST(IT,IN,IP), IT=1, NT)
                ENDIF
  160         CONTINUE

  142       CONTINUE
  140     CONTINUE
  130   CONTINUE

        CLOSE (LUN)
        CLOSE (LUN2)

C---- Write to unformatted temporary file by season ------------------
```

```
      ELSEIF (ACUTE .AND. ISEAS .GT. 1) THEN

        IF (ISEAS .EQ. 2) THEN
          LUN = 7
        ELSEIF (ISEAS .EQ. 3) THEN
          LUN = 49
        ELSEIF (ISEAS .EQ. 4) THEN
          LUN = 50
        ENDIF

        DO 180 IN = 1, NONUC

          WRITE (LUN) ELT(IN), AW(IN), SEALAB(ISEAS)

          DO 182 IP = 1, NPATH
            IF (PATH(IP) .OR. (IP .EQ. 1 .AND. FINITE)) THEN
              WRITE (LUN) EXPLAB(IP),
     .                    (EXPOST(IT,IN,IP), IT=1, NT)
            ENDIF
  182     CONTINUE

  180   CONTINUE

C---- Write to output file ---------------------------------------------

      ELSE

        DO 100 IN = 1, NONUC

          IF (ACUTE .AND. (TFOOD .OR. ANFOOD)) THEN
            WRITE (LUN,1000,ERR=98) ELT(IN), AW(IN), SEALAB(ISEAS)
          ELSE
            WRITE (LUN,1000,ERR=98) ELT(IN), AW(IN)
          ENDIF

          DO 110 IP = 1, NPATH
            IF (PATH(IP) .OR. (IP .EQ. 1 .AND. FINITE)) THEN
              WRITE (LUN,1010,ERR=98) EXPLAB(IP),
     .                    (EXPOST(IT,IN,IP), IT=1, NT)
            ENDIF
  110     CONTINUE

  100   CONTINUE
      ENDIF

      RETURN

C---- Error Messages ----------------------------------------------------
```

```
   98 CALL FILERR (3, LUN, 'In RITEXP')

C---- Format Statements ------------------------------------------------------

 1000 FORMAT (1X,A2,A6,10X,A8)
 1010 FORMAT (' ',A8,1P, 8E8.1E2 / 9(9X,8E8.1E2/))
 1020 FORMAT (' ',A8,1P, 8E8.1E2 / '   ',A3,'/',A2,1X,
     .        8E8.1E2 / 9(9X,8E8.1E2/))

C-----------------------------------------------------------------------------
      END
```


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```
C--------------------------------------------------------------------
C
      SUBROUTINE RITMED (RELFLG)
C
C     This module prints a media report for the residential location.
C
C     Module of Program ENV of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 26-Feb-88  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C---------------------------------------------------------------------
C
C     AIRC     - Air concentration or population-weighted air
C                concentration used, UoA/m3
C     FIRST    - Logical set if this is the first call to this subroutine
C     RELFLG   - Flag set if this is during the release period
C
C---------------------------------------------------------------------

      INCLUDE 'RAD.CMN'
      INCLUDE 'CONC.CMN'
      INCLUDE 'TIMES.CMN'
      INCLUDE 'EXPALL.CMN'
      INCLUDE 'OPT.CMN'
      INCLUDE 'SWPAR.CMN'
      INCLUDE 'SOLPAR.CMN'

      REAL AIRC
      LOGICAL FIRST, RELFLG
      DATA FIRST /.TRUE./

      IF (ACUTE) FIRST = .FALSE.
      LUN = 21

      IF (FIRST) THEN
        IF (SWAT .AND. MIXFLG .NE. 0) WRITE (LUN,16) MIXR

        WRITE (LUN, 12) UNIT1(IUNIT), UNIT1(IUNIT), UNIT1(IUNIT),
     .                  UNIT1(IUNIT), UNIT1(IUNIT), UNIT1(IUNIT)
        FIRST = .FALSE.
      ENDIF

      IF (RELFLG) THEN
        DO 132 IN = 1, NONUC
          AIRC = ARPCON(IN) * YRSEC
          IF (ACUTE) THEN
            WRITE (LUN,15) ELT(IN), AW(IN), ITIME, RESSOL(IN)
```

```
          ELSE
            WRITE (LUN,14) ELT(IN), AW(IN), ITIME, AIRC, RESSOL(IN),
     .                     DSRES(IN), GWCON(IN), SWCON(IN), SWIRR(IN)
          ENDIF
  132   CONTINUE
      ENDIF

      RETURN

C---- Format Statements -----------------------------------------------

   12 FORMAT (//
     .        '                      ------Residential------         ',
     .        '          Irr.'/
     .        ' Radio-                           Surface Deep    Ground ',
     .        ' Surface Surface'/
     .        ' nuclide  Year    Air     Soil    Soil    Water   Water',
     .        '   Water'/
     .        '                    ',A3,'/m3  ',A3,'/m2  ',A3,'/m3  ',A3,
     .        '/L   ',A3,'/L   ',A3,'/L'/
     .        ' -------- ------- ------- ------- ------- ------- ',
     .        '------- -------')

   14 FORMAT (' ', A2, A6, I8, 1P6E8.1)
   15 FORMAT (' ', A2, A6, I8, 16X, 1PE8.1)
   16 FORMAT (//' Surface water mixing ratio: ',1PE8.1E2//)

C---------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------
C
      SUBROUTINE SWCAL
C
C     SWCAL computes dilution factors for flow through river and
C     near-shore lake environments, surface water concentration, and
C     decay during transit to irrigation withdrawl site.  Parts of
C     this module were adapted from the LADTAPII computer program;
C     see documentation Volume 1 for reference.
C
C      Module of Program ENV of the GENII Software Package
C      Pacific Northwest Laboratory Environmental Dosimetry System
C
C      Last Modification: 11-Apr-88 RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C     D          - Dispersion factor, M**5/S**2
C     DY         - Y-direction dispersion, M**2/S
C     DZ         - Z-direction dispersion, M**2/S
C     F          - Term in series expansion
C     F1         - Integral value in series
C     Q          - Total river flow rate, M**3/S
C     SWDZI      - Depth of effluent discharge point used in lake calculation
C     SWOSYI     - Input point used in river calculation
C     VELOC      - Velocity used for concentration calculation, m3/sec
C
C-----------------------------------------------------------------------

      INCLUDE 'CONC.CMN'
      INCLUDE 'OPT.CMN'
      INCLUDE 'RAD.CMN'
      INCLUDE 'SWPAR.CMN'
      INCLUDE 'TIMES.CMN'

      REAL VELOC

      IF (MIXFLG .GT. 0) THEN

C       Set initial parameter values--
        DY = 0.06 * SWDPTH * SWFLOW
```


9 1 0 4 8 1 1 2 9

```
          D = 0.06 * SWDPTH ** 3.0 * SWFLOW ** 2.0

          R = D * SWLSX

        ENDIF

C---- River solution ---------------------------------------------------
      IF (MIXFLG .EQ. 1) THEN

C         Limit intake point to width of the river--

          SWOSYI = SWOSY

          IF (SWOSY .GT. SWIDTH) SWOSYI = SWIDTH

          RJY=SWOSYI/SWIDTH

          Q=SWFLOW*SWDPTH*SWIDTH

          F1=0.

          F=0.

C         Series expansion limited to 100 terms--
          N=101

  620     N=N-1

          IF(N .LE. 0) GO TO 790

          E1=-(N*P/Q)**2.*R

          IF(ABS(E1) .GT. 20.) GO TO 620

          E3=N*P*RJY

C         Terms of series--
  760     F=EXP(E1)*COS(E3)

          F1=F1+F

          GO TO 620
```

```
  790   A=1.+2.*F1

C       Limit normalized conc and dilution--
        IF(A .LT. 1.00E-20) THEN
          A=0.

          GO TO 93
        ELSE

          MIXR=(SWQB*A)/Q

        ENDIF

C---- Lake Solution ---------------------------------------------------------

      ELSEIF (MIXFLG .EQ. 2) THEN

        SWDZI = SWDZ
        IF (SWDZ .GT. SWDPTH) SWDZI = SWDPTH

        DZ=0.0059*SWDPTH*SWFLOW

        M=SQRT(0.295*SWLSX/SWDPTH) + SWDZI/2./SWDPTH

C       Failure--
        IF (M .LT. 1) GO TO 93

        DZXU=4.*DZ*SWLSX/SWFLOW

        DYXU=4.*DY*SWLSX/SWFLOW

C       Divide-by-zero check--
        IF (DZXU .EQ. 0.0) GOTO 91
        IF (DYXU .EQ. 0.0) GOTO 92

        AA=(2.*M*SWDPTH-SWDZI)**2./DZXU + SWOSY**2./DYXU

C       Failure--
        IF (AA .GE. 50) GO TO 93

C       Series expansion limited to M terms (i.e., EXP(-50)>solution)--

        MM=-M-1
```

```
      M=2*M+1

      F1=0.

      FY=0.

      FZ=0.

      AA=0.

      DO 123 I1=1,M

        I=MM+I1

        AA=(2.*I*SWDPTH-SWDZI)**2./DZXU

        AA=EXP(-AA)

        FZ=FZ+2.*AA

123   CONTINUE

      AA=SWOSY**2./DYXU

      FY=2.*EXP(-AA)

      F1=SWQB/4./P/SWLSX/SQRT(DY*DZ)

      MIXR=F1*FY*FZ

      ENDIF

C----- Calculate surface water concentrations--------------------------

C     Apply mixing ratio to release term--

      IF (MIXFLG .EQ. 1 .OR. MIXFLG .EQ. 2) THEN
        VELOC = SWQB
      ELSE
        VELOC = SWFLOW
      ENDIF

      DO 102 IN = 1, NONUC
        SWCON(IN) = QSW(IN) * MIXR / VELOC * M3L * YRSEC
  102 CONTINUE

C     Decay surface water for transit time to irrigation withdrawl
```

```
C     location--
      IF (QSW(1) .GT. 0.0) THEN
        T = SWTT * YRHR
        CALL CHAIN (T, DUMMY, SWCON, SWIRR, 0)
      ENDIF

      RETURN

C---- Error Messages ----------------------------------------------------

   91 WRITE (*,*) 'MIXRTO: DZXU = 0.0, invalid (divide by zero)'
      CALL EXIT (1)

   92 WRITE (*,*) 'MIXRTO: DYXU = 0.0, invalid (divide by zero)'
      CALL EXIT (1)

   93 MIXR=1.E-20

      WRITE (*,*) 'MIXRTO: The dilution calculation has failed;'
      WRITE (*,'(2A)') '        A value of 1E-20 will be returned for ',
     .             'the mixing ratio.'
      RETURN
C-----------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------
C
      SUBROUTINE TRNSPT (RELFLG)
C
C     This module controls calculation of yearly radionuclide transport
C     through the environment.
C
C     Module of Program ENV of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 2-Aug-88  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C     RELFGL   - Flag set if during exposure period, false during prior
C                build-up period
C
C-----------------------------------------------------------------------

      INCLUDE 'RAD.CMN'
      INCLUDE 'CONC.CMN'
      INCLUDE 'EXPALL.CMN'
      INCLUDE 'OPT.CMN'
      INCLUDE 'SWPAR.CMN'
      INCLUDE 'SOLPAR.CMN'
      INCLUDE 'TIMES.CMN'

      LOGICAL RELFLG

C     Waste package availability--
      IF (DOWAST .AND. BURWAS) CALL PACKAG

C     If this is the first year of the exposure period, do manual
C     redistribution--
      IF (RELFLG .AND. ITIME .EQ. 1) CALL REDIST

C     Decay soils/buried waste for previous year, harvest removal--
      IF (ITIMT .GT. 1) CALL DKHARV

C     Do all soils except for C14 and H3--
      IF (.NOT. C14 .AND. .NOT. H3) THEN

        IF (NONAG) THEN
C         Non-agricultural soil--
          CALL EDRNON

        ELSE
```


9 1 0 4 8 1 1 3 4

```
C         Environmental deposition/removal to residential soil--
          IF (AIREXT .OR. FINITE .OR. GROUND .OR. INHAL .OR. SLING)
     .      CALL EDRRES

C         Environmental deposition/removal to terrestrial food soils--
          IF (TFOOD) CALL EDRCRP

C         Environmental deposition/removal to animal food soils--
          IF (ANFOOD) CALL EDRANM

        ENDIF
      ENDIF

      RETURN
C-----------------------------------------------------------------------
      END
```

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```
C-------------------------------------------------------------------
C
      SUBROUTINE XQCAL
C
C     This module controls reading of population, food production,
C     and chi/Q input files and then calculates total population,
C     food-effective population, and food export adjustmentment
C     factors.
C
C     Module of Program ENV of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 6-Jun-88  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-------------------------------------------------------------------
C
C     AFRAC     - Fraction of grid area in current sector
C     AREAT     - Total area in grid
C     EFCON     - Effective consumption rate of current food pathway
C                 (kg person/yr)
C
C-------------------------------------------------------------------

      INCLUDE 'AFPPAR.CMN'
      INCLUDE 'AIRPAR.CMN'
      INCLUDE 'ANMPAR.CMN'
      INCLUDE 'AQUPAR.CMN'
      INCLUDE 'CONC.CMN'
      INCLUDE 'FODPAR.CMN'
      INCLUDE 'LABELS.CMN'
      INCLUDE 'OPT.CMN'
      INCLUDE 'RAD.CMN'

      CHARACTER DUM*8
      REAL EFCON

C---- Read or find chi/Q -------------------------------------------

      IF (ACUTE) THEN

        IF (AIR .AND. XOQOPT .NE. 1) THEN
          POPT = TPOPS
        ELSE
          POPT = 1.0
        ENDIF

      ELSE
        IF (POPDOS) THEN
```

```
C         Population exposure--

C         Read chi/Q input file--
          IF (AIR .AND. (XOQOPT .NE. 1 .OR. FOQOPT .EQ. 1))
     .      CALL XQIN ((1))

C         Read population input file, and total population for air paths--
          IF (POPOPT .EQ. 1) CALL XQIN ((2))

          IF (XOQOPT .NE. 1) THEN
C           Accumulate chi/Q total--
            XOQI = 0.0
            DO 131 IR =  1, NDIR
              DO 132 ID = 1, NDIST
                XOQI = XOQI + (XOQ(ID,IR) * POP(ID,IR))
  132         CONTINUE
  131       CONTINUE
          ENDIF

        ELSE
C         Maximum individual--

          IF (XOQOPT .EQ. 3) THEN
C           Read chi/Q and interpolate--
C            CALL XQIN ((1))
C            CALL INTPOL


          ELSEIF (XOQOPT .EQ. 2) THEN
C           Select greatest chi/Q value where there is population--

            CALL XQIN ((1))
            CALL XQIN ((4))
            XOQI = 0.0
            MIDIR = 0
            MIDIST = 0.0
            IDSAV = 0

            DO 121 IR =  1, NDIR
              DO 122 ID = 1, NDIST
                IF (POP(ID,IR) .GT. 0.0 .AND. XOQ(ID,IR) .GT. XOQI) THEN
                  XOQI = XOQ(ID,IR)
                  MIDIR = IR
                  MIDIST = X(ID)
                  IDSAV = ID
                ENDIF
  122         CONTINUE
  121       CONTINUE
```

```
            IF (MIDIR .EQ. 0 .OR. MIDIST .EQ. 0.0) GOTO 123

            IF (FINITE) THEN
              DO 124 IE = 1, 6
                DRFSAV(IE) = DRFOQ(MIDIR,IDSAV,IE)
 124          CONTINUE
            ENDIF

          ENDIF

C         Set individual population--
          POPT = 1.0

        ENDIF
      ENDIF

      IF (TFOOD .OR. ANFOOD) THEN

C------ Set effective population to total ------------------------------
        IF (FOQOPT .LT. 2) THEN

          DO 140 ITF = 1, NTF
            IF (TFD(ITF)) EFPOP(ITF) = POPT
 140      CONTINUE

          DO 150 IAN = 1, NAN
            IF (ANF(IAN)) EFPOPA(IAN) = POPT
 150      CONTINUE

C------ Assume uniform production --------------------------------------
        ELSEIF (FOQOPT .EQ. 2) THEN

C         Calculate total area in grid, production at each grid point--
          AREAT = P * X(NDIST)**2.0

          DO 410 ITF = 1, NTF
            IF (TFD(ITF)) THEN
              EFPOP(ITF) = 0.0
              DO 162 IX = 1, NDIST-1
                AFRAC = (P * X(IX+1)**2.0 - P * X(IX)**2.0)
                AFRAC = AFRAC / 16.0 / AREAT
                DO 146 IS = 1, 16
                  FPRD(IX,IS,ITF) = AFRAC * TPRODT(ITF)
                  EFPOP(ITF) = EFPOP(ITF) + FPRD(IX,IS,ITF) / CONS(ITF)
146           CONTINUE
 162          CONTINUE
            ENDIF
 410      CONTINUE
```

```
      DO 440 IAN = 1, NAN
        IF (ANF(IAN)) THEN
          EFPOPA(IAN) = 0.0
          DO 144 IX = 1, NDIST-1
            AFRAC = (P * X(IX+1)**2.0 - P * X(IX)**2.0)
            AFRAC = AFRAC / 16.0 / AREAT
            DO 145 IS = 1, 16
              FPRDA(IX,IS,IAN) = AFRAC * TPRODA(IAN)
              EFPOPA(IAN) = EFPOPA(IAN) +
     .                      FPRDA(IX,IS,IAN)/CONS2(IAN)
  145       CONTINUE
  144     CONTINUE
        ENDIF
  440 CONTINUE

C------ Use chi/Q and production grids -------------------------------
        ELSEIF (FOQOPT .EQ. 3) THEN

C         Read food production file and accumulate total production and
C         effective population--
          CALL XQIN ((3))

        ENDIF
      ENDIF

C---- Set export adjustment and write report --------------------------

      IF ((POPDOS .AND. POPOPT .EQ. 2) .OR. (AIR .AND. XOQOPT .NE. 1)
     .  .OR. EXPORT .OR. IMPORT) THEN

        LUN = 28
        CALL OPNFIL (2,0,LUN)
        CALL HEADNG (LUN)

        IF (POPDOS .AND. POPOPT .EQ. 2) WRITE (LUN,105) POPT

        IF (AIR) THEN
          IF (ACUTE) THEN
            IF (POPDOS) THEN
              WRITE (LUN,110) XOQI
            ELSE
              WRITE (LUN,109) XOQI
            ENDIF
          ELSE
C           Chronic--
            IF (POPDOS) THEN
              WRITE (LUN,108) XOQI
            ELSE
              WRITE (LUN,107) XOQI
```

```
            IF (XOQOPT .EQ. 2) WRITE (LUN,106) MIDIST, MIDIR
          ENDIF
        ENDIF
      ENDIF

      IF (EXPORT .OR. IMPORT) THEN
        IF (TFOOD .OR. ANFOOD .OR. AQFOOD) WRITE (LUN,12)
      ENDIF

      IF (TFOOD) THEN
        DO 700 ITF = 1, NTF
          IF (TFD(ITF)) THEN

            ADJEAT(ITF) = 1.0
            IF (.NOT. POPDOS) THEN
              EFPOP(ITF) = 1.0
              EFCON = CONS(ITF)
            ELSEIF (EXPORT) THEN
              EFCON = TPRODT(ITF)
            ELSE
              EFCON = EFPOP(ITF) * CONS(ITF)
            ENDIF
            IF (TPRODT(ITF) .GT. 0.0 .AND.
     .        TPRODT(ITF) .LT. EFCON) ADJEAT(ITF)=TPRODT(ITF)/EFCON
            IF (EXPORT .OR. IMPORT) THEN
              WRITE (LUN,20) PLTLAB(ITF), EFPOP(ITF), EFCON,
     .          TPRODT(ITF), ADJEAT(ITF)
            ENDIF
          ENDIF
  700   CONTINUE
      ENDIF

      IF (ANFOOD) THEN
        DO 710 IAN = 1, NAN
          IF (ANF(IAN)) THEN

            ADJET2(IAN) = 1.0

            IF (.NOT. POPDOS) THEN
              EFPOPA(IAN) = 1.0
              EFCON = CONS2(IAN)
            ELSEIF (EXPORT) THEN
              EFCON = TPRODA(IAN)
            ELSE
              EFCON = EFPOPA(IAN) * CONS2(IAN)
            ENDIF
            IF (TPRODA(IAN) .GT. 0.0 .AND.
     .        TPRODA(IAN) .LT. EFCON) ADJET2(IAN)=TPRODA(IAN)/EFCON
```


9 1 0 4 8 1 1 4 0

```
            IF (EXPORT .OR. IMPORT) THEN
              WRITE (LUN,20) ANMLAB(IAN), EFPOPA(IAN), EFCON,
     .                       TPRODA(IAN), ADJET2(IAN)
            ENDIF
          ENDIF
  710   CONTINUE
      ENDIF

      IF (AQFOOD) THEN
        DO 720 IAQ = 1, NAQ
          IF (AQF(IAQ)) THEN
            ADJETQ(IAQ) = 1.0
            IF (.NOT. POPDOS) THEN
              EFCON = USAG(IAQ)
            ELSE
              EFCON = AQUPOP * USAG(IAQ)
            ENDIF
            IF (TPRODQ(IAQ) .GT. 0.0 .AND. TPRODQ(IAQ) .LT. EFCON)
     .        ADJETQ(IAQ) = TPRODQ(IAQ) / EFCON

            IF (EXPORT .OR. IMPORT) THEN
              WRITE (LUN,20) AQFLAB(IAQ), AQUPOP, EFCON, TPRODQ(IAQ),
     .                       ADJETQ(IAQ)
            ENDIF
          ENDIF
  720   CONTINUE
      ENDIF

      CLOSE (LUN)

    ENDIF
    RETURN

C---- Error Messages ----------------------------------------------

   98 CALL FILERR (3, LUN, 'In XQCAL')
   99 CALL FILERR (2, LUN, 'In XQCAL')

  123 WRITE (*,*) 'MI location selection error:'
      WRITE (*,*) '  Direction index:',MIDIR
      WRITE (*,*) '  Distance:',MIDIST
      CALL EXIT (1)

C---- Format Statements -------------------------------------------

    1 FORMAT (A8)
   11 FORMAT (A10/A10)
  111 FORMAT (A10/A10/A10)
```

```
   2 FORMAT (/6X,10(5X,I2,2X))
   5 FORMAT (8X,10(F8.1,1X))
   3 FORMAT (0PF6.0,10(1X,1PE8.2))
  10 FORMAT (10E8.1)
  12 FORMAT (//T12,'                                                   Total'/
     .T12,'                Effective    Effective   Production    Export'/
     .T12,'Path            Population  Consumption   (Input)     Adjustment'/
     .T12,'                (persons)     (kg/yr)     (kg/yr)'/
     .T12,'----------    ----------   ----------  ----------   ----------')
  20 FORMAT (T12,1X,A8,2X,1P,4(E10.1,2X))
 105 FORMAT (//' ',1PE7.1,T12,'Total population'/)
 106 FORMAT (//' ',1PE7.1,T12,'Maximum individual distance (m)'/
     .        ' ',0P,I7,T12,'Maximum individual sector index (1=S)')
 107 FORMAT (' ',1PE7.1,T12,'Individual chi/Q'/)
 109 FORMAT (' ',1PE7.1,T12,'Individual E/Q'/)
 108 FORMAT (' ',1PE7.1,T12,'Population-weighted chi/Q'/)
 110 FORMAT (' ',1PE7.1,T12,'Population-weighted E/Q'/)
C-----------------------------------------------------------------------
      END
```

9 1 0 4 8 1 1 4 2

9 1 0 4 8 1 1 4 3

DOSE

```
C-----------------------------------------------------------------
C
C     Program title:                     DOSE - A module of the GENII
C                                        environmental dosimetry software
C                                        package.
C
C     Prepared for:                      U. S. Department of Energy under
C                                        Contract DE-AC06-76RLO 1830
C
C
C     Contact:                           Bruce Napier
C                                        Pacific Northwest Laboratory
C                                        Richland WA 99352
C                                        (509) 375-3916
C
C     Code developers:                   B. A. Napier, R. A. Peloquin,
C                                        D. L. Strenge, and J. V. Ramsdell
C                                        Pacific Northwest Laboratory
C                                        Richland WA  99352
C
C
C     This code was prepared for an agency of the United States
C     Government.  Neither the United States Government or any agency
C     thereof, or any of their employees, make any warranty, expressed
C     or implied, or assumes any legal liability or responsibility for
C     any third party's use, or the results of such use, of any portion
C     of this program or represents that its use by such third party
C     would not infringe privately owned rights.
C
C
C--- Program Information -------------------------------------------
C
C     Problem description:         To perform dosimetric calculations using
C                                  the exposure calculation results calculated
C                                  with the ENV code for individuals
C                                  or population groups, acute or chronic,
C                                  as required for near-field and
C                                  far-field short-term scenarios.
C
C     Results format:              The output of DOSE is a report file
C                                  called DOSE.OUT.
C
C     Computer:                    This version is for the IBM PC/AT.
C
C     Programming language:        FORTRAN compiled using Lahey(tm)
C                                  FORTRAN Compiler.
C
C     Machine requirements:        IBM PC/AT with a minimum of 640 Kbytes
C                                  random access memory and 1 20-Mbyte fixed
```

```
C                                       disk drive.
C
C
C    Reference:                         B. A. Napier, R. A. Peloquin, D. L. Strenge,
C                                       and J. V. Ramsdell. 1988. "GENII - The
C                                       Hanford Environmental Radiation Dosimetry
C                                       Software System." PNL-6584, Volumes 1, 2,
C                                       and 3. Pacific Northwest Laboratory,
C                                       Richland, WA  99352
C
C
C-----------------------------------------------------------------------
C
      PROGRAM DOSE
C
C     This module controls reading of the input files, initializing
C     parameters, and indexing of the radionuclide chain and time step
C     loops.
C
C     Program of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Version of 31-May-88  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-------------------------------------------------------------------
C
C     ISEAS     - Season index for acute cases, 1-winter...
C
C-------------------------------------------------------------------

      INCLUDE 'LABELS.CMN'
      INCLUDE 'OPT.CMN'
      INCLUDE 'RADIN.CMN'
      INCLUDE 'TIMES.CMN'
      INCLUDE 'TITL.CMN'

      CHARACTER DUM*80

C     Get system time and read file names--
      CALL MAKDA2
      CALL OPNFIL (3,0,1)

C     Open various input files--
      CALL REDFIL

      IF (ACUTE) THEN

C       Determine if seasons needed--
```


9 1 0 4 8 1 1 4 5

```
      NSEAS = 1
      IF (TFOOD .OR. ANFOOD) NSEAS = 4

C     Reposition title to include season--
      IF (NSEAS .GT. 1) THEN
        DUM = TITLS(5) (1:70)
        WRITE (TITLS(5) (9:79), '(A70)') DUM
        TITLS(5) (7:8) = ': '
      ENDIF

C     Open workspace file--
      LUN2 = 7
      CALL OPNFIL (8,0,LUN2)

      DO 100 ISEAS = 1, NSEAS

C       Store season in title--
        IF (NSEAS .GT. 1) TITLS(5) (1:6) = SEALAB(ISEAS)

C       Calculate doses--
        CALL DOSCTL (LUN2, ISEAS)

C       Calculate totals, whole bode effective dose equivalents
C       and set flags--
        CALL TOTCAL

C       Print dose summary report--
        CALL DOSSUM

C       Print dose by pathway report--
        IF (OUTPTH) CALL RITBYP

C       Print dose by radionuclide reports--
        IF (OUTRAD .AND. NUCTOT .GT. 1) CALL RITBYR
        IF (OUTEDE .AND. NUCTOT .GT. 1) CALL RITEDE

  100 CONTINUE
      CLOSE (13)
      CLOSE (LUN2)

    ELSE

C     Calculate chronic doses--
      CALL DOSCTL (0,0)

C     Calculate totals, whole body effective dose equivalents and set
C     flags--
      CALL TOTCAL
```


9 1 0 4 8 1 1 4 6

```
C       Print dose summary report--
        CALL DOSSUM

C       Print dose by pathway report--
        IF (OUTPTH) CALL RITBYP

C       Print dose by radionuclide report--
        IF (OUTRAD .AND. NUCTOT .GT. 1) CALL RITBYR
        IF (OUTEDE .AND. NUCTOT .GT. 1) CALL RITEDE

        CLOSE (13)

      ENDIF
      CALL OPNFIL (9, 9, LUN)

      STOP

C-----------------------------------------------------------------------
      END
```

9 1 0 4 8 1 1 4 7

```
C-----------------------------------------------------------------
C
      SUBROUTINE DOSCAL (IN, INTDF)
C
C     This module calculates dose for each year for the given
C     environmental pathway and radionuclide, and then accumulates
C     dose by year, path, and radionuclide.
C
C     Module of Program DOSE of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 7-Jun-88  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-----------------------------------------------------------------
C
C     ADJUNT    - Dose unit adjustment factor for non-SI units,
C                 1.0 for Sv/Sv, 100.0 for rem/Sv
C     DOSINC    - Current dose increment, (Sv/Bq)
C     FIRST     - Flag cleared after first call to this subroutine
C     IDFIP     - Temporary parameter, IDF(IP)
C     IN        - Index of the current radionuclide in this case
C     IP        - Index of the current exposure pathway
C     NYRDC     - Number of years in dose commitment period, integer
C     NYRINT    - Integer value of the number of years of intake
C
C-----------------------------------------------------------------

      INCLUDE 'TIMES.CMN'
      INCLUDE 'OPT.CMN'
      INCLUDE 'DOSALL.CMN'
      INCLUDE 'DFPAR.CMN'
      INCLUDE 'INVIN.CMN'
      INCLUDE 'RADIN.CMN'
      INCLUDE 'ORGMAS.CMN'
      INCLUDE 'SOLPAR.CMN'

      REAL DOSINC, ADJUNT
      INTEGER NYRDC, NYRINT
      LOGICAL FIRST, INTDF(100)
      DATA FIRST /.TRUE./

      IF (FIRST) THEN

C       Initialize parameters--
        NYRINT = INT (NTKEND)
        NYRDC = INT (DCEND)

C       Set dose unit adjustment--
```

```
      IF (IUNIT .GT. 4) THEN
C       Units: Bq and Sv
        ADJUNT = 1.0
      ELSE
C       Units: Ci and rem
        ADJUNT = 100.0
      ENDIF
      ADJUNT = ADJUNT * NVU(IUNIT)

      FIRST = .FALSE.
    ENDIF

C   For each year of the dose commitment period--
    DO 110 IY = 1, NYRDC

      DO 170 IP = 1, NPATH
        IF (PATH(IP)) THEN
          IDFIP = IDF(IP)

C         For internal paths--
          IF (IDFIP .NE. 3) THEN
            IF (INTDF(IN)) THEN

              ID = IY
              IEND = IY
              IF (OUTEDE) IEND = 1

C             For each year of intake--
              DO 150 IE = 1, IEND

C               For each organ in the master list considered for this
C               radionuclide--

                DO 120 IO = 1, MORG
                  IF (IOR(IO)) THEN

                    DOSINC = 0.0

                    IF (IDFIP .EQ. 2) THEN
C                     Ingestion--
                      DF = DFG(ID,IO)
                    ELSE
C                     Inhalation--
                      DF = DFH(ID,IO)
                    ENDIF

C                   Calculate dose increment--
                    DOSINC = Q(IE,IP) * DF * ADJUNT
```

```
C                 Accumulate cumulative dose, "PABLM bits"--
                  DOSV(IO,IP) = DOSV(IO,IP) + DOSINC
                  DOSR(IO,IN) = DOSR(IO,IN) + DOSINC
                  DOSO2(IO) =DOSO2(IO) + DOSINC
                  CUMIOR(IO,IY) = CUMIOR(IO,IY) + DOSINC

C                 Accumulate EDE "bits"--
                  IF (IE .EQ. 1) THEN
                    DOSCDR(IO,IN) = DOSCDR(IO,IN) + DOSINC
                    DOSCDV(IO,IP) = DOSCDV(IO,IP) + DOSINC
                    DOSO1(IO) = DOSO1(IO) + DOSINC
                    IF (IDFIP .EQ. 1) THEN
C                     Inhalation--
                      DOSRP(IO,IN,1) = DOSRP(IO,IN,1) + DOSINC
                      CDEINH(IO) = CDEINH(IO) + DOSINC
                    ELSE
C                     Ingestion--
                      DOSRP(IO,IN,2) = DOSRP(IO,IN,2) + DOSINC
                      CDEING(IO) = CDEING(IO) + DOSINC
                    ENDIF
                  ENDIF

C                 Save yearly increment "bits" for summary report--
                  IF (IY .LT. 4 .AND. IE .LT. 4)
     .              SAVORG(IO,IE,IY) = SAVORG(IO,IE,IY) + DOSINC

                ENDIF
  120         CONTINUE

C             Next do the previous year--
              ID = ID - 1
  150       CONTINUE
          ENDIF

        ELSEIF (IY .LE. NYRINT) THEN

          DOSINC = 0.0

          IF (IP .EQ. 1) THEN

C           Air submersion--
            IF (FINITE) THEN
              DOSINC = Q(IY,IP) * NVU(IUNIT) * 1.0 / NVU(4)
            ELSE
C             Infinite plume--
              DOSINC = Q(IY,IP) * DAIT(IN) * ADJUNT
            ENDIF

          ELSEIF (IP .EQ. 3) THEN
```

```
C                   Surface soil exposure--
                    DOSINC = Q(IY,IP) * DSIT(IN) * ADJUNT

                  ELSEIF (IP .EQ. 14) THEN
C                   Swimming exposure--
                    DOSINC = Q(IY,IP) * DBIT(IN) * ADJUNT * SI2I

                  ELSEIF (IP .EQ. 15) THEN
C                   Boating exposure--
                    DOSINC = Q(IY,IP) * DBIT(IN) * ADJUNT

                  ELSEIF (IP .EQ. 16) THEN
C                   Shoreline exposure--
                    DOSINC = Q(IY,IP) * DSIT(IN) * ADJUNT

                  ELSEIF (IP .EQ. 22) THEN
C                   Deep soil exposure--
                    DOSINC = Q(IY,IP) * DDIT(IN,INDW) * ADJUNT

                  ELSEIF (IP .EQ. 23) THEN
C                   Buried waste exposure--
                    DOSINC = Q(IY,IP) * DDIT(IN,INDW) * ADJUNT

                  ENDIF

C                 External "PABLM bits"--
                  DOSRE(IN) = DOSRE(IN) + DOSINC
                  DOSVE(IP) = DOSVE(IP) + DOSINC

C                 External "AEDE bits"--
                  IF (IY .EQ. 1) THEN
                    DEX1R(IN) = DEX1R(IN) + DOSINC
                    DEX1V(IP) = DEX1V(IP) + DOSINC
                  ENDIF

C                 External by year--
                  EXTDOS(IY) = EXTDOS(IY) + DOSINC

                ENDIF

              ENDIF
  170       CONTINUE

  110     CONTINUE

          RETURN
C-------------------------------------------------------------------------
          END
```

```
C-----------------------------------------------------------------------
C
      SUBROUTINE DOSCTL (LUN2, ISEAS)
C
C     This module controls calculation of dose.  Doses calculated are
C     one year dose, external dose, maximum annual dose, cumulative
C     dose, and whole body effective dose equivalent.
C
C     Module of Program DOSE of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 29-Aug-88  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C     ALZERO    - Flag cleared if values in exposure array
C     FIRST     - Flag cleared after first season in an acute case,
C                 used to control reading of data sets
C     FOUND     - Flag set if dose factors are found for the current
C                 radionuclide in REDSET subroutine
C     IN        - Index of the current radionuclide in this case
C     IP        - Index of the current exposure pathway
C     LUN2      - Temporary file of unformatted dose rate factors,
C                 used for acute and summary cases
C
C-----------------------------------------------------------------------

      INCLUDE 'DFPAR.CMN'
      INCLUDE 'DOSALL.CMN'
      INCLUDE 'INVIN.CMN'
      INCLUDE 'OPT.CMN'
      INCLUDE 'ORGMAS.CMN'
      INCLUDE 'RADIN.CMN'
      INCLUDE 'SOLPAR.CMN'
      INCLUDE 'TIMES.CMN'

      LOGICAL FOUND, FIRST, INTDF(100)
      DATA FIRST /.TRUE./

      NYRINT = INT (NTKEND)

      IF (ACUTE) THEN

C        Rewind dose factor work file--
         REWIND (LUN2)

         IF (.NOT. FIRST) THEN
```

```
C         Reinitialize arrays--
          DO 152 IN = 1, NUCTOT
            DOSRE(IN) = 0.0
            DEX1R(IN) = 0.0
            DO 153 IO = 1, MORG
              DOSR(IO,IN) = 0.0
              DOSCDR(IO,IN) = 0.0
  153       CONTINUE
  152     CONTINUE

          DO 154 IP = 1, NPATH
            DOSVE(IP) = 0.0
            DEX1V(IP) = 0.0
            DO 155 IO = 1, MORG
              DOSV(IO,IP) = 0.0
              DOSCDV(IO,IP) = 0.0
  155       CONTINUE
  154     CONTINUE

          DO 156 IY = 1, 70
            EXTDOS(IY) = 0.0
            DO 157 IO = 1, MORG
              CUMIOR(IO,IY) = 0.0
  157       CONTINUE
  156     CONTINUE

          DO 158 IO = 1, MORG
            DOS01(IO) = 0.0
            DOS02(IO) = 0.0
            CDEINH(IO) = 0.0
            CDEING(IO) = 0.0
            DO 159 I = 1, 3
              DO 160 J = 1, 3
                SAVORG(IO,I,J) = 0.0
  160         CONTINUE
  159       CONTINUE
  158     CONTINUE

        ENDIF

C       For each radionuclide considered in this case--
        DO 132 IN = 1, NUCTOT

          IF (FIRST) THEN
C           Read from external files--
            FOUND = .FALSE.
            CALL REDSET (IN, FOUND, LUN2)
            IF (FOUND) THEN
              INTDF(IN) = .TRUE.
```

```
                  ELSE
                    INTDF(IN) = .FALSE.
                  ENDIF
                ELSE
C                 Read from work file--
                  READ (LUN2) DFH, DFG, IOR
                ENDIF

C               Read over radionuclide name from ENV file--
                READ (13, '(A)') DUM

C               For each selected environmental pathway--
                DO 142 IP = 1, NPATH
                  IF (PATH(IP) .OR. (IP .EQ. 1 .AND. FINITE)) THEN

C                   Read environmental exposure for current pathway for
C                   each year of intake--
                    READ (13,12) (Q(IE,IP),IE=1, NYRINT)

                  ENDIF
  142           CONTINUE

C               Calculate dose--
                CALL DOSCAL (IN, INTDF)

  132         CONTINUE
              FIRST = .FALSE.

            ELSE
C             Chronic exposure--

C             For each radionuclide considered in this case--
              DO 130 IN = 1, NUCTOT

C               Read data sets for this radionuclide--
                FOUND = .FALSE.

                IF (ELTI(IN) .EQ. 'KR' .OR. ELTI(IN) .EQ. 'XE'
                  .OR. ELTI(IN) .EQ. 'RN' .OR. ELTI(IN) .EQ. 'AR') THEN
                  INTDF(IN) = .FALSE.

                ELSE
                  CALL REDSET (IN, FOUND, LUN2)
                  IF (FOUND) THEN
                    INTDF(IN) = .TRUE.
                  ELSE
                    INTDF(IN) = .FALSE.
                  ENDIF
                ENDIF
```


9 1 0 4 8 1 1 5 4

```
C          Read over radionuclide name from ENV file--
           READ (13, '(A)') DUM

C          For each selected environmental pathway--
           DO 143 IP = 1, NPATH
             IF (PATH(IP) .OR. (IP .EQ. 1 .AND. FINITE)) THEN

C              Read environmental exposure for current pathway for
C              each year of intake--
               READ (13,12) (Q(IE,IP),IE=1, NYRINT)
             ENDIF
  143      CONTINUE

C          Calculate doses--
           CALL DOSCAL (IN,INTDF)

  130    CONTINUE

       ENDIF
       RETURN

C---- Format Statements ------------------------------------------

   12 FORMAT (9X, 8E8.1, / 9(9x, 8E8.1/))

C---------------------------------------------------------------
       END
```

```
C-----------------------------------------------------------------------
C
      SUBROUTINE DOSSUM
C
C     This module prints the dose summary and whole body EDE reports
C
C     Module of Program DOSE of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 2-Aug-88  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-------------------------------------------------------------------
C
C     IN          - Index of the current radionuclide in this case
C     IP          - Index of the current exposure pathway
C     L()         - Array of lines (78 characters each) containing
C                   text of dose summary report
C     NL          - Number of lines in dose summay text array
C     NIO         - Number of organs for which data is to be printed in
C                   the whole body EDE report, NIO <= 11
C     DOSMAX      - Largest organ contribution to EDE
C     IOMAX       - Index of organ with largest contribution to EDE
C
C-------------------------------------------------------------------

      INCLUDE 'DAYPC.CMN'
      INCLUDE 'DOSALL.CMN'
      INCLUDE 'OPT.CMN'
      INCLUDE 'ORGMAS.CMN'
      INCLUDE 'RADIN.CMN'
      INCLUDE 'TIMES.CMN'
      INCLUDE 'TITL.CMN'

      CHARACTER L(50)*78, DUM*3, DASH1*50, DASH2*50, UN1*1, UN2*3,
     .          UN3(4)*3, PORG*8
      INTEGER NL, NIO

      DATA UN3 /'Inh','Ing','Ext','   '/, PORG /'        '/
      DATA DASH1 /'--------------  ----------  ---------  ----------'/
      DATA DASH2 /'--------------------------------------------------'/
      DATA NL /28/

      IF (POPDOS) THEN
        UN1 = 'P'
      ELSE
        UN1 = ' '
      ENDIF
```


91048 1 1 56

```
      IF (IUNIT .LT. 5) THEN
        UN2 = 'rem'
      ELSE
        UN2 = 'Sv'
      ENDIF

C---- Determine no. of organs to print, controlling organ---------------

      NIO = 0
      MAXO = 0
      OMAX = 0.0

      DO 306 IO = 1, 11
        IF (ICDE(IO) .GT. 0) NIO = NIO + 1
        IF (CDE(IO) .GT. OMAX) THEN
          OMAX = CDE(IO)
          MAXO = IO
        ENDIF
  306 CONTINUE

      IF (MAXO .GT. 0) PORG = MASORG(ICDE(MAXO))

C---- Write quality assurance one-line report -------------------------

      CALL MAKDA2
      LUN = 39
      CALL OPNFIL (5, 0, LUN)
      WRITE (LUN,5) TITLS(5) (1:18), EDEINH, EDEING, EXTDOS(1), EDE,
     .              AEDEQ, UN1, UN2, PORG(1:3), UN3(MAXP),
     .              ELTT(MAXR), AWT(MAXR)(1:4), TODAY(1:8), CLOCK(1:5),
     .              NEAR, ACUTE, POPDOS, PATH, INT(NTKEND),
     .              INT(RELEND), INT(DCEND)
      CLOSE (LUN)

C---- Read DOSSUM text file -------------------------------------------

      LUN = 12
      CALL OPNFIL (1,0,LUN)
      READ (LUN,'(A/A/A)') DUM, DUM, DUM

      DO 100 I = 1, NL
        READ (LUN,'(A3,A77)') DUM, L(I)
C       IF (DEBUG) WRITE (*,*) L(I)
  100 CONTINUE
      CLOSE (LUN)

C---- Write whole body EDE report -------------------------------------

      LUN = 14
```

```
      IF (EDE .GT. 0.0) THEN
        CALL SUBHED (1, ILINE)
        WRITE (LUN,1110) DASH1
        DO 304 IO = 1, NIO

          IF (IO .EQ. 1) THEN
            WRITE (LUN,1114) 'Gonads  ', CDE(IO), WT(IO), WDE(IO)
          ELSEIF (IO .EQ. 2) THEN
            WRITE (LUN,1114) 'Breast  ', CDE(IO), WT(IO), WDE(IO)
          ELSE
            WRITE (LUN,1114) MASORG(ICDE(IO)), CDE(IO), WT(IO), WDE(IO)
          ENDIF

  304   CONTINUE
        WRITE (LUN,1112) DASH2, EDE, EXTDOS(1), DASH2, AEDEQ
        WRITE (LUN,1113) DASH2, MASORG(ICDE(MAXO)), UN3(MAXP),
     .                   ELTT(MAXR), AWT(MAXR), EDEINH, EDEING,
     .                   DASH2
      ENDIF

C---- Print grid report ---------------------------------------------

C     Store internal dose increments into character array--
      WRITE (L(10) (15:21), 1) SAVINC(1,1)
      WRITE (L(10) (25:31), 1) SAVINC(1,2)
      WRITE (L(10) (35:41), 1) SAVINC(1,3)
      WRITE (L( 8) (25:31), 1) SAVINC(2,2)
      WRITE (L( 8) (35:41), 1) SAVINC(2,3)
      WRITE (L( 6) (35:41), 1) SAVINC(3,3)

C     Store internal annual dose into character array--
      WRITE (L(14) (15:21), 1) CUMIYR(1)
      WRITE (L(14) (25:31), 1) CUMIYR(2)
      WRITE (L(14) (35:41), 1) CUMIYR(3)

C     Store external annual dose into character array--
      WRITE (L(18) (15:21), 1) EXTDOS(1)
      WRITE (L(18) (25:31), 1) EXTDOS(2)
      WRITE (L(18) (35:41), 1) EXTDOS(3)

C     Store annual dose into character array--
      WRITE (L(22) (15:21), 1) ANNULD(1)
      WRITE (L(22) (25:31), 1) ANNULD(2)
      WRITE (L(22) (35:41), 1) ANNULD(3)

C     Store effective dose equivalent--
      WRITE (L(10) (53:59), 1) EDE
```

9 1 0 4 8 1 1 5 8

```
C     Store cumulative internal dose--
      WRITE (L(14) (53:59), 1) CUMID

C     Store external dose--
      WRITE (L(18) (53:59), 1) EXTD

C     Store cumulative dose--
      WRITE (L(22) (53:59), 1) CUMD

C     Store maximum annual dose and year--
      WRITE (L(25) (53:59), 1) MAXD
      WRITE (L(27) (70:72),'(I3)') MAXYR

C     Write summary report--
      CALL SUBHED (2, ILINE)
      WRITE (LUN,'(///)')

      DO 200 I = 1, NL
        WRITE (LUN,'(1X,A)') L(I)
  200 CONTINUE

      RETURN

C---- Format Statements ------------------------------------------------

    1 FORMAT (1PE7.1)
    5 FORMAT (A18,':', 1P, 5E8.1, 0P,1X, A1,A3, 1X, A3, 1X, A3, 1X,
     .                 A2, A4, 1X, A8, 1X, A5, 1X, 3L1, 1X, 24L1, 3I2)
 1004 FORMAT (' ',A1,I3,1P, 15E8.1E2)
 1110 FORMAT (///,
     .       T10,'                 Committed                  Weighted'/
     .       T10,'                   Dose      Weighting       Dose'/
     .       T10,'    Organ        Equivalent   Factors     Equivalent'/
     .       ' ',T10,A50)
 1112 FORMAT (' ',T10,A50/
     .        T10,'Internal Effective Dose Equivalent',T48,1P,E9.1E2/
     .        T10,'External Dose',T48,E9.1E2/' ',T10,A50,/
     .        T10,'Annual Effective Dose Equivalent',
     .        T48,E9.1E2////////)
 1113 FORMAT (' ',T10,A50/
     .        T10,'Controlling Organ:',T50,A8/
     .        T10,'Controlling Pathway:',T50,A3/
     .        T10,'Controlling Radionuclide:',T50,A2,A6//
     .        T10,'Inhalation EDE:',T48,1P,E9.1/
     .        T10,'Ingestion EDE: ',T48,E9.1/
     .        T10,A50)
 1114 FORMAT (' ',T10,A12,4X,1P,3(E9.1E2,2X))
C----------------------------------------------------------------------
      END
```


9 1 0 4 8 1 1 5 9

```
C-----------------------------------------------------------------------
C
      SUBROUTINE REDFIL
C
C     This module controls reading of the environmental exposure and dose
C     rate factors yearly increments from input files.
C
C     Module of Program DOSE of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 11-Aug-88 RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C------------------------------------------------------------------
C
C     E           - Input element symbol
C     A           - Input isotopic number plus optional metastable spec-
C                   ification
C     DAIN        - Input external dose rate factor for air submersion
C     DBIN        - Input external dose factor for immersion in water
C     DSIN        - Input external dose factor for exposure to contaminated
C                   surface soil
C     DD15IN      - Input external dose factor for exposure to contaminated
C                   soil or waste with a 15 cm overburden of soil
C     DD50IN      - Input external dose factor for exposure to contaminated
C                   soil or waste with a 50 cm overburden of soil
C     DD100I      - Input external dose factor for exposure to contaminated
C                   soil or waste with a 100 cm overburden of soil
C     DUM         - Dummy input variable
C     DUM2        - Character input checking for 'ORGAN' in default parameter
C                   input file
C     IN          - Index of the current radionuclide in this case
C     IP          - Index of the current exposure pathway
C     LUN2        - Logical unit number of the default parameter input file
C     RTEMP       - Temporary REAL input parameter
C     TEMP()      - Temporary REAL input parameter array
C     0.15        - m3/m2 conversion
C
C------------------------------------------------------------------

      INCLUDE 'AIRPAR.CMN'
      INCLUDE 'AFPPAR.CMN'
      INCLUDE 'DFPAR.CMN'
      INCLUDE 'FILES.CMN'
      INCLUDE 'LABELS.CMN'
      INCLUDE 'OPT.CMN'
      INCLUDE 'ORGMAS.CMN'
      INCLUDE 'RADIN.CMN'
      INCLUDE 'SOLPAR.CMN'
```

```
      INCLUDE 'TIMES.CMN'
      INCLUDE 'TITL.CMN'

      CHARACTER DUM*1, E*2, A*6, DUM2*5
      REAL DAIN, DBIN, DSIN, DD15IN, DD50IN, DD100I, RTEMP, TEMP(11)

C---- Read options from ENV input file -------------------------------

      LUN = 11
      CALL OPNFIL (4, 0, LUN)
      READ (LUN,'(A)',ERR=98,END=99) DUM
      READ (LUN,*) OUTEDE, OUTRAD, OUTPTH, DEBUG,
     .             NEAR, POPDOS, ACUTE, ONEDOS, AEDE, MAXDOS, CUMDOS,
     .             DOSTYP, RELTRM, BASIC, DERIVE, AIRCN, DEEP, FINITE

      READ (LUN,*) NCHAIN, IUNIT, SOLUNT, NUCTOT, POPOPT, POPT
      READ (LUN,*) (IOFNUC(I), I=1,NCHAIN)
      READ (LUN,72) (ELTT(IN), AWT(IN),IN=1,NUCTOT)
   72 FORMAT (9(A2,A6)/)

      READ (LUN,*) AIR, SWAT, BIOT, BURWAS
      READ (LUN,*) PATH, RECRE, AQFOOD, TFOOD, ANFOOD
      READ (LUN,*) NTKEND, DCEND, RELEND, BEFAIR, BEFIRR
      IF (NEAR) READ (LUN,*) BEFORE, LOIC, RF1, RF2, MANULR

      READ (LUN,*) NDIST
      BACKSPACE (LUN)
      IF (NDIST .GT. 5) THEN
        READ (LUN,*) ITEMP, (X(I),I=1,5)
        READ (LUN,*) (X(I),I=6,NDIST)
      ELSE
        READ (LUN,*) ITEMP, (X(I),I=1,NDIST)
        READ (LUN,'(A)') DUM
      ENDIF

      IF (AIR) THEN
        READ (LUN,*) STACK, XOQOPT, SHITE, SFLOW, XOQI, SRAD
        READ (LUN,*) ETEMP, MIDIST, MIDIR, EFFSTK, JFIN, TTAIRI, MIUBAR
        READ (LUN,*) TPOPS, (TTAIR(I),I=1,NDIST)
        IF (.NOT. POPDOS) THEN
          IF (FINITE) READ (LUN,*) (DRFSAV(J),J=1,6)
        ELSEIF (XOQOPT .GT. 1) THEN
          IF (FINITE) THEN
            READ (LUN,*) ((PWTX(I,J), J=1,6), I=1,10)
          ELSE
            READ (LUN,*)  (PWT(I),I=1,NDIST)
          ENDIF
        ENDIF
      ENDIF
```


9 1 0 4 8 1 1 6 1

```
      IF (SWAT) THEN
        READ (LUN,*) MIXFLG, MIXR, SWFLOW, SWTT
        IF (MIXFLG .GT. 0) READ (LUN,*)
     .                   SWQB, SWLSX, SWOSY, SWDPTH, SWIDTH, SWDZ
      ENDIF

      IF (BURWAS .OR. BIOT .OR. DEEP)
     .  READ (LUN,*) PACKHL, WASDEP, OVRBRD

      CLOSE (11)

C     Set overburden index--
      CALL BIOCAL
      IF (INDW .GT. 3) INDW = 3

C     Set plume flag if finite plume--
      IF (FINITE) PATH(1) = .TRUE.

C     Set times--
      NTIME = INT(DCEND)

C---- Open environmental exposure rate file, store and read over -------
C     headings--

      LUN = 13
      CALL OPNFIL (4,0,LUN)

C     If files do not match, stop--
      IF (TITLS(11) .NE. TITLS(13)) GOTO 91

C---- Open internal dose rate factor file and store title -------------

C     CALL OPNFIL (4,0,37)
C     CLOSE (37)
      CALL OPNFIL (6,0,40)

C---- Read external exposure dose rate factors ------------------------
C
      NC=1
      IFLG1=0

  150 CONTINUE
      LUN = 10
      CLOSE (LUN)
      CALL OPNFIL (4,0,LUN)
      READ (LUN,111,ERR=98,END=99) DUM, DUM, DUM
```


9 1 0 4 8 1 1 6 2

```
 151 CONTINUE

        READ(LUN,3,ERR=98,END=153) E, A, DAIN, DBIN, DSIN, DD15IN,
    .     DD50IN, DD100I

        IF (E .EQ. ELTT(NC) .AND. A .EQ. AWT(NC)) THEN
          DAIT(NC) = DAIN
          DBIT(NC) = DBIN
          DSIT(NC) = DSIN / 0.15
          DDIT(NC,1) = DD15IN
          DDIT(NC,2) = DD50IN
          DDIT(NC,3) = DD100I
          NC = NC+1
          IF (NC .GT. NUCTOT) GOTO 155
        ENDIF
        GOTO 151

 153    CONTINUE
          IF (IFLG1 .EQ. 0) THEN
          IFLG1 = 1
        ELSE
C         No information this radionuclide
          IFLG1 = 0
          NC = NC + 1
        ENDIF

      IF (NC .LE. NUCTOT) GOTO 150
 155 CLOSE (LUN)

C---- Open output file -------------------------------------------------

      LUN = 14
      CALL OPNFIL (2,0,LUN)

C---- Read from default parameter file ---------------------------------

      LUN2  = 22
      OPEN (LUN2, FILE=FILN(LUN2), STATUS='OLD', IOSTAT=IOS)
      IF (IOS .NE. 0) GOTO 97

 301 CONTINUE
        READ (LUN2,1,ERR=98,END=99) DUM2
      IF (DUM2 .NE. 'DOSE ') GOTO 301

      READ (LUN2,*,ERR=98,END=99) (TEMP(I), I=1,11)
      DO 302 I = 1, 11
        IF (TEMP(I) .NE. WT(I)) THEN
          WRITE (LUN,10) WT(I), TEMP(I), I
          WT(I) = TEMP(I)
```


9 1 0 4 8 1 1 6 3

```
           ENDIF
  302 CONTINUE

        READ (LUN2,*) RTEMP
        IF (RTEMP .NE. SI2I) THEN
          WRITE (LUN,20) SI2I, RTEMP, 'SI2I'
          SI2I = RTEMP
        ENDIF
        CLOSE (LUN2)

        RETURN

C---- Format Statements -------------------------------------------

    1 FORMAT (A5)
    3 FORMAT (A2, A6, E8.2, 5( 2X, E8.2))
   10 FORMAT (' Default weight changed from ',1P,E9.1,' to ',E9.1,
     .        ' for organ ',I2)
   20 FORMAT (' Default value changed from ',1P,E9.1,' to ',E9.1,
     .        ' for parameter ',A10)
  111 FORMAT (A1/A1/A1)

C---- Error Messages ----------------------------------------------

   91 WRITE (*,*) 'File titles do not match, LUN 11 and 13.'
      WRITE (*,*) '  Assumed to be invalid case.'
      CALL EXIT (1)

   97 CALL FILERR (1, LUN2, 'In REDFIL    ')
   98 CALL FILERR (2, LUN, 'In REDFIL    ')
   99 CALL FILERR (3, LUN, 'In REDFIL    ')

C------------------------------------------------------------------
        END
```

```
C---------------------------------------------------------------------
C
      SUBROUTINE REDSET (IN, FOUND, LUN2)
C
C     This module reads a data sets of inhalation and ingestion dose rate
C     factor yearly increments and exposure by year of intake and
C     pathway for the current radionuclide.
C
C     Module of Program DOSE of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 18-Apr-88 RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C---------------------------------------------------------------------
C
C     FOUND     - Flag set if data set was found for the current
C                 radionuclide
C     IN        - Index of the current radionuclide in this case
C     NGORG()   - Number of years of ingestion df's for each organ
C     NHORG()   - Number of years of inhalation df's for each organ
C
C---------------------------------------------------------------------

      INCLUDE 'OPT.CMN'
      INCLUDE 'DFPAR.CMN'
      INCLUDE 'RADIN.CMN'
      INCLUDE 'ORGMAS.CMN'
      INCLUDE 'TIMES.CMN'

      INTEGER NGORG(25), NHORG(25), LUN2, NYRINT
      REAL DFGIN(70,25), DFHIN(70,25)
      CHARACTER E*2, A*6
      LOGICAL FOUND, FIRST, CHKNEXT

      DATA FIRST /.TRUE./
      LUN = 40
      CHKNEXT = .TRUE.

C     Initialize dose factor arrays--
      DO 402 IO = 1, MORG
        DO 400 IY = 1, 70
          DFG(IY,IO) = 0.0
          DFH(IY,IO) = 0.0
 400    CONTINUE
 402  CONTINUE

C     Check for noble gases, no internal dose factors--
```


9 1 0 4 8 1 1 6 5

```
      IF (ELTT(IN) .EQ. "KR" .OR. ELTT(IN) .EQ. "XE" .OR.
     .    ELTT(IN) .EQ. "AR" .OR. ELTT(IN) .EQ. "RN") GOTO 701

  151 CONTINUE

        READ (LUN,END=700) E, A,
     .               (NGORG(IO),IO=1,23), (NHORG(IO),IO=1,23),
     .               ((DFGIN(IY,IO),IY=1,NGORG(IO)),IO=1,23),
     .               ((DFHIN(IY,IO),IY=1,NHORG(IO)),IO=1,23)

        IF (E .EQ. ELTT(IN) .AND. A .EQ. AWT(IN)) THEN

          FOUND = .TRUE.

          DO 200 IO = 1, 23
            DO 201 IY = 1, NGORG(IO)
              DFG(IY,IO) = DFGIN(IY,IO)
  201       CONTINUE
            DO 202 IY = 1, NHORG(IO)
              DFH(IY,IO) = DFHIN(IY,IO)
  202       CONTINUE
  200     CONTINUE

          IF (DEBUG) THEN
            WRITE (*,'(3A)') 'Dose factors for:',E, A
            WRITE (*,*) (NGORG(IO),IO=1,23)
            WRITE (*,*) (NHORG(IO),IO=1,23)
            DO 155 IO = 1, 23
              IF (NGORG(IO) .GT. 0)
     .          WRITE (*,*) 'Ing:',IO, (DFG(IY,IO),IY=1,NGORG(IO))
              IF (NHORG(IO) .GT. 0)
     .          WRITE (*,*) 'Inh:',IO, (DFH(IY,IO),IY=1,NHORG(IO))
  155       CONTINUE
          ENDIF

C         Set organ flags and initialize maximum year arrays--
          DO 132 IO = 1, MORG
            IF (NGORG(IO) .GT. 0 .OR. NHORG(IO) .GT. 0) THEN
              IOR(IO) = .TRUE.
            ELSE
              IOR(IO) = .FALSE.
            ENDIF
  132     CONTINUE

C         Set remaining organs to "Other"--
          DO 300 IO = 15, 22
            IF (DFG(1,IO) .EQ. 0.0) THEN
              DO 302 IY = 1, NGORG(23)
                DFG(IY,IO) = DFG(IY,23)
```


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```
  302         CONTINUE
              DO 304 IY = 1, NHORG(23)
                DFH(IY,IO) = DFH(IY,23)
  304         CONTINUE
            ENDIF
  300     CONTINUE

          GOTO 135
        ELSE

C         If current radionuclide not next data set, rewind file--
          IF (CHKNEXT) THEN
            REWIND LUN
            CHKNEXT = .FALSE.
          ENDIF

        ENDIF
      GOTO 151

C     Data set not found--
  700 CONTINUE
      REWIND LUN
      IF (CHKNEXT) THEN
        CHKNEXT = .FALSE.
        GOTO 151
      ENDIF

  701 CONTINUE
C     Data set not found, or noble gas--
      DO 134 IO = 1, MORG
        IOR(IO) = .FALSE.
  134 CONTINUE

      WRITE (*,*) 'Internal dose factors not found for ',
     .            ELTT(IN),AWT(IN)

  135 CONTINUE
C     Read exposure file--

      IF (FIRST) THEN
C       Read over heading in quantity file--
        REWIND (13)
        READ (13, '(A)') DUM
        READ (13, '(A)') DUM
        DO 136 IP = 1, NPATH
          IF (PATH(IP) .OR. (IP .EQ. 1 .AND. FINITE))
     .      READ (13,'(A)') DUM
  136   CONTINUE
        NYRINT = INT (NTKEND)
```

```
      FIRST = .FALSE.
    ENDIF

    IF (ACUTE .AND. (TFOOD .OR. ANFOOD)) WRITE (LUN2) DFH, DFG, IOR

    RETURN

C-----------------------------------------------------------------------
    END
```

```
C----------------------------------------------------------------------
C
      SUBROUTINE RITBYP
C
C     This module writes a report of dose by exposure pathway.
C
C     Module of Program DOSE of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 31-May-88  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C----------------------------------------------------------------------
C
C     DOEXT      - Flag set if any external pathways are considered
C     IEND       - Loop terminating index, used to print only CDE reports
C                  if only AEDE was requested
C     ILINE      - Number of data lines this page
C     IP         - Index of the current exposure pathway
C     NA         - Number of organs to be printed this data set, used to
C                  control printing of dashes
C     NL         - Intermediate organ index for printing
C
C----------------------------------------------------------------------

      INCLUDE 'OPT.CMN'
      INCLUDE 'ORGMAS.CMN'
      INCLUDE 'TIMES.CMN'
      INCLUDE 'DOSALL.CMN'
      INCLUDE 'LABELS.CMN'

      INTEGER NL, ILINE, IEND
      LOGICAL DOEXT

      IF (OUTEDE) THEN
        IEND = 1
      ELSE
        IEND = 2
      ENDIF

C---- Loop through subroutine for each dose type ---------------------

      DO  100 ITYP = 1, IEND

C     External dose only--
      IF (NORGS .EQ. 0) GOTO 201

      CALL SUBHED (2, ILINE)
```

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```
C     Write internal dose report--

      IF (ITYP .EQ. 1) THEN
         WRITE (LUN,1021)
      ELSEIF (ITYP .EQ. 2) THEN
         WRITE (LUN,1022)
      ENDIF

      WRITE (LUN,1003) (MASORG(ICLN(IO)),IO=1,8)
      WRITE (LUN,1002) DASHES
      DO 141 IP = 1, NPATH
        IF (PATH(IP) .AND. IDF(IP) .LT. 3) THEN
          IF (ITYP .EQ. 1) THEN
            WRITE (LUN,1006) EXPLAB(IP), (DOSCDV(ICLN(IO),IP),IO = 1, 8)
          ELSEIF (ITYP .EQ. 2) THEN
            WRITE (LUN,1006) EXPLAB(IP), (DOSV(ICLN(IO),IP),IO = 1, 8)
          ENDIF
          ILINE = ILINE + 1
        ENDIF
  141 CONTINUE

      WRITE (LUN,1002) DASHES
      IF (ITYP .EQ. 1) THEN
        WRITE (LUN,1007) (DOSO1(ICLN(IO)),IO=1,8)
      ELSEIF (ITYP .EQ. 2) THEN
        WRITE (LUN,1007) (DOSO2(ICLN(IO)),IO=1,8)
      ENDIF

      NL = 16
      IF (NORGS .LT. NL) NL = NORGS
      NA = NORGS-6
      IF (NA .GT. 10) NA = 10

      WRITE (LUN,1003) (MASORG(ICLN(IO)),IO=9,NL)
      WRITE (LUN,1002) (DASHES(I),I=1,NA)
      DO 142 IP = 1, NPATH
        IF (PATH(IP) .AND. IDF(IP) .LT. 3) THEN
          IF (ITYP .EQ. 1) THEN
            WRITE (LUN,1006) EXPLAB(IP), (DOSCDV(ICLN(IO),IP),IO=9,NL)
          ELSEIF (ITYP .EQ. 2) THEN
            WRITE (LUN,1006) EXPLAB(IP), (DOSV(ICLN(IO),IP),IO=9,NL)
          ENDIF
          ILINE = ILINE + 1
        ENDIF
  142 CONTINUE
      WRITE (LUN,1002) (DASHES(I),I=1,NA)
      IF (ITYP .EQ. 1) THEN
        WRITE (LUN,1007) (DOSO1(ICLN(IO)),IO=9,NL)
      ELSEIF (ITYP .EQ. 2) THEN
```

9 1 0 4 8 1 1 7 0

```
        WRITE (LUN,1007) (DOSO2(ICLN(IO)),IO=9,NL)
      ENDIF


      IF (NL  .GT. 16) THEN
        IF (ILINE .GT. 24) CALL SUBHED (2, ILINE)
        NL = 24
        IF (NORGS .LT. NL) NL = NORGS
        NA = NORGS - 14

        WRITE (LUN,1003) (MASORG(ICLN(IO)),IO=17,NL)
        WRITE (LUN,1002) (DASHES(I),I=1,NA)
        DO 143 IP = 1, NPATH
          IF (PATH(IP) .AND. IDF(IP) .LT. 3) THEN
            IF (ITYP .EQ. 1) THEN
              WRITE (LUN,1006) EXPLAB(IP),
     .                           (DOSCDV(ICLN(IO),IP),IO=17,NL)
            ELSEIF (ITYP .EQ. 2) THEN
              WRITE (LUN,1006) EXPLAB(IP), (DOSV(ICLN(IO),IP),IO=17,NL)
            ENDIF
            ILINE = ILINE + 1
          ENDIF
  143   CONTINUE

        WRITE (LUN,1002) (DASHES(I),I=1,NA)
        IF (ITYP .EQ. 1) THEN
          WRITE (LUN,1007) (DOSO1(ICLN(IO)),IO=17,NL)
        ELSEIF (ITYP .EQ. 2) THEN
          WRITE (LUN,1007) (DOSO2(ICLN(IO)),IO=17,NL)
        ENDIF

        IF (NORGS .GT. 24) WRITE (LUN,'(2A)')
     .         'Data not printed for organ ',MASORG(ICLN(NORGS))
      ENDIF

      IF (ILINE .GT. 30) THEN
        CALL SUBHED (2, ILINE)

        ILINE = 0
      ENDIF

C     Write external dose report--
  201 CONTINUE

C     Check if external exposure considered--
      DOEXT = .FALSE.
      DO 151 IP = 1, NPATH
        IF (IDF(IP) .EQ. 3) DOEXT = .TRUE.
  151 CONTINUE
```


9 1 0 4 8 1 1 7 1

```
      IF (DOEXT) THEN
        WRITE (LUN,1011)
        WRITE (LUN,1003)
        WRITE (LUN,1002) (DASHES(I),I=1,3)
        ILINE = ILINE + 8

        DO 150 IP = 1, NPATH
          IF (PATH(IP) .AND. IDF(IP) .EQ. 3) THEN

            IF (ITYP .EQ. 1) THEN
               WRITE (LUN,1006) EXPLAB(IP), DEX1V(IP)
            ELSEIF (ITYP .EQ. 2) THEN
              WRITE (LUN,1006) EXPLAB(IP), DOSVE(IP)
            ENDIF
          ENDIF
  150   CONTINUE

        WRITE (LUN,1002) (DASHES(I),I=1,3)
        IF (ITYP .EQ. 1) THEN
          WRITE (LUN,1007) EXTDOS(1)
        ELSEIF (ITYP .EQ. 2) THEN
          WRITE (LUN,1007) EXTD
        ENDIF

      ENDIF

  100 CONTINUE

      RETURN

C---- Format Statements -----------------------------------------------

 1002 FORMAT (' ',10A8)
 1003 FORMAT (' Pathway            ',8(A7,1X))
 1004 FORMAT (//' Pathway           ',25I3/)
 1005 FORMAT (' ',A8,8X,25I3)
 1006 FORMAT (' ',A8,8X,1P, 8E8.1E2)
 1007 FORMAT (' Total    ',8X,1P, 8E8.1//)
 1009 FORMAT (' Total internal  ',1P, 8E8.1)
 1011 FORMAT (////,T25,'External Dose by Exposure Pathway',/)
 1012 FORMAT (' External dose   ',1P, 8E8.1)

 1021 FORMAT (//,T20,'Committed Dose Equivalent by Exposure Pathway',/)
 1022 FORMAT (//,T14,'Cumulative Internal Dose to Organs by Exposure ',
     .               'Pathway',/)

C----------------------------------------------------------------------
      END
```

```
C------------------------------------------------------------------------
C
      SUBROUTINE RITBYR
C
C     This module writes a report of dose by radionuclide.
C
C     Module of Program DOSE of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 31-May-88  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C------------------------------------------------------------------
C
C     IN        - Index of the current radionuclide
C     NL        - Intermediate organ index for printing
C     ILINE     - Number of data lines this page
C     NA        - Number of organs to be printed this data set, used to
C                 control printing of dashes
C     IEND      - Loop terminating index, used to print only CDE reports
C                 if only AEDE was requested
C
C------------------------------------------------------------------

      INCLUDE 'ORGMAS.CMN'
      INCLUDE 'TIMES.CMN'
      INCLUDE 'DOSALL.CMN'
      INCLUDE 'LABELS.CMN'
      INCLUDE 'OPT.CMN'
      INCLUDE 'RADIN.CMN'

      INTEGER NL, ILINE, IEND, NSET, ISET, ISTART, ISTOP, MAXLIN

      IF (OUTEDE) THEN
        IEND = 1
      ELSE
        IEND = 2
      ENDIF

      MAXLIN = 38
      NSET = NUCTOT / MAXLIN
      IDD = MOD (NUCTOT, MAXLIN)
      IF (IDD .GT. 0) NSET = NSET + 1

C     Break radionuclides into pages--
      DO 200 ISET = 1, NSET

        ISTART = (ISET - 1) * MAXLIN + 1
        ISTOP = ISET * MAXLIN
```

```
      IF (ISTOP .GT. NUCTOT) ISTOP = NUCTOT

C------ Loop through subroutine for each dose type ----------------------

      DO 110 ITYP = 1, IEND

C        External dose only--
         IF (NORGS .EQ. 0) GOTO 100

         CALL SUBHED (2, ILINE)

C        Write internal report--

         IF (ITYP .EQ. 1) THEN
           WRITE (LUN,1021)
         ELSEIF (ITYP .EQ. 2) THEN
           WRITE (LUN,1022)
         ENDIF

         WRITE (LUN,1003) (MASORG(ICLN(IO)),IO=1,8)
         WRITE (LUN,1002) DASHES

         DO 141 IN = ISTART, ISTOP
           IF (ITYP .EQ. 1) THEN
             WRITE (LUN,1006) ELTT(IN), AWT(IN),
     .                        (DOSCDR(ICLN(IO),IN),IO=1,8)
           ELSEIF (ITYP .EQ. 2) THEN
             WRITE (LUN,1006) ELTT(IN), AWT(IN),
     .                        (DOSR(ICLN(IO),IN),IO=1,8)
           ENDIF
  141    CONTINUE

         WRITE (LUN,1002) DASHES
         IF (ISET .EQ. NSET) THEN
           IF (ITYP .EQ. 1) THEN
             WRITE (LUN,1007) (DOSO1(ICLN(IO)),IO=1,8)
           ELSEIF (ITYP .EQ. 2) THEN
             WRITE (LUN,1007) (DOSO2(ICLN(IO)),IO=1,8)
           ENDIF
         ENDIF

         NL = 16
         IF (NORGS .LT. NL) NL = NORGS
         NA = NORGS-6
         IF (NA .GT. 10) NA = 10

         IF (NUCTOT .GT. 15) THEN
           CALL SUBHED (2, ILINE)
           IF (ITYP .EQ. 1) THEN
```

```
         WRITE (LUN,1021)
       ELSEIF (ITYP .EQ. 2) THEN
         WRITE (LUN,1022)
       ENDIF
     ENDIF

     WRITE (LUN,1003) (MASORG(ICLN(IO)),IO=9,NL)
     WRITE (LUN,1002) (DASHES(I),I=1,NA)

     DO 142 IN = ISTART, ISTOP
       IF (ITYP .EQ. 1) THEN
         WRITE (LUN,1006) ELTT(IN), AWT(IN),
    .                     (DOSCDR(ICLN(IO),IN),IO=9,NL)
       ELSEIF (ITYP .EQ. 2) THEN
         WRITE (LUN,1006) ELTT(IN), AWT(IN),
    .                     (DOSR(ICLN(IO),IN),IO=9,NL)
       ENDIF
142  CONTINUE

     WRITE (LUN,1002) (DASHES(I),I=1,NA)
     IF (ISET .EQ. NSET) THEN
       IF (ITYP .EQ. 1) THEN
         WRITE (LUN,1007) (DOSO1(ICLN(IO)),IO=9,NL)
       ELSEIF (ITYP .EQ. 2) THEN
         WRITE (LUN,1007) (DOSO2(ICLN(IO)),IO=9,NL)
       ENDIF
     ENDIF

     IF (NL  .GT. 16) THEN
       IF (NUCTOT .GT. 15) THEN
         CALL SUBHED (2, ILINE)
         IF (ITYP .EQ. 1) THEN
           WRITE (LUN,1021)
         ELSEIF (ITYP .EQ. 2) THEN
           WRITE (LUN,1022)
         ENDIF
       ENDIF

       NL = 24
       IF (NORGS .LT. NL) NL = NORGS
       NA = NORGS - 14

       WRITE (LUN,1003) (MASORG(ICLN(IO)),IO=17,NL)
       WRITE (LUN,1002) (DASHES(I),I=1,NA)

       DO 143 IN = ISTART, ISTOP
         IF (ITYP .EQ. 1) THEN
           WRITE (LUN,1006) ELTT(IN), AWT(IN),
    .                       (DOSCDR(ICLN(IO),IN),IO=17,NL)
```

```
            ELSEIF (ITYP .EQ. 2) THEN
              WRITE (LUN,1006) ELTT(IN), AWT(IN),
     .                         (DOSR(ICLN(IO),IN),IO=17,NL)
            ENDIF
  143     CONTINUE

          WRITE (LUN,1002) (DASHES(I),I=1,NA)
          IF (ISET .EQ. NSET) THEN
            IF (ITYP .EQ. 1) THEN
              WRITE (LUN,1007) (DOSO1(ICLN(IO)),IO=17,NL)
            ELSEIF (ITYP .EQ. 2) THEN
              WRITE (LUN,1007) (DOSO2(ICLN(IO)),IO=17,NL)
            ENDIF
          ENDIF

          IF (NORGS .GT. 24) WRITE (LUN,'(2A)')
     .      'Data not printed for organ ',MASORG(ICLN(NORGS))
        ENDIF

C-------- Write external report ----------------------------------------
  100   CONTINUE
        IF (OUTEDE) GOTO 110

        WRITE (LUN,1011)
        WRITE (LUN,1003)
        WRITE (LUN,1002) (DASHES(I),I=1,3)

        DO 144 IN = ISTART, ISTOP
          IF (ITYP .EQ. 1) THEN
            WRITE (LUN,1006) ELTT(IN), AWT(IN), DEX1R(IN)
          ELSEIF (ITYP .EQ. 2) THEN
            WRITE (LUN,1006) ELTT(IN), AWT(IN), DOSRE(IN)
          ENDIF
  144   CONTINUE

        WRITE (LUN,1002) (DASHES(I),I=1,3)
        IF (ITYP .EQ. 1) THEN
          WRITE (LUN,1007) EXTDOS(1)
        ELSEIF (ITYP .EQ. 2) THEN
          WRITE (LUN,1007) EXTD
        ENDIF

  110   CONTINUE
  200 CONTINUE

      RETURN

C---- Format Statements ------------------------------------------
```

```
1001 FORMAT (/,T25,'Internal Dose To Organ by Radionuclide',/)
1002 FORMAT (' ',10A8)
1003 FORMAT (' Radionuclide     ',8(A7,1X))
1004 FORMAT (/' Radionuclide    ',25I3/)
1005 FORMAT (' ',A2,1X,A6,7X,25I3)
1006 FORMAT (' ',A2,1X,A6, 7X,1P, 8E8.1E2)
1007 FORMAT (' Total   ',8X,1P, 8E8.1E2//)
1008 FORMAT (' Maximum year  ', 8I8)
1009 FORMAT (' Total internal  ',1P, 8E8.1)
1011 FORMAT (/,T25,'External Dose by Radionuclide',/)
1012 FORMAT (' External dose   ',1P, 8E8.1)
1021 FORMAT (/,T25,'Committed Dose Equivalent by Radionuclide',/)
1022 FORMAT (/,T15,'Cumulative Internal Dose to Organs by ',
     .                'Radionuclide',/)

C-----------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------
C
      SUBROUTINE RITEDE
C
C     This module prints the EDE by radionuclide report
C
C     Module of Program DOSE of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 13-Jun-88  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-------------------------------------------------------------------
C
C     IN        - Index of the current radionuclide in this case
C
C-------------------------------------------------------------------

      INCLUDE 'DOSALL.CMN'
      INCLUDE 'OPT.CMN'
      INCLUDE 'ORGMAS.CMN'
      INCLUDE 'RADIN.CMN'
      INCLUDE 'TIMES.CMN'

      INTEGER NSET, ISET, ISTART, ISTOP, MAXLIN
      CHARACTER DASH1*68
      DATA DASH1 /'--------  ----------  ----------  ----------  -------
     .---  ----------'/

      MAXLIN = 37
      NSET = NUCTOT / MAXLIN
      IDD = MOD (NUCTOT, MAXLIN)
      IF (IDD .GT. 0) NSET = NSET + 1

C     Break radionuclides into pages--
      DO 200 ISET = 1, NSET

        ISTART = (ISET - 1) * MAXLIN + 1
        ISTOP = ISET * MAXLIN
        IF (ISTOP .GT. NUCTOT) ISTOP = NUCTOT

        CALL SUBHED (1, ILINE)
        WRITE (LUN,1110) DASH1

        DO 300 IN = ISTART, ISTOP

          WRITE (LUN,1114) ELTT(IN), AWT(IN), EDERH(IN), EDERG(IN),
     .                     DEX1R(IN), RADEDE(IN),
     .                     RADEDE(IN) + DEX1R(IN)
```

```
 300   CONTINUE
       WRITE (LUN,1111) DASH1

 200 CONTINUE

     RETURN

C---- Format Statements --------------------------------------------------

   1 FORMAT (1PE7.1)

1004 FORMAT (' ',A1,I3,1P, 15E8.1E2)
1110 FORMAT (//,
   .        T5,'           Inhalation  Ingestion                   ',
   .           'Internal     Annual'/
   .        T5,'           Effective   Effective                   ',
   .           'Effective   Effective'/
   .        T5,'Radio-        Dose         Dose      External      ',
   .           '  Dose         Dose'/
   .        T5,'nuclide   Equivalent  Equivalent     Dose         ',
   .           'Equivalent  Equivalent'/
   .        T5,A68)
1111 FORMAT (T5,A68)
1114 FORMAT (' ',T5,A2,1X,A6,1X,1P,5(E9.1,3X))

C------------------------------------------------------------------------
     END
```


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```
C-----------------------------------------------------------------------
C
      SUBROUTINE TOTCAL
C
C     This module totals doses and sets flags for report writing.
C
C     Module of Program DOSE of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 2-Aug-88  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-------------------------------------------------------------------
C
C     IN         - Index of the current radionuclide in this case
C     IP         - Index of the current exposure pathway
C
C-------------------------------------------------------------------

      INCLUDE 'DOSALL.CMN'
      INCLUDE 'OPT.CMN'
      INCLUDE 'ORGMAS.CMN'
      INCLUDE 'RADIN.CMN'
      INCLUDE 'TIMES.CMN'

C     Determine dose units--
      IF (IUNIT .LT. 5) THEN
        IF (POPDOS) THEN
          DOSUNT = 'Person rem'
        ELSE
          DOSUNT = 'Rem'
        ENDIF
      ELSE
        IF (POPDOS) THEN
          DOSUNT = 'Person Sv'
        ELSE
          DOSUNT = 'Sv'
        ENDIF
      ENDIF

C     Set organ column indices and number of organs to print--

      NORGS = 0
C     Set organ print index--
      DO 300 IO = 1, MORG
        IF (DOSO1(IO) .GT. 0.0 .OR. DOSO2(IO) .GT. 0.0) THEN
          NORGS = NORGS + 1
          ICLN(NORGS) =IO
        ENDIF
```

```
  300 CONTINUE

C     Calculate whole body dose equivalent for first three years for
C     summary report--
      DO 310 IY = 1, 3
        DO 320 IE = 1, 3
          CALL WBEDE(SAVORG(1,IE,IY), EDE, CDE, WDE, NCDE, ICDE)
          SAVINC(IE,IY) = EDE
  320   CONTINUE
  310 CONTINUE

C     Cumulative EDE yearly increment--
      DO 330 IY = 1, INT(DCEND)
        CALL WBEDE (CUMIOR(1,IY), EDE, CDE, WDE, NCDE, ICDE)
        CUMIYR(IY) = EDE
  330 CONTINUE

C     Inhalation EDE--
      CALL WBEDE (CDEINH, EDE, CDE, WDE, NCDE, ICDE)
        EDEINH = EDE

C     Ingestion EDE--
      CALL WBEDE (CDEING, EDE, CDE, WDE, NCDE, ICDE)
        EDEING = EDE

C     Determine controlling pathway--
      MAXP = 4
      PMAX = 0.0
      IF (EDEINH .GT. PMAX) THEN
        PMAX = EDEINH
        MAXP = 1
      ENDIF
      IF (EDEING .GT. PMAX) THEN
        PMAX = EDEING
        MAXP = 2
      ENDIF
      IF (EXTDOS(1) .GT. PMAX) THEN
        PMAX = EXTDOS(1)
        MAXP = 3
      ENDIF

      RMAX = 0.0
      MAXR = 1

      DO 331 IN = 1, NUCTOT
        RADEDE(IN) = 0.0
        EDERH(IN) = 0.0
        EDERG(IN) = 0.0
  331 CONTINUE
```

```
      IF (NUCTOT .GT. 1) THEN
        DO 332 IN = 1, NUCTOT
C
          EDE by radionuclide--
          CALL WBEDE (DOSR(1,IN), EDE, CDE, WDE, NCDE, ICDE)
          RADEDE(IN) = EDE
C
          Inhalation EDE by radionuclide--
          CALL WBEDE (DOSRP(1,IN,1), EDE, CDE, WDE, NCDE, ICDE)
          EDERH(IN) = EDE
C
          Ingestion EDE by radionuclide--
          CALL WBEDE (DOSRP(1,IN,2), EDE, CDE, WDE, NCDE, ICDE)
          EDERG(IN) = EDE
C
          Determine controlling radionuclide--
          IF (RADEDE(IN) + DEX1R(IN) .GT. RMAX) THEN
            RMAX = RADEDE(IN) + DEX1R(IN)
            MAXR = IN
          ENDIF
  332   CONTINUE
      ENDIF
C
      Calculate whole bode dose equivalent--
      CALL WBEDE (DOS01, EDE, CDE, WDE, NCDE, ICDE)
      AEDEQ = EDE + EXTDOS(1)
C
      Accumulate dose totals--
      CUMID = 0.0
      EXTD = 0.0
      MAXYR = 0
      MAXD = 0.0

      DO 220 IY = 1, INT(DCEND)
C
        Total external dose--
        EXTD = EXTD + EXTDOS(IY)
C
        Cumulative internal dose--
        CUMID = CUMID + CUMIYR(IY)
C
        Annual dose--
        ANNULD(IY) = CUMIYR(IY) + EXTDOS(IY)
C
        Check for maximum annual dose--
        IF (ANNULD(IY) .GT. MAXD) THEN
```

9 1 0 4 8 1 1 3 2

```
            MAXYR = IY
            MAXD = ANNULD(IY)
          ENDIF
  220 CONTINUE

C     Cumulative dose--
      CUMD = CUMID + EXTD

      RETURN
C-----------------------------------------------------------------------
      END
```

9 1 0 4 8 1 1 8 3

```
C-----------------------------------------------------------------------------
C
      SUBROUTINE SUBHED (ITAB, ILINE)
C
C     This module prints a subheading on dose reports
C
C     Module of Program DOSE of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 8-Jan-88  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-------------------------------------------------------------------------
C
C     ITAB      - Flag indicating tab settings to use; 1-set 1, 2-set2
C     ILINE     - Line number on page returned to calling program
C
C-------------------------------------------------------------------------

      INCLUDE 'OPT.CMN'
      INCLUDE 'TIMES.CMN'

      INTEGER ITAB, ILINE

      CALL HEADNG (LUN)
      WRITE (LUN,'(A)') ' '
      ILINE = 9

      IF (ITAB .EQ. 1) THEN

        IF (ACUTE) THEN
          WRITE (LUN,2)
          ILINE = ILINE + 1
        ELSEIF (RELTRM) THEN
          WRITE (LUN,3) RELEND
          ILINE = ILINE + 1
        ENDIF

        IF (OUTEDE) NTKEND = 1
        WRITE (LUN,4) NTKEND, DCEND, DOSUNT
        ILINE = ILINE + 2

      ELSE

        IF (ACUTE) THEN
          WRITE (LUN,12)
          ILINE = ILINE + 1
        ELSEIF (RELTRM) THEN
          WRITE (LUN,13) RELEND
```

```
      ILINE = ILINE + 1
    ENDIF

    IF (OUTEDE) NTKEND = 1
    WRITE (LUN,14) NTKEND, DCEND, DOSUNT
    ILINE = ILINE + 2

  ENDIF
  RETURN

C---- Format Statements ----------------------------------------------

    2 FORMAT (T15,'Acute release')
    3 FORMAT (T15,'Release period:',T45,F8.1)
    4 FORMAT (T15,'Uptake/exposure period:',T45,F8.1,/
     .       ,T15,'Dose commitment period:',T45,F8.1/
     .       ,T15,'Dose units:',T45,A10)

   12 FORMAT (' Acute release')
   13 FORMAT (' Release period:',T60,F8.1)
   14 FORMAT (' Uptake/exposure period:',T60,F8.1,/
     .       ,' Dose commitment period:',T60,F8.1/
     .       ,' Dose units:',T60,A10)

C--------------------------------------------------------------------
      END
```

9 1 0 4 8 1 1 8 5

```
C------------------------------------------------------------------
C
      SUBROUTINE WBEDE (DOSIN, EDE, CDE, WDE, NCDE, ICDE)
C
C     Subroutine WBEDE calculates the wholy body effective dose
C     equivalent (EDE) from the current case
C
C     Module of Program DOSE of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 11-Apr-88 RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-------------------------------------------------------------------
C
C     CDE()     - Committed dose equivalent to the top eleven organs, (Sv
C                 or rem), returned
C     DOSEMO()  - Dose to each organ in the master list, work array
C     DOSIN     - Dose to each organ in the master list, passed in
C     EDE       - Effective dose equivalent, (Sv or rem) returned
C     FLAG      - Flag set in bubble sort to indicate that a switch was
C                 made this pass
C     ICDE()    - Master organ index of each of the top eleven organs,
C                 returned
C     IREMAN()  - Index in organ list corresponding to the organ dose
C                 in array REMAN
C     ITEMP     - Workspace for sort
C     NCDE      - Number of organs in the CDE and WDE arrays, 11 or less,
C                 returned
C     NREM      - Index of the current position in the REMAN and IREMAN
C                 arrays
C     REMAN()   - Work array for ordering remaining organ doses by
C                 highest dose
C     RTEMP     - Workspace for sort
C     WDE()     - Weighted dose equivalent to the top eleven organs, (sv
C                 or rem), returned
C
C-------------------------------------------------------------------

      INCLUDE 'TIMES.CMN'
      INCLUDE 'OPT.CMN'
      INCLUDE 'ORGMAS.CMN'

      REAL RTEMP, REMAN(25), DOSMO(25), DOSIN(25), CDE(11), WDE(11), EDE
      INTEGER ITEMP, IREMAN(25), NREM, NCDE, FLAG, ICDE(11)

C     Transfer doses to work array--
      DO 401 IO = 1, MORG
        DOSMO(IO) = DOSIN(IO)
```


9 1 0 4 8 1 1 8 6

```
  401 CONTINUE
C     Move whole body organs to CDE array--
C     Gonads--
      IF (DOSMO(12) .GT. DOSMO(11)) THEN
        CDE(1) = DOSMO(12)
        ICDE(1) = 12
      ELSE
        CDE(1) = DOSMO(11)
        ICDE(1) = 11
      ENDIF
C     Breast (muscle)--
      CDE(2) = DOSMO(13)
      ICDE(2) = 13
C     Red blood marrow--
      CDE(3) = DOSMO(8)
      ICDE(3) = 8
C     Lung (and lymph) --
      CDE(4) = DOSMO(1)
      ICDE(4) = 1
C     Thyroid--
      CDE(5) = DOSMO(14)
      ICDE(5) = 14
C     Bone surface--
      CDE(6) = DOSMO(7)
      ICDE(6) = 7
C     Move remaining organs into REMAN array for sorting--
      NREM = 0
C     Gastro-intestinal tract--
      DO 100 IO = 3, 6
        NREM = NREM + 1
        REMAN(NREM) = DOSMO(IO)
        IREMAN(NREM) = IO
  100 CONTINUE
C     Specified organs--
      DO 110 IO = 15, MORG
        IF (IO .EQ. 22) THEN
C         Add stomach wall to gut--
          REMAN(3) = REMAN(3) + DOSMO(IO)
```

```
        ELSEIF (DOSMO(IO) .GT. 0.0) THEN
C         WRITE (*,'(3A)') ' ',MASORG(IO),' added'
          NREM = NREM + 1
          REMAN(NREM) = DOSMO(IO)
          IREMAN(NREM) = IO
        ENDIF
  110 CONTINUE

C     Order remaining organs by highest dose--

      N = NREM - 1
  200 CONTINUE
        FLAG = 0
        J = 1
  201   CONTINUE
          IF (REMAN(J) .LT. REMAN(J+1)) THEN
            RTEMP = REMAN(J)
            ITEMP = IREMAN(J)
            REMAN(J) = REMAN(J+1)
            IREMAN(J) = IREMAN(J+1)
            REMAN(J+1) = RTEMP
            IREMAN(J+1) = ITEMP
            FLAG = 1
          ENDIF
          J = J + 1
        IF (J .LE. N) GOTO 201
      IF (FLAG .GT. 0) THEN
        N = N - 1
        IF (N .GT. 0) GOTO 200
      ENDIF

C     IF (DEBUG) THEN
C       WRITE (*,*) 'Ordered list of remaining organs'
C       DO 210 I = 1, NREM
C         WRITE (*,*) IREMAN(I), REMAN(I)
C 210   CONTINUE
C     ENDIF

C     Move top 5 remaining organs into CDE array--

      NCDE = 6
      N2 = MIN (NREM, 5)

      DO 300 I = 1, N2
        NCDE = NCDE + 1
        CDE(NCDE) = REMAN(I)
        ICDE(NCDE) = IREMAN(I)
        IF (ICDE(NCDE) .LT. 1 .OR. ICDE(NCDE) .GT. MORG) THEN
          WRITE (*,*) 'Invalid master organ index in WBEDE',
```

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```
     .             NCDE,  ICDE(NCDE)
            CALL EXIT (1)
          ENDIF
  300 CONTINUE

C     Calculate WDE and EDE--

      EDE = 0.0

      DO 302 IO = 1, NCDE
        WDE(IO) = CDE(IO) * WT(IO)
        EDE = EDE + WDE(IO)
  302 CONTINUE


      RETURN
C------------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------
C
C     Program title:                      DITTY -- A Computer Program for
C                                         Calculating Population Dose
C                                         Integrated Over Ten Thousand
C                                         Years
C
C     Prepared for:                       U. S. Department of Energy under
C                                         Contract DE-AC06-76RLO 1830
C
C     Contact:                            Bruce Napier
C                                         Pacific Northwest Laboratory
C                                         Richland WA 99352
C                                         (509) 375-3916
C
C     Code developers:                    B. A. Napier, R. A. Peloquin,
C                                         and D. L. Strenge,
C                                         Pacific Northwest Laboratory
C                                         Richland WA  99352
C
C
C     This code was prepared for an agency of the United States
C     Government.  Neither the United States Government or any agency
C     thereof, or any of their employees, make any warranty, expressed
C     or implied, or assumes any legal liability or responsibility for
C     any third party's use, or the results of such use, of any portion
C     of this program or represents that its use by such third party
C     would not infringe privately onwed rights.
C
C
C--- Program Information -----------------------------------------------
C
C     Problem description:         To determine the collective dose from
C                                  long term nuclear waste disposal sites.
C
C     Solution method:             DITTY estimates the time integral of
C                                  collective dose over a ten-thousand-year
C                                  period for time-variant radionuclide
C                                  releases to surface waters, wells, or the
C                                  atmosphere.
C
C                                  The time frame for the calculation is any
C                                  10,000 year period.  This period is broken
C                                  into 143 periods of 70 years each.  The
C                                  average release in each of these periods is
C                                  calculated from source-term data provided,
C                                  and the total population dose
C                                  is determined for each period.  The
C                                  activity present during any period is the
```

```
C                                       sum of material release during that period
C                                       and residual material in the environment
C                                       from releases in previous periods.
C
C    Results format:                    The dose is calculated for all contributing
C                                       pathways of exposure, including external
C                                       exposure, inhalation, and ingestion of
C                                       contaminated water and foods.  The doses are
C                                       calculated as the population dose received
C                                       in each 70-year time period from material
C                                       releases to the environment during that
C                                       period plus all previous periods.
C
C
C    Computer:                          This version is for the IBM PC/AT as a
C                                       portion of the GENII Environmental Dosimetry
C                                       Software Package.  Earlier versions of
C                                       DITTY are also available in VAX-11/780
C                                       Versions.
C
C
C    Programming language:              FORTRAN compiled using LAHEY compiler (tm).
C
C    Machine requirements:              IBM PC/AT with a minimum of 640 Kbytes
C                                       random access memory and 2 360-Kbyte floppy
C                                       disk drives or the equivalent storage on
C                                       a hard disk drive.
C
C
C    Original Reference:                B. A. Napier, R. A. Peloquin, and D. L.
C                                       Strenge.  1986.  "DITTY -- A Computer Program
C                                       for Calculating Population Dose Integrated
C                                       Over Ten Thousand Years."  PNL-4456. Pacific
C                                       Northwest Laboratory, Richland, WA .
C                                       Available from National Technical Information
C                                       Service.  5285 Port Royal Road, Springfield
C                                       Virginia.  22161
C
C    Current Reference:                 B. A. Napier, R. A. Peloquin, D. L. Strenge,
C                                       and J. V. Ramsdell. 1988. "GENII - The
C                                       Hanford Environmental Radiation Dosimetry
C                                       Software System."  PNL-6584, Volumes 1, 2,
C                                       and 3.  Pacific Northwest Laboratory, C
                                 Richland, WA  99352
C
C
C
      PROGRAM DITTY
C
```

```
C--- Module Information ---------------------------------------------------
C
C
C     MAIN CONTROLS INPUT OF DATA AND CASE ITERATION
C
C--------------------------------------------------------------------------
C
C     SUBORDINATE ROUTINES-- RLIBIN, SETNUC, ORGCHK, AIRLIN, BIOLIN,
C                            FOOLIN, GRDLIN, CASEIN, POPLIN, ACTIN,
C                            QAPAGE, CONTRL, REPORT, GETDAT, GETTIM
C     INPUTS-- NONE
C     INPUT COMMONS-- DKAY
C     OUTPUTS-- NONE
C     OUTPUT COMMONS-- BEGEND, BIODAT, DECAY, DISPSN, DKAY, NAMLIST,
C                      OPTION, ORGID, PATHIN, SOURCE, TIMES2, TITLES,
C                      VARYBL, FODATA
C
C     Module of Program DITTY of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification:  11-Apr-88  RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C--------------------------------------------------------------------------
C
      INCLUDE 'BIODAT.CMN'
      INCLUDE 'DISPSN.CMN'
      INCLUDE 'DKAY.CMN'
      INCLUDE 'FODATA.CMN'
      INCLUDE 'NAMLST.CMN'
      INCLUDE 'OPTION.CMN'
      INCLUDE 'PATHIN.CMN'
      INCLUDE 'SOURCE.CMN'
      INCLUDE 'TIMES2.CMN'
      INCLUDE 'TITL.CMN'
      INCLUDE 'VARYBL.CMN'
C
      DIMENSION  IBEGA(100), IBEGW(100), IENDA(100), IENDW(100)
C
C
C     Get system time and date--
      CALL MAKDA2

C     Read file names--
      CALL OPNFIL ((3),(0),(1))

C     Open input and output files, set default values for LUNs--

      IUN = 33
```


9 1 0 4 8 1 1 9 2

```
      CALL OPNFIL ((4),(0),IUN)

      ION = 17
      CALL OPNFIL ((2),(0),ION)

      CALL RLIBIN
C     TO READ MASTER RADIONUCLIDE DATA LIBRARY RMDLIB.
C
C     READ MASTER RADIONUCLIDE NAME LIST--
C
C     READ NUMBER OF RADIONUCLIDES - RECORD TYPE 2
      READ (IUN,2000,ERR=800,END=900) NIN
C
C     READ NAMES OF RADIONUCLIDES - RECORD TYPE 3
      READ (IUN,3000,ERR=800,END=900) (E(I), A(I), I = 1, NIN)
C
      CALL SETNUC
C     TO ESTABLISH MASTER RADIONUCLIDE LIST FOR THIS RUN.
C
      CALL AIRLIN
C     TO READ AIR SUBMERSION/INHALATION AND INGESTION DOSE FACTORS.
C
      CALL FOOLIN
C     TO READ FOOD TRANSFER FACTOR DATA.
C
      CALL GRDLIN
C     TO READ GROUND AND WATER EXTERNAL EXPOSURE FACTORS.
C
C
C   SET AB TO SUM OF RADIOLOGICAL AND NON-RAD REMOVAL CONSTANTS
      DO 456 I = 1 ,INUC
        AB(I) = AB(I) + AR(I)
  456 CONTINUE
C
C     LOOP UNTIL END-OF-FILE ENCOUNTERED ON INPUT--
  100 CONTINUE
C
        CALL CASE2
C       TO READ DATA FOR ONE CASE.
C
C       IF DIFFERENT FROM PREVIOUS CASE--
        IF (ISALT .NE. IOSALT)    THEN
C
          CALL BIOLIN
C         TO READ IN BIOACCUMULATION FACTORS.
C
C         STORE VALUE OF ISALT FOR COMPARISON IN NEXT CASE--
          IOSALT = ISALT
C
```


9 1 0 4 8 1 1 9 3

```
      ENDIF
C
C
C     IF AIRBORNE RELEASE IS CONSIDERED--
      IF (IAIR .GT. 0)    CALL ACTIN (1, LUA, ITAX, ITAM,
     .                    IBEGA, IENDA)
C     TO GENERATE NEW RELEASE RATE DATA FOR ATMOSPHERIC PATHWAYS.
C
C     IF WATERBORNE RELEASE IS CONSIDERED--
C
      IF (IWAT .GT. 0)     CALL ACTIN (2, LUW, ITWX, ITWM,
     .                     IBEGW, IENDW)

C     TO GENERATE NEW RELEASE RATE DATA FOR AQUATIC PATHWAYS.
C
      CALL QAPAGE
C     TO WRITE INPUT SUMMARY REPORT.
C
      CALL CONTRL (IAC, IPATH, ITAM, ITAX, ITWM, ITWX)
C     TO CONTROL DOSE RESULT CALCULATIONS.
C
      CALL REPORT
C     TO WRITE RESULT REPORTS.
C
C     READ TITLE CARD FOR NEXT CASE--
      READ (IUN,'(A)',ERR=800,END=999) TITLS(IUN)
C
    GO TO 100

C---- Error Conditions -------------------------------------------

  800 CALL FILERR (3, IUN, 'In DITTY')
  900 CALL FILERR (2, IUN, 'In DITTY')

C---- Format Statements ------------------------------------------

 2000 FORMAT (I5)
 3000 FORMAT (A2, A6 )
 4000 FORMAT (I5)
 5000 FORMAT (10I3)

C----------------------------------------------------------------

  999 CONTINUE
      WRITE (*,*) ' Normal termination of DITTY'
      STOP
C
C----------------------------------------------------------------
      END
```


9 1 0 4 8 1 1 9 4

```
C-----------------------------------------------------------------------
C
      SUBROUTINE ACTIN (IP, IAW, ITX, ITM, IBEG, IEND)
C
C     This module reads the release activity time history data
C
C     Module of DITTY of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification:  3-Aug-88 RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C     IP          -  PATHWAY SELECTION INDEX: 1- AIRBORNE
C                    RELEASE, 2- WATERBORNE RELEASE
C     IAW         -  CONTROL FOR INPUT FILE SPECIFICATIONS:
C                    1- FOR CARD INPUT, 2- FOR PERMANENT FILE
C                    INPUT ON UNIT 26 OR UNIT 24
C     ITX         -  MAXIMUM TIME INCREMENT INDEX DURING WHICH
C                    ANY RELEASE WAS MADE FOR THIS MODE
C     ITM         -  MINIMUM TIME INCREMENT INDEX DURING WHICH
C                    ANY RELEASES WAS MADE FOR THIS MODE
C     IBEG(100)   -  1ST TIME INCRMENT DURING WHICH EACH
C                    RADIONUCLIDE IS RELEASED 1<=IBEG(I)<=144
C     IEND(100)   -  LAST TIME INCREMENT DURING WHICH EACH
C                    RADIONUCLIDE IS RELEASED 1<=IEND(I)<=144
C                    IBEG(I) <= IEND(I)
C     CIN(100)    -  Double precision input concentration array
C     ACTSET      -  Flag set if activity was set into air or water
C                    activity array, (ACTA or ACTW).  Warning printed
C                    to screen if not set.
C
C-----------------------------------------------------------------------
C
      INTEGER IBEG(100), IEND(100)
      REAL T(450), C(450)
      REAL*8 CIN(100)
      LOGICAL ACTSET
C
      INCLUDE 'NUCNAM.CMN'
      INCLUDE 'OPTION.CMN'
      INCLUDE 'VARYBL.CMN'
      INCLUDE 'TITL.CMN'
C
      CHARACTER A*6, E*2
C
C     INITIALIZE ARRAYS AND CONTROL PARAMETERS--
      DO 102 I = 1, NUCTOT
```

```
        IBEG(I) = 0.0
        IEND(I) = 0.0
        DO 104 J = 1, 144
          ACTA(J,I) = 0.0
          ACTW(J,I) = 0.0
  104   CONTINUE
  102 CONTINUE

      ITX = 0
      ITM = 999
C
C     IF AIRBORNE RELEASE, SET LOGICAL UNIT DEVICE AND READ TITLE--
      IF (IP .EQ. 1)   THEN
        IF (IAW .EQ. 1)  THEN
          IUN = 33
        ELSE
          IUN = 32
          CALL OPNFIL ((4), (0), IUN)
        ENDIF
C
      ELSE
C     IF WATERBORNE RELASE, SET LOGICAL UNIT DEVICE AND READ TITLE--
        IF (IAW .EQ. 1)   THEN
          IUN = 33
        ELSE
          IUN = 31
          CALL OPNFIL ((4), (0), IUN)
        ENDIF
      ENDIF
C
C
C     READ IN NO. OF NUCLIDES DATA SUPPLIED FOR AND LOOP ON--
      READ (IUN,2001,ERR=804,END=900) NNACT
C
      DO 400 INN = 1, NNACT
C
C       READ NAME OF RADIONUCLIDE AND NO. OF TIME PERIODS--
        READ (IUN,1000,ERR=806,END=900) E, A, NT
C
C       CHECK IF NT IS WITHIN LIMITS--
        IF (NT .GT. 0)  THEN
          IF (NT .LE. 450)  THEN
C
            IN = 1
C
          ELSE
            GOTO 801
          ENDIF
C
```


9 1 0 4 8 1 1 9 6

```
C
C         READ NT DATA RECORDS--
          READ (IUN,3001,ERR=800,END=900) (T(I), CIN(I), I = 1, NT)
          LNUC = 0

C         Store input concentrations--
          DO 202 I = 1, NT
            IF (CIN(I) .LT. 1.0D-30) CIN(I) = 0.0D0
            C(I) = CIN(I)
  202     CONTINUE

C
C         LOOP UNTIL IN > NUCTOT OR LNUC > 0--
  200     CONTINUE
C
C           IF RADIONUCLIDE IS IN MASTER LIBRARY--
            IF (E .EQ. ELT(IN))  THEN
              IF (A .EQ. AW(IN))   THEN
C
                LNUC = IN
C
                ACTSET = .FALSE.
                IF (IP .EQ. 2) THEN
                  CALL CONSET (ACTSET, T, C, NT, IBEG(IN), IEND(IN),
     .                         ACTW(1,IN))
                ELSE
                  CALL CONSET (ACTSET, T, C, NT, IBEG(IN), IEND(IN),
     .                         ACTA(1,IN))
                ENDIF

                IF (.NOT. ACTSET) WRITE (*,'(4A)') ' Inventory for ',
     .            E,A, ' was outside 10,000-year time period.'

C
              ENDIF
            ENDIF
C
            IN = IN + 1
C
           IF (IN .GT. NUCTOT .AND. LNUC .LE. 0) WRITE (*,'(4A)')
     .       ' Radionuclide ',E,A,
     .       ' in release file not included in master list.'

           IF (IN .LE. NUCTOT  .AND.  LNUC .LE. 0)  GO TO 200
C          JUMP OUT OF LOOP IF MATCH FOUND OR LIBRARY EXHAUSTED--
C
          ENDIF
C
C     READ RELEASE DATA FOR NEXT RADIONUCLIDE--
```

```
  400 CONTINUE
C
C
C     SET EARLIEST AND LATEST RELEASE INDEX OF ALL RADIONUCLIDES--
C
      DO 300 I = 1, NUCTOT
C
        IF (IBEG(I) .GT. 0)    THEN
          IF (IBEG(I) .LT. ITM)    ITM = IBEG(I)
        ENDIF
C
        IF (IEND(I) .GT. ITX)    ITX = IEND(I)

  300 CONTINUE

C     Close release files if open--
      IF (IUN .EQ. 31 .OR. IUN .EQ. 32) CLOSE (IUN)

      RETURN

C---- Error Conditions -----------------------------------------------

  800 WRITE (*,8000) NT, T(I), C(I)
 8000 FORMAT ('0 Read error encountered in ACTIN'/
     .        '    N: ',I7,' T(N): ',1PG10.3, ' C(N): ',1PG10.3)
       CALL EXIT (1)

  801 WRITE (*,8001) NT, E, A
 8001 FORMAT ('0 NT for radionuclide ', A2, A6, ' is too large, = ',I5)
      CALL EXIT (1)

  804 WRITE (*,8004) NNACT
 8004 FORMAT ('0 ERROR: Number of radionuclides in ACTIN,  NNACT=',I5)
      CALL EXIT (1)

  806 WRITE(*,8006) E, A, NT
 8006 FORMAT ('0 ERROR: Number of time periods in ACTIN'/
     .        ' Radionuclide : ',A2,A6,'   Times: ',I6)
      CALL EXIT (1)

  900 CALL FILERR (2, IUN, 'In ACTIN')

C---- Format Statements ----------------------------------------------

 1000 FORMAT (A2, A6, 2X, I5)
 2000 FORMAT (20A4)
 3000 FORMAT (2E10.0)
 3001 FORMAT (E10.0,D10.0)
 2001 FORMAT (I5)
```

```
C-----------------------------------------------------------------------
  999 RETURN
      END
```

```
C-----------------------------------------------------------------------
C
      SUBROUTINE AIRLIN
C
C     This module reads internal dose conversion factor data
C
C     Module of DITTY of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification:  18-Aug-88  RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
      INCLUDE 'RMD.CMN'
      INCLUDE 'FLAGS.CMN'
      INCLUDE 'DOSFAC.CMN'
      INCLUDE 'DAYPC.CMN'
      INCLUDE 'NUCNAM.CMN'
      INCLUDE 'ORGID.CMN'
      INCLUDE 'TITL.CMN'
      INCLUDE 'ORGMAS.CMN'
C
      CHARACTER AA*6, EE*2, DUM*8
C
      DIMENSION MO(25), DH1(25), DH2(25), DG1(25), DG2(25)
C
C
C     ASSIGN LOGICAL UNIT DEVICE--
      IUN = 30
      CALL OPNFIL ((4), (0), IUN)
C
C     INITIALIZE ARRAYS--
      CALL ZEROR (2500, DFH)
      CALL ZEROR (2500, DFG)
      CALL ZEROI (100,INFLG)
      DO 120 IO = 1, MORG
        IOFLG(IO) = .FALSE.
  120 CONTINUE
C

      NC = 1
      IFLG1 = 0

  150 CONTINUE
      REWIND (IUN)
      READ (IUN,'(A)') DUM

  151 CONTINUE
```

```
      READ (IUN,2,END=153)  EE, AA

      IF (EE .EQ. ELT(NC)  .AND.  AA .EQ. AW(NC) )   THEN

        READ (IUN,*,END=153) LORG, (MO(IO), IO =1, LORG)
        READ (IUN, '(A)',END=153) DUM
        READ (IUN,3,END=153) (DG2(IO), IO = 1, LORG)
        READ (IUN,3,END=153) (DH2(IO), IO = 1, LORG)

        DO 152 IO = 1, LORG
          IOFLG(MO(IO)) = .TRUE.
          DFH(1,MO(IO),NC) = DH2(IO)
          DFG(1,MO(IO),NC) = DG2(IO)
          DFH(2,MO(IO),NC) = DH2(IO)
          DFG(2,MO(IO),NC) = DG2(IO)
152     CONTINUE

        INFLG(NC) = 1
        NC = NC + 1
        IFLG1 = 0
        IF (NC .GT. NUCTOT) GOTO 155

      ELSE
C       Read past data set--
        READ (IUN,'(A)') DUM
        READ (IUN,'(A)') DUM
        READ (IUN,'(A)') DUM
        READ (IUN,'(A)') DUM

      ENDIF
      GOTO 151

153   CONTINUE
      IF (IFLG1 .EQ. 0) THEN
        IFLG1 = 1
      ELSE
C       No dose factors for this radionuclide--
        WRITE (*,*) 'No internal dose factors for ',ELT(NC),AW(NC)
        NC = NC + 1
        IFLG1 = 0
      ENDIF
      IF (NC .LE. NUCTOT) GOTO 150

155 CONTINUE

C     Set additional organs to "Other" if not set--
      DO 160 IN = 1, NUCTOT
        DO 162 IO = 15, 22
```

```
          IF (DFG(2,IO,IN) .EQ. 0.0) THEN
            DFG(1,IO,IN) = DFG(1,23,IN)
            DFG(2,IO,IN) = DFG(2,23,IN)
            DFH(1,IO,IN) = DFH(1,23,IN)
            DFH(2,IO,IN) = DFH(2,23,IN)
          ENDIF
  162   CONTINUE
  160 CONTINUE

      CLOSE (IUN)
      RETURN

C---- Format Statements ---------------------------------------------

    2 FORMAT (A2, A6)
    3 FORMAT (4X, 20E8.1)

C-------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------
C
      SUBROUTINE APATHS (ITIM, ITAX)
C
C     This module calculates the environmental concentrations from
C     atmospheric deposition.
C
C     Module of DITTY of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification:  13-Jul-88 RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
      INCLUDE 'DKAY.CMN'
      INCLUDE 'EDCN.CMN'
      INCLUDE 'FODATA.CMN'
      INCLUDE 'NUCNAM.CMN'
      INCLUDE 'PATHIN.CMN'
      INCLUDE 'VARYBL.CMN'
C
      CHARACTER*2 CONSTC, CONSTH
C
      DIMENSION TRNL(7), ANCONS(7), RATE(100), DUMMY(100)
      DATA TRNL / 1.0, 0.1, 0.1, 1.0, 0.1, 0.1, 0.1/
      DATA ANCONS /0., 0., 0.12, 55., 68., 4.2, 0.12/
      DATA DUMMY /100 * 0./
      DATA DUMMY1 /0./
C
      DATA CONST1 /3.169E-8/
C
C     CONST2 = 224. / 3.156E+7
      DATA CONST2 /7.098E-6/
C
C     CONST3 = 0.69315 / 14. * 365.25
      DATA CONST3 /18.0838/
C
      DATA CONST4 /0.25/
      DATA CONST5 /3.156E+07/
      DATA CONST6 /365.25/
C
C     CONST7 /1.09E-09 * 224. / 15.
      DATA CONST7 /1.4933E-08/
C
      DATA ONE /1./
      DATA CONSTC /'C '/
      DATA CONSTH /'H '/
C
```

```
      JNUC = 0
C
C
C     FOR EACH DECAY CHAIN--
      DO 100 ICH = 1, ICHN
C
        J = NOFN(ICH)
        IST = JNUC + 1
        JNUC = JNUC + J
        K = IST + J - 1
C
C
C       FOR EACH NUCLIDE IN THE CHAIN--
        DO 200 I = IST, K
C
C
C         CALCULATE AIR CONCENTRATION OF NUCLIDE I, WEIGHTED BY POP-
C         ULATION AND RADIOLOGICAL DECAY CONSTANT,  PERSON-CI-YR/M**3

          IF (AR(I) .GT. 0.0) THEN
            AIRCON(I) = PM(ITIM) * ACTA(ITIM,I) * CONST1 / AR(I)
          ELSE
            AIRCON(I) = 0.0
          ENDIF

  200   CONTINUE
C
C       IF THIS ELEMENT IS 'H '--
        IF (ELT(IST) .EQ.  CONSTH)  THEN
C
          CALL TRITUM (IST, 1, DUMMY1, AIRCON(IST), ANCONS, DUMMY,
     .                 SLCON(IST), EDBCON(1,IST), DUMMY, RIRR, MOPYR)
C
        ELSE
C         IF THIS ELEMENT IS 'C '--
          IF (ELT(IST) .EQ. CONSTC)  THEN
C
            CALL CARBON(IST, 1, DUMMY1, AIRCON(IST), ANCONS, DUMMY,
     .                 SLCON(IST), EDBCON(1,IST), DUMMY,
     .                 RIRR, MOPYR)
C
          ELSE
C
C           SKIP OVER IF ACUTE RELEASE, FIRST YEAR--
            IF (ITIM .NE. 1)   THEN
C
C             DECAY PREVIOUS SOIL ACCUMULATION--
              CALL BCHAIN (J, 70., DK2(1,IST), IFR2(1,IST), AR(IST),
     .                     AB(IST), SLCON(IST), SLCON(IST), 0)
C
```

```
C
C                IF THERE IS A RELEASE--
                 IF (ITIM .LE. ITAX)   THEN
C
C                  ADD IN INTEGRATED CONTRIBUTION FROM THIS 70-YR PERIOD--
                   DO 300 I = IST, K
C
C                    CALCULATE DEPOSTION RATE, WEIGHTED BY POPULATION AND
C                    DECAY CONSTANT, PERSON-CI-YR / KG-YR
                     RATE(I) = AIRCON(I) * DVEL(I) / CONST2
C
  300              CONTINUE
C
                   CALL BCHAIN (J, 70., DK2(1,IST), IFR2(1,IST), AR(IST),
                                AB(IST), RATE(IST), RATE(IST), 1)
C
C                  SUM PREVIOUS AND CURRENT DEPOSTIONS--
C
C                  The following was added to correct population included in
SLCON
                   PMT = 1.0
                   IF (ITIM .GT. 1) THEN
                     IF (PM(ITIM-1) .GT. 0. .AND. PM(ITIM) .GT. 0.0) THEN
                       PMT = PM(ITIM) / PM(ITIM-1)
                     ENDIF
                   ENDIF

                   DO 400 I = IST, K
                     SLCON(I) = SLCON(I) * PMT + RATE(I)
  400              CONTINUE

                 ENDIF
               ELSE
C                FOR ACUTE FIRST YEAR RELEASE--
C
                 DO 500 I = IST, K
C                  CALCULATE ACUTE DEPOSTITION ON SOIL--
                   SLCON(I) = AIRCON(I) * DVEL(I) / CONST2
  500            CONTINUE
C
                 CALL BCHAIN (J, 1.0, DK2(1,IST), IFR2(1,IST), AR(IST),
                              AB(IST), SLCON(IST), SLCON(IST), 0)
C
               ENDIF
C
C              CALCULATE PLANT AND ANIMAL CONCENTRATIONS--
C
C              FOR EACH NUCLIDE IN CHAIN--
               DO 600 I = IST, K
```

```
C
C               CALCULATE ENVIRONMENTAL REMOVAL CONSTANT--
                ENVLAM = AR(I) + CONST3
C
C               FOR EACH TERRESTRIAL PATHWAY--
                DO 700 IP = 1, 7

                  IF (YELD(IP) .GT. 0.0) THEN

                    IF (ITIM .EQ. 1)  THEN
C                     ACUTE LEAF CONCENTRATION--
                      RLFCON = CONST4 * AIRCON(I) * DVEL(I) * CONST5
     .                        / YELD(IP)
                    ELSE
C                     CHRONIC LEAF CONCENTRATION--
                      RLFC1 = CONST4 * (AIRCON(I)+SLCON(I)*CONST7)
     .                        * DVEL(I)
                      RLFC2 = ONE - EXP (-ENVLAM * GRWP(IP)/CONST6)
                      RLFCON = RLFC1 * RLFC2 / ENVLAM/YELD(IP)*CONST5
                    ENDIF

                  ELSE
                    RLFCON = 0.0
                  ENDIF
C
C
                  PLTCON = RLFCON* TRNL(IP) + SLCON(I) * CRATIO(1,I)
C
C                 IF VEGATABLE PATHWAY--
                  IF (IP .LE. 2)  THEN
C
                    EDBCON(IP,I) = PLTCON
C
                  ELSE
C
                    EDBCON(IP,I) = PLTCON*ANCONS(IP)*CRATIO(IP-1,I)
C
                  ENDIF
C
C
  700         CONTINUE
  600       CONTINUE
          ENDIF
        ENDIF
  100 CONTINUE
C
      RETURN
C-----------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------
C
      SUBROUTINE BCHAIN (NUC, T, DK, IFRM, AL, AB, AM, AO, INTGRL)
C
C     This module calculates decay for one chain
C
C     Module of DITTY of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification:  22-Aug-88 RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C
      REAL*8 A(45), SUMPR, ASUM, AMD, EXPO(9), ABD(9)
      REAL*8 ARG, TERM
      DIMENSION DK(2,9), IFRM(2,9), AL(9), AM(9), AO(9),
     .          AB(9)
C
C     CHANGE TO QUAD PRECISION
      DO 113 IJK = 1, 9
        ABD(IJK) = AB(IJK)
  113 CONTINUE
C
C     INITIALIZE COEFFICIENT ARRAY TO ZERO--
      N2N = NUC * (NUC-1) / 2 + NUC
C
C      CALL ZEROR (N2N, A)
      DO 100 IJK = 1, N2N
        A(IJK) = 0.0D0
  100 CONTINUE
C
C     DO LOOP ON CHAIN MEMBERS,  MAX = NUC--
      DO 5 J = 1, NUC
C
C       CALCULATE EXPONENTIAL FOR CURRENT NUCLIDE--
        ARG=-ABD(J) * T
C
        IF (INTGRL .GT. 0)    THEN
          IF (ARG .GT. 0.0) THEN
            WRITE (*,111) ARG
  111       FORMAT (' ERROR IN EXMO OF ACHAIN, POS ARG= '
     .              1PE10.3)
          ELSE
C           FORM IS:  (1 - DEXP (ARG) ) / AB   FOR INTGRL > 0
C           EXPO(J) = EXMO (ARG, AB(J) )
            IF (-ARG .GT. 3.0D1) THEN
              EXPO(J) = 1.0D0 / ABD(J)
```

```
            ELSEIF (-ARG .GT. 0.001) THEN
              EXPO(J) = (1.0D0 - DEXP(ARG)) / ABD(J)
            ELSE
              FX = -(DLOG10(-ARG))
              I = 10 - IFIX(FX)
              IF (I .LT. 2)  I=2
              TERM = - ARG
              EXPO(J) = - ARG / ABD(J)
             DO 13 IT = 2,I
                TERM = (TERM*ARG) /DBLE(IT)
                EXPO(J) = EXPO(J) + TERM/ABD(J)
 13           CONTINUE
            ENDIF
          ENDIF
        ELSE
C         FORM IS EXP(ARG) FOR INTGRL = 0
          IF (-ARG .GT. 3.0D1) THEN
            EXPO(J) = 0.0D0
          ELSE
            EXPO(J) = DEXP (ARG)
          ENDIF
        ENDIF
C
C       SET STARTING INDEX FOR TERM ARRAY A--
        JJ = J * (J-1) / 2
C
C       SET CHAIN POSITION MINUS ONE--
        J1 = J - 1
C
        IF(J1 .GT. 0)   THEN
C
          IMAX = MIN0 (J1, 2)
          DO 3 M = 1, J1
            DO 2 L = M, J1
              DO 1 I = 1, IMAX
C
                IF (IFRM(I,J) .EQ. L)    THEN
                  A(M+JJ) = A(M+JJ) + DK(I,J) * AL(L) * A(M+L * (L-1)/2)
                ENDIF
C
    1         CONTINUE
    2       CONTINUE
C
            A(M+JJ) = A(M+JJ) / (ABD(J) - ABD(M))
C
    3     CONTINUE
C
        ENDIF
C
```

```
C
         ASUM = 0.0D0
         IF (J1 .EQ. 0) GO TO 11
           DO 12 IRAP = 1, J1
             JK = JJ + IRAP
             ASUM = ASUM + A(JK)
   12      CONTINUE
   11    CONTINUE
C
C
C         A(J + JJ) = AM(J) - ASUM (J1, A(JJ+1) )
C
         AMD = AM(J)
         A(J+JJ) = AMD - ASUM
C
C
C         AO(J)= SUMPRD (J, EXPO, A(JJ + 1) )
C
         SUMPR = 0.0D0
         DO 8884 IN = 1, J
           JK = JJ + IN
           SUMPR = SUMPR + EXPO(IN) * A(JK)
 8884    CONTINUE
         AO(J) = SUMPR

C
    5 CONTINUE
C
      RETURN
      END
```


9 1 0 4 8 1 2 0 9

```
C-----------------------------------------------------------------------
C
      SUBROUTINE BIOLIN
C
C     This module reads the values of the bioaccumulation factor for
C     fish, molluscs, crustaceans, and water plants, as well as drinking
C     water cleanup factors from the library file
C
C     Module of DITTY of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification:  11-Apr-88 RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
      INCLUDE 'BIODAT.CMN'
      INCLUDE 'NUCNAM.CMN'
C
      CHARACTER E*2, DUM*8
C
      DIMENSION BF(8)
C
C     ASSIGN LOGICAL UNIT DEVICE NUMBERS, open file and read title--
      IUN = 9
      CALL OPNFIL ((4), (0), IUN)
      READ (IUN,'(A)') DUM
C
C     FRESH OR SALT WATER DOSE FACTORS TO BE USED?--
      IF (ISALT .EQ. 1)  THEN
        KSLT = 4
      ELSE
        KSLT = 0
      ENDIF
C
C     LOOP UNTIL END OF FILE--
  100 CONTINUE
C
C       READ DATA RECORD--
        READ (IUN,2000,ERR=800,END=999) E, (BF(I), I=1,8), DW
C
C       IF RADIONUCLIDE FOUND IN MASTER LIST, SET BIOACCUMULATION FACTORS--
        DO 200 J = 1, NUCTOT
C
          IF (E .EQ. ELT(J) )  THEN
C
            DWCF(J) = DW
            DO 300 K = 1, 4
              BIOACF(K,J) = BF(K+KSLT)
```


9 1 0 4 8 1 2 1 0

```
  300       CONTINUE
C
          ENDIF
  200   CONTINUE
C
      GO TO 100
C     IF NOT END-OF-FILE, READ NEXT RECORD--

C     NORMAL TERMINATION POINT--
  999 CLOSE (IUN)
      RETURN

C---- Error Conditions -------------------------------------------------

  800 CALL FILERR (3, IUN, 'In BIOLIN')

C---- Format Statements ------------------------------------------------

 1000 FORMAT (20A4)
 2000 FORMAT (A2, 8F9.1, F6.1)

C----------------------------------------------------------------------
      END
```

```
C------------------------------------------------------------------
      BLOCK DATA BLOCK2
C
C     This module initializes common block data variables.
C
C     Module of DITTY of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification:  17-Aug-88  RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C------------------------------------------------------------------

      INCLUDE 'BIODAT.CMN'
      INCLUDE 'DECAY.CMN'
      INCLUDE 'DISPSN.CMN'
      INCLUDE 'DKAY.CMN'
      INCLUDE 'FODATA.CMN'
      INCLUDE 'NAMLST.CMN'
      INCLUDE 'OPTION.CMN'
      INCLUDE 'PATHIN.CMN'
      INCLUDE 'SOURCE.CMN'
      INCLUDE 'TIMES2.CMN'
      INCLUDE 'TITL.CMN'
      INCLUDE 'VARYBL.CMN'
      INCLUDE 'PLOT.CMN'
      INCLUDE 'RESULT.CMN'
      INCLUDE 'FILES.CMN'
C
C     SET PREVIOUS CASE VALUE OF ISALT TO ENSURE BIOACCUMULATION
C     LIBRARY IS READ IN FOR FIRST CASE--
      DATA IOSALT /-1/
C
C     SET NAMELIST DEFAULT VALUES--
      DATA IAC /0/
      DATA IAIR /0/
      DATA IWAT /0/
      DATA LUA /1/
      DATA LUW /1/
      DATA ISALT /0/
      DATA ISPEC /0/
C
      DATA TZ /2000./
      DATA TZR /2000./
C
      DATA NDIST /0/
      DATA NSECT /16/
C
```

```
      DATA IEOQ /0/
      DATA HS /0./
      DATA NMET /6/
      DATA NUBAR /0/
      DATA MET /1,2,3,4,5,6,7/
      DATA UBAR /8 * 0./
C
      DATA IPA /1/
      DATA IPL /1/
      DATA IPOP /4/
      DATA IPOPL /2/
      DATA NTA /1/
      DATA NTL /1/
      DATA PL /144 * 0./
      DATA PL1 /20 * 0./
      DATA PMA /0./
      DATA PPL /0./
      DATA TL /20 * 0./
      DATA POPT /20 * 0./
C
      DATA RECON /1.0/
      DATA RM /1.0/
C
      DATA IGRPOP /0/
      DATA IGRPM /0/
      DATA IGRPL /0/
      DATA IGRTNU /0/
      DATA IGRNUC /0/
      DATA IGRDOS /0/
      DATA IREDE /1/
C
      DATA TICKX /73*' '/
      DATA TICKY(1) /'.'/
      DATA TICKY(9) /'.'/
      DATA TICKY(17) /'.'/
      DATA TICKY(25) /'.'/
      DATA TICKY(33) /'.'/
      DATA TICKX(1), TICKX(36), TICKX(73) /3 * '|'/
C
      DATA LABELX /'TIME  ---->'/
C
      DATA FILN /'FILENAME.DAT', 49*' '/

C----------------------------------------------------------------------
      END
```

```
C-------------------------------------------------------------------
C
      SUBROUTINE CARBON (IST, IAW, WATCN, AIRCN, ANCONS, ANDRNK, CSOIL,
     .                   EDIBL, AQUA, RIRR, MOPYR)
C
C     This module calculates environmental concentrations of C-14 using
C     a simplified specific-activity model
C
C     Module of DITTY of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification:  13-Jul-88 RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-------------------------------------------------------------------
C
C     IST
C     IAW
C     WATCN
C     AIRCN
C     ANCONS(7)
C     ANDRNK(7)
C     CSOIL
C     EDIBL(7)
C     AQUA(5)
C
C-------------------------------------------------------------------
C
      INCLUDE 'BIODAT.CMN'
C
C
      DIMENSION ANCONS(7), ANDRNK(7), EDIBL(7), AQUA(5)
C
      REAL MOPYR
C
      DATA C0 /2.0E-5/
      DATA C1 /1.6E-4/
      DATA C2 /0.09/
      DATA C3 /0.4/
      DATA C4 /0.09/
      DATA C5 /0.07/
      DATA C6 /0.24/
      DATA C7 /0.33/
      DATA C8 /0.20/
      DATA C9 /0.15/
C
      DATA Z1 /0.1/
      DATA Z2 /0.03/
      DATA SDEN /224./
```


9 1 0 4 8 1 2 1 4

```
      DATA SKG /0.01/
      DATA PKG /0.1/
      DATA RMV /1.25/
C
C
      CWAT = WATCN*RIRR*MOPYR*PKG*RMV/(SDEN*SKG)
      CAIR = AIRCN / C1
      CLEAF = CAIR + CWAT
      IF (RIRR .EQ. 0.0 .OR. MOPYR .EQ. 0.0) THEN
        CSOIL = 0.0
      ELSE
        CSOIL = (CAIR + WATCN/C0) * Z2
      ENDIF
C
      EDIBL(1) = CLEAF * C2
      EDIBL(2) = EDIBL(1)
      EDIBL(3) = C9 * CLEAF
      EDIBL(4) = C5 * CLEAF
      EDIBL(5) = C6 * CLEAF
      EDIBL(6) = C7 * CLEAF
      EDIBL(7) = C8 * CLEAF
C
      IF (IAW .EQ. 2)  THEN
C
        DO 100 I = 1, 4
          AQUA(I) = BIOACF(I,IST) * WATCN
  100   CONTINUE
C
        AQUA(5) = WATCN * DWCF(IST)
C
      ENDIF
C
      RETURN
      END
```

```
C-----------------------------------------------------------------------
C
      SUBROUTINE CASE2
C
C     This module controls data input
C
C     Module of DITTY of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification:  15-Jul-88 RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
      INCLUDE 'AIRCON.CMN'
      INCLUDE 'BIODAT.CMN'
      INCLUDE 'DISPSN.CMN'
      INCLUDE 'NAMLST.CMN'
      INCLUDE 'OPTION.CMN'
      INCLUDE 'PATHIN.CMN'
      INCLUDE 'POPU.CMN'
      INCLUDE 'TIMES2.CMN'
      INCLUDE 'TITL.CMN'
      INCLUDE 'VARYBL.CMN'

      CHARACTER DUM*8
      INTEGER IEND
      REAL RTEMP

      NAMELIST /INPUT/ IAC, IAIR, IPATH, IWAT, LUA, LUW, ISALT, TZ, TZR,
     .                 DIST, NDIST, NSECT, IEOQ, HS,
     .                 IPA, IPL, IPOP, NTA, NTL, PL, PL1, PM1, PM,
     .                 IPOPL, PMA, POPT, PPL, T, TL, CFLO, RECON, RM,
     .                 USAGE, CONSUM, EXTIM, GRWP, MOPYR, RIRR, YELD,
     .                 IGRPOP, IGRPM, IGRPL, IGRTNU, IGRNUC, IGRDOS,
     .                 IREDE

      DATA TEN4 /10000./
C
C     ASSIGN LOGICAL UNIT DEVICE NUMBER OF INPUT FILE--
      IUN = 33
C
C     READ A NAMELIST INPUT DATA SET--
      READ (IUN,INPUT,ERR=91,END=9)
C
C     IF AIRBORNE RELEASES ARE TO BE CONSIDERED--
      IF (IPATH .LE. 1)   THEN
C
        IF (IEOQ .EQ. 1)  THEN
```

```
C         READ E/Q FOR EACH DISTANCE AND DIRECTION--

          CALL ZEROR (160, EOQ)

          LUN = 24
          CALL OPNFIL (4, 0, LUN)
          READ (LUN,111,ERR=98,END=99) DUM, DUM, DUM

C         Read EOQ data set for first eight directions, followed by 9-16--
          IEND = (NSECT + 1) / 2

C         Read over effective average windspeed--
          READ (LUN,'(A8)') DUM

C         Read distance, EOQ--
          DO 100 ID = 1, NDIST
            READ (LUN,*) RTEMP, (EOQ(ID,IS), IS=1,IEND)
  100     CONTINUE

C         Repeat--
          READ (LUN,111) DUM, DUM, DUM
          DO 101 ID = 1, NDIST
            READ (LUN,*) RTEMP, (EOQ(ID,IS), IS=IEND+1,NSECT)
  101     CONTINUE
C
        ELSE
C
          IF (IEOQ .EQ. 2)  THEN
C           READ JOINT FREQUENCY DATA--
C
            CALL ZEROR (896,F)
C
            LUN = 23
            CALL OPNFIL (4,0,LUN)
            READ (LUN,'(A8)') DUM
            READ (LUN,*) NUBAR, NMET
            READ (LUN,*) (UBAR(IU), IU=1,NUBAR)

            DO 200 IU = 1, NUBAR
              DO 300 IM = 1, NMET
                READ (LUN,*) (F(IU,IM,IT), IT=1,16)
  300         CONTINUE
  200       CONTINUE
C
            CALL EOVRQ
C           TO GENERATE E/Q.
C
          ELSE
C
```


9 1 0 4 8 1 2 1 7

```
            IF (IEOQ .EQ. 3)  THEN
              CALL EOVRQ
C             TO GENERATE E/Q.
            ENDIF

          ENDIF
        ENDIF
C
C
C       IF REQUIRED--
        IF (IPOP .EQ. 2)    THEN
C
          CALL ZEROR (160, POP)
          POPT(1) = 0.
C
C         TRANSFER INPUT TOTAL POPULATION--
          IF (NTA .GT. 0) THEN
            DO 602 I = 2, NTA
              POPT(I) = PM1(I)
  602       CONTINUE
          ENDIF
C
C         Read times in NAMELIST--
          LUN = 27
          CALL OPNFIL (4,0,LUN)
          READ (LUN,11) DUM, DUM

C         READ POPULATION DATA FOR TIME(1)--
          DO 400 IS = 1, 16
            READ (LUN,1000,ERR=98,END=99) (POP(I,IS), I=1,NDIST)
            DO 401 I = 1, NDIST
              POPT(1) = POPT(1) + POP(I,IS)
  401       CONTINUE
  400     CONTINUE
C
C         CALCULATE FIRST PM1 VALUE--
          CALL PMEQ (NDIST, PM1(1) )
C
          IF (NTA .GT. 1) CALL PMSET (NTA, POPT, PM1)
C
        ELSE
C
C
          IF (IPOP .EQ. 3)   THEN
C
            NTAT = 0
            CALL ZEROR (20, POPT)
C
C           Open file, read population file title--
```

```
            LUN = 27
            CALL OPNFIL (4,0,LUN)
            READ (LUN,11) DUM, DUM
C
C           LOOP UNTIL NTAT = 20 OR T(NTAT) > TZ+10000 OR NTAT-1 = NTA
  500       CONTINUE
C
              NTAT = NTAT + 1
C
C             READ POPULATION DATA FOR TIME NTAT FROM LIBRARY FILE 22--
              DO 600 IS = 1, 16
                READ (LUN,1000,ERR=98,END=99) (POP(I,IS), I=1,NDIST)
                DO 601 I = 1, NDIST
                  POPT(NTAT) = POPT(NTAT) + POP(I,IS)
  601           CONTINUE
  600         CONTINUE
              CLOSE (LUN)
C
              CALL PMEQ (NDIST, PM1(NTAT) )
C
            IF (NTAT .LT. 20 .AND. T(NTAT) .LE. (TZ + TEN4)
     .          .AND. NTAT  .LT. NTA)  GO TO 500
C
          ELSE
            IF (IPOP .EQ. 5)    THEN
C

              CALL PMEQ (NDIST, PM1(1) )
              IF (NTA .GT. 1) CALL PMSET (NTA, POPT, PM1)
C
            ELSE
              IF (IPOP .EQ. 6) THEN
                DO 612 I = 2, 144
                  PM(I) = 0.0
  612           CONTINUE
              ENDIF
C
            ENDIF
          ENDIF
        ENDIF
C
C
        IF (IPOP .GT. 1 .AND. IPOP .LT. 6) THEN
          CALL PMINT (NTA, TZ, T, PM1, PM(2) )
        ENDIF
C
C
        IF (IAC .GT. 0)   THEN
C
```

```
            IF (IPA .EQ. 1)  PM(1) = PMA
            IF (IPA .GT. 1)  CALL PMAC (NTA, PM1, T, TZ, PM(1) )
C
          ENDIF
C
        ENDIF
C
C
C
C       IF WATERBORNE RELEASES ARE TO BE CONSIDERED, TOTAL POPULATION IN
C       EACH 70 YEAR PERIOD IS SET IF NECESSARY--
C
        IF (IPATH .NE. 1)  THEN
          IF (IPOPL .EQ. 2)  THEN
            CALL PMINT (NTL, TZ, TL, PL1, PL(2) )
          ENDIF
C
          IF (IAC .GT. 0)   THEN
C
            IF (IPL .EQ. 1)  PL(1) = PPL
            IF (IPL .GT. 1) CALL PMAC (NTL, PL1, TL, TZ, PL(1) )
C
          ENDIF
C
        ENDIF
        RETURN

      9 CONTINUE
        WRITE (*,*) 'Normal termination of DITTY'
        STOP

C       ERROR CONDITIONS--

     91 WRITE (*,*) 'NAMELIST READ ERROR ENCOUNTERED IN CASE2'
        STOP

     98 CALL FILERR (2, LUN, 'In CASE2          ')
     99 CALL FILERR (3, LUN, 'In CASE2          ')

C       FORMAT STATEMENTS--

     11 FORMAT (A8/A8)
    111 FORMAT (A8/A8/A8)
   1000 FORMAT (10E8.0)
   2000 FORMAT (16F5.0)
   3000 FORMAT (E10.0)
   4000 FORMAT (20A4)

        END
```


9104812220

```
C-----------------------------------------------------------------------
C
      SUBROUTINE CONSET (ACTSET, T, C, NT, IBEG, IEND, CONS)
C
C     This module establishes release data for one radionuclide for the
C     seventy year increment
C
C     Module of DITTY of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification:  3-Aug-88  RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C     T(450)       -  TIME POINTS FOR SPECIFYING ACTIVITY RELEASE
C                     RATES, YEARS SINCE START OF CALCULATION
C     C(450)       -  ACTIVITY RELEASED PER YEAR AT EACH TIME
C                     POINT, CI/YR
C     NT           -  NO. OF TIME POINTS DATA SUPPLIED FOR IN
C                     ARRAYS T & C, 2 <= NT <= 300
C     IBEG         -  1ST 70-YR INCREMENT WITH A NON-ZERO RELEASE
C                     ACTIVITY FOR THE CURRENT RADIONUCLIDE
C     IEND         -  LAST 70-YR INCREMENT THAT HAS A NON-ZERO
C                     RELEASE ACTIVITY FOR THE CURRENT NUCLIDE
C     CONS(143)    -  TOTAL ACTIVITY RELEASED IN EACH OF THE 143
C                     70-YR INCREMENTS, CI
C     ACTSET       -  Flag set if activity was set into air or water
C                     activity array, (ACTA or ACTW).  Warning printed
C                     to screen if not set.
C
C-----------------------------------------------------------------------

      INCLUDE 'TIMES2.CMN'
      INCLUDE 'OPTION.CMN'

      REAL T(450), C(450), CONS(144)
      LOGICAL ACTSET

C     INITIALIZE VARIABLES--
      IR = 1
      IRS = 0
      IEND = 0
      IBEG = 0
C
      S70 = 70.
      S35 = 35.
C
C     IF ACUTE RELEASE, SET CONS AND SKIP TO END OF SUBROUTINE--
```


9 1 0 4 8 1 2 2 1

```
      IF (T(1) .EQ. 0.0 .AND. T(2) .EQ. 1.0) THEN
        CONS(1) = C(1)
        IBEG = 0
        IEND = 1
        ACTSET = .TRUE.
        GO TO 500
      ENDIF
C
C
C     LOOP UNTIL IRS IS GREATER THAN 0   OR   IR IS GREATER THAN NT--
  100   IF (TZ .LT. T(IR) + TZR)    THEN
          IRS = IR
          IF (TZ+70. .GE. T(IR)+TZR)  IBEG = 1
        ELSE
          IR = IR + 1
        ENDIF
      IF (IRS .LE. 0  .AND.  IR .LE. NT)   GO TO 100
C
C
      IF (IR .LE. NT)    THEN
C
        IR = IRS
        IN = 1
        TIR = TZR + T(IR)
        IF (IBEG .LT. 1)    IBEG = IN
C
C       LOOP UNTIL IN IS GREATER THAN 143 OR IR IS GREATER THAN NT--
C
  200     T7B = TZ + 70. * FLOAT (IN - 1)
          T7E = T7B + 70.
          R = 0.
C
          IF (T7E .LE. TIR)    THEN
C
            IF (IR .GT. 1)    THEN
C
C
              CIR = C(IR)
              TIR = T(IR) + TZR
C
              SLOPE = (CIR -C(IR-1)) / (TIR - T(IR-1)-TZR)
C
              CONS(IN+1) = S35 * SLOPE * (T7E+ T7B)  +  S70 * CIR
     .                   - S70 * SLOPE * TIR
              ACTSET = .TRUE.
C
            ENDIF
C
            IN = IN + 1
```

```
C
         ELSE
C
           IF (IR .GT. 1)    THEN
C
             TIR = TZR + T(IR)
             C1 = C(IR-1)
             C2 = C(IR)
             T1 = TZR + T(IR-1)
             C7 = (C2 -C1) * (T7B - T1) / (TIR-T1) + C1
             R = (C2 + C7) * (TIR - T7B) / 2.
C
           ENDIF
C
           IR = IR + 1
C
           IF (IR .LE. NT)    THEN
C
             KEND = 0
C
C            LOOP UNTIL END IS GREATER THAN 0 OR IR IS GREATER THAN NT--
C
  300          TIR = TZR + T(IR)
C
               IF (T7E .LE. TIR)    THEN
C
                 KEND = 1
                 C1 = C(IR-1)
                 C2 = C(IR)
                 T1 = TZR + T(IR-1)
                 C7 = (C2-C1) * (T7E - T1) / (TIR - T1) + C1
                 R = R + (C1 + C7) * (T7E - T1) / 2.
C
               ELSE
C
                 R = R + (C(IR) + C(IR-1)) * (T(IR) - T(IR-1)) / 2.
                 IR = IR + 1
C
               ENDIF
C
               IF (KEND .GT. 0) GO TO 400
                  IF (NT .LT. IR) GO TO 400
                GO TO 300
  400 CONTINUE
C
           ENDIF
C
           CONS(IN+1) = R
           ACTSET = .TRUE.
```

```
            IN = IN + 1
            IEND = IN
C
          ENDIF
C
        IF (IN .LE. 143   .AND. IR .LE. NT) GO TO 200
C
      ENDIF
C
  500 CONTINUE
C
C
      RETURN
      END
```

91048 1224

```
C-----------------------------------------------------------------------
C
      SUBROUTINE CONTRL (IAC, IPATH, ITAM, ITAX, ITWM, ITWX)
C
C     This module controls the calling of the routines calculating
C     environmental accumulation and decay ofradionuclides and
C     the accumulation and sumation of resulting doses
C
C     Module of DITTY of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification:  17-Aug-88 RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C     IAC     -  IF > 0, CONSIDER AN ACUTE RELEASE PERIOD
C                AT BEGINNING OF 70-YR PERIOD
C     IPATH   -  PATHWAY SELECTION: BOTH = 0, AIR = 1,
C                WATER = 2
C
C-----------------------------------------------------------------------
C
      INCLUDE 'EDCN.CMN'
      INCLUDE 'RESULT.CMN'
      INCLUDE 'NUCNAM.CMN'
C
C     INITIALIZE CONCENTRATION ARRAYS--
C
      DO 200 IN = 1, NUCTOT
        SLCON(IN) = 0.0
        AIRCON(IN) = 0.0
        WATCON(IN) = 0.0
        SCONW(IN) = 0.0
        SEDCON(IN) = 0.0
        POPSUB(IN) = 0.0
        POPEXT(IN) = 0.0
        DO 204 IO = 1, 25
          POPINT(IO,IN) = 0.0
  204   CONTINUE
        DO 201 IN2 = 1, 7
          EDBCON(IN2,IN) = 0.0
          EDBCNW(IN2,IN) = 0.0
  201   CONTINUE
        DO 202 IN2 = 1,5
          AQUATC(IN2,IN) = 0.0
  202   CONTINUE
  200 CONTINUE
C
```

```
      DO 203 IT = 1, 144
        DTOTAL(IT) = 0.0
        DOSSUB(IT) = 0.0
        DOSEXT(IT) = 0.0
  203 CONTINUE
C
C
      HIAEDE = 0.0
      HIEXT = 0.0
      HISUB = 0.0
      HIEDE = 0.0
      MAXTIM = 0

      IF (IAC .GT. 0)  THEN
C
        IF (IPATH .LE. 1)  CALL APATHS (1, ITAX)
C       TO CALCULATE CONCENTRATIONS FROM ATMOSPHERIC DEPOSITION.
C
        IF (IPATH .NE. 1)  CALL WPATHS (1, ITWX)
C       TO CALCULATE CONCENTRATIONS FROM AQAUATIC PATHWAYS.
C
C       Third parameter added to call list to indicate acute/chronic case--
        CALL DOSADD (1, 1, IAC)
C       TO ACCUMULATE 70-YR INCREMENTAL DOSES.
C
      ENDIF
C
C
C     FOR EACH 70-YR TIME STEP FOR 10,000 YEARS--
      DO 100 ITT = 2, 144
C
        IF (IPATH .LE. 1 .AND. (ITT .GE. ITAM .OR. IAC .GT. 0))  THEN
          CALL APATHS (ITT, ITAX)
        ENDIF
C
        IF (IPATH .NE. 1 .AND. (ITT .GE. ITWM .OR. IAC .GT. 0))  THEN
          CALL WPATHS (ITT, ITWX)
        ENDIF
C
        CALL DOSADD (2, ITT, IAC)
C
C
  100 CONTINUE

      RETURN
      END
```

```
C-----------------------------------------------------------------------
C
      SUBROUTINE DITBYP
C
C     This module writes a report of dose by exposure pathway.
C
C     Module of Program DITTY of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 18-Aug-88  RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C     IP         - Index of the current exposure pathway
C     NL         - Intermediate organ index for printing
C     ILINE      - Number of data lines this page
C     NA         - Number of organs to be printed this data set, used to
C                  control printing of dashes
C
C-----------------------------------------------------------------------

      INCLUDE 'ORGMAS.CMN'
      INCLUDE 'RESULT.CMN'
      INCLUDE 'NUCNAM.CMN'
      INCLUDE 'TIMES2.CMN'

      INTEGER NL, ILINE, NPATH, LUN, NA
      CHARACTER DASHES*8(10), EXPLAB*16(4)

      DATA NPATH /4/
      DATA DASHES /'--------','-------  ',8*' -------'/
      DATA EXPLAB /'Inhalation',
     .             'Ingestion (Terr)',
     .             'Ingestion (Aqua)',
     .             'Drinking Water'/

      NA = 10
      LUN = 17
      CALL HEADIT (LUN)

C     Write internal dose report--

      WRITE (LUN,1021)
      WRITE (LUN,1111) MAXTIM*70 + TZ, MAXTIM

      WRITE (LUN,1003) (MASORG(ICLN(IO)),IO=1,8)
      WRITE (LUN,1002) DASHES
      DO 141 IP = 1, NPATH
```

```
      WRITE (LUN,1006) EXPLAB(IP), (HIDOSV(ICLN(IO),IP),IO = 1, 8)
  141 CONTINUE

      WRITE (LUN,1002) DASHES
      WRITE (LUN,1009) (DOSINT(ICLN(IO),MAXTIM),IO=1,8)

      NL = 16
      IF (NORGS .LT. NL) THEN
        NL = NORGS
        NA = NORGS-6
      ENDIF

      WRITE (LUN,1003) (MASORG(ICLN(IO)),IO=9,NL)
      WRITE (LUN,1002) (DASHES(I),I=1,NA)
      DO 142 IP = 1, NPATH
        WRITE (LUN,1006) EXPLAB(IP), (HIDOSV(ICLN(IO),IP),IO=9,NL)
  142 CONTINUE
      WRITE (LUN,1002) (DASHES(I),I=1,NA)
      WRITE (LUN,1009) (DOSINT(ICLN(IO),MAXTIM),IO=9,NL)

      IF (NL  .GT. 16) THEN
        NL = 24
        IF (NORGS .LT. NL) THEN
          NL = NORGS
          NA = NORGS - 14
        ENDIF

        WRITE (LUN,1003) (MASORG(ICLN(IO)),IO=17,NL)
        WRITE (LUN,1002) (DASHES(I),I=1,NA)
        DO 143 IP = 1, NPATH
          WRITE (LUN,1006) EXPLAB(IP), (HIDOSV(ICLN(IO),IP),IO=17,NL)
  143   CONTINUE
        WRITE (LUN,1002) (DASHES(I),I=1,NA)
        WRITE (LUN,1009) (DOSINT(ICLN(IO),MAXTIM),IO=17,NL)

        IF (NORGS .GT. 24) WRITE (LUN,'(2A)')
     .         'Data not printed for organ ',MASORG(ICLN(NORGS))
      ENDIF

      WRITE (LUN,2004)

      RETURN

C---- Format Statements ------------------------------------------------

 1002 FORMAT (' ',10A8)
 1003 FORMAT (' Pathway          ',8(A7,1X))
 1006 FORMAT (' ',A16,1P, 8E8.1E2)
 1008 FORMAT (' ',A2, A6, 8X,1P, 8E8.1E2)
```

```
1009 FORMAT (' Total internal  ',1P, 8E8.1/)

1021 FORMAT (//,T16,'Population Internal Dose To Organ by Exposure ',
    .         'Pathway')
1111 FORMAT (//, T13,'In Year ',I5,
    .         ' (70-yr Time Period Number No:',I4,')'/)

2004 FORMAT (//,' Dose in units of person-rem;'/
    .          '   that is the cumulative population dose received by ',
    .          'the local population '/
    .          '   with an assumed 70-yr individual lifetime.')


C-----------------------------------------------------------------------
      END
```

9 1 0 4 8 1 2 2 9

```
C-----------------------------------------------------------------------
C
      SUBROUTINE DITBYR
C
C     This module writes a report of dose by radionuclide.
C
C     Module of Program DITTY of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 18-Aug-88  RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-------------------------------------------------------------------
C
C     IN        - Index of the current radionuclide
C     NL        - Intermediate organ index for printing
C     ILINE     - Number of data lines this page
C     NA        - Number of organs to be printed this data set, used to
C                 control printing of dashes
C
C-------------------------------------------------------------------

      INCLUDE 'ORGMAS.CMN'
      INCLUDE 'RESULT.CMN'
      INCLUDE 'NUCNAM.CMN'
      INCLUDE 'TIMES2.CMN'

      INTEGER NL, ILINE, LUN, NA

      CHARACTER DASHES*8(10)
      DATA DASHES /'--------','-------  ',8*' -------'/
      NA = 10

      LUN = 17
      MAXLIN = 38
      NSET = NUCTOT / MAXLIN
      IDD = MOD (NUCTOT, MAXLIN)
      IF (IDD .GT. 0) NSET = NSET + 1

C     Break radionuclides into pages--
      DO 200 ISET = 1, NSET

        ISTART = (ISET - 1) * MAXLIN + 1
        ISTOP = ISET * MAXLIN
        IF (ISTOP .GT. NUCTOT) ISTOP = NUCTOT

        CALL HEADIT (LUN)

C       Write internal report--
```


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```
      WRITE (LUN,1021)
      WRITE (LUN,1111) MAXTIM*70 + TZ, MAXTIM
      WRITE (LUN,1003) (MASORG(ICLN(IO)),IO=1,8)
      WRITE (LUN,1002) DASHES

      DO 141 IN = ISTART, ISTOP
        WRITE (LUN,1006) ELT(IN), AW(IN),
     .                   (HIDOSR(ICLN(IO),IN),IO=1,8)
141   CONTINUE

      WRITE (LUN,1002) DASHES
      WRITE (LUN,1009) (DOSINT(ICLN(IO),MAXTIM),IO=1,8)

      NL = 16
      IF (NORGS .LT. NL) THEN
        NL = NORGS
        NA = NORGS-6
      ENDIF

      IF (NUCTOT. GT. 15) THEN
        WRITE (LUN,2004)
        CALL HEADIT (LUN)
        WRITE (LUN,1021)
        WRITE (LUN,1111) MAXTIM*70 + TZ, MAXTIM
      ENDIF

      WRITE (LUN,1003) (MASORG(ICLN(IO)),IO=9,NL)
      WRITE (LUN,1002) (DASHES(I),I=1,NA)

      DO 142 IN = ISTART, ISTOP
        WRITE (LUN,1006) ELT(IN), AW(IN),
     .                   (HIDOSR(ICLN(IO),IN),IO=9,NL)
142   CONTINUE

      WRITE (LUN,1002) (DASHES(I),I=1,NA)
      WRITE (LUN,1009) (DOSINT(ICLN(IO),MAXTIM),IO=9,NL)

      IF (NL  .GT. 16) THEN
        NL = 24
        IF (NORGS .LT. NL) THEN
          NL = NORGS
          NA = NORGS - 14
        ENDIF

        WRITE (LUN,1003) (MASORG(ICLN(IO)),IO=17,NL)
        WRITE (LUN,1002) (DASHES(I),I=1,NA)

        DO 143 IN = 1, ISTART, ISTOP
```

```
            WRITE (LUN,1006) ELT(IN), AW(IN),
     .                       (HIDOSR(ICLN(IO),IN),IO=17,NL)
  143     CONTINUE

          WRITE (LUN,1002) (DASHES(I),I=1,NA)
          WRITE (LUN,1009) (DOSINT(ICLN(IO),MAXTIM),IO=17,NL)

          IF (NORGS .GT. 24) WRITE (LUN,'(2A)')
     .      'Data not printed for organ ',MASORG(ICLN(NORGS))
        ENDIF

C------ Write external report ------------------------------------------

        IF (NUCTOT. GT. 15) THEN
          WRITE (LUN,2004)
          CALL HEADIT (LUN)
        ENDIF
        WRITE (LUN,1011)
        WRITE (LUN,1111) MAXTIM*70 + TZ, MAXTIM
        WRITE (LUN,1004)
        WRITE (LUN,1002) (DASHES(I),I=1,4)
        ILINE = ILINE + 8

        DO 144 IN = ISTART, ISTOP
          WRITE (LUN,1006) ELT(IN), AW(IN), HISUBR(IN), HIEXTR(IN)
          ILINE = ILINE + 1
  144   CONTINUE

        WRITE (LUN,1002) (DASHES(I),I=1,4)
        WRITE (LUN,1007) HISUB, HIEXT
        WRITE (LUN,2004)

  200 CONTINUE

      RETURN

C---- Format Statements ------------------------------------------------

 1002 FORMAT (' ',10A8)
 1003 FORMAT (/' Radionuclide     ',8(A7,1X))
 1004 FORMAT (/'                  Air'/
     .        '                  Submer-  Exter-'/
     .        ' Radionuclide     sion     nal')
 1006 FORMAT (' ',A2,1X,A6, 7X,1P, 8E8.1E2)
 1007 FORMAT (' Total external  ',1P, 8E8.1E2//)
 1009 FORMAT (' Total internal  ',1P, 8E8.1)
 1011 FORMAT (//,T8,'Population Air Submersion and External ',
     .        'Incremental Dose by Radionuclide')
```


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```
1021 FORMAT (//,T17,'Population Internal Dose To Organ by ',
     .         'Radionuclide')
1111 FORMAT (T17,'In Year ',I5,
     .         ' (70-yr Time Period Number No:',I4,')'/)

2004 FORMAT (//,' Dose in units of person-rem;'/
     .         '    that is the cumulative population dose received by ',
     .         'the local population '/
     .         '    with an assumed 70-yr individual lifetime.')

C-----------------------------------------------------------------------
      END
```

9 1 0 4 8 1 2 3 3

```
C------------------------------------------------------------------------
C
      SUBROUTINE DOSADD (ICUTE, ITT, IAC)
C
C     This module calculates 70-year incremental population doses
C     from exposure to contaminated environmental media
C
C     Module of DITTY of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification:  17-Aug-88 RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C------------------------------------------------------------------------
C
C     CONST4    - Internal dose factor conversion unit; from person Sv
C                 per 70 Bq/70 yr to person rem per Ci/70 yr
C     CONST5    - Breathing rate (m3/sec)
C     DEXTR()   - External dose by radionuclide
C     DOSCDR()  - Dose commitment te each organ by radionuclide
C     DOSCDV()  - Dose commitment to each organ by pathway
C     DSUBR()   - Air submersion dose by radionuclide
C     ICUTE     - INDICATES IF ACUTE OR CHRONIC DOSE FACTORS ARE TO BE
C                 USED IN CALCULATIONS
C     ITT       - INDEX OF 70-YR INCEREMENTS
C     IAC       - ACUTE/CHRONIC INDEX
C     RADEDE()  - Effective dose equivalent by radionuclide
C
C------------------------------------------------------------------------
C
      INCLUDE 'PATHIN.CMN'
      INCLUDE 'EDCN.CMN'
      INCLUDE 'DKAY.CMN'
      INCLUDE 'ORGMAS.CMN'
      INCLUDE 'DOSFAC.CMN'
      INCLUDE 'GRDDAT.CMN'
      INCLUDE 'RESULT.CMN'
      INCLUDE 'FLAGS.CMN'

      REAL DOSINC, DOSCDR(25,100), DOSCDV(25,4),
     .     DSUBR(100), DEXTR(100)
C
      DATA CONST1 /3.15E+07/
      DATA CONST2 /1.49E-8/
      DATA CONST3 /224./
      DATA CONST4 /5.29E+10/
      DATA CONST5 /2.66E-4/
C
      IF (ITT .EQ. 1 .OR. (ITT .EQ. 2 .AND. IAC .EQ. 0)) HIAEDE = 0.
```


9 1 0 4 8 1 2 3 4

```
C
      CALL ZEROR (2500, DOSCDR)
      CALL ZEROR (100, DOSCDV)
      CALL ZEROR (100, DSUBR)
      CALL ZEROR (100, DEXTR)
C
C
C     FOR EACH RADIONUCLIDE--
      DO 100 I = 1, INUC
C
        ARI = AR(I)
C
C       Internal dose--

C       FOR EACH ORGAN--
        DO 200 IO = 1, 22
          IF (IOFLG(IO)) THEN

C           ADD INHALATION DOSE--
            DOSINC = DFH(ICUTE,IO,I) * CONST4 * CONST5 * CONST1 *
     .               ARI *
     .               (AIRCON(I) + CONST2 * (SLCON(I) + SCONW(I)) )
            DOSCDR(IO,I) = DOSCDR(IO,I) + DOSINC
            DOSCDV(IO,1) = DOSCDV(IO,1) + DOSINC
C
C           ADD TERRESTRIAL PATHWAY DOSES--
            DO 300 IP = 1, 7
              DOSINC = ARI * CONSUM(IP) * DFG(ICUTE,IO,I) * CONST4
     .                 * (EDBCON(IP,I) + EDBCNW(IP,I) )
              DOSCDR(IO,I) = DOSCDR(IO,I) + DOSINC
              DOSCDV(IO,2) = DOSCDV(IO,2) + DOSINC

  300       CONTINUE
C
C           ADD AQUATIC PATHWAY DOSES--
            DO 400 IWP = 1, 4
              DOSINC =  ARI * USAGE(IWP) * DFG(ICUTE,IO,I) * CONST4
     .                  * AQUATC(IWP,I)
              DOSCDR(IO,I) = DOSCDR(IO,I) + DOSINC
              DOSCDV(IO,3) = DOSCDV(IO,3) + DOSINC
  400       CONTINUE
C
C           ADD DRINKING WATER--
            DOSINC =  ARI * USAGE(5) * DFG(ICUTE,IO,I) * CONST4
     .                * AQUATC(5,I)
            DOSCDR(IO,I) = DOSCDR(IO,I) + DOSINC
            DOSCDV(IO,4) = DOSCDV(IO,4) + DOSINC

C           Total CDE to each organ this time period--
```

```
          DOSINT(IO,ITT) = DOSCDV(IO,1) + DOSCDV(IO,2) +
     .                     DOSCDV(IO,3) + DOSCDV(IO,4)
C
         ENDIF
  200   CONTINUE

C       External dose--

C       ADD AIR SUBMERSION DOSE--
        DOSINC = EDA(I) * ARI * CONST1 *
     .           (AIRCON(I) + CONST2 * (SLCON(I) + SCONW(I)) )
        DSUBR(I) = DOSINC
        DOSSUB(ITT) = DOSSUB(ITT) + DOSINC

C       ADD SWIMMING AND SHORELINE--
        IF (SW .EQ. 0.0)    SW = 0.2
        DOSINC = (USAGE(6) * SEDCON(I) * SW * EDS(I)  +
     .            USAGE(7) * WATCON(I) * EDW(I) ) * ARI
        DEXTR(I) = DOSINC
        DOSEXT(ITT) = DOSEXT(ITT) + DOSINC
C
C       ADD SOIL EXTERNAL--
        DOSINC = EXTIM * ARI * EDS(I) *
     .           (SLCON(I) + SCONW(I)) * CONST3
        DEXTR(I) = DEXTR(I) + DOSINC
        DOSEXT(ITT) = DOSEXT(ITT) + DOSINC
C
  100 CONTINUE
C
C     Calculate whole bode effective dose equivalent--
      CALL WBEDE2 (ITT)

C     ADD PREVIOUS DOSE TO TOTAL--
      IF (ITT .EQ. 1) THEN
        DTOTAL(1) = AEDE2(ITT)
      ELSE
        DTOTAL(ITT) = AEDE2(ITT) + DTOTAL(ITT-1)
      ENDIF
C
C     Accumulate total dose by radionuclide--
      DO 704 I = 1, INUC
        POPSUB(I) = POPSUB(I) + DSUBR(I)
        POPEXT(I) = POPEXT(I) + DEXTR(I)
        DO 702 IO = 1, MORG
          POPINT(IO,I) = POPINT(IO,I) + DOSCDR(IO,I)
  702   CONTINUE
  704 CONTINUE
```

```
C     CAPTURE PERIOD WITH HIGHEST DOSE RATE--

      IF (AEDE2(ITT) .GT. HIAEDE)   THEN

C       Save maximum internal dose by radionuclide and pathway--
        MAXTIM  = ITT
        HIAEDE = AEDE2(ITT)
        HIEXT = DOSEXT(ITT)
        HISUB = DOSSUB(ITT)

        DO 600 IO = 1, MORG
          DO 500 I = 1, INUC
            HIDOSR(IO,I) = DOSCDR(IO,I)
  500     CONTINUE
          DO 510 IP = 1, 4
            HIDOSV(IO,IP) = DOSCDV(IO,IP)
  510     CONTINUE
  600   CONTINUE
C
C       Save external/air submersion doses--
        DO 610 I = 1, INUC
          HISUBR(I) = DSUBR(I)
          HIEXTR(I) = DEXTR(I)
  610   CONTINUE

      ENDIF
C
C
      RETURN
      END
```


9 1 0 4 8 1 2 3 7

```
C-----------------------------------------------------------------------
C
      SUBROUTINE EOVRQ
C
C     This module calculates annual average air concentration at each
C     spatial interval midpoint
C
C     Module of DITTY of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification:  11-Apr-88  RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
      INCLUDE 'DISPSN.CMN'
      INCLUDE 'AIRCON.CMN'
C
C     MESAGE IS USED TO OUTPUT ERROR MESSAGES--
      CHARACTER MESAGE*6
C
      DATA ZERO /0./
      DATA ONE /1./
      DATA IONE /1/
      DATA TWO /2./
      DATA ITWO /2/
      CALL ZEROR (160,EOQ)
      CONST1 = 0.02032
C
      IF (NUBAR .LT. 1  .OR.  NUBAR .GT. 8)  THEN
        MESAGE = 'NUBAR'
        WRITE (*,1000) MESAGE, NUBAR
        IER = 1
      ELSE
        IER = 0
      ENDIF
C
      IF (NDIST .LT. 1  .OR.  NDIST .GT. 10)  THEN
        MESAGE = 'NDIST'
        IER = IER + 1
        WRITE (*, 1000) MESAGE, NDIST
      ENDIF
C
      IF (NMET .LT. 1  .OR. NMET .GT. 7)  THEN
        MESAGE = 'NMET'
        IER = IER + 1
        WRITE (*, 1000) MESAGE, NMET
      ENDIF
```

```
      IF (IER .GT. 0)  CALL EXIT (1)

C     FOR EACH DISTANCE--
      DO 100 IX = 1, NDIST
C
        X = DIST(IX)
C
C       FOR EACH STABILITY CATEGORY--
        DO 200 IS = 1, NMET
C
          IP = MET(IS)
C
          CALL SIGMA (X, IP, SZ, SY)
C         TO INTERPOLATE PASQUILL CURVES FOR SY AND SZ FOR DISTANCE X
C         AND STABILITY IP.
C
          XSZ = X * SZ
C
          IF (HS .GT. ONE)  THEN
            EX = EXP( -HS * HS / (TWO * SZ * SZ) )
          ELSE
            EX = 1.0
          ENDIF
C
C
C         FOR EACH WINDSPEED--
          DO 300 IU = 1, NUBAR
C
            EQX = CONST1* EX / (UBAR (IU) * XSZ)
C
C           FOR EACH DIRECTION--
            DO 400 IT = 1, 16
C
              FF = F(IU,IS,IT)
              IF (FF .GT. ZERO)  EOQ(IX,IT) = EOQ(IX,IT)  +  EQX * FF
C
  400       CONTINUE
C
  300     CONTINUE
  200   CONTINUE
  100 CONTINUE
C
      RETURN
C
C     FORMAT STATMENTS--
C
 1000 FORMAT (10X, A6, ' IS OUT OF RANGE; ', I5)
      END
```

```
C-------------------------------------------------------------------
C
      SUBROUTINE FILLUP (FOFX, YINC, IN, NOAVE)
C
C     This module plots points of FOFX in the graphics array
C
C     Module of DITTY of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification:  9-Feb-88  RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-------------------------------------------------------------------
C
C     FOFX   -  FUNCTION OF TIME ARRAY
C     YINC   -  Y PLOTTING INCREMENT
C     IN     -  INDEX OF FUNCTIONS TO BE PLACED IN PRINTING
C               ARRAY
C     NOAVE  -  IF SET TO 1, DO NOT AVERAGE ZEROS INTO ARRAY
C
C-------------------------------------------------------------------
C
      INCLUDE 'PLOT.CMN'
      INCLUDE 'NUCNAM.CMN'
C
      REAL FOFX(144,8)
      LOGICAL NOFIND
      CHARACTER*1 THIS1, BLANK, POINT(8), MULT(9), AST
      CHARACTER*3 DASH
C
      DASH = ' - '
      AST = '.'
      BLANK = ' '
      POINT(1) = 'X'
      POINT(2) = 'O'
      POINT(3) = '+'
      POINT(4) = '='
      POINT(5) = '@'
      POINT(6) = '-'
      POINT(7) = '#'
      POINT(8) = '$'

      MULT(1) = '1'
      MULT(2) = '2'
      MULT(3) = '3'
      MULT(4) = '4'
      MULT(5) = '5'
      MULT(6) = '6'
      MULT(7) = '7'
```

```
      MULT(8) = '8'
      MULT(9) = '9'
C
      IY = 40
      IX = 73
C
C
C     PLOT EACH POINT IN ARRAY--
C
      DO 100 I = 1, IX
C
        I2 = (I - 1) * 2
C
        IF ( I .EQ. 1)    THEN
C
C         FIRST VALUE OF ARRAY--
          R1 = FOFX(1,IN) / YINC
C
        ELSE
C
C
          IF ( I .EQ. IX)    THEN
C
C           LAST VALUE OF ARRAY--
            R1 = FOFX(144,IN) / YINC
C
          ELSE
C
C         FOR ALL OTHER POINTS--
C
          F1 = FOFX(I2,IN)
          F2 = FOFX(I2+1,IN)
C
          R1 = (F1 + F2) / YINC
C
          IF (NOAVE .GT. 0)    THEN
C
C           AVERAGE IF NEITHER POINT IS EQUAL TO ZERO--
            IF (F1 .GT. 0.  .AND.  F2 .GT. 0.)  THEN
              R1 = R1 * 0.5
            ENDIF
C
          ELSE
C
            R1 = R1 * 0.5
C
          ENDIF
        ENDIF
C
```


9 1 0 4 8 1 2 4 1

```
         ENDIF
C
C
         IR2 = IFIX (R1)
         R2 = FLOAT (IR2)
C
         IF (ABS(R1 - R2) .GT. .5)   IR2 = IR2 + 1
         IP = IY - IR2
         IF (IP .LT. 1)    IP = 1
         IF (IP .GT. 40)    IP = 40
C
         THIS1 = ARRAY(IP,I)
C
         IF (THIS1 .EQ. BLANK  .OR.  THIS1 .EQ. AST)  THEN
C
           ARRAY(IP,I) = POINT(IN)
C
         ELSE
C
           NOFIND = .TRUE.
C
           DO 200 K = 2, 9
             IF (THIS1 .EQ. MULT(K))  THEN
C
               ARRAY(IP,I) = MULT(K+1)
               NOFIND = .FALSE.
C
             ENDIF
  200      CONTINUE
C
           IF (NOFIND)   ARRAY(IP,I) = MULT(1)
C
         ENDIF
C
  100 CONTINUE
C     LEGEND(IN + 30) = MULT(IN) & DASH & ELT(IN) & AW(IN)
      RETURN
      END
```


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```
C-----------------------------------------------------------------------
C
      SUBROUTINE FOOLIN
C
C     This module reads in crop and animal food concentration ratios,
C     deposition velocities and soil percolation constants from
C     a library file
C
C     Module of DITTY of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification:  17-Aug-88 RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
      INCLUDE 'FODATA.CMN'
      INCLUDE 'NUCNAM.CMN'
C
      CHARACTER E*2, DUM*8
      REAL CR(8)
C
C     INITIALIZE LOGICAL UNIT DEVICES, and open file--
      IUN = 8
      CALL OPNFIL ((4), (0), IUN)
      READ (IUN,'(A)') DUM
      READ (IUN,'(A)') DUM
C
C     LOOP UNTIL END-OF-FILE ENCOUNTERED--
  300 CONTINUE
C
C        READ DATA CARD--
         READ (IUN,2001,ERR=800,END=999) E, DVL, (CR(I),I=1,8), PERC
C
C        SEARCH FOR MATCHING RADIONUCLIDE IN MASTER LIBRARY--
         DO 100 J = 1, NUCTOT
C
           IF (E .EQ. ELT(J))   THEN
C
C            TRANSFER DATA INTO ARRAYS--
             DVEL(J) = DVL
             AB(J) = PERC

C            Leafy and other vegetables--
             CRATIO(1,J) = CR(1) / 4.0

C            Eggs-
             CRATIO(2,J) = CR(8)
```

```
C            Milk--
             CRATIO(3,J) = CR(7)

C            Beef--
             CRATIO(4,J) = CR(5)

C            Poultry--
             CRATIO(6,J) = CR(6)

           ENDIF
  100    CONTINUE
C
C
C     IF NOT END-OF-FILE, READ NEXT CARD--
      GO TO 300

C     NORMAL TERMINATION--
  999 CLOSE (IUN)
      RETURN

C---- Error Conditions ---------------------------------------------------

  800 CALL FILERR (3, IUN, 'In FOOLIN')

C---- Format Statements --------------------------------------------------

 1000 FORMAT (20A4)
 2000 FORMAT (A2, 8E9.2)
 2001 FORMAT (A2, 1X, 10E8.0)

C-------------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------
C
      SUBROUTINE GRAPH (IYL, FOFX, NGRF, IORNUC, IFROM, NOAVE, IGRAW)
C
C     This module controls the printing of graphs of functions in
C     relation to time
C
C     Module of DITTY of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification:  9-Feb-88 RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C                   ARGUMENT LIST PARAMETER DESCRIPTIONS
C     ----------  ---------  ---------------------------------------
C     PARAMETER   TYPE       DESCRIPTION
C     ----------  ---------  ---------------------------------------
C
C     IYL         INTEGER    INDEX OF FUNCTION LABEL ARRAY
C     FOFX        REAL       FUNCTION OF TIME ARRAY
C     NGRF        INTEGER    NUMBER OF FUNCTIONS TO BE SUPERIMPOSED
C                            ON THIS GRAPH
C     IORNUC      INTEGER    INDEX OF RADIONULIDE OR ORGAN TO BE GRAPHED
C     IFROM       INTEGER    CALLED FROM: 0 = QAPAGE, 1 = REPORT
C     NOAVE       INTEGER    IF SET TO 1, DO NOT AVERAGE IN ZERO VALUES
C     IGRAW       INTEGER    RELEASE MESSAGE FLAG; 0 = NO MESSAGE,
C                            1 = AIR MESSAGE, 2 = WATER MESSAGE
C
C-----------------------------------------------------------------------
C
      INCLUDE 'NUCNAM.CMN'
      INCLUDE 'PLOT.CMN'
      INCLUDE 'TIMES2.CMN'

      CHARACTER ZERO*10, AST*1
      CHARACTER YLA*40(7)
      CHARACTER YLABEL*1(40,7), YLAB5*1(21), YLAB7*1(5)
      CHARACTER YL5*21, YL7*5
      CHARACTER*1 ELTM1(2,100), AWM1(6,100)

      EQUIVALENCE (YLABEL(1,1), YLA(1))
      EQUIVALENCE (YLAB5(1), YL5)
      EQUIVALENCE (YLAB7(1), YL7)
      EQUIVALENCE (ELTM1(1,1), ELT(1))
      EQUIVALENCE (AWM1(1,1), AW(1))
C
      DIMENSION NYL(7), TY(5), FOFX(144,8)
```

```
C
      YLA(1) = 'TOTAL POPULATION                                      '
      YLA(2) = 'POPULATION DISPERSION FACTOR - AIR                    '
      YLA(3) = 'POPULATION - WATER                                    '
      YLA(4) = 'TOTAL CURIES PER PERIOD                               '
      YLA(5) = '                                                      '
      YLA(6) = 'TOTAL ORGAN DOSE                                      '
      YLA(7) = '                                                      '
C
      YL5 = 'CURIES PER PERIOD OF '
      YL7 = ' DOSE'
      AST = '.'
      IY = 40
      IX = 73
      ZERO = 'ZERO'
C
      DATA NYL /16, 34, 18, 23, 29, 16, 15/
C
C     Output file--
      LUN = 17

      IF (IYL .EQ. 5)    THEN
        DO 510 I = 1,21
          YLABEL(I,5) = YLAB5(I)
  510   CONTINUE
        DO 511 I = 1,2
          YLABEL(I+21,5) = ELTM1(I,IORNUC)
  511   CONTINUE
        DO 512 I = 1,6
          YLABEL(I+23,5) = AWM1(I,IORNUC)
  512   CONTINUE
      ENDIF
C
C
      CALL SETUP (YLABEL(1,IYL), NYL(IYL))
C     TO STORE LABELS IN ARRAYS.
C
C     FIND MAXIMUM VALUE OF FOFX ARRAY--
      YMAX = 0.
      DO 300 IN = 1, NGRF
        DO 301 I = 1, 144
          IF (FOFX(I,IN) .GT. YMAX)   YMAX = FOFX(I,IN)
  301   CONTINUE
  300 CONTINUE
C
C
C     CALCULATE INCREMENT--
      YINC = YMAX / 40.
C
```

```
C     CHECK IF YINC IS ZERO OR VERY SMALL AND SKIP--
      IF (YINC .LT. 1.0E-30) THEN
        WRITE (LUN,1000) (YLABEL(I,IYL),I=1,40)
      ELSE
C       FILL TICK VALUE ARRAY--
        DO 200 I = 1, 5
          J = I - 1
          TY(I) = YMAX - (8 * YINC * J)
  200   CONTINUE
C
C
C       FOR EACH FUNCTION--
        DO 400 IN = 1, NGRF
          CALL FILLUP (FOFX, YINC, IN, NOAVE)
C         TO PLOT FOFX FUNCTION IN ARRAY.
  400   CONTINUE
C
        TZ5 = TZ + 5000.
        TZ10 = TZ + 10000.
        CALL HEADIT (IFROM)

C       PRINT INCREMENT INFORMATION
        WRITE (LUN,4000) YINC
C
C       PRINT AIR OR WATER RELEASE MESSAGE IF APPLICABLE--
        IF (IGRAW .GT. 0)   THEN
          IF (IGRAW .EQ. 1)  THEN
            WRITE (LUN,5000)
          ELSE
            WRITE (LUN,5001)
          ENDIF
        ENDIF
C
C       PRINT UPPER BORDER--
        WRITE (LUN,1001)
C
C       PRINT Y-AXIS INFORMATION AND ARRAY--
C
        K = 1
        DO 101 I = 1, IY
          IF (TICKY(I) .EQ. AST)   THEN
            WRITE (LUN,2000) LABELY(I), TY(K), TICKY(I),
     .                           (ARRAY(I,J), J = 1, IX)
            K = K + 1
          ELSE
            WRITE (LUN,2001) LABELY(I), TICKY(I),
     .                         (ARRAY(I,J), J = 1, IX)
          ENDIF
  101   CONTINUE
```


9 1 0 4 8 1 2 4 7

```
C
C        PRINT LOWER BORDER, X-AXIS INFORMATION--
         WRITE (LUN,3000) ZERO
         WRITE (LUN,3001) (TICKX(J), J = 1, IX)
         WRITE (LUN,3002) TZ, TZ5, TZ10
         WRITE (LUN,3003) LABELX
C
C
      ENDIF
C
      RETURN
C
C---- FORMAT STATEMENTS ---------------------------------------------
C
 1000 FORMAT (1X,A40, 'NOT PRINTED BECAUSE ALL ZERO.')
 1001 FORMAT (10X,73('.'))
 2000 FORMAT (1X, A1, 1PE8.1, 75A1)
 2001 FORMAT (1X, A1, 9X,     75A1)
C
 3000 FORMAT (2X,A8, 73('.') )
 3001 FORMAT (10X, 73A1)
 3002 FORMAT (6X, F10.0, 25X, F10.0, 25X, F10.0)
 3003 FORMAT (40X, A40)
C
 4000 FORMAT (/ ' Y-AXIS INCREMENT = ', 1PE10.2 /
     .          ' X-AXIS INCREMENT =   70 YEARS')
C
 5000 FORMAT (' AIR RELEASE'/)
 5001 FORMAT (' WATER RELEASE'/)
C
      END
```

```
C-----------------------------------------------------------------------
C
      SUBROUTINE GRDLIN
C
C     This module reads in dose factors for external exposure to soil
C     and water and air
C
C     Module of DITTY of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification:  29-Sep-87 RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
      INCLUDE 'GRDDAT.CMN'
      INCLUDE 'NUCNAM.CMN'
C
      CHARACTER A*6, E*2

C     Bq/Ci times yr/sec times rem/Sv
      DATA CONST1 /4.22E+8/

C     Bq/Ci times yr/hr times rem/sv
      DATA CONST2 /1.17E+5/

C     Finite to infinite conversion factor (water surface to immersion)--
      DATA TWO /2.0/

      NC=1
      IFLG1=0

  150 CONTINUE
      LUN = 10
      CLOSE (LUN)
      CALL OPNFIL (4,0,LUN)
      READ (LUN,111,ERR=98,END=99) DUM, DUM, DUM


  151 CONTINUE

        READ(LUN,1020,ERR=98,END=153) E, A, DAIN, DBIN, DSIN

        IF (E .EQ. ELT(NC) .AND. A .EQ. AW(NC)) THEN
          EDA(NC) = DAIN * CONST2
          EDW(NC) = DBIN * CONST1 * TWO
          EDS(NC) = DSIN * CONST1
          NC = NC+1
          IF (NC .GT. NUCTOT) GOTO 155
```

```
      ENDIF
      GOTO 151

  153 CONTINUE
        IF (IFLG1 .EQ. 0) THEN
        IFLG1 = 1
      ELSE
C       No information this radionuclide
        IFLG1 = 0
        NC = NC + 1
      ENDIF

      IF (NC .LE. NUCTOT) GOTO 150
  155 CLOSE (LUN)

      RETURN

C---- Format Statements --------------------------------------------

  111 FORMAT (A1/A1/A1)
 1020 FORMAT (A2, A6, E8.2, 5( 2X, E8.2))

C---- Error Messages -----------------------------------------------

   98 CALL FILERR (2, LUN, 'In GRDLIN')
   99 CALL FILERR (3, LUN, 'In GRDLIN')

C-------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------
C
       SUBROUTINE GRFIL (IT, Y20, FOFX, NT)
C
C     This module transfers values in a 20-position array to be plotted
C     vs. time into corresponding positions in a 144-position array
C
C     Module of DITTY of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification:  12-Aug-87  MDT
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C     IT(20)      -  CROSS-INDEX OF SUBSCRIPTS CORRESPONDING
C                    TO A 144-POSITION ARRAY
C     Y20(20)     -  INPUT ARRAY TO BE PLOTTED VS TIME
C     FOFX(144)   -  OUTPUT ARRAY CORRESPONDING TO THE 144-
C                    POSITION TIME ARRAY
C     NT          -  NO. OF TIME PERIODS IN ARRAYS IT AND Y20
C
C------------------------------------------------------------------------------
C
      DIMENSION IT(20), Y20(20), FOFX(144)
C
C     INITIALIZE FLAG WHICH INDICATES IF MORE THAT ONE POINT IS TO BE
C     PLOTTED IN EACH TIME PERIOD--
      K = 0
C
C     LOOP ON NO. OF DATA POINTS IN INPUT ARRAY--
      DO 100 I = 2, NT
C
        IF (IT(I) .GT. IT(I-1))  THEN
C
          IF (K .EQ. 0)    THEN
C
            FOFX(IT(I-1)) = Y20(I-1)
C
          ELSE
C
            TSUM = 0.
C
            DO 200 L = 1, K
              TSUM = TSUM + Y20(I-L)
  200       CONTINUE
C
            FOFX(IT(I-1)) = TSUM / K
```

```
C
              K = 0
C
            ENDIF
C
          ELSE
C
            K = K + 1
C
          ENDIF
C
  100 CONTINUE
C
C       TAKE CARE OF LAST POINT--
C
        IF (K .EQ. 0)    THEN
C
          FOFX(IT(NT)) = Y20(NT)
C
        ELSE
C
          DO 300 L = 1, K
            TSUM = TSUM + Y20(I-L+1)
  300     CONTINUE
          FOFX(IT(NT)) = TSUM / K
C
        ENDIF
C
C
        RETURN
        END
```

```
C-----------------------------------------------------------------------
C
      SUBROUTINE HEADIT (IFROM)
C
C     This module outputs page headings for quality assurance page and
C     reports
C
C     Module of DITTY of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification:  30-Aug-88  RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C----------------------------------------------------------------------
C
C     LUN      - Logical unit device
C     IOS      - Control integer set to a positive number if a file
C                error occurrs
C     IPN      - Page number counter of primary output file
C
C----------------------------------------------------------------------
C
      INCLUDE 'TIMES2.CMN'
      INCLUDE 'TITL.CMN'
      INCLUDE 'DAYPC.CMN'
      INCLUDE 'DAY.CMN'
C
      INTEGER LUN, IOS, IPN
      CHARACTER*1 FF
      DATA IPN /0/
      IPN = IPN + 1
      FF = CHAR(12)

      LUN = 17
      WRITE (LUN,1,ERR=98,IOSTAT=IOS) FF, CHIAC, CHIPAT, TZ, TITLS(33)
      WRITE (LUN,2,ERR=98) TODAY, CLOCK, IPN
      WRITE (LUN,3,ERR=98)

      RETURN

C---- Error Messages ---------------------------------------------------

   98 CALL FILERR (2, LUN, 'In HEADIT')

C---- Format Statements ------------------------------------------------

    1 FORMAT(A1,1X,78('-'),/,T25,
     . 'DITTY Dose Calculation Program'/, T25,
     . '(GENII Version 1.351 30-Aug-88)',//,
```


9 1 0 4 8 1 2 5 3

```
     . ' Integrated population dose calculated for ',A7, 1X, A30/
     . ' Release from time ',F5.0, ' A.D. onward for 10,000 years'/
     . ' Case title:   ',A70)
    2 FORMAT(' Executed on:  ',A10,' at ',A10,30X,'Page',I4)
    3 FORMAT (1X,78('-'))

C-----------------------------------------------------------------------
      END
```

9 1 0 4 8 1 2 5 4

```
C-----------------------------------------------------------------------
C
      SUBROUTINE NUCTST
C
C     This module tests the input radionuclide list for unidentified
C     radionuclides
C
C     Module of DITTY of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification:  11-Apr-88 RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C     NIN  -  NO. OF RADIONUCLIDES INPUT FOR MASTER LIST
C
C-----------------------------------------------------------------------

      INCLUDE 'FLAGS.CMN'
      INCLUDE 'NUCNAM.CMN'
      INCLUDE 'SOURCE.CMN'

C     INITIALIZE ERROR COUNTER--
      NUM = 0
C
C     FOR EACH INPUT RADIONUCLIDE--
      DO 100 IN = 1, NIN
C
C       CHECK IF NOT FOUND IN MASTER DATA LIBRARY--
        IF (INFLG(IN) .LE. 0)  THEN
C
          NUM = NUM + 1
          WRITE (*, 1000) IN, E(IN), A(IN)
C
        ENDIF
  100 CONTINUE

C---- Check for Error Conditions -------------------------------------

      IF (NUCTOT .GT. 100)   THEN
        WRITE (*, 2000) NUCTOT
 2000   FORMAT ('0 Too many radionuclides in this case (Max=100):', I5)
        CALL EXIT (1)
      ENDIF

C     Stop if there are unidentified radionuclides--
      IF (NUM .GT. 0)  CALL EXIT (1)
```

```
C---- Format Statements ---------------------------------------------
 1000 FORMAT (' Radionuclide ', I3, ' not found, ', A2, A6)
C-------------------------------------------------------------------
      RETURN
      END
```

```
C-----------------------------------------------------------------
C
      SUBROUTINE PMAC   (NT, P, T, TZ, P1)
C
C     This module interpolates population data at one time
C
C     Module of DITTY of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification:  12-Aug-87  MDT
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------
C
C     NT  -  NO. OF POPULATION VALUES CONSIDERED
C     P   -  POPULATION DATA ARRAY
C     T   -  TIME POINTS CORRESPONDING TO PM1
C     TZ  -  THE TIME AT START OF 10,000 INTEGRATION
C            PERIOD, YEARS A.D.
C     P1  -
C
C-----------------------------------------------------------------
C
      DIMENSION P(20), T(20)
C
C     IF ONLY 1 POPULATION CONSIDERED OR TZ <= TO FIRST TIME--
      IF (NT .LE. 1  .OR.  TZ .LE. T(1) )  THEN
C
        P1 = P(1)
C
      ELSE
C
C       IF TZ GREATER THAN LAST VALUE--
        IF (TZ .GE. T(NT))   THEN
C
          P1 = P(NT)
C
        ELSE
C
          N = 1
          IEND = 0
C
C         LOOP UNTIL IEND > 0--
  100     CONTINUE

            IF (TZ .LT. T(N) )  THEN
C
              P1 = P(N-1) + (P(N)-P(N-1)) * (TZ-T(N-1)) /(T(N) - T(N-1))
              IEND = 1
```


9 1 0 4 8 1 2 5 7

```
C
          ELSE
C
            N = N + 1
C
          ENDIF
C
C
        IF (IEND .LE. 0)  GO TO 100
C       END OF IEND LOOP.
C
      ENDIF
    ENDIF
C
    RETURN
    END
```

9 1 0 4 8 1 2 5 8

```
C-----------------------------------------------------------------------
C
      SUBROUTINE PMEQ   (NDIST, PM)
C
C     This module calculates a population dispersion factor from air
C     concentrations and a population distribution
C
C     Module of DITTY of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification:  12-Aug-87  MDT
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C     NDIST  -  NO. OF DISTANCE INTERVALS
C     PM     -  POPULATION DISPERSION FACTOR
C
C-----------------------------------------------------------------------
C
      INCLUDE 'AIRCON.CMN'
      INCLUDE 'POPU.CMN'
C
      PM = 0.
C
C     FOR EACH DISTANCE--
      DO 100 IX = 1, NDIST
C
C       FOR EACH DIRECTION--
        DO 200 IT = 1, 16
C
          PM = PM + EOQ(IX,IT) * POP(IX,IT)
C
 200    CONTINUE
 100  CONTINUE
C
      RETURN
      END
```

```
C-----------------------------------------------------------------
C
      SUBROUTINE PMINT  (NT, TZ, T, PM1, PM)
C
C     This module interpolates time vs. population dispersion factor
C     arrays to determine population dispersion factors at each 70 year
C     increment midpoint
C
C     Module of DITTY of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification:  12-Aug-87  MDT
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------
C
C     NT       -  NO. OF TIME PERIODS FOR WHICH DATA IS
C                 SUPPLIED IN ARRAYS T AND PM1.
C     TZ       -  TIME (YEARS A.D.) AT THE START OF THE
C                 10,000 YEAR INTEGRATION PERIOD.
C     T(20)    -  TIME POINTS CORRESPONDING TO DEFINITION
C                 OF DATA IN ARRAY PM1, YEARS A.D.
C     PM1(20)  -  POPULATION DISPERSION FACTOR ARRAY TO
C                 BE INTERPOLATED, PERSON-SEC/M**3
C     PM(144)  -  POPULATION DISPERSION FACTOR ARRAY FOR
C                 EACH 70-YR PERIOD OF THE 10,000 YR. PER.
C
C-----------------------------------------------------------------
C
      DIMENSION PM1(20), PM(143), T(20)
C
      IF (NT .LE. 1)   THEN
C
C       USE FIRST VALUE OF PM1 FOR ALL INCREMENTS--
        DO 100 I = 1, 143
          PM(I) = PM1(1)
  100   CONTINUE
C
      ELSE
C
C       CALCULATE MIDPOINT--
        TT = TZ + 35.
C
C       INITIALIZE INDEXING VARIABLES--
        IT = 1
        II = 1
C
C       LOOP UNTIL IT > NT OR II > 143--
  200   CONTINUE
```

```
C
          IF (TT .LE. T(IT))   THEN
C
            IF (TT .EQ. T(IT)) THEN
C
              PM(II) = PM1(IT)
C
            ELSE
C
              IF (IT .EQ. 1)   THEN
C
                PM(II) = PM1(1)
C
              ELSE
C
                PM(II) = PM1(IT-1) + (TT - T(IT-1) ) /
     .                   (T(IT) - T(IT-1)) * (PM1(IT) - PM1(IT-1))
C
              ENDIF
            ENDIF
C
            II = II + 1
            TT = TT + 70.
C
          ELSE
C
            IT = IT + 1
C
          ENDIF
C
        IF (IT .LE. NT  .AND.  II .LE. 143)  GO TO 200
C       END OF LOOP.
C
        IF (IT .GT. NT  .AND.  II .LE. 143)   THEN
C
C         SET TO MAXIMUM VALUE--
          DO 300 I = II, 143
            PM(I) = PM1(NT)
  300     CONTINUE
C
        ENDIF
C
      ENDIF
C
      RETURN
      END
```

```
C------------------------------------------------------------------
C
      SUBROUTINE PMSET  (NTA, POPT, PM1)
C
C     This module establishes interpolation values for population
C     dispersion factor options two and five
C
C     Module of DITTY of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification:  12-Aug-87  MDT
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C------------------------------------------------------------------
C
C     NTA        -  TIME PERIOD USED FOR INTERPOLATION
C     POPT(  )   -  POPULATION AT EACH TIME PERIOD
C     PM1(   )   -  POPULATION DISPERSION FACTOR FOR EACH
C                   TIME PERIOD
C
C------------------------------------------------------------------
C
C
      DIMENSION POPT(20), PM1(20)
C
C
      IF (POPT(1) .EQ. 0) THEN
        P1 = 0.
      ELSE
        P1 = PM1(1) / POPT(1)
      ENDIF
C
      DO 100 IT = 1, NTA
C
        PM1(IT) = P1 * POPT(IT)
C
  100 CONTINUE
C
C     RETURN
      END
```


9 1 0 4 8 1 2 6 2

```
C--------------------------------------------------------------------
C
      SUBROUTINE QAPAGE
C
C     QAPAGE PRINTS A REPORT OF INPUT PARAMETERS
C
C
C     Module of DITTY of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification:  15-Jul-88  RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C--------------------------------------------------------------------
C
      INCLUDE 'BIODAT.CMN'
      INCLUDE 'DAYPC.CMN'
      INCLUDE 'DAY.CMN'
      INCLUDE 'DISPSN.CMN'
      INCLUDE 'NAMLST.CMN'
      INCLUDE 'NUCNAM.CMN'
      INCLUDE 'OPTION.CMN'
      INCLUDE 'ORGID.CMN'
      INCLUDE 'PATHIN.CMN'
      INCLUDE 'POPU.CMN'
      INCLUDE 'VARYBL.CMN'
      INCLUDE 'TITL.CMN'
      INCLUDE 'FLAGS.CMN'
C
      CHARACTER  CHISAL*5, CHTPA(7)*16, CHAPA(7)*18, CHMET(9)*20,
     .           CHDIR(16)*6
      LOGICAL WATPOP
C
      DIMENSION FOFX(144,8), PRACT(144), IPRIT(144)
C
      DATA CHTPA /'LEAFY VEGATABLES', 'OTHER VEGATABLES', 'EGGS',
     .            'MILK', 'BEEF', 'PORK', 'POULTRY'/
C
      DATA CHAPA /'FISH', 'CRUSTACEA', 'MOLLUSES', 'PLANTS',
     .            'DRINKING WATER', 'SEDIMENT EXPOSURE',
     .            'SWIMMING TIME'/
C
      DATA CHMET /
     .    'PASQUILL A', 'PASQUILL B', 'PASQUILL C', 'PASQUILL D',
     .    'PASQUILL E', 'PASQUILL F', 'PASQUILL G', ' ', ' '/
C
      DATA CHDIR /'NNE', 'NE', 'ENE', 'E', 'ESE', 'SE', 'SSE', 'S',
     .            'SSW', 'SW', 'WSW', 'W', 'WNW', 'NW', 'NNW', 'N'/
C
```

```
C     SET FLAG FOR HEADING SUBROUTINE--
      DATA IFROM /0/

C     Output file-
      LUN = 17
C
      IF (IAC .EQ. 0)   THEN
        CHIAC = 'chronic'
      ELSE
        CHIAC = 'acute'
      ENDIF
C
      IF (IPATH .EQ. 0)  THEN
        CHIPAT = 'atmospheric and liquid release'
      ELSE
        IF (IPATH .EQ. 1)  THEN
          CHIPAT = 'atmospheric release'
        ELSE
          CHIPAT = 'liquid release'
        ENDIF
      ENDIF
C
      IF (ISALT .EQ. 0)   THEN
        CHISAL = 'Fresh'
      ELSE
        CHISAL = 'Salt'
      ENDIF
C
      IF (LUA .EQ. 1) TITLS(32) = 'DITTY.IN'
      IF (LUW .EQ. 1) TITLS(31) = 'DITTY.IN'
C
      CALL HEADIT (IFROM)
C     TO PRINT DITTY1 HEADING LINES.
C
C
C     PRINT LIBRARY INFORMATION--
C
      WRITE (LUN, 2000)
      WRITE (LUN, 2001) TITLS(2)
      WRITE (LUN, 2002) TITLS(8)
      WRITE (LUN, 2003) CHISAL, TITLS(9)
      WRITE (LUN, 2004) TITLS(10)
      WRITE (LUN, 2005) TITLS(30)
      IF (IPOP .EQ. 3)   WRITE (LUN, 2006) TITLS(27)
      IF (IWAT .GT. 0)   WRITE (LUN, 2007) TITLS(31)
      IF (IAIR .GT. 0)   WRITE (LUN, 2008) TITLS(32)
C
C     PRINT MASTER RADIONUCLIDE CONTROL LIST--
      WRITE (LUN, 8000)
```


9 1 0 4 8 1 2 6 4

```
      WRITE (LUN, 8001) (ELT(I), AW(I), I = 1, NUCTOT)
C
C
C     PRINT TERRESTRIAL AND AQUATIC PATHWAYS DATA--
C
      WRITE (LUN, 3000)
      WRITE (LUN, 3001)
      DO 100 I = 1, 7
        WRITE (LUN, 3002) CHTPA(I), GRWP(I), YELD(I), CONSUM(I),
     .                    CHAPA(I), USAGE(I)
  100 CONTINUE
      WRITE (LUN, 3003) EXTIM
C
C
C     PRINT WATERBORNE PARAMETERS--
C
      IF (IPATH .NE. 1)   THEN
        WRITE (LUN, 4000)
        WRITE (LUN, 4001) CFLO, MOPYR, RECON, RM, RIRR
      ENDIF
C
C
C     PRINT SIGNATURE LINES--
      WRITE (LUN, 7000)

C     PRINT SITE GRID INFORMATION--
C
      IF (IEOQ .GT. 1)  THEN
C
        CALL HEADIT (IFROM)
        WRITE (LUN, 6000)
        WRITE (LUN, 6001) NSECT
        WRITE (LUN, 6002) NDIST, (DIST(I), I = 1, NDIST)
C
        IF (IPATH .LE. 1  .AND. IEOQ .EQ. 2)    THEN
          NSPRT = NSECT / 2

C         Write first half--
          WRITE (LUN, 6100)
          WRITE (LUN, 6101) (CHDIR(I), I = 1, NSPRT)
          DO 200 IU = 1, NUBAR
            WRITE (LUN, 6103)
            DO 300 IM = 1, NMET
              WRITE (LUN, 6102) UBAR(IU), CHMET(MET(IM)),
     .                          (F(IU,IM,I), I= 1, NSPRT)
  300       CONTINUE
  200     CONTINUE

          CALL HEADIT (IFROM)
```

```
             WRITE (LUN, 6100)
             WRITE (LUN, 6101) (CHDIR(I), I = NSPRT+1, NSECT)
             DO 201 IU = 1, NUBAR
               WRITE (LUN, 6103)
               DO 301 IM = 1, NMET
                 WRITE (LUN, 6102) UBAR(IU), CHMET(MET(IM)),
     .                        (F(IU,IM,I), I= NSPRT+1, NSECT)
 301           CONTINUE
 201         CONTINUE
           ENDIF
C
           WRITE (LUN, 6200) HS
C
         ENDIF
C
C
C        PRINT RELEASE DATA IF GRPAH OPTION NOT SELECTED--
         IF (IGRNUC .EQ. 0)    THEN
C
C          IF AIR RELEASE--
           IF (IPATH .LT. 2)    THEN
C
             CALL HEADIT (IFROM)
             WRITE (LUN,9010)
             WRITE (LUN,9011)
             DO 770 IN = 1, NUCTOT
               NPR = 0
               DO 771 IT = 1, 144
                 IF (ACTA(IT,IN) .GT. 0 )  THEN
                   NPR = NPR + 1
                   IPRIT(NPR) = IT-1
                   PRACT(NPR) = ACTA(IT,IN)
                 ENDIF
 771           CONTINUE
               IF (NPR .GT. 0) WRITE (LUN,9012)
     .           ELT(IN),AW(IN),(IPRIT(I),PRACT(I),I=1,NPR)
 770         CONTINUE
C
           ENDIF
C
C          IF WATER RELEASE--
           IF (IPATH .NE. 1)    THEN
C
               CALL HEADIT (IFROM)
               WRITE (LUN,9020)
               WRITE (LUN,9011)
               DO 780 IN = 1, NUCTOT
                 NPR = 0
                 DO 781 IT = 1, 144
```

```
                IF (ACTW(IT,IN) .GT. 0)  THEN
                  NPR = NPR + 1
                  IPRIT(NPR) = IT-1
                  PRACT(NPR) = ACTW(IT,IN)
                ENDIF
 781          CONTINUE
              IF (NPR .GT. 0) THEN
                WRITE (LUN,9012) ELT(IN),AW(IN),(IPRIT(I),
     .                           PRACT(I),I=1,NPR)
              ENDIF
 780        CONTINUE
          ENDIF
C
      ENDIF
C
C
C
      CALL HEADIT (IFROM)
C     PRINT NAMES OF RADIONUCLIDES WITH NO INTERNAL DF's--
      DO 420 I = 1, NUCTOT
        IF (INFLG(I) .EQ. 0) WRITE (LUN, 8011) ELT(I), AW(I)
  420 CONTINUE
C
C     PRINT INPUT POPULATION DATA--
      WRITE (LUN,9100)
C
      IF (IPATH .LT. 2 .AND. IAC .GT. 0) THEN

        IF (IPA .LE. 0) THEN
          WRITE (LUN,9110)
        ELSEIF (IPA .EQ. 1) THEN
          WRITE (LUN,9112) PMA
        ELSEIF (IPA .GT. 1) THEN
          WRITE (LUN,9112) PM(1)
        ENDIF
C
      ELSEIF (IPATH .LT. 2) THEN
C
        IF (IPOP .EQ. 0) THEN
          WRITE (LUN,9120)
        ELSEIF (IPOP .EQ. 1) THEN
          WRITE (LUN,9122)
        ELSEIF (IPOP .EQ. 2) THEN
          WRITE (LUN,9127)
          WATPOP = .FALSE.
          DO 734 I = 1, NTA
            IF (POPT(I) .GT. 1.0) WATPOP = .TRUE.
  734     CONTINUE
          WRITE (LUN,9128) (T(I), POPT(I), I=1,NTA)
```

```
      ELSEIF (IPOP .EQ. 3) THEN
        WRITE (LUN,9130)
      ELSEIF (IPOP .EQ. 5) THEN
        WRITE (LUN,9134)
      ELSEIF (IPOP .EQ. 6) THEN
        WRITE (LUN,9136)
      ENDIF
C
      IF (IPOP .EQ. 4 .OR. (IPOP .EQ. 3 .AND. NTA .GT. 0)) THEN
        WRITE (LUN,9132)
        WRITE (LUN,9128)(T(I), PM1(I), I=1,NTA)
      ENDIF
C
    ENDIF
C
C
    IF (IPATH .NE. 1 .AND. IAC .GT. 0) THEN
      IF (IPL .LE. 0) WRITE (LUN,9140)
      IF (IPL .EQ. 1) WRITE (LUN,9142) PPL
      IF (IPL .GT. 1) WRITE (LUN,9142) PL(1)
    ELSEIF (IPATH .NE. 1) THEN
      IF (IPOPL .LE. 0) WRITE (LUN,9150)
      IF (IPOPL .EQ. 1) WRITE (LUN,9152)
      IF (IPOPL .EQ. 2) THEN
        WRITE (LUN,9153)
        WRITE (LUN,9128) (TL(I), PL1(I), I=1,NTL)
      ENDIF
    ENDIF
C
    IF (IPATH .LT. 2 .AND. IPOP .EQ. 2) THEN
      CALL HEADIT (IFROM)
C     Print first half--
      NDPRT = (NDIST+1) / 2
      WRITE (LUN,9124) T(1), (DIST(I), I=1,NDPRT)
      WRITE (LUN,9125)
      DO 222 IS = 1, 16
        WRITE (LUN,9126) CHDIR(IS), (POP(I,IS), I=1,NDPRT)
  222 CONTINUE
C     Print second half--
      WRITE (LUN,9124) T(1), (DIST(I), I=NDPRT+1,NDIST)
      WRITE (LUN,9125)
      DO 223 IS = 1, 16
        WRITE (LUN,9126) CHDIR(IS), (POP(I,IS), I=NDPRT+1,NDIST)
  223 CONTINUE
     ENDIF

C     PRINT GRAPH OF POPULATION DISPERSION VALUES--
C
    IF (IGRPM .GT. 0)    THEN
```

```
C
        IF (IPATH .LT. 2)    THEN
          IF (IAC .GT. 0 .AND. IPOP .EQ. 6) GOTO 410
            DO 400 I = 1, 144
              FOFX(I,1) = PM(I)
  400       CONTINUE
            CALL GRAPH (2, FOFX, 1, 0, 0, 0, 0)
  410     CONTINUE
        ENDIF
C
        IF (IPATH .NE. 1) THEN
          DO 401 I = 1, 144
            FOFX(I,1) = PL(I)
  401     CONTINUE
          CALL GRAPH (3, FOFX, 1, 0, 0, 0, 0)
        ENDIF
C
      ELSE
C     PRINT NUMERIC REPORT OF PM--
C
C
        IF (IPATH .LT. 2)  THEN
          IF (IAC .GT. 0 .AND. IPOP .EQ. 6) GOTO 411
          IF (IPOP .EQ. 0 .OR. IPOP .EQ. 5) GOTO 411
            CALL HEADIT (IFROM)
            WRITE (LUN,9030)
            WRITE (LUN,9031)
            WRITE (LUN,9032) (I-1, PM(I), I=1,144)
  411     CONTINUE
        ENDIF
C
        IF (IPATH .NE. 1 .AND. IPOPL .GT. 0 .AND. WATPOP) THEN
          CALL HEADIT (IFROM)
          WRITE (LUN,9033)
          WRITE (LUN,9034)
          WRITE (LUN,9032) (I-1, PL(I), I=1,144)
        ENDIF
C
      ENDIF
C

C
C     PRINT GRAPH OF POPULATION FOR WATERBORNE PATHWAYS--
C
      IF (IGRPL .GT. 0)    THEN
        IF (IWAT .GT. 0)    THEN
C
          DO 500 I = 1, 144
            FOFX(I,1) = PL(I)
```


9 1 0 4 8 1 2 6 9

```
 500      CONTINUE
C
          CALL GRAPH (3, FOFX, 1, 0, 0, 0, 0)
C
        ENDIF
      ENDIF
C
C
C     PRINT GRAPH OF TOTAL ACTIVITY OF ALL SELECTED RADIONUCLIDES--
C
      IF (IGRTNU .GT. 0)    THEN
C
C       IF AIR RELEASE--
        IF (IPATH .LT. 2)    THEN
C
          CALL ZEROR (144, FOFX)
C
          DO 600 I = 1, 144
            DO 601 J = 1, NUCTOT
              FOFX(I,1) = FOFX(I,1) + ACTA(I,J)
 601        CONTINUE
 600      CONTINUE
C
          CALL GRAPH (4, FOFX, 1, 0, 0, 0, 1)
C
        ENDIF
C
C
C       IF WATER RELEASE--
        IF (IPATH .NE. 1)    THEN
C
          CALL ZEROR (144, FOFX)
C
          DO 700 I = 1, 144
            DO 701 J = 1, NUCTOT
              FOFX(I,1) = FOFX(I,1) + ACTW(I,J)
 701        CONTINUE
 700      CONTINUE
C
          CALL GRAPH (4, FOFX, 1, 0, 0, 0, 2)
C
        ENDIF
C
      ENDIF
C
C
C     PRINT GRAPH OF ACTIVITY OF EACH RADIONUCLIDE--
C
      IF (IGRNUC .GT. 0)    THEN
```

```
C
C        IF AIR RELEASE--
         IF (IPATH .LT. 2)    THEN
C
           DO 750 IN = 1, NUCTOT
             DO 751 IT = 1, 144
                FOFX(IT,1) = ACTA(IT,IN)
  751        CONTINUE
C
             CALL GRAPH (5, FOFX, 1, IN, 0, 0, 1)
C
  750      CONTINUE
C
         ENDIF
C
C
C        IF WATER RELEASE--
         IF (IPATH .NE. 1)   THEN
C
           DO 760 IN = 1, NUCTOT
C
             DO 761 IT = 1, 144
               FOFX(IT,1) = ACTW(IT,IN)
  761        CONTINUE
C
             CALL GRAPH (5, FOFX, 1, IN, 0, 0, 2)
C
  760      CONTINUE
C
         ENDIF
C
       ENDIF
C
       RETURN
C
C      FORMAT STATEMENTS--
C
 2000 FORMAT (//' ---- DATA LIBRARIES USED ',42('-'),'(File)-----'/)
 2001 FORMAT (' Master Radionuclide Data:',T70,' (2)',/'    ',A77)
 2002 FORMAT (' Food Concentration Ratios:',T70,' (8)',/'    ', A77)
 2003 FORMAT (' ',A5,' Water Bioaccumulation Factors:',T70,' (9)',
     .        /'    ',A77)
 2004 FORMAT (' External Exposure D.F.''s:',T70,'(10)'/,'    ',A77)
 2005 FORMAT (' Inhalation/Ingestion D.F.''s:',T70,'(30)',/'    ',A77)
 2006 FORMAT (' Population Distribution:',T70,'(27)'/'    ',A77)
 2007 FORMAT (' Waterborne Release Data:',T70,'(31)'/'    ',A77)
 2008 FORMAT (' Airborne Release Data:',T70,'(32)'/'    ',A77)
C
 3000 FORMAT (//' ---- TERRESTRIAL/AQUATIC PATHWAY DATA FOR AN ',
```

```
     .             'AVERAGE INDIVIDUAL ',13('-')/)
 3001 FORMAT ('                  Growing'/
     .        ' Pathway          Period      Yield ',
     .        ' Consumption      Pathway                Usage'/
     .           14X, ' (days)      (kg/m2)     (kg/yr)',
     .           21X, '(kg or hr/yr)'/)
 3002 FORMAT (' ', A9, 2X, 1P3E10.1, 6X, A15, 1PE10.1)
 3003 FORMAT (/' External Exposure Time: ', 1PE10.2, ' hr/yr')
C
 4000 FORMAT (//' ---- LIQUID RELEASE PARAMETERS ',45('-')/)
 4001 FORMAT (' River Flow Rate, (ft3/sec) : ', 1PE8.1,
     .        T45,'Months/Year Irrigated : ', 1PE8.1/
     .        ' Reconcentration Ratio      : ', 1PE8.1,
     .        T45,'Irrigation Rate' /
     .        ' Mixing Ratio               : ', 1PE8.1,
     .        T45,' (liters/m2/month)    : ', 1PE8.1)
C
 6000 FORMAT (//' ---- SITE GRID DEFINITION ',52('-'))
 6001 FORMAT (' Number of Sectors:   ', I5)
 6002 FORMAT (' Number of Distances: ', I5 / 1X, 10(8F9.0/))
C
 6100 FORMAT (//' ---- JOINT FREQUENCY DATA ',52('-'))
 6101 FORMAT (' Wind                      Wind from:'/,
     .        ' Speed  Stability    ', 16A6)
 6102 FORMAT (1X, F5.1, 2X, A10, 16F6.2)
 6103 FORMAT (' ')
C
 6200 FORMAT (/' Stack Height: ', F6.2)
C
 7000 FORMAT (////' Input Prepared By: ______________________________',
     .            '    Date: ______________',//
     .            ' Input Checked By: ______________________________',
     .            '    Date: ______________')
C
 8000 FORMAT (/' ---- MASTER RADIONUCLIDE CONTROL LIST ',39('-'))
 8001 FORMAT ( 7(2X, A2, A6))
 8011 FORMAT (' No internal dose factors for ',A2,A6)
C
 9010 FORMAT (/' ---- AIR RELEASE OF EACH RADIONUCLIDE PER 70-YR'
     .         ' PERIOD (Ci) ------------------'/)
 9011 FORMAT (' Radio-   ',5('   Period/   '),/
     .        ' nuclide  ',5('   Activity  '),/
     .        ' -------- ',5('  ---------- '))
 9012 FORMAT (' ',A2, A6, 5(1X,I3,1PE9.1)/
     .        40( 9X,     5(1X,I3,1PE9.1)/))

 9020 FORMAT (/' ---- WATER RELEASE OF EACH RADIONCLIDE PER 70-YR'
     .         ' PERIOD (Ci) ------------------'/)
```

```
 9030 FORMAT (// ' Population Dispersion Factors for Airborne ',
     .            'Release, (person-sec/m3)'/)
 9031 FORMAT ( 6('  Period/PM  ')/6(' ----------- '))
 9032 FORMAT ( 6(1X,I3, 1PE8.1,1X))
 9033 FORMAT (// ' Population for Waterborne Release:'/)
 9034 FORMAT ( 6('  Period/PL  ')/6(' ----------- '))
C
 9100 FORMAT (//' ---- POPULATION DATA ',50('-')/)
C
 9110 FORMAT ('  Previous input values used for acute airborne ',
     .        'release.'/)
C
 9112 FORMAT ('  Population dispersion factor for acute airborne ',
     .        'release = ',1PE10.2/)
C
 9120 FORMAT ('  Previous input values used for chronic airborne ',
     .        'release.'/)
C
 9122 FORMAT ('  Population-weighted E/Q values were input for each ',
     .        '70-yr time period.'/)
C
 9124 FORMAT (/' Population for Chronic Airborne Release at Time ',
     .       F7.0,':'//
     .        ' Sector ',10(1PE9.1))
 9125 FORMAT (' ------ ',5('  -------'))
 9126 FORMAT (' ',A7,10(1PE9.1))
C
 9127 FORMAT (/' Population for Chronic Airborne Release at the ',
     .        'following Times A.D.:'//(' Time   Population')/
     .                                 (' -----------------'))
C
 9128 FORMAT (' ',0PF7.0,1PE10.1)
C
 9130 FORMAT (' Population for chronic airborne release read from ',
     .        'file.'/)
C
 9132 FORMAT (/' Population Dispersion Factors for Chronic Airborne',
     .        ' Release at the Following Times A.D.:'//
     .        ('  Time      PDF     ')/
     .        (' ------------------'))
C
 9134 FORMAT (' Previous population data used for chronic airborne ',
     .        'release. Changes made to E/Q input.'/
     .        '     Population-weighted E/Q values recalculated.'/)
C
 9136 FORMAT (' No chronic airborne release, constant population '
     .        'assumed.'/)
C
 9140 FORMAT (' Previous population values used for acute ',
```

```
     .        'waterborne release.'/)
C
 9142 FORMAT (' Population for acute waterborne ',
     .        'release = ',1PE9.2/)
C
 9150 FORMAT (' Previous population values used for chronic ',
     .        'waterborne release.'/)
C
 9152 FORMAT (' Population for chronic ',
     .'waterborne release were input for each 70-yr time period.'/)
C
 9153 FORMAT (' Population for Chronic Waterborne Release at the ',
     .        'following Times A.D.:'//(' Time   Population')/
     .                                  (' -----------------'))
C
 9154 FORMAT ('   ',0PF7.0,1PE10.1)
C
      END
```


9 1 0 4 8 1 2 7 4

```
C-----------------------------------------------------------------------
C
      SUBROUTINE REPORT
C
C     This module prints graphic reports of organ doses as a
C     function of time, numerical reports of organ doses, and maximum
C     dose period reports
C
C     Module of DITTY of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification:  22-Aug-88  RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------------

      INCLUDE 'DAYPC.CMN'
      INCLUDE 'FLAGS.CMN'
      INCLUDE 'NUCNAM.CMN'
      INCLUDE 'OPT.CMN'
      INCLUDE 'OPTION.CMN'
      INCLUDE 'ORGID.CMN'
      INCLUDE 'ORGMAS.CMN'
      INCLUDE 'VARYBL.CMN'
      INCLUDE 'RESULT.CMN'
      INCLUDE 'TIMES2.CMN'
      INCLUDE 'TITL.CMN'

      INTEGER IPAGE, NSET, ISET, ISTART, ISTOP, MAXLIN
      REAL FOFX(144,8), RADEDE(100), POPEDE(100)
      CHARACTER LINE*127, DUM*3, DASH1*50, DASH2*50, DASH3*50, DASH4*60,
     .          UNIT*1
      LOGICAL FIRST
      DATA DASH3 /'--------  ----------  ---------  ----------'/
      DATA DASH4
     .    /'--------  ----------  ---------  ----------  ----------'/
      DATA DASH1 /'--------------  ----------  ---------  ----------'/
      DATA DASH2 /'--------------------------------------------------'/
      DATA IFROM /1/

      NPATH = 4
      LINE = '         ----------       ----------       ---------- '
      LUN = 17
      FIRST = .TRUE.
      MAXLIN = 41
      NSET = NUCTOT / MAXLIN
      IDD = MOD (NUCTOT, MAXLIN)
      IF (IDD .GT. 0) NSET = NSET + 1
```


9 1 0 4 8 1 2 7 5

```
C     PRINT GRAPH OF DOSE TO EACH SELECTED ORGAN--

      IF (IGRDOS .GT. 0) THEN
        DO 200 I = 1, 144
          FOFX(I,1) = DTOTAL(I)
  200     CONTINUE
C
          CALL GRAPH (7, FOFX, 1, IO, IFROM, 0, 0)
C         TO PRINT GRAPH FOR THIS ORGAN.
          WRITE (LUN,2004)
C
  100   CONTINUE
      ENDIF
C
C
C     PRINT NUMERIC REPORT OF DOSE TO EACH ORGAN FOR EACH TIME PERIOD--
C
      TT = TZ
      IPAGE = 50
      INTL = 0
C
      DO 300 IT = 1, 144
C
        IF (IPAGE .GT. 43) THEN
          IF (IT .GT. 1) WRITE (LUN,2002) LINE
          CALL HEADIT (IFROM)
          WRITE (LUN,2000)
          WRITE (LUN,2002) LINE
          WRITE (LUN,2001)
          WRITE (LUN,2002) LINE
          IPAGE = 1
        ENDIF
C
        IF (IT .EQ. 1 .AND. IAC .GT. 0)    THEN
C
          WRITE (LUN,1001) DTOTAL(1)
          IPAGE = IPAGE + 1
          FIRST = .FALSE.
C
        ELSEIF (IT .GT. 1) THEN
C
          ISAME = 1
          IF (IT .EQ. 1 .AND. FIRST) THEN
            ISAME = 0
          ELSEIF (IT .EQ. 144) THEN
            ISAME = 0
          ELSEIF (DTOTAL(IT) .NE. DTOTAL(IT-1)) THEN
            ISAME = 0
```

```
         ENDIF
C
         IF (ISAME .EQ. 1 .AND. INTL .EQ. 0) THEN
             WRITE (LUN, 2010)
             INTL = 1
             IPAGE = IPAGE +1
         ELSEIF (ISAME .EQ. 0) THEN
           WRITE (LUN,1000) IT, TT, DTOTAL(IT)
           INTL = 0
           IPAGE = IPAGE + 1
         ENDIF
C
       ENDIF
C
       IF (IT .EQ. 144) THEN
         WRITE (LUN,2002) LINE
         WRITE (LUN,2004)
       ENDIF
C
       TT = TT + 70.
C
  300 CONTINUE
C
C     Prepare EDE by radionuclide for population--

       BIGPOP = 0.0
       IBIGP = 0
       IBIGPN = 0

C      Calculate EDE by radionuclide--
       DO 308 IN = 1, NUCTOT
         CALL WBEDE4 (POPINT(1,IN), POPEDE(IN))
  308  CONTINUE

C      Break radionuclides into pages--
       DO 309 ISET = 1, NSET

         ISTART = (ISET - 1) * MAXLIN + 1
         ISTOP = ISET * MAXLIN
         IF (ISTOP .GT. NUCTOT) ISTOP = NUCTOT

         CALL HEADIT (LUN)
         WRITE (LUN,5115)
         WRITE (LUN,5110) DASH4

         DO 310 IN = ISTART, ISTOP
           POPTOT = POPEDE(IN) + POPSUB(IN) + POPEXT(IN)
           IPR = POPTOT / DTOTAL(144) * 100.0
           IF (POPTOT .GT. BIGPOP) THEN
```


9 1 0 4 8 1 2 7 7

```
            BIGPOP = POPTOT
            IBIGP = IPR
            IBIGPN = IN
          ENDIF
          WRITE (LUN,5114) ELT(IN), AW(IN), POPEDE(IN),
     .                     POPSUB(IN)+POPEXT(IN), POPTOT, IPR

 310    CONTINUE
        WRITE (LUN,5111) DASH4
        WRITE (LUN,4115)

 309  CONTINUE


C     Set organ column indices and number of organs to print--

      NORGS = 0
C     Set organ print index--
      DO 306 IO = 1, 22
        DO 305 IN = 1, NUCTOT
          IF (IOFLG(IO)) THEN
            NORGS = NORGS + 1
            ICLN(NORGS) =IO
C           WRITE (*,*) NORGS, ICLN(NORGS), MASORG(ICLN(NORGS))
            GOTO 303
          ENDIF
 305    CONTINUE
 303    CONTINUE
 306  CONTINUE

C     Error return--
      IF (NORGS .EQ. 0) RETURN

C     Write whole body EDE report for maximum time period--

      CALL HEADIT (LUN)
      WRITE (LUN,1111) MAXTIM*70 + TZ, MAXTIM
      WRITE (LUN,1110) DASH1
      DO 304 IO = 1, NORGW
        IF (IO .EQ. 1) THEN
          WRITE (LUN,1114) 'Gonads  ', HICDE(IO), WT(IO), HIWBE(IO)
        ELSEIF (IO .EQ. 2) THEN
          WRITE (LUN,1114) 'Breast  ', HICDE(IO), WT(IO), HIWBE(IO)
        ELSE
          WRITE (LUN,1114) MASORG(ICDEH(IO)), HICDE(IO), WT(IO),
     .                     HIWBE(IO)
        ENDIF
 304  CONTINUE
      WRITE (LUN,1112) DASH2, HIEDE, HIEXT+HISUB, DASH2, HIAEDE
```


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```
      WRITE (LUN,4115)

C     Prepare EDE by radionuclide in maximum dose period if IREDE > 0--
      IF (IREDE .GT. 0) THEN

        BIGMAX = 0.0
        IBIGM = 0
        IBIGMN = 0

C       Calculate EDE by radionuclide--
        DO 307 IN = 1, NUCTOT
          CALL WBEDE4 (HIDOSR(1,IN), RADEDE(IN))
  307   CONTINUE

C       If air case then print population report--
        IF (IPATH .EQ. 1) THEN

          UNIT = 'P'
          HIMI = HIAEDE

C         Break radionuclides into pages--
          DO 400 ISET = 1, NSET

            ISTART = (ISET - 1) * MAXLIN + 1
            ISTOP = ISET * MAXLIN
            IF (ISTOP .GT. NUCTOT) ISTOP = NUCTOT

            CALL HEADIT (LUN)
            WRITE (LUN,1111) MAXTIM*70 + TZ, MAXTIM
            WRITE (LUN,4110) DASH4

            DO 402 IN = ISTART, ISTOP
              DEXT = HISUBR(IN) + HIEXTR(IN)
              AIRTOT = RADEDE(IN) + DEXT
              IPR = AIRTOT / HIMI * 100.0
              IF (AIRTOT .GT. BIGMAX) THEN
                BIGMAX = AIRTOT
                IBIGM = IPR
                IBIGMN = IN
              ENDIF
              WRITE (LUN,4114) ELT(IN), AW(IN), RADEDE(IN), DEXT,
                               AIRTOT, IPR
  402       CONTINUE

            WRITE (LUN,4111) DASH4
            WRITE (LUN,4115)

  400     CONTINUE
```

```
        ELSE
C         This is a water case, print average individual report--

          UNIT = ' '
          HIMI = HIAEDE / PL(MAXTIM)

C         Break radionuclides into pages--
          DO 420 ISET = 1, NSET

            ISTART = (ISET - 1) * MAXLIN + 1
            ISTOP = ISET * MAXLIN
            IF (ISTOP .GT. NUCTOT) ISTOP = NUCTOT

            CALL HEADIT (LUN)
            WRITE (LUN,1113) MAXTIM*70 + TZ, MAXTIM
            WRITE (LUN,4110) DASH4

            DO 422 IN = ISTART, ISTOP
              DEXT = (HISUBR(IN) + HIEXTR(IN)) / PL(MAXTIM)
              WATTOT = RADEDE(IN) / PL(MAXTIM) + DEXT
              IPR = WATTOT / HIMI * 100.0
              IF (WATTOT .GT. BIGMAX) THEN
                BIGMAX = WATTOT
                IBIGM = IPR
                IBIGMN = IN
              ENDIF
              WRITE (LUN,4114) ELT(IN), AW(IN), RADEDE(IN)/PL(MAXTIM),
     .                         DEXT, WATTOT, IPR
  422       CONTINUE

            WRITE (LUN,4111) DASH4

  420     CONTINUE

        ENDIF
      ENDIF

C     Write detail reports for maximum time period--
      IF (NORGS .GT. 0) CALL DITBYR
      IF (NORGS .GT. 0) CALL DITBYP

C     Write one line QA report--

      LUN = 19
      CALL OPNFIL (5, 0, LUN)
      WRITE (LUN, 6000) TITLS(33) (1:18), DTOTAL(144), ELT(IBIGPN),
     .                  AW(IBIGPN), IBIGP, HIMI, UNIT, ELT(IBIGMN),
     .                  AW(IBIGMN), IBIGM, MAXTIM*70 + TZ,
     .                  TODAY(1:8), CLOCK(1:5)
```

```
      RETURN

C---- Format Statements ------------------------------------------------

    1 FORMAT (1PE7.1)

 1004 FORMAT (' ',A1,I3,1P, 15E8.1E2)
 1110 FORMAT (//
     .        T10,'                                           Weighted'/
     .        T10,'                     Cumulative           Cumulative'/
     .        T10,'                        Dose    Weighting    Dose'/
     .        T10,'     Organ           Equivalent  Factors   Equivalent'/
     .            ' ',T10,A50)

 1111 FORMAT (//, T13,'Maximum Dose Increment Received By Population'/
     .            T13,'In Year ',I5,
     .                ' (70-yr Time Period Number No:',I4,')'/)

 1113 FORMAT (//, T13,'Maximum Dose Increment Received By ',
     .                'Individual (rem)'/
     .            T13,'In Year ',I5,
     .                ' (70-yr Time Period Number No:',I4,')'/)

 1114 FORMAT (' ',T10,A12,4X,1P,3(E9.1,2X), I11)

 1112 FORMAT (' ',T10,A50/
     .         T10,'Cumulative Effective Dose Equivalent',T48,1P,E9.1/
     .         T10,'External Dose',T48,E9.1/' ',T10,A50,/
     .         T10,'Lifetime Effective Cumulative '/
     .         T12,'Dose Equivalent',T48,E9.1)

 1000 FORMAT (11X, I10, 8X,  F10.0, 5( 8X, 1PE10.2))
 1001 FORMAT (16X, 'Acute     ', 13X, 5( 8X, 1PE10.2) /)

 2000 FORMAT (/5X, ' Lifetime Effective Cumulative Dose Equivalent ',
     .        'as a Function of Time' / )
 2001 FORMAT (13X, 'Period', 13X,  'Year', 14X, 'Dose')
 2002 FORMAT (' ', A127)
 2004 FORMAT (//,' Dose in units of person-rem;'/
     .          '   that is the cumulative population dose received by ',
     .          'the local population '/
     .          '   over 10,000 years with an '
     .          'assumed 70-yr individual lifetime.')

 2005 FORMAT (//,10X,
     .          ' Dose in units of rem.')
 2010 FORMAT (10X,'   until          until ')
```


9 1 0 4 8 1 2 8 1

```
3005 FORMAT (21X, 127A1)
3006 FORMAT (30X,'Total    ',5(8X,1PG10.2))

4110 FORMAT (/,
    .T15,'                                          Annual'/
    .T15,'           Effective                      Effective     Percent'/
    .T15,'Radio-      Dose          External         Dose         Of Total '/
    .T15,'nuclide   Equivalent       Dose         Equivalent      Dose '/
    .T15,A60)
4111 FORMAT (T15,A60)
4114 FORMAT (' ',T15,A2,1X,A6,1X,1P,3(E9.1,2X), I11)
4115 FORMAT (//,' Dose in units of person-rem;'/
    .          '   that is the cumulative population dose received by ',
    .          'the local population '/
    .          '   with an assumed 70-yr individual lifetime.')

5110 FORMAT (/,
    .T15,'                                          Annual'/
    .T15,'           Effective                      Effective      Percent'/
    .T15,'Radio-      Dose          External         Dose          Of Total'/
    .T15,'nuclide   Equivalent       Dose         Equivalent        Dose'/
    .T15,A60)
5111 FORMAT (T15,A60)
5114 FORMAT (' ',T15,A2,1X,A6,1X,1P,3(E9.1,2X), I11)
5115 FORMAT (/13X, ' Cumulative Population Dose Equivalent ',
    .        'by Radionuclide' / )

6000 FORMAT (A18,':',1PE8.1, OP,' Prem ', A2, A6, I3, 1X,
    .                 1PE8.1, OP, 1X, A1,'rem ', A2, A6, I3, 1X, I5,
    .                 A8,1X,A5)
C------------------------------------------------------------------------
     END
```


9104812822

```
C-------------------------------------------------------------------------
C
      SUBROUTINE SETNUC
C
C     This module establishes the master list of radionuclides to be
C     included in this run
C
C     Module of DITTY of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 12-Aug-87  MDT
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-------------------------------------------------------------------------
C
      INCLUDE 'RMD.CMN'
      INCLUDE 'DKAY.CMN'
      INCLUDE 'NUCNAM.CMN'
      INCLUDE 'SOURCE.CMN'
      INCLUDE 'FLAGS.CMN'
C
C
      AL2 = ALOG (2.0)

C     INITIALIZE PARAMETERS--
1     CALL ZEROI (100, INFLG)
      ICHN = 0
      INUC = 0
C
C     FOR EACH DECAY CHAIN IN THE MASTER RADIONUCLIDE LIBRARY--
      DO 100 IC = 1, NCH
C
        NCN = NOFNUC(IC)
        N1 = NCHST(IC)
        N2 = N1 + NCN - 1
        IONE = 0
        I = 0
C
        DO 200 IL = N1, N2
C
C         HAS A MEMBER OF THIS CHAIN BEEN FOUND BEFORE?--
          IF (IONE .EQ. 1)   THEN
C
            INUC = INUC + 1
C
            IFR2(1,INUC) = MAX (0, IFR(1,IL)-I )
            IFR2(2,INUC) = MAX (0, IFR(2,IL)-I )
C
            DK2(1,INUC) = DKF(1,IL)
```

```
                DK2(2,INUC) = DKF(2,IL)
C
                AW(INUC) = AWM(IL)
                ELT(INUC) = ELTM(IL)
                AR(INUC) = AL2 * 365.25 / TR(IL)
C
              ENDIF
C
C
              IN = 1
              IEND = 0
C
C             LOOP UNTIL MASTER RADIONUCLIDE LIST EXHAUSED OR A MEMBER IS FOUND--
  300         CONTINUE
C
C               DO ATOMIC WEIGHT SYMBOLS MATCH?--
                IF (AWM(IL) .EQ. A(IN) ) THEN
C
C                 DO THE ELEMENT NAMES MATCH?--
                  IF (ELTM(IL) .EQ. E(IN) )  THEN
C
C                   SET FLAG FOR THIS NUCLIDE FOUND--
                    INFLG(IN) = 1
C
C                   IF THIS IS FIRST MEMBER OF CHAIN TO BE FOUND--
                    IF (IONE .LE. 0)   THEN
C
                      IONE = 1
                      I = IL - N1
C
                      INUC = INUC + 1
                      ICHN = ICHN + 1
                      IF (ICHN .GT. 0)  NOFN(ICHN) = NCN - I
C
                      IFR2(1,INUC) = MAX (0, IFR(1,IL) - I )
                      IFR2(2,INUC) = MAX (0, IFR(2,IL) - I )
C
                      DK2(1,INUC) = DKF(1,IL)
                      DK2(2,INUC) = DKF(2,IL)
C
                      AW(INUC) = AWM(IL)
                      ELT(INUC) = ELTM(IL)
                      AR(INUC) = AL2 * 365.25 / TR(IL)
C
                    ENDIF
C
C                   STOP SEARCHING--
                    IEND = 1
```

```
C
                 ELSE
C                  MATCH NOT FOUND, COMPARE WITH NEXT MASTER LIST RECORD--
                   IN = IN + 1
                 ENDIF
C
               ELSE
C                MATCH NOT FOUND; COMPARE WITH NEXT MASTER LIST RECORD--
                 IN = IN + 1
               ENDIF
C
             IF (IEND .LT. 1  .AND.  IN .LE. NIN)  GO TO 300
C
  200   CONTINUE
  100 CONTINUE
C
C
      NUCTOT = INUC
      CALL NUCTST
C     TO DETERMINE IF ALL MASTER LIST RADIONUCLIDES WERE FOUND IN DATA
LIBRARY
C
      RETURN
      END
```

```
C-----------------------------------------------------------------------
C
      SUBROUTINE SETUP  ( YL1, NL   )
C
C     This module fills the y-axis label array, y-axis tick marks, and
C     blanks out the graph storage array
C
C     Module of DITTY of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification:  9-Feb-88 RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C     YL  -  SELECTED Y-AXIS LABEL
C     NL  -  NUMBER OF CHARACTERS IN SELECTED Y-AXIS
C              LABEL
C
C-----------------------------------------------------------------------
C
      INCLUDE 'PLOT.CMN'
C
      CHARACTER YL1*1(40), BLANK*1, AST*1, BLANK2*12
C
      BLANK2 = '            '
      AST = '.'
      BLANK = ' '
      IY = 40
      IX = 73
C
C     CENTER Y-AXIS LABEL--
C
      IS = (IY - NL) / 2

      IF (IS .GT. 0)  THEN
        DO 100 I = 1, IS
          LABELY(I) = BLANK
  100   CONTINUE
      ENDIF
C
C
C     TRANSFER SELECTED LABEL TO LABEL-Y ARRAY--

      DO 200 I = 1, NL
        IJ = IS + I
        LABELY(IJ) = YL1(I)
  200 CONTINUE
C
```


9 1 0 4 8 1 2 8 6

```
C      BLANK OUT REMAINDER OF LABELY ARRAY--
       IT = NL + IS + 1
       IF (IT .LT. IY)  THEN
         DO 700 I = IT, IY
           LABELY(I) = BLANK
  700    CONTINUE
       ENDIF
C
C
C
C
C      BLANK-OUT ARRAY--
C
       DO 500 I = 2, IX-1
         DO 400 J = 1, IY
           ARRAY(J,I) = BLANK
  400    CONTINUE
  500  CONTINUE
C
C
C
C      SET VERTICAL BORDER INTO ARRAY--
C
       DO 600 J = 1, IY
         ARRAY(J,1) = AST
         ARRAY(J,73) = AST
  600  CONTINUE
C
C
C
C      BLANK OUT LEGEND ARRAY
C
       DO 800 I = 1,40
         LEGEND(I) = BLANK2
  800  CONTINUE
C
C
       RETURN
       END
```

```
C-----------------------------------------------------------------
C
      SUBROUTINE TRITUM (IST, IAW, WATCN, AIRCN, ANCONS, ANDRNK, CSOIL,
     .                   EDIBL, AQUA, RIRR, MOPYR)
C
C     This module calculates environmental concentrations of Tritium
C     using a specific-activity model
C
C     Module of DITTY of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification:  13-Jul-88 RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------
C
C     IST
C     IAW
C     WATCN
C     AIRCN
C     ANCONS(7)
C     ANDRNK(7)
C     CSOIL
C     EDIBL(7)
C     AQUA(5)
C
C-----------------------------------------------------------------
C
      INCLUDE 'BIODAT.CMN'
C
C
      DIMENSION ANCONS(7), ANDRNK(7), EDIBL(7), AQUA(5)
      REAL RIRR, MOPYR
C
C
      DATA H1 /9.0/
      DATA H2 /0.008/
      DATA H3 /0.0625/
      DATA H4 /0.083/
      DATA H5 /0.094/
      DATA H6 /0.10/
      DATA H7 /0.087/
      DATA H8 /0.092/
C
      DATA W1 /0.80/
      DATA W2 /0.12/
      DATA W3 /0.80/
      DATA W4 /0.88/
      DATA W5 /0.60/
```

```
      DATA W6 /0.50/
      DATA W7 /0.70/
      DATA W8 /0.75/
C
      DATA Z1 /0.1/
      DATA Z2 /0.03/
C
      TAIR = AIRCN * H1 / H2
      TWAT = WATCN * H1
      CLEAF = TAIR + TWAT

      IF (RIRR .EQ. 0.0 .OR. MOPYR .EQ. 0.0) THEN
        CSOIL = 0.0
      ELSE
        CSOIL = AIRCN * Z1 / H2  +  WATCN * Z1
      ENDIF
C
      W1M = W1 / H1 + (1.0 - W1) * H3
      W2M = W2 / H1 + (1.0 - W2) * H3
      W3M = W3 / H1 + (1.0 - W3) * H3
C
      EDIBL(1) = CLEAF * W1M
C
      EDIBL(2) = EDIBL(1)
C
      EDIBL(3) = (ANCONS(3) * CLEAF * W2M  +  ANDRNK(3) * WATCN) /
     .           (ANCONS(3) * W2M  + ANDRNK(3) / H1) *
     .           (W8 / H1 + (1. - W8) * H8)
C
      EDIBL(4) = (ANCONS(4) * CLEAF * W3M  +  ANDRNK(4) * WATCN) /
     .           (ANCONS(4) * W3M  +  ANDRNK(4) / H1 ) *
     .           (W4 / H1  + (1. - W4) * H4)
C
      EDIBL(5) = (ANCONS(5) * CLEAF * W2M  +  ANDRNK(5) * WATCN) /
     .           (ANCONS(5) * W2M  + ANDRNK(5) /H1) *
     .           (W5 / H1  +  (1. - W5) * H5)
C
      EDIBL(6) = (ANCONS(6) * CLEAF * W2M  + ANDRNK(6) * WATCN) /
     .           (ANCONS(6) * W2M  + ANDRNK(6) / H1) *
     .           (W6 / H1  +  (1. - W6) * H6)
C
      EDIBL(7) = (ANCONS(7) * CLEAF * W2M  + ANDRNK(7) * WATCN) /
     .            (ANCONS(7) * W2M  + ANDRNK(7) / H1) *
     .            (W7 / H1  +  (1. - W7) * H7)
C
C
      IF (IAW .EQ. 2)  THEN
C
        DO 100 I = 1, 4
```

```
           AQUA(I) = BIOACF(I,IST) * WATCN
  100    CONTINUE
C
         AQUA(5) = WATCN * DWCF(IST)
C
      ENDIF
C
      RETURN
      END
```

```
C------------------------------------------------------------------
C
      SUBROUTINE WBEDE2 (ITT)
C
C     Subroutine WBEDE calculates the wholy body effective dose
C     equivalent (EDE) from the current time period
C
C     Module of Program DITTY of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 11-Apr-88 RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C------------------------------------------------------------------
C
C     DOSEMO    - Dose to each organ in the master list
C     FLAG      - Flag set in bubble sort to indicate that a switch was
C                 made this pass
C     IREMAN()  - Index in organ list corresponding to the organ dose
C                 in array REMAN
C     ITEMP     - Workspace for sort
C     NCDE      - Index of the current position in the CDE and ICDE
C                 arrays
C     NREM      - Index of the current position in the REMAN and IREMAN
C                 arrays
C     REMAN()   - Work array for ordering remaining organ doses by
C                 highest dose
C     RTEMP     - Workspace for sort
C
C------------------------------------------------------------------

      INCLUDE 'ORGMAS.CMN'
      INCLUDE 'RESULT.CMN'
      INCLUDE 'ORGID.CMN'
      INCLUDE 'OPT.CMN'

      REAL RTEMP, REMAN(25), DOSMO(25), WDE(11), CDE(11)
      INTEGER ITEMP, IREMAN(25), NREM, NCDE, FLAG, ICDE(11)

C     Order doses by master organ list--
      DO 401 IO = 1, MORG
        DOSMO(IO) = DOSINT(IO,ITT)
  401 CONTINUE

C     Initialize arrays--
      DO 402 IO = 1, 11
        CDE(IO) = 0.0
        WDE(IO) = 0.0
        ICDE(IO) = 0
```


9 1 0 4 8 1 2 9 1

```
  402 CONTINUE
C     Move whole body organs to CDE array--
C     Gonads--
      IF (DOSMO(12) .GT. DOSMO(11)) THEN
        CDE(1) = DOSMO(12)
        ICDE(1) = 12
      ELSE
        CDE(1) = DOSMO(11)
        ICDE(1) = 11
      ENDIF
C     Breast (muscle)--
      CDE(2) = DOSMO(13)
      ICDE(2) = 13
C     Red blood marrow--
      CDE(3) = DOSMO(8)
      ICDE(3) = 8
C     Lung (and lymph) --
      CDE(4) = DOSMO(1)
      ICDE(4) = 1
C     Thyroid--
      CDE(5) = DOSMO(14)
      ICDE(5) = 14
C     Bone surface--
      CDE(6) = DOSMO(7)
      ICDE(6) = 7
C     Move remaining organs into REMAN array for sorting--
      NREM = 0
C     Gastro-intestinal tract--
      DO 100 IO = 3, 6
        NREM = NREM + 1
        REMAN(NREM) = DOSMO(IO)
        IREMAN(NREM) = IO
  100 CONTINUE
C     Specified organs--
      DO 110 IO = 15, MORG
        IF (IO .EQ. 22) THEN
C         Add stomach wall to gut--
          REMAN(3) = REMAN(3) + DOSMO(IO)
```

```
      ELSEIF (DOSMO(IO) .GT. 0.0) THEN
        NREM = NREM + 1
        REMAN(NREM) = DOSMO(IO)
        IREMAN(NREM) = IO
      ENDIF
  110 CONTINUE

C     Order remaining organs by highest dose--

      N = NREM - 1
  200 CONTINUE
        FLAG = 0
        J = 1
  201   CONTINUE
          IF (REMAN(J) .LT. REMAN(J+1)) THEN
            RTEMP = REMAN(J)
            ITEMP = IREMAN(J)
            REMAN(J) = REMAN(J+1)
            IREMAN(J) = IREMAN(J+1)
            REMAN(J+1) = RTEMP
            IREMAN(J+1) = ITEMP
            FLAG = 1
          ENDIF
          J = J + 1
        IF (J .LE. N) GOTO 201
      IF (FLAG .GT. 0) THEN
        N = N - 1
        IF (N .GT. 0) GOTO 200
      ENDIF

C     Move top 5 remaining organs into CDE array--

      NCDE = 6
      N2 = MIN (NREM, 5)

      DO 300 I = 1, N2
        NCDE = NCDE + 1
        CDE(NCDE) = REMAN(I)
        ICDE(NCDE) = IREMAN(I)
        IF (ICDE(NCDE) .LT. 1 .OR. ICDE(NCDE) .GT. MORG) GOTO 91
  300 CONTINUE

C     Calculate WDE, EDE, and AEDE--

      EDE = 0.0

      DO 302 IO = 1, NCDE
        WDE(IO) = CDE(IO) * WT(IO)
```


9 1 0 4 8 1 2 9 3

```
      EDE = EDE + WDE(IO)
302 CONTINUE

    AEDE2(ITT) = EDE + DOSSUB(ITT) + DOSEXT(ITT)

C     Check if maximum dose so far--
      IF (AEDE2(ITT) .GT. HIAEDE) THEN
        DO 304 IO = 1, 11
          HICDE(IO) = CDE(IO)
          HIWBE(IO) = WDE(IO)
          ICDEH(IO) = ICDE(IO)
304     CONTINUE
        HIEDE = EDE
        NORGW = N2 + 6
      ENDIF

      RETURN

C---- Error Conditions -------------------------------------------

   91 CONTINUE
      WRITE (*,*) 'Invalid master organ index in WBEDE',
     .                NCDE,  ICDE(NCDE)
      CALL EXIT (1)

C----------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------
C
      SUBROUTINE WBEDE4 (DOSIN, EDE)
C
C     Subroutine WBEDE calculates the wholy body effective dose
C     equivalent (EDE) from the current time period
C
C     Module of Program DITTY of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 6-Nov-87 RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C     DOSEMO    - Dose to each organ in the master list
C     FLAG      - Flag set in bubble sort to indicate that a switch was
C                 made this pass
C     IREMAN()  - Index in organ list corresponding to the organ dose
C                 in array REMAN
C     ITEMP     - Workspace for sort
C     NCDE      - Index of the current position in the CDE and ICDE
C                 arrays
C     NREM      - Index of the current position in the REMAN and IREMAN
C                 arrays
C     REMAN()   - Work array for ordering remaining organ doses by
C                 highest dose
C     RTEMP     - Workspace for sort
C
C-----------------------------------------------------------------------

      INCLUDE 'ORGMAS.CMN'
      INCLUDE 'RESULT.CMN'
      INCLUDE 'ORGID.CMN'
      INCLUDE 'OPT.CMN'

      REAL RTEMP, REMAN(25), DOSMO(25), WDE(11), CDE(11), DOSIN(25)
      INTEGER ITEMP, IREMAN(25), NREM, NCDE, FLAG, ICDE(11)

C     Order doses by master organ list--
      DO 401 IO = 1, MORG
        DOSMO(IO) = DOSIN(IO)
  401 CONTINUE

C     Initialize arrays--
      DO 402 IO = 1, 11
        CDE(IO) = 0.0
        WDE(IO) = 0.0
        ICDE(IO) = 0
```

```
  402 CONTINUE
C     Move whole body organs to CDE array--

C     Gonads--
      IF (DOSMO(12) .GT. DOSMO(11)) THEN
        CDE(1) = DOSMO(12)
        ICDE(1) = 12
      ELSE
        CDE(1) = DOSMO(11)
        ICDE(1) = 11
      ENDIF

C     Breast (muscle)--
      CDE(2) = DOSMO(13)
      ICDE(2) = 13

C     Red blood marrow--
      CDE(3) = DOSMO(8)
      ICDE(3) = 8

C     Lung (and lymph) --
      CDE(4) = DOSMO(1)
      ICDE(4) = 1

C     Thyroid--
      CDE(5) = DOSMO(14)
      ICDE(5) = 14

C     Bone surface--
      CDE(6) = DOSMO(7)
      ICDE(6) = 7

C     Move remaining organs into REMAN array for sorting--

      NREM = 0

C     Gastro-intestinal tract--
      DO 100 IO = 3, 6
        NREM = NREM + 1
        REMAN(NREM) = DOSMO(IO)
        IREMAN(NREM) = IO
  100 CONTINUE

C     Specified organs--
      DO 110 IO = 15, MORG
        IF (IO .EQ. 22) THEN
C         Add stomach wall to gut--
          REMAN(3) = REMAN(3) + DOSMO(IO)
```

```
         ELSEIF (DOSMO(IO) .GT. 0.0) THEN
           NREM = NREM + 1
           REMAN(NREM) = DOSMO(IO)
           IREMAN(NREM) = IO
         ENDIF
  110 CONTINUE

C     Order remaining organs by highest dose--

      N = NREM - 1
  200 CONTINUE
        FLAG = 0
        J = 1
  201   CONTINUE
          IF (REMAN(J) .LT. REMAN(J+1)) THEN
            RTEMP = REMAN(J)
            ITEMP = IREMAN(J)
            REMAN(J) = REMAN(J+1)
            IREMAN(J) = IREMAN(J+1)
            REMAN(J+1) = RTEMP
            IREMAN(J+1) = ITEMP
            FLAG = 1
          ENDIF
          J = J + 1
        IF (J .LE. N) GOTO 201
      IF (FLAG .GT. 0) THEN
        N = N - 1
        IF (N .GT. 0) GOTO 200
      ENDIF

C     Move top 5 remaining organs into CDE array--

      NCDE = 6
      N2 = MIN (NREM, 5)

      DO 300 I = 1, N2
        NCDE = NCDE + 1
        CDE(NCDE) = REMAN(I)
        ICDE(NCDE) = IREMAN(I)
        IF (ICDE(NCDE) .LT. 1 .OR. ICDE(NCDE) .GT. MORG) THEN
          WRITE (*,*) 'Invalid master organ index in WBEDE',
     .                NCDE,  ICDE(NCDE)
          STOP
        ENDIF
  300 CONTINUE
```

```
C     Calculate WDE, EDE, and AEDE--

      EDE = 0.0

      DO 302 IO = 1, NCDE
        WDE(IO) = CDE(IO) * WT(IO)
        EDE = EDE + WDE(IO)
  302 CONTINUE

      RETURN
C-----------------------------------------------------------------------
      END
```

9 1 0 4 8 1 2 9 8

```
C-----------------------------------------------------------------------
C
      SUBROUTINE WPATHS (ITIM, ITWX)
C
C     This module calculates environmental concentrations of
C     radionuclides from aquatic pathways
C
C     Module of DITTY of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification:  13-Jul-88 RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C     ITIM
C     ITWX
C
C-----------------------------------------------------------------------
C
      INCLUDE 'BIODAT.CMN'
      INCLUDE 'DKAY.CMN'
      INCLUDE 'EDCN.CMN'
      INCLUDE 'FODATA.CMN'
      INCLUDE 'PATHIN.CMN'
      INCLUDE 'NUCNAM.CMN'
      INCLUDE 'VARYBL.CMN'
C
C
      CHARACTER*2 CONSTH, CONSTC
      DIMENSION RATIRR(100), RATSED(100)
C
      DIMENSION TRNL(7), ANCONS(7), ANDRNK(7), DUMMY(100)
      DATA TRNL / 1.0, 0.1, 0.1, 1.0, 0.1, 0.1, 0.1/
      DATA ANCONS /0., 0., 0.12, 55., 68., 4.2, 0.12/
      DATA ANDRNK /0., 0., 0.3, 60., 50., 10., 0.3/
C
      DATA CONST1 /1.119E-9/
      DATA CONST2 /224./
      DATA CONST3 /25300./
      DATA CONST5 /0.25/
      DATA CONST6 /365.25/
C
C     CONST4 = 0.69315 / 14. * 365.25
      DATA CONST4 /18.0838/
C
      DATA ONE /1./
      DATA CONSTC /'C '/
      DATA CONSTH /'H '/
```


9 1 0 4 8 1 2 9 9

```
C
      IF (RM .EQ. 0.0)     RM = 1.0
      IF (RECON .EQ. 0.0)    RECON = 1.0
C
      DO 101 I = 1, NUCTOT
        DUMMY(I) = AR(I)
  101 CONTINUE
C
      JNUC = 0
C
C
C     FOR EACH DECAY CHAIN--
      DO 100 ICH = 1, ICHN
C
        J = NOFN(ICH)
        IST = JNUC + 1
        JNUC = JNUC + J
        K = IST + J - 1
C
C
C       FOR EACH NUCLIDE IN THE CHAIN--
        DO 200 I = IST, K
          IF (CFLO .GT. 0.0 .AND. AR(I) .GT. 0.0) THEN
            WATCON(I) = PL(ITIM) * RECON * RM * ACTW(ITIM,I) * CONST1 /
     .                  CFLO / AR(I)
          ELSE
            WATCON(I) = 0.0
          ENDIF
  200   CONTINUE
C
C       IF THIS ELEMENT IS 'H '--
        IF (ELT(IST) .EQ.  CONSTH)  THEN
C
          CALL TRITUM (IST, 2, WATCON(IST), DUMMY1, ANCONS, ANDRNK,
     .                 SCONW(IST), EDBCNW(1,IST), AQUATC(1,IST),
     .                 RIRR, MOPYR)
C
        ELSE
C         IF THIS ELEMENT IS 'C '--
          IF (ELT(IST) .EQ. CONSTC)  THEN
C
            CALL CARBON (IST, 2, WATCON(IST), DUMMY1, ANCONS, ANDRNK,
     .                   SCONW(IST), EDBCNW(1,IST), AQUATC(1,IST),
     .                   RIRR, MOPYR )
C
          ELSE
C
C           SKIP OVER IF ACUTE RELEASE, FIRST YEAR--
            IF (ITIM .NE. 1)   THEN
```

```
C
C            SKIP OVER IF FIRST TIME CHRONIC RELEASE--
             IF (ITIM .NE. 2)  THEN
C
C              DECAY PREVIOUS SOIL CONCENTRATIONS--
               CALL BCHAIN (J, 70., DK2(1,IST), IFR2(1,IST), AR(IST),
     .                      AB(IST), SCONW(IST), SCONW(IST), 0)
C
C              WASH OUT PREVIOUS SEDIMENT CONCENTRATIONS (AND RE-
C              ESTABLISH EQUILIBRIUM WITH THIS PERIOD'S WATER
C              CONCENTRATION, IN FOLLOWING DO LOOP)
               CALL ZEROR ( 100, SEDCON )
C
             ENDIF
           ENDIF
C
C            IF THERE IS A RELEASE--
             IF (ITIM .LE. ITWX)   THEN
C
               TIME = 70.
               IOONE = 1
C
               IF (ITIM .EQ. 1)  THEN
                 TIME = 1.0
                 IOONE = 0
               ENDIF
C
               DO 300 I = IST, K
C
C                IRRIGATION DEPOSITION RATE, WEIGHTED BY POPULATION
C                AND DECAY CONSTANT, PERSON-CI-YR/KG-YR
                 RATIRR(I) = WATCON(I) *  RIRR / CONST2 * MOPYR
C
C                SEDIMENT DEPOSITION RATE IN PERSON-CI-YR/M**2-YR
                 RATSED(I) = WATCON(I) * CONST3
C
  300          CONTINUE
C
               CALL BCHAIN (J, TIME, DK2(1,IST), IFR2(1,IST), AR(IST),
     .                      AB(IST), RATIRR(IST), RATIRR(IST), IOONE)
C
               CALL BCHAIN (J, TIME, DK2(1,IST), IFR2(1,IST), AR(IST),
     .                      DUMMY(IST), RATSED(IST), RATSED(IST), 1)
C
C
C              The following code was added to correct population included
C              in soil concentration--
               PLC = 1.0
               IF (ITIM .GT. 1) THEN
```

```
            IF (PL(ITIM) .GT. 0.0 .AND. PL(ITIM-1) .GT. 0.0) THEN
              PLC = PL(ITIM) / PL(ITIM-1)
            ENDIF
          ENDIF
C
C         SUM PREVIOUS AND CURRENT DEPOSITIONS--
          DO 400 I = IST, K
C
            SCONW(I) = SCONW(I) * PLC  + RATIRR(I)
            SEDCON(I) = SEDCON(I) + RATSED(I)
C
  400     CONTINUE
C
        ENDIF
C
C
C     CALCULATE PATHWAY CONCENTRATIONS--
      DO 500 I = IST, K
C
C       FIND ENVIRONMENTAL REMOVAL CONSTANT--
        ENVLAM = AR(I) + CONST4
C
C       LOOP ON TERRESTRIAL PATHWAYS--
        DO 600 IP = 1, 7
C
          IF (YELD(IP) .GT. 0.0) THEN
            IF (ITIM .EQ. 1)   THEN
C             ACUTE LEAF CONCENTRATION--
              RLFCON = CONST5 * WATCON(I) * RIRR * 12. /
     .                YELD(IP)
            ELSE
C             CHRONIC LEAF CONCENTRATION--
              RLFCON = CONST5 * (WATCON(I) * RIRR * 12.
     .                + SCONW(I) * DVEL(I) * .47)
     .                * (ONE - EXP (-ENVLAM * GRWP(IP)/CONST6))
     .                / YELD(IP) / ENVLAM
            ENDIF
          ELSE
            RLFCON = 0.0
          ENDIF
C
C
          PLTCON = RLFCON * TRNL(IP) + SCONW(I) * CRATIO(1,I)
C
C         IF VEGATABLE PATHWAY--
          IF (IP .LE. 2)  THEN
C
            EDBCNW(IP,I) = PLTCON
C
```

```
                 ELSE
C
                   EDBCNW(IP,I) = (PLTCON * ANCONS(IP) + WATCON(I)
     .                            * ANDRNK(IP)) * CRATIO(IP-1,I)
C
                 ENDIF
C
  600          CONTINUE
C
C              LOOP ON AQUATIC PATHWAYS--
               DO 700 IWP = 1, 4
                 AQUATC(IWP,I) = WATCON(I) * BIOACF(IWP,I)
  700          CONTINUE
C
C              DRINKING WATER--
               AQUATC(5,I) = WATCON(I) * DWCF(I)
C
  500        CONTINUE
           ENDIF
         ENDIF
  100 CONTINUE
C
      RETURN
C-----------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------
C
      SUBROUTINE ZEROI(N,K)
C
C     THIS MODULE SETS N VALUES OF ARRAY K TO INTEGER ZERO.
C
C     Module of DITTY of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification:  27-Apr-87  RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
      DIMENSION K(1)
C
      DO 1 J=1,N
        K(J)=0
    1 CONTINUE
C
      RETURN
C
C-----------------------------------------------------------------------
C
      END
```

```
C-----------------------------------------------------------------------
C
      SUBROUTINE ZEROR(N,A)
C
C
C     THIS MODULE SETS N VALUES OF ARRAY A TO REAL ZERO.
C
C     Module of DITTY of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification:  27-Apr-87  RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
      DIMENSION A(1)
C
      DO 1 J=1,N
        A(J)=0.
    1 CONTINUE
C
      RETURN
C
C-----------------------------------------------------------------------
C
      END
```

```
C----------------------------------------------------------------------
C
C     Program title:                  INTDF -  A module of the GENII
C                                     environmental dosimetry software
C                                     package.
C
C     Prepared for:                   U. S. Department of Energy under
C                                     Contract DE-AC06-76RLO 1830
C
C
C     Contact:                        Bruce Napier
C                                     Pacific Northwest Laboratory
C                                     Richland WA 99352
C                                     (509) 375-3916
C
C     Code developers:                B. A. Napier, R. A. Peloquin,
C                                     and D. L. Strenge.
C                                     Pacific Northwest Laboratory
C                                     Richland WA  99352
C
C
C     This code was prepared for an agency of the United States
C     Government.  Neither the United States Government or any agency
C     thereof, or any of their employees, make any warranty, expressed
C     or implied, or assumes any legal liability or responsibility for
C     any third party's use, or the results of such use, of any portion
C     of this program or represents that its use by such third party
C     would not infringe privately owned rights.
C
C
C--- Program Information ----------------------------------------------
C
C     Problem description:       To perform internal radiation dosimetry
C                                calculations for individuals for
C                                acute or chronic inhalation or ingestion
C                                of radionuclides.
C
C     Results format:            The output of INTDF is an output file
C                                called INTDF.OUT. A separate data
C                                transfer file is prepared containing
C                                either dose increment factors or lifetime
C                                doses for chronic exposure.
C
C     Computer:                  This version is for the IBM PC/AT.
C
C     Programming language:      FORTRAN compiled using Lahey(tm)
C                                FORTRAN Compiler.
C
C     Machine requirements:      IBM PC/AT with a minimum of 640 Kbytes
```


910481306

```
C                                    random access memory and 1 20-Mbyte fixed
C                                    disk drive.
C
C
C   Reference:                       B. A. Napier, R. A. Peloquin, D. L. Strenge,
C                                    and J. V. Ramsdell. 1988. "GENII - The
C                                    Hanford Environmental Radiation Dosimetry
C                                    Software System."  PNL-6584, Volumes 1, 2,
C                                    and 3.  Pacific Northwest Laboratory,
C                                    Richland, WA  99352
C
C
C-----------------------------------------------------------------------------
C
      PROGRAM INTDF
C
C     This module controls reading of the input file and data libraries,
C     calculation of ingestion and inhalation dose rate factors, and
C     writes library files for program DOSE
C
C     Module of Program INTDF of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification:  15-Apr-88  RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-------------------------------------------------------------------------
C
C     NOTDUM     - Dummy logical to ensure dummy calls are not made
C     IEND       - Final year of dose calculations - 1, integer
C     INRAD      - Index of the current radionuclide chain in the input
C                  list
C     ISTOP      - Flag set if no information for the current radionuclide
C                  was found in the metabolic data library
C     TIMEND     - End time of simulation in REAL days
C     TIMCUR     - Start time of current time loop in REAL days
C-------------------------------------------------------------------------
C
      INCLUDE 'FILES.CMN'
      INCLUDE 'TITL.CMN'
      INCLUDE 'TIMES.CMN'
      INCLUDE 'OPT.CMN'
      INCLUDE 'INVIN.CMN'
      INCLUDE 'DAYPC.CMN'
      INCLUDE 'INTDFS.CMN'
      INCLUDE 'MTBPAR.CMN'
      INCLUDE 'RAD.CMN'
```

```
      EXTERNAL DIFEQ2
      INTEGER IEND, INRAD
      LOGICAL ISTOP, NOTDUM

C     Dummy call for compilation--
      DATA NOTDUM /.FALSE./
      IF (NOTDUM) THEN
C       CALL DIFEQU (0.0, YT)
        CALL DIFEQ2 (0, 0.0D0, YWORK, YT)
      ENDIF

C     Get system time and date--
      CALL MAKDA2

C     Read file names--
      LUN = 1
      CALL OPNFIL ((3),(0),LUN)

C     Set integration method to LSODES2--
      METHOD = 3

C---- Read input file and check inventory ------------------------------

      LUN = 18
      CALL OPNFIL ((4),(4),LUN)
      READ (LUN,*) DCEND
      READ (LUN,*) ACUTE
      READ (LUN,*) DIAM
      IF (DIAM .EQ. 0.0) DIAM = 1.0
      READ (LUN,*) DEBUG
      READ (LUN,*) RTOL
      READ (LUN,*) ATOL
      READ (LUN,*) ASSA
      READ (LUN,*) HSTART
      READ (LUN,*) NSC
      READ (LUN,*) FETDOS
      IF (FETDOS) THEN
        BACKSPACE (LUN)
        READ (LUN,*) FETDOS, FETAGE
      ENDIF
      IF (DEBUG) WRITE (*,*) DCEND, HSTART, ACUTE, METHOD, DEBUG

      I = 0
    1 CONTINUE
        READ (LUN,'(A2,A6)',END=2,ERR=98) ELTI(I+1), AWI(I+1)
        IF (DEBUG) WRITE (*,'(3A)')
     .    ' Radionuclide: ',ELTI(I+1), AWI(I+1)
        IF (ELTI(I+1) .NE. '  ') I = I + 1
        IF (I .LT. 100) GOTO 1
```

```
    2 CONTINUE

      CLOSE (LUN)
      NIN = I

C     Set time indices--
      NTIME = INT(DCEND)
      IEND = NTIME - 1

C     Read master radionuclide library--
      CALL RLIBIN

C     Check input radionuclide list for validity--
      CALL IDNUC

C     Calculate lung deposition fraction--
      CALL DEP

C---- Open output files and print headings ----------------------------


      LUN = 15
      CALL OPNFIL ((2), (0), LUN)

      LUN = 20
      CALL OPNFIL ((2),(0),LUN)
C     WRITE (LUN,'(A)') 'Committed Dose Equivalents (Sv/Bq)'

      LUN = 16
      CALL OPNFIL ((2),(0),LUN)

C==== Process each radionuclide in input list ==========================

      DO 200 INRAD = 1, NIN

C       Identify radionuclide and find daughters--
        CALL ORDIN (INRAD)

C       Read metabolic data for this radionuclide chain--
        ISTOP = .FALSE.
        CALL METLIB (ISTOP)
        IF (ISTOP) THEN
          LUN = 15
          CALL HEADNG (LUN)
          WRITE (LUN,1001) ELTI(INRAD), AWI(INRAD)
          GOTO 200
        ENDIF

C       Read SIJ library--
```


9 1 0 4 8 1 3 0 9

```
      CALL SIJLIB (ISTOP)
      IF (ISTOP) THEN
        LUN = 15
        CALL HEADNG (LUN)
        WRITE (LUN,1002) ELTI(INRAD), AWI(INRAD)
        GOTO 200
      ENDIF

C     Set organ prameters--
      CALL SETORG

C     Get system time and date--
      CALL MAKDA2

C     Write input parameter report--
      CALL RITINT

C------ Calculate ingestion dose factors ------------------------------


      INHDF = .FALSE.
      ISTOP = .FALSE.

      IF (DEBUG) WRITE (*,*) 'Beginning ingestion calculations'

C     Initialize organ compartments for this radionuclide--
      CALL SETPAR

C     For each year of dose commitment period--
      DO 110 ITIME = 0, IEND

C       Set time in days--
        TIMEND = FLOAT ((ITIME+1)*365)
        TIMCUR = TIMEND - INT(AYEAR)

        IF (DEBUG) WRITE (*,*)
     .    'ITIME,TIMCUR,AYEAR: ',ITIME,TIMCUR,AYEAR

C       Perform integration of contamination remaining in each
C       organ model compartment--

        IF (METHOD .EQ. 1) THEN
C         CALL EULER (DIFEQU, TIMCUR, AYEAR)
        ELSEIF (METHOD .EQ. 2) THEN
C         CALL RUNGE (DIFEQU, TIMCUR, AYEAR)
        ELSE
          CALL LS2 (DIFEQ2, TIMCUR, TIMEND, HSTART, DCEND)
        ENDIF
```


9 1 0 4 8 1 3 1 0

```
C         Transfer to standard organs, multiply by Sij factors,
C         sum over daughters, calculate yearly dose increment, and
C         write line to output line--
          CALL CDECAL (ITIME+1)

  110   CONTINUE

C       Write integrated retention report--
        CALL RITEND


C------ Calculate inhalation dose factors ------------------------------

        INHDF = .TRUE.
        ISTOP = .FALSE.

C       Initialize organ compartments for this radionuclide--
        CALL SETPAR

C       For each year of dose commitment period--
        DO 120 ITIME = 0, IEND

C         Set time indices--
          TIMEND = FLOAT ((ITIME+1)*365)
          TIMCUR = TIMEND - INT(AYEAR)

C         Perform integration of contamination remaining in each
C         organ model compartment--
          IF (METHOD .EQ. 1) THEN
C           CALL EULER (DIFEQU, TIMCUR, AYEAR)
          ELSEIF (METHOD .EQ. 2) THEN
C           CALL RUNGE (DIFEQU, TIMCUR, AYEAR)
          ELSE
            CALL LS2 (DIFEQ2, TIMCUR, TIMEND, HSTART, DCEND)
          ENDIF

C         Transfer to standard organs, multiply by Sij factors,
C         sum over daughters, calculate yearly dose increment, and
C         write line to output line--
          CALL CDECAL (ITIME+1)

  120   CONTINUE

C       Write integrated retention report--
        CALL RITEND

C       Write CDE increment data set--
        CALL RITINC (NTIME)
```

```
C==== End of Radionuclide loop ==========================================
  200 CONTINUE
      STOP

C---- Error Messages ----------------------------------------------------

   91 CALL FILERR (1, LUN, 'In INTDF')
   98 CALL FILERR (2, LUN, 'In INTDF')
   99 CALL FILERR (3, LUN, 'In INTDF')

C---- Format Statements -------------------------------------------------

 1000 FORMAT (10X,A30)
 1001 FORMAT (//' Data not found for ',A2,A6,' in metabolic data ',
     .        'library.')
 1002 FORMAT (//' Data not found for ',A2,A6,' in specific effective ',
     .        'energy library.')

C-----------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------
C
      SUBROUTINE ALK (YWORK2, YT2, NETDK, GUT2TC, LG2TC)
C
C     This module defines the ordinary differential equations for
C     the ALKALINE EARTH models formatted for LS2.
C
C     Module of INTDF
C     Last modification: 24-Nov-87 RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------
C
C     GUT2TC() - Transfer rate from gut to transfer compartment
C                (blood and body fluids)
C     LG2TC()  - Transfer rate from lung to transfer compartment
C     YT2()    - Array of results for each equation passed to
C                calling subroutine
C     YWORK2() - YWORK ordered by j,i where j=equation index, i=
C                radionuclide position in chain as a single-
C                dimensioned array
C     NETDK()  - Decay for each radionuclide in each compartment
C
C     In YWORK2 and YT2 for each radionuclide i:
C       (17,i)  Transfer compartment (blood & fluids)
C       (24,i)  Retention in cancellous bone
C       (25,i)  Retention in OTHER organs
C       (26,i)  Retention in cortical bone
C       (27,i)  Retention in bone surface
C       (29,i)  Cancelleous a bone compartment
C       (30,i)  Cancelleous b bone compartment
C       (31,i)  Cortical a bone compartment
C       (32,i)  Cortical b bone compartment
C       (33,i)  OTHER organs compartments (33, 34, & 35)
C       (36,i)  Bone surface compartment
C
C-----------------------------------------------------------------

      INCLUDE 'MTBPAR.CMN'
      INCLUDE 'RAD.CMN'
      INCLUDE 'ORGPAR.CMN'
      INCLUDE 'OPT.CMN'

      REAL*8 NETDK(9,45), LG2TC(9), GUT2TC(9), YWORK2(45,9), YT2(45,9)

C---- Transfer compartment (blood and body fluids) -------------------

      DO 50 I = 1, NONUC
        YT2(17,I) = LG2TC(I) + GUT2TC(I) + RTORG(1) * YWORK2(36,I)
```

```
     .             + RTOTHR(1) * YWORK2(33,I)  + RTBONE(1)
     .             * YWORK2(29,I) + RTBONE(3) * YWORK2(31,I)
     .             - (RTBLOOD + TCBONE(1) + TCBONE(3) + TCORG(1)
     .             + TCOTHR(1)) * YWORK2(17,I)
     .             - NETDK(I,17)

53   CONTINUE
50 CONTINUE

C---- Cancelleous and cortical bone compartments ---------------------

      DO 52 I = 1, NONUC
        YT2(29,I) = TCBONE(1) * YWORK2(17,I)
     .              + RTBONE(2) * YWORK2(30,I)
     .              - (RTBONE(1) + TCBONE(2)) * YWORK2(29,I)
     .              - NETDK(I,29)

        YT2(30,I) = TCBONE(2) * YWORK2(29,I)
     .              - RTBONE(2) * YWORK2(30,I) - NETDK(I,30)

        YT2(31,I) = TCBONE(3) * YWORK2(17,I)
     .              + RTBONE(4) * YWORK2(32,I)
     .              - (RTBONE(3) + TCBONE(4)) * YWORK2(31,I)
     .              - NETDK(I,31)
        YT2(32,I) = TCBONE(4) * YWORK2(31,I)
     .              - RTBONE(4) * YWORK2(32,I) - NETDK(I,32)
52 CONTINUE

C---- Bone Surface compartment ----------------------------------------

      DO 62 I = 1, NONUC
       YT2(36,I) = TCORG(1) * YWORK2(17,I) -
     .             RTORG(1) * YWORK2(36,I) - NETDK(I,36)
62 CONTINUE

C---- OTHER organ/tissues compartments --------------------------------

      DO 58 I = 1, NONUC
       YT2(33,I) = TCOTHR(1) * YWORK2(17,I) -
     .             RTOTHR(1) * YWORK2(33,I) - NETDK(I,33)
58 CONTINUE


C---- Integrated retentions -------------------------------------------

      DO 59 I = 1, NONUC
       YT2(24,I) = YWORK2(29,I) + YWORK2(30,I)  +
     .             (YWORK2(17,I) * TCMULT(24))
       YT2(25,I) = YWORK2(33,I) + (YWORK2(17,I) * TCMULT(25))
```

```
      YT2(26,I) = YWORK2(31,I) + YWORK2(32,I) +
     .            (YWORK2(17,I) * TCMULT(26))
      YT2(27,I) = YWORK2(36,I)
   59 CONTINUE

      RETURN
C-----------------------------------------------------------------------
      END
```

9 1 0 4 8 1 3 1 5

```
C-----------------------------------------------------------------------
C
      SUBROUTINE CDECAL (ITIM)
C
C     Subroutine CDECAL calculates the committed dose equivalent for
C     each organ for the current radionuclide chain, for a yearly
C     increment
C
C     Module of Program INTDF of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 3-DEC-87 RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C     ITIM      - ITIME+1, the current year passed from the calling
C                 program
C     CDE()     - Work arrary for committed dose equivalent, either
C                 inhalation or ingestion
C     DTYPE     - Character flag to indicate dose type; 'G'-ingestion,
C                 'H'-inhalation
C     OTHR()    - 'Other' contribution to specified organs
C     RA226M    - Bone compartment multiplier for RA daughters
C
C     Assumption:  NORGL is the index of "other"
C
C-----------------------------------------------------------------------

      INCLUDE 'ORGPAR.CMN'
      INCLUDE 'RAD.CMN'
      INCLUDE 'INTDFS.CMN'
      INCLUDE 'DOSES.CMN'
      INCLUDE 'DAYPC.CMN'
      INCLUDE 'OPT.CMN'
      INCLUDE 'SIJS.CMN'
      INCLUDE 'TITL.CMN'
      INCLUDE 'MTBPAR.CMN'

      CHARACTER DTYPE*1
      INTEGER ITIM
      REAL CDE(25), OTHR(9), RA226M

      IF (TEI) THEN
        N = NONUC - 1
      ELSE
        N = NONUC
      ENDIF
```

```
C     Add lymph to lung; calculate other contrib. to specified organs--
      DO 101 IN = 1, N
        YWORK(IN,18) = YWORK(IN,18) + YWORK(IN,19)
        YWORK(IN,19) = 0.0D0
  101 CONTINUE

C     For each target organ, total over sources and chain members--
      DO 100 IT = 1, NORGL - 1

        CDE(IT) = 0.0
        IF (TARGET(IT)) THEN
          DO 110 IS = 1, NORGL
            DO 120 IN = 1, N

              IF (RA226 .AND. IN .GT. 1) THEN
                IF (IS .EQ. 9 .OR. IS .EQ. 10) THEN
                  RA226M = 0.3
                ELSE
                  RA226M = 0.0
                ENDIF
              ELSE
                RA226M = 1.0
              ENDIF

              IF (INHDF) THEN
C                Source organ contribution from each organ--
                 CDE(IT) = CDE(IT) +
     .                     (YWORK(IN,IYX(IS)) * ORGMLT(IS) +
     .                     YWORK(IN,25) * ORGINH(IS))
     .                     * RA226M * SIJ(IT,IS,IN)
              ELSE
                 CDE(IT) = CDE(IT) +
     .                     (YWORK(IN,IYX(IS)) * ORGMLT(IS) +
     .                     YWORK(IN,25) * ORGING(IS))
     .                     * RA226M * SIJ(IT,IS,IN)
              ENDIF
  120       CONTINUE
  110     CONTINUE
        ENDIF
  100 CONTINUE

C     Special handling for tellerium-iodine--
      IF (TEI) THEN

        IN = NONUC
        YWORK(IN,18) = YWORK(IN,18) + YWORK(IN,19)
        YWORK(IN,19) = 0.0D0
```

```
         DO 102 IT = NORGL-2, NORGL
           DO 111 IS = NORGL-2, NORGL
             CDE(IT) = CDE(IT) + YWORK(IN,IYX(IS)) * ORGMLT(IS) *
     .                 SIJ(IT,IS,IN)
  111      CONTINUE
  102    CONTINUE

       ENDIF

       IF (INHDF) THEN

C        Store inhalation dose factors--
         DO 200 IT = 1, NORGL - 1
           CDEINH(IT,ITIM) = CDE(IT)
  200    CONTINUE
         DTYPE = 'H'
       ELSE

C        Store ingestion dose factors--
         DO 210 IT = 1, NORGL - 1
           CDEING(IT,ITIM) = CDE(IT)
  210    CONTINUE
         DTYPE = 'G'
       ENDIF

C-----------------------------------------------------------------------
       END
```

```
C-----------------------------------------------------------------
C
      SUBROUTINE DEP
C
C     This module calculates the respiratory tract deposition factors
C     from the activity median atmospheric diameter of an aerosol
C     distribution.
C
C     Module of Program INTDF of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last modification: 25-Feb-88  RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------

      INCLUDE 'MTBPAR.CMN'

      EXTERNAL ERFXP
      REAL DELTA, DP, SP, DPL, SPL, XL, XP, FP, FAC, FP
      DATA DELTA /1.0E-06/

      DP = 0.19
      SP = 10.0
      DPL = ALOG10 (DP)
      SPL = ALOG10 (SP)

      XL = ALOG10 (DIAM)
      XP = ( XL - DPL) / SPL

      FP = SIMPS (DBLE(-5.0), DBLE(XP), DELTA, ERFXP)
      FAC = SQRT (2.0 * 3.1415927)

      ZP = 1.0 - FP / FAC

      DP = 2.0
      SP = 3.45
      DPL = ALOG10 (DP)
      SPL = ALOG10 (SP)

      XP = (XL - DPL) / SPL
      FP = SIMPS (DBLE(-5.0), DBLE(XP), DELTA, ERFXP)
      ZNP = FP / FAC

      ZTB = 0.08

      RETURN
C-----------------------------------------------------------------
      END
```

```
C-------------------------------------------------------------------
C
      FUNCTION SIMPS (A, B, DELTA, ERFXP)
C
C     Module of Program INTDF of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last modification: 16-Feb-88  RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C----------------------------------------------------------------------
C
C     A          - Minimum of the definite integral
C     B          - Maximum of the definite integral
C     DELTA      - Permissible difference between two successive sums
C
C----------------------------------------------------------------------

      EXTERNAL ERFXP
      DOUBLE PRECISION A, B

      N = 1
      H = (B - A) / 2.0
      FJAY = H * (ERFXP(A) + ERFXP(B))

C     A maximum of 2049 points will be used when L=11
      DO 35 L = 1, 11
        S = 0.0
        DO 20 K = 1, N
          S = S + ERFXP(A + DBLE((2.0 * FLOAT(K) - 1.0) * H ))
   20   CONTINUE

        FI = FJAY + 4.0 * H * S
        IF (L - 3) 26, 26, 23

   23   CONTINUE
        IF (DELTA - ABS((FI-BAR)/FI))  30, 40, 40
   26   CONTINUE
   30   BAR = FI
        FJAY = (FI + FJAY) / 4.0
        N = 2 * N
        H = H / 2.0
   35 CONTINUE

   40 SIMPS = FI / 3.0

      RETURN
C----------------------------------------------------------------------
      END
```


9 1 0 4 8 1 3 2 0

```
C-------------------------------------------------------------------
C
      FUNCTION ERFXP (ARG)
C
C     Error function.
C
C     Module of Program INTDF of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last modification: 16-Feb-88  RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-------------------------------------------------------------------

      DOUBLE PRECISION ARG, EX

      EX = -0.5D0 * ARG ** 2.0
      ERFXP = DEXP (EX)

      RETURN
C-------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------
C
      SUBROUTINE DGCHAIN (T, AM, AO)
C
C     This subroutine calculates dQ/dt for a decay chain
C     containing up to nine members.  DGCHAIN is a double precision
C     version of ACHAIN inputting the quantity of Q at t sub 0 and the
C     desired timestep and returning dQ/dt as opposed to the total amount
C     as returned in ACHAIN.
C
C     Module of INTDF
C     Last modification: 9-Jun-87  RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C     T         - Timestep to be used in calculation in units of
C                 time corresponding to units of ALDAY, da
C     AM()      - Initial mass of each chain member
C     AMD()     - Internal array of AM / ALDAY
C     AO()      - The net change of mass per unit time of each chain member
C                 to radiological decay and the corresponding ingrowth of
C                 daughters.
C
C-----------------------------------------------------------------------

      INCLUDE 'DECAY.CMN'

      REAL*8 A(45), SUMPR, ASUM, EXPO(9), ARG, AMD(9)
      REAL*8 T, AM(9), AO(9), AO2(9)

      DO 101 IJK = 1, NUC
        AMD(IJK) = AM(IJK) / ALDAY(IJK)
        AO(IJK) = 0.0D0
        AO2(IJK) = 0.0D0
  101 CONTINUE

C     If this is an initialization call (time=zero), then skip--
      IF (T .EQ. 0.0D0) RETURN

C     Initialize coefficient array to zero--
      DO 100 IJK = 1, 45
        A(IJK) = 0.0D0
  100 CONTINUE

C     Loop on each chain member--
      DO 5 J=1,NUC

C       Calculate exponential for current radionuclide--
```


9 1 0 4 8 1 3 2 2

```
          ARG = -ALDAY(J) * T
          IF (-ARG .GT. 50.0D0) THEN
            EXPO(J) = 0.0D0
          ELSE
            EXPO(J)=DEXP(ARG)
          ENDIF

C         Index of offset of Nn in A array--
          JJ=J*(J-1)/2
          JJJ = J + JJ

C         Upper limit of possible parent range--
          J1=J-1

C         If this radionuclide is not the first member in the chain--
          IF (J1 .GT. 0) THEN

C           Establish if 1 or 2 parents are possible--
            IMAX=MIN0(J1,2)
C
C           Loop through all possible parents--
            DO 3 M=1,J1

              MJJ = M + JJ

C             Loop through all possible grandparents, both decay fractions--
              DO 2 L=M,J1
                DO 1 I=1,IMAX
C                 If IFRM index matches the current parent/grandparent--
                  IF(IFRM(I,J).EQ.L) THEN
                    M2 = M + L*(L-1)/2
                    A(MJJ)=A(MJJ)+DBLE(DK(I,J))*ALDAY(L)*A(M2)
                  ENDIF
    1           CONTINUE
    2         CONTINUE
              IF (ALDAY(J) .EQ. ALDAY(M)) THEN
                A(MJJ) = 0.0D0
              ELSE
                A(MJJ)=A(MJJ)/(ALDAY(J)-ALDAY(M))
              ENDIF
    3       CONTINUE

          ENDIF

          ASUM = 0.0D0
          IF (J1 .GT. 0) THEN
            DO 12 IM = 1, J1
              JK = JJ + IM
```

```
            ASUM = ASUM + A(JK)
   12     CONTINUE
        ENDIF
        A(JJJ) = AMD(J) - ASUM

        SUMPR = 0.0D0
        J2 = J
        DO 110 IN = 1,J2
          JJIN = JJ + IN
          SUMPR = SUMPR + EXPO(IN) * A(JJIN)
  110   CONTINUE
        AO2(J) = SUMPR

    5 CONTINUE

C     Calculate net change of mass per unit time--
      IF (T .GT. 1.0D-50) THEN
        DO 114 IJK = 1, NUC
          AO(IJK) = (AMD(IJK) - AO2(IJK)) * ALDAY(IJK) / T
  114   CONTINUE
      ENDIF

      RETURN
C-------------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------
C
      SUBROUTINE DIFEQ2 (NEQ, H1, YWORK2, YT2)
C
C     This module defines the ordinary differential equations for
C     the GENERAL, ALKALINE EARTH, IODINE, and TELLURIUM/IODINE
C     models formatted for LS2.
C
C     Module of INTDF of the GENII Software System
C     Pacific Northwest Laboratory Environmental DOsimetry System
C
C     Last modification: 17-Aug-88 RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C     ALZERO    - Flag set if all zeros
C     GUT2TC    - Transfer rate from gut to blood
C     H1        - Timestep, da
C     YWORK2() - YWORK ordered by j,i where j=equation index, i=
C                 radionuclide position in chain
C     YT2()     - YT ordered by j,i where j=equation index,, i=
C                 radionuclide position in chain
C
C     In YWORK2 and YT2 for each radionuclide i:
C       (1,i)   Lung compartments
C       (13,i)  Gut compartments
C       (18,i)  Retention in the lung
C       (19,i)  Retention in the lymph
C       (20,i)  Retention in the gut (stomach)
C       (21,i)  Retention in the small intestine
C       (22,i)  Retention in the upper large intestine
C       (23,i)  Retention in the lower large intestine
C
C     TE2I          - Sum of decay rates from all telluriums to iodine;
C                     only used for tellurium/iodine model
C     N             - Number of radionuclide chain members to process;
C                     normally NONUC, but excludes iodines in tellurium/
C                     iodine chains
C     SAVIOD        - Iodine compartments to be saved and decayed separately,
C                     NETDK iodine compartments will be used to accumulate
C                     tellurium decay contributions
C
C-----------------------------------------------------------------------

      INCLUDE 'MTBPAR.CMN'
      INCLUDE 'RAD.CMN'
      INCLUDE 'ORGPAR.CMN'
      INCLUDE 'OPT.CMN'
```

```
      INCLUDE 'DECAY.CMN'

      REAL*8 YWORK2(45,9), YT2(45,9)
      REAL*8 H1, NETDK(9,45), DKIN(9,45), TE2I
      REAL*8 LG2TC(9), LG2GUT(9), GUT2TC(9), SAVIOD(45)
      INTEGER NEQ, NEQ2, N

C---- Set indices, initialize parameters if tellurium/iodine ----------

      IF (TEI) THEN
        N = NONUC-1
      ELSE
        N = NONUC
      ENDIF

C     Clean out accumulators-
      DO 60 I = 1, N
        LG2TC(I) = ZERO
        LG2GUT(I) = ZERO
        GUT2TC(I) = ZERO
   60 CONTINUE

      TE2I = 0.0D0

C---- Calculate radionuclide decay ------------------------------------

      NEQ2 = NEQ / NONUC

        DO 12 J = 1, NEQ2

          DO 13 I = 1, NONUC
            DKIN(I,J) = YWORK2(J,I)
   13     CONTINUE

C         Save iodine for later decay; clear compartment to allow
C         accumulation of tellurium decay to pass to inorganic
C         compartment--

          IF (TEI) THEN
            SAVIOD(J) = YWORK2(J,NONUC)
            DKIN(J,NONUC) = 0.0
          ELSE
            SAVIOD(J) = ZERO
          ENDIF

          CALL DGCHAIN (H2, DKIN(1,J), NETDK(1,J))

   12   CONTINUE
```

```
C---- Lung model -------------------------------------------------------

      IF (INHDF) THEN
        IF (.NOT. CARBON .AND. .NOT. TRITUM) THEN

          DO 10 J = 1,9
            YT2(J,1) = DBLE(DEPOSIT(J)) - RTLUNG(J) * YWORK2(J,1)
     .                 - NETDK(1,J)
            IF (TEI .AND. N .EQ. 1) TE2I = TE2I + NETDK(N+1,J)
            DO 11 I = 2, N
              YT2(J,I) = -RTLUNG(J) * YWORK2(J,I) - NETDK(I,J)
              IF (TEI .AND. I .EQ. N) TE2I = TE2I + NETDK(N+1,J)
   11       CONTINUE
   10     CONTINUE

          DO 14 I = 1, N

            YT2(10,I) = RTLUNG(8) * YWORK2(8,I) -
     .                  RTLUNG(10) * YWORK2(10,I) - NETDK(I,10)
            YT2(11,I) = RTLUNG(9) * YWORK2(9,I) - NETDK(I,11)
            YT2(12,I) = RTLUNG(6) * YWORK2(6,I) +
     .                  RTLUNG(7) * YWORK2(7,I) -
     .                  RTLUNG(12) * YWORK2(12,I) - NETDK(I,12)

            LG2TC(I) = RTLUNG(1) * YWORK2(1,I) +
     .                 RTLUNG(3) * YWORK2(3,I) +
     .                 RTLUNG(5) * YWORK2(5,I) +
     .                 RTLUNG(10) * YWORK2(10,I)

            LG2GUT(I) = RTLUNG(2) * YWORK2(2,I) +
     .                  RTLUNG(4) * YWORK2(4,I)
     .                  + RTLUNG(12) * YWORK2(12,I)

            IF (TEI .AND. I .EQ. N)
     .        TE2I = TE2I + NETDK(N+1,10) + NETDK(N+1,11) +
     .               NETDK(N+1,12)

   14     CONTINUE
        ENDIF
      ENDIF

C---- Gut model --------------------------------------------------------

      IF (CARBON .OR. TRITUM) THEN

        IF (.NOT. ACUTE) THEN
          DO 19 I = 1, N
```

```
          GUT2TC(I) = 1.0 / 365.0
   19   CONTINUE
       ENDIF

     ELSE
       DO 18 I = 1, N

         YT2(13,I) = LG2GUT(I) - RTGUT(1) * YWORK2(13,I) - NETDK(I,13)
         IF (I .EQ. 1) YT2(13,I) = YT2(13,I) + DBLE (UPTGUT)

         YT2(14,I) = FG2SI * RTGUT(1) * YWORK2(13,I) -
     .                 (RTSIBL + RTGUT(2)) * YWORK2(14,I) - NETDK(I,14)
         YT2(15,I) = RTGUT(2) * YWORK2(14,I) -
     .               RTGUT(3) * YWORK2(15,I) - NETDK(I,15)
         YT2(16,I) = RTGUT(3) * YWORK2(15,I) -
     .               RTGUT(4) * YWORK2(16,I) - NETDK(I,16)

         GUT2TC(I) = RTSIBL * YWORK2(14,I) + FG2TC * RTGUT(1) *
     .                YWORK2(13,I)
         IF (TEI .AND. I .EQ. N) TE2I = TE2I + NETDK(N+1,13)
     .                                       + NETDK(N+1,14)
     .                                       + NETDK(N+1,15)
     .                                       + NETDK(N+1,16)

   18  CONTINUE
     ENDIF

C---- Call specific models -------------------------------------------

     IF (IMOD(1) .EQ. 0) THEN
C      General model--
       CALL GEN (H1, YWORK2, YT2, NETDK, GUT2TC, LG2TC, TE2I, N,
     .           SAVIOD)

     ELSEIF (IMOD(1) .EQ. 1) THEN
C      Alkaline earth model--
       CALL ALK (YWORK2, YT2, NETDK, GUT2TC, LG2TC)

     ELSEIF (IMOD(1) .EQ. 2) THEN
C      Iodine model--
       CALL IOD (H1, YWORK2, YT2, NETDK, GUT2TC, LG2TC, TE2I)
     ENDIF

C---- Integrated retentions -------------------------------------------

     DO 40 I = 1, N
C      Lung and lymph--
       YT2(18,I) = YWORK2(3,I) + YWORK2(4,I) + YWORK2(5,I)
     .             + YWORK2(6,I) + YWORK2(7,I) + YWORK2(8,I)
```


9 1 0 4 8 1 3 2 8

```
     .            + YWORK2(9,I) + YWORK2(12,I)
        YT2(19,I) = YWORK2(10,I) + YWORK2(11,I)

C       Gut--
        DO 41 J = 1, 4
          YT2(19+J,I) = YWORK2(J+12,I) + YWORK2(17,I) * TCMULT(19+J)
   41   CONTINUE
40    CONTINUE

      RETURN
C-----------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------
C
      SUBROUTINE GEN (H1, YWORK2, YT2, NETDK, GUT2TC, LG2TC, TE2I,
     .                N, SAVIOD)
C
C     This module defines the ordinary differential equations for
C     the GENERAL model.
C
C     Module of Program INTDF of the GENII Software Package
C     PAcific Northwest Laboratory Environmental Dosimetry System
C
C     Last modification: 17-Mar-88 RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------
C
C     GUT2TC()      - Transfer rate from gut to transfer compartment,
C                     (blood and body fluids)
C     LG2TC()       - Transfer rate from lung to transfer compartment
C     YT2()         - Array of results for each equation passed to
C                     calling program
C     YWORK2()      - YWORK ordered by j,i where j=equation index, i=
C                     radionuclide position in chain, as a single dimen-
C                     sioned array
C     NETDK()       - Decay for each radionuclide in each compartment
C
C     YWORK2(17,i) - Quantity in the transfer compartment
C     YWORK2(24,i) - Integrated retention in bone
C     YWORK2(25,i) - Integrated retention in OTHER tissues/organs
C     YWORK2(26,i) - Integrated retention specified organ no. 1
C     YWORK2(27,i) - Integrated retention specified organ no. 2
C     YWORK2(28,i) - Integrated retention specified organ no. 3
C     YWORK2(29,i) - Quantity in each of 4 bone compartments
C     YWORK2(33,i) - Quantity in each of 3 OTHER compartments
C     YWORK2(36,i) - Quantity in each of 9 specified organ
C                    compartments
C
C     YT2(17,i)     - Transfer compartment (blood & fluids)
C     YT2(24,i)     - Retention in the bone,
C     YT2(25,i)     - Retention in OTHER organs
C     YT2(26,i)     - Retention in specified organs
C     YT2(29,i)     - Bone compartments
C     YT2(33,i)     - OTHER organs compartment
C     YT2(36,i)     - Specified organ compartments
C
C     TE2I          - Sum of decay rates from all telleriums to iodine;
C                     only used for tellerium/iodine model
C     N             - Number of radionuclide chain members to process;
C                     normally NONUC, but excludes iodines in tellerium/
```

```
C                   iodine chains
C     SAVIOD      - Iodine compartments to be saved and decayed separately,
C                   NETDK iodine compartments will be used to accumulate
C                   tellerium decay contributions
C
C-----------------------------------------------------------------------

       INCLUDE 'DECAY.CMN'
       INCLUDE 'MTBPAR.CMN'
       INCLUDE 'OPT.CMN'
       INCLUDE 'ORGPAR.CMN'
       INCLUDE 'RAD.CMN'

      INTEGER N
      REAL*8 YWORK2(45,9), YT2(45,9), NETDK(9,45), LG2TC(9), GUT2TC(9),
     .       TE2I, SAVIOD(45)

C---- Transfer compartment (blood and body fluids) -------------------

      DO 20 I = 1, N
        YT2(17,I) = LG2TC(I) + GUT2TC(I) - RTBLOOD * YWORK2(17,I)
     .              - NETDK(I,17)
        IF (TEI .AND. I .EQ. N) TE2I = TE2I + NETDK(N+1,17)
   20 CONTINUE

C---- Bone compartments -----------------------------------------------

      DO 24 J = 1, NBONE
        DO 26 I = 1, N
          YT2(J+28,I) = RTBLOOD * TCBONE(J) * YWORK2(17,I) -
     .                  RTBONE(J) * YWORK2(J+28,I) - NETDK(I,J+28)
        IF (TEI .AND. I .EQ. N) TE2I = TE2I + NETDK(N+1,J+28)
   26   CONTINUE
   24 CONTINUE

C---- OTHER organ/tissues compartments -------------------------------

        DO 27 J = 1, NOTHER
          DO 28 I = 1, N
            YT2(J+32,I) = RTBLOOD * TCOTHR(J) * YWORK2(17,I) -
     .                    RTOTHR(J) * YWORK2(J+32,I) - NETDK(I,J+32)
            IF (TEI .AND. I.EQ.N) TE2I = TE2I + NETDK(N+1,J+32)
   28     CONTINUE
   27   CONTINUE

C---- Specified organ compartments ------------------------------------

      DO 30 J = 1, NOCOMP
        DO 32 I = 1, N
```

```
         YT2(J+35,I) = RTBLOOD * TCORG(J) * YWORK2(17,I) -
     .                RTORG(J) * YWORK2(J+35,I) - NETDK(I,J+35)
         IF (TEI .AND. I.EQ.N) TE2I = TE2I + NETDK(N+1,J+35)
   32   CONTINUE
   30 CONTINUE

C---- Tellerium/iodine special handling -------------------------------

      IF (TEI) THEN

C       Replace decayed iodine in compartments now that tellerium
C       contributions have been accumulated--
        DO 35 J = 1, 45
          NETDK(N+1,J) = SAVIOD(J) * (1.0D0 - EXP(-ALDAY(N+1) * H2))/H2
   35   CONTINUE

        CALL IOD (H1, YWORK2, YT2, NETDK, GUT2TC, LG2TC, TE2I)
      ENDIF

C---- Integrated retention ---------------------------------------------

      DO 33 I = 1, N

        YT2(25,I) = YWORK2(33,I) + YWORK2(34,I) + YWORK2(35,I) +
     .              YWORK2(17,I) * TCMULT(25)
        YT2(24,I) = YWORK2(29,I) + YWORK2(30,I) + YWORK2(31,I) +
     .              YWORK2(32,I) + YWORK2(17,I) * TCMULT(24)

        K = 35
        DO 42 J1 = 1, NORG
          YT2(J1+25,I) = 0.0D0
          DO 43 J2 = 1, NORGCM(J1)
            K = K + 1
            YT2(J1+25,I) = YT2(J1+25,I) + YWORK2(K,I) +
     .                     YWORK2(17,I) * TCMULT(J1+25)
   43     CONTINUE
   42   CONTINUE
   33 CONTINUE

C     If tritium inhalation increase by 50% to account for transpiration--
      IF (TRITUM .AND. INHDF) THEN

        DO 53 I = 1, N
          YT2(25,I) = YT2(25,I) * 1.5
          YT2(24,I) = YT2(24,I) * 1.5
          DO 52 J1 = 1, NORG
            YT2(J1+25,I) = YT2(J1+25,I) * 1.5
   52     CONTINUE
   53   CONTINUE
```

```
      ENDIF

      RETURN
C-------------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------
C
      SUBROUTINE IOD (H1, YWORK2, YT2, NETDK, GUT2TC, LG2TC, TE2I)
C
C     This module defines the ordinary differential equations for
C     the IODINE and TELLURIUM/IODINE models formatted for LS2.
C
C     Module of INTDF
C     Last modification: 24-Sep-87 RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------
C
C     GUT2TC() - Transfer rate from gut to transfer compartment
C                (blood and body fluids)
C     LG2TC()  - Transfer rate from lung to transfer compartment
C     YT2()    - Array of results for each equation passed to
C                calling subroutine
C     YWORK2() - YWORK ordered by j,i where j=equation index, i=
C                radionuclide position in chain as a single-
C                dimensioned array
C     NETDK()  - Decay for each radionuclide in each compartment
C     FF       - Fraction to fetal thyroid; 0.0 if off or if age
C                <=90days, 0.03*(Age/90 -1.0) if on and age > 90 da.
C     FM       - Fraction to thyroid
C     FB       - Fraction to bladder; 0.7-FF
C     RTI      - Loss from inorganic (da-1), lambda 17
C     RTFO     - Loss from fetal organic (da-1), lambda 39
C     RTMO     - Loss from maternal organic (da-1), lambda 33
C     RTFT     - Loss from fetal thyroid (da-1), lambda 38
C     RTMT     - Loss from maternal thyroid (da-1), lambda 36
C     RTBLAD   - Loss form bladder (da-1), lambda 37
C     H1       - Current time of integration (da)
C     DAYS     - Same as H1 in single precision (da)
C     AGESTP() - Age steps for s-factors in SIJI array
C     SIJI()   - S-factors for days as specified in AGESTP, for each
C                iodine isotope
C     INDX     - Proper age index of fetus in AGESTP array, used to select
C                s-factor from SIJI array
C     AGE      - Current age of the fetus
C     TE2I     - Sum of decay rates from all telluriums to iodine;
C                only used for tellurium/iodine model
C
C     In YWORK2 and YT2 for each radionuclide i:
C       (25,i)  Retention in inorganic/transfer, maternal organic = other
C       (26,i)  Retention in maternal thyroid
C       (27,i)  Retention in bladder
C       (28,i)  Retention in fetal thyroid
C       (33,i)  OTHER, = organic/transfer (maternal)
```

```
C       (36,i)  Thyroid compartment (maternal)
C       (37,i)  Bladder compartment (maternal)
C       (38,i)  Fetal thyroid compartment
C       (39,i)  Fetal organic transfer
C       (40,i)  S-factor multiplication
C       (41,i)  Inorganic/transfer compartment
C       (45,i)  Integrated S-factor multiplication

C---------------------------------------------------------------------

      INCLUDE 'MTBPAR.CMN'
      INCLUDE 'RAD.CMN'
      INCLUDE 'ORGPAR.CMN'
      INCLUDE 'OPT.CMN'

      REAL*8 NETDK(9,45), LG2TC(9), GUT2TC(9), YWORK2(45,9), YT2(45,9),
     .       H1, TE2I
      REAL RTI, RTFO, RTMO, RTFT, RTMT, RTBLAD, AGESTP(11), SIJI(11,7),
     .     DAYS, AGE

      DATA AGESTP /90.0, 91.0, 92.0, 95.0, 100.0, 110.0, 130.0,
     .             150.0, 170.0, 200.0, 250.0/

      DATA SIJI /43.0, 41.0, 39.0, 35.0, 28.0, 20.0, 10.0, 5.9,
     .           3.7, 2.0, 8.8,
     .           140.0, 130.0, 120.0, 110.0, 87.0, 62.0, 33.0,
     .           19.0, 11.0, 6.1, 2.6,
     .           330.0, 320.0, 300.0, 270.0, 210.0, 160.0, 83.0,
     .           49.0, 30.0, 17.0, 7.2,
     .           530.0, 520.0, 500.0, 440.0, 390.0, 290.0, 170.0,
     .           100.0, 67.0, 38.0, 17.0,
     .           680.0, 650.0, 630.0, 550.0, 450.0, 310.0, 170.0,
     .           98.0, 61.0, 37.0, 15.0,
     .           820.0, 790.0, 760.0, 710.0, 580.0, 420.0, 240.0,
     .           140.0, 93.0, 54.0, 24.0,
     .           630.0, 610.0, 590.0, 530.0, 440.0, 310.0, 170.0,
     .           97.0, 62.0, 34.0, 15.0/

C---- Initialize transfer rates -------------------------------------

      DATA RTI /1.92/,
     .     RTFO /5.8E-2/,
     .     RTMO /5.8E-2/,
     .     RTFT /5.3E-5/,
     .     RTMT /8.7E-3/,
     .     RTBLAD /9.1/

C---- Determine iodine position in chain ----------------------------
```

```
      IF (TEI) THEN
        I = NONUC
      ELSE
        I = 1
      ENDIF

C---- Calculate current age of fetus and fractions --------------------

      DAYS = REAL(H1)
      AGE = FETAGE + DAYS
      FM = 0.3

      IF (.NOT. FETDOS) THEN
        FF = 0.0
      ELSEIF (AGE .LT. 90.0) THEN
        FF = 0.0
      ELSEIF (AGE .GT. 270.0) THEN
        FF = 0.0
      ELSE
        FF = 0.03 * (AGE / 90.0 - 1.0)
      ENDIF

      FB = 0.7 - FF

C---- Inorganic/transfer compartment ---------------------------------

C      WRITE (*,*), NETDK(I,41), TE2I
      YT2(41,I) = LG2TC(I) + GUT2TC(I) - RTI * YWORK2(41,I)
     .            - NETDK(I,41) + RTFO * YWORK2(39,I)
     .            + RTMO * YWORK2(33,I) * 0.9 - TE2I

C---- Fetal compartments ---------------------------------------------

      IF (FETDOS) THEN
         YT2(38,I) = FF * RTI * YWORK2(41,I)
     .               - RTFT * YWORK2(38,I) - NETDK(I,38)

         YT2(39,I) = RTFT * YWORK2(38,I)
     .               - RTFO  * YWORK2(39,I) - NETDK(I,39)
      ENDIF

C---- Maternal compartments ------------------------------------------

      YT2(36,I) = FM * RTI * YWORK2(41,I) -
     .            RTMT * YWORK2(36,I) - NETDK(I,36)

      YT2(33,I) = RTMT * YWORK2(36,I) -
```


9 1 0 4 8 1 3 3 6

```
     .           RTMO * YWORK2(33,I) - NETDK(I,33)

      YT2(37,I) = FB * RTI * YWORK2(41,I) -
     .            0.9 * 0.1 * RTMO * YWORK2(33,I)
     .            - RTBLAD * YWORK2(37,I) - NETDK(I,37)

C---- S-factor multiplication -----------------------------------------

      IF (FETDOS .AND. AGE .LT. 270.0) THEN

C        Find s-factor based on time--
         DO 70 IG = 1, 11
            IF (DAYS .GE. AGESTP(IG)) INDX = IG
   70    CONTINUE

         YT2(40,I) = YWORK2(40,I) * SIJI(INDX,IODI)

      ENDIF

C---- Integrated retentions --------------------------------------------

      YT2(25,I) = (YWORK2(41,I) + YWORK2(33,I)) * TCMULT(25)
      YT2(26,I) = YWORK2(36,I) + (YWORK2(41,I) + YWORK2(33,I))
     .            * TCMULT(26)
      YT2(27,I) = YWORK2(37,I) + (YWORK2(41,I) + YWORK2(33,I))
     .            * TCMULT(27)
      YT2(28,I) = YWORK2(38,I)
      YT2(45,I) = YWORK2(40,I)

      RETURN
C----------------------------------------------------------------------
      END
```

9 1 0 4 8 1 3 3 7

```
C-------------------------------------------------------------------
C
      SUBROUTINE LS2  (F, TI, HI, HSTART, DCEND)
C
C     Subroutine LS2 implements the LSODES stiff differential
C     equation solver.
C
C     Module of Program INTDF of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last modification: 3-Dec-87  RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-------------------------------------------------------------------
C
C        F        - Subroutine defining the differential equations. F
C                   must have the form:   F( H1, YT)
C        T        - Value of independent variable - time, da
C        TI       - Initial value of time this execution of LS2
C        TE       - Final value of time this execution of LS2
C        HI       - Absolute time when evaluation should be stopped (Passed
in)
C        H        - Absolute time when evaluation should be stopped (Double)
C        F        - Name of subroutine for right-hand side vector F
C        T        - The initial value of the independent variable
C        TOUT     - First point where output is desired
C        ITOL     - Control integer for error tolerance calculation
C        RTOL     - Relative tolerance parameter
C        ATOL     - Absolute tolerance parameter  (scalar or array)
C        HSTART   - Initial step size
C        ITASK    - Set to 1 for normal computation of output values of
C                   YWORK at T=TOUT
C        ISTATE   - Control integer, used for both input and output
C        IOPT     - 0 to indicate no optional inputs used
C        RWORK()  - Real work array
C        LRW      - Decalared length of RWORK
C        IWORK()  - Integer work array
C        LIW      - Declared length of IWORK
C        JAC      - Dummy name for Jacobian matrix subroutine
C        MF       - Method flag: 222 for stiff method, internally-generated
C                   sparse Jacobian.
C        NEQALL   - Total number of equations processed by LSODES2
C        DCEND    - Time of the dose commitment period, yrs
C
C-------------------------------------------------------------------

      INCLUDE 'INTDFS.CMN'
      INCLUDE 'RAD.CMN'
      INCLUDE 'OPT.CMN'
```


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```
      INCLUDE 'MTBPAR.CMN'

      EXTERNAL F
      INTEGER LAST, IWORK(1500), ITOL, ITASK, ISTATE, IOPT, LRW, LIW,
     .        NEQALL
      REAL TI, HI, DCEND
      REAL*8 T, RWORK(22000)
      REAL*8 H, HSTART, YWORK2(405), YT2(405)
      CHARACTER JAC*6

      T = DBLE(TI)
      H = DBLE(HI)

      IF (TI .EQ. 0.0) THEN
C       Initialize parameters--

        ISTATE = 1
        ITOL =1
        LIW = 1500
        LRW = 22000
        MF = 222
        ITASK = 1
        IOPT = 1

        DO 10 I = 1, LIW
          IWORK(I) = 0
   10   CONTINUE
        DO 11 I = 1, LRW
          RWORK(I) = 0.0
   11   CONTINUE

        DO 16 I = 1, 405
          YWORK2(I) = ZERO
          YT2(I) = ZERO
   16   CONTINUE
C       Maximum absolute step size allowed--
        RWORK(6) = ASSA

C       Initial step size--
        RWORK(5) = REAL(HSTART)

C       Maximum number of steps allowed during one call to the solver--

        IWORK(6) = NSC

C       Maximum number of messages printed per problem--
        IWORK(7) = 3
```

```
      NEQALL = 45 * NONUC
C     Transfer into YWORK2 array--
      I1 = 1
      DO 12 I = 1, NONUC
        DO 14 J = 1, 45
          YWORK2(I1) = YWORK(I,J)
          I1 = I1 + 1
14      CONTINUE
12    CONTINUE
    ELSE
C     This is a continuation call--
      ISTATE = 2
    ENDIF
    CALL LSODES2(F, NEQALL, YWORK2, T, H, ITOL, RTOL, ATOL,
   .             ITASK, ISTATE, IOPT, RWORK, LRW, IWORK, LIW,
   .             JAC, MF)

    IF (ISTATE .EQ. -1) THEN
      ISTATE = 1
      IWORK(6) = NSC*2
      CALL LSODES2(F, NEQALL, YWORK2, T, H, ITOL, RTOL, ATOL,
   .               ITASK, ISTATE, IOPT, RWORK, LRW, IWORK, LIW,
   .               JAC, MF)
    ENDIF
C   Check if successful step--
    IF (ISTATE .LT. 0) GOTO 91

    CALL DIFEQ2 (NEQALL, ZERO, YWORK2, YT2)
C   Transfer results into YWORK array--
    I1 = 1
    DO 20 I = 1, NONUC
      DO 22 J = 1, 45

        YWORK(I,J) = YWORK2(I1)
        I1 = I1 + 1

22    CONTINUE
20  CONTINUE
```

```
C     Save LSODES information report--
      IF (HI .EQ. DCEND*365.0) THEN
        IF (INHDF) THEN
          I = 2
        ELSE
          I = 1
        ENDIF
        ISTAT(1,I) = IWORK(11)
        ISTAT(2,I) = IWORK(12)
        ISTAT(3,I) = IWORK(13)
        ISTAT(4,I) = IWORK(17)
        ISTAT(5,I) = IWORK(18)
        ISTAT(6,I) = IWORK(19)
      ENDIF

      RETURN

C---- Error Condidtions ------------------------------------------------

   91 WRITE (*,*) ' Error return for LSODES2, ISTATE = ', ISTATE
      WRITE (*,*) ' RWORK(11 to 14) ',(RWORK(I),I=11,14)
      WRITE (*,*) ' IWORK(11 to 26) ',(IWORK(I),I=11,26)
      STOP

C----------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------
C
      SUBROUTINE METLIB (ISTOP)
C
C     Subroutine METLIB reads the metabolic parameters for the organs
C     specified in this run and constructs the organ list for this
C     radionuclide chain.
C
C     Module of Program INTDF of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 11-Apr-88 RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C     ELMNT      - Element name read from metabolic data library
C     AGEM       - Age flag read from metabolic data library; A-Adult,
C                  I-Infant
C     ORG        - Organ name read from metabolic data library
C     F1IN()     - Input array of F1 input values
C     ISTOP      - Flag returned to calling program if no data is found
C                  for the current radionuclide in the metabolic data
C                  library
C     ATNOIN     - Input atomic number
C     FOUND      - Logical flag set when element is found
C
C-----------------------------------------------------------------------

       INCLUDE 'INTDFS.CMN'
       INCLUDE 'ORGPAR.CMN'
       INCLUDE 'MTBPAR.CMN'
       INCLUDE 'OPT.CMN'
       INCLUDE 'RAD.CMN'
       INCLUDE 'ORGMAS.CMN'

      REAL F1IN(5)
      INTEGER ATNOIN
      LOGICAL FOUND, ISTOP
      CHARACTER ELMNT*14, AGEM*1, AGE*1, ORG*8, OTHERI*8, BONEIN*8,
     .          ENDIN*8, MARROW*8, CAN*8, DUM*8

      DATA AGE /'A'/, OTHERI /'Other   '/, BONEIN /'Bone    '/,
     .     ENDIN /'End     '/, MARROW /'R Marrow'/,
     .     CAN /'Bone Can'/

C     Initialize organ index parameters to base list--
      NORGL = 14
      DO 164 I = 15, 25
```

```
      IORG(I) = 0
  164 CONTINUE

      NORG = 0
      NOCOMP = 0
      NBONE = 0
      NOTHER = 0

C     Initialize all specified organ flags--
      DO 12 I = 1, 25
        SPECOR(I) = .FALSE.
   12 CONTINUE

C---- Open file and read title -----------------------------------------

      LUN = 3
      CALL OPNFIL ((4),(0),LUN)

C---- Read file until element is found --------------------------------

      FOUND = .FALSE.
10    CONTINUE

      READ (LUN,*,END=91,ERR=98) ATNOIN

      IF (ATNOIN .EQ. ATNUM(1)) THEN
        READ (LUN,20) ELMNT, AGEM, RTBLOOD, UEXTC, FEXTC
        READ (LUN,*) (F1IN(I),I=1,3)
        IF (AGE .EQ.AGEM) FOUND = .TRUE.
      ENDIF

      IF (.NOT. FOUND) THEN
        DO 14 I=1,19
          READ(LUN,21,END=99,ERR=98) ORG
          IF(ORG .EQ. ENDIN) GOTO 10
   14   CONTINUE
      ELSE

C------ Element found, read data set ----------------------------------

        IF (CLASS(1) .EQ. 'D') THEN
          F1 = F1IN(1)
        ELSEIF (CLASS(1) .EQ. 'W') THEN
          F1 = F1IN(2)
        ELSE
          F1 = F1IN(3)
        ENDIF

C       No other information needed for iodine--
```

```
      IF (IMOD(1) .EQ. 2) GO TO 40
C     ---- Organ data loop -----------------------------------------
41    CONTINUE
      READ (LUN,21,END=99,ERR=98) ORG,TCIN, RTIN, UIN, FIN

      IF (ORG .EQ. ENDIN) GOTO 40

      IF (IMOD(1) .EQ. 0) THEN
C       ---- General Model Input ------------------------------------

        IF (ORG .EQ. OTHERI) THEN
C         "Other" organ data--
          NOTHER = 1
          TCOTHR(1) = TCIN
          RTOTHR(1) = ALOG2 / RTIN
          DO 33 I = 2, 4
            READ (LUN,21,END=99,ERR=98) ORG,TCIN, RTIN, UIN, FIN
            IF (ORG .EQ. ENDIN) GOTO 40
            IF (TCIN .GT. 0.0) THEN
              NOTHER = I
              TCOTHR(I) = TCIN
              RTOTHR(I) = ALOG2 / RTIN
            ENDIF
33        CONTINUE

        ELSEIF (ORG .EQ. BONEIN .OR. ORG .EQ. MARROW) THEN
C         Bone compartments data--
          NBONE = 1
          TCBONE(1) = TCIN
          RTBONE(1) = ALOG2 / RTIN

          IF (ORG .EQ. BONEIN) THEN
            SPECOR(9) = .TRUE.
            SPECOR(10) = .TRUE.
          ELSEIF (ORG .EQ. MARROW) THEN
            SPECOR(10) = .TRUE.
          ENDIF

          DO 34 I = 2, 4
            READ (LUN,21,END=99,ERR=98) ORG,TCIN, RTIN, UIN, FIN
            IF (ORG .EQ. ENDIN) GOTO 40
            IF (TCIN .GT. 0.0) THEN
              NBONE = I
              TCBONE(I) = TCIN
```

```
          RTBONE(I) = ALOG2 / RTIN
        ENDIF
   34   CONTINUE

      ELSE

C       Assume that this is a specified-organ--
        NORG = NORG + 1
        NOCOMP = NOCOMP + 1
        IF (NOCOMP .GT. 9) GOTO 93
        NORGCM(NORG) = 1

C       Check if this organ is in standard list--
        DO 135 IO = 11, 14
          IF (ORG .EQ. MASORG(IO)) THEN
            SPECOR(IO) = .TRUE.
            NORGCR(NORG) = IO
            GOTO 131
          ENDIF
  135   CONTINUE

C       Add additional organs to organ list--
        DO 130 IO = 15, 22
          IF (ORG .EQ. MASORG(IO)) THEN
            NORGL = NORGL + 1
            IORG(NORGL) = IO
            SPECOR(NORGL) = .TRUE.
            NORGCR(NORG) = NORGL
            GOTO 131
          ENDIF
  130   CONTINUE
        GOTO 92
  131   CONTINUE

        TCORG(NOCOMP) = TCIN
        RTORG(NOCOMP) = ALOG2 / RTIN
        DO 35 I = 2, 4
          READ (LUN,21,END=99,ERR=98) ORG,TCIN, RTIN, UIN, FIN
          IF (ORG .EQ. ENDIN) GOTO 40
          IF (TCIN .GT. 0.0) THEN
            NOCOMP = NOCOMP + 1
            IF (NOCOMP .GT. 9) GOTO 93
            NORGCM(NORG) = NORGCM(NORG) + 1
            TCORG(NOCOMP) = TCIN
            RTORG(NOCOMP) = ALOG2 / RTIN
          ENDIF
   35   CONTINUE
      ENDIF
```

```
C       ---- Alkaline Earth Model Input -------------------------------
        ELSEIF (IMOD(1) .EQ. 1) THEN

          IF (DEBUG) WRITE (*,*) 'Alkaline earth model'
          IF (ORG .EQ. CAN) THEN

            NBONE = 4

C           Set specified organ flags--
            SPECOR(7) = .TRUE.
            SPECOR(9) = .TRUE.
            SPECOR(10) = .TRUE.

C           Read trabecular/cancellous bone data--
            TCBONE(1) = TCIN
            RTBONE(1) = RTIN
            READ (LUN,21) ORG,TCIN, RTIN, UIN, FIN
            TCBONE(2) = TCIN
            RTBONE(2) = RTIN
            READ (LUN,11) DUM, DUM

C           Read cortical bone data--
            READ (LUN,21) ORG,TCIN, RTIN, UIN, FIN
            TCBONE(3) = TCIN
            RTBONE(3) = RTIN
            READ (LUN,21) ORG,TCIN, RTIN, UIN, FIN
            TCBONE(4) = TCIN
            RTBONE(4) = RTIN
            READ (LUN,11) DUM, DUM

C           Read bone surface data, store as first specified organ--

            READ (LUN,21) ORG,TCIN, RTIN, UIN, FIN
            NORGCR(1) = 7
            NORG = 1
            NOCOMP = 1
            NORGCM(1) = 1
            TCORG(1) = TCIN
            RTORG(1) = RTIN
            READ (LUN,111) DUM, DUM, DUM

C           Read "Other" organ  data--
            READ (LUN,21) ORG,TCIN, RTIN, UIN, FIN
            NOTHER = 1
            TCOTHR(1) = TCIN
            RTOTHR(1) = RTIN
            IF (DEBUG) WRITE (*,*) 'No. :',NBONE, NOTHER, NORG, NOCOMP
            GOTO 40
```

```
          ELSE
            GOTO 94
          ENDIF
        ENDIF
      GOTO 41
      ENDIF

   40 CONTINUE

C     Specify thyroid and bladder for tellurium/iodine and iodine organs--
      IF (IMOD(1) .EQ. 2 .OR. TEI) THEN
        NORGL = NORGL + 1
        IORG(NORGL) = 15
        SPECOR(14) = .TRUE.
        SPECOR(15) = .TRUE.
      ENDIF

C     Add "other" to organ list--
      NORGL = NORGL + 1
      IORG(NORGL) = 23

 1000 CONTINUE

C     Need to check this for different models--
      NEQ = 35 + NOCOMP

      CLOSE (LUN)
      RETURN

C---- ERROR MESSAGES --------------------------------------------------

   91 WRITE (*,*) 'No data in METLIB for ',ATNUM(1),'; skipped'
      CLOSE (LUN)
      ISTOP = .TRUE.

      RETURN
   92 WRITE (*,'(3A)') ' Organ ',ORG,
     .                 ' in METLIB not in master organ list.'
      CALL EXIT (1)

   93 WRITE (*,*) 'Error in METLIB: too many organs (NORG)'
      CALL EXIT (1)

   94 WRITE (*,*) 'Error in METLIB: Alkaline Earth organs expected'
      CALL EXIT (1)

   98 CALL FILERR (3, LUN, ELMNT)
   99 CALL FILERR (2, LUN, 'In METLIB')
```

```
C---- FORMATS ----------------------------------------------------------

   11 FORMAT (A8/A8)
  111 FORMAT (A8/A8/A8)
   20 FORMAT(A14, 1X, A1, 7X, 3F5.3)
   21 FORMAT(1X, A8, 1X, 4E10.3)

C-----------------------------------------------------------------------
      END
```

9 1 0 4 8 1 3 4 8

```
C-----------------------------------------------------------------------
C
      SUBROUTINE ORDIN (INRAD)
C
C     This module controls reading of the master radionuclide library and
C     identification of each radionuclide in the input list.
C
C     Module of Program INTDF of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 11-Apr-88  RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C     ELTEMP   - Temporary character parameter used to parse element
C                name (ELNAME), out of full element name string (FULNAM)
C     INRAD    - Loop index of the radionuclide chain currently considered
C     IL       - Loop index of the master radionuclide library
C     IN       - Loop index of the list of radionuclides to be considered
C                for this case
C     H4       - Halflife / 10.0 for current radionuclide, used to find
C                shortest halflife in chain
C     NXENON   - Number of xenon daughters of the current iodine chain
C     TRCUR    - Halflife of each radionuclide in the current change,
C                (da)
C
C-----------------------------------------------------------------------

        INCLUDE 'RMD.CMN'
        INCLUDE 'RMD2.CMN'
        INCLUDE 'RAD.CMN'
        INCLUDE 'DECAY.CMN'
        INCLUDE 'INVIN.CMN'
        INCLUDE 'OPT.CMN'
        INCLUDE 'MTBPAR.CMN'

      INTEGER INRAD, IL, IN
      REAL*8 H4
      REAL TRCUR(9)

C     Initialize special flags--
      CARBON = .FALSE.
      TRITUM = .FALSE.
      RA226 = .FALSE.
      TEI = .FALSE.
      IODI = 0
      NXENON = 0
```

```
      N1 = NFLAG2(INRAD)
      NCN = NOFNUC(NCHN(N1))
      N3 = NCHST(NCHN(N1))
      N2 = N3 + NCN -1
      N4 = NCN - (N2 - N1 + 1)
      IF (DEBUG) WRITE (*,*) 'N1, N3, NCN, N2, N4:'
      IF (DEBUG) WRITE (*,*)  N1, N3, NCN,N2,N4

      IN = 0

C     Loop on all nuclides in active chain --
      DO 15 IL=N1,N2

        IN = IN + 1

C       Include nuclide IL in array position IN--

        ELT(IN) = ELTM(IL)
        AW(IN) = AWM(IL)
        HL(IN) = TR(IL)
        TRCUR(IN) = TR(IL)
        ALDAY(IN) = DBLE (0.693 / TR(IL))
        AL(IN) = ALDAY(IN) / SECDA
        IRMD(IN) = IL

        IFRM(1,IN) = MAX (0,IFR(1,IL)-N4)
        IFRM(2,IN) = MAX (0,IFR(2,IL)-N4)
        IF (IFRM(1,IN) .GT. 0) DK(1,IN) = DKF(1,IL)
        IF (IFRM(2,IN) .GT. 0) THEN
          IF (IFRM(1,IN) .GT. 0) THEN
            DK(2,IN) = DKF(2,IL)
          ELSE
C           If first parent is not in input list, move to 1st branching
C           ratio column--
            IFRM(1,IN) = IFRM(2,IN)
            IFRM(2,IN) = 0
            DK(1,IN) = DKF(2,IL)
          ENDIF
        ENDIF

        IMOD(IN) = IMODM(IL)
        BONE(IN) = BONED(IL)
        CLASS(IN) = TCLASS(IL)
        ATNUM(IN) = ATNO(IL)

        IF (CLASS(IN) .EQ. 'D') THEN
          ICL(IN) = 1
        ELSEIF (CLASS(IN) .EQ. 'W') THEN
          ICL(IN) = 2
```

```
      ELSE
        ICL(IN) = 3
      ENDIF

C     Set special flags--

      IF (IN.EQ.1 .AND. ELT(IN).EQ.'RA' .AND. AW(IN).EQ.'226') THEN
        RA226 = .TRUE.
      ELSEIF (ELT(IN) .EQ. 'I ') THEN
        IF (DEBUG) WRITE (*,*) 'Iodine found in chain'
        IF (AW(IN) .EQ. '125   ') THEN
          IODI = 1
        ELSEIF (AW(IN) .EQ. '129   ') THEN
          IODI = 2
        ELSEIF (AW(IN) .EQ. '131   ') THEN
          IODI = 3
          NXENON = 1
        ELSEIF (AW(IN) .EQ. '132   ') THEN
          IODI = 4
        ELSEIF (AW(IN) .EQ. '133   ') THEN
          IODI = 5
          NXENON = 2
        ELSEIF (AW(IN) .EQ. '134   ') THEN
          IODI = 6
        ELSEIF (AW(IN) .EQ. '135   ') THEN
          IODI = 7
          NXENON = 3
C         Includes Cs135 under xenon exclusion
        ENDIF
      ELSEIF (ELT(IN) .EQ. 'TE') THEN
        TEI = .TRUE.
      ELSEIF (ELT(IN) .EQ. 'C ') THEN
        CARBON = .TRUE.
      ELSEIF (ELT(IN) .EQ. 'H ') THEN
        TRITUM = .TRUE.
      ENDIF

   15 CONTINUE
      NONUC = IN
      NUC = NONUC

C     Check for TE/I and XE daughters--
      IF (TEI .AND. IODI .EQ. 0) THEN
C       Reset tellurium/iodine flag--
        IF (DEBUG) WRITE (*,*) 'Tellurium flag set off:',TEI, IODI
        TEI = .FALSE.
      ELSEIF (IODI .GT. 0) THEN
C       Remove any xenon daughters--
        NONUC = NONUC - NXENON
```


9 1 0 4 8 1 3 5 1

```
      ENDIF

      IF (DEBUG) WRITE (*,*) 'TEI, IODI:',TEI, IODI

C     Check for smallest halflife to establish timestep for DGCHAIN calls;
C     but should not be greater than 1 day--

      H2 = 1.0D20
      DO 31 IN = 1, NONUC
        H4 = DBLE (TRCUR(IN) / 10.0D0)
        IF (H4 .LT. H2) H2 = H4
   31 CONTINUE
      IF (H2 .GT. 1.0D0) H2 = 1.0D0

C     Check number of radionuclides in chain, INTDF at present dimensions
C     is only guaranteed to handle 8-member chains--
      IF (NONUC .GT. 8) GOTO 91

      RETURN

C---- Error Handling ----------------------------------------------------

   91 WRITE (*,*) 'INTDF can only handle 8-member chains.'
      CALL EXIT (1)

C---- Format Statements -------------------------------------------------

 1000 FORMAT (' ',I3,2X,A2,A6,2X,A14,2A2,E9.2,2(I2,E9.2))

C-----------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------
C
      SUBROUTINE RITEND
C
C     Subroutine RITINC writes total transformation report.
C
C     Module of Program INTDF of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 17-Mar-88 RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C     N     - No. of specified organ compartments to print
C     ORG() - Organ titles for integrated retention reports
C
C-----------------------------------------------------------------------

      INCLUDE 'DAYPC.CMN'
      INCLUDE 'DOSES.CMN'
      INCLUDE 'INTDFS.CMN'
      INCLUDE 'MTBPAR.CMN'
      INCLUDE 'OPT.CMN'
      INCLUDE 'ORGMAS.CMN'
      INCLUDE 'ORGPAR.CMN'
      INCLUDE 'RAD.CMN'
      INCLUDE 'TIMES.CMN'

      INTEGER N
      CHARACTER ORG*8(25), EXPTYP*7, AUNIT*30, CUNIT*30, UNIT*30, AST*1

      DATA AST /'*'/
      DATA CUNIT /'Sv per 70 yr/Bq/yr for 70 yr'/
      DATA AUNIT /'Sv/Bq                        '/

      LUN = 15

C     Fill organ name array--
      DO 101 I = 1, 6
        ORG(I) = MASORG(I)
  101 CONTINUE

      IF (IMOD(1) .EQ. 0) THEN
C       General Model--

        ORG(7) = 'Bone'
        ORG(8) = 'Other'
        IF (TEI) THEN
```


9 1 0 4 8 1 3 5 3

```
          ORG(9) = 'Thyroid'
          ORG(10) = 'Bladder'
          N = 2
        ELSE
          DO 102 I = 1, NORG
            ORG(I+8) = ORGANS(NORGCR(I))
102       CONTINUE
          N = NORG
        ENDIF

      ELSEIF (IMOD(1) .EQ. 1) THEN
C       Alkaline Earth--

        ORG(7) = 'Can Bone'
        ORG(8) = 'Other'
        ORG(9) = 'Cor Bone'
        ORG(10) = 'Bone Sur'
        N = 2

      ELSEIF (IMOD(1) .EQ. 2) THEN
C       Iodine--

        ORG(7) = ' '
        ORG(8) = 'Other'
        ORG(9) = 'Thyroid'
        ORG(10) = 'Bladder'
        N = 2
      ENDIF

C     Print headings--

      IF (INHDF) THEN
        WRITE (LUN, 14)
      ELSE
        CALL HEADNG (LUN)
        IF (RA226) THEN
          WRITE (LUN, 10)  INT(DCEND), ELT(1), AW(1), AST
        ELSE
          WRITE (LUN, 10)  INT(DCEND), ELT(1), AW(1)
        ENDIF
        WRITE (LUN, 15) CLASS(1), F1
        WRITE (LUN, 11)
      ENDIF
      WRITE (LUN,12) (ELT(I), AW(I), I=1, NONUC)

      WRITE (LUN,13) ORG(1), (YWORK(I,18) * SECDA,I=1,NONUC)
```

```
      IF (IMOD(1) .EQ. 2) THEN

        WRITE (LUN,13) ORG(3), (YWORK(I,3+17) * SECDA,I=1,NONUC)
        WRITE (LUN,13) ORG(4), (YWORK(I,4+17) * SECDA,I=1,NONUC)
        WRITE (LUN,13) ORG(5), (YWORK(I,5+17) * SECDA,I=1,NONUC)
        WRITE (LUN,13) ORG(6), (YWORK(I,6+17) * SECDA,I=1,NONUC)
        WRITE (LUN,13) ORG(9), (YWORK(I,9+17) * SECDA,I=1,NONUC)
        WRITE (LUN,13) ORG(10), (YWORK(I,10+17) * SECDA,I=1,NONUC)
        WRITE (LUN,13) ORG(8), (YWORK(I,8+17) * SECDA,I=1,NONUC)

      ELSEIF (TEI) THEN

        DO 202 J = 3, 7
          WRITE (LUN,13) ORG(J), (YWORK(I,J+17) * SECDA,I=1,NONUC)
  202   CONTINUE
        WRITE (LUN,13) ORG(9), (YWORK(I,9+17) * SECDA,I=1,NONUC)
        WRITE (LUN,13) ORG(10), (YWORK(I,10+17) * SECDA,I=1,NONUC)
        WRITE (LUN,13) ORG(8), (YWORK(I,8+17) * SECDA,I=1,NONUC)

      ELSE

        DO 100 J = 3, 8 + N
          WRITE (LUN,13) ORG(J), (YWORK(I,J+17) * SECDA,I=1,NONUC)
  100   CONTINUE
      ENDIF

      IF (FETDOS) THEN
        WRITE (LUN,13) 'Fetal    '
        WRITE (LUN,13) 'Thyroid ',(YWORK(I,28) * SECDA, I=1,NONUC)
        WRITE (LUN,20) (YWORK(I,45) * SECDA, I=1,NONUC)
      ENDIF

      IF (INHDF) THEN
C       Write CDE reports--

        WRITE (LUN,19) INT(DCEND), ELT(1), AW(1)
        WRITE (LUN,18) ORGANS(1),(ORGANS(I),I=3,8)
        WRITE (LUN,17) 'Oral       ', CDEING(1,NTIME),
     .                 (CDEING(J,NTIME),J=3,8)
        WRITE (LUN,17) 'Inhalation', CDEINH(1,NTIME),
     .                 (CDEINH(J,NTIME),J=3,8)

        WRITE (LUN,18) (ORGANS(I),I=11,NORGL-1)
        WRITE (LUN,17) 'Oral       ', (CDEING(J,NTIME),J=11,NORGL-1)
        WRITE (LUN,17) 'Inhalation', (CDEINH(J,NTIME),J=11,NORGL-1)

        IF (ACUTE) THEN
          EXPTYP = 'Acute   '
          UNIT = AUNIT
```

```
        ELSE
          EXPTYP = 'Chronic'
          UNIT = CUNIT
        ENDIF

        LUN = 20
        WRITE (LUN,2) ELT(1), AW(1), CLASS(1), F1, TODAY, CLOCK,
     .         EXPTYP, UNIT
        WRITE (LUN,3) NORGL-4, IORG(1),(IORG(J),J=3,8),
     .         (IORG(J),J=11, NORGL-1)
        WRITE (LUN,4) ORGANS(1),(ORGANS(I),I=3,8),
     .         (ORGANS(I),I=11,NORGL-1)
        WRITE (LUN,16) 'G', NTIME, CDEING(1,NTIME),
     .         (CDEING(J,NTIME),J=3,8), (CDEING(J,NTIME),J=11,NORGL-1)
        WRITE (LUN,16) 'H', NTIME, CDEINH(1,NTIME),
     .         (CDEINH(J,NTIME),J=3,8), (CDEINH(J,NTIME),J=11,NORGL-1)
        LUN = 15
      ENDIF

      IF (METHOD .EQ. 3 .AND. INHDF) THEN
C       Print LSODES status report--
        WRITE (LUN,1) ((ISTAT(J,I),I=1,2), J=1,6)
      ENDIF

C     Write RA226 and H3 footnotes --
      IF (RA226 .AND. INHDF) WRITE (LUN,21)
      IF (TRITUM .AND. INHDF) WRITE (LUN,22)

      RETURN

C---- Format Statements -------------------------------------------

    1 FORMAT (//50X,'Oral   Inhalation'/
     . ' Number of steps taken by the LSODES solver:      ',2I7/
     . ' Number of F (DIFEQ2) evaulations:                ',2I7/
     . ' Number of Jacobian evaluations:                  ',2I7/
     . ' Length of RWORK actually required:               ',2I7/
     . ' Length of IWORK actually required:               ',2I7/
     . ' Number of non-zero elements in Jacobian matrix: ',2I7)
    2 FORMAT (A2,A6,'Class: ',A1,' F1: ',F9.5, 5X, 3A10, A30)
    3 FORMAT (18(I3))
    4 FORMAT (5X,20A8)
   10 FORMAT (17X,'Number of Nuclear Transformation Over',I3,' Years'/
     .13X,'In Source Organs or Tissue per Unit Intake of Activity'/
     .26X,'(Transformations/Bq) of ',A2, A6, A1)
   11 FORMAT (' Oral')
   12 FORMAT (14X, 9(A2,A6,1X))
   13 FORMAT (' ',A10, 1X, 1P, 9E9.1)
   14 FORMAT (/' Inhalation')
```

```
   15 FORMAT (1X,T60,' Inhalation Class ',A1,/1X,T60,' F1: ',1PE8.1)
   16 FORMAT (A1, I3, 1P, 15E8.1E2)
   17 FORMAT (A10, 1P, 15E9.1E2)
   18 FORMAT (/12X,20(A8,1X))
   19 FORMAT (//17X,'Committed Dose Equivalent Over',I3,' Years'/
     .10X, 'In Target Organs or Tissue per Unit Intake of Activity'/
     .28X, '(Sv/Bq) of ',A2,A6)
   20 FORMAT (/' Fetal Thyroid Dose:'/1P,10X,9E8.1E2)
   21 FORMAT (/' *Note: RA226 daughters corrected for RN222 diffusion ',
     .          'in dose calculation.')
   22 FORMAT (/' *Note: Inhalation dose increased by 50% to account ',
     .          'for transpiration.')
C---------------------------------------------------------------------
      END
```

9 1 0 4 8 1 3 5 7

```
C-----------------------------------------------------------------------
C
      SUBROUTINE RITINC (NTIM)
C
C     Subroutine RITINC writes ingestion and inhalation dose increment
C     data sets to be read by the DOSE program.  RITINC also checks
C     for dose increment of zero or stable; if so, a flag is passed
C     back to stop calculations
C
C     Module of INTDF
C     Last Modification: 12-Nov-87  RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C     DTYPE    - Character flag to indicate dose type; 'G'-ingestion,
C                'H'-inhalation
C     HINC()   - Inhalation CDE increment for each organ
C     GINC()   - Ingestion CDE increment for each organ
C     LARGEH   - Largest inhalation increment
C     LARGEG   - Largest ingestion increment
C     CUTOFH   - Cutoff value for writing inhalation CDE increments to
C                file for each organ. Value is equal to 1/1000 of starting
C                value.
C     CUTOFG   - Cutoff value for writing ingestion CDE increments to
C                file for each organ. Value is equal to 1/1000 of starting
C                value.
C     NTIM     - Final year of simulation
C
C-----------------------------------------------------------------------

      INCLUDE 'ORGPAR.CMN'
      INCLUDE 'RAD.CMN'
      INCLUDE 'DOSES.CMN'
      INCLUDE 'OPT.CMN'

      REAL HINC(25,70), GINC(25,70), LARGEH, LARGEG, CUTOFH, CUTOFG
      INTEGER NTIM, NGORG(30), NHORG(30)
      CHARACTER DTYPE

      LUN = 16

      LARGEH = 0.0
      LARGEG = 0.0
      CUTOFH = 0.0
      CUTOFG = 0.0

C     Calculate cutoff--
```

```
      DO 200 IT = 1, NORGL-1
        NGORG(IT) = 0
        NHORG(IT) = 0
        GINC(IT,1) = CDEING(IT,1)
        HINC(IT,1) = CDEINH(IT,1)
        IF (GINC(IT,1) .GT. 0) NGORG(IT) = 1
        IF (HINC(IT,1) .GT. 0) NHORG(IT) = 1
        IF (CDEING(IT,1) .GT. LARGEG) LARGEG = CDEING(IT,1)
        IF (CDEINH(IT,1) .GT. LARGEH) LARGEH = CDEINH(IT,1)
  200 CONTINUE

      CUTOFG = LARGEG / 1000.0
      CUTOFH = LARGEH / 1000.0

C     Calculate increments and check cutoff--
      DO 202 IY = 2, NTIM

C       Ingestion increments--
        DO 214 IT = 1, NORGL-1
          GINC(IT,IY) = CDEING(IT,IY) - CDEING(IT,IY-1)
          IF (GINC(IT,IY) .GT. CUTOFG) THEN
            NGORG(IT) = IY
          ELSE
            GINC(IT,IY) = 0.0
          ENDIF
  214   CONTINUE

C       Inhalation increments--
        DO 204 IT = 1, NORGL-1
          HINC(IT,IY) = CDEINH(IT,IY) - CDEINH(IT,IY-1)
          IF (HINC(IT,IY) .GT. CUTOFH) THEN
            NHORG(IT) = IY
          ELSE
            HINC(IT,IY) = 0.0
          ENDIF
  204   CONTINUE

  202 CONTINUE

C     Write increments to file--

      DTYPE = 'G'
      WRITE (LUN,1003) NGORG(1), (NGORG(IT),IT=3,8),
     .                 (NGORG(IT), IT=11,NORGL-1)
      DO 304 IT = 1, NORGL-1
        IF (NGORG(IT) .GT. 0) THEN
          WRITE (LUN,1004) DTYPE, (GINC(IT,IY), IY=1, NGORG(IT))
        ENDIF
  304 CONTINUE
```

```
      DTYPE = 'H'
      WRITE (LUN,1003) NHORG(1), (NHORG(IT), IT=3,8),
     .                 (NHORG(IT), IT=11,NORGL-1)
      DO 302 IT = 1, NORGL-1
        IF (NHORG(IT) .GT. 0) THEN
          WRITE (LUN,1004) DTYPE, (HINC(IT,IY), IY=1, NHORG(IT))
        ENDIF
  302 CONTINUE

      RETURN

C---- Format Statements -----------------------------------------------

 1003 FORMAT (30I3)
 1004 FORMAT (A1,1P,15E8.1E2/,10(1X,15E8.1/))

C----------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------
C
      SUBROUTINE RITINT
C
C     This subroutine prints a report of input parameters for the INTDF
C     program to the standard output file (LUN=6) and file headings to
C     the integrated retention, CDE, and CDE increment data files.
C
C     Module of Program INTDF of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 6-Jun-88  RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C---------------------------------------------------------------------
C
C     EXPTYP   - Exposure type descriptive parameter, set to either acute
C                or chronic
C
C---------------------------------------------------------------------

      INCLUDE 'RAD.CMN'
      INCLUDE 'DECAY.CMN'
      INCLUDE 'INTDFS.CMN'
      INCLUDE 'MTBPAR.CMN'
      INCLUDE 'ORGPAR.CMN'
      INCLUDE 'ORGMAS.CMN'
      INCLUDE 'SIJS.CMN'
      INCLUDE 'OPT.CMN'
      INCLUDE 'TIMES.CMN'
      INCLUDE 'DAYPC.CMN'

      CHARACTER EXPTYP*7, CUNIT*30, AUNIT*30, UNIT*30
      CUNIT = 'Sv per 70 yr/Bq/yr for 70 yr'
      AUNIT = 'Sv/Bq                        '

      LUN = 15
      CALL HEADNG (LUN)
C     Write radionuclide report--

      WRITE (LUN,*) ' '
      DO 100 IN = 1, NONUC
        WRITE (LUN,1000) IN, ELT(IN), AW(IN), BONE(IN),
     .                   CLASS(IN), HL(IN), ALDAY(IN),
     .                   (IFRM(J,IN),DK(J,IN),J=1,2)
  100 CONTINUE

C     Write model selection, input parameters--
```


9 1 0 4 8 1 3 6 1

```
WRITE (LUN,*) ' '
IF (TEI) THEN
  WRITE (LUN,1022) 'Tellurium/Iodine Model'
ELSEIF (IMOD(1) .EQ. 0) THEN
  WRITE (LUN,1022) 'General Model'
ELSEIF (IMOD(1) .EQ. 1) THEN
  WRITE (LUN,1022) 'Alkaline Earth Model'
ELSEIF (IMOD(1) .EQ. 2) THEN
  WRITE (LUN,1022) 'Iodine Model'
ELSE
  WRITE (LUN,1022) 'Unspecified model'
ENDIF
IF (FETDOS) WRITE (LUN,1022) 'Fetal Thyroid Dose'

IF (ACUTE) THEN
  WRITE (LUN,1022) 'Acute exposure'
  EXPTYP = 'Acute  '
  UNIT = AUNIT
ELSE
  WRITE (LUN,1022) 'Chronic exposure'
  EXPTYP = 'Chronic'
  UNIT = CUNIT
ENDIF

WRITE (LUN,*) ' '
WRITE (LUN,*) 'Dose commitment period:                  ',DCEND
IF (FETDOS) WRITE (LUN,*)
              'Fetal age (days):                        ',FETAGE


WRITE (LUN,*) ' '
WRITE (LUN,*) 'Particle size:                           ',DIAM
WRITE (LUN,*) 'Lung deposition fractions:'
WRITE (LUN,*) '  Nasal-pharynx region:                  ',ZNP
WRITE (LUN,*) '  Pulmonary region:                      ',ZP
WRITE (LUN,*) '  Tracheo-bronchial region:              ',ZTB

WRITE (LUN,*) ' '
IF (METHOD .EQ. 1) THEN
  WRITE (LUN,1021) 'Euler'
ELSEIF (METHOD .EQ. 2) THEN
  WRITE (LUN,1021) 'Runge-Kutta'
ELSEIF (METHOD .EQ. 3) THEN
  WRITE (LUN,1021) 'LSODES2 equation solver'
  WRITE (LUN,*) 'Relative error tolerance:             ',REAL(RTOL)
  WRITE (LUN,*) 'Absolute error tolerance:             ',REAL(ATOL)
  WRITE (LUN,*) 'Absolute step size allowed:           ',REAL(ASSA)
  WRITE (LUN,*) 'No. of steps to convergence allowed: ',NSC
ELSE
```

```
          WRITE (LUN,*) 'Integration method:                unspecified'
        ENDIF

        WRITE (LUN,*) 'Starting time step:                ',REAL(HSTART)

C       Write organ report--

        WRITE (LUN,1023)
        DO 150 IO = 1, NORGL
          WRITE (LUN,1020) ORGANS(IO), IORG(IO), TARGET(IO),
     .                     IYX(IO), MASMAS(IORG(IO)), ORGMLT(IO),
     .                     ORGING(IO), ORGINH(IO)
  150   CONTINUE
        WRITE (LUN,*) ' '
        IF (IMOD(1) .NE. 2) WRITE (LUN,*)
     .   'Transfer compartment rate:', RTBLOOD

C       Write metabolic report--

        CALL HEADNG (LUN)
        WRITE (LUN,*) ' '
        WRITE (LUN,*) 'No. of OTHER compartments (TCMULT):',NOTHER,
     .                 TCMULT(25)
        WRITE (LUN,*) ' '
        DO 110 I = 1, NOTHER
          WRITE (LUN,*) 'TC, RT: ',I, TCOTHR(I), RTOTHR(I)
  110   CONTINUE

        WRITE (LUN,*) ' '
        WRITE (LUN,*) 'No. of bone compartments (TCMULT):',NBONE,
     .                TCMULT(24)
        WRITE (LUN,*) ' '
        DO 120 I = 1, NBONE
          WRITE (LUN,*) 'TC, RT: ',I, TCBONE(I), RTBONE(I)
  120   CONTINUE

        I = 0
        WRITE (LUN,1011) NORG, (TCMULT(25+IJ),IJ=1,NORG)
        WRITE (LUN,*) ' '
        IF (NORG .GT. 0) THEN
          WRITE (LUN,1013) NOCOMP
          DO 130 I1 = 1, NORG
            DO 131 I2 = 1, NORGCM(I1)
              I = I + 1
              WRITE (LUN,1010) ORGANS(NORGCR(I1)),I, I1, I2,
     .                         TCORG(I), RTORG(I)
  131       CONTINUE
  130     CONTINUE
        ENDIF
```


9 1 0 4 8 1 3 6 3

```
C     Signature lines--

      WRITE (LUN,85)
   85 FORMAT (/79('='))
      WRITE(LUN,89)
   89 FORMAT(///,'Input prepared by: ______________________________',
     .    '              Date: _____________',//
     .         'Input checked by: ______________________________',
     .    '              Date: _____________'//)
      WRITE (LUN,85)

C     SIJ report skipped for production runs--
      IF (DEBUG) THEN
        DO 140 IN = 1, NONUC
          CALL HEADNG (LUN)
          WRITE (LUN,*) ' '
          WRITE (LUN,'(4A)') ' SEEs for ',ELT(IN),AW(IN),
     .      ' (MeV/g transformation)'

          WRITE (LUN,*) ' '
          WRITE (LUN,1003) (ORGANS(J),J=1,8)
          DO 141 IT = 1, NORGL
            WRITE (LUN,1006) ORGANS(IT), (SIJ(IT,IS,IN)/MEVSV,IS=1,8)
  141     CONTINUE

          WRITE (LUN,*) ' '
          WRITE (LUN,1003) (ORGANS(J),J=9,NORGL)
          DO 142 IT = 1, NORGL
            WRITE (LUN,1006) ORGANS(IT),
     .                       (SIJ(IT,IS,IN)/MEVSV,IS=9,NORGL)
  142     CONTINUE

  140   CONTINUE
      ENDIF

C---- Write file subheadings ------------------------------------------

      LUN = 16
      WRITE (LUN,1001) ELT(1), AW(1), CLASS(1), F1, TODAY, CLOCK,
     .                 EXPTYP, UNIT
      WRITE (LUN,1005) NORGL-4, IORG(1),(IORG(J),J=3,8),
     .                 (IORG(J),J=11, NORGL-1)

      RETURN

C---- Error Messages --------------------------------------------------

   98 CALL FILERR (3, LUN, 'In RITINT')
```

```
   99 CALL FILERR (2, LUN, 'In RITINT')

C---- Format Statements ---------------------------------------------------

 1000 FORMAT (I1,1X,A2,A6,6X,2A2,1P,2E9.2,0P,2(I2,E9.2))
 1001 FORMAT ('! ',A2,A6,'Class: ',A1,' F1: ',F9.5, 5X, 3A10, A30)
 1002 FORMAT ('      Lung    Lymph   Gut     S Int   UL Int  ',
     .        'LL Int  Bone    OTHERs  Organ 1 Organ 2')
 1003 FORMAT (/' Target                         Source Organs'/
     .         ' Organ    ',15(A7,1X))
 1004 FORMAT (' ',A1,I3,3X,1P, 15E8.1E2)
 1005 FORMAT (18(I3))
 1006 FORMAT (' ',A8,1P, 15E8.1E2)
 1007 FORMAT (9(A2,A6,1X))
 1010 FORMAT (' ',A8,3I7,2E9.2)
 1011 FORMAT (/ 'No. of specified organs (TCMULT):',T41,I3,1P,5E9.2)
 1013 FORMAT (  'No. of specified organ compartments:',T41,I3//
     .          'Organ       Comp.  Organ  Sub    TCORG   RTORG'/
     .          'Name        Index  Index  Index (frac)   (rate)'/)
 1020 FORMAT (A8,I5,L7,3X,I8,2X,1P,4E10.1)
 1021 FORMAT ('Integration method:',T41,A)
 1022 FORMAT (1X,T41,A)
 1023 FORMAT (//
     .'          Organ            Compartment  Organ'/,
     .' Organ    Index  Target?    Index       Mass       ORGMLT',
     .'     ORGING    ORGINH'/)

C-------------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------
C
      SUBROUTINE SEERED (ITYP, IUNIT, IPASS, NPASS, ISTOP, IEOF)
C
C     This subroutine reads a data set from SEE file.
C
C     Module of Program INTDF of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Version of 1-Dec-87  RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------
C
C     ITYP     - Integer flag indicating file format; 0-unformatted,
C                1-formatted sequential
C     IUNIT    - Logical unit number of the SEE file
C     IPASS    - Pass counter, increased for each time end of file is
C                encountered, incremented and tested in this subroutine
C     NPASS    - Maximum number of passes for this radionuclide chain
C
C-----------------------------------------------------------------

      INCLUDE 'SEE.CMN'

      CHARACTER EXCH1*1, EXCH2*1, DUM*1
      INTEGER IUNIT, ITYP, IPASS, NPASS
      LOGICAL ISTOP, IEOF

      IEOF = .FALSE.

      IF (ITYP .EQ. 1) THEN

C       Formatted file--
        READ (IUNIT,70,END=100) AHO1, EXCH1, LEME1, ZHO1, HLIFE1, UNITS1

        READ (IUNIT,71) AHO, EXCH, LEME, ZHO, HLIFE, UNITS, NPRS, NPRT,

     .                  IG, IGBAR, TODAY, BONES

        READ (IUNIT,72) (IPRS(I),I=1,NPRS), (IPRT(I),I=1,NPRT)
        READ (IUNIT,73) ((DBLIN(I,K),I=1,NPRS),K=1,NPRT)
        READ(IUNIT,70,END=100) AHO2,EXCH2,LEME2,ZHO2,HLIFE2,UNITS2

        IF (AHO1 .NE. AHO2) GO TO 92

      ELSE

C       Unformatted file--
```


9 1 0 4 8 1 3 6 6

```
          READ (IUNIT,END=100) AHO, EXCH, LEME, ZHO, HLIFE, UNITS,
     .                         NPRS, NPRT, IG, IGBAR, TODAY, BONES

          READ (IUNIT) (IPRS(I),I=1,NPRS), (IPRT(I),I=1,NPRT)
          READ (IUNIT,END=100) ((DBLIN(I,K),I=1,NPRS),K=1,NPRT)

        ENDIF
        RETURN

  100   CONTINUE

C       End of file encountered; increment counter and check limit--
        IPASS = IPASS + 1
        IF (IPASS .GT. NPASS) THEN
          ISTOP = .TRUE.
        ELSE
          IEOF = .TRUE.
          REWIND (IUNIT)
          IF (ITYP .EQ. 1) THEN
            READ (IUNIT,'(A)') DUM
          ELSE
            READ (IUNIT) DUM
          ENDIF
        ENDIF
        RETURN

C---- Error Conditions -------------------------------------------------

   91   CALL FILERR (2, IUNIT, LEME)

   92   WRITE (*,1) AHO1,AHO2
        CALL FILERR (3, IUNIT, LEME)

C---- Format Statements ------------------------------------------------

   70   FORMAT (5X,F5.0,1X,A1,1X,3A4,F5.0,1PE11.4,1X,2A4)
   71   FORMAT (1X,F5.0,1X,A1,3A4,F5.0,E11.4,1X,2A4,8I3,A3,1X,A1)
   72   FORMAT (40I2)
   73   FORMAT (8E10.2)
    1   FORMAT (' UNEXPECTED ERROR:  HEADER=',F5.0,'TRAILER= ',F5.0)

C----------------------------------------------------------------------
        END
```


9 1 0 4 8 1 3 6 7

```
C-----------------------------------------------------------------------
C
      SUBROUTINE SETORG
C
C     Subroutine SETORG sets organ flags, indices, and cross-indices
C
C     Module of Program INTDF of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 19-Feb-88 RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C     ACTMAS  - Total mass of all active organs for this radionuclide
C     OTHMAS  - Mass of OTHER compartment
C     OTHORG  - Mass of remaining OTHER after non-specified organs
C               have been accounted for
C
C-----------------------------------------------------------------------

       INCLUDE 'ORGPAR.CMN'
       INCLUDE 'ORGMAS.CMN'
       INCLUDE 'OPT.CMN'
       INCLUDE 'RAD.CMN'
       INCLUDE 'INTDFS.CMN'
       INCLUDE 'MTBPAR.CMN'

      LOGICAL FOUND
      REAL ACTMAS, MASING, MASINH, OTHMAS

      ACTMAS = 0.0
      MASING = 0.0
      MASINH = 0.0
      OTHMAS = 0.0

C     Set transfer compartment fractions for gut--
      TCMULT(20) = 0.0
      TCMULT(21) = 0.0
      TCMULT(22) = 0.0
      TCMULT(23) = 0.0

      DO 141 IO = 1, NORGL

C       Store organ names into array--
        ORGANS(IO) = MASORG(IORG(IO))

C       Set target flags--
```


9 1 0 4 8 1 3 5 8

```
      IF (IORG(IO) .EQ. 2) THEN
        TARGET(IO) = .FALSE.
      ELSEIF (IORG(IO) .EQ. 9) THEN
        TARGET(IO) = .FALSE.
      ELSEIF (IORG(IO) .EQ. 10) THEN
        TARGET(IO) = .FALSE.
      ELSE
        TARGET(IO) = .TRUE.
      ENDIF

C     Set integrated retention compartment (YWORK) cross-index--

C     ---- Iodine Model -----------------------------------------------
      IF (IMOD(1) .EQ. 2 .OR. TEI) THEN

        IF (IORG(IO) .LT. 7) THEN
          IYX(IO) = IO + 17
        ELSEIF (IORG(IO) .EQ. 14) THEN
          IYX(IO) = 26
        ELSEIF (IORG(IO) .EQ. 15) THEN
          IYX(IO) = 27
        ELSE
          IYX(IO) = 25
        ENDIF

C       There is always a bone compartment for tellurium--
        IF (TEI .AND. (IO .GT. 6 .AND. IO .LT. 12)) IYX(IO) = 24

C       Set transfer compartment apportion fraction based on mass-
        TCMULT(26) = MASMAS(14) / (TOTMAS - MASMAS(1))
        TCMULT(27) = MASMAS(15) / (TOTMAS - MASMAS(1))

C     ---- General Model ----------------------------------------------
      ELSEIF (IMOD(1) .EQ. 0) THEN

        IF (IORG(IO) .LT. 7) THEN
          IYX(IO) = IO + 17
        ELSEIF (IORG(IO) .LT. 11) THEN
          IYX(IO) = 24
        ELSE
          FOUND = .FALSE.
          DO 142 J = 1, NORG
            IF (IO .EQ. NORGCR(J)) THEN
              IYX(IO) = 25 + J
              FOUND = .TRUE.
            ENDIF
  142     CONTINUE
          IF (.NOT. FOUND) IYX(IO) = 25
        ENDIF
```

```
C         Set transfer compartment apportion fraction based on mass-
          TCMULT(24) = (MASMAS(9) + MASMAS(10)) / (TOTMAS - MASMAS(1))

          DO 152 J = 1, NORG
            IOG = IORG(NORGCR(J))
            IF (DEBUG) WRITE (*,*) 'SETORG (j,norgcr,iog):',J,
     .        NORGCR(J),IOG
            TCMULT(25+J) = MASMAS(IOG) / (TOTMAS - MASMAS(1))
  152     CONTINUE

C       ---- Alkaline Earth Model --------------------------------------
        ELSEIF (IMOD(1) .EQ. 1) THEN

          IF (IORG(IO) .LT. 7) THEN
            IYX(IO) = IO + 17
          ELSEIF (IORG(IO) .EQ. 7) THEN
            IYX(IO) = 27
          ELSEIF (IORG(IO) .EQ. 9) THEN
            IYX(IO) = 26
          ELSEIF (IORG(IO) .EQ. 10) THEN
            IYX(IO) = 24
          ELSE
            IYX(IO) = 25
          ENDIF

C         Set transfer compartment apportion fraction based on mass-
          TCMULT(24) = MASMAS(10) / (TOTMAS - MASMAS(1))
          TCMULT(26) = MASMAS(9) / (TOTMAS - MASMAS(1))

        ENDIF

  141 CONTINUE

C---- Set organ multipliers -------------------------------------------

C     First set to 1.0 or bone fraction if specified, 0.0 if not--
      DO 145 IO = 1, NORGL

        ORGMLT(IO) = 0.0

        IF (SPECOR(IO)) THEN
          ORGMLT(IO) = 1.0
          IF (IMOD(1) .EQ. 1) THEN
C           Alkaline earth model
            ORGMLT(9) = 1.0
            ORGMLT(10) = 1.0
          ELSEIF (BONE(1) .EQ. 'S') THEN
```

```
C          Surface seeker: area of cort and cann is about equal.
           ORGMLT(9) = 0.5
           ORGMLT(10) = 0.5
         ELSEIF (BONE(1) .EQ. 'V') THEN
C          Volume seeker: ratios are about five to one
           ORGMLT(9) = 0.8
           ORGMLT(10) = 0.2
         ENDIF

C        Accumulate total mass of active organs--
         ACTMAS =  ACTMAS + MASMAS(IORG(IO))

       ELSE
         IF (IO .GT. 6 .AND. IO .LT. 11) GO TO 146
         IF (IYX(IO) .EQ. 25) GO TO 146
         ORGMLT(IO) = 1.0
  146    CONTINUE
       ENDIF

  145 CONTINUE

C     Determine mass of active lung and gut
      TEMPH = 0.0
      TEMPG = 0.0
      OTHG = 0.0
      OTHH = 0.0

C     Ingestion--

      IF (F1 .EQ. 1.0) THEN
        TEMPG = MASMAS(3)
        SPECOR(3) = .TRUE.
      ELSE
        TEMPG = MASMAS(3) +
     .         MASMAS(4) + MASMAS(5) + MASMAS(6)
        SPECOR(3) = .TRUE.
        SPECOR(4) = .TRUE.
        SPECOR(5) = .TRUE.
        SPECOR(6) = .TRUE.
      ENDIF

C     Set mass of other--
      MASING  =  TOTMAS - ACTMAS - TEMPG

C     Apportion OTHER compartment by mass of organs--

      DO 151 IO = 1, NORGL-1
        IF (.NOT. SPECOR(IO)) THEN
```

```
          IF (IO .EQ. 9 .OR. IO .EQ. 10) THEN
            ORGING(IO) = 0.0
          ELSE
            ORGING(IO) = MASMAS(IORG(IO)) / MASING
            OTHG = OTHG + MASMAS(IORG(IO))
          ENDIF
        ELSE
          ORGING(IO) = 0.0
        ENDIF
  151 CONTINUE
      IF (DEBUG) WRITE (*,*) 'OTHG:',OTHG

C     Set fraction of remaining OTHER by mass--
      ORGING(NORGL) = (MASING - OTHG) / MASING

C     Inhalation--
      IF (F1 .EQ. 1.0) THEN
        TEMPH = MASMAS(1) + MASMAS(2) + MASMAS(3)
        SPECOR(1) = .TRUE.
        SPECOR(2) = .TRUE.
        SPECOR(3) = .TRUE.
      ELSE
        TEMPH = MASMAS(1) + MASMAS(2) + MASMAS(3) +
     .          MASMAS(4) + MASMAS(5) + MASMAS(6)
        SPECOR(1) = .TRUE.
        SPECOR(2) = .TRUE.
        SPECOR(3) = .TRUE.
        SPECOR(4) = .TRUE.
        SPECOR(5) = .TRUE.
        SPECOR(6) = .TRUE.
      ENDIF

C     Set mass of other--
      MASINH  =  TOTMAS - ACTMAS - TEMPH
      OTHMAS = TOTMAS - ACTMAS - MASMAS(1) - MASMAS(2) - MASMAS(3) -
     .         MASMAS(4) - MASMAS(5) - MASMAS(6)

C     Apportion OTHER compartment by mass of organs--

      DO 181 IO = 1, NORGL-1
        IF (.NOT. SPECOR(IO)) THEN
          IF (IO .EQ. 9 .OR. IO .EQ. 10) THEN
            ORGINH(IO) = 0.0
          ELSE
            ORGINH(IO) = MASMAS(IORG(IO)) / MASINH
            OTHH = OTHH + MASMAS(IORG(IO))
          ENDIF
        ELSEIF ((CARBON .OR. TRITUM) .AND. IO .EQ. 1) THEN
          ORGINH(IO) = MASMAS(IORG(IO)) / MASINH
```

```
            OTHH = OTHH + MASMAS(IORG(IO))
          ELSE
            ORGINH(IO) = 0.0
          ENDIF
  181 CONTINUE
      IF (DEBUG) WRITE (*,*) 'OTHH:',OTHH

C     Set fraction of remaining OTHER by mass--
      ORGINH(NORGL) = (MASINH - OTHH) / MASINH

C     Set transfer compartment apportion fraction for OTHER--
      TCMULT(25) = OTHMAS / (TOTMAS - MASMAS(1))

      RETURN

C-----------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------
C
      SUBROUTINE SETPAR
C
C     This modules initializes lung and gut model compartments for
C     either an ingestion run or an inhalation run.  Rate units, da-1.
C
C     Module of Program INTDF of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 17-Aug-88  RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------------

        INCLUDE 'ORGPAR.CMN'
        INCLUDE 'MTBPAR.CMN'
        INCLUDE 'INTDFS.CMN'
        INCLUDE 'DECAY.CMN'
        INCLUDE 'RAD.CMN'
        INCLUDE 'OPT.CMN'

      DO 22 J = 1, 45
        DO 23 I = 1, 9
          YWORK(I,J) = 0.0
   23   CONTINUE
   22 CONTINUE

        UPTGUT = 0.0
        DO 24 I = 1, 9
          DEPOSIT(I) = 0.0
   24 CONTINUE

C     Set gut model rates--

      RTGUT(1) = 24.0
      RTGUT(2) = 6.0
      RTGUT(3) = 24.0/13.0
      RTGUT(4) = 1.0

      IF(F1.EQ.1.0) THEN
        FG2SI = 0.0
        FG2TC = 1.0
        RTSIBL = 0.0
      ELSE
        FG2SI = 1.0
        FG2TC = 0.0
        RTSIBL = (F1 * RTGUT(2)) / (1.0 - F1)
        IF (DEBUG) WRITE (*,*) 'RTSIBL: ', RTSIBL
```

```
      ENDIF

C---- Set lung model rates -------------------------------------------
      IF (INHDF) THEN
        RTLUNG(1) = ALOG2 / 0.01
        RTLUNG(2) = ALOG2 / 0.4
        RTLUNG(3) = ALOG2 / 0.01
        RTLUNG(4) = ALOG2 / 0.2
        RTLUNG(12) = RTLUNG(4)

        IF (CLASS(1) .EQ. 'D') THEN

          RTLUNG(2) = RTLUNG(1)
          RTLUNG(5) = ALOG2 / XDIV(1)
          RTLUNG(6) = 0.0
          RTLUNG(7) = 0.0
          RTLUNG(8) = RTLUNG(5)
          RTLUNG(9) = 0.0
          RTLUNG(10) = RTLUNG(5)


        ELSEIF (CLASS(1) .EQ. 'W') THEN

          RTLUNG(5) = ALOG2 / XDIV(2)
          RTLUNG(6) = ALOG2
          RTLUNG(7) = RTLUNG(5)
          RTLUNG(8) = RTLUNG(5)
          RTLUNG(9) = 0.0
          RTLUNG(10) = RTLUNG(5)

        ELSE

          RTLUNG(5) = ALOG2 / XDIV(3)
          RTLUNG(6) = ALOG2
          RTLUNG(7) = RTLUNG(5)
          RTLUNG(8) = RTLUNG(5)
          RTLUNG(9) = RTLUNG(5)
          RTLUNG(10) = ALOG2 / 1000.0

        ENDIF


        IF (ACUTE) THEN

          IF (CARBON .OR. TRITUM) THEN
            YWORK(1,17) = 1.0

          ELSE
            DO 42 I = 1, 1
```

```
            YLUNG(I,1) = DBLE( ZNP )
            YLUNG(I,2) = YLUNG(I,1)
            YLUNG(I,3) = DBLE( ZTB )
            YLUNG(I,4) = YLUNG(I,3)
            YLUNG(I,5) = DBLE( ZP )
            YLUNG(I,6) = YLUNG(I,5)
            YLUNG(I,7) = YLUNG(I,5)
            YLUNG(I,8) = YLUNG(I,5)
            YLUNG(I,9) = YLUNG(I,5)
   42     CONTINUE

          DO 43 J = 1, 1
            DO 20 I=1,9

              YLUNG(J,I) = YLUNG(J,I) * ADJ(I,ICL(1))
   20       CONTINUE

   43     CONTINUE
        ENDIF


      ELSE
C       Chronic--

        DEPOSIT(1) = ZNP / 365.0
        DEPOSIT(2) = DEPOSIT(1)
        DEPOSIT(3) = ZTB / 365.0
        DEPOSIT(4) = DEPOSIT(3)
        DEPOSIT(5) = ZP / 365.0
        DEPOSIT(6) = DEPOSIT(5)
        DEPOSIT(7) = DEPOSIT(5)
        DEPOSIT(8) = DEPOSIT(5)
        DEPOSIT(9) = DEPOSIT(5)

        DO 21 I=1,9

          DEPOSIT(I) = DEPOSIT(I) * ADJ(I,ICL(1))

 21     CONTINUE

      ENDIF

    ELSE

C   Set ingestion rates --

    IF (ACUTE) THEN

      IF (CARBON .OR. TRITUM) THEN
```

```
              YWORK(1,17) = 1.0

            ELSE
              DO 44 I = 1, 1
                YGUT(I,1) = DBLE(1.0)
                IF (DEBUG) WRITE (*,1034) YGUT(I,1)
   44         CONTINUE
              UPTGUT = 0.0
            ENDIF

          ELSE
C           Chronic--

            UPTGUT = 1.0 / 365.0
            IF (DEBUG) WRITE (*,1033) UPTGUT

          ENDIF

C         Clear lung rates--
          DO 30 I = 1, 9
            RTLUNG(I) = 0.0
            DEPOSIT(I) = 0.0
   30     CONTINUE
          RTLUNG(10) = 0.0
          RTLUNG(12) = 0.0

          ENDIF
          RETURN

C---- Format Statements ------------------------------------------------

 1031 FORMAT (' Initial quantity in Y lung compartments: '/,
     .           9(10X, I4, 4X, E10.3/))
 1032 FORMAT (' Initial quantity in DEPOSIT lung compartments: '/
     .           9(10X, I4, 4X, E10.3/))
 1033 FORMAT (' Initial quantity in UPTGUT for ingestion: ',E10.3)
 1034 FORMAT (' Initial quantity in YGUT(1,1) for ingestion: ',E10.3)

C-----------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------
C
      SUBROUTINE SIJLIB (ISTOP)
C
C
C     This subroutine handles reading of the SEE data libraries and
C     storing of Sij (SEE) values for radionuclides considered in this
C     chain.
C
C     Module of Program INTDF of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 11-Apr-88 RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------
C
C     DENOM    - Summation of mass of target organ; used for Sij of
C                OTHER to target calculation
C     ITYP     - Integer flag indicating file format; 0-unformatted,
C                1-formatted sequential
C     IUNIT    - Logical unit number of the SEE file
C     IPASS    - Pass counter, increased for each time end of file is
C                encountered, incremented and tested in this subroutine
C     IWORK    - Logical unit number of workspace file
C     NPASS    - Maximum number of passes for this radionuclide chain
C     NUMER    - Summation of mass of target organ times SEE of target
C                organ; used for Sij of OTHER to target calculation
C
C-----------------------------------------------------------------

      INCLUDE 'RAD.CMN'
      INCLUDE 'SIJS.CMN'
      INCLUDE 'ORGPAR.CMN'
      INCLUDE 'OPT.CMN'
      INCLUDE 'ORGMAS.CMN'
      INCLUDE 'MTBPAR.CMN'
      INCLUDE 'SEE.CMN'
      INCLUDE 'RMD.CMN'
      INCLUDE 'RMD2.CMN'

      CHARACTER A*6, A1(6)*1, DUM*1
      EQUIVALENCE (A, A1(1))
      LOGICAL META(9), META2(30), FOUND, ISTOP, IEOF
      REAL RMDAW(9), RMDAW2(30), TEFE2(30,40), NUMER, DENOM
      INTEGER IWORK, ITYP

C     Unformatted file--
      ITYP = 0
```

```
C     Workspace file--
      IWORK = 7
      CALL OPNFIL (1, 0, IWORK)
      REWIND IWORK

C     Process radionuclide chain, determine if metastable and
C     convert atomic mass to real number--

      DO 203 IN = 1, NONUC
        META(IN) = .FALSE.
        A = AW(IN)
        DO 204 I = 3, 6
          IF (A1(I) .EQ. 'M') THEN
            META(IN) = .TRUE.
            A1(I) = '.'
          ENDIF
  204   CONTINUE
        WRITE (7,'(A)') A
        BACKSPACE (7)
        READ (7,'(F6.0)') RMDAW(IN)
  203 CONTINUE

      IF (DEBUG) WRITE (*,*) 'META:',META,'RMDAW:',RMDAW

C     Also process implicit daughter array--

      DO 207 ID = 1, NIDRMD
        META2(ID) = .FALSE.
        A = AW2M(ID)
        DO 208 I = 3, 6
          IF (A1(I) .EQ. 'M') THEN
            META2(ID) = .TRUE.
            A1(I) = ' '
          ENDIF
  208   CONTINUE
        WRITE (7,'(A)') A
        BACKSPACE (7)
        READ (7,*) RMDAW2(ID)
  207 CONTINUE

      CLOSE (IWORK)

C     Determine if this chain is to be treated as surface or volume seeker--
      IF (BONE(1) .EQ. 'N') THEN
        IF (HL(1) .GT. 15.0) THEN
          BONE(1) = 'V'
        ELSE
          BONE(1) = 'S'
```

```
        ENDIF
      ENDIF

C     Input file--
      IUN = 41
      CALL OPNFIL (1, 0, IUN)

      READ (IUN,10) SOPT,VOPT,LPAGE
      READ (IUN,30) NSORS,NTARG
      DO 50 I=1,NSORS
        READ (IUN,40) (SORG(I,J),J=1,8)

   50 CONTINUE
      DO 60 I=1,NTARG
        READ (IUN,40) (TORG(I,J),J=1,12)

   60 CONTINUE
      READ (IUN,65) (SYMBOL(I),I=1,103)
      CLOSE (IUN)

C     Select SEE file based on atomic number of parent--
      IF (ATNUM(1) .LT. 44) THEN
        IUNIT = 45
      ELSEIF (ATNUM(1) .LT. 81) THEN
        IUNIT = 46
      ELSE
        IUNIT = 47
      ENDIF
      CALL OPNFIL (7, 0, IUNIT)

C     Determine maximum number of passes through file to allow--
      NPASS = NONUC
      IPASS = 1
      DO 403 IN = 1, NONUC
        NPASS = NPASS + NDAU(IRMD(IN))
  403 CONTINUE
      IF (DEBUG) WRITE (*,*) 'Maximum no. of passes of SEE file:',NPASS

C     Loop through all radionuclides in chain--
      DO 404 IN = 1, NONUC

        IF (IN .GT. 1) THEN
          IF (ATNO(IRMD(IN)) .LT. ATNO(IRMD(IN-1))) THEN
            REWIND (IUNIT)
            READ (IUNIT) DUM
          ENDIF
        ENDIF

        FOUND = .FALSE.
```

```
C       Loop until radionculide found in SEE library--
  500   CONTINUE

C       Read a data set from SEE file--
        CALL SEERED (ITYP, IUNIT, IPASS, NPASS, ISTOP, IEOF)
        IF (IEOF) GOTO 500
        IF (ISTOP) GOTO 600
        ISY = INT (ZHO)

C       Check if this data set matches radionuclide--
        IF (SYMBOL(ISY) .EQ. ELT(IN)) THEN
          IF (AHO .EQ. RMDAW(IN)) THEN
            IF (META(IN)) THEN
              IF (EXCH .EQ. 'M') FOUND = .TRUE.
            ELSE
              IF (EXCH .EQ. ' ') FOUND = .TRUE.
            ENDIF
          ENDIF
        ENDIF

        IF (.NOT. FOUND) THEN

C         Radionuclide was not found, skip volume data set,
C         go to next record--
          CALL SEERED (ITYP, IUNIT, IPASS, NPASS, ISTOP, IEOF)
          IF (IEOF) GOTO 500
          IF (ISTOP) GOTO 600
          GOTO 500

        ELSE

C         Radionuclide was found, read data set into array--
          DO 111 K = 1, NPRT
            DO 112 I = 1, NPRS
              TEFE(IPRS(I),IPRT(K)) = REAL(DBLIN(I,K))
  112       CONTINUE
  111     CONTINUE

          IF (BONE(1) .EQ. 'S') THEN

C           Surface seeker, double check and skip over volume data set--
            CALL SEERED (ITYP, IUNIT, IPASS, NPASS, ISTOP, IEOF)
            IF (IEOF) GOTO 500
            IF (ISTOP) GOTO 600

          ELSE
C           Volume seeker, read second data set and double check--
            CALL SEERED (ITYP, IUNIT, IPASS, NPASS, ISTOP, IEOF)
```

```
          IF (IEOF) GOTO 500
          IF (ISTOP) GOTO 600
C
          Overlay volume data into array--
          DO 117 K = 1, NPRT
            DO 118 I = 1, NPRS
              TEFE(IPRS(I),IPRT(K)) = REAL(DBLIN(I,K))
  118       CONTINUE
  117     CONTINUE
        ENDIF
C
        Check for implicit daughters--
        IF (NDAU(IRMD(IN)) .GT. 0) THEN

          DO 301 ID = 1, NIDRMD
            IF (IPNDX(ID) .EQ. IRMD(IN)) THEN
  501         CONTINUE
              CALL SEERED (ITYP, IUNIT, IPASS, NPASS, ISTOP, IEOF)
              IF (IEOF) GOTO 501
              IF (ISTOP) GOTO 600
              ISY = INT (ZHO)
C
              Check if this radionuclide is an implicit daughter--
              IDD = 0
              IF (SYMBOL(ISY) .EQ. ELT2M(ID)) THEN
                IF (AHO .EQ. RMDAW2(ID)) THEN
                  IF (META2(ID)) THEN
                    IF (EXCH .EQ. 'M') IDD = ID
                  ELSE
                    IF (EXCH .EQ. ' ') IDD = ID
                  ENDIF
                ENDIF
              ENDIF

              IF (IDD .EQ. 0) THEN
C
                Daughter was not found, skip volume data set--
                CALL SEERED (ITYP, IUNIT, IPASS, NPASS, ISTOP, IEOF)
              IF (IEOF) GOTO 501
                IF (ISTOP) GOTO 600
                GOTO 501
              ELSE
C
                Daughter was found, read data set into holding array--
                DO 311 K = 1, NPRT
                  DO 312 I = 1, NPRS
                    TEFE2(IPRS(I),IPRT(K)) = REAL(DBLIN(I,K))
  312             CONTINUE
  311           CONTINUE
```

```
                    IF (BONE(1) .EQ. 'S') THEN
C                     Surface seeker, double check and skip over volume--
                      CALL SEERED (ITYP, IUNIT, IPASS, NPASS, ISTOP, IEOF)
                      IF (IEOF) GOTO 501
                      IF (ISTOP) GOTO 600

                    ELSE
C                     Volume seeker, read second data set and double check--
                      CALL SEERED (ITYP, IUNIT, IPASS, NPASS, ISTOP, IEOF)
                      IF (IEOF) GOTO 501
                      IF (ISTOP) GOTO 600

C                     Overlay volume data into array--
                      DO 317 K = 1, NPRT
                        DO 318 I = 1, NPRS
                          TEFE2(IPRS(I),IPRT(K)) = REAL (DBLIN(I,K))
  318                   CONTINUE
  317                 CONTINUE
                    ENDIF

C                   Add daughter to parent--
                    DO 417 K = 1, NTARG
                      DO 418 I = 1, NSORS
                        TEFE(I,K) = TEFE(I,K) + (TEFE2(I,K) * BRANCH(ID))
  418                 CONTINUE
  417               CONTINUE

                  ENDIF
                ENDIF
  301         CONTINUE
            ENDIF

C           Transfer data for this radionuclide into Sij array, collect
C           summations, calculate OTHER to target organ--

C           For each target organ--
            DO 401 IT = 1, NORGL-1

              NUMER = 0.0
              DENOM = 0.0

              ITT = TINDX(IORG(IT))
              IF (ITT .LE. 0) GOTO 92

C             For each source organ--
              DO 402 IS = 1, NORGL
                ISS = SINDX(IORG(IS))
```

```
         IF (ISS .GT. 0) THEN
           SIJ(IT,IS,IN) = TEFE(ISS,ITT) * MEVSV
           NUMER = NUMER + (MASMAS(IORG(IS)) * SIJ(IT,IS,IN))
           DENOM = DENOM + MASMAS(IORG(IS))
         ENDIF

  402    CONTINUE


         SIJ(IT,NORGL,IN) = (TOTMAS * SIJ(IT,NORGL,IN) - NUMER) /
                            (TOTMAS - DENOM)
         IF (DEBUG) THEN
           WRITE (*,*) IN, IT, numer, denom, totmas*sij(it,norgl,in)
           WRITE (*,*) (SIJ(IT,IS,IN) / MEVSV ,IS=1,NORGL)
         ENDIF

C        There is a significance problem because we only read 2
C        significant figures on TEFE but values vary by up to
C        20 orders of magnitude.
         IF (SIJ(IT,NORGL,IN) .LT. 0.0) SIJ(IT,NORGL,IN) = 0.0

  401   CONTINUE

        IF (META(IN)) THEN
          REWIND (IUNIT)
          READ (IUNIT) DUM
        ENDIF

      ENDIF
  404 CONTINUE

  600 CONTINUE
      CLOSE (IUNIT)
      RETURN

C---- Error Conditions -------------------------------------------

   92 WRITE (*,*) 'Target organ index is 0 (IT,IORG(it):',IT, IORG(IT)
      CALL EXIT (1)

C---- Format Statements ------------------------------------------

   10 FORMAT(I2,/,I2,/,I3)
   30 FORMAT(2I4)
   40 FORMAT(12A2)
   65 FORMAT(2X, A2)

C----------------------------------------------------------------
      END
```

EXTDF

```
C----------------------------------------------------------------------
C
C     Program title:                 EXTDF -  A module of the GENII
C                                    environmental dosimetry software
C                                    package.
C
C     Prepared for:                  U. S. Department of Energy under
C                                    Contract DE-AC06-76RLO 1830
C
C
C     Contact:                       Bruce Napier
C                                    Pacific Northwest Laboratory
C                                    Richland WA 99352
C                                    (509) 375-3916
C
C     Code developers:               B. A. Napier, R. A. Peloquin,
C                                    and D. L. Strenge.
C                                    Pacific Northwest Laboratory
C                                    Richland WA  99352
C
C
C     This code was prepared for an agency of the United States
C     Government.  Neither the United States Government or any agency
C     thereof, or any of their employees, make any warranty, expressed
C     or implied, or assumes any legal liability or responsibility for
C     any third party's use, or the results of such use, of any portion
C     of this program or represents that its use by such third party
C     would not infringe privately owned rights.
C
C
C--- Program Information ----------------------------------------------
C
C     Problem description:      To perform external radiation dosimetry
C                               calculations for individuals for
C                               numerous potential geometries for the
C                               entire master list of radionuclides.
C
C     Results format:           The output of EXTDF is an output file
C                               called EXTDF.OUT. A separate data
C                               transfer file is prepared containing
C                               normalized external dose rate factors.
C
C     Computer:                 This version is for the IBM PC/AT.
C
C     Programming language:     FORTRAN compiled using Lahey(tm)
C                               FORTRAN Compiler.
C
C     Machine requirements:     IBM PC/AT with a minimum of 640 Kbytes
C                               random access memory and 1 20-Mbyte fixed
```

910481386

```
C                                 disk drive.
C
C
C   Current Reference:            B. A. Napier, R. A. Peloquin, D. L. Strenge,
C                                 and J. V. Ramsdell. 1988. "GENII - The C
                             Hanford Environmental Radiation Dosimetry C
                        Software System." PNL-6584, Volumes 1, 2, C
                      and 3.  Pacific Northwest Laboratory, C
        Richland, WA  99352
C
C   Original Reference:           R. L. Engel, J. Greenborg, and M. M.
C                                 Hendrickson. 1966. "ISOSHLD - A Computer Code
C                                 for General Purpose Isotope Shielding C
                          Analysis" BNWL-236, Pacific Northwest C
                    Laboratory,  Richland, WA
C
C-------------------------------------------------------------------------
C
      PROGRAM EXTDF
C
C     This module is the main program to calculate gamma attenuation
C     for various source and shield configurations.  This module is
C     a modified version of the CONTRL subroutine of the ISOSHLD
C     computer program, see references in the documentation.  This
C     version of the program calculates dose rate factors for all
C     members of the radionuclide library.  RIBD has been removed,
C     only single cases may be processed (NEXT has been eliminated),
C     and MODE has been removed from input with only MODE=2
C     operational.
C
C     Module of Program EXTDF of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last modification:  25-Jul-88 RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-------------------------------------------------------------------------
C
C     Legend:
C     C          - Variable is calculated internally
C     I          - Variable is input is NAMELIST input
C     L          - Variable is input from libraries
C     O          - Other input
C
C     ANG1       - Cone angle for Tr. cone source, shield normal angle for
C                  line source (I)
C     ANG2       - Detector angle for line source (I)
C     BAN(8)     - Effective atomic number of build up LIBE (L)
C     BLIB()     - Buildup factor library (L):
```

```
C                       i= Energy group,
C                       j= 1 for A1, 2 for ALFA1, 3 for ALFA2
C                       k= Material
C       COEF()     - Energy dependent shield material coefficient (L):
C                       i= Determines energy
C                       j= 1=Mass absorption coef (MU), 2=Energy absorption coef C
                      (MUE)
C                       k= determines material
C       DELR       - Length of radial intervals for numerical integration (I)
C       DSRATE     - Gamma dose rate due to energy flux rate of 1 Mev/scm/sec
C                    at 16 energy levels (C)
C       EAN(20)    - Effective atomic number for shield LIBE (L)
C       EAW(20)    - Effective atomic weight for shield LIBE (L)
C       ENERGY()   - Photon energy in MeV for 25 groups   (C)
C       IEXTU      - Index of selected input/output units:
C                    0= rem/hr per Ci/cm3 (ISOSHLD default)
C                    1= mrem/hr per Ci/m3 (MAXI1)
C                    2= mrem/yr per uCi/cm3 (Kocher)
C                    3= person Sv/yr per Bq/m3 (GENII air)
C                    4= person Sv/yr per Bq/L (GENII on water surface)
C                    5= mrem/yr per uCi/cm2 (Kocher)
C                    6= person Sv/yr per Bq/m2 (GENII ground)
C                    7= mrem/yr per pCi/m3 (IMPACTS-BRC ground)
C                    8= mrem/hr per Ci/m2 (MAXI1)
C       IGEOM      - Variable to specify source and shield geometries (I):
C                    1= Point source, slab shields
C                    2= Line source, slab shields
C                    3= Spherical source and shields
C                    4= Spherical source, slab shields
C                    5= Truncated cone source and shields- detector at apex
C                    6= Disc source, slab shields
C                    7= Cylindrical source and shields
C                    8= Cylindrical source, slab shields
C                    9= Cylinder with detector at end
C                   10= Rectangular solid
C                   11= Cylindrical source, cyl and slab shields
C                   12= Annular cylindrical source, cyl and slab shields
C       IPHSUB()   - Startind subscript in photon array of each RMDLIB member (C)
C       JBUF       - Shield region to be used for calculatind build up; will be
C                    set to last shield if not specified (I)
C       LA()       - Atomic number (L)
C       ML()       - Mass number (L)
C       MODE       - Type of source strength input (O).  Only mode=2 is
C                    allowed in this environmental version of ISOSHLD; Ci
C                    of each isotope input in WEIGHT
C       MU()       - Mass absorption coeff for each shield no and energy group C
     MULTI      - Units correction aplied to result corresponding to option
C                    parameter IEXTU
C       NPHEN      - Number of photon energy groups (C)
```

```
C     NPSI      - No. of vertical intervals for numerical integration (I)
C     NSHLD     - Number of shield regions, maximum = 5, (I)
C     NTHETA    - No. of lateral intervals for numeric integration (I)
C     PHOTON()  - Photon probability library (L):
C                 PHOTON(1,  ) = Probability at
C                 PHOTON(2,  ) = MeV
C     RANGE()   - Range of photon energy in MeV for 16 energy groups (C)
C     SLTH      - Length of line or cyl source, radius of disc or end cyl
C                 source, length of rect source (I)
C     SSV1      - Exponential SS dist  SS=SSV2*XPN(SSV1*VARIABLE) (I)
C     SURORG()  - Organ dose to surface dose ratio for each energy range
C     T         - Thickness of shield regions, solid sources are considered
C                 as first shield region
C     WIN       - Scalar source inventory modification factor
C     X         - Dist. to detector from center of cyl and sph sources,
C                 through source of cone, endcyl and rect sources (I)
C     Y         - Offset of detector from shield normal to point source and
C                 and base of cyl, height of rect source (I)
C
C------------------------------------------------------------------------

      INCLUDE 'ISO.CMN'
      INCLUDE 'RMD.CMN'
      INCLUDE 'DAYPC.CMN'
      INCLUDE 'TITL.CMN'

      DIMENSION WEIGHT(250), DUMMY(26), COEF(25,2,20),
     .          SHNAM(2,20), DSRATE(25), DOSE(25), EAN(20),
     .          EAW(20), BAN(8), DUM(25), MSHLD1(20),
     .          BREMS(25), ERANGE(25), TEMP(27), SURORG(25)

      REAL MULTI

      NAMELIST /INPUT/ T,WIN,NSHLD,SLTH,X,Y,ANG1,ANG2,ANG3,
     .JBUF,IGEOM,SSV1,SSV2,NTHETA,NPSI,DELR,IEXTU

      DATA WIN /1.0/, IEXTU /0/
      DATA BLANK /4H    /
      DATA  DSRATE/ 8.23E-5, 1.73E-5,.635E-5,.328E-5, .229E-5,
     1   .1891E-5, .1714E-5, .1617E-5, .1603E-5, .1728E-5, .196E-5,
     2   .206E-5, .204E-5, .208E-5, .200E-5, .193E-5, .184E-5, .176E-5,
     3   .171E-5, .166E-5, .160E-5, .154E-5, .152E-5, .148E-5, .143E-5/

      DATA (DUMMY(I),I=1,26)/.01,.02,.03,.04,.05,.06,.07,.08,.09,.1,.2,
     1 .3,.4,.55,.75,.9,1.1,1.35,1.6,1.8,2.0,2.2,2.4,2.6,2.8,3.2/

      DATA (DUM(I),I=1,25)/.015,.025,.035,.045,.055,.065,.075,.085,.095,
     1 .15,.25,.35,.475,.65,.825,1.0,1.225,1.475,1.7,1.9,2.1,2.3,2.5,
     2 2.7,3.0/
```

```
      DATA ERANGE /9*.01,3*.1,.15,.2,.15,.2,2*.25,6*.2,.4/
      DATA SURORG /0.0424, 0.131, 0.267, 0.410, 0.507,
     .             0.550, 0.59, 0.62, 0.65, 0.67,
     .             0.66, 0.65, 0.65, 0.66, 0.67,
     .             0.68, 0.7, 0.72, 0.74, 0.76,
     .             0.765, 0.77, 0.775, 0.777, 0.78/

C     Read file names, get system date and time, read master radionuclide
C     library, open library files--
      CALL OPNFIL (3, 0, 1)
      CALL MAKDA2
      CALL RLIBIN
      CALL OPNFIL (4, 0, 34)
      CALL OPNFIL (4, 0, 26)

C     Default is to do both gamma and beta--
      MODE = 2
      ISPEC = 3

      DO 1 I=1,26
    1   RANGE(I) = DUMMY(I)

      DO 2 I=1,25
    2   ENERGY(I) = DUM(I)

      PI = 3.1415927

C     Set number of isotopes equal to no. in RMDLIB
      ISOS = NUCS

C     Read energies from library--
      CALL NRGLIB

C     Read shield material library--

      DO 205 IMU=1, 20
        READ (34,201) DUMMY(1),DUMMY(2),J1,K1,TEMP,ILL
        DO 701 I=1,9
          COEF(I,1,J1) = TEMP(I)
  701   CONTINUE
        AN = TEMP(10)
        AW = TEMP(11)
        DO 702 I=10,25
          COEF(I,1,J1) = TEMP(I+2)
  702   CONTINUE

        IF(3*IMU.NE.ILL.AND.K1.NE.1.AND.J1.LT.1.AND.J1.GT.20)  THEN
          WRITE (*,202) J1
```

```
         ELSE
           SHNAM(1,J1)=DUMMY(1)
           SHNAM(2,J1)=DUMMY(2)
           EAN(J1)=AN
           EAW(J1)=AW
         ENDIF

  205 CONTINUE

C       Read buildup coeffiecient library--

  225 READ (34,226) J,K, (DUMMY(I),I=1,8), AN, KEY

      IF (J.GT.0 .AND.J.LE.8 .AND. K.GT.0.AND. K.LE.6) GO TO 230
C         WRITE (*,228) J,K,(DUMMY(I),I=1,8), AN,KEY

      GO TO 235
  230 KS =(K+1)/ 2
      KM2= MOD(K+1,2)
      DO 232  L=1,8
      LS = L + KM2*8
  232 BLIB(LS,KS ,J) = DUMMY(L)
      IF (K.EQ.1) BAN(J) = AN

  235 IF (KEY.EQ.0) GO TO 225
      DO 238  I=1,8
      IF(BAN(I).GT.0.) GO TO 238

      NBUD = I-1

      GO TO 240
  238 CONTINUE
      NBUD = 8
  240 CONTINUE

C       Read in buildup factor for low energy groups--
C       BUPLWE(I,J,K)  I= Z NUMBER, J = ENERGY,  K = MEAN FREE PATH
      DO 745 IB=1,7
        READ (34,9240)  ((BUPLWE(IB,JB,KB), JB=1,5), KB=1,7)
  745 CONTINUE
      CLOSE (34)

C       Initialize--

      MODE = 2
      MODSAV = MODE
      NSHLD = 0
      SLTH = 0.
      X = 0.
```

```
      Y = 0.
      ANG1 = 0.
      ANG2 = 0.
      ANG3 = 0.
      NPSI = 1
      JBUF = 1
      IGEOM = 0
      SSV1 = 0.
      SSV2 = 0.
      SABAN = 0.
      NPHEN=25

      DO 501 I=1,25
        DO 501 J=1,6
  501     MU(J,I) = 0.

      DO 255 I=1,5
        T(I) = 0.
  255 CONTINUE


C     Read input parameters and transfer title for printing--

      CALL OPNFIL (4, 0, 35)
      READ (35,INPUT)
      TITLS(5) = TITLS(35)

C     Convert deg to radians--
      ANG1 = ANG1 * PI / 180.
      ANG2 = ANG2 * PI / 180.
      ANG3 = ANG3 * PI / 180.

C     Open output file and print heading--
      CALL OPNFIL (2, 0, 36)
      CALL HEADNG (36)
      IF (WIN .NE. 1.0) WRITE (36,112) WIN
  112 FORMAT (//'All values have been adjusted by a factor of:',
     .        T60,1PE9.1/
     .        'Note: printed units are not correct.')

C     Read and process shield material specs--

      IF (JBUF.EQ.0) JBUF = NSHLD
      SUM1 = 0.
      SUM2 = 0.
      NMAXS1 = 0
      SUMSLD = 0

      WRITE (36,502) (I,I=1,5)
```

```
 503 CONTINUE
        READ (35,*) KEY,MAT,(DUMMY(J),J=1,5)
        WRITE (36,523) (SHNAM(I,MAT),I=1,2),(DUMMY(J),J=1,5)

        IF (MAT .LT. 1 .OR. MAT .GT. 20) GOTO 91

 509    IF(DUMMY(1) .GT. 0.0) THEN
          NMAXS1 = NMAXS1 + 1

          MSHLD1(NMAXS1) = MAT

          FRACT(NMAXS1)=DUMMY(1)

          IF (EAW(MAT).NE.0.) THEN
            SUMSLD = SUMSLD + EAN(MAT)*DUMMY(1)/EAW(MAT)

          ENDIF
        ENDIF

C       Calculate mass absorbtion coefficients--
C
        DO 520  I=1,NPHEN
          DO 521  J=1,NSHLD

            MU (J,I) = MU(J,I) + DUMMY(J) * COEF(I,1,MAT)

 521      CONTINUE
 520    CONTINUE

        IF (EAW(MAT).EQ.0.) GO TO 525
          SUM1 = DUMMY(JBUF)/ EAW(MAT)  + SUM1

          SUM2 = DUMMY(JBUF) * EAN(MAT) / EAW(MAT) + SUM2


 525 IF (KEY .EQ. 0) GO TO 503

      DO 530 IK = 1,NMAXS1
        L = MSHLD1(IK)
        ZABS(IK)=EAN(L)
        IF (EAW(L)*SUMSLD.EQ.0.) GO TO 530
        FRACT(IK) = EAN(L)*FRACT(IK)/(EAW(L)*SUMSLD)
 530 CONTINUE

      NZABS = NMAXS1
      IF (SUM1.NE.0.) ABAN = SUM2/SUM1

C     Build MU for summy shield of air
      DO 535 I=1,NPHEN
```

```
      MU(NSHLD+1,I) = COEF(I,1,3) * 1.2929E-3
  535 CONTINUE

C     For environmental version always process entire RMDLIB--
      DO 620 IN=1,ISOS
C      DO 620 IN=25,25

       DO 270 I=1,3
         DO 270 J=1,25
  270       SOURCE(I,J) = 0.


C      Build source strength table and calculate attenuation--
       DO 602 J=1,25
         BREMS(J) = 0.0
C        BREMS(J) is Bremsstralung yield in photons per MeV--
         SOURCE (1,J) =0.
         SOURCE (2,J) = ENERGY(J)
         SOURCE (3,J) = 0.
  602  CONTINUE

C      Set multiplier to activity per unit area or volume--
       IF (IGEOM .EQ. 6) THEN
         MULTI = PI * SLTH * SLTH
       ELSEIF (IGEOM .EQ. 9) THEN
         MULTI = PI * SLTH * SLTH * T(1)
       ELSEIF (IGEOM .EQ. 10) THEN
         MULTI = Y * SLTH * T(1)
       ELSE
         MULTI = 1.0
       ENDIF

       IF (IEXTU .EQ. 1) THEN
C        Units are mrem/hr per Ci/m3 (MAXI1 volume)
         MULTI = MULTI * 1.0E-03

       ELSEIF (IEXTU .EQ. 2) THEN
C        Units are mrem/yr per uCi/cm3 (Kocher)
         MULTI = MULTI * 8.766

       ELSEIF (IEXTU .EQ. 3) THEN
C        Units are person Sv/yr per Bq/m3 (GENII air)
         MULTI = MULTI * 2.37E-15

       ELSEIF (IEXTU .EQ. 4) THEN
C        Units are person Sv/yr per Bq/L (GENII on water surface)
         MULTI = MULTI * 2.37E-12

       ELSEIF (IEXTU .EQ. 5) THEN
```

```
C        Units are mrem/yr per uCi/cm2 (Kocher)
         MULTI = MULTI * 8.766

       ELSEIF (IEXTU .EQ. 6) THEN
C        Units are person Sv/yr per Bq/m2 (GENII ground)
         MULTI = MULTI * 2.37E-13

       ELSEIF (IEXTU .EQ. 7) THEN
C        Units are mrem/yr per pCi/m3  (Impacts-BRC)
         MULTI = MULTI * 8.766E-12

       ELSEIF (IEXTU .EQ. 8) THEN
C        Units are mrem/hr per Ci/m2  (MAXI1 ground)
         MULTI = MULTI * 0.1

       ELSE
C        Units are rem/hr per Ci/cm2 or cm3
         MULTI = MULTI * 1.0
       ENDIF

       IF (IN .GT. 1) WEIGHT(IN-1) = 0.0
       WEIGHT(IN) = WIN
       TERM = WEIGHT(IN)
       KBEG = IPHSUB(IN)
       KEND = KBEG + NP(IN) - 1


C      WRITE (*,*) ELTM(IN), AWM(IN), '(B/P)',NB(IN), NP(IN)
C      WRITE (*,*) '    Photons:   ', KBEG, KEND
C      WRITE (*,*) '       Energy  ',(PHOTON(2,I),I=KBEG,KEND)
C      WRITE (*,*) '       Inten.  ',(PHOTON(1,I),I=KBEG,KEND)

       IF (NB(IN) .GT. 0) THEN

C        there are beta emitters--
         CALL BETA (IN,TERM)

         DO 9630  II=1,25

C          BRGAM(II) is the Bremsstralung yield in photons per MeV
C          ERANGE(II) is the group energy range in MeV
           BREMS(II) = BREMS(II) + BRGAM(II) * ERANGE(II)
           SOURCE(1,II) = SOURCE(1,II) + BRGAM(II) * ERANGE(II)

 9630    CONTINUE
       ENDIF

C      WRITE (*,*) 'BRGAM:',BRGAM
```

```
      IF (NP(IN) .GT. 0) THEN
C       do gamma calculations--

        DO 610  K=KBEG,KEND

C         group photon energies--

          IF (PHOTON(2,K) .GT. 0.0) THEN
            DO 605 L=1,26

              IF (PHOTON(2,K).LT. RANGE(L)) GOTO 607
  605       CONTINUE

            L = 25
            GOTO 608
  607       L = MAX0 (L-1, 1)
  608       CONTINUE
            RAP = SOURCE(1,L)
            SOURCE(1,L) = TERM * PHOTON(1,K) * 3.7E+10 + SOURCE(1,L)
C           WRITE (*,*) 'Photon: ',L, TERM, PHOTON(1,K), RAP,
C                         SOURCE(1,L)
          ENDIF
  610   CONTINUE
      ENDIF

C     Build two sets of buildup coefficients for later interpolation
C     on effective atomic no.(ABAN)
C     BUF (1,  ) = A1, BUF(2,  )= A2 =1.-A1, BUF(3,  )=ALPHA 1,
C     BUF (4, ) = ALPHA 2,  BUIF = Buildup interpolation factor
C     The calculated buildup factor will be interpolated rather
C     than the coefficient

 6302 IF(BAN(1).LT.ABAN) GO TO 631
      JBS1   = 1
      JBS2   = 2
      GO TO 635

 631  DO 634  J=2,NBUD
        IF (ABAN - BAN(J)) 632,633,634

  632   JBS1   = J-1
        JBS2   = J
        GO TO 635
  633   JBS1   = J
        JBS2   = J+1
        GO TO 635

  634 CONTINUE
```

```
        JBS1   = NBUD
        JBS2   = NBUD-1
  635   FRED = BAN(JBS2)-BAN(JBS1)
        IF (FRED.NE.0.) BUIF = (ABAN-BAN(JBS1))/FRED

        DO 650 J=1,NPHEN
          JSAVE = J

  636     IF(SOURCE(1,J)) 6636,650,6636
 6636     IF(SOURCE(1,J)-.1) 6637,6361,6361

 6361     BUF (1,1)= TERP (ENERGY,BLIB(1,1,JBS1),SOURCE(2,J))
          BUF (1,2)= TERP (ENERGY,BLIB(1,1,JBS2),SOURCE(2,J))

          BUF (2,2)= 1. - BUF(1,2)

          DO 637 L=3,4

            BUF(L,1) = TERP (ENERGY,BLIB(1,L-1,JBS1), SOURCE(2,J))
            BUF(L,2) = TERP (ENERGY,BLIB(1,L-1,JBS2), SOURCE(2,J))

  637     CONTINUE

C         Attenuation calculation--

 6637     CONTINUE

          JPH = J

          IF (IGEOM .EQ. 1) THEN
            CALL POINT

          ELSEIF (IGEOM .EQ. 2) THEN
            CALL LINE

          ELSEIF (IGEOM .LT. 5) THEN
            CALL SPHERE

          ELSEIF (IGEOM .EQ. 5) THEN
            CALL TCONE

          ELSEIF (IGEOM .EQ. 6) THEN
            CALL DISC

          ELSEIF (IGEOM .LT. 9 .OR. IGEOM .EQ. 11) THEN
            CALL CYL

          ELSEIF (IGEOM .EQ. 9) THEN
```

```
            CALL ENDCYL

          ELSEIF (IGEOM .EQ. 10) THEN
            CALL RECT

          ELSEIF (IGEOM .EQ. 12) THEN
            CALL ANCYL

          ELSE
            GOTO 92
          ENDIF

C         Dose for each energy group--
          TERPB1 = TERPB(ENERGY,DSRATE,SOURCE(2,J))
          DOSE(J) = SOURCE(3,J) * TERPB1 * SURORG(J)

C         WRITE (*,*) 'SOURCE/TERPB1: ',J, SOURCE(3,J), TERPB1

C         Total dose for this radionuclide--
          TDOSE(IN) = TDOSE(IN) + DOSE(J) * MULTI

  650   CONTINUE

        WRITE (*,*) 'DOSE from :', ELTM(IN), AWM(IN), TDOSE(IN)

  620 CONTINUE

C     Write report--
      CALL SHORT (IEXTU)

      WRITE (*,*) 'No. of betas:   ', IBESUB(NUCS)
      WRITE (*,*) 'No. of photons: ', IPHSUB(NUCS)

      STOP

C---- Error Conditions ---------------------------------------------

   91 WRITE (*,*) 'The following shield specs data rejected'

      WRITE (*,504) KEY,MAT,(DUMMY(I),I=1,5)
      STOP

   92 WRITE (*,*) 'IGEOM', IGEOM, ' is out of range'

      STOP

C---- Format Statements --------------------------------------------

  201 FORMAT(A4,A3,I2,I1,9F7.0,F2.0,F3.0/10X,9F7.0/10X,7F7.0,19X,I2)
```

```
 202 FORMAT(' INVALID ATTENUATION COEFFICIENT SET FOR THE ',I2,
    .16H SHIELD MATERIAL/1H ,32HCHECK YOUR RESULTS CAREFULLY....)
 226 FORMAT (8X, 2I1,8F7.0,F3.0,2X,I1)
 228 FORMAT ( 47H0FOLLOWING INVALID BUILDUP FACTOR DATA REJECTED /
    1  1X, 2I1,8E10.3,-3PF6.3,I3)
 502 FORMAT(/,'Shield composition (gm/cc):',/9X, 5I8)
 504 FORMAT (I1,7X,I2,5E10.4)
 523 FORMAT (2A4,4X,1P,5E8.1)
9240 FORMAT ( 6X, 10F6.3)

C-------------------------------------------------------------------
      END
```


9 1 0 4 8 1 3 9 9

```
C-----------------------------------------------------------------------
C
      SUBROUTINE BETA (J, TERM)
C
C     This module counts the number of beta end point energies or
C     probabilities.  This module was taken from ISOSHLD, see
C     references in documentation.
C
C     Module of Program EXTDF of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last modification:  29-Jul-87  RAP
C
C-----------------------------------------------------------------------

      INCLUDE 'ISO.CMN'

      ZSORCE = LA(J)
      L = 1
      LL = IBESUB(J)
      LLEND  = LL + NB(J) - 1
      KOUNT = NB(J)

C    WRITE (*,*) '    Betas:     ', LL, LLEND
C    WRITE (*,*) '      Energy   ', (BETENS(2,I),I=LL, LLEND)
C    WRITE (*,*) '      Inten.   ', (BETENS(1,I),I=LL, LLEND)

      DO 50 I =LL,LLEND
      BETAEP(L) = BETENS(2,I)
      BETAPR(L) = BETENS(1,I)
   50 L = L + 1

      CALL  BYIELD (ZSORCE)

      DO  70 I = 1,25
   70 BRGAM(I) = TERM * 3.7E10 * YIELD(I)

      RETURN

C-----------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------
C
      BLOCK DATA BLOCK3
C
C     This block data routine contains the bremsstralung source
C     tables.  This block data module was taken from ISOSHLD, see
C     references in the documentation.  The filename array is also
C     initialized.
C
C     Module of Program EXTDF of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last modification:  10-Nov-87 RAP
C
C-----------------------------------------------------------------------
C
C     BREMI = Internal Tables
C     BRME10 - 90 = External Tables
C
C-----------------------------------------------------------------------

      INCLUDE 'FILES.CMN'
      INCLUDE 'ISO.CMN'

      DATA FILN /'FILENAME.DAT', 49*' '/

      DATA (BREMI( 1, 1,I),I=1,25) /
     X3.37E -1,1.87E -1,1.08E -1,6.92E -2,6.03E -2,1.56E -2,7.22E -3,
     X3.94E -3,2.32E -3,1.42E -3,8.82E -4,5.52E -4,3.44E -4,2.12E -4,
     X1.28E -4,7.50E -5,4.22E -5,2.25E -5,1.11E -5,4.89E -6,1.82E -6,
     X5.03E -7,7.62E -8,1.48E -9, .00E  0  /
      DATA ((BRME10(I, 1,J),J=1,25),I=1,5) /
     X3.67E -1,2.19E -1,9.67E -2,6.10E -2,3.48E -1,7.12E -2,2.96E -2,
     X1.51E -2,8.44E -3,4.94E -3,2.96E -3,1.79E -3,1.08E -3,6.40E -4,
     X3.72E -4,2.09E -4,1.12E -4,5.65E -5,2.60E -5,1.05E -5,3.51E -6,
     X8.34E -7,9.94E -8,1.14E -9, .00E  0,1.34E  1,5.68E  0,2.65E  0,
     X1.48E  0,1.13E  0,2.40E -1,1.03E -1,5.44E -2,3.13E -2,1.88E -2,
     X1.16E -2,7.16E -3,4.41E -3,2.68E -3,1.59E -3,9.15E -4,5.02E -4,
     X2.58E -4,1.21E -4,5.00E -5,1.70E -5,4.11E -6,4.97E -7,5.75E -9,
     X .00E  0,2.26E  1,9.74E  0,4.46E  0,2.50E  0,2.01E  0,4.26E -1,
     X1.84E -1,9.70E -2,5.60E -2,3.38E -2,2.08E -2,1.29E -2,8.01E -3,
     X4.88E -3,2.91E -3,1.68E -3,9.22E -4,4.75E -4,2.24E -4,9.28E -5,
     X3.15E -5,7.65E -6,9.28E -7,1.08E -8, .00E  0,3.16E  1,1.38E  1,
     X6.24E  0,3.49E  0,2.92E  0,6.20E -1,2.67E -1,1.41E -1,8.14E -2,
     X4.91E -2,3.03E -2,1.88E -2,1.17E -2,7.11E -3,4.24E -3,2.44E -3,
     X1.34E -3,6.93E -4,3.27E -4,1.35E -4,4.60E -5,1.12E -5,1.36E -6,
     X1.57E -8, .00E  0,4.05E  1,1.80E  1,7.98E  0,4.46E  0,3.89E  0,
     X8.24E -1,3.55E -1,1.87E -1,1.08E -1,6.51E -2,4.02E -2,2.49E -2,
     X1.54E -2,9.41E -3,5.61E -3,3.23E -3,1.78E -3,9.16E -4,4.32E -4,
```

```
X1.79E -4,6.08E -5,1.48E -5,1.79E -6,2.08E -8, .00E  0  /
 DATA (BREMI( 1, 2,I),I=1,25) /
X3.37E -1,1.87E -1,1.08E -1,6.92E -2,6.35E -2,1.66E -2,7.82E -3,
X4.34E -3,2.60E -3,1.62E -3,1.03E -3,6.58E -4,4.21E -4,2.67E -4,
X1.67E -4,1.01E -4,5.94E -5,3.30E -5,1.70E -5,7.89E -6,3.09E -6,
X9.03E -7,1.45E -7,2.98E -9, .00E  0  /
 DATA ((BRME10(I, 2,J),J=1,25),I=1,5) /
X3.67E -1,2.19E -1,9.67E -2,6.10E -2,3.49E -1,6.97E -2,2.84E -2,
X1.42E -2,7.84E -3,4.52E -3,2.67E -3,1.59E -3,9.46E -4,5.55E -4,
X3.18E -4,1.77E -4,9.35E -5,4.65E -5,2.11E -5,8.42E -6,2.76E -6,
X6.45E -7,7.55E -8,8.49E-10, .00E  0,1.34E  1,5.68E  0,2.65E  0,
X1.48E  0,1.13E  0,2.36E -1,1.00E -1,5.20E -2,2.95E -2,1.75E -2,
X1.06E -2,6.49E -3,3.95E -3,2.37E -3,1.39E -3,7.93E -4,4.30E -4,
X2.19E -4,1.02E -4,4.18E -5,1.41E -5,3.38E -6,4.07E -7,4.69E -9,
X .00E  0,2.26E  1,9.74E  0,4.46E  0,2.50E  0,2.00E  0,4.20E -1,
X1.79E -1,9.35E -2,5.34E -2,3.19E -2,1.95E -2,1.20E -2,7.33E -3,
X4.43E -3,2.62E -3,1.49E -3,8.15E -4,4.17E -4,1.95E -4,8.02E -5,
X2.71E -5,6.53E -6,7.88E -7,9.08E -9, .00E  0,3.16E  1,1.38E  1,
X6.24E  0,3.49E  0,2.90E  0,6.09E -1,2.60E -1,1.36E -1,7.77E -2,
X4.65E -2,2.84E -2,1.75E -2,1.07E -2,6.49E -3,3.83E -3,2.19E -3,
X1.20E -3,6.12E -4,2.87E -4,1.18E -4,3.99E -5,9.63E -6,1.16E -6,
X1.34E -8, .00E  0,4.05E  1,1.80E  1,7.98E  0,4.46E  0,3.85E  0,
X8.07E -1,3.44E -1,1.80E -1,1.03E -1,6.14E -2,3.75E -2,2.31E -2,
X1.42E -2,8.57E -3,5.07E -3,2.90E -3,1.58E -3,8.09E -4,3.79E -4,
X1.56E -4,5.27E -5,1.27E -5,1.54E -6,1.77E -8, .00E  0  /
 DATA (BREMI( 1, 3,I),I=1,25) /
X3.37E -1,1.87E -1,1.08E -1,6.92E -2,6.67E -2,1.79E -2,8.59E -3,
X4.90E -3,3.02E -3,1.95E -3,1.28E -3,8.57E -4,5.73E -4,3.80E -4,
X2.49E -4,1.59E -4,9.76E -5,5.69E -5,3.08E -5,1.50E -5,6.13E -6,
X1.87E -6,3.12E -7,6.68E -9, .00E  0  /
 DATA ((BRME10(I, 3,J),J=1,25),I=1,5) /
X3.67E -1,2.19E -1,9.67E -2,6.10E -2,3.53E -1,6.79E -2,2.69E -2,
X1.31E -2,7.06E -3,3.99E -3,2.32E -3,1.36E -3,7.94E -4,4.59E -4,
X2.60E -4,1.42E -4,7.43E -5,3.64E -5,1.63E -5,6.40E -6,2.06E -6,
X4.70E -7,5.35E -8,5.80E-10, .00E  0,1.34E  1,5.68E  0,2.65E  0,
X1.48E  0,1.14E  0,2.28E -1,9.31E -2,4.67E -2,2.57E -2,1.49E -2,
X8.81E -3,5.27E -3,3.15E -3,1.86E -3,1.08E -3,6.03E -4,3.23E -4,
X1.63E -4,7.52E -5,3.06E -5,1.02E -5,2.45E -6,2.93E -7,3.37E -9,
X .00E  0,2.26E  1,9.74E  0,4.46E  0,2.50E  0,2.00E  0,4.05E -1,
X1.67E -1,8.47E -2,4.70E -2,2.74E -2,1.64E -2,9.86E -3,5.93E -3,
X3.53E -3,2.05E -3,1.16E -3,6.25E -4,3.17E -4,1.47E -4,6.02E -5,
X2.02E -5,4.86E -6,5.85E -7,6.74E -9, .00E  0,3.16E  1,1.38E  1,
X6.24E  0,3.49E  0,2.89E  0,5.86E -1,2.43E -1,1.23E -1,6.86E -2,
X4.01E -2,2.40E -2,1.45E -2,8.74E -3,5.20E -3,3.04E -3,1.72E -3,
X9.27E -4,4.70E -4,2.19E -4,8.95E -5,3.01E -5,7.24E -6,8.72E -7,
X1.00E -8, .00E  0,4.05E  1,1.80E  1,7.98E  0,4.46E  0,3.81E  0,
X7.73E -1,3.20E -1,1.62E -1,9.05E -2,5.29E -2,3.17E -2,1.91E -2,
X1.15E -2,6.87E -3,4.01E -3,2.27E -3,1.22E -3,6.21E -4,2.89E -4,
X1.18E -4,3.98E -5,9.57E -6,1.15E -6,1.33E -8, .00E  0  /
```


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```
 DATA (BREMI( 1, 4,I),I=1,25) /
X3.37E -1,1.87E -1,1.08E -1,6.92E -2,6.62E -2,1.81E -2,8.87E -3,
X5.18E -3,3.28E -3,2.17E -3,1.48E -3,1.01E -3,6.99E -4,4.78E -4,
X3.22E -4,2.11E -4,1.33E -4,7.99E -5,4.43E -5,2.20E -5,9.17E -6,
X2.85E -6,4.84E -7,1.05E -8, .00E  0  /
 DATA ((BRME10(I, 4,J),J=1,25),I=1,5) /
X3.67E -1,2.19E -1,9.67E -2,6.10E -2,3.61E -1,6.75E -2,2.62E -2,
X1.26E -2,6.74E -3,3.79E -3,2.19E -3,1.28E -3,7.53E -4,4.37E -4,
X2.48E -4,1.36E -4,7.17E -5,3.53E -5,1.58E -5,6.23E -6,2.00E -6,
X4.54E -7,5.07E -8,5.29E-10, .00E  0,1.34E  1,5.68E  0,2.65E  0,
X1.48E  0,1.15E  0,2.21E -1,8.74E -2,4.28E -2,2.32E -2,1.32E -2,
X7.76E -3,4.61E -3,2.75E -3,1.62E -3,9.38E -4,5.27E -4,2.83E -4,
X1.43E -4,6.63E -5,2.70E -5,9.07E -6,2.18E -6,2.62E -7,3.02E -9,
X .00E  0,2.26E  1,9.74E  0,4.46E  0,2.50E  0,2.00E  0,3.89E -1,
X1.56E -1,7.68E -2,4.18E -2,2.40E -2,1.42E -2,8.48E -3,5.08E -3,
X3.02E -3,1.76E -3,9.94E -4,5.38E -4,2.74E -4,1.28E -4,5.26E -5,
X1.78E -5,4.30E -6,5.21E -7,6.05E -9, .00E  0,3.16E  1,1.38E  1,
X6.24E  0,3.49E  0,2.87E  0,5.61E -1,2.25E -1,1.11E -1,6.07E -2,
X3.49E -2,2.07E -2,1.24E -2,7.44E -3,4.42E -3,2.58E -3,1.46E -3,
X7.93E -4,4.04E -4,1.89E -4,7.78E -5,2.64E -5,6.38E -6,7.74E -7,
X8.98E -9, .00E  0,4.05E  1,1.80E  1,7.98E  0,4.46E  0,3.76E  0,
X7.35E -1,2.95E -1,1.46E -1,7.97E -2,4.59E -2,2.71E -2,1.63E -2,
X9.77E -3,5.81E -3,3.39E -3,1.92E -3,1.04E -3,5.31E -4,2.48E -4,
X1.02E -4,3.46E -5,8.38E -6,1.01E -6,1.18E -8, .00E  0  /
 DATA (BREMI( 1, 5,I),I=1,25) /
X3.37E -1,1.87E -1,1.08E -1,6.92E -2,6.09E -2,1.69E -2,8.47E -3,
X5.06E -3,3.28E -3,2.23E -3,1.55E -3,1.09E -3,7.71E -4,5.39E -4,
X3.71E -4,2.48E -4,1.60E -4,9.72E -5,5.47E -5,2.75E -5,1.16E -5,
X3.66E -6,6.26E -7,1.37E -8, .00E  0  /
 DATA ((BRME10(I, 5,J),J=1,25),I=1,5) /
X3.67E -1,2.19E -1,9.67E -2,6.10E -2,3.73E -1,6.91E -2,2.68E -2,
X1.30E -2,7.01E -3,4.00E -3,2.35E -3,1.41E -3,8.40E -4,4.97E -4,
X2.87E -4,1.61E -4,8.58E -5,4.28E -5,1.94E -5,7.67E -6,2.46E -6,
X5.54E -7,6.05E -8,5.94E-10, .00E  0,1.34E  1,5.68E  0,2.65E  0,
X1.48E  0,1.16E  0,2.17E -1,8.50E -2,4.15E -2,2.25E -2,1.30E -2,
X7.69E -3,4.63E -3,2.79E -3,1.67E -3,9.80E -4,5.57E -4,3.02E -4,
X1.54E -4,7.17E -5,2.93E -5,9.80E -6,2.34E -6,2.78E -7,3.16E -9,
X .00E  0,2.26E  1,9.74E  0,4.46E  0,2.50E  0,1.99E  0,3.77E -1,
X1.48E -1,7.25E -2,3.95E -2,2.28E -2,1.36E -2,8.19E -3,4.96E -3,
X2.98E -3,1.76E -3,1.00E -3,5.49E -4,2.81E -4,1.32E -4,5.45E -5,
X1.85E -5,4.46E -6,5.38E -7,6.21E -9, .00E  0,3.16E  1,1.38E  1,
X6.24E  0,3.49E  0,2.83E  0,5.36E -1,2.11E -1,1.03E -1,5.63E -2,
X3.25E -2,1.94E -2,1.17E -2,7.11E -3,4.28E -3,2.52E -3,1.44E -3,
X7.90E -4,4.06E -4,1.91E -4,7.90E -5,2.68E -5,6.49E -6,7.85E -7,
X9.06E -9, .00E  0,4.05E  1,1.80E  1,7.98E  0,4.46E  0,3.68E  0,
X6.96E -1,2.73E -1,1.34E -1,7.30E -2,4.21E -2,2.51E -2,1.52E -2,
X9.20E -3,5.53E -3,3.26E -3,1.87E -3,1.02E -3,5.24E -4,2.47E -4,
X1.02E -4,3.46E -5,8.37E -6,1.01E -6,1.17E -8, .00E  0  /
 DATA (BREMI( 1, 6,I),I=1,25) /
```

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```
X3.37E -1,1.87E -1,1.08E -1,6.92E -2,5.05E -2,1.42E -2,7.25E -3,
X4.40E -3,2.91E -3,2.01E -3,1.43E -3,1.02E -3,7.33E -4,5.21E -4,
X3.63E -4,2.46E -4,1.60E -4,9.86E -5,5.60E -5,2.84E -5,1.21E -5,
X3.85E -6,6.65E -7,1.47E -8, .00E  0  /
 DATA ((BRME10(I, 6,J),J=1,25),I=1,5) /
X3.67E -1,2.19E -1,9.67E -2,6.10E -2,3.88E -1,7.30E -2,2.89E -2,
X1.44E -2,7.97E -3,4.67E -3,2.82E -3,1.73E -3,1.06E -3,6.38E -4,
X3.76E -4,2.14E -4,1.16E -4,5.83E -5,2.66E -5,1.05E -5,3.36E -6,
X7.45E -7,7.87E -8,7.14E-10, .00E  0,1.34E  1,5.68E  0,2.65E  0,
X1.48E  0,1.17E  0,2.20E -1,8.72E -2,4.34E -2,2.40E -2,1.41E -2,
X8.56E -3,5.26E -3,3.23E -3,1.96E -3,1.16E -3,6.67E -4,3.64E -4,
X1.86E -4,8.63E -5,3.50E -5,1.15E -5,2.69E -6,3.09E -7,3.34E -9,
X .00E  0,2.26E  1,9.74E  0,4.46E  0,2.50E  0,1.97E  0,3.70E -1,
X1.47E -1,7.30E -2,4.05E -2,2.38E -2,1.44E -2,8.86E -3,5.45E -3,
X3.31E -3,1.97E -3,1.13E -3,6.21E -4,3.19E -4,1.49E -4,6.08E -5,
X2.03E -5,4.80E -6,5.64E -7,6.28E -9, .00E  0,3.16E  1,1.38E  1,
X6.24E  0,3.49E  0,2.75E  0,5.16E -1,2.04E -1,1.01E -1,5.62E -2,
X3.30E -2,2.00E -2,1.23E -2,7.54E -3,4.59E -3,2.73E -3,1.57E -3,
X8.60E -4,4.41E -4,2.07E -4,8.46E -5,2.83E -5,6.72E -6,7.93E -7,
X8.87E -9, .00E  0,4.05E  1,1.80E  1,7.98E  0,4.46E  0,3.52E  0,
X6.58E -1,2.60E -1,1.29E -1,7.12E -2,4.17E -2,2.52E -2,1.55E -2,
X9.50E -3,5.77E -3,3.43E -3,1.97E -3,1.08E -3,5.53E -4,2.59E -4,
X1.06E -4,3.54E -5,8.41E -6,9.92E -7,1.11E -8, .00E  0  /
 DATA (BREMI( 2, 1,I),I=1,25) /
X3.63E -1,1.92E -1,9.04E -2,6.77E -2,5.49E -2,1.40E -2,6.37E -3,
X3.44E -3,2.00E -3,1.21E -3,7.46E -4,4.63E -4,2.86E -4,1.75E -4,
X1.05E -4,6.10E -5,3.41E -5,1.81E -5,8.85E -6,3.88E -6,1.43E -6,
X3.95E -7,5.94E -8,1.15E -9, .00E  0  /
 DATA ((BRME30(I, 1,J),J=1,25),I=1,5) /
X4.39E  0,1.78E  0,8.64E -1,4.83E -1,3.15E -1,6.37E -2,2.62E -2,
X1.32E -2,7.30E -3,4.23E -3,2.51E -3,1.50E -3,8.97E -4,5.29E -4,
X3.05E -4,1.70E -4,9.07E -5,4.54E -5,2.08E -5,8.36E -6,2.76E -6,
X6.54E -7,7.75E -8,8.82E-10, .00E  0,1.32E  1,5.49E  0,2.60E  0,
X1.45E  0,1.03E  0,2.15E -1,9.14E -2,4.75E -2,2.71E -2,1.61E -2,
X9.82E -3,6.02E -3,3.68E -3,2.22E -3,1.31E -3,7.45E -4,4.05E -4,
X2.07E -4,9.66E -5,3.97E -5,1.34E -5,3.22E -6,3.88E -7,4.46E -9,
X .00E  0,2.22E  1,9.42E  0,4.38E  0,2.45E  0,1.82E  0,3.81E -1,
X1.63E -1,8.48E -2,4.84E -2,2.89E -2,1.77E -2,1.09E -2,6.68E -3,
X4.04E -3,2.39E -3,1.37E -3,7.45E -4,3.81E -4,1.79E -4,7.35E -5,
X2.48E -5,6.00E -6,7.24E -7,8.35E -9, .00E  0,3.10E  1,1.34E  1,
X6.12E  0,3.42E  0,2.65E  0,5.55E -1,2.37E -1,1.23E -1,7.05E -2,
X4.21E -2,2.57E -2,1.58E -2,9.71E -3,5.88E -3,3.48E -3,1.99E -3,
X1.09E -3,5.56E -4,2.60E -4,1.07E -4,3.63E -5,8.76E -6,1.06E -6,
X1.22E -8, .00E  0,3.98E  1,1.74E  1,7.83E  0,4.38E  0,3.53E  0,
X7.38E -1,3.14E -1,1.64E -1,9.34E -2,5.58E -2,3.41E -2,2.10E -2,
X1.29E -2,7.78E -3,4.60E -3,2.63E -3,1.44E -3,7.35E -4,3.44E -4,
X1.42E -4,4.80E -5,1.16E -5,1.40E -6,1.61E -8, .00E  0  /
 DATA (BREMI( 2, 2,I),I=1,25) /
X3.63E -1,1.92E -1,9.04E -2,6.77E -2,5.73E -2,1.48E -2,6.84E -3,
```

9 1 0 4 8 1 4 0 4

```
X3.75E -3,2.22E -3,1.37E -3,8.65E -4,5.50E -4,3.50E -4,2.20E -4,
X1.37E -4,8.26E -5,4.81E -5,2.66E -5,1.37E -5,6.30E -6,2.45E -6,
X7.13E -7,1.14E -7,2.33E -9, .00E  0  /
 DATA ((BRME30(I, 2,J),J=1,25),I=1,5) /
X4.39E  0,1.78E  0,8.64E -1,4.83E -1,3.12E -1,6.16E -2,2.48E -2,
X1.23E -2,6.71E -3,3.84E -3,2.25E -3,1.33E -3,7.84E -4,4.57E -4,
X2.61E -4,1.44E -4,7.56E -5,3.74E -5,1.69E -5,6.71E -6,2.19E -6,
X5.09E -7,5.93E -8,6.64E-10, .00E  0,1.32E  1,5.49E  0,2.60E  0,
X1.45E  0,1.02E  0,2.09E -1,8.78E -2,4.50E -2,2.53E -2,1.49E -2,
X8.95E -3,5.43E -3,3.28E -3,1.96E -3,1.14E -3,6.45E -4,3.48E -4,
X1.76E -4,8.17E -5,3.33E -5,1.12E -5,2.67E -6,3.20E -7,3.67E -9,
X .00E  0,2.22E  1,9.42E  0,4.38E  0,2.45E  0,1.79E  0,3.72E -1,
X1.57E -1,8.10E -2,4.58E -2,2.71E -2,1.64E -2,1.00E -2,6.09E -3,
X3.66E -3,2.14E -3,1.22E -3,6.60E -4,3.35E -4,1.56E -4,6.39E -5,
X2.15E -5,5.15E -6,6.19E -7,7.11E -9, .00E  0,3.10E  1,1.34E  1,
X6.12E  0,3.42E  0,2.61E  0,5.40E -1,2.28E -1,1.18E -1,6.67E -2,
X3.95E -2,2.39E -2,1.46E -2,8.90E -3,5.35E -3,3.14E -3,1.78E -3,
X9.68E -4,4.93E -4,2.29E -4,9.40E -5,3.16E -5,7.60E -6,9.13E -7,
X1.05E -8, .00E  0,3.98E  1,1.74E  1,7.83E  0,4.38E  0,3.45E  0,
X7.15E -1,3.02E -1,1.56E -1,8.82E -2,5.22E -2,3.17E -2,1.93E -2,
X1.18E -2,7.07E -3,4.15E -3,2.36E -3,1.28E -3,6.51E -4,3.03E -4,
X1.24E -4,4.18E -5,1.00E -5,1.21E -6,1.39E -8, .00E  0  /
 DATA (BREMI( 2, 3,I),I=1,25) /
X3.63E -1,1.92E -1,9.04E -2,6.77E -2,6.13E -2,1.62E -2,7.73E -3,
X4.38E -3,2.68E -3,1.72E -3,1.13E -3,7.49E -4,4.98E -4,3.29E -4,
X2.14E -4,1.36E -4,8.35E -5,4.85E -5,2.62E -5,1.27E -5,5.17E -6,
X1.57E -6,2.62E -7,5.59E -9, .00E  0  /
 DATA ((BRME30(I, 3,J),J=1,25),I=1,5) /
X4.39E  0,1.78E  0,8.64E -1,4.83E -1,3.23E -1,6.14E -2,2.41E -2,
X1.17E -2,6.25E -3,3.51E -3,2.03E -3,1.18E -3,6.88E -4,3.96E -4,
X2.23E -4,1.22E -4,6.34E -5,3.09E -5,1.38E -5,5.41E -6,1.73E -6,
X3.95E -7,4.48E -8,4.85E-10, .00E  0,1.32E  1,5.49E  0,2.60E  0,
X1.45E  0,1.04E  0,2.06E -1,8.37E -2,4.17E -2,2.28E -2,1.31E -2,
X7.72E -3,4.59E -3,2.73E -3,1.61E -3,9.26E -4,5.17E -4,2.76E -4,
X1.39E -4,6.38E -5,2.58E -5,8.61E -6,2.05E -6,2.46E -7,2.82E -9,
X .00E  0,2.22E  1,9.42E  0,4.38E  0,2.45E  0,1.83E  0,3.67E -1,
X1.50E -1,7.56E -2,4.17E -2,2.42E -2,1.43E -2,8.60E -3,5.15E -3,
X3.05E -3,1.77E -3,9.94E -4,5.34E -4,2.70E -4,1.25E -4,5.08E -5,
X1.70E -5,4.08E -6,4.90E -7,5.63E -9, .00E  0,3.10E  1,1.34E  1,
X6.12E  0,3.42E  0,2.64E  0,5.31E -1,2.18E -1,1.10E -1,6.09E -2,
X3.53E -2,2.10E -2,1.26E -2,7.58E -3,4.50E -3,2.61E -3,1.47E -3,
X7.91E -4,4.00E -4,1.85E -4,7.56E -5,2.54E -5,6.08E -6,7.30E -7,
X8.39E -9, .00E  0,3.98E  1,1.74E  1,7.83E  0,4.38E  0,3.48E  0,
X7.00E -1,2.88E -1,1.45E -1,8.03E -2,4.66E -2,2.78E -2,1.67E -2,
X1.00E -2,5.94E -3,3.45E -3,1.94E -3,1.05E -3,5.29E -4,2.45E -4,
X9.99E -5,3.35E -5,8.04E -6,9.65E -7,1.11E -8, .00E  0  /
 DATA (BREMI( 2, 4,I),I=1,25) /
X3.63E -1,1.92E -1,9.04E -2,6.77E -2,6.26E -2,1.70E -2,8.28E -3,
X4.81E -3,3.03E -3,2.00E -3,1.36E -3,9.29E -4,6.38E -4,4.35E -4,
```

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```
X2.92E -4,1.91E -4,1.20E -4,7.19E -5,3.98E -5,1.97E -5,8.20E -6,
X2.54E -6,4.31E -7,9.34E -9, .00E  0  /
 DATA ((BRME30(I, 4,J),J=1,25),I=1,5) /
X4.39E  0,1.78E  0,8.64E -1,4.83E -1,3.39E -1,6.30E -2,2.44E -2,
X1.17E -2,6.20E -3,3.47E -3,2.00E -3,1.17E -3,6.84E -4,3.96E -4,
X2.24E -4,1.23E -4,6.45E -5,3.17E -5,1.42E -5,5.57E -6,1.78E -6,
X4.04E -7,4.51E -8,4.69E-10, .00E  0,1.32E  1,5.49E  0,2.60E  0,
X1.45E  0,1.08E  0,2.06E -1,8.13E -2,3.96E -2,2.14E -2,1.21E -2,
X7.10E -3,4.21E -3,2.50E -3,1.47E -3,8.49E -4,4.75E -4,2.55E -4,
X1.29E -4,5.94E -5,2.42E -5,8.09E -6,1.94E -6,2.33E -7,2.68E -9,
X .00E  0,2.22E  1,9.42E  0,4.38E  0,2.45E  0,1.88E  0,3.64E -1,
X1.45E -1,7.12E -2,3.86E -2,2.21E -2,1.30E -2,7.74E -3,4.62E -3,
X2.74E -3,1.59E -3,8.97E -4,4.84E -4,2.46E -4,1.15E -4,4.70E -5,
X1.59E -5,3.83E -6,4.64E -7,5.37E -9, .00E  0,3.10E  1,1.34E  1,
X6.12E  0,3.42E  0,2.70E  0,5.25E -1,2.09E -1,1.03E -1,5.60E -2,
X3.21E -2,1.89E -2,1.13E -2,6.77E -3,4.01E -3,2.34E -3,1.32E -3,
X7.14E -4,3.63E -4,1.69E -4,6.96E -5,2.35E -5,5.69E -6,6.88E -7,
X7.97E -9, .00E  0,3.98E  1,1.74E  1,7.83E  0,4.38E  0,3.54E  0,
X6.88E -1,2.74E -1,1.35E -1,7.35E -2,4.21E -2,2.49E -2,1.49E -2,
X8.89E -3,5.27E -3,3.07E -3,1.73E -3,9.37E -4,4.77E -4,2.22E -4,
X9.14E -5,3.09E -5,7.46E -6,9.03E -7,1.04E -8, .00E  0  /
 DATA (BREMI( 2, 5,I),I=1,25) /
X3.63E -1,1.92E -1,9.04E -2,6.77E -2,5.91E -2,1.63E -2,8.16E -3,
X4.86E -3,3.14E -3,2.13E -3,1.48E -3,1.04E -3,7.32E -4,5.11E -4,
X3.51E -4,2.34E -4,1.50E -4,9.12E -5,5.12E -5,2.57E -5,1.08E -5,
X3.41E -6,5.83E -7,1.28E -8, .00E  0  /
 DATA ((BRME30(I, 5,J),J=1,25),I=1,5) /
X4.39E  0,1.78E  0,8.64E -1,4.83E -1,3.60E -1,6.64E -2,2.57E -2,
X1.24E -2,6.67E -3,3.80E -3,2.23E -3,1.33E -3,7.93E -4,4.68E -4,
X2.71E -4,1.51E -4,8.05E -5,4.01E -5,1.81E -5,7.17E -6,2.30E -6,
X5.16E -7,5.62E -8,5.52E-10, .00E  0,1.32E  1,5.49E  0,2.60E  0,
X1.45E  0,1.12E  0,2.09E -1,8.15E -2,3.97E -2,2.15E -2,1.23E -2,
X7.29E -3,4.38E -3,2.64E -3,1.58E -3,9.23E -4,5.24E -4,2.84E -4,
X1.44E -4,6.71E -5,2.74E -5,9.14E -6,2.18E -6,2.58E -7,2.94E -9,
X .00E  0,2.22E  1,9.42E  0,4.38E  0,2.45E  0,1.93E  0,3.62E -1,
X1.42E -1,6.93E -2,3.76E -2,2.16E -2,1.29E -2,7.76E -3,4.69E -3,
X2.82E -3,1.66E -3,9.45E -4,5.15E -4,2.64E -4,1.24E -4,5.09E -5,
X1.72E -5,4.15E -6,5.00E -7,5.77E -9, .00E  0,3.10E  1,1.34E  1,
X6.12E  0,3.42E  0,2.74E  0,5.16E -1,2.02E -1,9.89E -2,5.37E -2,
X3.09E -2,1.84E -2,1.11E -2,6.73E -3,4.04E -3,2.38E -3,1.36E -3,
X7.42E -4,3.81E -4,1.79E -4,7.38E -5,2.50E -5,6.04E -6,7.30E -7,
X8.41E -9, .00E  0,3.98E  1,1.74E  1,7.83E  0,4.38E  0,3.55E  0,
X6.69E -1,2.62E -1,1.28E -1,6.96E -2,4.01E -2,2.38E -2,1.44E -2,
X8.70E -3,5.22E -3,3.07E -3,1.75E -3,9.58E -4,4.91E -4,2.31E -4,
X9.52E -5,3.22E -5,7.79E -6,9.41E -7,1.08E -8, .00E  0  /
 DATA (BREMI( 2, 6,I),I=1,25) /
X3.63E -1,1.92E -1,9.04E -2,6.77E -2,4.97E -2,1.40E -2,7.11E -3,
X4.31E -3,2.84E -3,1.96E -3,1.39E -3,9.93E -4,7.11E -4,5.04E -4,
X3.51E -4,2.37E -4,1.54E -4,9.47E -5,5.38E -5,2.72E -5,1.16E -5,
```

```
X3.67E -6,6.34E -7,1.40E -8, .00E  0  /
 DATA ((BRME30(I, 6,J),J=1,25),I=1,5) /
X4.39E  0,1.78E  0,8.64E -1,4.83E -1,3.80E -1,7.13E -2,2.82E -2,
X1.40E -2,7.74E -3,4.53E -3,2.73E -3,1.67E -3,1.02E -3,6.15E -4,
X3.62E -4,2.06E -4,1.11E -4,5.59E -5,2.55E -5,1.01E -5,3.21E -6,
X7.11E -7,7.50E -8,6.80E-10, .00E  0,1.32E  1,5.49E  0,2.60E  0,
X1.45E  0,1.14E  0,2.15E -1,8.50E -2,4.22E -2,2.34E -2,1.37E -2,
X8.29E -3,5.09E -3,3.12E -3,1.89E -3,1.12E -3,6.42E -4,3.50E -4,
X1.78E -4,8.27E -5,3.35E -5,1.10E -5,2.57E -6,2.94E -7,3.18E -9,
X .00E  0,2.22E  1,9.42E  0,4.38E  0,2.45E  0,1.93E  0,3.62E -1,
X1.43E -1,7.11E -2,3.93E -2,2.31E -2,1.40E -2,8.57E -3,5.26E -3,
X3.20E -3,1.90E -3,1.09E -3,5.97E -4,3.06E -4,1.43E -4,5.82E -5,
X1.94E -5,4.58E -6,5.37E -7,5.98E -9, .00E  0,3.10E  1,1.34E  1,
X6.12E  0,3.42E  0,2.70E  0,5.05E -1,1.99E -1,9.88E -2,5.46E -2,
X3.20E -2,1.94E -2,1.19E -2,7.29E -3,4.42E -3,2.63E -3,1.51E -3,
X8.26E -4,4.23E -4,1.98E -4,8.09E -5,2.70E -5,6.41E -6,7.55E -7,
X8.44E -9, .00E  0,3.98E  1,1.74E  1,7.83E  0,4.38E  0,3.45E  0,
X6.44E -1,2.54E -1,1.25E -1,6.92E -2,4.05E -2,2.45E -2,1.50E -2,
X9.18E -3,5.57E -3,3.30E -3,1.89E -3,1.04E -3,5.31E -4,2.48E -4,
X1.01E -4,3.38E -5,8.03E -6,9.45E -7,1.06E -8, .00E  0  /
 DATA (BREMI( 3, 1,I),I=1,25) /
X3.56E -1,1.87E -1,8.90E -2,6.55E -2,5.43E -2,1.38E -2,6.26E -3,
X3.37E -3,1.96E -3,1.18E -3,7.26E -4,4.49E -4,2.77E -4,1.69E -4,
X1.01E -4,5.86E -5,3.27E -5,1.73E -5,8.45E -6,3.70E -6,1.36E -6,
X3.74E -7,5.62E -8,1.08E -9, .00E  0  /
 DATA ((BRME50(I, 1,J),J=1,25),I=1,5) /
X4.27E  0,1.72E  0,8.40E -1,4.69E -1,3.11E -1,6.28E -2,2.57E -2,
X1.29E -2,7.14E -3,4.13E -3,2.44E -3,1.46E -3,8.69E -4,5.11E -4,
X2.94E -4,1.64E -4,8.70E -5,4.34E -5,1.98E -5,7.96E -6,2.63E -6,
X6.20E -7,7.33E -8,8.32E-10, .00E  0,1.28E  1,5.31E  0,2.53E  0,
X1.41E  0,1.01E  0,2.12E -1,8.99E -2,4.67E -2,2.65E -2,1.57E -2,
X9.56E -3,5.85E -3,3.57E -3,2.14E -3,1.26E -3,7.17E -4,3.89E -4,
X1.98E -4,9.22E -5,3.78E -5,1.27E -5,3.05E -6,3.67E -7,4.21E -9,
X .00E  0,2.16E  1,9.12E  0,4.26E  0,2.38E  0,1.80E  0,3.76E -1,
X1.60E -1,8.32E -2,4.74E -2,2.83E -2,1.72E -2,1.06E -2,6.47E -3,
X3.90E -3,2.30E -3,1.31E -3,7.15E -4,3.65E -4,1.71E -4,7.00E -5,
X2.36E -5,5.69E -6,6.84E -7,7.88E -9, .00E  0,3.03E  1,1.30E  1,
X5.96E  0,3.33E  0,2.62E  0,5.48E -1,2.33E -1,1.21E -1,6.90E -2,
X4.11E -2,2.51E -2,1.54E -2,9.42E -3,5.68E -3,3.35E -3,1.91E -3,
X1.04E -3,5.32E -4,2.49E -4,1.02E -4,3.45E -5,8.30E -6,1.00E -6,
X1.15E -8, .00E  0,3.88E  1,1.68E  1,7.63E  0,4.26E  0,3.49E  0,
X7.28E -1,3.09E -1,1.61E -1,9.15E -2,5.45E -2,3.32E -2,2.04E -2,
X1.25E -2,7.52E -3,4.44E -3,2.53E -3,1.38E -3,7.04E -4,3.29E -4,
X1.35E -4,4.56E -5,1.10E -5,1.32E -6,1.52E -8, .00E  0  /
 DATA (BREMI( 3, 2,I),I=1,25) /
X3.56E -1,1.87E -1,8.90E -2,6.55E -2,5.58E -2,1.43E -2,6.60E -3,
X3.60E -3,2.13E -3,1.31E -3,8.21E -4,5.20E -4,3.30E -4,2.07E -4,
X1.28E -4,7.71E -5,4.48E -5,2.47E -5,1.26E -5,5.80E -6,2.25E -6,
X6.54E -7,1.04E -7,2.12E -9, .00E  0  /
```

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```
 DATA ((BRME50(I, 2,J),J=1,25),I=1,5) /
X4.27E  0,1.72E  0,8.40E -1,4.69E -1,3.04E -1,5.96E -2,2.39E -2,
X1.18E -2,6.41E -3,3.65E -3,2.13E -3,1.26E -3,7.39E -4,4.29E -4,
X2.44E -4,1.34E -4,7.03E -5,3.46E -5,1.56E -5,6.18E -6,2.01E -6,
X4.66E -7,5.41E -8,6.05E-10, .00E  0,1.28E  1,5.31E  0,2.53E  0,
X1.41E  0,9.88E -1,2.03E -1,8.47E -2,4.33E -2,2.42E -2,1.42E -2,
X8.50E -3,5.13E -3,3.09E -3,1.84E -3,1.07E -3,6.02E -4,3.24E -4,
X1.63E -4,7.55E -5,3.07E -5,1.02E -5,2.45E -6,2.92E -7,3.34E -9,
X .00E  0,2.16E  1,9.12E  0,4.26E  0,2.38E  0,1.75E  0,3.60E -1,
X1.51E -1,7.79E -2,4.39E -2,2.59E -2,1.56E -2,9.48E -3,5.74E -3,
X3.43E -3,2.01E -3,1.14E -3,6.13E -4,3.11E -4,1.44E -4,5.88E -5,
X1.97E -5,4.72E -6,5.65E -7,6.47E -9, .00E  0,3.03E  1,1.30E  1,
X5.96E  0,3.33E  0,2.54E  0,5.23E -1,2.20E -1,1.13E -1,6.38E -2,
X3.77E -2,2.27E -2,1.38E -2,8.39E -3,5.02E -3,2.94E -3,1.67E -3,
X9.00E -4,4.57E -4,2.12E -4,8.66E -5,2.90E -5,6.96E -6,8.34E -7,
X9.55E -9, .00E  0,3.88E  1,1.68E  1,7.63E  0,4.26E  0,3.36E  0,
X6.93E -1,2.91E -1,1.50E -1,8.44E -2,4.98E -2,3.01E -2,1.83E -2,
X1.11E -2,6.64E -3,3.89E -3,2.20E -3,1.19E -3,6.04E -4,2.80E -4,
X1.14E -4,3.84E -5,9.20E -6,1.10E -6,1.26E -8, .00E  0  /
 DATA (BREMI( 3, 3,I),I=1,25) /
X3.56E -1,1.87E -1,8.90E -2,6.55E -2,5.89E -2,1.55E -2,7.33E -3,
X4.13E -3,2.52E -3,1.61E -3,1.05E -3,6.94E -4,4.60E -4,3.03E -4,
X1.97E -4,1.25E -4,7.60E -5,4.41E -5,2.37E -5,1.14E -5,4.65E -6,
X1.41E -6,2.34E -7,4.98E -9, .00E  0  /
 DATA ((BRME50(I, 3,J),J=1,25),I=1,5) /
X4.27E  0,1.72E  0,8.40E -1,4.69E -1,3.08E -1,5.83E -2,2.28E -2,
X1.10E -2,5.84E -3,3.27E -3,1.88E -3,1.09E -3,6.33E -4,3.63E -4,
X2.04E -4,1.11E -4,5.76E -5,2.80E -5,1.25E -5,4.87E -6,1.56E -6,
X3.54E -7,4.01E -8,4.32E-10, .00E  0,1.28E  1,5.31E  0,2.53E  0,
X1.41E  0,9.95E -1,1.96E -1,7.92E -2,3.92E -2,2.14E -2,1.22E -2,
X7.17E -3,4.25E -3,2.52E -3,1.48E -3,8.47E -4,4.72E -4,2.51E -4,
X1.26E -4,5.76E -5,2.33E -5,7.74E -6,1.84E -6,2.20E -7,2.51E -9,
X .00E  0,2.16E  1,9.12E  0,4.26E  0,2.38E  0,1.75E  0,3.49E -1,
X1.42E -1,7.12E -2,3.91E -2,2.25E -2,1.33E -2,7.96E -3,4.75E -3,
X2.80E -3,1.62E -3,9.06E -4,4.86E -4,2.44E -4,1.13E -4,4.58E -5,
X1.53E -5,3.66E -6,4.38E -7,5.03E -9, .00E  0,3.03E  1,1.30E  1,
X5.96E  0,3.33E  0,2.53E  0,5.06E -1,2.07E -1,1.04E -1,5.71E -2,
X3.30E -2,1.95E -2,1.17E -2,6.99E -3,4.13E -3,2.39E -3,1.34E -3,
X7.20E -4,3.63E -4,1.68E -4,6.82E -5,2.28E -5,5.46E -6,6.53E -7,
X7.49E -9, .00E  0,3.88E  1,1.68E  1,7.63E  0,4.26E  0,3.33E  0,
X6.67E -1,2.72E -1,1.37E -1,7.53E -2,4.35E -2,2.58E -2,1.54E -2,
X9.23E -3,5.46E -3,3.16E -3,1.77E -3,9.51E -4,4.79E -4,2.21E -4,
X9.01E -5,3.01E -5,7.21E -6,8.63E -7,9.89E -9, .00E  0  /
 DATA (BREMI( 3, 4,I),I=1,25) /
X3.56E -1,1.87E -1,8.90E -2,6.55E -2,6.02E -2,1.62E -2,7.88E -3,
X4.56E -3,2.86E -3,1.88E -3,1.27E -3,8.67E -4,5.94E -4,4.04E -4,
X2.70E -4,1.76E -4,1.11E -4,6.59E -5,3.63E -5,1.79E -5,7.45E -6,
X2.30E -6,3.89E -7,8.41E -9, .00E  0  /
 DATA ((BRME50(I, 4,J),J=1,25),I=1,5) /
```

```
X4.27E  0,1.72E  0,8.40E -1,4.69E -1,3.24E -1,5.99E -2,2.30E -2,
X1.10E -2,5.82E -3,3.25E -3,1.87E -3,1.09E -3,6.34E -4,3.66E -4,
X2.07E -4,1.13E -4,5.91E -5,2.89E -5,1.29E -5,5.07E -6,1.62E -6,
X3.66E -7,4.07E -8,4.23E-10, .00E  0,1.28E  1,5.31E  0,2.53E  0,
X1.41E  0,1.03E  0,1.96E -1,7.70E -2,3.74E -2,2.01E -2,1.14E -2,
X6.62E -3,3.91E -3,2.32E -3,1.36E -3,7.82E -4,4.37E -4,2.34E -4,
X1.18E -4,5.42E -5,2.20E -5,7.35E -6,1.75E -6,2.10E -7,2.42E -9,
X .00E  0,2.16E  1,9.12E  0,4.26E  0,2.38E  0,1.80E  0,3.47E -1,
X1.37E -1,6.72E -2,3.63E -2,2.07E -2,1.21E -2,7.21E -3,4.29E -3,
X2.53E -3,1.47E -3,8.25E -4,4.44E -4,2.25E -4,1.04E -4,4.28E -5,
X1.44E -5,3.47E -6,4.19E -7,4.84E -9, .00E  0,3.03E  1,1.30E  1,
X5.96E  0,3.33E  0,2.59E  0,5.00E -1,1.98E -1,9.73E -2,5.27E -2,
X3.01E -2,1.77E -2,1.05E -2,6.28E -3,3.71E -3,2.15E -3,1.21E -3,
X6.55E -4,3.32E -4,1.55E -4,6.33E -5,2.13E -5,5.15E -6,6.22E -7,
X7.18E -9, .00E  0,3.88E  1,1.68E  1,7.63E  0,4.26E  0,3.39E  0,
X6.55E -1,2.60E -1,1.28E -1,6.92E -2,3.95E -2,2.32E -2,1.38E -2,
X8.25E -3,4.88E -3,2.83E -3,1.59E -3,8.60E -4,4.36E -4,2.03E -4,
X8.31E -5,2.80E -5,6.75E -6,8.15E -7,9.41E -9, .00E  0  /
 DATA (BREMI( 3, 5,I),I=1,25) /
X3.56E -1,1.87E -1,8.90E -2,6.55E -2,5.74E -2,1.58E -2,7.86E -3,
X4.66E -3,3.01E -3,2.03E -3,1.41E -3,9.85E -4,6.91E -4,4.81E -4,
X3.29E -4,2.19E -4,1.40E -4,8.49E -5,4.76E -5,2.38E -5,1.00E -5,
X3.13E -6,5.34E -7,1.17E -8, .00E  0  /
 DATA ((BRME50(I, 5,J),J=1,25),I=1,5) /
X4.27E  0,1.72E  0,8.40E -1,4.69E -1,3.47E -1,6.37E -2,2.45E -2,
X1.18E -2,6.34E -3,3.60E -3,2.11E -3,1.25E -3,7.45E -4,4.39E -4,
X2.53E -4,1.41E -4,7.48E -5,3.72E -5,1.68E -5,6.61E -6,2.11E -6,
X4.74E -7,5.15E -8,5.04E-10, .00E  0,1.28E  1,5.31E  0,2.53E  0,
X1.41E  0,1.08E  0,2.01E -1,7.79E -2,3.78E -2,2.04E -2,1.17E -2,
X6.89E -3,4.13E -3,2.48E -3,1.48E -3,8.63E -4,4.88E -4,2.64E -4,
X1.34E -4,6.21E -5,2.53E -5,8.42E -6,2.00E -6,2.37E -7,2.68E -9,
X .00E  0,2.16E  1,9.12E  0,4.26E  0,2.38E  0,1.86E  0,3.48E -1,
X1.36E -1,6.61E -2,3.58E -2,2.05E -2,1.22E -2,7.32E -3,4.41E -3,
X2.64E -3,1.55E -3,8.81E -4,4.79E -4,2.45E -4,1.14E -4,4.70E -5,
X1.59E -5,3.81E -6,4.59E -7,5.27E -9, .00E  0,3.03E  1,1.30E  1,
X5.96E  0,3.33E  0,2.64E  0,4.96E -1,1.94E -1,9.43E -2,5.11E -2,
X2.93E -2,1.74E -2,1.05E -2,6.33E -3,3.79E -3,2.22E -3,1.27E -3,
X6.91E -4,3.53E -4,1.65E -4,6.81E -5,2.30E -5,5.55E -6,6.69E -7,
X7.69E -9, .00E  0,3.88E  1,1.68E  1,7.63E  0,4.26E  0,3.43E  0,
X6.43E -1,2.51E -1,1.22E -1,6.62E -2,3.80E -2,2.25E -2,1.36E -2,
X8.18E -3,4.90E -3,2.87E -3,1.64E -3,8.92E -4,4.56E -4,2.14E -4,
X8.79E -5,2.97E -5,7.16E -6,8.62E -7,9.90E -9, .00E  0  /
 DATA (BREMI( 3, 6,I),I=1,25) /
X3.56E -1,1.87E -1,8.90E -2,6.55E -2,4.88E -2,1.37E -2,6.92E -3,
X4.18E -3,2.75E -3,1.89E -3,1.34E -3,9.53E -4,6.80E -4,4.80E -4,
X3.33E -4,2.25E -4,1.46E -4,8.91E -5,5.04E -5,2.54E -5,1.08E -5,
X3.41E -6,5.87E -7,1.29E -8, .00E  0  /
 DATA ((BRME50(I, 6,J),J=1,25),I=1,5) /
X4.27E  0,1.72E  0,8.40E -1,4.69E -1,3.70E -1,6.90E -2,2.72E -2,
```

```
X1.35E -2,7.42E -3,4.33E -3,2.61E -3,1.59E -3,9.68E -4,5.82E -4,
X3.42E -4,1.94E -4,1.04E -4,5.23E -5,2.38E -5,9.39E -6,2.98E -6,
X6.59E -7,6.94E -8,6.27E-10, .00E  0,1.28E  1,5.31E  0,2.53E  0,
X1.41E  0,1.11E  0,2.08E -1,8.20E -2,4.06E -2,2.24E -2,1.31E -2,
X7.91E -3,4.84E -3,2.96E -3,1.79E -3,1.06E -3,6.04E -4,3.29E -4,
X1.67E -4,7.73E -5,3.12E -5,1.03E -5,2.38E -6,2.72E -7,2.94E -9,
X .00E  0,2.16E  1,9.12E  0,4.26E  0,2.38E  0,1.88E  0,3.51E -1,
X1.38E -1,6.84E -2,3.77E -2,2.21E -2,1.33E -2,8.16E -3,5.00E -3,
X3.03E -3,1.79E -3,1.03E -3,5.61E -4,2.86E -4,1.33E -4,5.43E -5,
X1.80E -5,4.25E -6,4.97E -7,5.52E -9, .00E  0,3.03E  1,1.30E  1,
X5.96E  0,3.33E  0,2.62E  0,4.89E -1,1.92E -1,9.51E -2,5.24E -2,
X3.06E -2,1.85E -2,1.13E -2,6.92E -3,4.19E -3,2.48E -3,1.42E -3,
X7.76E -4,3.97E -4,1.85E -4,7.55E -5,2.51E -5,5.95E -6,6.99E -7,
X7.79E -9, .00E  0,3.88E  1,1.68E  1,7.63E  0,4.26E  0,3.36E  0,
X6.24E -1,2.45E -1,1.21E -1,6.65E -2,3.88E -2,2.34E -2,1.43E -2,
X8.72E -3,5.27E -3,3.12E -3,1.78E -3,9.74E -4,4.97E -4,2.32E -4,
X9.44E -5,3.15E -5,7.45E -6,8.75E -7,9.74E -9, .00E  0  /
 DATA (BREMI( 4, 1,I),I=1,25) /
X3.46E -1,1.79E -1,8.65E -2,6.49E -2,5.43E -2,1.37E -2,6.25E -3,
X3.36E -3,1.95E -3,1.17E -3,7.22E -4,4.46E -4,2.75E -4,1.67E -4,
X1.00E -4,5.81E -5,3.24E -5,1.71E -5,8.35E -6,3.65E -6,1.34E -6,
X3.69E -7,5.53E -8,1.07E -9, .00E  0  /
 DATA ((BRME70(I, 1,J),J=1,25),I=1,5) /
X4.12E  0,1.66E  0,8.08E -1,4.51E -1,3.11E -1,6.26E -2,2.57E -2,
X1.29E -2,7.11E -3,4.11E -3,2.43E -3,1.45E -3,8.63E -4,5.07E -4,
X2.91E -4,1.62E -4,8.61E -5,4.29E -5,1.96E -5,7.85E -6,2.59E -6,
X6.10E -7,7.21E -8,8.18E-10, .00E  0,1.24E  1,5.11E  0,2.43E  0,
X1.36E  0,1.01E  0,2.11E -1,8.97E -2,4.65E -2,2.64E -2,1.57E -2,
X9.52E -3,5.82E -3,3.54E -3,2.13E -3,1.25E -3,7.10E -4,3.85E -4,
X1.96E -4,9.11E -5,3.73E -5,1.25E -5,3.01E -6,3.61E -7,4.14E -9,
X .00E  0,2.09E  1,8.78E  0,4.11E  0,2.29E  0,1.79E  0,3.75E -1,
X1.60E -1,8.30E -2,4.72E -2,2.81E -2,1.71E -2,1.05E -2,6.43E -3,
X3.87E -3,2.28E -3,1.30E -3,7.07E -4,3.61E -4,1.68E -4,6.91E -5,
X2.33E -5,5.60E -6,6.73E -7,7.74E -9, .00E  0,2.92E  1,1.25E  1,
X5.75E  0,3.21E  0,2.62E  0,5.47E -1,2.32E -1,1.21E -1,6.87E -2,
X4.09E -2,2.49E -2,1.53E -2,9.35E -3,5.64E -3,3.32E -3,1.89E -3,
X1.03E -3,5.26E -4,2.46E -4,1.01E -4,3.40E -5,8.17E -6,9.84E -7,
X1.13E -8, .00E  0,3.75E  1,1.62E  1,7.36E  0,4.11E  0,3.48E  0,
X7.27E -1,3.08E -1,1.60E -1,9.11E -2,5.43E -2,3.30E -2,2.03E -2,
X1.24E -2,7.46E -3,4.40E -3,2.51E -3,1.36E -3,6.96E -4,3.25E -4,
X1.33E -4,4.49E -5,1.08E -5,1.30E -6,1.50E -8, .00E  0  /
 DATA (BREMI( 4, 2,I),I=1,25) /
X3.46E -1,1.79E -1,8.65E -2,6.49E -2,5.54E -2,1.42E -2,6.52E -3,
X3.55E -3,2.09E -3,1.28E -3,8.05E -4,5.09E -4,3.22E -4,2.02E -4,
X1.25E -4,7.49E -5,4.34E -5,2.39E -5,1.22E -5,5.60E -6,2.17E -6,
X6.28E -7,9.95E -8,2.03E -9, .00E  0  /
 DATA ((BRME70(I, 2,J),J=1,25),I=1,5) /
X4.12E  0,1.66E  0,8.08E -1,4.51E -1,3.01E -1,5.90E -2,2.36E -2,
X1.17E -2,6.31E -3,3.59E -3,2.09E -3,1.23E -3,7.21E -4,4.18E -4,
```

```
     X2.37E -4,1.30E -4,6.81E -5,3.35E -5,1.51E -5,5.95E -6,1.93E -6,
     X4.47E -7,5.19E -8,5.79E-10, .00E  0,1.24E  1,5.11E  0,2.43E  0,
     X1.36E  0,9.79E -1,2.01E -1,8.37E -2,4.27E -2,2.38E -2,1.39E -2,
     X8.33E -3,5.03E -3,3.02E -3,1.79E -3,1.04E -3,5.85E -4,3.14E -4,
     X1.58E -4,7.29E -5,2.96E -5,9.85E -6,2.35E -6,2.80E -7,3.19E -9,
     X .00E  0,2.09E  1,8.78E  0,4.11E  0,2.29E  0,1.73E  0,3.57E -1,
     X1.50E -1,7.68E -2,4.32E -2,2.54E -2,1.53E -2,9.28E -3,5.61E -3,
     X3.35E -3,1.95E -3,1.10E -3,5.94E -4,3.01E -4,1.39E -4,5.67E -5,
     X1.90E -5,4.53E -6,5.42E -7,6.19E -9, .00E  0,2.92E  1,1.25E  1,
     X5.75E  0,3.21E  0,2.51E  0,5.18E -1,2.17E -1,1.12E -1,6.28E -2,
     X3.70E -2,2.23E -2,1.35E -2,8.20E -3,4.90E -3,2.86E -3,1.62E -3,
     X8.73E -4,4.42E -4,2.05E -4,8.35E -5,2.79E -5,6.68E -6,7.99E -7,
     X9.14E -9, .00E  0,3.75E  1,1.62E  1,7.36E  0,4.11E  0,3.33E  0,
     X6.86E -1,2.88E -1,1.48E -1,8.31E -2,4.90E -2,2.95E -2,1.79E -2,
     X1.08E -2,6.48E -3,3.78E -3,2.14E -3,1.15E -3,5.84E -4,2.71E -4,
     X1.10E -4,3.69E -5,8.83E -6,1.06E -6,1.21E -8, .00E  0  /
      DATA (BREMI( 4, 3,I),I=1,25) /
     X3.46E -1,1.79E -1,8.65E -2,6.49E -2,5.76E -2,1.51E -2,7.10E -3,
     X3.98E -3,2.42E -3,1.54E -3,1.00E -3,6.61E -4,4.37E -4,2.87E -4,
     X1.86E -4,1.17E -4,7.13E -5,4.12E -5,2.21E -5,1.06E -5,4.31E -6,
     X1.30E -6,2.16E -7,4.57E -9, .00E  0  /
      DATA ((BRME70(I, 3,J),J=1,25),I=1,5) /
     X4.12E  0,1.66E  0,8.08E -1,4.51E -1,3.01E -1,5.66E -2,2.20E -2,
     X1.06E -2,5.61E -3,3.13E -3,1.79E -3,1.04E -3,6.00E -4,3.43E -4,
     X1.92E -4,1.04E -4,5.39E -5,2.62E -5,1.16E -5,4.52E -6,1.44E -6,
     X3.27E -7,3.69E -8,3.97E-10, .00E  0,1.24E  1,5.11E  0,2.43E  0,
     X1.36E  0,9.71E -1,1.91E -1,7.67E -2,3.78E -2,2.05E -2,1.17E -2,
     X6.84E -3,4.04E -3,2.39E -3,1.39E -3,7.98E -4,4.43E -4,2.35E -4,
     X1.17E -4,5.36E -5,2.16E -5,7.16E -6,1.70E -6,2.02E -7,2.31E -9,
     X .00E  0,2.09E  1,8.78E  0,4.11E  0,2.29E  0,1.71E  0,3.39E -1,
     X1.38E -1,6.87E -2,3.76E -2,2.16E -2,1.27E -2,7.57E -3,4.50E -3,
     X2.65E -3,1.52E -3,8.51E -4,4.55E -4,2.28E -4,1.05E -4,4.25E -5,
     X1.42E -5,3.38E -6,4.03E -7,4.61E -9, .00E  0,2.92E  1,1.25E  1,
     X5.75E  0,3.21E  0,2.47E  0,4.91E -1,2.00E -1,1.00E -1,5.49E -2,
     X3.16E -2,1.87E -2,1.11E -2,6.63E -3,3.91E -3,2.25E -3,1.26E -3,
     X6.74E -4,3.39E -4,1.56E -4,6.33E -5,2.11E -5,5.03E -6,6.01E -7,
     X6.87E -9, .00E  0,3.75E  1,1.62E  1,7.36E  0,4.11E  0,3.25E  0,
     X6.48E -1,2.64E -1,1.32E -1,7.24E -2,4.17E -2,2.46E -2,1.47E -2,
     X8.75E -3,5.16E -3,2.98E -3,1.66E -3,8.90E -4,4.48E -4,2.06E -4,
     X8.36E -5,2.79E -5,6.65E -6,7.94E -7,9.07E -9, .00E  0  /
      DATA (BREMI( 4, 4,I),I=1,25) /
     X3.46E -1,1.79E -1,8.65E -2,6.49E -2,5.84E -2,1.56E -2,7.55E -3,
     X4.35E -3,2.72E -3,1.78E -3,1.20E -3,8.15E -4,5.56E -4,3.77E -4,
     X2.51E -4,1.63E -4,1.02E -4,6.05E -5,3.32E -5,1.63E -5,6.76E -6,
     X2.08E -6,3.50E -7,7.55E -9, .00E  0  /
      DATA ((BRME70(I, 4,J),J=1,25),I=1,5) /
     X4.12E  0,1.66E  0,8.08E -1,4.51E -1,3.12E -1,5.74E -2,2.20E -2,
     X1.04E -2,5.50E -3,3.06E -3,1.75E -3,1.02E -3,5.90E -4,3.39E -4,
     X1.91E -4,1.04E -4,5.42E -5,2.65E -5,1.18E -5,4.61E -6,1.47E -6,
```

```
     X3.31E -7,3.67E -8,3.79E-10, .00E  0,1.24E  1,5.11E  0,2.43E  0,
     X1.36E  0,9.95E -1,1.88E -1,7.36E -2,3.56E -2,1.90E -2,1.07E -2,
     X6.22E -3,3.66E -3,2.16E -3,1.26E -3,7.24E -4,4.03E -4,2.15E -4,
     X1.08E -4,4.94E -5,2.00E -5,6.66E -6,1.59E -6,1.89E -7,2.17E -9,
     X .00E  0,2.09E  1,8.78E  0,4.11E  0,2.29E  0,1.74E  0,3.33E -1,
     X1.31E -1,6.39E -2,3.44E -2,1.95E -2,1.14E -2,6.74E -3,4.00E -3,
     X2.35E -3,1.36E -3,7.60E -4,4.08E -4,2.06E -4,9.53E -5,3.89E -5,
     X1.31E -5,3.13E -6,3.77E -7,4.34E -9, .00E  0,2.92E  1,1.25E  1,
     X5.75E  0,3.21E  0,2.50E  0,4.80E -1,1.90E -1,9.26E -2,4.99E -2,
     X2.84E -2,1.66E -2,9.85E -3,5.86E -3,3.45E -3,1.99E -3,1.12E -3,
     X6.01E -4,3.04E -4,1.41E -4,5.76E -5,1.94E -5,4.65E -6,5.60E -7,
     X6.45E -9, .00E  0,3.75E  1,1.62E  1,7.36E  0,4.11E  0,3.27E  0,
     X6.29E -1,2.49E -1,1.21E -1,6.55E -2,3.73E -2,2.18E -2,1.29E -2,
     X7.69E -3,4.53E -3,2.62E -3,1.47E -3,7.90E -4,3.99E -4,1.85E -4,
     X7.56E -5,2.54E -5,6.10E -6,7.34E -7,8.45E -9, .00E  0  /
      DATA (BREMI( 4, 5,I),I=1,25) /
     X3.46E -1,1.79E -1,8.65E -2,6.49E -2,5.56E -2,1.52E -2,7.53E -3,
     X4.44E -3,2.85E -3,1.92E -3,1.32E -3,9.24E -4,6.45E -4,4.47E -4,
     X3.05E -4,2.02E -4,1.29E -4,7.75E -5,4.32E -5,2.15E -5,9.02E -6,
     X2.81E -6,4.78E -7,1.04E -8, .00E  0  /
      DATA ((BRME70(I, 5,J),J=1,25),I=1,5) /
     X4.12E  0,1.66E  0,8.08E -1,4.51E -1,3.33E -1,6.07E -2,2.33E -2,
     X1.12E -2,5.95E -3,3.37E -3,1.96E -3,1.16E -3,6.89E -4,4.04E -4,
     X2.32E -4,1.29E -4,6.82E -5,3.38E -5,1.52E -5,5.97E -6,1.90E -6,
     X4.25E -7,4.61E -8,4.49E-10, .00E  0,1.24E  1,5.11E  0,2.43E  0,
     X1.36E  0,1.04E  0,1.91E -1,7.40E -2,3.57E -2,1.92E -2,1.09E -2,
     X6.43E -3,3.84E -3,2.30E -3,1.36E -3,7.93E -4,4.47E -4,2.41E -4,
     X1.22E -4,5.62E -5,2.28E -5,7.58E -6,1.79E -6,2.12E -7,2.39E -9,
     X .00E  0,2.09E  1,8.78E  0,4.11E  0,2.29E  0,1.78E  0,3.32E -1,
     X1.29E -1,6.25E -2,3.37E -2,1.92E -2,1.14E -2,6.81E -3,4.09E -3,
     X2.44E -3,1.42E -3,8.07E -4,4.38E -4,2.23E -4,1.04E -4,4.25E -5,
     X1.43E -5,3.42E -6,4.10E -7,4.70E -9, .00E  0,2.92E  1,1.25E  1,
     X5.75E  0,3.21E  0,2.54E  0,4.74E -1,1.84E -1,8.92E -2,4.81E -2,
     X2.75E -2,1.62E -2,9.75E -3,5.86E -3,3.50E -3,2.05E -3,1.16E -3,
     X6.30E -4,3.21E -4,1.50E -4,6.16E -5,2.07E -5,4.98E -6,5.98E -7,
     X6.85E -9, .00E  0,3.75E  1,1.62E  1,7.36E  0,4.11E  0,3.30E  0,
     X6.15E -1,2.39E -1,1.16E -1,6.24E -2,3.56E -2,2.10E -2,1.26E -2,
     X7.58E -3,4.52E -3,2.64E -3,1.50E -3,8.14E -4,4.15E -4,1.94E -4,
     X7.94E -5,2.67E -5,6.42E -6,7.71E -7,8.82E -9, .00E  0  /
      DATA (BREMI( 4, 6,I),I=1,25) /
     X3.46E -1,1.79E -1,8.65E -2,6.49E -2,4.75E -2,1.32E -2,6.67E -3,
     X4.01E -3,2.63E -3,1.80E -3,1.26E -3,8.98E -4,6.37E -4,4.48E -4,
     X3.09E -4,2.07E -4,1.34E -4,8.14E -5,4.58E -5,2.30E -5,9.73E -6,
     X3.06E -6,5.23E -7,1.15E -8, .00E  0  /
      DATA ((BRME70(I, 6,J),J=1,25),I=1,5) /
     X4.12E  0,1.66E  0,8.08E -1,4.51E -1,3.55E -1,6.58E -2,2.58E -2,
     X1.27E -2,6.98E -3,4.06E -3,2.43E -3,1.48E -3,8.96E -4,5.37E -4,
     X3.14E -4,1.77E -4,9.51E -5,4.75E -5,2.15E -5,8.46E -6,2.68E -6,
     X5.89E -7,6.18E -8,5.57E-10, .00E  0,1.24E  1,5.11E  0,2.43E  0,
```

```
X1.36E  0,1.07E  0,1.99E -1,7.79E -2,3.84E -2,2.11E -2,1.23E -2,
X7.40E -3,4.51E -3,2.74E -3,1.65E -3,9.73E -4,5.54E -4,3.00E -4,
X1.52E -4,6.99E -5,2.81E -5,9.21E -6,2.13E -6,2.43E -7,2.61E -9,
X .00E  0,2.09E  1,8.78E  0,4.11E  0,2.29E  0,1.80E  0,3.35E -1,
X1.31E -1,6.48E -2,3.56E -2,2.07E -2,1.25E -2,7.60E -3,4.64E -3,
X2.80E -3,1.65E -3,9.41E -4,5.12E -4,2.60E -4,1.21E -4,4.89E -5,
X1.62E -5,3.80E -6,4.43E -7,4.90E -9, .00E  0,2.92E  1,1.25E  1,
X5.75E  0,3.21E  0,2.52E  0,4.68E -1,1.83E -1,9.01E -2,4.95E -2,
X2.88E -2,1.73E -2,1.05E -2,6.42E -3,3.87E -3,2.28E -3,1.30E -3,
X7.09E -4,3.61E -4,1.67E -4,6.81E -5,2.26E -5,5.32E -6,6.23E -7,
X6.92E -9, .00E  0,3.75E  1,1.62E  1,7.36E  0,4.11E  0,3.23E  0,
X5.97E -1,2.33E -1,1.14E -1,6.27E -2,3.64E -2,2.19E -2,1.33E -2,
X8.09E -3,4.87E -3,2.87E -3,1.64E -3,8.89E -4,4.52E -4,2.10E -4,
X8.52E -5,2.83E -5,6.66E -6,7.80E -7,8.65E -9, .00E  0 /
 DATA (BREMI( 5, 1,I),I=1,25) /
X3.33E -1,1.71E -1,9.60E -2,6.02E -2,5.42E -2,1.37E -2,6.23E -3,
X3.35E -3,1.94E -3,1.17E -3,7.17E -4,4.43E -4,2.73E -4,1.66E -4,
X9.91E -5,5.75E -5,3.20E -5,1.69E -5,8.25E -6,3.60E -6,1.32E -6,
X3.64E -7,5.45E -8,1.05E -9, .00E  0  /
 DATA ((BRME90(I, 1,J),J=1,25),I=1,5) /
X3.91E  0,1.58E  0,7.64E -1,4.25E -1,3.10E -1,6.25E -2,2.56E -2,
X1.29E -2,7.08E -3,4.09E -3,2.42E -3,1.44E -3,8.57E -4,5.03E -4,
X2.89E -4,1.61E -4,8.52E -5,4.24E -5,1.93E -5,7.76E -6,2.55E -6,
X6.02E -7,7.10E -8,8.05E-10, .00E  0,1.18E  1,4.87E  0,2.30E  0,
X1.28E  0,1.01E  0,2.11E -1,8.94E -2,4.64E -2,2.63E -2,1.56E -2,
X9.46E -3,5.78E -3,3.52E -3,2.11E -3,1.24E -3,7.03E -4,3.81E -4,
X1.94E -4,9.00E -5,3.68E -5,1.24E -5,2.96E -6,3.55E -7,4.07E -9,
X .00E  0,1.98E  1,8.36E  0,3.89E  0,2.17E  0,1.79E  0,3.74E -1,
X1.59E -1,8.27E -2,4.70E -2,2.80E -2,1.70E -2,1.04E -2,6.38E -3,
X3.84E -3,2.26E -3,1.29E -3,7.00E -4,3.57E -4,1.66E -4,6.82E -5,
X2.30E -5,5.52E -6,6.63E -7,7.62E -9, .00E  0,2.78E  1,1.19E  1,
X5.45E  0,3.03E  0,2.61E  0,5.45E -1,2.31E -1,1.20E -1,6.84E -2,
X4.07E -2,2.48E -2,1.52E -2,9.28E -3,5.59E -3,3.30E -3,1.88E -3,
X1.02E -3,5.20E -4,2.43E -4,9.96E -5,3.35E -5,8.06E -6,9.69E -7,
X1.11E -8, .00E  0,3.57E  1,1.55E  1,6.98E  0,3.89E  0,3.48E  0,
X7.25E -1,3.07E -1,1.60E -1,9.08E -2,5.40E -2,3.29E -2,2.01E -2,
X1.23E -2,7.41E -3,4.36E -3,2.48E -3,1.35E -3,6.88E -4,3.21E -4,
X1.32E -4,4.43E -5,1.07E -5,1.28E -6,1.47E -8, .00E  0 /
 DATA (BREMI( 5, 2,I),I=1,25) /
X3.33E -1,1.71E -1,9.60E -2,6.02E -2,5.50E -2,1.40E -2,6.45E -3,
X3.51E -3,2.06E -3,1.26E -3,7.91E -4,5.00E -4,3.16E -4,1.98E -4,
X1.22E -4,7.31E -5,4.23E -5,2.32E -5,1.19E -5,5.42E -6,2.10E -6,
X6.06E -7,9.59E -8,1.95E -9, .00E  0  /
 DATA ((BRME90(I, 2,J),J=1,25),I=1,5) /
X3.91E  0,1.58E  0,7.64E -1,4.25E -1,2.99E -1,5.84E -2,2.34E -2,
X1.15E -2,6.22E -3,3.53E -3,2.06E -3,1.21E -3,7.07E -4,4.09E -4,
X2.32E -4,1.27E -4,6.63E -5,3.26E -5,1.46E -5,5.76E -6,1.87E -6,
X4.32E -7,5.00E -8,5.57E-10, .00E  0,1.18E  1,4.87E  0,2.30E  0,
X1.28E  0,9.71E -1,1.99E -1,8.28E -2,4.22E -2,2.35E -2,1.37E -2,
```


9 1 0 4 8 1 4 1 3

```
X8.20E -3,4.94E -3,2.96E -3,1.75E -3,1.02E -3,5.70E -4,3.06E -4,
X1.54E -4,7.07E -5,2.86E -5,9.53E -6,2.27E -6,2.70E -7,3.07E -9,
X .00E  0,1.98E  1,8.36E  0,3.89E  0,2.17E  0,1.72E  0,3.53E -1,
X1.48E -1,7.59E -2,4.26E -2,2.50E -2,1.50E -2,9.11E -3,5.50E -3,
X3.28E -3,1.91E -3,1.08E -3,5.79E -4,2.92E -4,1.35E -4,5.49E -5,
X1.83E -5,4.37E -6,5.22E -7,5.96E -9, .00E  0,2.78E  1,1.19E  1,
X5.45E  0,3.03E  0,2.49E  0,5.13E -1,2.15E -1,1.10E -1,6.20E -2,
X3.65E -2,2.19E -2,1.33E -2,8.04E -3,4.80E -3,2.80E -3,1.58E -3,
X8.50E -4,4.30E -4,1.99E -4,8.09E -5,2.70E -5,6.45E -6,7.70E -7,
X8.79E -9, .00E  0,3.57E  1,1.55E  1,6.98E  0,3.89E  0,3.31E  0,
X6.80E -1,2.85E -1,1.46E -1,8.20E -2,4.82E -2,2.90E -2,1.76E -2,
X1.06E -2,6.34E -3,3.70E -3,2.09E -3,1.12E -3,5.68E -4,2.63E -4,
X1.07E -4,3.57E -5,8.53E -6,1.02E -6,1.16E -8, .00E  0  /
 DATA (BREMI( 5, 3,I),I=1,25) /
X3.33E -1,1.71E -1,9.60E -2,6.02E -2,5.64E -2,1.47E -2,6.90E -3,
X3.85E -3,2.33E -3,1.48E -3,9.60E -4,6.31E -4,4.15E -4,2.72E -4,
X1.75E -4,1.10E -4,6.69E -5,3.85E -5,2.06E -5,9.86E -6,3.98E -6,
X1.20E -6,1.98E -7,4.18E -9, .00E  0  /
 DATA ((BRME90(I, 3,J),J=1,25),I=1,5) /
X3.91E  0,1.58E  0,7.64E -1,4.25E -1,2.93E -1,5.50E -2,2.13E -2,
X1.02E -2,5.39E -3,3.00E -3,1.71E -3,9.87E -4,5.69E -4,3.24E -4,
X1.81E -4,9.77E -5,5.04E -5,2.44E -5,1.08E -5,4.19E -6,1.33E -6,
X3.01E -7,3.38E -8,3.63E-10, .00E  0,1.18E  1,4.87E  0,2.30E  0,
X1.28E  0,9.48E -1,1.86E -1,7.43E -2,3.66E -2,1.98E -2,1.12E -2,
X6.54E -3,3.85E -3,2.27E -3,1.32E -3,7.53E -4,4.16E -4,2.20E -4,
X1.09E -4,4.99E -5,2.00E -5,6.62E -6,1.57E -6,1.86E -7,2.11E -9,
X .00E  0,1.98E  1,8.36E  0,3.89E  0,2.17E  0,1.67E  0,3.30E -1,
X1.34E -1,6.64E -2,3.62E -2,2.07E -2,1.22E -2,7.22E -3,4.27E -3,
X2.50E -3,1.44E -3,8.00E -4,4.26E -4,2.13E -4,9.76E -5,3.94E -5,
X1.31E -5,3.11E -6,3.70E -7,4.22E -9, .00E  0,2.78E  1,1.19E  1,
X5.45E  0,3.03E  0,2.41E  0,4.78E -1,1.94E -1,9.66E -2,5.28E -2,
X3.03E -2,1.78E -2,1.06E -2,6.29E -3,3.70E -3,2.12E -3,1.18E -3,
X6.31E -4,3.16E -4,1.45E -4,5.86E -5,1.95E -5,4.63E -6,5.52E -7,
X6.29E -9, .00E  0,3.57E  1,1.55E  1,6.98E  0,3.89E  0,3.18E  0,
X6.31E -1,2.56E -1,1.27E -1,6.97E -2,4.00E -2,2.36E -2,1.40E -2,
X8.31E -3,4.88E -3,2.81E -3,1.56E -3,8.34E -4,4.18E -4,1.92E -4,
X7.75E -5,2.57E -5,6.12E -6,7.29E -7,8.30E -9, .00E  0  /
 DATA (BREMI( 5, 4,I),I=1,25) /
X3.33E -1,1.71E -1,9.60E -2,6.02E -2,5.65E -2,1.50E -2,7.21E -3,
X4.13E -3,2.57E -3,1.68E -3,1.12E -3,7.60E -4,5.16E -4,3.48E -4,
X2.31E -4,1.49E -4,9.28E -5,5.48E -5,2.99E -5,1.46E -5,6.02E -6,
X1.85E -6,3.09E -7,6.63E -9, .00E  0  /
 DATA ((BRME90(I, 4,J),J=1,25),I=1,5) /
X3.91E  0,1.58E  0,7.64E -1,4.25E -1,3.00E -1,5.48E -2,2.08E -2,
X9.85E -3,5.16E -3,2.85E -3,1.63E -3,9.39E -4,5.43E -4,3.11E -4,
X1.74E -4,9.46E -5,4.90E -5,2.38E -5,1.06E -5,4.11E -6,1.30E -6,
X2.93E -7,3.23E -8,3.33E-10, .00E  0,1.18E  1,4.87E  0,2.30E  0,
X1.28E  0,9.56E -1,1.80E -1,6.99E -2,3.36E -2,1.79E -2,1.00E -2,
X5.79E -3,3.39E -3,1.99E -3,1.16E -3,6.61E -4,3.66E -4,1.94E -4,
```

```
X9.70E -5,4.44E -5,1.79E -5,5.92E -6,1.40E -6,1.67E -7,1.90E -9,
X .00E  0,1.98E  1,8.36E  0,3.89E  0,2.17E  0,1.67E  0,3.18E -1,
X1.25E -1,6.04E -2,3.23E -2,1.82E -2,1.06E -2,6.25E -3,3.69E -3,
X2.16E -3,1.24E -3,6.92E -4,3.69E -4,1.86E -4,8.56E -5,3.48E -5,
X1.16E -5,2.78E -6,3.32E -7,3.81E -9, .00E  0,2.78E  1,1.19E  1,
X5.45E  0,3.03E  0,2.40E  0,4.59E -1,1.80E -1,8.76E -2,4.70E -2,
X2.66E -2,1.55E -2,9.14E -3,5.40E -3,3.17E -3,1.82E -3,1.02E -3,
X5.45E -4,2.74E -4,1.27E -4,5.15E -5,1.72E -5,4.12E -6,4.94E -7,
X5.66E -9, .00E  0,3.57E  1,1.55E  1,6.98E  0,3.89E  0,3.15E  0,
X6.01E -1,2.36E -1,1.15E -1,6.17E -2,3.49E -2,2.03E -2,1.20E -2,
X7.09E -3,4.16E -3,2.39E -3,1.34E -3,7.15E -4,3.60E -4,1.66E -4,
X6.76E -5,2.26E -5,5.41E -6,6.47E -7,7.42E -9, .00E  0  /
 DATA (BREMI( 5, 5,I),I=1,25) /
X3.33E -1,1.71E -1,9.60E -2,6.02E -2,5.33E -2,1.45E -2,7.12E -3,
X4.18E -3,2.67E -3,1.78E -3,1.22E -3,8.48E -4,5.89E -4,4.06E -4,
X2.74E -4,1.81E -4,1.14E -4,6.85E -5,3.80E -5,1.88E -5,7.83E -6,
X2.43E -6,4.10E -7,8.86E -9, .00E  0  /
 DATA ((BRME90(I, 5,J),J=1,25),I=1,5) /
X3.91E  0,1.58E  0,7.64E -1,4.25E -1,3.15E -1,5.70E -2,2.17E -2,
X1.03E -2,5.48E -3,3.08E -3,1.79E -3,1.05E -3,6.21E -4,3.62E -4,
X2.07E -4,1.14E -4,6.02E -5,2.96E -5,1.33E -5,5.19E -6,1.64E -6,
X3.66E -7,3.94E -8,3.83E-10, .00E  0,1.18E  1,4.87E  0,2.30E  0,
X1.28E  0,9.82E -1,1.80E -1,6.91E -2,3.32E -2,1.77E -2,1.00E -2,
X5.86E -3,3.48E -3,2.07E -3,1.22E -3,7.08E -4,3.97E -4,2.13E -4,
X1.07E -4,4.92E -5,1.98E -5,6.55E -6,1.54E -6,1.81E -7,2.04E -9,
X .00E  0,1.98E  1,8.36E  0,3.89E  0,2.17E  0,1.69E  0,3.13E -1,
X1.21E -1,5.81E -2,3.11E -2,1.77E -2,1.04E -2,6.18E -3,3.69E -3,
X2.19E -3,1.27E -3,7.17E -4,3.87E -4,1.96E -4,9.07E -5,3.69E -5,
X1.23E -5,2.95E -6,3.51E -7,4.00E -9, .00E  0,2.78E  1,1.19E  1,
X5.45E  0,3.03E  0,2.41E  0,4.46E -1,1.72E -1,8.29E -2,4.45E -2,
X2.53E -2,1.48E -2,8.85E -3,5.29E -3,3.14E -3,1.83E -3,1.03E -3,
X5.57E -4,2.82E -4,1.31E -4,5.35E -5,1.79E -5,4.29E -6,5.12E -7,
X5.84E -9, .00E  0,3.57E  1,1.55E  1,6.98E  0,3.89E  0,3.13E  0,
X5.79E -1,2.23E -1,1.08E -1,5.76E -2,3.27E -2,1.92E -2,1.15E -2,
X6.85E -3,4.06E -3,2.36E -3,1.33E -3,7.19E -4,3.65E -4,1.69E -4,
X6.91E -5,2.31E -5,5.53E -6,6.60E -7,7.52E -9, .00E  0  /
 DATA (BREMI( 5, 6,I),I=1,25) /
X3.33E -1,1.71E -1,9.60E -2,6.02E -2,4.56E -2,1.26E -2,6.31E -3,
X3.77E -3,2.45E -3,1.67E -3,1.16E -3,8.21E -4,5.79E -4,4.04E -4,
X2.77E -4,1.84E -4,1.18E -4,7.13E -5,3.98E -5,1.99E -5,8.33E -6,
X2.60E -6,4.42E -7,9.64E -9, .00E  0  /
 DATA ((BRME90(I, 6,J),J=1,25),I=1,5) /
X3.91E  0,1.58E  0,7.64E -1,4.25E -1,3.34E -1,6.14E -2,2.39E -2,
X1.17E -2,6.39E -3,3.69E -3,2.20E -3,1.33E -3,8.01E -4,4.77E -4,
X2.77E -4,1.56E -4,8.30E -5,4.12E -5,1.86E -5,7.26E -6,2.29E -6,
X5.00E -7,5.22E -8,4.67E-10, .00E  0,1.18E  1,4.87E  0,2.30E  0,
X1.28E  0,1.01E  0,1.86E -1,7.23E -2,3.54E -2,1.93E -2,1.12E -2,
X6.69E -3,4.05E -3,2.45E -3,1.47E -3,8.60E -4,4.86E -4,2.62E -4,
X1.32E -4,6.04E -5,2.42E -5,7.86E -6,1.81E -6,2.05E -7,2.19E -9,
```

9 1 0 4 8 1 4 1 5

```
     X .00E  0,1.98E  1,8.36E  0,3.89E  0,2.17E  0,1.70E  0,3.13E -1,
     X1.22E -1,5.97E -2,3.26E -2,1.89E -2,1.13E -2,6.84E -3,4.15E -3,
     X2.49E -3,1.46E -3,8.27E -4,4.47E -4,2.26E -4,1.04E -4,4.20E -5,
     X1.38E -5,3.23E -6,3.74E -7,4.11E -9, .00E  0,2.78E  1,1.19E  1,
     X5.45E  0,3.03E  0,2.39E  0,4.38E -1,1.70E -1,8.32E -2,4.54E -2,
     X2.62E -2,1.57E -2,9.49E -3,5.75E -3,3.45E -3,2.02E -3,1.15E -3,
     X6.19E -4,3.13E -4,1.45E -4,5.85E -5,1.93E -5,4.52E -6,5.26E -7,
     X5.81E -9, .00E  0,3.57E  1,1.55E  1,6.98E  0,3.89E  0,3.06E  0,
     X5.59E -1,2.17E -1,1.06E -1,5.75E -2,3.32E -2,1.98E -2,1.20E -2,
     X7.25E -3,4.34E -3,2.54E -3,1.44E -3,7.77E -4,3.93E -4,1.81E -4,
     X7.32E -5,2.41E -5,5.66E -6,6.58E -7,7.26E -9, .00E  0  /
C
C-----------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------
C
      SUBROUTINE ADJUST (ARG)
C
C     This module adjusts the thickness of last shield or adds
C     a dummy shield so the total shield distance equals the
C     distance to the detector.
C
C     This module was taken from ISOSHLD, see references in the
C     documentation.
C
C     This module is called by the IGEOM Subroutines ( POINT, LINE
C     SPHERE, TCONE, DISC, CYL, ENDCYL, ANCYL, RETL )
C
C     Module of Program EXTDF of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last modification:  17-June-87  RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------------

      INCLUDE 'ISO.CMN'

      TOTT = 0.
      IF(IGEOM.EQ.12)TOTT=T(3)

      DO 10 I=1,NSHLD
      TOTT = TOTT + T(I)
      IF (ARG.LT.TOTT) GO TO 20
   10 CONTINUE

      NSHLDA= NSHLD + 1
      T(NSHLDA) = ARG   - TOTT
      GO TO 30
   20 NSHLDA= I
      T(I) =  T(I) - TOTT + ARG
   30 CONTINUE

      RETURN
C
C-----------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------
C
      SUBROUTINE ANCYL
C
C     This module calculates the gamma attentuation for annular
C     cylindrical source with cylindrical and slab shields using
C     Simpsons rule for integration of point kernel ( specify
C     IGEOM=12).  This module was taken from ISOSHLD, see references
C     in the documentation.
C
C     Module of Program EXTDF of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last modificattion:  17-June-87 RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------
C
C     TSUM1 IS THE RADIAL DISTANCE TO THE OUTER EDGE OF THE SOURCE
C     REGION.
C     TSUM2 IS THE RADIAL DISTANCE TO THE INNER EDGE OF THE SOURCE REGIO
C     TSUM3 IS THE RADIAL DISTANCE TO THE OUTER EDGE OF OUTER SHIELD 3.
C   * SSV2 IS THE ENERGY FLUX PER UNIT VOLUME.
C   * TH1 IS THE ANGLE TO THE OUTER EDGE OF SHIELD REGION 1.
C   * TH2 IS THE ANGLE TO THE OUTER EDGE OF INNER SHIELD REGION 3.
C   * TH3 IS THE ANGLE TO THE OUTER EDGE OF THE SOURCE REGION (SHIELD 2)
C   * CON IS ONE HALF THE LENGTH OF THE CHORD THROUGH SHIELD 1 AT ANGLE
C     THETA
C   * CON1 IS HALF THE LENGTH OF THE CHORD THROUGH SHIELD 2,INNER SHIELD
C     3 AND SHIELD 1 AT ANGLE THETA.
C   * CON2 IS HALF THE LENGTH OF THE CHORD THROUGH SHIELD 1 AND INNER
C     SHIELD 3 AT ANGLE THETA.
C   * CON3 IS HALF THE LENGTH OF THE CHORD THROUGH SHIELD 1,SHIELD 2 AND
C     INNER AND OUTER SHIELD 3 AT ANGLE THETA.
C   * KREG IS A KEYING VARIABLE THAT INDICATES WHICH INTERIOR SHIELD
C     REGIONS RHO PASSES THROUGH.(KREG=1,SHIELDS 1,2,AND INNER 3)
C     (KREG=2,SHIELDS 2,AND INNER 3)(KREG=3,SHIELD 2)
C   * TM1 IS THE DISTANCE FROM THE DOSE POINT TO THE NEAREST EDGE OF
C     SHIELD 2, AT ANGLE THETA
C   * TM3 IS THE DISTANCE FROM THE DOSE POINT TO THE NEAREST EDGE OF
C     OUTER SHIELD 3 AT ANGLE THETA
C   * TM2 IS THE DISTANCE FROM THE DOSE POINT TO THE NEAREST EDGE OF
C     INNER SHIELD 3 AT ANGLE THETA
C   * L3 IS THE DISTANCE FROM  THE DOSE POINT TO THE OPPOSITE INNER EDGE
C     OF SHIELD 2 AT ANGLE THETA.
C   * TM IS THE DISTANCE FROM THE DOSE POINT TO THE NEAREST EDGE OF
C     SHIELD 1 AT ANGLE THETA.
C   * B1MFS IS THE NUMBER OF MEAN FREE PATHS THROUGH SHIELD 1 AND INNER
C     SHIELD 3 AT ANGLE THETA.
```

```
C   * B2MFS IS THE NUMBER OF MEAN FREE PATHS THROUGH INNER SHIELD 3
C     AT ANGLE THETA.
C      SOURCE AND OUTER SHIELD REGIONS
C   * TT IS THE DISTANCE THROUGH OUTER SHIELD 3 AT ANGLE THETA.
C   * PSI2 IS THE MAXIMUM VERTICAL ANGLE FOR INTEGRATION.
C   * RHO IS THE DISTANCE FROM THE DOSE POINT TO   THE NEAREST EDGE OF
C     SHIELD 2 AT ANGLES THETA AND PSI.
C   * RHO2 IS THE DISTANCE FROM THE DOSE POINT TO THE NEAREST EDGE OF
C     INNER SHIELD 3 AT ANGLES THETA AND PSI (RHO2=0 IF THETA IS SUCH
C     THAT THE LINE OF SIGHT TO THE DIFFERENTIAL VOLUME DOES NOT PASS
C     THROUGH THE SHIELD 1 AND INNER SHIELD 3).
C   * RHO3 IS THE DISTANCE FROM THE DOSE POINT TO THE OPPOSITE OUTER
C     EDGE OF INNER SHIELD 3 (RHO3=0 UNDER PREVIOUS CONDITIONS).
C   * RHO4 IS THE DISTANCE FROM THE DOSE POINT TO THE OPPOSITE OUTER
C     EDGE OF SHIELD 2 AT ANGLES THETA AND PSI.
C   * Q1 IS THE NUMBER OF MEAN FREE PATHS THROUGH SHIELD 1 AND INNER
C     SHIELD 3 AT ANGLE THETA.
C   * Q2 IS THE DISTANCE THROUGH SHIELD 1 AND INNER SHIELD 3 AT ANGLES
C     THETA AND PSI.
C   * Q1 IS THE NUMBER OF MEAN FREE PATHS THROUGH SHIELD 3 AT ANGLE THET
C   * Q2 IS THE DISTANCE THROUGH SHIELD 3 AT ANGLES THETA AND PSI.
C
C---------------------------------------------------------------------

      INCLUDE 'ISO.CMN'
      REAL L3,L4
C
      CALL ADJUST (X)
      IF (MOD(NTHETA,2).EQ.0)  NTHETA = NTHETA + 1
      NTHETA = MAX0 (5,NTHETA)
      IF (MOD(NPSI   ,2).EQ.0)NPSI=NPSI+1
      NPSI = MAX0(5,NPSI)
      XS = X*X

      TSUM1=T(1)+T(3)+T(2)
      TSUM2=T(1)+T(3)
      TSUM3=TSUM1+T(3)

      VOLUME=PI*(TSUM1**2-TSUM2**2)*SLTH
      SSV2=SOURCE(1,JPH)*SOURCE(2,JPH)/VOLUME

      TH1=ATAN2(T(1),SQRT(ABS(XS-T(1)**2)))
      TH2=ATAN2(TSUM2,SQRT(ABS(XS-TSUM2**2)))
      TH3=ATAN2(TSUM1,SQRT(ABS(XS-TSUM1**2)))

      DELTH=TH3/FLOAT(NTHETA-1)
      IF(Y.GT.SLTH) Y=0.
      HMAX=AMAX1(Y,SLTH-Y)
      AMID=AMIN1(Y,SLTH-Y)
```

```
      THETA=0.
      SUMI=0.
      FLIPI=2.

C     SUM OVER HORIZONTAL ANGLE THETA.
      DO 400 I=1,NTHETA
      SINT=SIN(THETA)
      COST=COS(THETA)
      XCOS=X*COST
      XSINS=(X*SINT)**2
      B1MFS=0.
      B2MFS=0.
      B3MFS=0.

      CON=SQRT(ABS(T(1)**2-XSINS))
      CON1=SQRT(ABS(TSUM1**2-XSINS))
      CON2=SQRT(ABS(TSUM2**2-XSINS))
      CON3=SQRT(ABS(TSUM3**2-XSINS))
      KREG=3
      TM2=0.
      L3=0.
      TTMFS=0.
      TM1=XCOS-CON1
      TM3=XCOS-CON3
      IF(THETA.LT.TH1) GO TO 70
      IF( THETA.LT.TH2) GO TO 90
      GO TO 120
C      CENTRAL REGION
   70 KREG=1
      TM2=XCOS-CON2
      L3=2.*XCOS-TM2
      TM=XCOS-CON
      B1MFS=2.*( TM-TM2)*MU(3,JPH)+2.*CON*MU(1,JPH)
      GO TO 120
C      SECOND REGION
   90 KREG=2
      TM2=XCOS-CON2
      L3=2.*XCOS-TM2
      B2MFS=2.*CON2*MU(3,JPH)
  120 TT=TM1-TM3
      TTMFS=TT*COST
      B3MFS=TT*MU(3,JPH)
C     B3MFS CONTAINS THE NO. OF MF PATHS IN OUTER SHIELD REGION 3
      IF (COST.EQ.0.) GO TO 144
      IF(NSHLDA.LT.5) GO TO 140
      DO 130 J=5,NSHLDA
      TTMFS=TTMFS+T(J)
  130 B3MFS=B3MFS+MU(J,JPH)*T(J)/COST
```

```
C     B3MFS NOW CONTAINS THE NO. MF PATHS THROUGH ALL SHIELDS EXCEPT
C     SHIELD 4 ALONG RHO
  140 B3MFS=B3MFS-MU(4,JPH)*TTMFS/COST+TM1*(MU(4,JPH)-MU(2,JPH))
C     B3MFS NOW CONTAINS THE TOTAL MF PATHS OUTSIDE THE SOURCE REGION
C   * L4 IS THE DISTANCE FROM THE DOSE POINT TO THE OPPOSITE OUTER EDGE
C     OF SHIELD 2 AT ANGLE THETA.
  144 L4 = 2.*XCOS-TM1
      L4=2.*XCOS-TM1
      PSI2=ATAN2(HMAX,TM1)
      SUMJ=0.
      DELPSI=PSI2/FLOAT(NPSI-1)
      PSI=0.
      FLIPJ=2.

C   * DO LOOP OVER THE VERTICAL ANGLE PSI.
      DO 300 J=1,NPSI
      COSPSI=COS(PSI)
      IF (COSPSI.EQ.0.) GO TO 146
      SECPSI=1./COSPSI
  146 IF (COSPSI.EQ.0.) SECPSI = 1.E20
      SINPSI=SIN(PSI)
      IF (SINPSI.EQ.0.) GO TO 148
      UPLIM=HMAX/SINPSI
  148 IF (SINPSI.EQ.0.) UPLIM = HMAX*1.E20
      RHO=TM1*SECPSI
      IF(PSI.GT.0.) GO TO 150
      RHO2=TM2*SECPSI
      RHO3=L3*SECPSI
      RHO4=L4*SECPSI
      GO TO 160
  150 RHO2=AMIN1(SECPSI*TM2,UPLIM)
      RHO3=AMIN1(L3*SECPSI,UPLIM)
      RHO4=AMIN1(L4*SECPSI,UPLIM)
      IF (DELR.EQ.0.) GO TO 170
  160 NRHO=INT((RHO2-RHO+RHO4-RHO3)/DELR)
  170 IF (DELR.EQ.0.) NRHO = 0
      IF(MOD(NRHO,2).EQ.0) NRHO=NRHO+1
      NRHO=MAX0(NRHO,5)
      DELRHO=(RHO4-RHO3+RHO2-RHO)/FLOAT(NRHO-1)
      FLIPK=2.
      SUMK=0.
      JUMP=0
      Q1=0.
      Q2=0.
      DO 260 K=1,NRHO
      GO TO (210,220,230), KREG
```

```
C        CENTRAL REGION
  210 IF(RHO.LT.RHO2.OR.JUMP.NE.0) GO TO 230
C   * THESE CALCULATIONS ARE MADE ONLY ONCE FOR EACH VALUE OF THETA AND
C     PSI WHEN RHO REACHES THE NEAREST EDGE OF INNER SHIELD 3.
C   * RHO IS INCREASED BY THE DISTANCE ACROSS INNER SHIELD 3 AND
C     SHIELD 1.
      RHO=RHO+2.*CON2*SECPSI
      JUMP=1
      Q1=B1MFS
      Q2=2.*CON2*SECPSI
      GO TO 230

C        SECOND REGION
  220 IF(RHO.LT.RHO2.OR.JUMP.NE.0) GO TO 230
      JUMP=1
C   * RHO IS INCREASED BY THE DISTANCE ACROSS INNER SHIELD 3.
      RHO=RHO+2.*CON2*SECPSI
      Q1=B2MFS
      Q2=2.*CON2*SECPSI

C        TOTAL MEAN FREE PATHS
  230 B1=(B3MFS+Q1)*SECPSI+(RHO-Q2)*MU(2,JPH)
      FACT=1.
      B=BFUNC(BUIF,B1)
      IF (K.EQ.1.OR.K.EQ.NRHO) GO TO 240
      FLIPK=6.-FLIPK
      FACT=FLIPK
  240 IF (SINPSI.NE.0.) GO TO 250
      IF (RHO.LT.DELRHO/2.) FACT = FACT*2.
      GO TO 252
  250 IF(RHO.LT.AMID/SINPSI+DELRHO/2.) FACT=FACT*2.
  252 IF (ABS(B1).LT.200.) GO TO 254
      VAL = 0.
      IF (B1.GT.0.) GO TO 256
      VAL = 100000.
      GO TO 256
  254 VAL = FACT*B*SSV2*XPN(-B1)
  256 SUMK = SUMK + VAL
      IF(K.EQ.1) FRST=VAL
      IF (FRST.EQ.0.) GO TO 260
      IF(ABS(VAL/FRST).LT.1.E-04) GO TO 265
  260 RHO=RHO+DELRHO
  265 SUMK=SUMK*DELRHO*ABS(COSPSI)
      FACT=1.
      IF(J.EQ.1.OR.J.EQ.NPSI) GO TO 270
      FLIPJ=6.-FLIPJ
      FACT=FLIPJ
  270 SUMJ=SUMJ+FACT*SUMK
```

```
  300 PSI=PSI+DELPSI
      SUMJ=SUMJ*DELPSI
      FACT=1.
      IF(I.EQ.1.OR.I.EQ.NTHETA) GO TO 340
      FLIPI=6.-FLIPI
      FACT=FLIPI
  340 SUMI=SUMI+FACT*SUMJ
  400 THETA=THETA+DELTH
      SUMI=SUMI/54./PI*DELTH
      SOURCE(3,JPH)=SUMI
C
C-----------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------
C
      FUNCTION BFUNC
C
C     This module interpolates calculated buildup factors.  This
C     module was taken from ISOSHLD, see references in the
C     documentation.
C
C     Module of Program EXTDF of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last modification:  17-June-87 RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------------

      INCLUDE 'ISO.CMN'

      DIMENSION BMUZ(7),BGE(5),BZABS(7)

      DATA(BMUZ(I),I=1,7)/ 1.,2.,4.,7.,10.,15.,20./
      DATA(BGE(I),I=1,5)/ .01,.02,.05,.1,.2/
      DATA(BZABS(I),I=1,7)/4.,13.,26.,50.,74.,82.,92./

C         BMUZ IS AN ARRAY OF MEAN FREE PATHS FOR BUPLWE.
C         BGE IS THE GAMMA RAY ENERGY GROUPS FOR BUPLWE.
C         BZABS IS THE EFFECTIVE ATOMIC NUMBER FOR DEFINING BUPLWE

      IF(SOURCE(2,JPH)-.1) 9001,50,50
C         TEST THE ENERGY GROUP UNDER CONSIDERATION TO SEE IF IT IS
C         LESS THAN .1 MEV, IF IT IS THEN CALCULATE THE BUILDUP FACTOR
C         FROM THE ARRAY BUPLWE(6,5,7).

 9001 IF(ABAN-BZABS(1)) 9002,9002,9003
 9002 IB1=1
      IB2=1
      GO TO 9008
 9003 IF (ABAN-BZABS(7)) 9005,9004,9004
 9004 IB1=7
      IB2=7
      GO TO 9008
 9005 DO 9007 IB1=2,7
      IF(ABAN-BZABS(IB1)) 9006,9006,9007
 9006 IB2=IB1-1
      GO TO 9008
 9007 CONTINUE

C     THE ABOVE STATEMENTS ARE USED TO BRACKET THE ATOMIC NUMBER.
```

```
 9008 IF(SOURCE(2,JPH)-BGE(1)) 9999,9999,9908
 9999 IBB1=1
      IBB2=1
      GO TO 9013
C
 9908 DO 9012 IBB1=2,5
      IF(SOURCE(2,JPH)-BGE(IBB1))9010,9009,9012
 9009 IBB2=IBB1
      GO TO 9013
 9010 IBB2=IBB1-1
      GO TO 9013
 9012 CONTINUE
      IBB1=6
      IBB2=6

C     THE ABOVE LOOPS LOCATE THE GAMMA RAY INDEX FOR INTERPOLATION.

 9013 IF(D-BMUZ(1)) 9014,9015,9016
 9014 BFUNC=1.
      RETURN

 9015 IBBB1=1
      IBBB2=1
      GO TO 9020
 9016 DO 9019 IBBB1=2,7
      IF(D-BMUZ(IBBB1)) 9018,9017,9019
 9017 IBBB2=IBBB1
      GO TO 9020
 9018 IBBB2=IBBB1-1
      GO TO 9020
 9019 CONTINUE
      IBBB1=7
      IBBB2=7
 9020  CONTINUE
         Y1 = 0
         Y2=0
         Y3 = 0
         Y4 = 0
         Y1A = 0
         Y2A = 0
         BFUNC = 0.
      IF (IBBB1.EQ.IBBB2) GO TO 9021
      Y1 = (BUPLWE(IB1,IBB2,IBBB1)-BUPLWE(IB1,IBB2,IBBB2))/(BMUZ(IBBB1)-
     1  BMUZ(IBBB2))*(D-BMUZ(IBBB2))
 9021 Y1 = Y1 + BUPLWE(IB1,IBB2,IBBB2)
C         Y1 IS THE BFUNC VALUE AT D MFP,LOW ENERGY,AND HIGH Z.
      IF (IBBB1.EQ.IBBB2) GO TO 9022
      Y2 = (BUPLWE(IB1,IBB1,IBBB1)-BUPLWE(IB1,IBB1,IBBB2))/(BMUZ(IBBB1)-
     1  BMUZ(IBBB2))*(D-BMUZ(IBBB2))
```

```
 9022 Y2 = Y2 + BUPLWE(IB1,IBB2,IBBB2)
C        Y2 IS THE BFUNC VALUE AT D MFP,HIGH ENERGY,AND HIGH Z.
      IF (IBBB1.EQ.IBBB2) GO TO 9023
      Y3 = (BUPLWE(IB1,IBB1,IBBB1)-BUPLWE(IB1,IBB1,IBBB2))/(BMUZ(IBBB1)-
     1  BMUZ(IBBB2))*(D-BMUZ(IBBB2))
 9023 Y3 = Y3 + BUPLWE(IB1,IBB2,IBBB2)

C     Y3 IS THE BFUNC VALUE AT D1MFP,LOW ENERGY,LOW Z.
      IF (IBBB1.EQ.IBBB2) GO TO 9024
      Y4 = (BUPLWE(IB1,IBB1,IBBB1)-BUPLWE(IB1,IBB1,IBBB2))/(BMUZ(IBBB1)-
     1  BMUZ(IBBB2))*(D-BMUZ(IBBB2))
 9024 Y4 = Y4 + BUPLWE(IB1,IBB2,IBBB2)

C     Y4 IS THE BFUNC VALUE AT D MFP,HIGH ENERGY, AND LOW Z.
      IF (IBB1.EQ.IBB2) GO TO 9025
      Y2A = (Y2-Y1)*(SOURCE(2,JPH)-BGE(IBB2))/(BGE(IBB1)-BGE(IBB2))
 9025 Y2 = Y2A + Y1
      IF (IBB1.EQ.IBB2) GO TO 9026
      Y1A = (Y4-Y3)*(SOURCE(2,JPH)-BGE(IBB2))/(BGE(IBB1)-BGE(IBB2))
 9026 Y1 = Y1A + Y3

C     Y1 AND Y2 ARE BFUNC VALUES AT D MFP,SOURCE ENERGY,AND HIGH AND
C     LOW ABSORBER Z.
      IF (IB1.EQ.IB2) GO TO 9027
      BFUNC = (Y2-Y1)*(ABAN-BZABS(IB1))/(BZABS(IB1)-BZABS(IB2))
 9027 BFUNC = BFUNC + Y2
      RETURN
   50 CONTINUE
      B = 0.
      B2 = 0.
      DO 400 J=1,2
      IF (C) 100,350,100
  100 ARG = -BUF(J+2,2)* D
      IF (ARG.LT.88.027) GO TO 340
      ARG = 88.027
  340 B2 = B2 + BUF(J,2) * XPN(ARG)
  350 ARG = -BUF(J+2,1) * D
      IF(ARG.LT.88.027) GO TO 400
      ARG = 88.027
  400 B = B + BUF(J,1) * XPN(ARG)
      BFUNC = B + C    * (B2-B)
      RETURN
C----------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------
C
      SUBROUTINE BYIELD (ZSORCE)
C
C     This module calculates the gamma ray yield for BREMSSTRAHLUNG-
C     ISOSHLD groups.  This module was taken from ISOSHLD, see
C     references in the documentation.
C
C     Module of Program EXTDF of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last modification:  25-June-87 RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C     ZSOURCE  - Atomic number, Z, of the source nuclide
C     BETAEP   - Array of the beta end points for ZSOURCE--max 20
C     NBETEP   - The number of values in BETAEP.  NBETEP is the same
C                as JOUNT in subroutine BETA
C     ZABS     - Array of the Z of shield region 1.--max 20
C     NZABS    - The number of values in ZABS
C     YIELD    - Gamma ray yield for BREMSSTRAHLUNG-ISOSHLD groups
C     ZNUM     - Array containing source and absorber definitions.
C     ENDPT    - Array for beta end point definition.
C
C-----------------------------------------------------------------------

      INCLUDE 'ISO.CMN'

      DIMENSION ZNUM(5),ENDPT(6),IPTZ(2,20),GETOBE(25)
      DIMENSION GRANGE(25),A(5,6,25),B(5,6,25),R(25)
      EQUIVALENCE  (KOUNT,NBETEP)

      DATA(ZNUM(I),I=1,5)/ 10.,30.,50.,70.,90./
      DATA (ENDPT(I),I=1,6)/ .1,.2,.5,1.0,2.0,4.0/
      DATA (GETOBE(I),I=1,25)/
     1      .00375,.00750,.01375,.02125,   .0250,.0750,.125,.175,.225,
     1 .275,.325,.375,.425,.475,.525,.575,.625,.675,.725,.775,.825,
     1 .875,.925,.975,1.0 /
      DATA (GRANGE(I),I=1,25)/
     X  .015,.025,.035,.045,.055,.065,.075,.085,.095,.15,
     X  .25,.35,.475,.65,.825,1.0,1.225,1.475,1.70,1.9,2.1,2.3,2.5,
     X   2.7,3.0/
C
      DO 1 I=1,25
    1 YIELD(I)=0
      IF(ZSORCE.GT.10.) GO TO 20
      DO 10 I=1,25
```


9 1 0 4 8   1 4 2 7

```
      DO 10 J=1,6
      DO 10 K=1,5
      A(K,J,I)=BRME10(K,J,I)
   10 B(K,J,I)=BRME10(K,J,I)
      L1=1
      L2=1
      GO TO 100
C           THE SOURCE Z IS LESS THAN OR EQUAL TO 10
   20 IF(ZSORCE-30.)21,30,30
   21 DO 25 I=1,25
      DO 25 J=1,6
      DO 25 K=1,5
      A(K,J,I)=BRME10(K,J,I)
   25 B(K,J,I)=BRME30(K,J,I)
      L1=1
      L2=2
      GO TO 100

C     THE SOURCE Z IS GREATER THAN 10,BUT LESS THAN 30.
   30 IF(ZSORCE.GT.30.) GO TO 40
      DO 35 I=1,25
      DO 35 J=1,6
      DO 35 K=1,5
      A(K,J,I)=BRME30(K,J,I)
   35 B(K,J,I)=BRME30(K,J,I)
      L1=2
      L2=2
      GO TO 100

C     THE SOURCE Z IS EQUAL TO 30
   40 IF(ZSORCE-50.) 41,50,50
   41 DO 45 I=1,25
      DO 45 J=1,6
      DO 45 K=1,5
      A(K,J,I)=BRME30(K,J,I)
   45 B(K,J,I)=BRME50(K,J,I)
      L1=2
      L2=3
      GO TO 100

C     THE SOURCE Z IS GREATER THAN 30, BUT LESS THAN 50.
   50 IF(ZSORCE.GT.50.) GO TO 60
      DO 55 I=1,25
      DO 55 J=1,6
      DO 55 K=1,5
      A(K,J,I)=BRME50(K,J,I)
   55 B(K,J,I)=BRME50(K,J,I)
      L1=3
      L2=3
```

```
      GO TO 100
C     THE SOURCE Z IS EQUAL TO 50
   60 IF(ZSORCE-70.) 61,70,70
   61 DO 65 I=1,25
      DO 65 J=1,6
      DO 65 K=1,5
      A(K,J,I)=BRME50(K,J,I)
   65 B(K,J,I)=BRME70(K,J,I)
      L1=3
      L2=4
      GO TO 100
C     THE SOURCE Z IS GREATER THAN 50, BUT LESS THAN 70.
   70 IF(ZSORCE.GT.70.) GO TO 80
      DO 75 I=1,25
      DO 75 J=1,6
      DO 75 K=1,5
      A(K,J,I)=BRME70(K,J,I)
   75 B(K,J,I)=BRME70(K,J,I)
      L1=4
      L2=4
      GO TO 100
C     THE SOURCE Z IS EQUAL TO 70.
   80 IF(ZSORCE-90.) 81,90,90
   81 DO 85 I=1,25
      DO 85 J=1,6
      DO 85 K=1,5
      A(K,J,I)=BRME70(K,J,I)
   85 B(K,J,I)=BRME90(K,J,I)
      L1=4
      L2=5
      GO TO 100
C     THE SOURCE Z IS GREATER THAN 70, BUT LESS THAN 90.
   90 DO 95 I=1,25
      DO 95 J=1,6
      DO 95 K=1,5
      A(K,J,I)=BRME90(K,J,I)
   95 B(K,J,I)=BRME90(K,J,I)
      L1=5
      L2=5
C     THE SOURCE Z IS GREATER THAN OR EQUAL TO 90. A AND B NOW BRACKET
C     THE SOURCE  Z
  100 DO 110 I=1,NZABS
      IF(ZABS(I)-10.) 101,101,102
  101 IPTZ(1,I)=1
```

```
      IPTZ(2,I)=1
      GO TO 110
  102 IF(ZABS(I)-90.) 104,103,103
  103 IPTZ(1,I)=5
      IPTZ(2,I)=5
      GO TO 110
  104 DO  109 J=2,5

      IF(ZABS(I)-ZNUM(J)) 105,106,109
  105 IPTZ(1,I)=J-1
      IPTZ(2,I)=J
      GO TO 110
  106 IPTZ(1,I)=J
      IPTZ(2,I)=J
      GO TO 110
  109 CONTINUE
  110 CONTINUE

C     IPTZ IS AN ARRAY THAT POINTS TO ARRAYS THAT BRACKET THE
C     Z OF THE ABSORBER.

      DO 500 LBETA=1,NBETEP
      IF(BETAEP(LBETA)-.010)500,9110,9110

C     IF THE BETA END ENERGY IS LESS THAN 5 KEV, THEN NO
C     CONTRIBUTION IS RECORDED.

 9110 IF(BETAEP(LBETA)-.1) 111,111,112
  111 MB1=1
      MB2=1
      GO TO 121
  112 IF(BETAEP(LBETA)-4.) 114,113,113
  113 MB1=6
      MB2=6
      GO TO 121
  114 DO 120 J=2,6
      IF(BETAEP(LBETA)-ENDPT(J)) 115,116,120
  115 MB1=J-1
      MB2=J
      GO TO 121
  116 MB1=J
      MB2=J
      GO TO 121
  120 CONTINUE

C     MB1 AND MB2 ARE THE LOWER AND UPPER ENDPOINT INDEXES.

  121 ME1=MB1
      ME2=MB2
```

```
      IF(ME1-ME2) 123,122,123
  122 XSL1=0
      GO TO 124
  123 XSL1=(BETAEP(LBETA)- ENDPT(ME1))/( ENDPT(ME2)- ENDPT(ME1))
C           XSL1 IS THE SLOPE FOR INTERPOLATING ON BETA END POINT ENERGY.
  124 IF(L1-L2) 126,125,126
  125 XSL2=0
      GO TO 127
  126 XSL2=(ZSORCE-ZNUM(L1))*.05
C           XSL2 IS THE SLOPE FOR INTERPOLATING ON SOURCE Z.
C           L1 IS THE INDEX OF THE LOWER Z NUMBER
  127 DO 128 I=1,24
      Y1=(BREMI(L2,ME1,I)-BREMI(L1,ME1,I))*XSL2+BREMI(L1,ME1,I)
      Y2=(BREMI(L2,ME2,I)-BREMI(L1,ME2,I))*XSL2+BREMI(L1,ME2,I)
  128 R(I)=(Y2-Y1)*XSL1+Y1
      R(25)=0

C     R NOW CONTAINS THE INTERNAL BREMSSTRAHLUNG CONTRIBUTION FOR
C     THE BETA END UNDER CONSIDERATION.

      DO 150 J=1,NZABS
      IF(IPTZ(1,J)-IPTZ(2,J)) 132,131,132
  131 XSL3=0
      N1 = 1
      N2 = 1
      GO TO 133
  132 N1=IPTZ(1,J)
      N2=IPTZ(2,J)
      XSL3=(ZABS(J)-ZNUM(N1))*.05

C     XSL1 IS THE SLOPE FOR INTERPOLATING ON BETA END POINT ENERGY.
C     XSL2 IS THE SLOPE FOR INTERPOLATING ON THE SOURCE Z.
C     XSL3 IS THE SLOPE FOR INTERPOLATING ON THE ABSORBER Z.
C     MB1 AND MB2 ARE INDEXES THE BETA END POINT ENERGY.
C     N1 AND N2 BRACKET THE ABSORBER Z.

  133 DO 135 I=1,24
      Y1B1=(A(N2,MB1,I)-A(N1,MB1,I))*XSL3+A(N1,MB1,I)
      Y1B2=(A(N2,MB2,I)-A(N1,MB2,I))*XSL3+A(N1,MB2,I)
      Y1=(Y1B2-Y1B1)*XSL1+Y1B1
      Y1B1=(B(N2,MB1,I)-B(N1,MB1,I))*XSL3+B(N1,MB1,I)
      Y1B2=(B(N2,MB2,I)-B(N1,MB2,I))*XSL3+B(N1,MB2,I)
      Y2=(Y1B2-Y1B1)*XSL1+Y1B1
      Y1=(Y2-Y1)*XSL2+Y1
  135 R(I)=R(I)+Y1*FRACT(J)
  150 CONTINUE

C     R CONTAINS THE TOTAL BREMSSTRAHLUNG CONTRIBUTION FOR THE
C     PARTICULAR SOURCE Z AND ALL ABSORBER Z, AT ONE BETA END
```

```
C     POINT ENERGY.

      DO 155 I=1,25
      IF(BETAEP(LBETA)-GRANGE(I)) 151,152,155
  151 IFIND=I-1
      GO TO 156
  152 IFIND=I-1
      GO TO 156
  155 CONTINUE
      IFIND=25
  156 DO 200 I=1,IFIND
      RATIO=GRANGE(I)/BETAEP(LBETA)
      IF(RATIO-GETOBE(1)) 160,160,161
  160 IN1=1
      GO TO 170
  161 IF(RATIO-1.) 163,162,162
  162 IN1=25
      GO TO 170
  163 DO 169 J=1,25
      IF(RATIO-GETOBE(J)) 165,164,169
  164 IN1=J
      GO TO 170
  165 IN1=J-1
      IN2=J
      IF(IN2.EQ.25) GO TO 9165
      GO TO 171
 9165 YIELD(I)=YIELD(I)+(RATIO-GETOBE(IN1))*(-R(IN1)/(1.-GETOBE(IN1)))+
     1   R(IN1)
      GO TO 200
  169 CONTINUE
  170 YIELD(I)=YIELD(I)+R(IN1)*BETAPR(LBETA)
      GO TO 200
  171 Q=(R(IN2)-R(IN1))*(RATIO-GETOBE(IN1))/(GETOBE(IN2)-GETOBE(IN1))+
     1  R(IN1)
      YIELD(I)=YIELD(I)+Q*BETAPR(LBETA)
  200 CONTINUE
  500 CONTINUE

      RETURN

C-------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------
C
      SUBROUTINE CYL
C
C     This module calculates gamma attenuation for cylindrical
C     source using Simpsons rule for integration of point kernel.
C     This module was taken from ISOSHLD, see references in the
C     documentation.
C
C     Module of Program EXTDF of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last modification:  17-June-87  RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------------

      INCLUDE 'ISO.CMN'

      DIMENSION  TM(6)
      REAL L2
C
      CALL ADJUST (X)

      IF (SLTH.EQ.0.) GO TO 410
      IF (MOD(NTHETA,2).EQ.0)  NTHETA = NTHETA + 1
      NTHETA = MAX0 (5,NTHETA)
      IF (MOD(NPSI   ,2).EQ.0)NPSI=NPSI+1
      NPSI = MAX0(5,NPSI)
      XS = X*X
      VOLUME = PI*SLTH*T(1)**2
      IF (SSV1) 50,60,50

C     EXPNONENTIAL SOURCE STRENGTH DISTRIBUTION

   50 SSV2 = SOURCE(1,JPH) * SOURCE(2,JPH) * SSV1**2 / 2. / PI /
     1 SLTH / (1.+XPN(SSV1*T(1))*(SSV1*T(1)-1.))
      GO TO 65

C     CONSTANT SOURCE STRENGTH
   60 SSV2 = SOURCE(1,JPH) * SOURCE(2,JPH) / VOLUME
   65 TH2 = ATAN2(T(1),SQRT(ABS(XS-T(1)**2)))
      DELTH = TH2 / FLOAT(NTHETA - 1)
      IF (Y.GT.SLTH) Y=0.
      HMAX = AMAX1(Y,SLTH-Y)
      AMID = AMIN1 ( Y, SLTH-Y)
      THETA = 0.
      SUMI = 0.
      FLIPI = 2.
```

```
      DO 400  I=1,NTHETA
      SINT = SIN(THETA)
      COST = COS(THETA)
      XCOS = X * COST
      XSINS=(X * SINT)**2
      SUM = 0.
      IF(IGEOM-8) 99,120,144

C     CYLINDRICAL SHIELD
   99 DO 100 J=1,NSHLDA
      SUM = SUM + T(J)
  100 TM(J) = XCOS - SQRT(ABS(SUM*SUM - XSINS))
      B1MFS =  TM(1) * MU(1,JPH)
      DO 110  J=2,NSHLDA
  110 B1MFS = B1MFS + (TM(J)-TM(J-1))*MU( J,JPH)
      B1MFS = - B1MFS
      GO TO 150

C     SLAB SHIELDS
  120 TTMFS = 0.
      B1MFS = 0.
      TM(1) = XCOS - SQRT(ABS(T(1)*T(1) - XSINS))
      IF (NSHLDA.LT.3) GO TO 135
      DO 130 J=3,NSHLDA
      TTMFS = TTMFS + T(J)
  130 B1MFS = B1MFS + MU(J,JPH)* T(J)
  135 IF (COST.EQ.0.) GO TO 142
  140 B1MFS = (B1MFS-MU(2,JPH)*TTMFS)  / COST    + TM(1)*(MU(2,JPH) -
     1    MU(1,JPH))
      GO TO 150
  142 B1MFS = TM(1)*(MU(2,JPH)-MU(1,JPH))
      GO TO 150

C     SECOND SHIELD IS CYLINDRICAL, THE THIRD SHIELD SURROUNDS THE FIRST
C     AND SECOND SHIELDS, THE REMAINING SHIELDS ARE SLAB.
C     ( SPECIFY  IGEOM=11 )

  144 TTMFS=0.
      B1MFS=0.
      DO 145 J=1,2
      SUM=SUM+T(J)
  145 TM(J)=XCOS-SQRT(ABS(SUM*SUM-XSINS))
      B1MFS=(TM(1)-TM(2))*MU(2,JPH)
      IF (COST.EQ.0.) GO TO 152
      IF(NSHLDA.LT.4) GO TO 148
      DO 147 J=4,NSHLDA
      TTMFS=TTMFS+T(J)
  147 B1MFS=B1MFS+T(J)*MU(J,JPH)/COST
  148 B1MFS=B1MFS-MU(3,JPH)*TTMFS/COST+TM(1)*(MU(3,JPH)-MU(1,JPH))
```

```
      GO TO 150
  152 IF (NSHLDA.LT.4) GO TO 156
      DO 154 J=4,NSHLDA
  154 TTMFS = TTMFS + T(J)
  156 B1MFS = B1MFS + TM(1)*(MU(3,JPH)-MU(1,JPH))
  150 L2 = 2.*XCOS-TM(1)
      PSI2    = ATAN2(HMAX,TM(1))
      SUMJ    = 0.
      DELPSI  = PSI2   / FLOAT(NPSI - 1)
      PSI = 0.
      FLIPJ = 2.
      DO 300  J=1, NPSI
      COSPSI = COS(PSI)
      IF(COSPSI.EQ.0.) GO TO 157
      SECPSI = 1. / COSPSI
  157 IF (COSPSI.EQ.0.) SECPSI = 1.E20
      SINPSI = SIN(PSI)
      COSPSS = COSPSI * COSPSI
      IF (COSPSI.EQ.0.) GO TO 158
      TANPSI  = SINPSI / COSPSI
  158 IF (COSPSI.EQ.0.) TANPSI = SINPSI*1.E20
      RHO= TM(1) * SECPSI
      IF (PSI.GT.0.) GO TO 160
      RHO2 = SECPSI * L2
      GO TO 165
  160 RHO2 = AMIN1(SECPSI*L2, HMAX/SINPSI/COST)
  165 IF (DELR.EQ.0.) GO TO 175
  170 NRHO =  INT ((RHO2-RHO )/ DELR)
  175 IF (DELR.EQ.0.) NRHO = 0
      IF (MOD (NRHO,2).EQ. 0) NRHO = NRHO+1
      NRHO = MAX0(5,NRHO)
      DELRHO  = (RHO2 - RHO) / FLOAT(NRHO-1)
      FLIPK = 2.
      SUMK = 0.
      DO 260  K=1,NRHO
      IF (SSV1) 190,180,190
  180 SS = SSV2
      GO TO 200
  190 SS = SSV2 * XPN(SQRT(ABS(XS - 2.*RHO*XCOS*COSPSI + RHO*RHO*COSPSS
     1 ))* SSV1)
  200 B1 = RHO * MU(1,JPH) + B1MFS*SECPSI
      FACT = 1.
      B = BFUNC(BUIF,B1)
      IF (K.EQ.1.OR.K.EQ.NRHO) GO TO 240
      IF (K.EQ.1 .OR.K.EQ.NRHO)  GO TO 250
      FLIPK = 6.-FLIPK
      FACT = FLIPK
  240 IF (SINPSI.NE.0.) GO TO 250
      IF (RHO.LT.DELRHO/2.) FACT = FACT*2.
```


9 1 0 4 8 1 4 3 5

```
      GO TO 252
  250 IF(RHO.LT.AMID/SINPSI+DELRHO/2.) FACT = FACT*2.
  252 IF (ABS(B1).LT.200.) GO TO 254
      VAL = 0.
      IF (B1.GT.0.) GO TO 256
      VAL = 100000.
      GO TO 256
  254 VAL = FACT * B * SS * XPN(-B1)
  256 SUMK = SUMK + VAL
      IF (K.EQ.1) FRST = VAL
      IF (FRST.EQ.0.) GO TO 260
      IF (ABS(VAL/FRST).LT.1.E-4) GO TO 265
  260 RHO = RHO + DELRHO
  265 SUMK = SUMK * DELRHO * ABS(COSPSI)
      FACT = 1.
      IF (J.EQ.1.OR. J.EQ. NPSI) GO TO 270
      FLIPJ = 6.-FLIPJ
      FACT = FLIPJ
  270 SUMJ =  SUMJ + FACT * SUMK
  300 PSI = PSI + DELPSI
      SUMJ = SUMJ * DELPSI
      FACT = 1.
      IF (I.EQ.1.OR. I.EQ.NTHETA) GO TO 340
      FLIPI=6.-FLIPI
      FACT = FLIPI
  340 SUMI = SUMI + FACT * SUMJ
  400 THETA = THETA + DELTH
      SUMI = SUMI/ 54./ PI * DELTH
      SOURCE (3,JPH) = SUMI
      RETURN

  410 WRITE (*,*) 'SLTH = 0.  EXECUTION TERMINATED IN SUBROUTINE CYL'
      STOP

C-----------------------------------------------------------------------
      END
```

```
C----------------------------------------------------------------------
C
      SUBROUTINE DISC
C
C     This module calculates attentuation for disc source using
C     SIMPS integration function and DSCSRC is the function which
C     is integrated over the source.  This module was taken from
C     ISOSHLD, see references in the documentation.
C
C     Module of Program EXTDF of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last modification:  17-June-87 RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C----------------------------------------------------------------------

      INCLUDE 'ISO.CMN'

      EXTERNAL DSCSRC
C
      CALL ADJUST(X)
      IF (SLTH.EQ.0.) GO TO 40
      B1 = 0.
      DO 10 J=1,NSHLDA
   10 B1 = B1 + T(J)*MU(J,JPH)
      IF (SSV1)  25,20,25

C     CONSTANT SOURCE DIST.
   20 SSV2 = SOURCE(1,JPH)* SOURCE(2,JPH)/PI/SLTH**2
      GO TO 30

C     EXPNONENTIAL SOURCE DIST.
   25 SSV2 = SOURCE(1,JPH) * SSV1**2 / 2. / PI / (1.+(SSV1*SLTH-1.) *
     1     XPN(SSV1*SLTH)) * SOURCE(2,JPH)
   30 SOURCE (3,JPH) = .5 * SIMPS(0,SLTH,.001,DSCSRC)
      RETURN

   40 WRITE (*,*) 'SLTH = 0. EXECUTION TERMINATED IN SUBROUTINE DISC'
      STOP

C----------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------
C
      FUNCTION DSCSRC (ARG)
C
C     This function integrates over the DISC source.  This module was
C     taken from ISOSHLD, see references in the documentation.
C
C     Module of Program EXTDF of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last modification:  17-June-87  RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------------

      INCLUDE 'ISO.CMN'

      IF (X.EQ.0.) GO TO 10
      RHOSQ = X * X + ARG * ARG
      RHO = SQRT (RHOSQ)
      B = BFUNC (BUIF,B1*RHO/X)
      DSCSRC = B * SSV2 * XPN(SSV1*ARG - B1*RHO/X) * ARG / RHOSQ

      RETURN

   10 WRITE (*,*) 'X=0.  EXECUTION TERMINATED IN SUBROUTINE DSCSRC'
C-----------------------------------------------------------------------
      END
```

```
C-------------------------------------------------------------------
C
      FUNCTION E1 (ARG)
C
C     This module is called by the functions E2 or F1 and the TCONE
C     subroutine to approximate the integral of  XPN(-T)/ T  DT for
C     positive arg.  This module was taken from ISOSHLD, see references
C     in the documentation.
C
C     Module of Program EXTDF of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last modification:  17-June-87 RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-------------------------------------------------------------------

      VALUE = 0.
      IF (ARG .GT. 0.0) GO TO 10

    4 WRITE (*,5) ARG
    5 FORMAT (19HO INVALID ARGUMENT ,E10.3,36H FOR FUNCTION E1.  RESULT
     1 SET TO 0.)
      GO TO 100

   10 IF (1.0 .LT. ARG) GO TO 20
      VALUE = -0.57721566 - ALOG(ARG)
      FACT = 1.
      DIV = -1.
      DO 15 I=1,10
      FI = FLOAT(I)
      FACT = FACT * FI
      DIV = -DIV* ARG
   15 VALUE = VALUE + DIV/FI/FACT
      GO TO 100
   20 IF (ARG .GT. 88.)GO TO 100
      VALUE = XPN(-ARG)/ARG* (0.2372905+ ARG*(4.5307924 + ARG*(5.1266902
     1 + ARG))) / (2.476631+ARG*(8.6660126+ARG*(6.1265272+ARG)))
  100 E1 = VALUE

      RETURN

C-------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------
C
      FUNCTION E2 (ARG)
C
C     This module is called by the TCONE subroutine to approximate
C     ARG * INTEGRAL(ARG,INF) OF XPN(-T)/T**2  DT.  This module was
C     taken from ISOSHLD, see references in the documentation.
C
C     Module of Program EXTDF of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last modification:  17-June-87 RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------------

      VALUE = 1.
      IF(ARG.GT.88.) GO TO 9
      IF (ARG ) 5,10,5
    5 VALUE = XPN(-ARG) - ARG* E1(ARG)
      GO TO 10
    9 VALUE=0.
   10 E2 = VALUE
      RETURN
C
C-----------------------------------------------------------------------
      END
```

```
C----------------------------------------------------------------------
C
      SUBROUTINE ENDCYL
C
C     This module calculates the attenuation of CYL source with
C     detector at end using Simpsons rule for integraton of point
C     kernel.  This module was taken from ISOSHLD, see references
C     in the documentation.
C
C     Module of Program EXTDF of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last modification:  17-June-87 RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C----------------------------------------------------------------------

      INCLUDE 'ISO.CMN'

      CALL ADJUST(X)
      FLIPI = 2.
      B1MFS = 0.
      TTMFS = 0.
      DO 5 I=2,NSHLDA
      TTMFS = TTMFS + T(I)
    5 B1MFS = B1MFS + MU(I,JPH) * T(I)
      IF (MOD(NTHETA,2).EQ.0) NTHETA=NTHETA+1
      NTHETA=MAX0(5,NTHETA)
      THETA = 0.
      TH2 = ATAN2(SLTH,X-T(1))
      DELTH=TH2/FLOAT(NTHETA-1)
      VOLUME = PI * SLTH**2 * T(1)
      IF (VOLUME.EQ.0.) GO TO 210
      IF (SSV1)  15 ,10,15
   10 SSV2 = SOURCE(1,JPH)* SOURCE(2,JPH)/ VOLUME
      GO TO 20
   15 SSV2 = SOURCE(1,JPH) * SOURCE(2,JPH) * SSV1**2 / 2. / PI / T(1) /
     1  (1. +  XPN(SSV1*SLTH) * (SSV1* SLTH - 1.))
   20 SUMI = 0.
      DO 200  I=1,NTHETA
      SINT = SIN(THETA)
      IF (COS(THETA).EQ.0.) GO TO 25
      SECANT = 1. / COS(THETA)
   25 IF (COS(THETA).EQ.0.) SECANT = 1.E20
      RHO = (X-T(1)) * SECANT
      IF (SINT.EQ.0.) GO TO 26
      RHO2 = AMIN1 (X * SECANT, SLTH / SINT )
   26 IF (SINT.EQ.0.) RHO2 = X
      IF (DELR.EQ.0.) GO TO 27
```

```
      NRHO = INT ( (RHO2- RHO) / DELR )
   27 IF (DELR.EQ.0.) NRHO = 0
      IF (MOD(NRHO,2).EQ.0) NRHO = NRHO + 1
      NRHO=MAX0(5,NRHO)
      DELRHO=(RHO2-RHO)/FLOAT(NRHO-1)
      SUMJ = 0.
      FLIPJ = 2.
      TT = TTMFS * SECANT
      B1 = B1MFS * SECANT
      DO  100 J=1,NRHO
      IF (SSV1) 35,30,35
   30 SS= SSV2
      GO TO 40
   35    SS    =          SSV2 * XPN (RHO*SINT*SSV1)
   40 B2 =  (RHO - TT)* MU(1,JPH) + B1
      B =  BFUNC (BUIF,B2)
      FACT = 1.
      IF (J.EQ.1.OR.J.EQ.NRHO) GO TO 45
      IF (J.EQ.1 .OR. J.EQ.NRHO) GO TO 50
      FLIPJ = 6. - FLIPJ
      FACT = FLIPJ
   45 IF (B2.LT.200..AND.B2.GE.0.) GO TO 50
      VAL = 0.
      IF (B2.GE.0.) GO TO 55
      VAL = 100000.
      GO TO 55
   50 VAL  =        FACT * B * SS * XPN(-B2)
   55 IF (J.EQ.1) FRST = VAL
      IF (FRST.EQ.0.) GO TO 110
      IF ( ABS(VAL / FRST) .LT. 1.E-4) GO TO 110
      SUMJ = SUMJ + VAL
  100 RHO = RHO + DELRHO
  110 SUMJ = SUMJ * DELRHO
      FACT = 1.
      IF ( I.EQ.1 .OR. I.EQ.NTHETA) GO TO 150
      FLIPI = 6.-FLIPI
      FACT = FLIPI
  150 SUMI = SUMI + FACT * SUMJ * SINT
  200 THETA = THETA + DELTH
      SOURCE (3,JPH) = SUMI * DELTH / 18.
      RETURN

  210 WRITE (*,*) 'VOLUME=0, EXECUTION TERMINATED IN SUBROUTINE ENDCYL'
      STOP

C------------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------
C
      FUNCTION F1 (T,A)
C
C     This module performs an approximation for integral from 0 to T
C     of  XPN(A*X)*E1(X) DX.  This module was taken from ISOSHLD, see
C     references in the documentation.
C
C     Module of Program EXTDF of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last modification:  17-June-87 RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------------

      VALUE = 0.
      IF (T ) 5,100,5
    5 IF (A.GT.0. .OR. A.LT.0. .OR. ABS(T).GT.88.)  GO TO 9
      VALUE  =  1. - E2(T)
      GO TO 100
    9 IF (A) 10,20,10
   10 IF (1.0 .LT. A .OR. ABS(T*(1.-A)).GT.88.) GO TO 20
   11 VALUE =  (XPN(A*T)* E1(T) - E1(T*(1.-A)) -ALOG(ABS(1.-A))) / A
      GO TO 100
   20 IF (ABS(A-1.).GT.1.E-10 .OR. T.LT.1.E-37 .OR. T.GT.88.) GO TO 30
      VALUE = XPN(T)* E1(T) +ALOG(T) + 0.57721566
      GO TO 100
   30 IF ( A.GT.1.0 .AND.ABS(A*T).LT. 88.)  GO TO 11

      WRITE (*,40) T,A
   40 FORMAT (40H0 F1 INTEGRATION FUNCTION FAILED.  TAU =, E11.3,
     1  5H, A= ,E11.3)
  100 F1 = VALUE
      RETURN
C-----------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------
C
      SUBROUTINE LINE
C
C     This module calculates the gamma attenuation for a line source
C     such that one end is considered origin using Simps integration
C     function.  This module was taken from ISOSHLD, see references
C     in the documentation.
C
C     Module of Program EXTDF of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last modification:  17-June-87 RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------
C
C     ANG1 = angle shield normal makes with the line source
C     ANG2 = angle to detector
C     X = dist to detector from origin
C     SLTH = source length
C
C-----------------------------------------------------------------

      INCLUDE 'ISO.CMN'

      EXTERNAL LINSRC
C
      XNORM = X * COS (ABS(ANG2-ANG1 ))
      IF (ANG1.LT.PI/2.) T(1) = AMAX1(T(1),SLTH*COS(ANG1))
      CALL ADJUST (XNORM)
      B1MFS = 0.
      TTMFS = 0.
      DO 105 K=2,NSHLDA
      TTMFS = TTMFS + T(K)
  105 B1MFS = B1MFS + T(K)* MU(K,JPH)
      IF (SLTH.EQ.0.) GO TO 109
      IF (SSV1)  106, 107,106

C     EXPNONENTIAL SOURCE DIST.
  106 SSV2 = SOURCE(1,JPH)* SOURCE(2,JPH)* SSV1/(XPN(SSV1*SLTH)-1.)
      GO TO 108
C     CONSTANT SOURCE DIST.
  107 SSV2 = SOURCE(1,JPH)* SOURCE(2,JPH) / SLTH
  109 IF (SLTH.EQ.0.) SSV2 = 0.
  108 SOURCE (3,JPH) = SIMPS (0,SLTH,.001, LINSRC)
  120 RETURN
C-----------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------
C
      FUNCTION LINSRC (ARG)
C
C     This function is integrated by Function SIMPS to calculate
C     attenuation for a line source.  This function was taken from
C     ISOSHLD, see references in the documentation.
C
C     Module of Program EXTDF of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last modification:  10-June-87 MDT
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------------

      INCLUDE 'ISO.CMN'

      RHOSQ = ARG**2 + X**2 - 2. *ARG*X*COS(ANG2)
      RHO = SQRT(RHOSQ)
      SINOM =  ARG * SIN(ANG2)/ RHO
      COSOM = (X**2  + RHOSQ - ARG**2) /2./ X /RHO
      OMEG= ATAN2 (SINOM,COSOM)
      THETA =  ABS (ANG1  - ANG2- OMEG)
      SECANT = 1. / COS (THETA)
      B1 =  (RHO- TTMFS* SECANT) * MU(1,JPH) + B1MFS * SECANT
      IF (SSV1) 200,150,200
  150 SS=SSV2
      GO TO 300
  200 SS = SSV2 * XPN(SSV1*ARG)
  300 B = BFUNC(BUIF,B1)
      LINSRC = B * SS * XPN(-B1) / 4. / PI / RHOSQ

      RETURN

C-----------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------
C
      SUBROUTINE POINT
C
C     This module calculates gamma attentuation of a point source
C     through multiple slab shields.  This module was taken from
C     ISOSHLD, see references in the documentation.
C
C     Module of Program EXTDF of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last modification:  17-June-87 RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------------

      INCLUDE 'ISO.CMN'

      CALL ADJUST (X)
      IF (COS(ATAN2(Y,X)).EQ.0.) GO TO 10
      SECANT  = 1. / COS(ATAN2(Y,X))
   10 IF (COS(ATAN2(Y,X)).EQ.0.) SECANT = 1.E20

C     CALCULATE B1 = SUM MU * THICKNESS OF SHIELDS, MU = ATTEN. COEF

      B1 = 0.
      DO  20  J=1,NSHLDA
   20 B1 = B1 + MU(J,JPH) * T(J)
      B1 = B1 * SECANT
      B = BFUNC(BUIF,B1)
      SOURCE(3,JPH) = B * SOURCE(1,JPH) * SOURCE(2,JPH) * XPN(-B1)
     1          / 4. / PI / (X * SECANT) **2

      RETURN
C
C-----------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------
C
      SUBROUTINE RECT
C
C     This module calculates the attenuation for a rectangular
C     source using Simpsons rule for numerical integration of a
C     point kernel.  This module was taken from ISOSHLD, see
C     references in the documentation.
C
C     Module of Program EXTDF of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last modification:  17-June-87  RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------

      INCLUDE 'ISO.CMN'

      VOLUME = SLTH*Y*T(1)

C     CONSTANT SOURCE STRENGTH ONLY FOR RECT. SOURCE

      SSV2 =  SOURCE(1,JPH) * SOURCE(2,JPH) / VOLUME
      IF (MOD(NPSI,2).EQ.0) NPSI = NPSI+1
      NPSI = MAXO(5,NPSI)
      DELPSI = Y/FLOAT(NPSI-1)/2.
      FLIPI = 2.
      SUMI = 0.
      CALL ADJUST(X)
      B1MFS = 0.
      TTMFS = 0.
      DO 10 I=2,NSHLDA
      TTMFS = TTMFS + T(I)
   10 B1MFS = B1MFS + T(I)* MU(I,JPH)
      IF (MOD(NTHETA,2).EQ.0) NTHETA = NTHETA +1
      NTHETA = MAXO(5,NTHETA)
      THETA = 0.
      DELTH = SLTH / 2. / FLOAT(NTHETA-1)
      IF (DELR.EQ.0.) GO TO 20
      NZ = INT(T(1)/DELR)
      IF (MOD(NZ,2).EQ.0) NZ= NZ + 1
      NZ = MAXO (5,NZ)
   20 IF (DELR.EQ.0.) NZ = 0
      DZ = T(1)/FLOAT(NZ-1)
      DO  300      I=1,NTHETA
      FLIPJ = 2.
      SUMJ = 0.
      PSI = 0.
```

```
      THSQ =  THETA**2
      DO 200   J=1,NPSI
      TSPS = THSQ + PSI**2
      SUMK = 0.
      FLIPK = 2.
      Z = 0.
      DO 100  K=1,NZ
      RHOSQ =       TSPS + (TTMFS+Z)**2
      RHO = SQRT (RHOSQ)
      SECANT = RHO /(TTMFS + Z )
      B1 =  (RHO-TTMFS*SECANT)* MU(1,JPH) + B1MFS * SECANT
      B = BFUNC (BUIF,B1)
      FACT = 1.
      IF (K.EQ.1.OR. K.EQ.NZ) GOTO 50
      FLIPK =6.-FLIPK
      FACT = FLIPK
   40 IF (B1.LT.200..AND.B1.GE.0..AND.RHOSQ.NE.0.) GO TO 50
      VAL = 0.
      IF (B1.GE.0.) GO TO 60
      VAL = 100000.
      GO TO 60
   50 VAL = FACT * B * SSV2 * XPN(-B1) / RHOSQ
   60 IF (K.EQ.1) FRST = VAL
      IF (K.EQ.1) FRST=VAL
      IF (ABS(VAL).LT.1.0E-4*ABS(FRST)) GOTO 110
      SUMK = SUMK + VAL
  100 Z = Z + DZ
  110 FACT = 1.
      IF (J.EQ.1.OR.J.EQ.NPSI) GO TO 150
      FLIPJ = 6. - FLIPJ
      FACT = FLIPJ
  150 SUMJ = SUMJ + FACT * SUMK
  200 PSI = PSI + DELPSI
      FACT = 1.
      IF (I.EQ.1.OR.I.EQ.NTHETA) GO TO 250
      FLIPI = 6.-FLIPI
      FACT = FLIPI
  250 SUMI = SUMI + FACT * SUMJ
  300 THETA = THETA + DELTH
      SOURCE (3,JPH) = SUMI * DZ * DELTH * DELPSI / PI / 27.

      RETURN

C-----------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------
C
      FUNCTION SIMPS (A, B, DELTA, F00000)
C
C     This fuction uses Function F00000  ( F00000 = SPHERE or
C     LINSRC or DSCSRC depending on the calling subroutine )
C     where A and B are min and max of the definite integral.
C     Delta is the permissible diference between two successive
C     sums.  This module was taken from ISOSHLD, see references in
C     the documentation.
C
C     Module of Program EXTDF of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last modification:  30-Jul-87 RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------------

      EXTERNAL F00000

      N=1
      H=(B-A)/2.
      TEMPA = F00000(A)
      TEMPB = F00000(B)
      FJAY = H * (TEMPA + TEMPB)
C      FJAY=H*(F00000(A)+F00000(B))

C     A MAXIMUM OF 2049 POINTS WILL BE USED WHEN L=11

      DO 35 L=1,11
   10 S=0.0
      DO 20 K=1,N
   20 S=S+F00000(A+(2.0*FLOAT (K)-1.0)*H)
      FI=FJAY+4.0*H*S
      IF(L-3)26,26,23
   23 CONTINUE
      IF (FI.EQ.0.) GO TO 40
      IF(DELTA-ABS ((FI-BAR)/FI))30,40,40
   26 CONTINUE
   30 BAR=FI
      FJAY=(FI+FJAY)/4.0
      N=2*N
      H=H/2.0
   35 CONTINUE
C     CALL SLITE (1)
   40 SIMPS =FI/3.0

      RETURN
```

```
C
C-----------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------
C
      SUBROUTINE SPHERE
C
C     This module calculates gamma attentuation of a spherical
C     source or slab shields using Function SIMPS to integrate
C     Function SPHSRC.  This module was taken from ISOSHLD, see
C     references in the documentation.
C
C     Module of Program EXTDF of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last modification:  17-June-87  RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------------

      INCLUDE 'ISO.CMN'

      EXTERNAL SPHSRC
C
      CALL ADJUST (X)
      THETA2 = ATAN2(T(1),SQRT(ABS(X**2-T(1)**2)))
      VOLUME = 4.189*T(1)**3
      IF (IGEOM-4) 10,8,8

C     SLAB SHIELDS

    8 TTMFS = 0.
      B1MFS = 0.
      IF(NSHLDA.LT.3)GO TO 10
      DO 9 K=3,NSHLDA
      TTMFS = TTMFS + T(K)
    9 B1MFS = B1MFS + T(K)*MU(K,JPH)

C     CONSTANT SOURCE STRENGTH ONLY FOR SPHERICAL SOURCE
   10 SSV2 =  SOURCE(2,JPH) * SOURCE(1,JPH) / VOLUME
      SOURCE (3,JPH) = .5 * SIMPS(0,THETA2,.001,SPHSRC) * SSV2

  120 RETURN

C-----------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------
C
      FUNCTION SPHSRC (ARG)
C
C     This function is called by the SPHERE subroutine.  This function
C     was taken from ISOSHLD, see references in the documentation.
C
C     Module of Program EXTDF of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last modification:  17-June-87 RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------

      INCLUDE 'ISO.CMN'

      DIMENSION VAL(2)
      REAL L1, L2
      DIMENSION TM(6)

      XCOS = X * COS(ARG)
      SINA = SIN(ARG)
      XSINS = (X*SINA)**2
      XX = SQRT (ABS( T(1) **2 - XSINS))
      L1 =  XCOS - XX
      L2 =  XCOS + XX
      IF (IGEOM-3) 5,9,5

C      SLAB SHIELDS
    5  TT = TTMFS * X/XCOS
      B1     = L1*MU(1,JPH) - (L1-TT)*MU(2,JPH) - B1MFS*X/XCOS
      GO TO 21

C     SPHERICAL SHIELDS
    9 XX = T(1)
      DO 10    I=2,NSHLDA
      XX =XX + T(I)
   10 TM(I) = XCOS - SQRT (ABS( XX**2 - XSINS)   )
      B1     =   L1   * MU(1,JPH)
      TM(1) = L1
      DO  20  I=2,NSHLDA
   20 B1     = B1     - (TM(I-1)-TM(I)) * MU(I,JPH)
   21 SPHSRC = 0.
      FRED1 = B1-L1*MU(1,JPH)
      FRED2 = B1-L2*MU(1,JPH)
      DO  30  K=1,2
      VAL(K) =0.
      DO 30   I=1,2
```


9 1 0 4 8 1 4 5 2

```
      A = 1. + BUF(I+2,K)
   30 VAL(K) = VAL(K)-BUF(I,K)/(A*MU(1,JPH))*(XPN(A*FRED2)-XPN(A*FRED1))
      SPHSRC =(VAL(1) + BUIF*(VAL(2) - VAL(1)))* SINA
      RETURN
C-----------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------
C
      SUBROUTINE TCONE
C
C     This module uses the Functions E1 and E2 to calculate the
C     attenuation for truncated cone source.  This module was taken
C     from ISOSHLD, see references in the documentation.
C
C     Module of Program EXTDF of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last modification:  17-June-87 RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------

      INCLUDE 'ISO.CMN'
      DIMENSION VAL(2)

      SECANT =  1. / COS(ANG1)
      CALL ADJUST (X)
      B1MFS = 0.
      DO 15 J=2,NSHLDA
   15 B1MFS = B1MFS + MU(J,JPH)* T(J)
      B1 = B1MFS + MU(1,JPH) * T(1)
      TANS = (SIN(ANG1)/COS(ANG1))** 2
      VOLUME = 1.047*TANS*(X**3-(X-T(1))**3)
      IF (SSV1) 38,16,38

C     CONSTANT SOURCE STRENGTH DISTRIBUTION
   16 IF (ANG1 - PI/2. +0.1) 18,20,20
   18 SSV2 = SOURCE(1,JPH) * SOURCE(2,JPH) / VOLUME
      GO TO 25

C     INFINITE SLAB SOURCE
   20 SSV2 = SOURCE(1,JPH) * SOURCE(2,JPH)
      VOLUME=9.999E30
      IF (T(1).GT. 0.) GO TO 25

C     INFINITE PLANE SOURCE
      DO  23  K=1,2
      VAL(K) = 0.
      DO 23 J=1,2
      A = 1.0 + BUF(J+2,K)
   23 VAL(K) = VAL(K) + BUF(J,K) * E1(A*B1)
      SOURCE(3,JPH) = .5 * SSV2 * (VAL(1) + BUIF*(VAL(2)-VAL(1)))
      RETURN

   25 DO 35 K=1,2
```


9 1 0 4 8 1 4 5 4

```
      VAL(K) = 0.
      DO 35 J = 1,2
      A=1.0 + BUF(J+2,K)
       IF (ANG1 .LT. PI/2. - 0.1) GO TO 30
      VAL(K) = VAL(K) + BUF(J,K)/A *(E2(A*B1MFS) - E2(A*B1) )
      GO TO 35
   30 VAL(K) = VAL(K) + BUF(J,K)/A * (E2(A*B1MFS)-E2(A*B1) - E2(A*B1MFS*
     1    SECANT)/ SECANT + E2(A*B1*SECANT)/SECANT)
   35 CONTINUE
      GO TO 100

C     EXPNONENTIAL SOURCE STRENGTH DISTRIBUTION
   38 IF (ANG1 .LT. PI/2. - 0.1) GO TO 40
      VOLUME=9.999E30
      SSV2 = SOURCE(1,JPH) * SOURCE(2,JPH)
      GO TO 42
   40 SSV2 = SOURCE(1,JPH)*SOURCE(2,JPH)*SSV1/(XPN(SSV1*T(1))*(X*X
     1 - (SSV1*T(1)-1.)*(-2./SSV1*(X+1./SSV1))+T(1)**2)-X**2-2./SSV1 *
     . (X + 1./ SSV1))
   42 DO 60 K=1,2
      VAL(K) = 0.
      DO 60 J=1,2
      A =1.0 + BUF(J+2,K)
      IF (PI/2.-0.1 .LT. ANG1)  GO TO 55
   45 VAL(K) = VAL(K) + BUF(J,K)/A * (F1(A*B1,BUF(J+2,K)) -
     1  F1(A*B1MFS,BUF(J+2,K)) - F1(A*B1*SECANT,BUF(J+2,K))/SECANT
     2  + F1(A*B1MFS*SECANT,BUF(J+2,K)))
      GO TO 60
   55 VAL(K) = VAL(K) + BUF(J,K)/A * (F1(A*B1,BUF(J+2,K))  -
     1      F1(A*B1MFS,BUF(J+2,K)))
   60 CONTINUE
  100 CONTINUE
      SOURCE (3,JPH) = .5 * SSV2 * XPN(SSV1/MU(1,JPH)*B1)/MU(1,JPH) *
     1  (VAL(1) +BUIF*(VAL(2)-VAL(1)))

      RETURN
C
C-----------------------------------------------------------------------
      END
```


9 1 0 4 8 1 4 5 5

```
C-----------------------------------------------------------------------
C
      FUNCTION TERP (XER,Y,A)
C
C     This function is a linear interpolation routine used on the
C     original ISOSHLD group structure.  This function was taken from
C     ISOSHLD, see references in the documentation.
C
C     Module of Program EXTDF of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last modification:  17-June-87 RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------------

      DIMENSION XER(25), X(16), Y(16)


      DO 50 I=1,16
   50 X(I)=XER(I+9)
      IF(A-AP) 5,30,5
    5 DO  10  I=1,16
      IF (X(I) .GT. A) GO TO 20
   10 CONTINUE
      J=16
      K=16
      GO TO 30
   20 K = MAX0 (I,2)
      J = MAX0(I-1,1)
   30 TERP = Y(J) + (A-X(J)) / (X(K)-X(K-1)) * (Y(K)-Y(K-1))
      AP=A

      RETURN
C
C-----------------------------------------------------------------------
      END
```


9 1 0 4 8 1 4 5 6

```
C-----------------------------------------------------------------------
C
      FUNCTION TERPB (X,Y,A)
C
C     This function performs interpolation of a 25 position list.
C     This function was taken from ISOSHLD, see references in the
C     documentation.
C
C     Module of Program EXTDF of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last modification:  17-June-87  RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------------

      DIMENSION X(25),Y(25)

      IF(AP-A) 5,30,5
    5 DO 10 I=1,25
      IF (X(I) .GT. A) GO TO 20
   10 CONTINUE
      J=25
      K=25
      GO TO 30
   20 K=MAX0(I,2)
      J=MAX0(I-1,1)
   30 TERPB=Y(J)+(A-X(J))/(X(K)-X(K-1))*(Y(K)-Y(K-1))
      AP=A

      RETURN
C
C-----------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------
C
      FUNCTION XPN (X)
C
C     This function sets appropriate system parameters.
C
C     This module was taken from ISOSHLD, see references in the
C     documentation
C
C     Module of Program EXTDF of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last modification:  17-June-87 RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------------

      REAL LOW,TOP,XPN

      DATA LOW /  0.0  /

      DATA TOP /  6.08E37  /

      IF (ABS(X) .GT. 87) GO TO 5

      XPN=EXP(X)

      RETURN

    5 CONTINUE

      IF(X .LT. -87)XPN=LOW

      IF(X .GT. +87)XPN=TOP

      RETURN

C-----------------------------------------------------------------------
       END
```

```
C-----------------------------------------------------------------
C
      SUBROUTINE NRGLIB
C
C     This module reads the DRALIST file as formatted by the CONVER
C     computer program (Kocher 1980).
C
C     Module of Program EXTDF of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last modification:  10-Jul-87  RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------
C
C     NSKIP     - Input index of number of data sets to skip
C     NBI       - Input number of beta data sets
C     NPHI      - Input number of photon data sets
C     NADDP     - Input number of gamma rays and xrays
C     NADDB     - Input number of Auger and internal conversion electrons
C     NB()      - Number of betas for each RMDLIB member
C     NP()      - Number of photons for each RMDLIB member
C     RDUM      - REAL dummy input variable
C     IBESUB()  - For each RMDLIB member; starting index in beta array
C     IPHSUB()  - For each RMDLIB member; starting index in photon array
C
C-----------------------------------------------------------------

      INCLUDE 'ISO.CMN'
      INCLUDE 'RMD.CMN'

      INTEGER NSKIP, NBETA, NBI, NPHI, NADDB, NADDP
      REAL RDUM(300)
      CHARACTER ELTI*2, AWI*6

C     Initialize indices for reading library--

      NPHTN = 1
      NBETA = 1

C     Read a data set for each member of RMDLIB--
      DO 50 J = 1, NUCS

        READ (26,30) ELTI, AWI, LATNO
   30   FORMAT (1X, A2,1X, A6, 16X, I3)
        IF (ELTI .NE. ELTM(J) .OR. AWI .NE. AWM(J)) GOTO 91

C       Set starting indices, atomic number and mass number--
        IPHSUB(J) = NPHTN
```

```
      IBESUB(J) = NBETA
      LA(J) = LATNO
C     ML(J) = check if this is really needed

C     Skip over alpha particles--
      READ (26,*) NSKIP
      IF (NSKIP .GT. 0) READ (26,*) (RDUM(I),I=1,NSKIP*2)

C     Read beta- particles--
      READ (26,*) NBI
      IF (NBI .GT. 0) READ (26,*)
     .  (BETENS(2,NBETA-1+I), RDUM(1), BETENS(1,NBETA-1+I), I=1,NBI)
      NBETA = NBETA + NBI

C     Skip beta+ particles (included in gamma)--
      READ (26,*) NSKIP
      IF (NSKIP .GT. 0) READ (26,*) (RDUM(I),I=1,NSKIP*3)

C     Read Auger and internal conversion electrons--
      READ (26,*) NADDB
      IF (NADDB .GT. 0) READ (26,*)
     .  (BETENS(2,NBETA-1+I), BETENS(1,NBETA-1+I), I=1,NADDB)
      NBETA = NBETA + NADDB

C     Read gamma rays and X-rays--
      READ (26,*) NADDP
      IF (NADDP .GT. 0) READ (26,*)
     .  (PHOTON(2,NPHTN-1+I), PHOTON(1,NPHTN-1+I), I=1,NADDP)
      NPHTN = NPHTN + NADDP

C     Set number of photons and betas for this radionuclide--
      NP(J) = NPHI + NADDP
      NB(J) = NBI + NADDB

   50 CONTINUE
      RETURN

C---- Error conditions -----------------------------------------------

   91 WRITE (*,*) 'Energy library out of order.'
      WRITE (*,*) 'RMDLIB: ', ELTM(J), AWM(J)
      WRITE (*,*) 'ENERGY: ', ELTI, AWI
      STOP

C--------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------
C
      PROGRAM UNFORMAT
C
C     This module reads data sets of inhalation and ingestion dose rate
C     factors and writes an unformatted file
C
C     Utility Module of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 3-Nov-87 RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-------------------------------------------------------------------
C
C     DUM        - Dummy input variable
C     IN         - Index of the current radionuclide in this case
C     EAIN       - Input element symbol and mass number input string
C     DAT        - Input date
C     TIM        - Input time
C     DFIN()     - Input dose factor for each organ
C     NYRG       - Number of years of ingestion dose factor increments
C     NYRH       - Number of years of inhalation dose factor increments
C     NGORG()    - Number of years of ingestion df's for each organ
C     NHORG()    - Number of years of inhalation df's for each organ
C
C-------------------------------------------------------------------

      INCLUDE 'OPT.CMN'
      INCLUDE 'DFPAR.CMN'
      INCLUDE 'RADIN.CMN'
      INCLUDE 'DOSALL.CMN'
      INCLUDE 'ORGMAS.CMN'
      INCLUDE 'TITL.CMN'

      REAL DFIN(70)
      INTEGER NYRG, NYRH, NGORG(25), NHORG(25), IORG(25),
     .        NGMAS(25), NHMAS(25)
      CHARACTER DUM*1, EXCL*1, ASTR*1, E*2, A*6, DAT*10, TIM*10,
     .          FILNAM*20
      DATA EXCL /'!'/, ASTR /'*'/

      LIN = 37
      LOT = 40

      WRITE (*,*) 'Enter input file name: '
      READ (*,*) FILNAM
      OPEN (37,FILE=FILNAM)
```

```
      WRITE (*,*) 'Enter output file name: '
      READ (*,*) FILNAM
      OPEN (40,FILE=FILNAM,FORM='UNFORMATTED')

      READ (LIN,'(A)',ERR=98, END=230) TITLS(LIN)

C     Loop through data sets for all radionuclides--
  200 CONTINUE

        DO 201 IO = 1, 25
          NGORG(IO) = 0
          NHORG(IO) = 0
          NHMAS(IO) = 0
          NGMAS(IO) = 0
          DO 202 IY = 1, 70
            DFG(IY,IO) = 0.0
            DFH(IY,IO) = 0.0
  202     CONTINUE
  201   CONTINUE

        READ (LIN, 1, END=230) E, A, DAT, TIM
        READ (LIN,*) NORGS, (IORG(IO),IO=1,NORGS)

C       Read ingestion dose factors--
        READ (LIN,*) (NGORG(IO),IO=1,NORGS)
        DO 242 IO = 1, NORGS
          NGMAS(IORG(IO)) = NGORG(IO)
          READ (LIN,2) DUM, (DFIN(IY), IY=1,NGORG(IO))
          DO 223 IY = 1, NGORG(IO)
            DFG(IY,IORG(IO)) = DFIN(IY)
  223     CONTINUE
  242   CONTINUE

C       Read inhalation dose factors--
        READ (LIN,*) (NHORG(IO),IO=1,NORGS)
        DO 241 IO = 1, NORGS
          NHMAS(IORG(IO)) = NHORG(IO)
          READ (LIN,2) DUM, (DFIN(IY), IY=1,NHORG(IO))
          DO 224 IY = 1, NHORG(IO)
            DFH(IY,IORG(IO)) = DFIN(IY)
  224     CONTINUE
  241   CONTINUE


        WRITE (LOT) E, A, (NGMAS(IO),IO=1,23), (NHMAS(IO),IO=1,23),
     .              ((DFG(IY,IO), IY=1,NGMAS(IO)), IO=1,23),
     .              ((DFH(IY,IO), IY=1,NHMAS(IO)), IO=1,23)
```

```
      GOTO 200
  230 CONTINUE

      CLOSE (LIN)
      CLOSE (LOT)
      STOP

C---- Format Statements ------------------------------------------------

    1 FORMAT (2X, A2, A6, 27X, A10, 1X, A10)
    2 FORMAT (A1, 15E8.1 / 10(1X, 15E8.1/))

C---- Error Messages ----------------------------------------------------

   98 CALL FILERR (2, LUN, 'In UNFORMAT')
   99 CALL FILERR (3, LUN, 'In UNFORMAT')

C-----------------------------------------------------------------------
      END
```

UNFORMAT

```
C-----------------------------------------------------------------------
C
      PROGRAM UNSEE
C
C     This module reads SEE formatted data files and writes unformatted
C     files.
C
C     Utility Module of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 12-Apr-88 RAP
C     Reviewed and Approved: 13-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C     DUM       - Dummy input variable
C
C-----------------------------------------------------------------------

      INCLUDE 'SEE.CMN'
      CHARACTER TITL*80, EXCH1*1, EXCH2*1, DUM*1, FILNAM*20

C     For the selected file--
      DO 100 ISEE = 1, 1

C       IF (ISEE .EQ. 1) THEN
C         OPEN (1,FILE='SEE1.OUT')
C         OPEN (2,FILE='SEE1.DAT',FORM='UNFORMATTED')
C       ELSEIF (ISEE .EQ. 2) THEN
C         OPEN (1,FILE='SEE2.OUT')
C         OPEN (2,FILE='SEE2.DAT',FORM='UNFORMATTED')
C       ELSEIF (ISEE .EQ. 3) THEN
C         OPEN (1,FILE='SEE3.OUT')
C         OPEN (2,FILE='SEE3.DAT',FORM='UNFORMATTED')
C       ENDIF

        WRITE (*,*) 'Enter input file name:'
        READ (*,*) FILNAM
        OPEN (1,FILE=FILNAM)
        WRITE (*,*) 'Enter output file name:'
        READ (*,*) FILNAM
        OPEN (2,FILE=FILNAM,FORM='UNFORMATTED')

        READ (1,'(A)',ERR=98, END=99) TITL
        WRITE (2) TITL

C       Process until end of file--
102     CONTINUE
```

```
C         Formatted file--
          READ (1,70,ERR=98,END=103) AHO1, EXCH1, LEME1, ZHO1, HLIFE1,
     .                              UNITS1
          READ (1,71) AHO, EXCH, LEME, ZHO, HLIFE, UNITS, NPRS, NPRT,

     .                 IG, IGBAR, TODAY, BONES

          READ (1,72) (IPRS(I),I=1,NPRS), (IPRT(I),I=1,NPRT)
          READ (1,73) ((DBLIN(I,K),I=1,NPRS),K=1,NPRT)
          READ(1,70,END=103) AHO2,EXCH2,LEME2,ZHO2,HLIFE2,UNITS2

          IF (AHO1 .NE. AHO2) GO TO 92

C         Unformatted file--
          WRITE (2) AHO, EXCH, LEME, ZHO, HLIFE, UNITS, NPRS, NPRT,

     .                     IG, IGBAR, TODAY, BONES

          WRITE (2) (IPRS(I),I=1,NPRS), (IPRT(I),I=1,NPRT)
          WRITE (2) ((DBLIN(I,K),I=1,NPRS),K=1,NPRT)

        GOTO 102
  103   CONTINUE

        CLOSE (1)
        CLOSE (2)
        STOP

  100 CONTINUE

C---- Error Conditions -------------------------------------------------

   91 CALL FILERR (2, IUNIT, LEME)

   92 WRITE (*,1) AHO1,AHO2
      CALL FILERR (3, IUNIT, LEME)

   98 CALL FILERR (2, LUN, 'In UNSEE')
   99 CALL FILERR (3, LUN, 'In UNSEE')

C---- Format Statements -----------------------------------------------

   70 FORMAT (5X,F5.0,1X,A1,1X,3A4,F5.0,1PE11.4,1X,2A4)
   71 FORMAT (1X,F5.0,1X,A1,3A4,F5.0,E11.4,1X,2A4,8I3,A3,1X,A1)
   72 FORMAT (40I2)
   73 FORMAT (8E10.2)
    1 FORMAT (' UNEXPECTED ERROR:  HEADER=',F5.0,'TRAILER= ',F5.0)
C----------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------
C
      SUBROUTINE BIOCAL
C
C
C     This subroutine pre-calculates biotic transport parameters.
C
C     Module of ENV of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Version of 26-Aug-87  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
      INCLUDE 'SOLPAR.CMN'
      INCLUDE 'OPT.CMN'

C     Set depth index--

      IF (OVRBRD .LE. 0.15) THEN
        INDW = 1
      ELSEIF (OVRBRD .LE. 0.5) THEN
        INDW = 2
      ELSEIF (OVRBRD .LE. 1.0) THEN
        INDW = 3
      ELSEIF (OVRBRD .LE. 1.5) THEN
        INDW = 4
      ELSEIF (OVRBRD .LE. 2.0) THEN
        INDW = 5
      ELSE
        INDW = 6
      ENDIF

C     Calculate quantity of soil brought to the surface by animals--
      IF (BTDSET .EQ. 0) BTDSET = 3
      EXCAMT = EXCAV(INDW,BTDSET) * TOTEXC(BTDSET)

      IF (DEBUG) WRITE (*,*) 'Biotic TR (INDW, BTDSET, EXCAMT):',
     .  INDW, BTDSET, EXCAMT

      RETURN
C-----------------------------------------------------------------------
      END
```

```
C--------------------------------------------------------------------
C
      BLOCK DATA BLKORG
C
C     This module initializes organ parameters.
C
C     Module of Programs INTDF and DOSE of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Version of 11-Feb-88  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C--------------------------------------------------------------------
C
      INCLUDE 'ORGMAS.CMN'
      INCLUDE 'ORGPAR.CMN'
      INCLUDE 'MTBPAR.CMN'
      INCLUDE 'OPT.CMN'

      DATA MORG /25/

C     Master organ list--
      DATA MASORG /'Lung     ','Lymph    ','Stomach ','S Int.   ',
     .            'UL Int. ','LL Int. ','Bone Sur','R Marrow',
     .            'Bone Cor','Bone Can','Testes  ','Ovaries ',
     .            'Muscle  ','Thyroid ','Bladder ','Kidneys ',
     .            'Liver   ','Pancreas','Spleen  ','Adrenals',
     .            'Brain   ','S Wall  ','Other   ','        ',
     .            '        '/

C     Mass of master organs--
      DATA MASMAS /1000.0, 0.0, 250.0, 400.0,
     .            250.0, 135.0, 0.0, 1500.0,
     .            4000.0, 1000.0, 35.0, 11.0,
     .            28000.0, 20.0, 200.0, 310.0,
     .            1800.0, 100.0, 180.0, 14.0,
     .            1400.0, 150.0, 3*0.0/

C     Mass of whole body--
      DATA TOTMAS /70000.0/

C     SEE source organ index--
      DATA SINDX / 10, 11, 2, 3, 4, 5, 0, 17, 15, 16, 21, 13, 12, 22,
     .            1, 6, 7, 14, 20, 25, 26, 27, 23, 2*0/

C     SEE target organ index--
      DATA TINDX / 8, 12, 2, 3, 4, 5, 33, 19, 17, 18, 27, 14, 13, 29,
     .            1, 6, 7, 15, 26, 32, 34, 2, 31, 2*0/
```


9 1 0 4 8 1 4 6 8

```
C       Default master organ index of each organ in standard list--
        DATA IORG /1,2,3,4,5,6,7,8,9,10,11,12,13,14,11*0/

C       Organ weighting factors--
        DATA WT /0.25, 0.15, 0.12, 0.12, 0.03, 0.03, 5*0.06/

C       Semi-infinite to infinite dose correction factor--
        DATA SI2I /2.0/

C       Lung model parameters--
        DATA ADJ /  0.5,  0.5, 0.95, 0.05,  0.8, 0.0, 0.0,   0.2, 0.0,
     .              0.1,  0.9,  0.5,  0.5, 0.15, 0.4, 0.4,  0.05, 0.0,
     .             0.01, 0.99, 0.01, 0.99, 0.05, 0.4, 0.4, 0.135, 0.015/

        DATA XDIV /0.5, 50.0, 500.0/

C------------------------------------------------------------------
        END
```

```
C-----------------------------------------------------------------------
C
      BLOCK DATA BLOCKD
C
C     This module initializes program parameters.
C
C     Module of Programs ENVIN, ENV, DOSE, and INTDF
C                       of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Version of 3-Aug-88  RAP
C     Reviewed and Approved: 12-Sept-88 BA Napier
C
C-----------------------------------------------------------------------

      INCLUDE 'AIRPAR.CMN'
      INCLUDE 'ANMPAR.CMN'
      INCLUDE 'DFPAR.CMN'
      INCLUDE 'EXTPAR.CMN'
      INCLUDE 'FILES.CMN'
      INCLUDE 'FODPAR.CMN'
      INCLUDE 'LABELS.CMN'
      INCLUDE 'OPT.CMN'
      INCLUDE 'SOLPAR.CMN'
      INCLUDE 'SWPAR.CMN'

      DATA NAQ /4/,   NTF /4/,   NAN /4/,   NRE /3/, NPATH /23/,
     .     NMAX /100/

C     Distances and direction--
      DATA NDIST /10/,  NDIR /16/, MINDIS /100.0/
      DATA IDIR/1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16/

C     Standard distances--
      DATA X/  805.,  2414.,  4023.,  5632.,  7241.,
     .        12068., 24135., 40255., 56315., 72405./

      DATA YRDA /2.74E-3/, AYEAR /365.25/, YRHR /1.14E-4/,
     .     SECYR /3.15E7/, YRSEC /3.17E-8/,
     .     HRYR /8766.0/, SECDA / 8.64E4/, DAYYR /365.25/,
     .     MOYR /12.0/, ONEYR /1.0/,
     .     ZERO /0.0D0/, LM2IN /25.4/,
     .     DPVRES /0.001/, DEPFR2 /0.25/,
     .     LEAFRS /1.0E-9/, WTIM /14.0/,
     .     SURCM /15.0/, SLDN /224.0/, SSLDN /1500.0/, SOLING /410.0/,
     .     UNITCF /1.E9/, P /3.1415926/, M3CM3 /1.0E-6/, KGG /1.0E-3/,
     .     ALOG2 /0.6931/, DUMMY /9*0.0/, KGMG /1.0E-6/, M3L /1.0E-3/,
     .     MEVSV /1.385E-5/
```

```
C     Initiailize inventory flags--
      DATA RELTRM /.FALSE./,  BASIC /.FALSE./,  DERIVE /.FALSE./

C     Air dispersion conservatism factor defaults to 95% percentile--
      DATA PRCNTI /2/

C     Exposure labels--
      DATA EXPLAB /'Plume   ','Inhale  ','Sur Soil','Leaf Veg',
     .            'Oth. Veg','Fruit   ','Cereals ','Meat    ',
     .            'Poultry ','Cow Milk','Eggs    ','Soil Ing',
     .            'Swim Ing','Swim Ext','Boating ','Shore   ',
     .            'Water   ','Fish    ','Mollusc ','Crustace',
     .            'Aqu Plnt','Dep Soil','Waste   ','        '/

      DATA SEALAB /'Winter','Spring','Summer','Autumn'/

C     Dose factor type for each exposure pathway--
      DATA IDF /3,1,3,10*2,3*3,5*2,3,3,0/

C     Inventory units--
      DATA NVU   /3.7E-2, 3.7E+4, 3.7E+7, 3.7E+10, 1.0/
      DATA UNIT1 /'pCi',   'uCi',   'mCi',   ' Ci',  ' Bq'/
      DATA UNIT2 /'m3','yr','m2',10*'yr',3*'L',5*'yr','m3','m3',' '/
      DATA UNIT3 /'m2','m3','kg'/
      DATA SVU /1.0, 0.15, 224.0/

C     Inhalation rates--
      DATA RINH /270.0/, RINHA /330.0/

C     Animal consumption, harvest removal, standing biomass--
      DATA CONSUM / 68.0, 0.12, 55.0, 0.12, 68.0, 55.0/
      DATA DWATER /50.0, 0.3, 60., 0.3/
      DATA FRACUT /0.0, 0.8, 1.0, 0.8/
      DATA HARVST /.TRUE./
      DATA BIOMAS /2.0, 2.0, 3.0, 0.8/
      DATA BIOMA2 /0.8, 0.8, 1.0, 0.8, 1.0, 1.5/
      DATA DRYFAC /0.1, 0.25, 0.18, 0.18/
      DATA DRYFA2 /0.18, 0.18, 0.18, 0.18, 0.2, 0.2/

C     Translocation factors--
      DATA TRANS /1.0, 3*0.1/, TRANSA /4*0.1, 2*1.0/

C     Biotic transport parameters--
      DATA YELDBT /0.4, 5.0, 4.0/
      DATA TOTEXC /9.41E-4, 2*7.48E-4/
      DATA EXCAV / 1.0, 0.81, 0.19, 0.02, 0.008, 0.002,
     .             1.0, 0.90, 0.096, 0.006, 0.0005, 0.0005,
     .             1.0, 0.90, 0.096, 0.006, 0.0005, 0.0005/
```

```
C     Shorewidth factors for different shoreline types--
      DATA SHORWI /0.2, 0.3, 0.5, 1.0/,
     .     TCWS /25295.0/

C     Ingestion of swimming water--
      DATA INGWAT /0.02/

C     Surface dose to EDE conversion for photons in energy groups:
C     (MeV)     0.15   0.4   0.75   1.25   1.75   2.25
      DATA FC /0.67,  0.66, 0.67,  0.71,  0.75,  0.78/

      DATA FILN /'FILENAME.DAT', 49*' '/
      DATA DASHES /'--------','-------  ',8*' -------'/

C-----------------------------------------------------------------------
      END
```

9 1 0 4 8 1 4 7 2

```
C-----------------------------------------------------------------
C
      SUBROUTINE DUMRED (LUN, NLINES)
C
C     Read past an unused data set
C
C
C     Module of Program ENVIN of the GENII Software Package
C     Last Change: 29-Aug-86  RAP
C     Reviewed and Approved: 12-Sept-88 BA Napier
C
C-----------------------------------------------------------------
C
C     I      - Loop index
C     LUN    - Logical unit device index
C     NLINES - Number of lines to read past
C
C-----------------------------------------------------------------

      INTEGER LUN, NLINES
      CHARACTER*10 DUM

      DO 100 I = 1, NLINES
        READ (LUN,1,ERR=98,END=99) DUM
C       WRITE (*,'(2A)') ' Skipped: ',DUM
  100 CONTINUE

      RETURN

C---- Error Messages ---------------------------------------------

   98 WRITE (*,*) 'DUMRED: Error while reading past unused data set.'
      WRITE (*,*) ' LUN:',LUN, 'Line',I,' of',NLINES
      STOP

   99 WRITE (*,*) 'DUMRED: End of file reading past unused data set.'
      WRITE (*,*) ' LUN:',LUN, 'Line',I,' of',NLINES
      STOP

C---- Format Statements ------------------------------------------

    1 FORMAT (A10)

C-----------------------------------------------------------------
      END
```

```
C----------------------------------------------------------------------
C
      SUBROUTINE FILERR (ICODE, LUN, MESSAG)
C
C     This subroutine prints fatal error messages associated with
C     data files and halts program execution
C
C     General Module of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 22-Apr-88  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C----------------------------------------------------------------------

      INCLUDE 'FILES.CMN'

      CHARACTER LINE*70, FACE*1
      INTEGER ICODE, LUN
      CHARACTER MESSAG*20, ERROR(4)*50

      DATA ERROR /' Error opening file named',
     .            ' Premature end-of-file encountered in',
     .            ' Error occurred while reading file',
     .            ' File out of order or other indexing problem' /
      FACE = CHAR(2)

      DO 100 I = 1, 70
        WRITE (LINE(I:I),'(A)') FACE
  100 CONTINUE

      IF (ICODE .EQ. 0) THEN
        WRITE (*,*) 'Error code = 0 in FILERR'
      ELSEIF (LUN .EQ. 0) THEN
        WRITE (*,*) 'Logical unit number = 0 in FILERR'
      ELSE
        WRITE (*,2) LINE, ERROR(ICODE), FILN(LUN), LUN, MESSAG
    2   FORMAT (////' ',A70,/A50, A20/
     .               ' ',T10, 'Assigned to LUN: ',I3/
     .               ' ',T10, 'Message:         ',A20////)
      ENDIF

      CALL EXIT (1)

C----------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------
C
      SUBROUTINE HEADNG (LUN)
C
C     This subroutine prints page heading for quality assurance and
C     results reports.
C
C     Module of Programs ENVIN, INTDF, ENV, and DOSE of the GENII
C     Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 30-Aug-88  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C     LUN      - Logical unit device
C     IOS      - Control integer set to a positive number if a file
C                error occurrs
C     IPN      - Page number counter of primary output file
C     CALPRG   - Name of calling program, based on logical unit number
C     PART     - Character part designator, A or B to control page
C                numbering of ENVIN and DOSE
C
C-----------------------------------------------------------------------

      INCLUDE 'TITL.CMN'
      INCLUDE 'DAYPC.CMN'

      INTEGER LUN, IOS, IPN
      CHARACTER FF*1, CALPRG*6, PART*2
      LOGICAL FIRST
      DATA IPN /0/, FIRST /.TRUE./

      FF = CHAR(12)
      IF (LUN .GT. 0) IPN = IPN + 1

      IF (LUN .EQ. 15) THEN
        CALPRG = 'INTDF '
      ELSEIF (LUN .EQ. 36) THEN
        CALPRG = 'EXTDF '
      ELSE
        CALPRG = 'GENII '
      ENDIF

      IF (LUN .EQ. 6) THEN
        PART = 'A.'
      ELSEIF (LUN .EQ. 28) THEN
        PART = 'B.'
```

```
      ELSEIF (LUN .EQ. 14) THEN
        PART = 'C.'
      ELSE
        PART = '  '
      ENDIF

C     Skip if this is not the first call in ENV--
      IF (LUN .EQ. 28 .AND. .NOT. FIRST) GOTO 100

      WRITE (LUN,1,ERR=98,IOSTAT=IOS) FF, CALPRG, TITLS(5)(1:60),
     .                                TITLS(5)(61:80)
      WRITE (LUN,2,ERR=98) TODAY, CLOCK, PART, IPN
      WRITE (LUN,3,ERR=98)

      FIRST = .FALSE.

100   CONTINUE
      RETURN

C---- Error Messages ---------------------------------------------------

   98 CALL FILERR (2, LUN, 'In HEADNG')

C---- Format Statements ------------------------------------------------

    1 FORMAT(A1,1X,78('-'),/,25X,A6,
     .        ' Dose Calculation Program'/,
     .        28X, '(Version 1.351 30-Aug-88)',//,
     .        ' Case title:   ',A60/15X,A20)
    2 FORMAT(' Executed on:  ',A8,' at ',A8,34X,'Page ',A2,I3)
    3 FORMAT (1X,78('-'))

C----------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------
C
      SUBROUTINE IDNUC
C
C     This module attempts to identify the input inventory by checking
C     input against the master radionuclide library.
C
C     General Module of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 11-Apr-88  RAP
C     Reviewed and Approved: 12-Sept-88 BA Napier
C
C------------------------------------------------------------------
C
C     IN      - Loop index for radionuclides in the input list
C     IL      - Loop index for radionuclides in the master radionuclide
C                library
C     ISTOP   - Count index of unidentified radionuclides
C     FOUND   - Logical set if either; 1-radionuclide is identified,
C               2-radionuclide declared unidentified.  Stop search if set.
C
C------------------------------------------------------------------

      INCLUDE 'RMD.CMN'
      INCLUDE 'INVIN.CMN'

      LOGICAL FOUND
      DATA ISTOP /0/

C     Loop on input radionuclides, test against master library--
      DO 3 IN=1,NIN

        FOUND = .FALSE.
        IL = 0

    1   CONTINUE

          IL = IL+1
          IF (IL .GT. NUCS) THEN
            ISTOP=ISTOP+1
            WRITE (*,100) ELTI(IN),AWI(IN)
  100       FORMAT (' Unidentified radionuclide in input ',A2,A6)
            FOUND = .TRUE.
          ELSE

C          WRITE (*,88) ELTI(IN),ELTM(IL),AWI(IN),AWM(IL)
C   88     FORMAT (2(' #',A2,'##'), 2('#',A6,'#'))
```

```
            IF (ELTM(IL) .EQ. ELTI(IN)) THEN
              IF (AWM(IL) .EQ. AWI(IN)) THEN

C               Store input into arrays at proper positions--
                NFLAG(IL) = IN
                NFLAG2(IN) = IL
                NFLAGC(NCHN(IL)) = 1
                FOUND = .TRUE.

              ENDIF
            ENDIF

          ENDIF
        IF (.NOT. FOUND) GO TO 1

    3 CONTINUE

C---- Error Conditions ---------------------------------------------------

      IF (ISTOP .GT. 0) THEN
        WRITE (*, 200) ISTOP
  200   FORMAT ('IDNUC: There were ',I4,' unidentified radionuclides.')
        CALL EXIT (1)
      ENDIF

      RETURN
C-----------------------------------------------------------------------
      END
```

```
C-------------------------------------------------------------------
C
      SUBROUTINE MAKDA2
C
C     This subroutine gets system date and time and stores them as
C     character strings.
C
C     General Module of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Version of 15-May-87  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-------------------------------------------------------------------
C
       INCLUDE 'DAYPC.CMN'

       CALL DATE (TODAY)
       CALL TIME (CLOCK)

      RETURN
C-------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------
C
      SUBROUTINE OPNFIL (IMODE, IHEAD, LUN)
C
C     This module controls opening of input and output files.  This
C     module may also read the file containing filenames and optionally
C     writes titling information to intermediate output files.
C
C     General Module of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 15-Jul-88  RAP
C     Reviewed and Approved: 12-Sept-88
C
C-------------------------------------------------------------------
C
C     IMODE     - Index to specify:
C                    1 - open an existing file,
C                    2 - open a new file,
C                    3 - open and read the filename file
C                    4 - open existing file, read and store title
C                    5 - open existing file for append
C                    6 - open an existing unformatted file
C                    7 - open an unformatted file, read and store title
C                    8 - open a new unformatted file
C                    9 - close file
C     IHEAD     - Index to specify heading type:
C                    0 - no heading,
C                    1 - ENV: output file (includes options)
C                    2 - ENV: Title plus date and time on second line
C                    3 - ENVIN: Title plus date and time on second line
C                    4 - INTDF: Copy title to TITLS(5)
C                    9 - form feed only
C     ILUN      - Logical unit number of the current file
C     IOS       - Status flag returned by system call to OPEN
C     LEXIST    - Logical set if file exists
C
C-------------------------------------------------------------------

      INCLUDE 'FILES.CMN'
      INCLUDE 'DAYPC.CMN'
      INCLUDE 'TITL.CMN'

      LOGICAL LEXIST
      INTEGER IMODE, IHEAD, IOS, LUN
      CHARACTER FF*1
      IOS = 0
      FF = CHAR(12)
```

```
      IF (IMODE .EQ. 3) LUN = 1
      IF (LUN .LT. 1 .OR. LUN .GT. 50) GOTO 91

      IF (IMODE .EQ. 1) THEN
C       Open existing file--

        OPEN (LUN, FILE=FILN(LUN), STATUS='OLD', IOSTAT=IOS)

      ELSEIF (IMODE .EQ. 2) THEN
C       Open new file--

        INQUIRE (FILE=FILN(LUN), EXIST=LEXIST)
        IF (LEXIST) THEN
          OPEN (LUN, FILE=FILN(LUN), STATUS='OLD', IOSTAT=IOS)
        ELSE
          OPEN (LUN, FILE=FILN(LUN), STATUS='NEW', IOSTAT=IOS)
        ENDIF

      ELSEIF (IMODE .EQ. 3) THEN

C       Open and read filename file, check first in default directory--

        INQUIRE (FILE=FILN(1), EXIST=LEXIST, IOSTAT=IOS)

        IF (LEXIST) THEN
          OPEN (1, FILE=FILN(1), STATUS='OLD', IOSTAT=IOS)
        ELSE
          OPEN (1, '\GENII\FILENAME.DAT', STATUS='OLD', IOSTAT=IOS)
        ENDIF

        DO 100 I = 2, 50
          READ (1,1000,ERR=98,END=101) FILN(I)
  100   CONTINUE
  101   CONTINUE

      ELSEIF (IMODE .EQ. 4) THEN
C       Open existing file, read and store title--

        OPEN (LUN, FILE=FILN(LUN), STATUS='OLD', IOSTAT=IOS)
        READ (LUN,'(A80)',ERR=98, END=99) TITLS(LUN)

C       Check if this is a DOSE, INTDF, or EXTDF call,
C       store title for reports--
        IF (LUN .EQ. 11) THEN
          TITLS(5) = TITLS(LUN)
        ELSEIF (LUN .EQ. 18) THEN
          TITLS(5) = TITLS(LUN)
        ELSEIF (LUN .EQ. 35) THEN
          TITLS(5) = TITLS(LUN)
```

```
        ENDIF

      ELSEIF (IMODE .EQ. 5) THEN
C       Open existing file for append--

        INQUIRE (FILE=FILN(LUN), EXIST=LEXIST)
        IF (LEXIST) THEN
          OPEN (LUN, FILE=FILN(LUN), STATUS='OLD', ACCESS='APPEND',
     .          IOSTAT=IOS)
        ELSE
          OPEN (LUN, FILE=FILN(LUN), STATUS='NEW', IOSTAT=IOS)
        ENDIF

      ELSEIF (IMODE .EQ. 6) THEN
C       Open an existing unformatted file--

        OPEN (LUN, FILE=FILN(LUN), STATUS='OLD', FORM='UNFORMATTED',
     .        IOSTAT=IOS)

      ELSEIF (IMODE .EQ. 7) THEN
C       Open an unformatted file, read and store title--

        OPEN (LUN, FILE=FILN(LUN), STATUS='OLD', FORM='UNFORMATTED',
     .        IOSTAT=IOS)
        READ (LUN) TITLS(LUN)

      ELSEIF (IMODE .EQ. 8) THEN
C       Open a scratch unformatted file--

        OPEN (LUN, STATUS='SCRATCH', FORM='UNFORMATTED',
     .        IOSTAT=IOS)

      ELSEIF (IMODE .EQ. 9) THEN
        IF (IHEAD .EQ. 9) WRITE (LUN,'(A)') FF
        CLOSE (LUN)
      ELSE
        GO TO 92
      ENDIF

      IF (IOS .NE. 0) GOTO 97

      IF (IMODE .EQ. 2) THEN
        IF (IHEAD .EQ. 1) THEN
          WRITE (LUN,'(A79)') TITLS(11)
          WRITE (LUN,'(5A)') 'Created on ',TODAY,' at ',CLOCK
        ELSEIF (IHEAD .EQ. 2) THEN
          WRITE (LUN,'(A79)') TITLS(11)
          WRITE (LUN,'(5A)') 'Created on ',TODAY,' at ',CLOCK
        ELSEIF (IHEAD .EQ. 3) THEN
```


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```
          WRITE (LUN,'(A79)') TITLS(5)
          WRITE (LUN,'(5A)') 'Created on ',TODAY,' at ',CLOCK
        ELSEIF (IHEAD .EQ. 4) THEN
          TITLS(5) = TITLS(18)
        ENDIF
      ENDIF

      RETURN

C---- Format Statements ---------------------------------------------

 1000 FORMAT (10X,A30)


C---- Error Messages ------------------------------------------------

   91 WRITE (*,*) 'OPNFIL: Invalid value for LUN: ',LUN
      CALL EXIT (1)

   92 WRITE (*,*) 'OPNFIL: Invalid value for IMODE: ', IMODE
      CALL EXIT (1)

   97 WRITE (*,*) 'IOS:',IOS
      CALL FILERR (1, LUN, 'In OPNFIL         ')
   98 CALL FILERR (2, LUN, 'In OPNFIL         ')
   99 CALL FILERR (3, LUN, 'Title OPNFIL      ')

C-------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------C
      SUBROUTINE RLIBIN
C
C
C     RLBIN reads the master radionuclide library with chain decay data
C
C     General Module of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Version of 5-Apr-88  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-------------------------------------------------------------------------

C
C     A         - Mass number (with optional metastable specification)
C                 of input radionuclide
C     BON       - Bone Dosimetry classification of the input radionuclide
C     E         - Element symbol of input radionuclide
C     ELN       - Full element name of input radionuclide
C     FR()      - Decay fraction for first and second precursor of current
C                 radionuclide
C     IM        - Chain position of the current radionuclide
C     IMO       - Control integer used to check order of chains
C     IMODIN    - Input model index
C     IT()      - Input idex of first and second precursor of current
C                 radionuclide
C     T         - Half life of the current radionuclide
C     TLC       - Translocation classification of the current radionuclide
C     ATNOIN    - Input atomic number for the current radionuclide
C     NDIN      - Input number of implicit daughters for the current
C                 radionuclide
C     RFL       - Special flag input field, used to select radionuclides
C                 for research applications, input as a character field
C                 to set logical flag
C
C-----------------------------------------------------------------------

      INCLUDE 'RMD.CMN'
      INCLUDE 'RMD2.CMN'

      INTEGER IT(2), IM, IMODIN, ATNOIN, NDIN
      REAL FR(2), T
      CHARACTER E*2, A*6, BON*1, TLC*1, RFL*1

      DATA IMO /0/
      NCH = 0
      NUCS = 1
      NIDRMD = 0
```

```
C     Open file and read title--

      LUN = 2
      CALL OPNFIL (4,0,LUN)

C     Read and count nuclide ID and decay data--
    1 READ(LUN,100,END=99) E,A,T,IM,IT(1),FR(1),IT(2),FR(2),ATNOIN,RFL,
     .                      IMODIN,BON,TLC, NDIN

C       Test for end of library--
        IF(IM.GT.0) GO TO 2
        NUCS=NUCS-1
        IF(NUCS .LT. 1 .OR. NUCS .GT. 300) GO TO 98
        CLOSE (LUN)
        RETURN

C       Test for new chain, IM=1--
    2   IF ( IM .LE. 1) THEN

C         First member of new chain--
          NCH=NCH+1
          NOFNUC(NCH)=1
          IMO=1
          NCHST(NCH)=NUCS

        ELSE

C         Daughter radionuclides; test order and store values--
          IF (IM-IMO.NE.1) GO TO 97
          IMO=IM
          NOFNUC(NCH)=NOFNUC(NCH)+1
          IFR(1,NUCS)=IT(1)
          IFR(2,NUCS)=IT(2) .
          DKF(1,NUCS)=FR(1)
          DKF(2,NUCS)=FR(2)

        ENDIF

C       Set data for current radionuclide--
        ELTM(NUCS) = E
        AWM(NUCS) = A
        TR(NUCS) = T
        ATNO(NUCS) = ATNOIN
        IMODM(NUCS) = IMODIN
        BONED(NUCS) = BON
        TCLASS(NUCS) = TLC
        NDAU(NUCS) = NDIN
        NCHN(NUCS) = NCH
```

```
      IF (RFL .EQ. 'T') THEN
        RFLAG(NUCS) = .TRUE.
      ELSE
        RFLAG(NUCS) = .FALSE.
      ENDIF

C     Store implicit daughter information--
      IF (NDIN .GT. 0) THEN
        NI = NIDRMD + 1
        NK = NIDRMD + NDIN
        BACKSPACE (LUN)
        READ (LUN,102) (ELT2M(I), AW2M(I), BRANCH(I), I = NI, NK)
        DO 3 I = NI, NK
          IPNDX(I) = NUCS
    3   CONTINUE
        NIDRMD = NIDRMD + NDIN
      ENDIF

      NUCS = NUCS+1
    GO TO 1

C---- Print error messages and stop ------------------------------------

   97 WRITE (*,901) NCH,IM,ELTM(NUCS),AWM(NUCS)
  901 FORMAT(' RLIBIN: Decay chain',I4,' has improper order. Current',
     .       ' member is',I4/,'         After ',A2,A6)
      CALL EXIT (1)

   98 WRITE (*,902) NUCS
  902 FORMAT(' RLIBIN: Improper number of nuclides in library: ',I4)
      CALL EXIT (1)

   99 CALL FILERR (3, LUN, 'In RLIBIN')

C---- Input data formats -----------------------------------------------

  100 FORMAT(A2,A6,E10.2,I2,2(I2,F7.4),I4,1X,A1,1X,I1,1X,2A1,I2)
  101 FORMAT (' ',A2,A6,E10.2,2X,I4)
  102 FORMAT (52X,8(A2,A6,F5.3,1X))
  200 FORMAT(20A4)

C-----------------------------------------------------------------------
      END
```

```
C-------------------------------------------------------------------------------
C
      SUBROUTINE SIGMA (X, STAB, SIGMAZ, SIGMAY)
C
C     SIGMA computations are made given the atmospheric stability,
C     distance from the source, and mixing layer thickness.  The curves
C     are based on the parameterizations of Martin and Tikvart (1968)
C     and Tadmor and Gur (1969).  The parameterizations are used in
C     the NRC PAVAN and XOQDOQ codes.
C
C     Written by Athey, G.F., J.V. Ramsdell, C.S. Glantz (Created: June
C       1983 for MESOI; revised: September 1986 for GENII)
C     Module of Program ENVIN of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 8-Jan-87  RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-----------------------------------------------------------------------
C
C     X         - Distance
C     STAB      - Stability class
C     LAYER     - Mixing layer thickness
C     SIGMAZ    - Calculated vertical diffusion coefficient   ==> SIGMAZ
C     SIGMAY    - Horizontal diffusion coefficient
C
C-----------------------------------------------------------------------

      REAL AY(7), AZ(7,3), BZ(7,3), CZ(7,3)
      INTEGER STAB

      DATA AY/ 0.3658, 0.2751,0.2089,0.1471,0.1046,0.0722,0.0481/
      DATA AZ/ 0.192,  0.156, 0.116, 0.079, 0.063, 0.053, 0.032,
     +         0.00066,0.0382,0.113, 0.222, 0.211, 0.086, 0.052,
     +         0.00024,0.055, 0.113, 1.26,  6.73, 18.05, 10.83 /
      DATA BZ/ 0.936, 0.922, 0.905, 0.881, 0.871, 0.814, 0.814,
     +         1.941,  1.149, 0.911, 0.725, 0.678, 0.74,  0.74,
     +         2.094,  1.098, 0.911, 0.516, 0.305, 0.18,  0.18 /
      DATA CZ/ 0.0,    0.0,   0.0,   0.0,   0.0,   0.0,   0.0,
     +         9.27,   3.3,   0.0,  -1.7,  -1.3,  -0.35, -0.21,
     +        -9.6,    2.0,   0.0, -13.,  -34.0, -48.6, -29.2  /

C     Compute SIGMAY--
       SIGMAY = AY(STAB) * X ** 0.9031

C     Compute SIZMAZ--

      IF( X .LE. 100.0 ) THEN
        SIGMAZ = AZ(STAB,1) * X ** BZ(STAB,1)
```

```
      ELSE IF ( X .LE. 1000.0 ) THEN
        SIGMAZ = AZ(STAB,2) * X ** BZ(STAB,2) + CZ(STAB,2)
      ELSE
        SIGMAZ = AZ(STAB,3) * X ** BZ(STAB,3) + CZ(STAB,3)
      ENDIF

      IF(SIGMAZ .GT. 10000.0) SIGMAZ = 10000.

      RETURN

C-----------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------
C
      SUBROUTINE XQIN (INOPT)
C
C     This module reads population, food production, and chi/Q input
C     files.
C
C     Module of Program ENVIN of the GENII Software Package
C     Pacific Northwest Laboratory Environmental Dosimetry System
C
C     Last Modification: 11-Feb-88 RAP
C     Reviewed and Approved: 12-Sept-88  BA Napier
C
C-----------------------------------------------------------------
C
C     RTEMP()  - Temporary input and calculation array
C     INOPT    - Input options:
C                1- read chi/Q file,
C                2- read population,
C                3- read food production grid
C                4- select MI location; read population file and set
C                   all locations with population equal to 1
C
C-----------------------------------------------------------------

      INCLUDE 'OPT.CMN'
      INCLUDE 'AFPPAR.CMN'
      INCLUDE 'AIRPAR.CMN'
      INCLUDE 'FODPAR.CMN'
      INCLUDE 'ANMPAR.CMN'

      CHARACTER DUM*8
      REAL RTEMP(9)

C---- Read chi/Q input file ---------------------------------------

      IF (INOPT .EQ. 1) THEN

        LUN = 24
        CALL OPNFIL (4,0,LUN)
        READ (LUN,111,ERR=98,END=99) DUM, DUM, DUM

C       READ XOQ data set for first eight directions, followed by 9-16--
        IEND = (NDIR + 1) / 2
C
C       Read average wind speed--
        READ (LUN,5) (AVEU(ID), ID=1,IEND)

C       Read distance, XOQ--
```


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```
      DO 610  IX = 1,NDIST
        READ (LUN,*) RTEMP(1), (XOQ(IX,ID), ID = 1,IEND)
  610 CONTINUE

C     Repeat--
      READ (LUN,11) DUM, DUM
      READ (LUN,5) (AVEU(ID), ID=IEND+1,NDIR)
      DO 620  IX = 1,NDIST
        READ (LUN,*) RTEMP(1), (XOQ(IX,ID),ID = IEND+1,NDIR)
  620 CONTINUE

C     If finite plume, read dose factors by energy group--
      IF (FINITE) THEN
        DO 632 IE = 1, 6

          READ (LUN,11,ERR=98,END=99) DUM, DUM
          DO 634  IX = 1,NDIST
            READ (LUN,*) RTEMP(1), (DRFOQ(ID,IX,IE), ID = 1,IEND)
  634     CONTINUE

          READ (LUN,11) DUM, DUM
          DO 636  IX = 1,NDIST
            READ (LUN,*) RTEMP(1), (DRFOQ(ID,IX,IE),ID = IEND+1,NDIR)
  636     CONTINUE

  632   CONTINUE

      ENDIF

C---- Read population input file, and total population for air paths ------

    ELSEIF (INOPT .EQ. 2) THEN

      POPT = 0.0

      LUN = 27
      CALL OPNFIL (4,0,LUN)
      READ (LUN,11) DUM, DUM

      DO 400 ID = 1, NDIR

        READ (LUN,*,ERR=98,END=99) (POP(I,ID), I=1,NDIST)
        DO 401 I = 1, NDIST
          POPT = POPT + POP(I,ID)
  401   CONTINUE
  400 CONTINUE
```

```
C---- Read food production file and accumulate total production --------

      ELSEIF (INOPT .EQ. 3) THEN

        LUN = 29
        CALL OPNFIL (4,0,LUN)
        READ (LUN,11,ERR=98,END=99) DUM, DUM

        DO 411 ITF = 1, NTF
          IF (TFD(ITF)) THEN
            EFPOP(ITF) = 0.0
            TPRODT(ITF) = 0.0
            DO 148 ID = 1, NDIR
              READ (LUN,10,ERR=98,END=99) (FPRD(I,ID,ITF), I=1,NDIST)
              DO 602 IX = 1, NDIST
                EFPOP(ITF) = EFPOP(ITF) + FPRD(IX,ID,ITF) / CONS(ITF)
                TPRODT(ITF) = TPRODT(ITF) + FPRD(IX,ID,ITF)
  602         CONTINUE
  148       CONTINUE
          ENDIF
  411   CONTINUE

        DO 413 IAN = 1, NAN
          IF (ANF(IAN)) THEN
            EFPOPA(IAN) = 0.0
            TPRODA(IAN) = 0.0
            DO 149 ID = 1, NDIR
              READ (LUN,10,ERR=98,END=99) (FPRDA(I,ID,IAN), I=1,NDIST)
              DO 604 IX = 1, NDIST
                TPRODA(IAN) = TPRODA(IAN) + FPRDA(IX,ID,IAN)
                EFPOPA(IAN) = EFPOPA(IAN) + FPRDA(I,ID,IAN)/CONS2(IAN)
  604         CONTINUE
  149       CONTINUE
          ENDIF
  413   CONTINUE

C---- Read population input file, set population to 1 or 0 -------------

      ELSEIF (INOPT .EQ. 4) THEN

        POPT = 1.0

        LUN = 27
        CALL OPNFIL (4,0,LUN)
        READ (LUN,11) DUM, DUM

        DO 410 ID = 1, NDIR

          READ (LUN,*,ERR=98,END=99) (POP(I,ID), I=1,NDIST)
```


9 1 0 4 8 1 4 9 1

```
        DO 412 I = 1, NDIST
          IF (POP(I,ID) .GT. 0.0) POP(I,ID) = 1.0
  412   CONTINUE
  410 CONTINUE



      ELSE
        WRITE (*,*) 'Invalid INOPT in XQIN'
      ENDIF

      CLOSE (LUN)
      RETURN

C---- Error Messages -----------------------------------------------

   98 CALL FILERR (3, LUN, 'In XQIN            ')
   99 CALL FILERR (2, LUN, 'In XQIN            ')

C---- Format Statements --------------------------------------------

    1 FORMAT (A8)
   11 FORMAT (A10/A10)
  111 FORMAT (A10/A10/A10)

    2 FORMAT (/6X,10(5X,I2,2X))
    5 FORMAT (8X,10(F8.0,1X))
   10 FORMAT (10E8.0)

C------------------------------------------------------------------
      END
```

```
C-----------------------------------------------------------------------

C     Air-weighted, Food-weighted & Population Parameters Common Block
C     Module of GENII                           Version of 12-Nov-87 RAP

      COMMON /AFPPAR/ EFPOP(4), EFPOPA(4),
     .                AVEU(16), POP(10,16), XOQ(10,16), XOQI,
     .                FPRD(10,16,4), FPRDA(10,16,4), DRFOQ(16,10,6)

      REAL EFPOP, EFPOPA, XOQI, AVEU, POP, XOQ, FPRD, FPRDA, DRFOQ

C-----------------------------------------------------------------------

C     NORMALIZED AIR CONCENTRATION FACTORS
C     Module of GENII

      COMMON /AIRCON/ EOQ(10,16)

C-----------------------------------------------------------------------

C     Air Pathway Parameters Common Block
C     Module of GENII                           Version of 5-Jul-88 RAP

      COMMON /AIRPAR/ ETEMP, HEIGHT,
     .                MIDIST, MIDIR, MISTAB, MIUBAR, MINDIS,
     .                NDIR, NDIST, NSEAS, NSPD, NSTAB, NTOD,
     .                SFLOW, SHITE, SIGMAY, SIGMAZ, SRAD,
     .                STACK, EFFSTK, JFIN,
     .                X(10), IDIR(16), TTAIR(10), PWT(10),
     .                TPOPS, TTAIRI,
     .                PWTX(10,6), DRFSAV(6), PMX(6), EDIS(6,9), FC(6),
     .                IRELES, BUILDX, BUILDH
      LOGICAL STACK, EFFSTK, JFIN
      INTEGER MISTAB, NDIR, NDIST, NSEAS, NSPD, NSTAB, NTOD, IDIR,
     .        MIDIR, IRELES
      REAL ETEMP, HEIGHT, MIDIST, MINDIS,
     .    MIUBAR, SFLOW, SHITE, SIGMAY, SIGMAZ, X, TTAIR, PWT,
     .    TPOPS, TTAIRI, PWTX, DRFSAV, PMX, EDIS, FC, BUILDX, BUILDH
```

```
C-------------------------------------------------------------------

C     Animal Products Parameters Common Block
C     Module of GENII                              Version of 12-Aug-88 RAP

      COMMON /ANMPAR/ TRANSA(6), YELDA(6), GRWPA(6),
     .                STORTM(6), DIETFR(6), FMI(6,9),
     .                DWFACA(4), HLDUPA(4),
     .                CONS2(4), HARVA(9,6,2), ADJET2(4),
     .                CONSUM(6), DWATER(4),
     .                IRRSA(6), IRTIMA(6), RIRRA(6),
     .                TPRODA(4), FRACUT(4), ANMFED,
     .                BIOMA2(6), DRYFA2(6)

      REAL RIRRA, TRANSA, YELDA, GRWPA, STORTM, DIETFR, FMI,
     .     DWFACA, HLDUPA, CONS2, CONSUM, DWATER, IRTIMA, ADJET2,
     .     FRACUT, BIOMA2, DRYFA2
      LOGICAL ANMFED
      INTEGER IRRSA

C-------------------------------------------------------------------

C     Aquatic Foods/ Drinking Water Parameters Common Block
C     Module of GENII                            Version of 14-Jan-87 RAP

      COMMON /AQUPAR/ BIOACF(4,9),
     .                HLDUP2(4),
     .                USAG(4), TPRODQ(4), ADJETQ(4), AQUPOP,
     .                DWUSAG, DWSRC, DWTRET, DWCLEN(9), DWPOP, HOLDDW

      REAL BIOACF, HLDUP2, USAG, DWUSAG, DWCLEN, DWPOP, TPRODQ, HOLDDW,
     .     ADJETQ, AQUPOP
      LOGICAL DWTRET
      INTEGER DWSRC

C-------------------------------------------------------------------

C     BIOACCUMULATION FACTORS FOR AQUATIC PATHWAYS
C     Module of GENII

      COMMON /BIODAT/ BIOACF(4,100), DWCF(100), ISALT, IOSALT
```

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C-----------------------------------------------------------------------

C     Concentration Common Block
C     Module of GENII                           Version of 22-Dec-87 RAP

      COMMON /CONC/ SOLCON(9,4), SL2CON(9,6), NONAGS(9), RESSOL(9),
     .              DSCON(9,4), DS2CON(9,6), NONAGD(9), DSRES(9),
     .              GWCON(9), SWCON(9), SWIRR(9),
     .              AIRCON(9), ARPCON(9), ARFCON(9,4), ARF2CN(9,6),
     .              AQUCON(9,4), SEDCON(9),
     .              PLTCON(9,4), ANMCON(9,4), DWCON(9),
     .              QAIR(9), QSW(9), QWAS(9),
     .              EXPOS(9,24), PAKADD(9),
     .              ARPXCN(9), PWTAIR(9), PWTXAR(9),
     .              CTOAIR(9), SWACUT(9)

      REAL DSCON, DS2CON, GWCON, SWCON, AIRCON,
     .     SOLCON, SL2CON, AQUCON, SEDCON, ARFCON, ARF2CN, ARPCON,
     .     QAIR, QSW, QWAS, NONAGS, NONAGD, RESSOL, DSRES,
     .     PLTCON, ANMCON, DWCON, EXPOS, PAKADD,
     .     ARPXCN, PWTAIR, PWTXAR, CTOAIR, SWACUT

C-----------------------------------------------------------------------

C     DATE OF THE CURRENT RUN AND HEADING INFO
C     Module of GENII

      COMMON /DAY/ CHIAC, CHIPAT

      CHARACTER*7 CHIAC
      CHARACTER*30 CHIPAT

C-----------------------------------------------------------------------

C     SYSTEM DATE FOR THE IBM PC IN INTEGER FORMAT
C     Module of GENII

      INTEGER*2 MONTH, DAY, YEAR, IHOUR, MINT, ISEC, IFRAC
      COMMON /DAYPC/ MONTH, DAY, YEAR, IHOUR, MINT, ISEC, IFRAC
C
      CHARACTER*10 TODAY, CLOCK
      COMMON /DACPCC/ TODAY, CLOCK
```

COMMON BLOCKS

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C-----------------------------------------------------------------------

C     Radionuclide Decay Parameters Common Block
C     Module of GENII                              Version of 1-Jun-87 RAP

C
      COMMON /DECAY/ NUC, IFRM(2,9), DK(2,9), AL(9), ALDAY(9)

      INTEGER IFRM, NUC
      REAL DK, AL
      REAL*8  ALDAY

C-----------------------------------------------------------------------

C     Dose Rate / Exposure Rate Parameters Common Block
C     Module of GENII                            Version of 8-Jan-88 RAP

      COMMON /DFPAR/ DFH(70,25), DFG(70,25),
     .               DBIT(100), DSIT(100), DAIT(100), DDIT(100,3),
     .               Q(70,24), IOR(25)

      REAL DFH, DFG, DBIT, DSIT, DAIT, DDIT, Q
      LOGICAL IOR

      COMMON /DFPARC/ DATINT(100), TIMINT(100)
      CHARACTER*10 DATINT, TIMINT

C-----------------------------------------------------------------------

C     ATMOSPHERIC DISPERSION DATA AND PARAMETERS
C     Module of GENII

      COMMON /DISPSN/ NDIST, DIST(10), NUBAR, UBAR(8), NMET, MET(7),
     .                F(8,7,16), HS

C-----------------------------------------------------------------------

C     RADIONUCLIDE DECAY INFORMATION FOR MASTER LIST
C     Module of GENII
C
      COMMON /DKAY/ INUC, ICHN, NOFN(100), IFR2(2,100), DK2(2,100),
     .              AR(100)
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C------------------------------------------------------------------

C     Dose and Report Arrays
C     Module of GENII                          Version of 7-Jun-88 RAP

      COMMON /DOSALL/ DOSR(25,100),     DOSV(25,24),
     .                DOSCDR(25,100),   DOSCDV(25,24),
     .                DOSO1(25), DOSO2(25), DOSO3(25),
     .                DEX1R(100), DEX1V(24),
     .                DOSRE(100),  DOSVE(24), EXTDOS(70), EXTD,
     .                CDE(11), ICDE(11), WDE(11), EDE, AEDEQ,
     .                ANNULD(70), MAXD, MAXYR, RADEDE(100),
     .                CUMIOR(25,70), CUMIYR(70), CUMID, CUMD,
     .                NORGS, ICLN(25), SAVORG(25,3,3), SAVINC(3,3),
     .                DOSRP(25,100,2), CDEINH(25), CDEING(25),
     .                EDEINH, EDEING, EDERH(100), EDERG(100),
     .                RMAX, PMAX, OMAX, MAXR, MAXP, MAXO

      REAL DOSR, DOSV, DOSCDR, DOSCDV,
     .     DOSO1, DOSO2, DOSO3,
     .     DEX1R, DEX1V,
     .     DOSRE, DOSVE, RADEDE, EXTDOS, EXTD,
     .     CDE, WDE, EDE, AEDEQ, ANNULD, MAXD,
     .     CUMIOR, SAVORG, CUMIYR, CUMID, CUMD, SAVINC,
     .     DOSRP, CDEINH, CDEING, EDEINH, EDEING, EDERH, EDERG,
     .     RMAX, PMAX, OMAX

      INTEGER ICDE, MAXYR, NORGS, ICLN, MAXR, MAXP, MAXO

C------------------------------------------------------------------

C     Doses Common Block
C     Module of GENII                          Version of 4-Sep-86 RAP

      COMMON /DOSES/ CDEINH(25,70),
     .               CDEING(25,70)

      REAL CDEINH, CDEING

C------------------------------------------------------------------

C     DOSE COMMITMENT FACTORS
C     Module of GENII                          Version of 27-Apr-87  RAP

      COMMON /DOSFAC/ DFH(2,25,100), DFG(2,25,100)
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COMMON BLOCKS

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C--------------------------------------------------------------------

C     RADIONUCLIDE CONCENTRATIONS IN VARIOUS MEDIA
C     Module of GENII

      COMMON /EDCN/ WATCON(100), SCONW(100), SEDCON(100), EDBCNW(7,100),
     .              AQUATC(5,100), AIRCON(100), SLCON(100),
     .              EDBCON(7,100)

C--------------------------------------------------------------------

C     Environmental Parameters Common Block
C     Module of GENII                            Version of 21-Dec-87 RAP

      COMMON /ENVPAR/ DPVLT(100),
     .                BVIT(4,100),
     .                FMIT(6,100),
     .                BIOACT(4,100),
     .                DWCLET(100),
     .                LEACHT(100),
     .                GAMMAT(6,100)

      REAL DPVLT, BVIT, FMIT, BIOACT, DWCLET, LEACHT, GAMMAT

C--------------------------------------------------------------------

C     Exposure Rates Common Block
C     Module of GENII                            Version of 2-Sep-87 RAP

      COMMON /EXPALL/ EXPOST(70,9,24)

      REAL EXPOST

C--------------------------------------------------------------------

C     External Exposure / Inhalation Parameters Common Block
C     Module of GENII                          Version of 5-Jul-88 RAP

      COMMON /EXTPAR/ HRPLUM, HRGRD, HRSWIM, HRBOAT, HRSHOR,
     .                SHRTYP, SHORWI(4), INGWAT, FRCLOD,
     .                HRINH, RINH, RINHA, RESFAC, AVALSL, XMLF, FRSIZ

      REAL HRPLUM, HRGRD, HRSWIM, HRBOAT, HRSHOR,
     .    SHORWI, INGWAT, FRCLOD, HRINH, RINH, RINHA,
     .    RESFAC, AVALSL, XMLF, FRSIZ
      INTEGER SHRTYP
```

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C-------------------------------------------------------------------

C     File Names Common Block
C     Module of GENII                        Version of 29-Jan-88 RAP

      COMMON  /FILES/ FILN(50), INFILN

      CHARACTER*30 FILN, INFILN

C--------------------------------------------------------------------

C     RADIONUCLIDE SELECTION CONTROL FLAGS
C     Module of GENII

      COMMON /FLAGS/  INFLG(100), IOFLG(100)

      LOGICAL IOFLG

C--------------------------------------------------------------------

C     DATA FOR TERRESTRIAL FOOD PATHWAYS
C     Module of GENII

      COMMON /FODATA/ DVEL(100), CRATIO(6,100), AB(100)

C-------------------------------------------------------------------

C     Terrestrial Foods Parameters Common Block
C     Module of GENII                     Version of 12-Aug-88 RAP

      COMMON /FODPAR/ DPVL(9),
     .                RIRR(4), IRRST(4), IRTIMT(4),
     .                TRANS(4),
     .                YELD(4),
     .                BVI(4,9), LEAFRS,
     .                GRWP(4),
     .                HLDUP(4), HARVT(9,4,2),
     .                CONS(4), TPRODT(4),
     .                FOQ,
     .                ADJEAT(4), BIOMAS(4), DRYFAC(4)

      REAL DPVL, RIRR, TRANS, YELD, BVI, GRWP, HLDUP, CONS, FOQ, ADJEAT,
     .     IRTIMT, LEAFRS, TPRODT, BIOMAS, DRYFAC

      INTEGER IRRST
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COMMON BLOCKS

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C-----------------------------------------------------------------

C     EXTERNAL DOSE CONVERSION FACTORS
C      Module of GENII

       COMMON /GRDDAT/ EDS(100), EDW(100), EDA(100)

C-----------------------------------------------------------------

C      Internal Dose Factors Common Block
C      Module of GENII                          Version of 23-Jun-87 RAP

       COMMON /INTDFS/ NEQ, YWORK(9,45), RTOL, ATOL, ASSA, NSC,
     .                 ISTAT(6,2)

       INTEGER NEQ, NSC, ISTAT
       REAL*8 YWORK, YLUNG(9,12), YGUT(9,4), YBLOOD(9), YBONE(9,4),
     .        YOTHR(9,3), YORG(9,10), RTOL, ATOL, ASSA

       EQUIVALENCE (YWORK(1,1), YLUNG(1,1)),
     .             (YWORK(1,13), YGUT(1,1)),
     .             (YWORK(1,17), YBLOOD(1)),
     .             (YWORK(1,29), YBONE(1,1)),
     .             (YWORK(1,33), YOTHR(1,1)),
     .             (YWORK(1,36), YORG(1,1))

C      YWORK(1,1)  YLUNG(1,1)   - Quantity in each of 12 lung compartments
C      YWORK(1,13) YGUT(1,1)    - Quantity in each of 4 gut compartments
C      YWORK(1,17) YBLOOD(1)    - Quantity in the transfer compartment
C      YWORK(1,18)              - Integrated retention in lung
C      YWORK(1,19)              - Integrated retention in lymph
C      YWORK(1,20)              - Integrated retention in stomach
C      YWORK(1,21)              - Integrated retention in SI
C      YWORK(1,22)              - Integrated retention in ULI
C      YWORK(1,23)              - Integrated retention in LLI
C      YWORK(1,24)              - Integrated retention in bone
C      YWORK(1,25)              - Integrated retention in OTHER tissues/organs
C      YWORK(1,26)              - Integrated retention specified organ no. 1
C      YWORK(1,27)              - Integrated retention specified organ no. 2
C      YWORK(1,28)              - Integrated retention specified organ no. 3
C      YWORK(1,29) YBONE(1,1)   - Quantity in each of 4 bone compartments
C      YWORK(1,33) YOTHR(1,1)   - Quantity in each of 3 OTHER compartments
C      YWORK(1,36) YORG(1,1)    - Quantity in each of 9 specified organ
C                                 compartments
```

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C-------------------------------------------------------------------

C       Source Term Common Block
C       Module of GENII                      Version of 13-Aug-87 RAP

        COMMON /INVIN/ NIN, CONCIN(9,100), QIN(3,100), NFLAG2(100)

        INTEGER NIN, NFLAG2
        REAL CONCIN, QIN

        COMMON /INVINC/ ELTI(100), AWI(100)
        CHARACTER ELTI*2, AWI*6

C-------------------------------------------------------------------

C       ISOSHLD Common Blocks
C       Module of GENII                      Version of 25-Jun-87  RAP

        COMMON /ISO1/ ML(250), LA(250),
     .                NCD, ENERGY(25), RANGE(26),
     .                SOURCE(3,25), MU(6,25), MUE(6,25),
     .                NDT, DATA2(5,450), SSV1, SSV2, SLTH, TOTAL(4), T(6),
     .                NSHLD, X, Y, ANG1, ANG2, ANG3, JBUF, IGEOM,
     .                JPH, BUF(4,2), BLIB(16,3,8), PI, NSHLDA, TTMFS,
     .                B1MFS, SECANT, BUIF, B1, CASER(10), FMWD, TET,
     .                TLN(5), TLH(5), NTHETA, NPSI, DELR, VOLUME,
     .                MODE, MODSAV, NZABS
        REAL MU, MUE

        COMMON /ISO2/ BETENS(2,4000), IBESUB(250), NB(250),
     .                PHOTON(2,4000), IPHSUB(250), NP(250), TDOSE(250),
     .                BRGAM(25),BUPLWE(7,5,7),BETAPR(200),BETAEP(200),
     .                ZABS(20), FRACT(20), YIELD(25), ABAN, KOUNT

        COMMON /ISO3/ BREMI(5,6,25),
     .                BRME10(5,6,25),
     .                BRME30(5,6,25),
     .                BRME50(5,6,25),
     .                BRME70(5,6,25),
     .                BRME90(5,6,25)

        COMMON /ISO4/ DATA1(10,450), FEED3(450), FEED4(450), FEED5(450),
     .
                      FEED6(450), FEED7(450)

        COMMON /ISO5/ IPRNT, CASE, JSAVE, TSUM1, TSUM2, NPHEN, DOSE

        COMMON  /ISOC/ TITLE1(2)
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C-----------------------------------------------------------------------

C     Labels Common Block
C     Module of GENII                        Version of 18-Nov-87 RAP

      COMMON /LABELS/ EXPLAB(24), SEALAB(4)

      CHARACTER EXPLAB*8, ANMLAB(4)*8, AQFLAB(4)*8, AQRLAB(3)*8,
     .          PLTLAB(4)*8, SEALAB*6

      EQUIVALENCE (EXPLAB(4), PLTLAB(1)),
     .            (EXPLAB(8), ANMLAB(1)),
     .            (EXPLAB(18), AQFLAB(1)),
     .            (EXPLAB(14), AQRLAB(1))


C-----------------------------------------------------------------------

C     Metabolic Data Common Block
C     Module of GENII                        Version of 11-Feb-88 RAP

      COMMON /MTBPAR/ F1, FG2TC, FG2SI, DIAM,
     .                RTLUNG(12), RTGUT(4), RTSIBL,
     .                TCBLOOD, RTBLOOD,
     .                TCBONE(4), RTBONE(4),
     .                TCOTHR(4), RTOTHR(4),
     .                TCORG(10), RTORG(10),
     .                ORGUEX(10), ORGFEX(10),
     .                UEXTC, FEXTC,
     .                DEPOSIT(9), UPTGUT,
     .                ADJ(9,3), XDIV(3), ZNP, ZTB, ZP, H2,
     .                IODI, TEI, FETAGE, RA226, FETDOS, CARBON, TRITUM

      REAL F1, RTLUNG, RTGUT, RTSIBL, TCBLOOD, RTBLOOD, TCBONE, RTBONE,
     .     TCOTHR, RTOTHR, TCORG, RTORG, ORGUEX, ORGFEX, UEXTC, FEXTC,
     .     FG2TC, FG2SI, ADJ, XDIV, ZNP, ZTB, ZP, DEPOSIT, UPTGUT,
     .     FETAGE, DIAM

      REAL*8 H2
      INTEGER IODI
      LOGICAL RA226, FETDOS, TEI, CARBON, TRITUM

      COMMON /MTBC/ ELNAME(9)
      CHARACTER*14 ELNAME
```

COMMON BLOCKS

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C---------------------------------------------------------------------

C     DATA FILE INPUT RADIONUCLIDE NAMES
C     Module of GENII

      COMMON /NAMES/  ELT(300),  AW(300)

      CHARACTER AW*6, ELT*2

C---------------------------------------------------------------------

C     INPUT PARAMETERS FOR POPULATION DEFINITION
C     Module of GENII

      COMMON /NAMLST/  IEOQ, IPA, IPOPL, IPL, NSECT, PMA, PPL, NTA,
     .                 NTL, T(20), TL(20), PM1(20), POPT(20), PL1(20)

C---------------------------------------------------------------------

C     RADIONUCLIDE NAMES IN MASTER LIST
C     Module of GENII                Last modification: 8-May-87

      COMMON /NUCNAM/ NUCTOT, AW(100), ELT(100)

      CHARACTER*2 ELT
      CHARACTER*6 AW

C---------------------------------------------------------------------

C     Options / Flags / General Common Block
C     Module of GENII                          Version of 7-Jan-88 RAP

      COMMON  /OPT/ ONEDOS, AEDE, MAXDOS, CUMDOS, DOSTYP,
     .              ACUTE, OUTRAD, OUTPTH, OUTEDE, INHDF, NEAR, METHOD,
     .              POPDOS, AIR, BURWAS, SWAT, RECRE, BIOT, HARVST,
     .              FINITE, PATH(24), IDF(24), PRCNTI,
     .              TFOOD, ANFOOD, AQFOOD,
     .              IRES, IRR, NPATH, IUNIT, SOLUNT,
     .              FOQOPT, XOQOPT, EXPORT, IMPORT, DEEP,
     .              RELTRM, BASIC, DERIVE, AIRCN,
     .              DERCRP, DERANM, DERAQU, DERDRK,
     .              DOAIR, DOIRR, DOBIOT, DOWAST, NONAG,
     .              NTF, NAN, NAQ, NRE, NMAX, NCHAIN,
     .              NVU(5), SVU(3), SLDN, SSLDN,
     .              DEPFR1, DEPFR2, DPVRES, WTIM,
     .              RF1, RF2, POPOPT, POPIN, POPT,
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     .              ISALT, DEBUG,
     .              LUN, WT(11),
     .              MOFIRR, ZERO, ONEYR, P, ALOG2, M3CM3, UNITCF,
     .              YRDA, AYEAR, SECYR, HRYR, MOYR, SECDA, YRSEC, YRHR,
     .              LM2IN, DUMMY(9), KGG, KGMG, DAYYR, M3L, MEVSV


      INTEGER DOSTYP, METHOD, IRES, IRR, NPATH, FOQOPT, XOQOPT,
     .        NTF, NAN, NAQ, NRE, LUN, MOFIRR, NMAX, IUNIT,
     .        NCHAIN, IDF, POPOPT, SOLUNT, PRCNTI

      LOGICAL ONEDOS, AEDE, MAXDOS, CUMDOS, ACUTE, OUTRAD, OUTPTH,
     .        POPDOS, INHDF, NEAR, DEBUG, ISALT, EXPORT, IMPORT, DEEP,
     .        AIR, SWAT, BIOT, FINITE, INHAL, AIREXT, SLING, HARVST,
     .        GROUND, TFOOD, TFD(4), ANFOOD, ANF(4), DRINK, AQFOOD,
     .        AQF(4), REC(3), RECRE, SWING, PATH, BURWAS,
     .        RELTRM, BASIC, DERIVE, DOAIR, DOIRR, DOBIOT, DOWAST,
     .        NONAG, AIRCN, OUTEDE,
     .        DERCRP, DERANM, DERAQU, DERDRK

      REAL NVU, SVU, SLDN, SSLDN, DEPFR1, DEPFR2, DPVRES,
     .     WTIM, RF1, RF2, ONEYR, M3L, POPIN, POPT,
     .     P, ALOG2, M3CM3, UNITCF, YRDA, AYEAR, SECYR, HRYR, MOYR,
     .     SECDA, YRSEC, WT, LM2IN, DUMMY, YRHR, KGG, KGMG, DAYYR, MEVSV

      REAL*8 ZERO

      EQUIVALENCE  (PATH(1),AIREXT),
     .             (PATH(2),INHAL),
     .             (PATH(3),GROUND),
     .             (PATH(4),TFD(1)),
     .             (PATH(8),ANF(1)),
     .             (PATH(12),SLING),
     .             (PATH(13),SWING),
     .             (PATH(14),REC(1)),
     .             (PATH(17),DRINK),
     .             (PATH(18),AQF(1))


      COMMON /OPT2/ UNIT1(5), UNIT2(24), UNIT3(3), DASHES(10), DOSUNT
      CHARACTER UNIT1*3, UNIT2*2, UNIT3*2, DASHES*8, DOSUNT*10
```

9 1 0 4 8 1 5 0 4

COMMON BLOCKS

```
C---------------------------------------------------------------------

C     INPUT OPTION PARAMETERS
C     Module of GENII                              Version of 11-Jan-88  RAP

      COMMON /OPTION/  IPOP, IPATH, IAC, IWAT, IAIR, LUA, LUW, IGRNUC,
     .                 IGRPOP, IGRPM, IGRPL, IGRTNU, ISPEC, IGRDOS,
     .                 LUN2, IREDE

C---------------------------------------------------------------------

C     NUCDFL LIBRARY DATA
C     Module of GENII                              Version of 14-May-87  RAP

      COMMON /ORGID/  LORG, IORG(25)

C---------------------------------------------------------------------

C     Master Organ List Common Block
C     Module of GENII                              Version of 28-Dec-87 RAP

      COMMON /ORGMAS/ MORG, SINDX(25), TINDX(25), MASMAS(25), SI2I
      INTEGER MORG, SINDX, TINDX
      REAL MASMAS, SI2I

      COMMON /ORGMAC/ MASORG(25)
      CHARACTER*8 MASORG

C---------------------------------------------------------------------

C     Organ Data Common Block
C     Module of GENII                              Version of 11-Nov-87 RAP

      COMMON /ORGPAR/ NORG, NORGCM(5), NORGL, NOTHER, NBONE, NOCOMP,
     .                IORG(25), NORGCR(4),
     .                TARGET(25), IYX(25), ORGMLT(25), TCMULT(45),
     .                TOTMAS, SPECOR(25), ORGING(25), ORGINH(25)

      INTEGER NORG, NORGCM, NORGL, NOTHER, NBONE, NOCOMP, IORG, NORGCR,
     .        IYX
      LOGICAL TARGET, SPECOR
      REAL ORGMLT, TOTMAS, TCMULT, ORGING, ORGINH

      COMMON /ORGPARC/ ORGANS(25)
      CHARACTER ORGANS*8
```

COMMON BLOCKS

```
C-------------------------------------------------------------------

C     ARRAY OF ORGAN DOSES AS A FUNCTION OF TIME, USED BY GRAPHING FOR
C     REPORT
C     Module of GENII                          Version of 8-May-87  RAP

      COMMON / OUTORG / DTOTAL (144)

C-------------------------------------------------------------------

C     NAMELIST DATA FOR CALCULATION
C     Module of GENII

      COMMON /PATHIN/ CONSUM(7), USAGE(7), EXTIM, SW, GRWP(7), YELD(7),
     .                MOPYR, RECON, RM, CFLO, RIRR

      REAL MOPYR

C-------------------------------------------------------------------

C     STORAGE ARRAYS FOR GRAPHING
C     Module of GENII

      COMMON /PLOT/ ARRAY(40,73), LABELY(40), LABELX, TICKY(40),
     .              TICKX(73), LEGEND(40)

      CHARACTER*1 ARRAY, LABELY, TICKY, TICKX
      CHARACTER*73  LABELX
      CHARACTER*12 LEGEND

C-------------------------------------------------------------------

C     SPATIAL POPULATION DATA
C     Module of GENII

      COMMON /POPU/  POP(10,16)
C
C        POP(10,16)    - POPULATION WITHIN EACH SPATIAL INTERVAL FOR 10
C                        DISTANCES AND 16 DIRECTION SECTORS.
```

9 1 0 4 8 1 5 0 6

```
C-----------------------------------------------------------------------

C     Radionuclide (Single Chain) Common Block
C     Module of GENII                               Version of 18-Feb-88 RAP

      COMMON /RAD/ NONUC, IMOD(9), ICL(9), HL(9), ATNUM(9), IRMD(9),
     .             C14, H3
      INTEGER NONUC, IMOD, ICL, ATNUM, IRMD
      REAL HL
      LOGICAL C14, H3

      COMMON /RADC/ ELT(9), AW(9),
     .              BONE(9),
     .              CLASS(9)

      CHARACTER ELT*2, AW*6, BONE*1, CLASS*1

C-----------------------------------------------------------------------

C     Total List of Radionuclides in this Case Common Block
C     Module of GENII                               Version of 23-Dec-87 RAP

      COMMON /RADIN/ NUCTOT, ICH,
     .               IOFNUC(70), ICLASS(100),
     .               IFRT(2,100), DKT(2,100),
     .               HLT(100), ALT(100),
     .               CASCON(9,100), CASQ(3,100), BAS(5)

      INTEGER NUCTOT, ICH, IOFNUC, IFRT, ICLASS
      REAL DKT, HLT, ALT, CASCON, CASQ
      LOGICAL BAS

      COMMON /RADINC/ ELTT(100), AWT(100),
     .                BONET(100),
     .                CLASST(100)

      CHARACTER ELTT*2, AWT*6, BONET*1, CLASST*1
```

```
C-------------------------------------------------------------------

C     CALCULATED POPULATION DOSES
C     Module of GENII                          Version of 17-Aug-88  RAP

      COMMON /RESULT/ DOSSUB(144), DOSEXT(144), DOSINT(25,144),
     .                AEDE2(144), DTOTAL(144),
     .                POPINT(25,100), POPSUB(100), POPEXT(100),
     .                HICDE(11), ICDEH(11), HIWBE(11),
     .                HIAEDE, HIEXT, HISUB, HIEDE, MAXTIM,
     .                HIDOSR(25,100), HIDOSV(25,4),
     .                HISUBR(100), HIEXTR(100),
     .                NORGS, NORGW, ICLN(25)

      REAL DOSSUB, DOSEXT, DOSINT, AEDE2, DTOTAL,
     .     POPINT, POPSUB, POPEXT, HICDE, HIWBE,
     .     HIAEDE, HIEXT, HISUB, HIEDE, HIDOSR, HIDOSV, HISUBR, HIEXTR

      INTEGER ICDEH, MAXTIM, NORGS, ICLN

C-------------------------------------------------------------------

C     Radionuclide Master Library Common Blocks
C     Module of GENII                          Version of 28-Mar-88 RAP

      COMMON /RMD/ NUCS, NCH,
     .             NOFNUC(200), NCHST(200), NCHN(300),
     .             IFR(2,300), DKF(2,300),
     .             TR(300),
     .             NFLAG(300), NFLAGC(300), IMODM(300), RFLAG(300)

      INTEGER IFR, NOFNUC, NCHST, NCHN, NFLAG, NFLAGC, NUCS, NCH, IMODM
      REAL TR, DKF
      LOGICAL RFLAG

      COMMON /RMDC/ ELTM(300), AWM(300), BONED(300), TCLASS(300)
      CHARACTER ELTM*2, AWM*6, BONED*1, TCLASS*1
```

COMMON BLOCKS

```
C-------------------------------------------------------------------

C     Radionuclide Master Library Auxilliary Common Block
C     Module of GENII                         Version of 28-Mar-88 RAP

      COMMON /RMD2/ ATNO(300), NDAU(300), IPNDX(30), BRANCH(30), NIDRMD
      INTEGER ATNO, NDAU, IPNDX, NIDRMD
      REAL BRANCH

      COMMON /RMD2C/ ELT2M(30), AW2M(30)
      CHARACTER ELT2M*2, AW2M*6


C-------------------------------------------------------------------

C     Specific Effective Energies (SEE) Utility Parameters (SEE.CMN)
C     Module of GENII

      COMMON/COMONE/ NSORS,NTARG,SORG(30,8),TORG(40,12)
      COMMON/COMSEV/ AHO,ZHO,LEME(3),HLIFE,UNITS(2),EXCH
      COMMON/COMNIN/ TEFE(30,40), DBLIN(30,40)
      COMMON/PRNTRX/ NPRS,NPRT,IPRS(30),IPRT(40),IGBAR(5),IG,TODAY
      COMMON/BONSEK/ BONES
      COMMON/PAGE/ LPAGE, FF
      COMMON/SYM/ SYMBOL(103)

      CHARACTER*2 SORG, TORG, SYMBOL
      CHARACTER*8 TODAY
      CHARACTER*1 BONES, EXCH, FF
      CHARACTER*4 LEME,LEME1(3),LEME2(3),UNITS1(2),UNITS2(2)
      INTEGER SOPT, VOPT, LPAGE, RADNUM
      REAL*8 DBLIN


C-------------------------------------------------------------------

C     Specific Effective Energies (SEE) Utility Parameters (SEE2.CMN)
C     Module of GENII

      COMMON/SEE2/ GEFE(30,40),BEFE(30,40),AEFE(30,40),REFE(30,40),
     1             SPEFE(5,30,40)
```

```
C------------------------------------------------------------------
C
C     Sij Factors Common Block
C     Module of GENII                              Version of 19-Jun-87 RAP

      COMMON /SIJS/ SIJ(25,25,9), SIJOTH(9)
      REAL SIJ, SIJOTH

C------------------------------------------------------------------

C     Soil Parameters/ Biotic Transport Common Block
C     Module of GENII                            Version of 30-Apr-87 RAP

      COMMON /SOLPAR/ LEACHR(9), BTDSET, INDW, MANULR,
     .                PACKHL, OVRBRD, BTPRE, BTNTK, TOTEXC(3),
     .                EXCAV(6,3), EXCAMT,
     .                YELDBT(3), AVGIRR, AVGYLD, AVGBVI(9),
     .                WASDEP, SOLING, SURCM,
     .                RESIRR, IRRSR, IRTIMR, RIRRR,
     .                RTAVAL(9), RTENV(9), RTPACK(9)

      REAL LEACHR, PACKHL, OVRBRD, EXCAV, EXCAMT, YELDBT, AVGIRR,
     .    AVGYLD, AVGBVI, TOTEXC, MANULR, WASDEP, SOLING, SURCM,
     .    IRTIMR, RIRRR, RTAVAL, RTENV, RTPACK
      INTEGER BTDSET, INDW, IRRSR
      LOGICAL BTPRE, BTNTK, RESIRR

C------------------------------------------------------------------

C     INPUT PARAMETERS FOR RADIONUCLIDE MASTER LIST
C     Module of GENII

      COMMON /SOURCE/ NIN, E(100), A(100)
C
      CHARACTER*2 E
      CHARACTER*6 A
```

```
C-----------------------------------------------------------------------

C     Surface Water Transport Data for a Usage Location
C     Module of GENII                              Version of 11-Dec-86 RAP

      COMMON /SWPAR/ MIXFLG, SWQB, SWDPTH, SWDZ, SWIDTH, SWFLOW,
     .                SWLSX, SWOSY, MIXR, TCWS
      INTEGER MIXFLG
      REAL SWQB, SWDPTH, SWDZ, SWIDTH, SWFLOW, SWLSX, SWOSY, MIXR, TCWS

C-----------------------------------------------------------------------

C     Time Common Block
C     Module of GENII                               Version of 1-Jul-87 RAP

      COMMON /TIMES/ NTIME, ITIME, NBEFORE, ITIMT,
     .               BEFORE, BEFAIR, BEFIRR, LOIC,
     .               RELEND, NTKEND, DCEND,
     .               AQUTT(4), RECTT, SWTT, HSTART

      INTEGER NTIME, ITIME, BEFAIR, BEFIRR, LOIC, NBEFORE, ITIMT
      REAL BEFORE, RELEND, NTKEND, DCEND, AQUTT, RECTT, SWTT
      REAL*8 HSTART

C-----------------------------------------------------------------------

C     REFERENCE TIME PARAMETERS (DITTY)
C     Module of GENII

      COMMON /TIMES2/ TZ, TZR

C-----------------------------------------------------------------------

C     Descriptive Titles Common Block
C     Module of GENII                               Version of 9-Nov-87 RAP

      COMMON /TITL/ TITLS(50)
      CHARACTER*80 TITLS

C-----------------------------------------------------------------------

C     CALCULATED POPULATION AND RELEASE DATA
C     Module of GENII

      COMMON /VARYBL/ PM(144), PL(144), ACTA(144,100), ACTW(144,100)
```

5.2 DATA FILE LISTINGS

Table 5.2 is a table of contents for the data files listed in this section. Data libraries and other text files are listed in the order assigned in the file named FILENAME.DAT.

TABLE 5.2. Data File Listings Table of Contents

```
RMDLIB - Radionuclide Master Library  (29-Aug-88 RAP)
H 3        4.49E+3 1 0 0.0000 0 0.0000   1      ND
BE10       5.84E+8 1 0 0.0000 0 0.0000   4      VY
C 14       2.09E+6 1 0 0.0000 0 0.0000   6      ND
N 13       6.92E-3 1 0 0.0000 0 0.0000   7      ND
F 18       7.62E-2 1 0 0.0000 0 0.0000   9      SD
NA22       9.50E+2 1 0 0.0000 0 0.0000  11      VD
NA24       6.26E-1 1 0 0.0000 0 0.0000  11      VD
SI31       1.09E-1 1 0 0.0000 0 0.0000  14      NW
P 32       1.43E+1 1 0 0.0000 0 0.0000  15      SD
P 33       2.54E+1 1 0 0.0000 0 0.0000  15      VD
S 35       8.74E+1 1 0 0.0000 0 0.0000  16      NW
CL36        1.1E+8 1 0 0.0000 0 0.0000  17      ND
K 40       4.67E11 1 0 0.0000 0 0.0000  19      ND
AR39       9.83E+4 1 0 0.0000 0 0.0000  18      ND
AR41       7.61E-2 1 0 0.0000 0 0.0000  18      ND
CA41       3.67E+7 1 0 0.0000 0 0.0000  20    1 VW
CA45       1.63E+2 1 0 0.0000 0 0.0000  20    1 VW
SC46       8.38E+1 1 0 0.0000 0 0.0000  21      VY
CR51       2.77E+1 1 0 0.0000 0 0.0000  24      VY
MN54       3.13E+2 1 0 0.0000 0 0.0000  25      SW
MN56       1.07E-1 1 0 0.0000 0 0.0000  25      SW
FE55       9.86E+2 1 0 0.0000 0 0.0000  26      NW
FE59       4.46E+1 1 0 0.0000 0 0.0000  26      NW
CO57       2.71E+2 1 0 0.0000 0 0.0000  27      NY
CO58       7.08E+1 1 0 0.0000 0 0.0000  27      NY
CO60       1.92E+3 1 0 0.0000 0 0.0000  27 T    NY
NI59       2.74E+7 1 0 0.0000 0 0.0000  28      NW
NI63       3.65E+4 1 0 0.0000 0 0.0000  28      NW
NI65       1.05E-1 1 0 0.0000 0 0.0000  28      NW
CU64       5.29E-1 1 0 0.0000 0 0.0000  29      ND
ZN65       2.44E+2 1 0 0.0000 0 0.0000  30 T    VY
ZN69M      5.73E-1 1 0 0.0000 0 0.0000  30      SY
ZN69       3.86E-2 2 1 1.0000 0 0.0000  30      SY
GA72       5.87E-1 1 0 0.0000 0 0.0000  31      SW
AS76       1.10E+0 1 0 0.0000 0 0.0000  33      NW
SE75        1.2E+2 1 0 0.0000 0 0.0000  34      NW
SE79       2.37E+7 1 0 0.0000 0 0.0000  34      NW
BR82       1.47E+0 1 0 0.0000 0 0.0000  35      ND
BR83       9.96E-2 1 0 0.0000 0 0.0000  35      ND
KR83M      7.63E-2 2 1 1.0000 0 0.0000  36      ND
BR84       2.21E-2 1 0 0.0000 0 0.0000  35      ND
KR85M      1.87E-1 1 0 0.0000 0 0.0000  36      ND
KR85       3.91E+3 2 1 0.2110 0 0.0000  36      ND
KR87       5.30E-2 1 0 0.0000 0 0.0000  36      ND
RB87       1.73E13 2 1 1.0000 0 0.0000  37      VD
KR88       1.18E-1 1 0 0.0000 0 0.0000  36      ND
RB88       1.24E-2 2 1 1.0000 0 0.0000  37      VD
```

RMDLIB.DAT

```
KR89     2.20E-3 1 0 0.0000 0 0.0000  36      ND
RB89     1.07E-2 2 1 1.0000 0 0.0000  37      VD
SR89     5.06E+1 3 2 1.0000 0 0.0000  38    1 VD
SR87M    1.17E-1 1 0 0.0000 0 0.0000  38    1 SD
RB86     1.87E+1 1 0 0.0000 0 0.0000  37      VD
SR85      6.5E+1 1 0 0.0000 0 0.0000  38    1 VD
SR90     1.04E+4 1 0 0.0000 0 0.0000  38 T  1 VD
Y 90     2.67E+0 2 1 1.0000 0 0.0000  39 T    SY
SR91     3.96E-1 1 0 0.0000 0 0.0000  38    1 SD
Y 91M    3.45E-2 2 1 0.5740 0 0.0000  39      SY
Y 91     5.85E+1 3 2 1.0000 1 0.4260  39      SY
SR92     1.13E-1 1 0 0.0000 0 0.0000  38    1 SD
Y 92     1.48E-1 2 1 1.0000 0 0.0000  39      SY
Y 93     4.21E-1 1 0 0.0000 0 0.0000  39      SY
MO93     1.28E+6 2 0 0.0000 0 0.0000  42.     SD
ZR93     5.58E+8 3 1 1.0000 0 0.0000  40      SW
NB93M    5.33E+3 4 3 1.0000 2 1.0000  41      VY
ZR95     6.40E+1 1 0 0.0000 0 0.0000  40      SW
NB95M    3.61E+0 2 1 0.0080 0 0.0000  41      SY
NB95     3.51E+1 3 2 0.9450 1 0.9922  41      SY
ZR97     7.04E-1 1 0 0.0000 0 0.0000  40      SW
NB97M    6.94E-4 2 1 0.9470 0 0.0000  41      SY
NB97     5.01E-2 3 2 1.0000 1 0.0530  41      SY
NB94     7.41E+6 1 0 0.0000 0 0.0000  41      VY
MO99     2.75E+0 1 0 0.0000 0 0.0000  42      SD
TC99M    2.51E-1 2 1 0.8860 0 0.0000  43      NW
TC99     7.77E+7 3 2 1.0000 1 0.1140  43 T    NW
TC101    9.86E-3 1 0 0.0000 0 0.0000  43      NW
RU103    3.94E+1 1 0 0.0000 0 0.0000  44      NY
PD103    1.70E+1 2 0 0.0000 0 0.0000  46      VY
RH103M   3.90E-2 3 1 0.9974 2 0.9997  45      NY
RU105    1.85E-1 1 0 0.0000 0 0.0000  44      NY 1 RH105M  1.000
RH105    1.47E+0 2 1 1.0000 0 0.0000  45      NY
RU106    3.68E+2 1 0 0.0000 0 0.0000  44 T    NY 1 RH106   1.000
PD107    2.37E+9 1 0 0.0000 0 0.0000  46      VY
PD109    5.61E-1 1 0 0.0000 0 0.0000  46      VY 1 AG109M  1.000
AG110M   2.50E+2 1 0 0.0000 0 0.0000  47      ND 1 AG110   0.985
AG111    7.46E+0 1 0 0.0000 0 0.0000  47      ND
CD109    4.64E+2 1 0 0.0000 0 0.0000  48      ND
CD113M   5.00E+3 1 0 0.0000 0 0.0000  48      ND
CD115M   4.46E+1 1 0 0.0000 0 0.0000  48      ND
CD115    2.23E+0 2 0 0.0000 0 0.0000  48      ND
IN115M   1.82E-1 3 2 1.0000 0 0.0000  49      VD
IN111     2.8E+0 1 0 0.0000 0 0.0000  49      VD
IN114M   5.00E+1 1 0 0.0000 0 0.0000  49      VD 1 IN114   0.957
SN113    1.15E+2 1 0 0.0000 0 0.0000  50      VW
IN113M   6.91E-2 2 1 1.0000 0 0.0000  49      VD
```


9 1 0 4 8 1 5 1 5

```
SN117M   1.40E+1 1 0 0.0000 0 0.0000  50      SW
SN119M   2.93E+2 1 0 0.0000 0 0.0000  50      VW
SN121M   2.01E+4 1 0 0.0000 0 0.0000  50      VW
SN121    1.13E+0 2 1 0.776  0 0.0000  50      VW
SN123    1.29E+2 1 0 0.0000 0 0.0000  50      VW
I 125    6.01E+1 1 0 0.0000 0 0.0000  53    2 ND
SN125    9.64E+0 1 0 0.0000 0 0.0000  50      SW
SB125    1.01E+3 2 1 1.0000 0 0.0000  51      SW
TE125M   5.80E+1 3 2 0.2310 0 0.0000  52      SW
SN126    3.65E+7 1 0 0.0000 0 0.0000  50      VW
SB126M   1.32E-2 2 1 1.0000 0 0.0000  51      SW
SB126    1.24E+1 3 2 0.1400 0 0.0000  51      SW
SB122    2.70E+0 1 0 0.0000 0 0.0000  51      SW
SB124    6.02E+1 1 0 0.0000 0 0.0000  51      SW
SB127    3.85E+0 1 0 0.0000 0 0.0000  51      SW
TE127M   1.09E+2 2 1 0.1690 0 0.0000  52      SW
TE127    3.90E-1 3 2 0.9820 1 0.8310  52      SW
TE123M   1.20E+2 1 0 0.0000 0 0.0000  52      SW
TE129M   3.36E+1 1 0 0.0000 0 0.0000  52      SW
TE129    4.83E-2 2 1 0.6290 0 0.0000  52      SW
I 129    5.73E+9 3 2 1.0000 1 0.3710  53 T  2 ND
TE131M   1.25E+0 1 0 0.0000 0 0.0000  52      SW
TE131    1.74E-2 2 1 0.2220 0 0.0000  52 T    SW
I 131    8.04E+0 3 2 1.0000 1 0.7780  53 T  2 ND
XE131M   1.18E+1 4 3 0.0109 0 0.0000  54      ND
TE132    3.26E+0 1 0 0.0000 0 0.0000  52      SW
I 132    9.58E-2 2 1 1.0000 0 0.0000  53    2 ND
TE133M   3.85E-2 1 0 0.0000 0 0.0000  52      SW
TE133    8.65E-3 2 1 0.1300 0 0.0000  52      SW
I 133    8.67E-1 3 2 1.0000 1 0.8700  53    2 ND
XE133M   2.19E+0 4 3 0.0288 0 0.0000  54      ND
XE133    5.25E+0 5 4 1.0000 3 0.9712  54      ND
TE134    2.90E-2 1 0 0.0000 0 0.0000  52      SW
I 134    3.65E-2 2 1 1.0000 0 0.0000  53    2 ND
CS134M   1.21E-1 1 0 0.0000 0 0.0000  55      ND
CS134    7.53E+2 1 1 1.0000 0 0.0000  55      ND
I 130    5.15E-1 1 0 0.0000 0 0.0000  53    2 ND
I 135    2.75E-1 1 0 0.0000 0 0.0000  53    2 ND
XE135M   1.07E-2 2 1 0.1650 0 0.0000  54      ND
XE135    3.80E-1 3 2 1.0000 1 0.8350  54      ND
CS135    8.40E+8 4 3 1.0000 0 0.0000  55      ND
XE137    2.66E-3 1 0 0.0000 0 0.0000  54      ND
CS137    1.10E+4 2 1 1.0000 0 0.0000  55 T    ND 1 BA137M  0.946
XE138    9.81E-3 1 0 0.0000 0 0.0000  54      ND
CS138    2.24E-2 2 1 1.0000 0 0.0000  55      ND
CS139    6.53E-3 1 0 0.0000 0 0.0000  55      ND
BA139    5.77E-2 2 1 1.0000 0 0.0000  56    1 SD
```


6 1 0 4 8 1 5 1 6

```
BA140    1.28E+1 1 0 0.0000 0 0.0000  56 T 1 SD
LA140    1.68E+0 2 1 1.0000 0 0.0000  57 T   SD
CS136    1.32E+1 1 0 0.0000 0 0.0000  55     ND
BA141    1.27E-2 1 0 0.0000 0 0.0000  56   1 SD
LA141    1.64E-1 2 1 1.0000 0 0.0000  57     SD
CE141    3.25E+1 3 2 1.0000 0 0.0000  58     SY
BA142    7.43E-3 1 0 0.0000 0 0.0000  56   1 SD
LA142    6.63E-2 2 1 1.0000 0 0.0000  57     SD
CE143    1.38E+0 1 0 0.0000 0 0.0000  58     SY
PR143    1.36E+1 2 1 1.0000 0 0.0000  59     SY
CE144    2.84E+2 1 0 0.0000 0 0.0000  58 T   SY
PR144M   5.00E-3 2 1 0.0143 0 0.0000  59     SY
PR144    1.20E-2 3 2 1.0000 1 0.9857  59 T   SY
PR142    7.97E-1 1 0 0.0000 0 0.0000  59     SY
ND147    1.10E+1 1 0 0.0000 0 0.0000  60     SY
PM147    9.58E+2 2 1 1.0000 0 0.0000  61     SY
SM147    3.87E13 3 2 1.0000 0 0.0000  62     SW
PM148M   4.13E+1 1 0 0.0000 0 0.0000  61     SY
PM148    5.37E+0 2 1 0.0420 0 0.0000  61     SY
PM149    2.21E+0 1 0 0.0000 0 0.0000  61     SY
PM151    1.18E+0 1 0 0.0000 0 0.0000  61     SY
SM151    3.29E+4 2 1 1.0000 0 0.0000  62     SW
SM153    1.95E+0 1 0 0.0000 0 0.0000  62     SW
EU152M   3.88E-1 1 0 0.0000 0 0.0000  63     SW
EU152    4.96E+3 1 0 0.0000 0 0.0000  63     SW
EU154    3.21E+3 1 0 0.0000 0 0.0000  63     SW
EU155    1.81E+3 1 0 0.0000 0 0.0000  63     SW
EU156    1.52E+1 1 0 0.0000 0 0.0000  63     SW
GD153    2.42E+2 1 0 0.0000 0 0.0000  64     SD
GD159    7.73E-1 1 0 0.0000 0 0.0000  64     SD
TB160    7.23E+1 1 0 0.0000 0 0.0000  65     SW
TB161    6.91E+0 1 0 0.0000 0 0.0000  65     SW
DY165    9.73E-2 1 0 0.0000 0 0.0000  66     SW
HO166M   4.38E+5 1 0 0.0000 0 0.0000  67     SW
HO166    1.12E+0 1 0 0.0000 0 0.0000  67     SW
ER169    9.40E+0 1 0 0.0000 0 0.0000  68     SW
ER171    3.13E-1 1 0 0.0000 0 0.0000  68     SW
TA182    1.15E+2 1 0 0.0000 0 0.0000  73     VY
W 181    1.21E+2 1 0 0.0000 0 0.0000  74     VD
W 185    7.51E+1 1 0 0.0000 0 0.0000  74     VD
W 187    9.93E-1 1 0 0.0000 0 0.0000  74     SD
RE187    1.72E13 2 1 1.0000 0 0.0000  75     NW
OS185    9.36E+1 1 0 0.0000 0 0.0000  76     ND
OS191     1.5E+1 1 0 0.0000 0 0.0000  76     ND
IR192    7.40E+1 1 0 0.0000 0 0.0000  77     NY
HG203    4.66E+1 1 0 0.0000 0 0.0000  80     ND
TH230    2.81E+7 1 0 0.0000 0 0.0000  90     SY
```


9 1 0 4 8 1 5 1 7

```
RA226   5.84E+5 2 1 1.0000 0 0.0000  88 T 1 VW
RN222   3.82E+0 3 2 1.0000 0 0.0000  86 T   ND 4 PO218   1.000 PB214   1.000 BI214   1.000 PO214   1.000
PB210   8.12E+3 4 3 1.0000 0 0.0000  82 T   VD
BI210   5.01E+0 5 4 1.0000 0 0.0000  83 T   NW
PO210   1.38E+2 6 5 1.0000 0 0.0000  84 T   NW
U 232   2.36E+4 1 0 0.0000 0 0.0000  92     VY
TH232   5.13E12 2 0 0.0000 0 0.0000  90     SY
RA228   2.10E+3 3 2 1.0000 0 0.0000  88   1 VW
AC228   2.55E-1 4 3 1.0000 0 0.0000  89     SY
TH228   6.98E+2 5 4 1.0000 1 1.0000  90     SY
RA224   3.62E+0 6 5 1.0000 0 0.0000  88   1 SW 2 RN220   1.000 PO216   1.000
PB212   4.43E-1 7 6 1.0000 0 0.0000  82     SD
BI212   4.20E-2 8 7 1.0000 0 0.0000  83     NW 2 PO212   .6407 TL208   .3593
U 234   8.29E+7 1 0 0.0000 0 0.0000  92     VY
U 236   8.55E+9 1 0 0.0000 0 0.0000  92     VY
U 235   2.57E11 1 0 0.0000 0 0.0000  92     VY
TH231   1.06E+0 2 1 1.0000 0 0.0000  90     SY
PA231   1.36E+7 3 2 1.0000 0 0.0000  91     SY
AC227   7.95E+3 4 3 1.0000 0 0.0000  89     SY
TH227   1.87E+1 5 4 0.9862 0 0.0000  90     SY
FR223   1.51E-2 6 4 0.0138 0 0.0000  87     ND
RA223   1.14E+1 7 5 1.0000 6 1.0000  88   1 SW 5 RN219   1.000 PO215   1.000 PB211   1.000 BI211   1.000 TL207   1.000
U 237   6.75E+0 1 0 0.0000 0 0.0000  92     SY
NP237   7.81E+8 2 1 1.0000 0 0.0000  93     SW
PA233   2.70E+1 3 2 1.0000 0 0.0000  91     SY
U 233   5.58E+7 4 3 1.0000 0 0.0000  92     VY
TH229   2.68E+6 5 4 1.0000 0 0.0000  90     SY
RA225   1.48E+1 6 5 1.0000 0 0.0000  88   1 SW
AC225   1.00E+1 7 6 1.0000 0 0.0000  89     SY 6 FR221   1.000 AT217   1.000 BI213   1.000 PO213   .9784 TL209   .0216 PB209   1.000
U 238   1.63E12 1 0 0.0000 0 0.0000  92     VY
TH234   2.41E+1 2 1 1.0000 0 0.0000  90     SY 1 PA234M  0.998
PA234   2.79E-1 3 2 0.0016 0 0.0000  91     SY
PU236   1.04E+3 1 0 0.0000 0 0.0000  94     SY
PU237   4.53E+1 1 0 0.0000 0 0.0000  94     SY
AM242M  5.55E+4 1 0 0.0000 0 0.0000  95     SW
AM242   6.68E-1 2 1 1.0000 0 0.0000  95     SW
CM242   1.63E+2 3 2 0.8270 0 0.0000  96     SW
PU242   1.37E+8 4 2 0.1730 0 0.0000  94     SY
NP238   2.12E+0 5 0 0.0000 0 0.0000  93     SW
PU238   3.20E+4 6 5 1.0000 3 1.0000  94     SY
CM244   6.61E+3 1 0 0.0000 0 0.0000  96     SW
PU244   3.01E10 2 0 0.0000 0 0.0000  94     SY
U 240   5.88E-1 3 2 0.9988 0 0.0000  92     SY 1 NP240M  1.000
PU240   2.40E+6 4 3 1.0000 1 1.0000  94     SY
CM245   3.10E+6 1 0 0.0000 0 0.0000  96     SW
PU241   5.26E+3 2 1 1.0000 0 0.0000  94     SY
AM241   1.58E+5 3 2 1.0000 0 0.0000  95 T   SW
```

```
CM246     1.73E+6 1 0 0.0000 0 0.0000  96     SW
CM247     5.69E+9 1 0 0.0000 0 0.0000  96     SW
CM243     1.04E+4 2 0 0.0000 0 0.0000  96     SW
PU243     1.92E-1 3 1 1.0000 0 0.0000  94     SY
AM243     2.69E+6 4 3 1.0000 2 0.0024  95     SW
NP239     2.36E+0 5 4 1.0000 0 0.0000  93     SW
PU239     8.81E+6 6 5 1.0000 2 0.9976  94 T   SY
CM248     1.24E+8 1 0 0.0000 0 0.0000  96     SW
CF252     9.63E+2 1 0 0.0000 0 0.0000  98     SW
                  0 0 0.0000 0 0.0000
```


9 1 5 1 9 8 4 0 1 6

METADATA.DAT

```
Metabolic Data Library (J.R. Johnson)  28-Aug-88 RAP
  6
CARBON          Adult    2.77  0.0  0.0        (as organic)
          1.0        0.0       0.0
 Other    1.0        40.0      0.        0.0
 End
  1
HYDROGEN        Adult   2.77  0.0  0.0      (H3 as HTO)
          1.0        0.0       0.0
 Other    1.0        10.0       0.        0.
 End
 53
IODINE          Adult    1.92 1.00 0.00
          1.0        0.0       0.0
 End
  9
FLUORINE        Adult    34.6 0.95 0.05
          1.0        1.0       1.0
 Bone     1.0        100.0     0.95      0.05



 End
 11
SODIUM          Adult    2.77 0.75 0.02
          1.         0.0       0.0
 Bone     0.3        10.       0.75      0.02
          0.003      500.      0.75      0.02


 Other    0.7        15.       0.75      0.02
 End
  4
BERYLLIUM       Adult    2.77 1.00 0.00
          0.0        .005     .005
 Bone     0.40       1500.     1.0       0.0



 Other    0.16        15.       1.0      0.0
          0.04        1500.     1.        .0
 End
 15
PHOSPHORUS      Adult    1.39 0.8  0.2
          0.8        0.8       0.0
 Bone     0.3        1500.     0.8       0.2
```

```
 Other    0.15       2.         0.8        0.2
          0.40       19.        0.8        0.2
 End
 21
SCANDIUM       Adult     2.77 1.0  0.
          0.0        0.0        .0001
 Bone     0.04       5.         0.1        0.9
          0.36       1500.      0.1        0.9

 Liver    0.03       5.         0.1        0.9
          0.27       1500.      0.1        0.9

 Spleen   .01        5.         0.1        0.9
          .09        1500.      0.1        0.9

 Other    0.02       5.         0.1        0.9
          0.18       1500.      0.1        0.9
 End
 16
SULFUR         Adult     2.77 0.80 0.14
          0.8        0.8        0.0
 Other    0.15       20.        0.80       0.14
          0.05       2000.      0.80       0.14
 End
 33
ARSENIC        Adult     2.77 0.05  0.8
          0.0        0.5         0.0
 Liver    0.028      1.          .05       0.8
          0.042      10.         .05       0.8

 Kidneys  0.006      1.          .05       0.8
          0.009      10.         .05       0.8

 Spleen   0.002      1.          .05       0.8
          0.003      10.         .05       0.8

 Other    .22        1.          .05       0.8
          .34        10.         .05       0.8
 End
 17
CHLORINE       Adult     2.77 0.95 0.03
```

```
          1.0        1.0        0.0
 Other    1.0        10.        0.95       0.03
 End
 19
POTASSIUM       Adult    20.  0.85 0.11
          1.0        0.0        0.0
 Other    1.0        30.        0.85       .11
 End
 20
CALCIUM         Adult    .919  .68  .32
           0.0        0.3       0.0
 Bone Can .426       .00112
          .000605    .000852


 Bone Cor .543       .00439
          .00366     .000189


 Bone Sur 10.5       .883



 Other    11.1       1.54
 End
 24
CHROMIUM        Adult    1.39 0.5  0.5
          0.1        0.1        0.1
 Bone     0.05       1000.      0.5        0.5



 Other    0.4        6.         0.5        0.5
          0.25       80.        0.5        0.5
 End
 25
MANGANESE       Adult    2.77 0.08  .92
          0.1        0.1        0.0
 Bone     0.35       40.        0.08       0.92



 Liver    0.1        4.         0.08       0.92
          0.15       40.        0.08       0.92


 Other    0.2        4.         0.08       0.92
          0.2        40.        0.08       0.92
```

```
 End
 26
IRON           Adult    2.77 0.16 0.84
          0.1       0.1       0.0
 Liver    0.08      2000.     0.16      0.84


 Spleen   0.013     2000.     0.16      0.84


 Other    0.907     2000.     0.16      0.84
 End
 27
COBALT         Adult    1.39 0.83 0.08
          0.8       0.05      0.05
 Liver    0.03      6.        0.83      0.08
          0.01      60.       0.83      0.08
          0.01      800.      0.83      0.08

 Other    0.27      6.0       0.83      0.08
          0.09      60.       0.83      0.08
          0.09      800.      0.83      0.08
 End
 28
NICKEL         Adult    2.77 0.50 0.0
          0.05      0.05      0.0
 Kidneys  0.02      .2        0.50


 Other    0.30      1200.     0.50
 End
 29
COPPER         Adult    2.77 0.03 0.97
          0.5       0.5       0.5
 Liver    0.1       40.       0.03      .97


 Brain    0.1       40.       0.03      .97


 Pancreas 0.006     40.       0.03      .97
```

```
 Other     0.797     40.        0.03       .97
 End
 30
ZINC           Adult    2.77 0.077 0.7
           0.5       0.5        0.5
 Bone      0.2       400.       0.077      0.7


 Other     0.24      20.        0.077      0.7
           0.56      400.       0.077      0.7
 End
 31
GALLIUM        Adult    2.77 0.1   0.1
           0.001     0.001      0.0
 Bone      0.09      1.0        0.1        0.1
           0.21      50.        0.1        0.1


 Liver     0.027     1.         0.1        0.1
           0.063     50.        0.1        0.1


 Spleen    0.003     1.0        0.1        0.1
           0.007     50.        0.1        0.1


 Other     0.18      1.         0.1        0.1
           0.42      50.        0.1        0.1
 End
 32
GERMANIUM      Adult    2.77  1.0  0.0
            1.00      1.00       0.0
 Kidneys    .5        .02        1.


 Other     0.5       1.         1.0
 End
 34
SELENIUM       Adult    2.77 0.35 0.14
           0.8       0.8        0.0
 Liver     .015      3.         .35        .14
           .060      30.        .35        .14
           .075      150.       .35        .14

 Kidneys   .005      3.         .35        .14
```

```
            .02       30.       .35       .14
            .025      150.      .35       .14

 Spleen     .001      3.        .35       .14
            .004      30.       .35       .14
            .005      150.      .35       .14

 Other      .079      3.        .35       .14
            .31       30.       .35       .14
            .39       150.      .35       .14
 End
 35
BROMINE          Adult    2.77 0.93 .009
            1.0       1.0       0.0
 Other      1.        10.       0.93      0.009
 End
 37
RUBIDIUM         Adult    2.77 0.86 0.14
            1.0       0.0       0.0
 Bone       0.25      44.       0.86      0.14


 Other      0.75      44.       0.86      0.14
 End
 38
STRONTIUM        Adult    3.44  .800  .20
             0.3      0.0       0.01
 Bone Can  .378       .00479
           .00725     .00105


 Bone Cor  .516       .00214
           .00136     .000149


 Bone Sur  2.66       .403


 Other      17.6      1.29
 End
 39
YTTRIUM          Adult    2.77 1.0    0.
            0.0     .0001      .0001
 Bone       0.5       8000.     0.1       0.9
```

```
 Liver    0.15      8000.     0.1       0.9


 Other    0.10      8000.     0.1       0.9
 End
 40
ZIRCONIUM       Adult    2.77 1.   0.
          0.002     0.002     0.002
 Bone     0.5       8000.     1.


 Other    0.5       7.        1.
 End
 41
NIOBIUM         Adult    2.77 1.0  0.0
          0.5      0.01      0.01
 Bone     0.35      6.0       1.0
          0.35      200.      1.0


 Kidneys  0.009     6.0       1.0
          0.009     200.      1.0


 Spleen   0.005     6.0       1.0
          0.005     200.      1.0


 Other    0.13      6.0       1.0
          0.13      200.      1.0
 End
 73
TANTALUM        Adult    2.77 1.0  0.0
          0.5       0.001     0.001
 Bone     0.3       100.      1.0


 Kidneys  0.03      4.0       1.0
          0.03      100.      1.0


 Other    0.32      4.0       1.0
          0.32      100.      1.0
 End
```

```
 42
MOLYBDENUM     Adult    2.77 0.63 0.1
          0.8       0.0       0.05
 Bone     0.015     1.        0.63      0.1
          0.14      50.       0.63      0.1


 Liver    0.03      1.        0.63      0.1
          0.27      50.       0.63      0.1


 Kidneys  0.005     1.        0.63      0.1
          0.045     50.       0.63      0.1


 Other    0.05      1.        0.63      0.1
          0.45      50.       0.63      0.1
 End
 43
TECHNETIUM     Adult    35.0 0.67 0.33
          0.8       0.8       0.0
 S Wall   0.075     1.6       0.67      0.33
          0.02      3.7       0.67      0.33
          0.005     22.       0.67      0.33

 Kidneys  0.05      1.6       0.67 0    0.33
          0.02      3.7       0.67      0.33
          0.005     22.       0.67      0.33

 Thyroid  0.04      0.5       0.67      0.33
          0.0007    100.      0.67      0.33


 Other    0.64      1.6       0.67      0.33
          0.17      3.7       0.67      0.33
          0.04      22.       0.67      0.33
 End
 44
RUTHENIUM      Adult    2.31 0.5  0.5
          0.05      0.05      0.05
 Other    0.35      8.0       0.5       0.5
          0.30      35.       0.5       0.5
          0.2       1000.     0.5       0.5
 End
 45
RHODIUM        Adult    2.31 0.5  0.5
          0.05      0.05      0.05
 Other    0.35      8.0       0.5       0.5
```

```
          0.30      35.       0.5       0.5
          0.2       1000.     0.5       0.5
 End
 46
PALLADIUM      Adult     2.77 0.5  0.5
          0.005     0.005     0.005
 Liver    0.45      15.       0.5       0.5


 Kidneys  0.15      15.       0.5       0.5


 Bone     0.07      15.       0.5       0.5


 Other    0.03      15.       0.5       0.5
 End
 47
SILVER         Adult     2.77 0.1  0.8
          0.05      0.05      0.05
 Liver    0.08      3.5       0.1       0.8
          0.72      50.       0.1       0.8


 Other    0.02      3.5       0.1       0.8
          0.18      50.       0.1       0.8
 End
 48
CADMIUM        Adult     2.77 0.8  0.2
          0.05      0.05      0.05
 Liver    0.3       9000.     0.8       0.2


 Kidneys  0.3       9000.     0.8       0.2


 Other    0.4       9000.     0.8       0.2
 End
 49
INDIUM         Adult     2.77  0.1  0.1
          0.02      0.02      0.0
 R Marrow 0.3       8000.     0.1       0.1
```

```
 Liver    0.2       8000.     0.1       0.1


 Kidneys  0.07      8000.     0.1       0.1


 Spleen   0.01      8000.     0.1       0.1
 End
 50
TIN             Adult    2.77 0.10 0.
          0.02      0.02      0.0
 Bone     .07       4.         .1
          .07       25.        .1
          .21       400.       .1

 Other    .03       4.         .1
          .03       25.        .1
          .09       400.       .1
 End
 51
ANTIMONY        Adult    16.64 1.0   0.
          0.1       0.01      0.0
 Bone     0.19      5.        1.
          0.01      100.      1.


 Liver    0.095     5.        1.
          0.005     100.      1.


 Other    0.475      5.        1.
          0.025     100.      1.
 End
 52
TELLURIUM       Adult    0.87 1.   0.
          0.2       0.2       0.0
 Bone     0.25      5000.     1.        0.


 Other    0.25      20.       1.        0.
 End
 55
CESIUM          Adult    2.77 0.9  0.05
```

```
          1.0       0.0       0.0
 Other    0.1       2.0       0.9       0.05
          0.9       110.      0.9       0.05
 End
 56
BARIUM         Adult     30.9    .1    .9
          0.1       0.0       0.0
 Bone Can .776      .00109
          .000396   .000863


 Bone Cor 1.21      .00483
          .00318    .000219


 Bone Sur 2.95      .265



 Other    18.4      .927
 End
 57
LANTHANUM      Adult     2.77 1.0  0.
          .001      .001      .001
 Bone     0.2       3500.     0.1       0.9



 Liver    0.6       3500.     0.1       0.9



 Other    0.20      3500.     0.1       0.9
 End
 58
CERIUM         Adult     2.77   1.0  0.0
          0.0       .0003     0.0003
 Bone     0.2       3500.     0.1       0.9



 Liver    0.6       3500.     0.1       0.9



 Spleen   0.05      3500.     0.1       0.9
```


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```
 Other    0.15        3500.      0.1        0.9
 End
 59
PRASEODYMIUM   Adult     2.77 1.0   0.0
          0.0         0.0003     0.0003
 Bone     0.25        3500.      0.1        0.9


 Liver    0.6         3500.      0.1        0.9


 Kidneys  0.05        10.00      0.1        0.9
 End
 60
NEODYMIUM      Adult     2.77   0.5   0.5
          0.0         0.0003     0.0003
 Bone     0.45        3500.      0.5        0.5


 Liver    0.45        3500.      0.5        0.5
 End
 61
PROMETHIUM     Adult     2.77 0.5  0.5
          0.0         0.0003     0.0003
 Bone     0.45        3500.      0.5        0.5


 Liver    0.45        3500.      0.5        0.5
 End
 62
SAMARIUM       Adult     2.77   0.5   0.5
          0.0003      0.0003     0.0003
 Bone     0.45        3500.      0.5        0.5


 Liver    0.45        3500.      0.5        0.5
 End
 64
GADOLINIUM     Adult     2.77   0.5   0.5
          0.0003      0.0003     0.0
 Bone     0.45        3500.      0.5        0.5
```

```
 Kidneys  0.03      10.       .5        .5


 Liver    0.3       3500.     0.5       0.5
 End
 63
EUROPIUM       Adult    2.77 0.5  0.5
          0.0       0.001     0.001
 Bone     0.4       3500.     0.5       0.5


 Kidneys   .06      10.        .5        .5


 Liver    0.4       3500.     0.5       0.5
 End
 65
TERBIUM        Adult    2.77  0.5  0.5
          0.0003    0.0003    0.0003
 Bone     0.5       3500.     0.5       0.5


 Kidneys  0.05      10.        .5        .5


 Liver    0.25      3500.     0.5       0.5
 End
 70
YTTERBIUM      Adult    2.77  0.5  0.5
          0.0       0.0003    0.0003
 Bone     0.50      3500.     0.5       0.5


 Kidneys  0.02      10.        .5        .5


 Spleen   0.005     3500.      .5        .5
```

9 1 0 4 8 1 5 3 2

```
 Liver    0.03      3500.     0.5       0.5
 End
 72
HAFNIUM         Adult    2.77  1.0  0.0
          .002      .002      .002
 Bone     .5        8000.     1.0        0.0


 Other    .5        7.        1.        0.0
 End
 67
HOLMIUM         Adult    2.77  0.1  0.9
          0.0       3.0E-4    0.0
 Bone     0.4       3500.0     0.1       0.9


 Liver    0.4       3500.0     0.1       0.9


 Pancreas 0.05      3500.0     0.1       0.9


 End
 80
MERCURY-O       Adult    2.77  1.0  0.0
          1.        0.0       0.0
 Brain    .19       80.       1.0
          .01       10000.    1.0


 Kidneys  0.076     80.       1.0
          0.004     10000.    1.0


 Other    0.68      80.       1.0
          0.036     10000.    1.0
 End
 80
MERCURY-I       Adult    2.77  1.0  0.0
          .02       0.02      0.0
 Kidneys  0.076     40.       1.0
          0.004     10000.    1.0
```

METADATA.DAT

```
 Other     0.87      40.       1.0
           0.046     10000.    1.0
 End
 79
GOLD            Adult     2.77  1.   0.0
           0.1       0.1       0.1
 Other     1.        3.        1.
 End
 81
THALLIUM        Adult     2.77 0.67 0.33
           1.0       0.0       0.0
 Kidneys   0.03      10.       0.67       .33


 Other     0.97      10.       0.67       .33
 End
 74
TUNGSTEN        Adult     2.77  0.6  0.1
           0.3       0.0        0.05
 Bone      0.005     5.         .6         .1
           0.0025    100.       .6         .1
           0.018     1000.      .6         .1

 Kidneys   0.007     5.         .6         .1
           0.003     100.       .6         .1


 Liver     0.007     5.         .6         .1
           0.003     100.       .6         .1


 Spleen    0.0035    5.         .6         .1
           0.0015    100.       .6         .1
 End
 75
RHENIUM         Adult     34.6  0.67 0.33
           0.8       0.8       0.0
 Thyroid   0.04      0.5       0.67       0.33


 S Wall    0.075     1.6       0.67       0.33
           0.02      3.7       0.67       0.33
           0.005     22.0      0.67       0.33

 Liver     0.0225    1.6       0.67       0.33
```

```
          0.006    3.7     0.67     0.33
          0.0015   22.0    0.67     0.33

Other     0.62     1.6     0.67     0.33
          0.17     3.7     0.67     0.33
          0.04     22.0    0.67     0.33

End
77
IRIDIUM        Adult    2.77   0.5  0.5
          0.01     0.01    0.01
Liver     0.04     8.0     0.5      0.5
          0.16     200.    0.5      0.5


Kidneys   0.0075   8.0     0.5      0.5
          0.033    200.    0.5      0.5


Spleen    0.004    8.0     0.5      0.5
          0.016    200.    0.5      0.5


Other     0.1      8.0     0.5      0.5
          0.44     200.    0.5      0.5
End
76
OSMIUM         Adult    2.77   0.5  0.5
          0.01     0.01    0.01
Liver     0.04     8.0     0.5      0.5
          0.16     200.    0.5      0.5


Kidneys   0.0075   8.0     0.5      0.5
          0.033    200.    0.5      0.5


Spleen    0.004    8.0     0.5      0.5
          0.016    200.    0.5      0.5


Other     0.1      8.0     0.5      0.5
          0.44     200.    0.5      0.5
End
82
LEAD           Adult    2.77  0.1  0.67
          0.2      0.0     0.0
Bone      0.33     12.     0.1      0.67
```

```
          0.11      180.      0.1        0.67
          0.11      10000.    0.1        0.67

 Liver    0.2       12.       0.1        0.67
          0.045     180.      0.1        0.67
          0.005     10000.    0.1        0.67

 Kidneys  0.016     12.       0.1        0.67
          0.0036    180.      0.1        0.67
          0.0004    10000.    0.1        0.67

 Other    0.14      12.       0.1        0.67
          0.032     180.      0.1        0.67
          0.0036    12000.    0.1        0.67
 End
 83
BISMUTH        Adult   69.3   0.9  0.1
          0.05      0.05      0.0
 Kidneys  0.24      0.6       0.9        0.1
          0.16      5.0       0.9        0.1


 Other    0.18      0.6       0.9        0.1
          0.12      5.0       0.9        0.1
 End
 84
POLONIUM       Adult   2.77  0.05 0.95
          0.1       0.1       0.0
 Liver    0.1       50.       0.05       0.95


 Kidneys  0.1       50.       0.05       0.95


 Spleen   0.1       50.       0.05       0.95


 Other    0.7       50.       0.05       0.95
 End
 87
FRANCIUM       Adult   2.77  0.9  0.05
          1.0       0.0       0.0
 Other    0.1       2.0       0.9        0.05
          0.9       110.      0.9        0.05
 End
```

METADATA.DAT

```
 88
RADIUM          Adult   26.9   .027 .973
          0.0        0.2        0.0
 Bone Can .241       .000462
          .0000900   .000251


 Bone Cor .430       .00188
          .000991    .000121


 Bone Sur 7.83       .221



 Other    16.2       1.08
 End
 89
ACTINIUM        Adult     2.77  1.0  0.0
          0.001      .001       0.001
 Bone     0.45       36500.     0.1        0.9



 Liver    0.45       15000.     0.1        0.9



 Testes   .00035     36500.     .1         .9
 End
 90
THORIUM         Adult     1.39  0.8  0.2
          0.0002     .0002      .0002
 Bone     0.7        8000.      0.8        0.2



 Liver    0.04       700.       0.8        0.2



 Other    0.16       700.       0.8        0.2
 End
 91
PROTACTINIUM    Adult     2.77  0.5  0.5
          0.0        0.001      0.001
 Bone     0.4        36500.     0.5        0.5
```

```
    Liver     0.11       10.         .5         .5
              0.05       60.         .5         .5


    Kidneys   0.004      10.         .5         .5
              0.016      60.         .5         .5
    End
    92
  URANIUM          Adult    2.77   1.0  0.0
              0.05       0.05      0.002
    Bone      0.2        20.       1.0
              0.023      5000.     1.0


    Kidneys   0.12       6.        1.0
              0.00052    1500.     1.0


    Other     0.12       6.        1.0
              0.00052    1500.     1.0
    End
    93
  NEPTUNIUM        Adult    2.77   0.5  0.5
              0.001      0.001    0.001
    Bone      0.75       36500.    0.5        0.5


    Liver     0.15       15000.    0.5        0.5


    Testes    0.00035    36500.    0.5        0.5
    End
    94
  PLUTONIUM        Adult    2.77   0.5  0.5
              0.001      .001     .0001
    Bone      0.45       18250.    0.5        0.5


    Liver     0.45        7300.    0.5        0.5


    Testes    0.00035    36500.    0.5        .05
```

```
 End
 95
AMERICIUM      Adult    2.77  0.5  0.5
         0.0        0.001     0.0
 Bone    0.45       18250.    0.5         0.5


 Liver   0.45        7300.    0.5         0.5


 Testes  0.00035    36500.    0.5         0.5
 End
 96
CURIUM         Adult    2.77  0.5  0.5
         0.0        .001      0.0
 Bone    0.45       18250.    0.5         0.5


 Liver   0.45        7300.    0.5         0.5


 Testes  0.00035    36500.    0.5         0.5
 End
 98
CALIFORNIUM    Adult    2.77  0.5  0.5
         0.0        0.001     0.001
 Bone    0.65       18250.    0.5         0.5


 Liver   0.25        7300.    0.5         0.5


 Testes  0.00035    36500.    0.5         0.5
 End
 14
SILICON        Adult    2.77 1.00 0.00
         0.0         .01     0.0
 Other   0.4         5.0        1.0       0.0
         0.6          100.      1.         .0
 End
 31
 66
```

```
DYPROSIUM         Adult     2.77 1.00 0.00
          0.0        .0003    0.0
 Bone     0.6        3500.      1.0       0.0


 Liver    0.1        3500.0     1.0       0.0


 Kidneys  0.02       10.        1.0       0.0


 End
 68
ERBIUM            Adult     2.77 1.00 0.00
          0.0        .0003    0.0
 Bone     0.6        3500.      1.0       0.0


 Liver    0.05       3500.0     1.0       0.0


 Other    0.1        3500.0     1.0       0.0
 End
 65
TANTALUM          Adult     2.77 1.00 0.00
          0.0        .00      0.001
 Bone     0.3         100.      1.0       0.0


 Kidneys  0.03         4.0      1.0       0.0
          0.03       100.


 Other    0.32         4.0      1.0       0.0
          0.32       100.
 End
  1
HYDROGEN-HTO      Infant    .167 0.47 0.00
          0.0        0.0        0.0
 WATER    0.         0.         0.        0.
```

METADATA.DAT

```
 BT1       0.        0.        0.        0.


 BT2       0.        0.        0.        0.


 Other     0.00011   0.002     0.        0.
           0.0011    0.02      0.        0.


 End
  1
HYDROGEN-HT     Infant    .167 0.47 0.00
            0.0       0.0      0.0
 HT/BLOOD  60.0      13.01     0.        0.
           1.851


 B WATER   7611.     0.0       0.        0.


 BT        0.        0.        0.        0.


 Other     0.00011   0.002     0.        0.
           0.0011    0.02      0.        0.


 End
 53
IODINE          Infant    1.92 1.00 0.00
           1.0       0.0       0.0
 End
 11
SODIUM          Infant    5.0  0.75 0.02
           1.        0.0       0.0
 Bone      0.3       5.0       0.75      0.02
           0.003     250.      0.75      0.02


 Other     0.7       5.0       0.75      0.02
 End
  4
```

METADATA.DAT

```
BERYLLIUM         Infant     5.0   1.0  0.0
            0.0          .005      0.005
 Bone       .4           750.      1.          0.0



 Other      .16          7.        1.           0.0
            .04          750.      1.
 End
 15
PHOSPHORUS        Infant     3.0   0.8  0.2
            0.8          0.8       0.0
 Bone       0.3          700.      0.8         0.2



 Other      0.15         1.        0.8         0.2
            0.40         9.        0.8         0.2
 End
 21
SCANDIUM          Infant     5.0   1.0  0.0
            0.0          0.0       0.0001
 Bone       0.04         5.        0.1         0.9
            0.34         750.       .1          .9


 Liver      0.03         5.       0.1         0.9
            0.27         750.      .1          .9

 Spleen     0.01         5.        .1          .9
            0.09         750.      .1          .9
 Other      0.02         5.        0.1         0.9
            0.18         750.      0.1         0.9
 End
 16
SULFUR            Infant     5.0   0.8 0.14
            .8           .8        0.0
 Other      0.15         10.       0.8         0.14
            0.05         1000.     0.8         0.14
 End
 33
ARSENIC           Infant   5.0   0.05  0.8
            0.0          0.5        0.0
 Liver      0.028        1.         .05         .8
            0.042        5.         .05         .8


 Kidneys    0.006        1.         .05         .8
```

```
           0.009     5.         .05        .8


Spleen     0.002     1.          .05        .8
           0.003     5.         .05         .8


Other      0.22      1.          .05        .8
           0.34      5.          .05        .8
End
17
CHLORINE        Infant   5.0  0.95 0.03
           1.        1.         0.0
Other      1.0       5.         0.95       0.03
End
19
POTASSIUM       Infant   20.  0.85 0.11
           1.        0.0        0.0
Other      1.0       15.        0.85       .11
End
20
CALCIUM         Infant   .919  .68  .32
           0.0        0.3       0.0
Bone Can 3.41        .00995
           .000605   .00968


Bone Cor 3.52        .0132
           .00366    .00902


Bone Sur 10.5        .883


Other      11.1      1.54
End
24
CHROMIUM        Infant    3.0  0.5  0.5
           0.1       0.1        0.1
Bone       0.5       500.       0.5        0.5


Other      0.4       3.         0.5        0.5
           0.25      40.        0.5        0.5
End
25
```

METADATA.DAT

```
MANGANESE          Infant   5.0  0.08  .92
           0.1        0.1        0.0
 Bone      0.35       20.        0.08       0.92


 Liver     0.1        2.         0.08       0.92
           0.15       20.        0.08       0.92


 Other     0.2        2.         0.08       0.92
           0.2        20.        0.08       0.92
 End
 26
IRON               Infant     5.0 0.16 0.84
           0.1        0.1        0.0
 Liver     0.08       500.       0.16       0.84


 Spleen    0.013      1000.      0.16       0.84


 Other     0.907      1000.      0.16       0.84
 End
 27
COBALT             Infant   2.0  0.83 0.08
           0.8        0.05       0.05
 Liver     0.03       3.         0.83       0.08
           0.01       30.        0.83       0.08
           0.01       400.       0.83       0.08

 Other     0.27       3.         0.83       0.08
           0.09       30.        0.83       0.08
           0.09       400.       0.83       0.08
 End
 28
NICKEL             Infant     5.0  0.5  0.0
           0.05       0.05       0.0
 Kidneys   0.02       0.2        0.50


 Other     0.30       600.       0.50
 End
 29
COPPER             Infant   2.77 0.03 0.97
```

```
          0.5       0.5       0.5
Brain     0.1       20.       0.03      .97


Liver     0.1       20.       0.03      .97


Pancreas  0.003     20.       0.03      .97


Other     0.797     20.       0.03      .97
End
30
ZINC           Infant   5.00 .077  0.7
          0.5       0.5       0.5
Bone      0.2       200.      0.077     0.7


Other     0.24      10.       0.077     0.7
          0.56      200.      0.077     0.7
End
31
GALLIUM        Infant    5.0  0.1   0.1
          0.001     0.001     0.0
Bone      0.09      1.        0.1       0.1
          0.21      25.        .1        .9


Liver     0.027     1.        0.1       0.1
          0.063     25.       .1         .1


Spleen    0.018     1.        0.1       0.1
          0.009     25.        .1        .1


Other     0.18      1.        0.1       0.1
          0.42      25.       0.1       0.1
End
32
GERMANIUM      Infant    5.0  1.0    0.
          1.00      1.00      0.0
Kidneys   0.5       .02       1.
```

```
Other    0.5      1.       1.
End
34
SELENIUM         Infant   5.0 0.35 0.14
         0.8      0.8      0.0
Liver    0.015    2.       1.
         0.06     15.      1.
         0.075    75.      1.

Kidneys  0.005    2.       1.
         0.02     15.      1.
         0.025    75.      1.

Spleen   0.001    2.       1.
         0.004    15.      1.
         0.005    75.      1.

Other    0.079    2.       1.
         0.31     15.      1.
         0.39     75.      1.
End
35
BROMINE          Infant   5.   0.93 .009
         1.0      1.0      0.0
Other    1.       2.       0.93      0.009
End
37
RUBIDIUM         Infant   5.   0.86 0.14
         1.       0.0      0.0
Bone     0.25     20.      0.86      0.14


Other    0.75     20.      0.86      0.14
End
38
STRONTIUM        Infant   3.44 .800  .20
         0.3      0.0      0.01
Bone Can 2.67     .0101
         .00725   .00635


Bone Cor 2.30     .00744
         .00136   .00545
```

```
 Bone Sur 2.66       .403


 Other    17.6       1.29
 End
 39
YTTRIUM         Infant    5.0  1.0   0.
          0.0        .0001     .0001
 Bone     0.5        4000.     0.1         0.9


 Liver    0.15       4000.     0.1         0.9


 Other    0.10       4000.     0.1         0.9
 End
 40
ZIRCONIUM       Infant   5.    1.   0.
          0.002      0.002     0.002
 Bone     0.5        3000.     1.


 Other    0.5        3.        1.
 End
 41
NIOBIUM         Infant    5.0  1.0  0.0
          0.5        0.01      0.01
 Bone     0.35       3.0       1.0
          0.35       100.      1.0

 Kidneys  0.009      3.0       1.0
          0.009      100.      1.0

 Spleen   0.005      3.0       1.0
          0.005      100.      1.0

 Other    0.13       3.0       1.0
          0.13       100.      1.0
 End
 73
TANTALUM        Infant    5.0  1.0  0.0
```

	0.5	0.001	0.001	
Bone	0.3	50.	1.0	
Kidneys	0.03	2.0	1.0	
	0.03	50.	1.0	
Other	0.32	2.0	1.0	
	0.32	50.	1.0	
End				
42				
MOLYBDENUM	Infant	5.0	0.63	0.1
	0.8	0.0	0.05	
Bone	0.015	1.	0.63	0.1
	0.14	25.	0.63	0.1
Liver	0.03	1.	0.63	0.1
	0.27	25.	0.63	0.1
Kidneys	0.005	1.	0.63	0.1
	0.045	25.	0.63	0.1
Other	0.05	1.	0.63	0.1
	0.45	25.	0.63	0.1
End				
43				
TECHNETIUM	Infant	35.0	0.67	0.33
	0.8	0.8	0.0	
S Wall	0.075	1.	0.67	0.33
	0.02	2.	0.67	0.33
	0.005	10.	0.67	0.33
Kidneys	0.05	1.	0.67 0	0.33
	0.02	2.	0.67	0.33
	0.005	10.	0.67	0.33
Thyroid	0.04	1.	0.67	0.33
	0.0007	50.	0.67	0.33
Other	0.64	1.	0.67	0.33
	0.17	2.	0.67	0.33
	0.04	10.	0.67	0.33

```
 End
 44
RUTHENIUM        Infant    5.0  0.5  0.5
          0.05       0.05       0.05
 Other    0.35       2.         0.5        0.5
          0.30       10.        0.5        0.5
          0.2        500.       0.5        0.5
 End
 45
RHODIUM          Infant   5.   0.5  0.5
          0.05       0.05       0.05
 Other    0.35       2.         0.5        0.5
          0.30       10.        0.5        0.5
          0.2        500.       0.5        0.5
 End
 46
PALLADIUM        Infant     5.  0.5  0.5
          0.005      0.005      0.005
 Liver    0.45       7.         0.5        0.5


 Kidneys  0.15       7.         0.5        0.5


 Spleen   0.07       7.         0.5        0.5


 Other    0.03       7.         0.5        0.5
 End
 47
SILVER           Infant    5.0   .1  0.0
          0.05       0.05       0.05
 Liver    0.08       1.         0.1        0.8
          0.72       20.        0.1        0.8

 Other    0.02       1.         0.1        0.8
          0.18       20.        0.1        0.8
 End
 48
CADMIUM          Infant     5.  0.8  0.2
          0.05       0.05       0.05
 Liver    0.3        4000.      0.8        0.2
```

9 1 0 4 8 1 5 4 9

```
 Kidneys 0.3       4000.    0.8        0.2


 Other   0.4       4000.    0.8        0.2
 End
 49
INDIUM         Infant    0.0  0.1  0.1
         0.02      0.02     0.0
 R Marrow 0.3      3000.    0.1        0.1


 Liver   0.2       3000.    0.1        0.1


 Kidneys 0.07      3000.    0.1        0.1


 Spleen  0.01      3000.    0.1        0.1
 End
 50
TIN            Infant    5.0 0.10  0.0
         0.02      0.02      0.0
 Bone    0.07      2.         .1
         0.07      15.        .1
         0.21      200.       .1

 Other   0.03      2.         .1
         0.03      15.        .1
         0.09      200.       .1
 End
 51
ANTIMONY       Infant    30.  1.0    0.
         0.1       0.01     0.0
 Bone    0.19      2.       1.
         0.01      50.      1.


 Liver   0.095     2.       1.
         0.005     50.      1.


 Other   0.475     2.       1.
         0.025     50.      1.
```

METADATA.DAT

```
 End
 52
TELLURIUM         Infant     2.   1.   0.
          0.2       0.2        0.0
 Bone     0.25      2000.      1.        0.


 Other    0.25      10.        1.        0.
 End
 55
CESIUM            Infant    5.0  0.9 0.05
          1.0       0.0        0.0
 Other    0.1       1.         0.9       0.05
          0.9       20.        0.9       0.05
 End
 56
BARIUM            Infant   30.9   .1   .9
          0.1       0.0         0.0
 Bone Can 2.33      .00568
          .000396   .00545


 Bone Cor 2.76      .00942
          .00318    .00481


 Bone Sur 2.95      .265


 Other    18.4      .927
 End
 57
LANTHANUM         Infant     5.  1.0   0.
          .001      .001       .001
 Bone     0.2       1500.      0.1       0.9


 Liver    0.6       1500.       .1        .9


 Other    0.2       1500.      0.1       0.9
 End
 58
CERIUM            Infant     5.  1.0  0.0
```

```
             0.0         .0003      0.0003
   Bone      0.2         1500.      0.1         0.9


   Liver     0.6         1500.      0.1         0.9


   Spleen    0.05        1500.      0.1         0.9


   Other     0.15        1500.      0.1         0.9
   End
   59
  PRASEODYMIUM    Infant     5.0   1.0  0.0
             0.          0.0003     0.0003
   Bone      0.25        1500.      0.1         0.9


   Liver     0.6         1500.      0.1         0.9


   Kidneys   0.05        10.         .1          .9
   End
   60
  NEODYMIUM       Infant     5.    0.5  0.5
             0.0         0.0003     0.0003
   Bone      0.45        1500.      0.5         0.5


   Liver     0.45        1500.      0.5         0.5
   End
   61
  PROMETHIUM      Infant     5.    0.5  0.5
             0.0         0.0003     0.0003
   Bone      0.45        1500.      0.5         0.5


   Liver     0.45        1500.      0.5         0.5
   End
   62
  SAMARIUM        Infant     5.    0.5  0.5
```

```
           0.0003     0.0003     0.0003
 Bone      0.45       1500.      0.5        0.5


 Liver     0.45       1500.      0.5        0.5
 End
 64
GADOLINIUM      Infant     5.   0.5  0.5
           0.0003     0.0003     0.0
 Bone      0.45       1500.      0.5        0.5


 Kidneys   0.06       10.         .5         .5


 Liver     0.30       1500.      0.5        0.5
 End
 63
EUROPIUM        Infant     5.   0.5  0.5
           0.0        0.001      0.001
 Bone      0.4        1500.      0.5        0.5


 Kidneys   0.06       10.         .5         .5


 Liver     0.4        1500.      0.5        0.5
 End
 65
TERBIUM         Infant     5.   0.5  0.5
           0.0003     0.0003     0.0003
 Bone      0.5        1500.      0.5        0.5


 Kidneys   0.06       10.         .5         .5


 Liver     0.25       1500.      0.5        0.5
 End
 72
HAFNIUM         Infant     5.    1.  0.0
```

```
               .002        .002        .002
   Bone        .5          4000.       1.          0.


   Other       .5          4.          1.          0.
   End
   70
 YTTERBIUM           Infant     5.     0.5  0.5
               0.0         0.0003      0.0003
   Bone        0.5         1500.       0.5         0.5


   Kidneys     0.02        10.          .5          .5


   Spleen      0.005       1500.        .5          .5


   Liver       0.03        1500.       0.5         0.5
   End
   80
 MERCURY-I           Infant     5.     1.0  0.0
               0.02        0.02        0.0
   Kidneys     0.076       10.         1.0
               0.004       2000.       1.0


   Other       0.87        10.         1.0
               0.046       2000.       1.0
   End
   80
 MERCURY-O           Infant   2.77  1.0  0.0
               1.          0.0         0.0
   Brain       .19         40.         1.
               .01         2000.       1.


   Kidneys     0.076       40.         1.0
               0.004       2000.       1.0


   Other       0.68        40.         1.0
               0.036       2000.       1.0
   End
```

```
 79
GOLD            Infant     5.   1.   0.
          0.1        0.1         0.1
 Other    1.         2.          1.
 End
 81
THALLIUM        Infant   5.    0.67 0.33
         1.0         0.0         0.0
 Kidneys 0.03        5.          0.67          .33


 Other   0.97        5.          0.67          .33
 End
 74
TUNGSTEN        Infant     5.  0.6   0.1
         0.3         0.0          0.05
 Bone    0.005       2.           .6            .1
         0.0025      50.          .6            .1
         0.018       500.         .6            .1

 Kidneys 0.007       2.           .6            .1
         0.003       50.          .6            .1


 Liver   0.007       2.           .6            .1
         0.003       50.          .6            .1


 Spleen  0.0035      2.           .6            .1
         0.0015      50.          .6            .1
 End
 77
IRIDIUM         Infant     5.  0.5   0.5
         0.01        0.01        0.01
 Liver   0.04        2.          0.5           0.5
         0.16        50.         0.5           0.5


 Kidneys 0.0075      2.          0.5           0.5
         0.033       50.         0.5           0.5


 Spleen  0.004       2.          0.5           0.5
         0.016       50.         0.5           0.5


 Other   0.1         2.          0.5           0.5
```

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	0.44	50.		0.5		0.5
End						
76						
OSMIUM	Infant		5.	0.5	0.5	
	0.01	0.01		0.01		
Liver	0.04	2.		0.5		0.5
	0.16	50.		0.5		0.5
Kidneys	0.0075	2.		0.5		0.5
	0.033	50.		0.5		0.5
Spleen	0.004	2.		0.5		0.5
	0.016	50.		0.5		0.5
Other	0.1	2.		0.5		0.5
	0.44	50.		0.5		0.5
End						
82						
LEAD	Infant		5.	0.1	0.67	
	0.2	0.0		0.0		
Bone	0.33	6.		0.1		0.67
	0.11	60.		0.1		0.67
	0.11	4000.		0.1		0.67
Liver	0.02	6.		0.1		0.67
	0.045	60.		0.1		0.67
	0.005	4000.		0.1		0.67
Kidneys	0.016	6.		0.1		0.67
	0.0036	60.		0.1		0.67
	0.0004	4000.		0.1		0.67
Other	0.14	6.		0.1		0.67
	0.032	60.		0.1		0.67
	0.0036	4000.		0.1		0.67
End						
83						
BISMUTH	Infant		69.3	0.9	0.1	
	0.05	0.05		0.0		
Kidneys	0.24	0.6		0.9		0.1
	0.16	2.		0.9		0.1
Other	0.18	0.6		0.9		0.1
	0.12	2.		0.9		0.1

```
 End
 84
POLONIUM        Infant   5.   0.05 0.95
          0.1        0.1       0.0
 Liver    0.1        10.       0.05       0.95


 Kidneys  0.1        10.       0.05       0.95


 Spleen   0.1        10.       0.05       0.95


 Other    0.7        10.       0.05       0.95
 End
 88
RADIUM          Infant   26.9 .027 .973
          0.0        0.2       0.0
 Bone Can 1.76       .00505
          .0000900   .00484


 Bone Cor 1.98       .00647
          .000991    .00471


 Bone Sur 7.83       .221


 Other    16.2       1.08
 End
 89
ACTINIUM        Infant     5.  1.0  0.0
          0.001      .001      0.001
 Bone     0.45       36500.    0.1        0.9


 Liver    0.45       15000.    0.1        0.9


 Testes   0.00035    36500.    .1         .9
 End
```

```
 90
THORIUM         Infant     3.  0.8  0.2
          0.0002     .0002     .0002
 Bone     0.7        2000.     0.8        0.2


 Liver    0.04       200.      0.8        0.2


 Other    0.16       200.      0.8        0.2
 End
 91
PROTACTINIUM    Infant   2.77  0.5  0.5
          0.0        0.001     0.001
 Bone     0.4        36500.    0.5        0.5


 Liver    0.11       5.        0.5        0.5
          0.05       30.        .5         .5


 Kidneys  0.004      5.         .5         .5
          0.016      30.        .5         .5
 End
 92
URANIUM         Infant     5.  1.0  0.0
          0.05       0.05      0.002
 Bone     0.2        10.       1.0
          0.023      1000.     1.0


 Kidneys  0.12       2.        1.0
          0.00052    400.      1.0


 Other    0.12       2.        1.0
          0.00052    400.      1.0
 End
 93
NEPTUNIUM       Infant   2.77  0.5  0.5
          0.001      0.001     0.001
 Bone     0.75       36500.    0.5        0.5
```

```
 Liver     0.15       15000.     0.5        0.5


 Testes    0.00035    36500.     0.5        0.5
 End
 94
PLUTONIUM        Infant    2.77   0.5  0.5
           0.001      .001       .0001
 Bone      0.45       18250.     0.5        0.5


 Liver     0.45        7300.     0.5        0.5


 Testes    0.00035    36500.     0.5        0.5
 End
 95
AMERICIUM        Infant    2.77   0.5  0.5
           0.0        .001       0.0
 Bone      0.45       18250.     0.5        0.5


 Liver     0.45       15000.     0.5        0.5


 Testes    0.00035    36500.     0.5        0.5
 End
 96
CURIUM           Infant    2.77   0.5  0.5
           0.0        .001      0.0
 Bone      0.45       18250.     0.5        0.5


 Liver     0.45        7300.     0.5        0.5


 Testes    0.00035    36500.     0.5        0.5
 End
 98
CALIFORNIUM      Infant    2.77   0.5  0.5
           0.0        .001       .001
```

METADATA.DAT

Bone	0.45	18250.	0.5	0.5
Liver	0.45	7300.	0.5	0.5
Testes	0.00035	36500.	0.5	0.5
End				

RMDBYELE: Radionuclide Master List Sorted by ELement/Isotope (26-Aug-88 RAP)

H 3	RB87	SN117M	BA139	PB210	AM242
BE10	RB88	SN119M	BA140	PB212	AM243
C 14	RB89	SN121M	BA141	BI210	CM242
N 13	SR87M	SN121	BA142	BI212	CM243
F 18	SR89	SN123	LA140	PO210	CM244
NA22	SR85	SN125	LA141	RN222	CM245
NA24	SR90	SN126	LA142	FR223	CM246
SI31	SR91	SB122	CE141	RA223	CM247
P 32	SR92	SB125	CE143	RA224	CM248
P 33	Y 90	SB126M	CE144	RA225	CF252
S 35	Y 91M	SB126	PR142	RA226	
CL36	Y 91	SB124	PR143	RA228	
K 40	Y 92	SB127	PR144M	AC225	
AR39	Y 93	TE123M	PR144	AC227	
AR41	ZR93	TE125M	ND147	AC228	
CA41	ZR95	TE127M	PM147	TH227	
CA45	ZR97	TE127	PM148M	TH228	
SC46	NB93M	TE129M	PM148	TH229	
CR51	NB94	TE129	PM149	TH230	
MN54	NB95M	TE131M	PM151	TH231	
MN56	NB95	TE131	SM147	TH232	
FE55	NB97M	TE132	SM151	TH234	
FE59	NB97	TE133M	SM153	PA231	
CO57	MO93	TE133	EU152M	PA233	
CO58	MO99	TE134	EU152	PA234	
CO60	TC99M	I 125	EU154	U 232	
NI59	TC99	I 129	EU155	U 233	
NI63	TC101	I 130	EU156	U 234	
NI65	RU103	I 131	GD152	U 235	
CU64	RU105	I 132	GD153	U 236	
ZN65	RU106	I 133	GD159	U 237	
ZN69M	RH103M	I 134	TB160	U 238	
ZN69	RH105	I 135	TB161	U 240	
GA72	PD103	XE131M	DY165	NP237	
AS76	PD107	XE133M	HO166M	NP238	
SE75	PD109	XE133	HO166	NP239	
SE79	AG110M	XE135M	ER169	PU236	
BR82	AG111	XE135	ER171	PU237	
BR83	CD109	XE137	TA182	PU238	
BR84	CD113M	XE138	W 181	PU239	
KR83M	CD115M	CS134M	W 185	PU240	
KR85M	CD115	CS134	W 187	PU241	
KR85	IN115M	CS135	RE187	PU242	
KR87	IN111	CS136	OS185	PU243	
KR88	IN113M	CS137	OS191	PU244	
KR89	IN114M	CS138	IR192	AM241	
RB86	SN113	CS139	HG203	AM242M	

FTRANS.DAT

Food Transfer Factor Library - (RAP 29-Aug-88) (UPDATED LEACHING FACTORS)

Ele-ment	Dep Vel m/sec	Leafy Veg	Root Veg	Fruit --	Grain --	Beef day/kg	Poulty day/kg	Milk day/L	Egg day/kg	Leaching Factor
AC	1.0E-3	1.0E-2	1.0E-2	3.0E-3	3.0E-4	4.0E-4	4.0E-3	2.0E-5	2.0E-3	1.3E-03
AM	1.0E-3	2.0E-3	2.0E-3	2.0E-3	2.0E-4	2.0E-5	2.0E-4	3.0E-7	9.0E-3	1.3E-03
SB	1.0E-3	5.0E-2	5.0E-2	5.0E-2	5.0E-2	1.0E-3	6.0E-3	7.5E-4	7.0E-2	4.2E-02
AR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8
BA	1.0E-3	4.0E-2	4.0E-2	4.0E-2	4.0E-3	5.0E-4	8.1E-4	4.8E-4	1.5E+0	9.5E-05
BE	1.0E-3	8.0E-3	8.0E-3	8.0E-3	3.3E-3	8.0E-4	4.0E-1	2.0E-6	2.0E-2	1.9E-04
BI	1.0E-3	6.0E-1	6.0E-1	6.0E-1	6.0E-1	1.7E-2	9.9E-4	5.0E-4	9.9E-4	2.7E-05
CD	1.0E-3	2.0E+0	2.0E+0	2.0E+0	6.0E-1	4.0E-4	8.4E-1	1.2E-4	1.0E-1	6.3E-04
CA	1.0E-3	2.0E+0	2.0E+0	2.0E+0	2.0E+0	1.6E-3	4.4E-2	8.0E-3	4.4E-1	1.9E-04
C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.0E-01
CS	1.0E-3	2.0E-2	2.0E-2	2.0E-2	1.0E-2	3.0E-2	4.4E+0	7.0E-3	4.9E-1	1.1E-03
CE	1.0E-3	4.0E-2	4.0E-2	4.0E-2	4.0E-3	2.0E-3	1.0E-2	4.0E-5	5.0E-3	5.0E-04
CL	1.0E-3	5.0E+1	5.0E+1	5.0E+1	1.0E+0	3.0E-2	3.0E-2	2.0E-2	9.9E-4	8.0E-01
CR	1.0E-3	4.0E-2	4.0E-2	4.0E-2	4.0E-3	9.0E-3	9.9E-4	1.0E-5	9.9E-4	4.7E-03
CO	1.0E-3	1.0E-1	1.0E-1	1.0E-1	4.0E-3	2.0E-2	5.0E-1	1.0E-4	1.0E-1	3.0E-02
CU	1.0E-3	5.0E-1	5.0E-1	5.0E-1	5.0E-2	9.0E-3	5.1E-1	2.0E-3	4.9E-1	2.9E-03
CM	1.0E-3	2.0E-3	2.0E-3	2.0E-3	2.0E-4	5.0E-3	4.0E-3	3.0E-7	2.0E-3	1.3E-04
EU	1.0E-3	1.0E-2	1.0E-2	1.0E-2	2.0E-3	6.0E-3	4.0E-3	2.0E-5	7.0E-3	5.0E-04
GD	1.0E-3	5.0E-2	5.0E-2	5.0E-2	5.0E-3	2.0E-3	9.9E-4	6.0E-5	9.9E-4	4.1E-04
GA	1.0E-3	1.0E-2	1.0E-2	1.0E-2	1.0E-3	3.0E-4	9.9E-4	1.0E-5	9.9E-4	1.8E-04
AU	1.0E-3	4.0E-1	4.0E-1	4.0E-1	4.0E-2	5.0E-3	9.9E-4	1.0E-5	9.9E-4	1.1E-02
HF	1.0E-3	1.0E-2	1.0E-2	1.0E-2	2.0E-3	4.0E-4	9.9E-4	2.0E-5	9.9E-4	1.8E-04
HO	1.0E-3	1.0E-2	2.0E-2	1.0E-2	2.7E-3	5.0E-3	4.0E-3	2.5E-6	7.0E-3	4.1E-04
IN	1.0E-3	1.0E-2	1.0E-2	1.0E-2	1.0E-3	4.0E-3	9.9E-4	2.0E-4	9.9E-4	1.8E-04
I	1.0E-2	4.0E-1	4.0E-1	4.0E-1	4.0E-1	2.0E-3	1.8E-2	1.2E-2	2.8E+0	0.8
IR	1.0E-3	1.0E-1	1.0E-1	1.0E-1	4.0E-3	2.0E-3	9.9E-4	2.0E-6	9.9E-4	1.8E-03
FE	1.0E-3	2.0E-2	2.0E-2	2.0E-2	5.0E-3	2.0E-2	1.5E+0	5.0E-5	1.3E+0	1.8E-02
KR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8
LA	1.0E-3	1.0E-2	1.0E-2	1.0E-2	3.0E-4	5.0E-3	1.0E-1	2.5E-6	9.0E-3	4.1E-04
PB	1.0E-3	1.0E-1	1.0E-1	1.0E-1	1.0E-2	4.0E-4	9.9E-4	3.0E-5	9.9E-4	4.5E-04
MN	1.0E-3	7.0E-1	7.0E-1	7.0E-1	2.0E-1	5.0E-4	5.0E-2	3.0E-4	6.5E-2	1.1E-02
HG	1.0E-3	1.0E+0	1.0E+0	1.0E+0	1.0E-1	1.0E-1	1.1E-2	4.0E-4	9.9E-4	4.6E-04
MO	1.0E-3	1.0E+0	1.0E+0	1.0E+0	1.0E-1	1.2E-3	1.9E-1	1.7E-3	7.8E-1	0.8
ND	1.0E-3	1.0E-2	1.0E-2	1.0E-2	1.0E-3	5.0E-3	4.0E-3	2.0E-5	2.0E-4	4.1E-04
NP	1.0E-3	1.0E+0	1.0E+0	1.0E+0	1.0E-1	1.0E-3	4.0E-3	1.0E-5	2.0E-3	3.3E-03
NI	1.0E-3	1.0E-1	1.0E-1	1.0E-1	5.0E-2	2.0E-3	1.0E-3	1.0E-3	1.0E-1	4.6E-03
NB	1.0E-3	4.0E-2	4.0E-2	4.0E-2	8.0E-3	2.6E-7	3.1E-4	4.1E-7	1.3E-3	2.7E-03
PD	1.0E-3	3.0E-1	3.0E-1	3.0E-1	5.0E-2	1.0E-3	3.0E-4	5.0E-3	4.0E-3	4.6E-03
P	1.0E-3	4.0E+0	4.0E+0	4.0E+0	4.0E+0	5.0E-2	1.9E-1	1.5E-2	1.0E+1	0.8
PU	1.0E-3	4.0E-4	4.0E-4	4.0E-4	4.0E-5	2.0E-6	1.5E-4	1.0E-7	8.0E-3	1.3E-03
PO	1.0E-3	1.0E-2	1.0E-2	1.0E-2	1.0E-3	4.5E-3	9.9E-4	1.2E-4	9.9E-4	2.7E-05
K	1.0E-3	3.0E+0	3.0E+0	3.0E+0	3.0E+0	1.8E-2	9.9E-4	7.0E-3	9.9E-4	0.5
PR	1.0E-3	1.0E-2	1.0E-2	1.0E-2	1.0E-3	5.0E-3	3.0E-2	2.5E-6	5.0E-3	5.0E-04
PM	1.0E-3	1.0E-2	1.0E-2	1.0E-2	1.0E-3	5.0E-3	2.0E-3	2.5E-6	2.0E-2	5.0E-04
PA	1.0E-3	5.0E-2	5.0E-2	5.0E-2	2.0E-2	5.0E-3	4.0E-3	2.5E-6	2.0E-3	1.3E-03

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FTRANS.DAT

RA	1.0E-3	1.0E-1	1.0E-1	1.0E-1	1.0E-2	9.0E-4	9.9E-4	2.0E-4	2.0E-5	5.9E-04
RH	1.0E-3	5.0E+1	5.0E+1	5.0E+1	5.0E+0	1.0E-3	3.0E-4	5.0E-3	4.0E-3	4.4E-03
RB	1.0E-3	3.0E-1	3.0E-1	3.0E-1	3.0E-1	1.0E-2	2.0E+0	1.0E-2	3.0E+0	4.4E-03
RU	1.0E-3	2.0E-1	2.0E-1	2.0E-1	2.0E-1	2.0E-3	7.0E-3	6.0E-7	6.0E-3	7.6E-04
SM	1.0E-3	1.0E-2	1.0E-2	1.0E-2	2.0E-3	5.0E-3	4.0E-3	2.0E-5	7.0E-3	4.1E-04
SC	1.0E-3	1.0E-2	1.0E-2	1.0E-2	1.0E-2	6.0E-3	4.0E-3	2.5E-6	9.9E-4	2.7E-04
AG	1.0E-3	6.0E-1	6.0E-1	6.0E-1	6.0E-2	2.0E-3	9.9E-4	2.5E-2	9.9E-4	2.7E-01
SE	1.0E-3	5.0E-1	5.0E-1	5.0E-1	5.0E-2	1.0E+0	8.5E+0	2.3E-2	9.3E+0	1.7E-02
NA	1.0E-3	1.0E+1	1.0E+1	1.0E+1	1.0E+1	8.0E-2	1.0E-2	2.0E-2	2.0E-1	0.5
SR	1.0E-3	2.0E+0	2.0E+0	2.0E+0	2.0E-1	8.0E-4	3.5E-2	1.3E-3	3.0E-1	2.7E-03
S	1.0E-3	2.0E+0	2.0E+0	2.0E+0	2.0E+0	2.0E-1	9.9E-4	1.5E-2	9.9E-4	3.4E-02
TC	1.0E-3	4.0E+1	4.0E+1	4.0E+1	4.0E+1	9.9E-4	3.0E-2	3.0E-4	3.0E+0	0.8
TE	1.0E-3	5.0E+0	5.0E+0	5.0E+0	5.0E-1	7.0E-3	8.5E-2	4.5E-4	5.2E+0	0.8
TH	1.0E-3	4.0E-3	4.0E-3	4.0E-3	4.0E-4	5.0E-3	4.0E-3	2.5E-6	2.0E-3	5.3E-04
SN	1.0E-3	1.0E-1	1.0E-1	1.0E-1	1.0E-2	1.0E-2	9.9E-4	1.0E-3	9.9E-4	2.7E-03
W	1.0E-3	3.0E+0	3.0E+0	3.0E+0	3.0E-1	3.7E-2	9.9E-4	3.0E-4	9.9E-4	1.8E-03
U.	1.0E-3	4.0E-3	4.0E-3	4.0E-3	2.0E-4	2.0E-4	1.2E+0	6.0E-4	9.9E-1	1.3E-03
XE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8
Y	1.0E-3	1.0E-2	1.0E-2	1.0E-2	1.0E-3	1.0E-3	1.0E-2	5.0E-6	2.0E-3	5.0E-04
ZN	1.0E-3	2.0E+0	2.0E+0	2.0E+0	2.0E+0	1.0E-1	6.5E+0	1.0E-2	2.6E+0	2.8E-04
ZR	1.0E-3	4.0E-2	4.0E-2	4.0E-2	4.0E-2	1.2E-6	6.4E-5	5.5E-7	1.9E-4	5.3E-04
H	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.0E-01
N	1.0E-3	7.5E+0	7.5E+0	7.5E+0	7.5E+0	9.9E-4	9.9E-4	1.1E-2	9.9E-4	0.8
F	1.0E-2	2.0E-2	2.0E-2	2.0E-2	2.0E-2	2.0E-2	9.9E-4	7.0E-3	9.9E-4	0.8
AS	1.0E-3	1.0E-2	1.0E-2	1.0E-2	1.0E-2	1.5E-3	8.3E-1	8.0E-5	9.9E-4	1.3E-03
BR	1.0E-2	7.6E-1	7.6E-1	7.6E-1	7.6E-1	2.0E-2	4.0E-3	2.0E-2	1.6E+0	1.1E-01
TB	1.0E-3	2.6E-3	2.6E-3	2.6E-3	2.6E-3	5.0E-3	4.0E-3	2.5E-6	7.0E-3	4.1E-04
RN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8
CF	1.0E-3	2.5E-3	2.5E-3	2.5E-3	2.5E-3	5.0E-3	4.0E-3	7.5E-7	2.0E-3	4.1E-04
DY	1.0E-3	9.9E-4	9.9E-4	9.9E-4	9.9E-4	5.3E-3	9.9E-4	5.0E-6	9.9E-4	4.1E-04
MG	1.0E-3	9.9E-4	9.9E-4	9.9E-4	9.9E-4	1.8E-2	9.9E-4	9.9E-4	1.6E+0	1.9E-04
RE	1.0E-3	9.9E-4	9.9E-4	9.9E-4	9.9E-4	9.9E-4	9.9E-4	1.0E-3	9.9E-4	3.3E-02
TA	1.0E-3	9.9E-4	9.9E-4	9.9E-4	9.9E-4	9.9E-4	9.9E-4	3.0E-6	9.9E-4	4.1E-04
TL	1.0E-3	9.9E-4	9.9E-4	9.9E-4	9.9E-4	9.9E-4	9.9E-4	2.0E-3	9.9E-4	0.5
SI	1.0E-3	3.5E-1	3.5E-1	3.5E-1	3.5E-1	4.0E-5	9.9E-4	2.0E-5	9.9E-4	8.8E-03
ER	1.0E-3	1.0E-2	1.0E-2	1.0E-2	1.0E-2	4.0E-3	9.9E-4	2.0E-5	9.9E-4	4.1E-04

BIOAC1.DAT

Bioaccumulation Factor Library - (30-Aug-88) RAP

Salt:	Fish	Crustacea	Molluscs	Plants	Fr:Fish	Crustacea	Molluscs	Plants	Cleanup
AC	30.0	1000.0	1000.0	1000.0	330.0	1000.0	1000.0	10000.0	.7
AM	2500.0	360.0	290.0	2900.0	100.0	100.0	100.0	3000.0	.7
SB	1000.0	100.0	1200.0	100.0	200.0	100.0	100.0	1000.0	.8
BA	10.0	1.0	20.0	100.0	200.0	200.0	200.0	500.0	.4
BE	1000.0	10000.0	10000.0	10000.0	10.0	50.0	50.0	200.0	.2
BI	15.0	1000.0	1000.0	10000.0	15.0	100000.0	100000.0	1500.0	.9
BK	50.0	500.0	20000.0	1.0	50.0	500.0	20000.0	1.0	
BR	10.0	10.0	10.0	10.0	420.0	330.0	330.0	50.0	
CD	2000.0	5000.0	10000.0	1000.0	200.0	10000.0	10000.0	500.0	.6
CA	2.0	5.0	1.0	50.0	200.0	2000.0	2000.0	1000.0	.2
CF	50.0	500.0	2000.0	5000.0	25.0	1000.0	1000.0	5000.0	
C	20000.0	20000.0	20000.0	1800.0	9000.0	9000.0	9000.0	4500.0	1.0
CE	100.0	500.0	500.0	5000.0	500.0	1000.0	1000.0	4000.0	.2
CS	100.0	30.0	30.0	700.0	15000.0	500.0	500.0	1000.0	.9
CL	1.0	1.0	1.0	1.0	50.0	50.0	50.0	50.0	1.0
CR	600.0	500.0	1140.0	4000.0	20.0	2000.0	2000.0	4000.0	
CO	100.0	2000.0	3000.0	400.0	330.0	2000.0	2000.0	1000.0	.2
CU	1000.0	5000.0	5000.0	1000.0	2500.0	400.0	400.0	2000.0	
CM	2500.0	460.0	460.0	43000.0	30.0	1000.0	1000.0	10000.0	.7
DY	500.0	1000.0	5000.0	1.0	25.0	1000.0	5000.0	1.0	
EU	300.0	1000.0	7000.0	5000.0	300.0	3000.0	3000.0	5000.0	.2
GD	500.0	2000.0	5000.0	1.0	500.0	2000.0	5000.0	1.0	
HF	40.0	1000.0	3000.0	1.0	40.0	1000.0	3000.0	1.0	
HO	300.0	1000.0	1000.0	5000.0	300.0	3000.0	3000.0	5000.0	.2
H	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
IN	1000.0	10000.0	10000.0	1.0	1000.0	10000.0	10000.0	1.0	
I	10.0	50.0	50.0	1500.0	50.0	100.0	100.0	300.0	.8
IR	20.0	100.0	100.0	100.0	50.0	200.0	200.0	200.0	
FE	3000.0	5000.0	30000.0	50000.0	2000.0	100.0	100.0	1000.0	.2
KR	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
PB	200.0	1000.0	1000.0	50000.0	2000.0	500.0	500.0	2000.0	.9
MN	400.0	800.0	6000.0	10000.0	400.0	100000.0	100000.0	10000.0	.5
HG	20000.0	20000.0	10000.0	34000.0	20000.0	20000.0	20000.0	34000.0	
MO	40.0	20.0	20.0	100.0	10.0	100.0	100.0	1000.0	.9
NP	2500.0	10.0	150.0	6.0	2500.0	30.0	30.0	300.0	.7
NI	100.0	500.0	500.0	3000.0	100.0	500.0	500.0	500.0	.2
NB	100.0	50.0	50.0	500.0	100.0	50.0	50.0	500.0	.7
PD	50.0	300.0	300.0	20000.0	50.0	2000.0	2000.0	2000.0	.5
P	28000.0	38000.0	45000.0	100000.0	66700.0	100000.0	100000.0	500000.0	.4
PU	1000.0	300.0	3000.0	3600.0	250.0	100.0	100.0	890.0	.7
PO	2000.0	50000.0	10000.0	1000.0	50.0	20000.0	20000.0	2000.0	.8
PR	100.0	1000.0	1000.0	1000.0	25.0	1000.0	1000.0	5000.0	.2
PM	500.0	1000.0	5000.0	3000.0	300.0	3000.0	3000.0	5000.0	.2
PA	300.0	10.0	10.0	50.0	30.0	30.0	30.0	300.0	.7
RA	950.0	100.0	100.0	1000.0	50.0	1000.0	1000.0	30000.0	.7
RB	500.0	200.0	200.0	1000.0	2000.0	1000.0	1000.0	1000.0	.9

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BIOAC1.DAT

RU	10.0	100.0	2000.0	1000.0	100.0	300.0	300.0	2000.0	.5
SM	500.0	1000.0	5000.0	5000.0	300.0	3000.0	3000.0	5000.0	.2
SC	750.0	300.0	100000.0	1000.0	100.0	1000.0	1000.0	10000.0	.3
SE	6000.0	5000.0	6000.0	1000.0	1000.0	2000.0	2000.0	100.0	.8
AG	300.0	350.0	580.0	1000.0	100.0	200.0	200.0	1000.0	.7
NA	1.0	0.1	0.3	1.0	70.0	100.0	100.0	100.0	.9
SR	4.0	1.0	40.0	300.0	50.0	100.0	100.0	3000.0	.2
S	2.0	1.0	4.0	5.0	750.0	100.0	100.0	1.0	
TA	60.0	3000.0	3000.0	1.0	60.0	3000.0	3000.0	1.0	
TC	30.0	10.0	20.0	5000.0	15.0	100.0	100.0	5000.0	.7
TE	1000.0	1000.0	1000.0	400.0	400.0	6100.0	6100.0	100.0	.8
TB	60.0	1000.0	3000.0	1000.0	25.0	1000.0	1000.0	5000.0	.2
TH	600.0	1000.0	1000.0	2000.0	100.0	100.0	100.0	3000.0	.7
TL	5000.0	1000.0	5000.0	1.0	5000.0	1000.0	5000.0	1.0	
TM	500.0	1000.0	5000.0	1.0	500.0	1000.0	5000.0	1.0	
SN	50000.0	50000.0	50000.0	50000.0	1000.0	10000.0	10000.0	50000.0	.7
W	10.0	10.0	100.0	100.0	1200.0	10.0	10.0	1200.0	
U	50.0	10.0	30.0	1000.0	50.0	100.0	100.0	900.0	.7
XE	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
Y	20.0	1000.0	1000.0	300.0	25.0	1000.0	1000.0	5000.0	.2
YB	200.0	1000.0	3000.0	1.0	200.0	1000.0	3000.0	1.0	
ZN	1000.0	50000.0	30000.0	50000.0	2500.0	10000.0	10000.0	20000.0	.4
ZR	50.0	50.0	50.0	5000.0	200.0	50.0	50.0	5000.0	.7
N	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
F	4.0	4.0	4.0	1.0	10.0	100.0	100.0	2.0	.8
AR	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	.0
AS	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	.7
RH	10.0	100.0	100.0	100.0	10.0	300.0	300.0	200.0	.5
LA	30.0	100.0	100.0	300.0	25.0	1000.0	1000.0	5000.0	.2
ND	100.0	1000.0	1000.0	1000.0	25.0	1000.0	1000.0	5000.0	.2
RN	1.0	1.0	1.0	1.0	57.0	1.0	1.0	1.0	.0
SI	50000.0	50000.0	50000.0	50000.0	1000.0	10000.0	10000.0	50000.0	.7
GA	1000.0	10000.0	10000.0	1.0	1000.0	10000.0	10000.0	1.0	
ER	100.0	500.0	500.0	5000.0	500.0	1000.0	1000.0	4000.0	.2

GRDF.DAT

External Dose Factors for GENII in person Sv/yr per Bq/n (28-Aug-88 RAP)

n	Air Submersion m3	Water Surface L	Soil Surface "m3"	Buried 0.15 m m3	Buried 0.5 m m3	Buried 1.0m m3
H 3	1.95E-16	2.86E-16	1.04E-20	0.00E+00	0.00E+00	0.00E+00
BE10	4.21E-10	5.88E-10	1.30E-13	1.66E-15	1.95E-18	5.66E-22
C 14	1.41E-11	2.02E-11	2.23E-15	8.89E-19	3.86E-24	3.56E-31
N 13	1.93E-06	2.66E-06	1.03E-09	9.53E-11	5.30E-13	3.72E-16
F 18	1.87E-06	2.58E-06	1.00E-09	9.23E-11	5.13E-13	3.60E-16
NA22	3.89E-06	4.99E-06	2.11E-09	2.77E-10	4.59E-12	2.07E-14
NA24	8.08E-06	1.00E-05	4.07E-09	1.07E-09	6.29E-11	1.54E-12
SI31	6.17E-09	8.26E-09	2.89E-12	2.32E-13	3.40E-15	1.51E-17
P 32	6.32E-09	8.71E-09	2.89E-12	1.56E-13	9.86E-16	2.03E-18
P 33	4.90E-11	6.96E-11	1.01E-14	2.12E-17	5.55E-22	3.34E-28
S 35	1.63E-11	2.34E-11	2.67E-15	1.31E-18	7.67E-24	1.82E-30
CL36	7.52E-10	1.05E-09	2.57E-13	5.16E-15	1.09E-17	4.80E-21
K 40	2.86E-07	3.87E-07	1.53E-10	2.87E-11	8.40E-13	6.53E-15
AR39	4.22E-10	5.89E-10	1.31E-13	1.71E-15	2.11E-18	6.34E-22
AR41	2.14E-06	2.58E-06	1.17E-09	1.90E-10	4.09E-12	2.03E-14
CA41	2.65E-10	3.89E-10	1.41E-14	0.00E+00	0.00E+00	0.00E+00
CA45	5.11E-11	7.26E-11	1.07E-14	2.40E-17	6.49E-22	5.39E-28
SC46	3.62E-06	4.42E-06	1.96E-09	2.83E-10	5.10E-12	2.22E-14
CR51	6.43E-08	8.84E-08	3.47E-11	2.43E-12	7.66E-15	2.43E-18
MN54	1.46E-06	1.82E-06	7.85E-10	9.20E-11	9.88E-13	1.78E-15
MN56	3.22E-06	3.93E-06	1.69E-09	3.27E-10	1.34E-11	2.36E-13
FE55	6.07E-10	8.90E-10	3.23E-14	0.00E+00	0.00E+00	0.00E+00
FE59	1.92E-06	2.32E-06	1.08E-09	1.73E-10	3.53E-12	1.62E-14
CO57	1.79E-07	2.45E-07	7.48E-11	7.80E-13	7.38E-16	6.00E-19
CO58	1.77E-06	2.25E-06	9.50E-10	1.08E-10	1.13E-12	2.47E-15
CO60	4.31E-06	5.19E-06	2.35E-09	3.83E-10	8.23E-12	4.08E-14
NI59	7.37E-10	1.08E-09	3.92E-14	0.00E+00	0.00E+00	0.00E+00
NI63	6.50E-13	9.47E-13	5.65E-17	6.96E-24	4.40E-34	0.00E+00
NI65	1.02E-06	1.32E-06	5.46E-10	9.62E-11	2.57E-12	1.84E-14
CU64	3.57E-07	4.91E-07	1.91E-10	1.80E-11	1.15E-13	1.67E-16
ZN65	1.12E-06	1.36E-06	6.12E-10	9.85E-11	2.10E-12	1.04E-14
ZN69M	9.18E-07	1.27E-06	4.91E-10	4.53E-11	2.52E-13	1.77E-16
ZN69	1.34E-09	1.86E-09	4.98E-13	1.45E-14	4.53E-17	2.56E-20
GA72	5.10E-06	6.31E-06	2.67E-09	5.28E-10	2.35E-11	4.72E-13
AS76	8.60E-07	1.21E-06	4.83E-10	5.68E-11	9.34E-13	8.54E-15
SE75	6.05E-07	8.29E-07	2.90E-10	1.17E-11	3.47E-14	2.17E-17
SE79	1.05E-11	1.50E-11	1.59E-15	5.17E-19	2.03E-24	1.33E-31
BR82	4.81E-06	6.39E-06	2.67E-09	3.36E-10	5.07E-12	2.30E-14
BR83	1.49E-08	2.06E-08	7.77E-12	6.85E-13	3.77E-15	2.64E-18
KR83M	5.16E-10	7.57E-10	2.90E-14	8.11E-26	0.00E+00	0.00E+00
BR84	3.30E-06	3.97E-06	1.71E-09	4.29E-10	2.87E-11	1.01E-12
KR85M	2.30E-07	3.15E-07	1.08E-10	4.00E-12	1.10E-14	3.54E-18
KR85	4.84E-09	6.69E-09	2.46E-12	2.11E-13	1.16E-15	8.12E-19
KR87	1.66E-06	2.08E-06	8.53E-10	1.72E-10	8.65E-12	2.07E-13

9 1 0 4 8 1 5 6 6

RB87	5.51E-11	7.81E-11	1.19E-14	3.08E-17	1.02E-21	5.93E-27
KR88	3.63E-06	4.43E-06	1.86E-09	4.44E-10	2.24E-11	4.21E-13
RB88	1.32E-06	1.61E-06	6.86E-10	1.57E-10	7.82E-12	1.60E-13
KR89	3.45E-06	4.34E-06	1.82E-09	3.89E-10	2.20E-11	7.06E-13
RB89	3.73E-06	4.53E-06	2.02E-09	4.04E-10	1.64E-11	3.14E-13
SR89	4.77E-09	6.55E-09	2.09E-12	1.14E-13	9.39E-16	2.67E-18
SR87M	5.34E-07	7.34E-07	2.90E-10	2.03E-11	6.41E-14	2.03E-17
RB86	1.59E-07	1.93E-07	9.13E-11	1.41E-11	2.72E-13	1.15E-15
SR85	9.62E-07	1.33E-06	5.14E-10	4.74E-11	2.64E-13	1.85E-16
SR90	3.51E-10	4.90E-10	1.06E-13	1.28E-15	1.41E-18	3.85E-22
Y 90	1.27E-08	1.74E-08	5.92E-12	3.83E-13	3.52E-15	1.31E-17
SR91	1.17E-06	1.53E-06	6.67E-10	8.95E-11	1.48E-12	6.34E-15
Y 91M	1.10E-06	1.63E-06	6.29E-10	5.96E-11	3.79E-13	3.25E-16
Y 91	1.13E-08	1.45E-08	5.64E-12	6.76E-13	1.29E-14	6.21E-17
SR92	2.57E-06	3.45E-06	1.38E-09	2.55E-10	7.32E-12	5.62E-14
Y 92	5.09E-07	6.51E-07	2.83E-10	4.41E-11	9.95E-13	6.77E-15
Y 93	1.82E-07	2.33E-07	9.59E-11	1.62E-11	5.91E-13	8.29E-15
MO93	1.42E-09	2.08E-09	7.54E-14	0.00E+00	0.00E+00	0.00E+00
ZR93	4.83E-13	7.06E-13	3.97E-17	1.35E-24	3.32E-35	0.00E+00
NB93M	2.94E-10	4.31E-10	1.56E-14	0.00E+00	0.00E+00	0.00E+00
ZR95	1.31E-06	1.76E-06	7.23E-10	7.83E-11	7.21E-13	1.14E-15
NB95M	1.01E-07	1.39E-07	4.91E-11	1.59E-12	9.96E-16	5.06E-20
NB95	1.46E-06	1.82E-06	7.84E-10	9.19E-11	9.86E-13	1.78E-15
ZR97	3.41E-07	4.42E-07	1.84E-10	2.64E-11	5.97E-13	4.79E-15
NB97M	1.13E-06	1.68E-06	6.48E-10	6.14E-11	3.90E-13	3.35E-16
NB97	1.17E-06	1.72E-06	6.69E-10	6.44E-11	4.45E-13	5.89E-16
NB94	2.62E-06	3.54E-06	1.45E-09	1.55E-10	1.39E-12	2.13E-15
MO99	2.48E-07	3.49E-07	1.36E-10	1.29E-11	9.88E-14	1.27E-16
TC99M	1.63E-07	2.22E-07	6.81E-11	6.18E-13	2.28E-17	1.45E-23
TC99	6.61E-11	9.35E-11	1.50E-14	4.52E-17	2.44E-21	3.90E-26
TC101	6.97E-07	9.62E-07	3.78E-10	2.77E-11	1.06E-13	6.61E-17
RU103	9.40E-07	1.30E-06	5.05E-10	4.67E-11	2.63E-13	1.88E-16
PD103	1.12E-08	1.64E-08	9.37E-13	7.62E-15	2.40E-17	7.62E-21
RH103M	1.32E-09	1.93E-09	9.91E-14	1.13E-25	0.00E+00	0.00E+00
RU105	1.40E-06	2.00E-06	7.75E-10	7.20E-11	5.21E-13	8.48E-16
RH105	1.59E-07	2.19E-07	8.63E-11	6.03E-12	1.90E-14	6.01E-18
RU106	4.15E-07	5.77E-07	2.27E-10	2.36E-11	2.50E-13	1.05E-15
PD107	2.20E-14	3.23E-14	1.24E-18	0.00E+00	0.00E+00	0.00E+00
PD109	1.14E-08	1.64E-08	2.89E-12	8.98E-14	4.36E-16	3.00E-19
AG110M	4.91E-06	6.60E-06	2.71E-09	3.54E-10	6.00E-12	3.29E-14
AG111	5.07E-08	6.97E-08	2.70E-11	1.78E-12	5.55E-15	1.89E-18
CD109	1.04E-08	1.52E-08	7.81E-13	0.00E+00	0.00E+00	0.00E+00
CD113M	4.10E-10	5.72E-10	1.28E-13	1.76E-15	2.39E-18	7.80E-22
CD115M	4.47E-08	5.51E-08	2.47E-11	3.61E-12	6.96E-14	3.09E-16
CD115	3.78E-07	5.22E-07	2.01E-10	1.82E-11	1.00E-13	7.02E-17
IN115M	3.09E-07	4.25E-07	1.65E-10	1.16E-11	3.65E-14	1.16E-17
IN111	5.53E-07	7.57E-07	2.53E-10	6.56E-12	3.66E-15	1.16E-19
IN114M	2.07E-07	3.01E-07	1.10E-10	9.35E-12	6.46E-14	9.08E-17

GRDF.DAT

SN113	1.93E-08	2.75E-08	4.63E-12	1.23E-13	7.86E-17	5.71E-21
IN113M	4.25E-07	5.85E-07	2.29E-10	1.60E-11	5.06E-14	1.60E-17
SN117M	1.72E-07	2.36E-07	6.85E-11	6.14E-13	2.26E-17	1.44E-23
SN119M	7.15E-09	1.05E-08	5.36E-13	6.42E-19	4.76E-27	2.11E-38
SN121M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SN121	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SN123	1.48E-08	1.85E-08	7.98E-12	1.08E-12	2.00E-14	8.35E-17
I 125	2.78E-08	4.05E-08	2.84E-12	5.10E-23	0.00E+00	0.00E+00
SN125	5.49E-07	6.72E-07	3.05E-10	5.06E-11	1.40E-12	1.66E-14
SB125	8.41E-07	1.20E-06	4.60E-10	4.23E-11	2.51E-13	1.98E-16
TE125M	2.39E-08	3.46E-08	2.62E-12	1.96E-15	7.23E-20	4.61E-26
SN126	4.62E-08	6.54E-08	1.55E-11	3.53E-14	7.97E-20	1.31E-27
SB126M	2.90E-06	4.20E-06	1.63E-09	1.56E-10	1.06E-12	1.43E-15
SB126	4.88E-06	7.02E-06	2.75E-09	2.71E-10	2.06E-12	3.55E-15
SB122	8.97E-07	1.32E-06	5.12E-10	4.97E-11	3.62E-13	5.77E-16
SB124	3.58E-06	4.73E-06	1.92E-09	3.09E-10	8.87E-12	9.60E-14
SB127	1.20E-06	1.68E-06	6.62E-10	6.43E-11	4.80E-13	7.04E-16
TE127M	7.52E-09	1.09E-08	8.46E-13	7.22E-15	4.51E-17	3.86E-20
TE127	1.13E-08	1.56E-08	5.89E-12	5.10E-13	2.73E-15	1.88E-18
TE123M	1.63E-07	2.23E-07	6.52E-11	5.83E-13	2.15E-17	1.37E-23
TE129M	5.88E-08	8.69E-08	3.10E-11	2.84E-12	1.80E-14	1.57E-17
TE129	1.11E-07	1.52E-07	5.82E-11	5.62E-12	4.73E-14	1.16E-16
I 129	1.55E-08	2.25E-08	1.65E-12	5.72E-19	2.27E-24	1.51E-31
TE131M	2.61E-06	3.29E-06	1.41E-09	1.87E-10	3.61E-12	3.12E-14
TE131	7.33E-07	9.73E-07	3.87E-10	4.14E-11	5.92E-13	2.39E-15
I 131	6.68E-07	9.31E-07	3.64E-10	2.65E-11	1.02E-13	5.26E-17
XE131M	1.39E-08	1.99E-08	2.51E-12	1.36E-14	5.01E-19	3.19E-25
TE132	3.75E-07	5.15E-07	1.76E-10	5.58E-12	3.40E-15	1.09E-19
I 132	4.16E-06	5.59E-06	2.30E-09	2.82E-10	4.38E-12	2.98E-14
TE133M	4.08E-06	5.14E-06	2.27E-09	3.38E-10	7.71E-12	6.88E-14
TE133	1.79E-06	2.33E-06	9.74E-10	1.24E-10	2.48E-12	2.20E-14
I 133	1.09E-06	1.48E-06	5.88E-10	5.93E-11	5.07E-13	1.28E-15
XE133M	5.17E-08	7.17E-08	2.11E-11	6.50E-13	3.98E-16	1.27E-20
XE133	4.28E-08	6.06E-08	1.31E-11	2.84E-14	9.68E-20	4.29E-25
TE134	1.58E-06	2.16E-06	8.45E-10	7.85E-11	6.37E-13	1.05E-15
I 134	4.67E-06	5.91E-06	2.52E-09	3.41E-10	6.46E-12	5.18E-14
CS134M	3.37E-08	4.66E-08	1.14E-11	8.95E-14	3.30E-18	2.10E-24
CS134	2.93E-06	3.99E-06	1.62E-09	1.77E-10	1.76E-12	4.46E-15
I 130	3.74E-06	5.33E-06	2.09E-09	2.07E-10	1.69E-12	3.85E-15
I 135	2.89E-06	3.56E-06	1.55E-09	2.70E-10	7.49E-12	6.89E-14
XE135M	7.86E-07	1.09E-06	4.19E-10	3.87E-11	2.15E-13	1.51E-16
XE135	4.02E-07	5.55E-07	1.99E-10	7.86E-12	1.70E-14	1.15E-17
CS135	2.36E-11	3.36E-11	4.32E-15	4.52E-18	7.93E-23	4.31E-29
XE137	4.34E-07	5.87E-07	2.29E-10	2.64E-11	5.43E-13	1.17E-14
CS137	9.84E-07	1.46E-06	5.63E-10	5.33E-11	3.39E-13	2.91E-16
XE138	2.21E-06	2.73E-06	1.13E-09	2.30E-10	1.00E-11	1.66E-13
CS138	4.49E-06	5.78E-06	2.38E-09	4.65E-10	1.80E-11	3.03E-13
CS139	5.98E-07	7.48E-07	3.15E-10	6.25E-11	2.57E-12	5.04E-14

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BA139	5.45E-08	7.39E-08	2.42E-11	1.43E-12	2.96E-14	2.05E-16
BA140	3.45E-07	4.76E-07	1.82E-10	1.59E-11	8.55E-14	5.87E-17
LA140	4.05E-06	5.37E-06	2.17E-09	3.64E-10	1.02E-11	1.05E-13
CS136	3.72E-06	4.62E-06	2.05E-09	2.70E-10	4.30E-12	1.62E-14
BA141	1.55E-06	2.06E-06	8.26E-10	9.76E-11	1.97E-12	1.76E-14
LA141	9.77E-08	1.30E-07	5.10E-11	8.96E-12	2.62E-13	2.13E-15
CE141	9.44E-08	1.29E-07	3.80E-11	3.36E-13	1.31E-17	2.24E-22
BA142	1.58E-06	1.98E-06	8.65E-10	1.20E-10	2.23E-12	1.05E-14
LA142	5.20E-06	6.40E-06	2.69E-09	6.63E-10	4.06E-11	1.21E-12
CE143	4.05E-07	5.68E-07	2.04E-10	1.36E-11	8.07E-14	1.36E-16
PR143	1.34E-09	1.86E-09	5.01E-13	1.45E-14	4.48E-17	2.56E-20
CE144	2.42E-08	3.32E-08	9.24E-12	7.61E-14	2.77E-18	1.87E-24
PR144M	1.03E-08	1.46E-08	1.59E-12	1.70E-19	3.96E-30	0.00E+00
PR144	8.01E-08	1.06E-07	4.16E-11	6.99E-12	2.79E-13	4.73E-15
PR142	1.08E-07	1.47E-07	5.74E-11	1.02E-11	2.94E-13	2.27E-15
ND147	2.19E-07	3.04E-07	1.09E-10	8.51E-12	4.57E-14	3.19E-17
PM147	3.67E-11	5.19E-11	8.15E-15	2.83E-17	9.20E-22	5.75E-28
SM147	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PM148M	3.75E-06	5.35E-06	2.14E-09	2.24E-10	2.18E-12	5.76E-15
PM148	1.09E-06	1.48E-06	6.03E-10	9.44E-11	2.22E-12	1.53E-14
PM149	1.92E-08	2.65E-08	9.53E-12	5.01E-13	2.41E-15	2.91E-18
PM151	5.84E-07	8.07E-07	3.05E-10	2.31E-11	1.35E-13	1.72E-16
SM151	8.04E-12	1.18E-11	5.78E-16	1.25E-22	5.74E-31	0.00E+00
SM153	8.38E-08	1.16E-07	2.88E-11	3.35E-13	7.53E-16	5.21E-19
EU152M	5.53E-07	6.89E-07	3.01E-10	4.07E-11	6.76E-13	2.75E-15
EU152	2.07E-06	2.66E-06	1.12E-09	1.63E-10	3.47E-12	2.05E-14
EU154	2.12E-06	2.69E-06	1.16E-09	1.63E-10	3.00E-12	1.40E-14
EU155	7.19E-08	9.96E-08	2.68E-11	1.67E-13	5.34E-18	3.37E-24
EU156	2.48E-06	3.05E-06	1.33E-09	2.55E-10	9.49E-12	1.42E-13
GD153	1.22E-07	1.70E-07	3.82E-11	2.10E-13	6.15E-18	3.66E-24
GD159	6.62E-08	9.13E-08	3.32E-11	2.19E-12	6.89E-15	2.20E-18
TB160	1.84E-06	2.27E-06	1.01E-09	1.41E-10	2.55E-12	1.09E-14
TB161	2.01E-08	2.84E-08	4.43E-12	2.85E-15	7.97E-19	2.08E-22
DY165	4.08E-08	5.87E-08	2.06E-11	1.56E-12	8.87E-15	7.19E-18
HO166M	2.69E-06	3.62E-06	1.45E-09	1.45E-10	1.38E-12	3.01E-15
HO166	5.08E-08	6.85E-08	2.43E-11	3.73E-12	1.06E-13	8.42E-16
ER169	1.04E-10	1.47E-10	2.54E-14	1.15E-16	1.59E-20	4.17E-25
ER171	6.63E-07	9.08E-07	3.39E-10	2.08E-11	8.50E-14	1.19E-16
TA182	2.28E-06	2.78E-06	1.23E-09	1.90E-10	4.05E-12	2.01E-14
W 181	3.30E-08	4.61E-08	8.23E-12	1.51E-15	3.58E-20	2.28E-26
W 185	2.14E-10	3.00E-10	6.37E-14	4.86E-16	1.55E-19	2.25E-23
W 187	8.43E-07	1.20E-06	4.62E-10	4.30E-11	2.83E-13	2.79E-16
RE187	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
OS185	1.20E-06	1.74E-06	6.69E-10	6.43E-11	4.56E-13	5.05E-16
OS191	7.98E-08	1.10E-07	2.94E-11	1.83E-13	6.62E-18	4.22E-24
IR192	1.60E-06	2.22E-06	8.60E-10	6.68E-11	3.05E-13	1.95E-16
HG203	3.19E-07	4.37E-07	1.54E-10	4.89E-12	2.99E-15	9.56E-20
TH230	5.11E-10	7.22E-10	1.22E-13	4.90E-16	1.76E-20	1.12E-26

GRDF.DAT

RA226	6.55E-09	8.94E-09	2.72E-12	2.50E-14	6.04E-18	1.65E-21
RN222	3.28E-06	4.23E-06	1.75E-09	2.83E-10	8.70E-12	1.11E-13
PB210	2.16E-09	3.08E-09	3.10E-13	1.31E-20	1.12E-35	0.00E+00
BI210	2.13E-09	2.95E-09	8.49E-13	3.15E-14	1.21E-16	9.31E-20
PO210	1.55E-11	1.93E-11	8.31E-15	9.75E-16	1.05E-17	1.89E-20
U 232	4.89E-10	6.96E-10	9.26E-14	5.06E-16	1.86E-20	1.19E-26
TH232	3.49E-10	4.97E-10	6.35E-14	2.92E-16	1.07E-20	6.84E-27
RA228	5.40E-14	7.92E-14	3.23E-18	9.00E-31	0.00E+00	0.00E+00
AC228	1.70E-06	2.13E-06	9.50E-10	1.40E-10	2.84E-12	1.58E-14
TH228	2.51E-09	3.49E-09	1.01E-12	1.77E-14	9.30E-18	2.96E-22
RA224	1.72E-08	2.36E-08	8.41E-12	3.05E-13	4.70E-16	2.48E-19
PB212	2.26E-07	3.10E-07	1.08E-10	3.68E-12	4.38E-15	8.97E-19
BI212	2.79E-06	3.48E-06	1.42E-09	3.39E-10	2.05E-11	5.35E-13
U 234	3.56E-10	5.11E-10	5.62E-14	2.78E-16	1.02E-20	6.52E-27
U 236	2.75E-10	3.99E-10	2.92E-14	3.56E-18	2.64E-26	1.24E-37
U 235	1.67E-07	2.28E-07	7.12E-11	8.96E-13	2.43E-16	7.19E-21
TH231	1.43E-08	2.02E-08	4.37E-12	1.82E-14	3.88E-19	2.61E-25
PA231	5.54E-08	7.63E-08	2.78E-11	1.68E-12	4.93E-15	1.54E-18
AC227	2.05E-10	2.82E-10	7.65E-14	6.81E-16	2.51E-20	1.60E-26
TH227	1.68E-07	2.30E-07	8.18E-11	3.42E-12	6.46E-15	1.76E-18
FR223	6.96E-08	9.55E-08	2.91E-11	1.40E-12	7.83E-15	9.46E-18
RA223	4.88E-07	6.65E-07	2.48E-10	1.66E-11	8.84E-14	9.54E-17
U 237	2.08E-07	2.85E-07	9.08E-11	2.09E-12	1.94E-15	3.57E-19
NP237	2.45E-08	3.44E-08	8.75E-12	5.14E-14	7.12E-18	1.99E-22
PA233	3.98E-07	5.47E-07	2.10E-10	1.37E-11	4.46E-14	1.58E-17
U 233	4.17E-10	5.77E-10	1.44E-13	1.26E-15	4.65E-20	2.96E-26
TH229	1.01E-07	1.39E-07	4.10E-11	4.33E-13	1.38E-16	4.22E-21
RA225	1.30E-08	1.83E-08	2.20E-12	8.50E-17	1.11E-20	3.08E-25
AC225	4.49E-07	6.15E-07	2.34E-10	2.27E-11	2.76E-13	1.48E-15
U 238	2.43E-10	3.53E-10	2.56E-14	3.11E-18	2.31E-26	1.04E-37
TH234	3.87E-08	5.01E-08	1.94E-11	2.05E-12	3.45E-14	1.39E-16
PA234	3.44E-06	4.45E-06	1.89E-09	2.46E-10	4.38E-12	2.53E-14
PU236	3.25E-10	4.74E-10	2.81E-14	2.64E-18	1.96E-26	8.65E-38
PU237	6.98E-08	9.55E-08	2.85E-11	2.33E-13	7.94E-18	4.95E-24
AM242M	1.03E-09	1.48E-09	1.74E-13	1.14E-15	4.21E-20	2.69E-26
AM242	2.03E-08	2.78E-08	8.18E-12	6.85E-14	5.63E-18	1.29E-21
CM242	2.67E-10	3.90E-10	1.76E-14	7.11E-20	1.87E-30	0.00E+00
PU242	2.18E-10	3.18E-10	1.55E-14	8.15E-20	2.14E-30	0.00E+00
NP238	9.55E-07	1.15E-06	5.52E-10	8.65E-11	1.67E-12	7.04E-15
PU238	2.72E-10	3.97E-10	1.87E-14	8.71E-20	2.29E-30	0.00E+00
CM244	2.35E-10	3.44E-10	1.51E-14	5.23E-20	1.38E-30	0.00E+00
PU244	1.82E-10	2.66E-10	1.10E-14	9.13E-23	0.00E+00	0.00E+00
U 240	6.45E-07	9.10E-07	3.62E-10	4.10E-11	5.41E-13	2.55E-15
PU240	2.62E-10	3.83E-10	1.86E-14	9.66E-20	2.54E-30	0.00E+00
CM245	9.58E-08	1.31E-07	3.95E-11	3.35E-13	1.17E-17	7.32E-24
PU241	6.50E-16	9.54E-16	3.46E-20	0.00E+00	0.00E+00	0.00E+00
AM241	1.87E-08	2.63E-08	4.24E-12	7.18E-17	4.44E-26	1.97E-37
CM246	2.09E-10	3.05E-10	1.24E-14	8.91E-23	0.00E+00	0.00E+00

CM247	7.37E-07	1.02E-06	3.92E-10	3.52E-11	1.93E-13	1.35E-16
CM243	1.92E-07	2.62E-07	8.75E-11	2.07E-12	1.12E-15	3.55E-20
PU243	2.40E-08	3.36E-08	9.85E-12	1.92E-13	5.34E-16	1.69E-19
AM243	4.72E-08	6.55E-08	1.55E-11	1.82E-14	1.77E-19	1.11E-25
NP239	2.62E-07	3.58E-07	1.20E-10	3.17E-12	3.97E-15	9.31E-19
PU239	1.82E-10	2.58E-10	4.14E-14	3.30E-16	1.22E-20	7.75E-27
CM248	1.69E-10	2.47E-10	1.13E-14	4.83E-20	1.27E-30	0.00E+00
CF252	1.71E-10	2.50E-10	1.26E-14	8.61E-19	6.39E-27	2.83E-38

DOSSUM.DAT

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GENII text file for report  29-Sep-87 RAP
              1         2         3         4         5         6         7
    1234567890123456789012345678901234567890123456789012345678901234567890123456
  1                Dose Commitment Year
  2                      1         2         3    ...
  3
  4 Internal   :  ________________________________
  5 Intake     : |
  6 Year:      3 |                       x.xE+xx  ...
  7              |                          +
  8            2 |             x.xE+xx   x.xE+xx  ...              Internal
  9              |                +         +                      Effective
 10            1 | x.xE+xx + x.xE+xx + x.xE+xx + ...  =  x.xE+xx   Dose
 11                                                                Equivalent
 12                 ||        ||        ||
 13 Internal                                                       Cumulative
 14 Annual         x.xE+xx + x.xE+xx + x.xE+xx + ...  =  x.xE+xx   Internal
 15 Dose                                                           Dose
 16                 +         +         +                 +
 17 External
 18 Annual         x.xE+xx   x.xE+xx   x.xE+xx   ...
 19 Dose
 20                 ||        ||        ||                ||
 21 Annual                                                         Cumulative
 22 Dose           x.xE+xx + x.xE+xx + x.xE+xx + ...  =  x.xE+xx   Dose
 23
 24                                                                Maximum
 25                                                      x.xE+xx   Annual
 26                                                                Dose Occurred
 27                                                                In Year
 28
 29 ____________________________________________________________________________
              1         2         3         4         5         6         7
    1234567890123456789012345678901234567890123456789012345678901234567890123456
```

DEFAULT.IN

```
GENII Default Parameter Values (3-Aug-88 RAP)

INVENTORY PARAMETERS---------------------------------------------------------------
0.037, 3.7E4, 3.7E7, 3.7E10, 1.0        NVU      Source input conversion
1.0, 0.15, 224.0                        SVU      Soil source conversion

ENVIRONMENTAL PARAMETERS-----------------------------------------------------------
2                                       PRCNTI   Air dispersion conserv. flag
0.001                                   DPVRES   Deposition vel./resuspension
1.0E-9                                  LEAFRS   Leaf resuspension factor
2.0,2.0,3.0,0.8,0.8,0.8,1.0,0.8,1.0,1.5 BIOMAS   BIOMA2 Biomass (kg/m2)
0.25                                    DEPFR2   Interception frac./irrigate
15.0                                    SURCM    Depth of surface soil (cm)
224.0                                   SLDN     Surface soil density (kg/m2)
1.5E3                                   SSLDN    Soil density (kg/m3)
True                                    HARVST   Harvest removal considered?
410.0                                   SOLING   Soil ingested (mg/da)
14.0                                    WTIM     Weathering time (da)
1.0, 0.1, 0.1, 0.1                      TRANS    Translocation, plants
0.1, 0.1, 0.1, 0.1, 1.0, 1.0            TRANSA   Translocation, animal food
68.0, 0.12, 55.0, 0.12, 68.0, 55.0      CONSUM   Animal Consumption (kg/da)
50.0, 0.3, 60., 0.3                     DWATER   Animal drinking water (L/da)
0.0, 0.8, 1.0, 0.8                      FRACUT   Acute fresh forage by season
0.2, 0.3, 0.5, 1.0                      SHORWI   Shore width factors
0.02                                    INGWAT   Swim water ingested (L/hr)
25295.0                                 TCWS     H2O/sed. transfer (L/m2/yr)
0.4,  5.0, 4.0                          YELDBT   BIOT: Veg. prod. (kg/m2/yr)
9.41E-4, 2*7.48E-4                      TOTEXC   BIOT: Excavation (m2/m3-yr)
1.0, 0.81, 0.19, 0.02, 0.008, 0.002,    EXCAV    BIOT: Frac. soil brought to
1.0, 0.9, 0.096, 0.006, 0.0005, 0.0005,          surface from within the
1.0, 0.9, 0.096, 0.006, 0.0005, 0.0005           waste by animal excavation
270.0                                   RINH     Chronic breathing (cm3/sec)
330.0                                   RINHA    Acute breathing (cm3/sec)
10                                      NDIST    Number of distances
805.0, 2414.0, 4023.0, 5632.0, 7241.0,
12068.0, 24135.0, 40255.0, 56315.0,
72405.0                                 X        JF/chi/Q/pop grid dist. (m)
0.1, 0.25, 6*0.18, 2*0.2                DRYFAC,  DRYFA2 dry/wet ratio
METABOLIC PARAMETERS---------------------------------------------------------------
0.5, 50.0, 500.0                                         XDIV
0.5,  0.5,  0.95, 0.05,  0.8, 0.0, 0.0,  0.2, 0.0,       ADJ
0.1,  0.9,  0.5,  0.5,  0.15, 0.4, 0.4,  0.05, 0.0,
0.01, 0.99, 0.01, 0.99, 0.05, 0.4, 0.4, 0.135, 0.015

DOSE PARAMETERS--------------------------------------------------------------------
0.25, 0.15, 0.12, 0.12, 0.03, 0.03, 5*0.06               WT   Weighting factors
2.0                                                      SI2I Semi-infinite/inf
===================================================================================
```

```
DLC-80/DRALIST (Kocher's Format) Decay Data  (29-Aug-88 RAP)
 H -3          12.28 Y      1.
   0
   1
 1.8601E-02 5.6850E-03 1.0000E+00
   0
   0
   0
 BE-10          1.6E6 Y      4.
   0
   1
 5.5580E-01 2.0250E-01 1.0000E+00
   0
   0
   0
 C -14         5.73E3 Y      6.
   0
   1
 1.5648E-01 4.9470E-02 1.0000E+00
   0
   0
   0
 N -13          9.97 M      7.
   0
   0
   1
 1.1985E+00 4.9180E-01 9.9804E-01
   1
 2.6000E-04 1.8563E-03
   2
 2.7700E-04 3.7200E-06 5.1100E-01 1.9961E+00
 F -18         109.74 M      9.
   0
   0
   1
 6.3350E-01 2.4980E-01 9.6730E-01
   1
 5.2000E-04 3.0691E-02
   2
 5.2490E-04 1.7905E-04 5.1100E-01 1.9346E+00
 NA-22         2.602 Y     11.
   0
   0
   2
 5.4552E-01 2.1554E-01 8.9840E-01 2.8421E+00 8.3480E-01 6.0000E-04
   1
 8.2000E-04 9.2004E-02
   3
```

ENERGY.DAT

```
8.4860E-04 1.2495E-03 1.2745E+00 9.9940E-01 5.1100E-01 1.7980E+00
NA-24          15.00 H      11.
 0
 2
1.3902E+00 5.5390E-01 9.9935E-01 2.7670E-01 8.8600E-02 6.2000E-04
 0
 0
 3
1.3685E+00 9.9999E-01 2.7541E+00 9.9862E-01 3.8236E+00 6.4089E-04
SI-31          157.3 M      14.
 0
 2
1.4908E+00 5.9560E-01 9.9930E-01 2.2470E-01 6.8700E-02 7.0000E-04
 0
 0
 1
1.2661E+00 7.0000E-04
P -32          14.29 D      15.
 0
 1
1.7104E+00 6.9490E-01 1.0000E+00
 0
 0
 0
P -33           25.4 D      15.
 0
 1
2.4900E-01 7.6600E-02 1.0000E+00
 0
 0
 0
S -35          87.44 D      16.
 0
 1
1.6747E-01 4.8830E-02 1.0000E+00
 0
 0
 0
CL-36          3.01E5 Y     17.
 0
 1
7.0955E-01 2.5133E-01 9.9000E-01
 0
 1
2.1100E-03 8.3555E-03
 1
2.3078E-03 6.8725E-04
K -40        1.277E9 Y      19.
```

```
  0
  1
1.3116E+00 5.0854E-01 8.9330E-01
  0
  1
2.6600E-03 7.2154E-02
  2
2.9577E-03 9.3760E-03 1.4608E+00 1.0670E-01
AR-39             269 Y      18.
  0
  1   1   1
5.6500E-01 2.1880E-01 1.0000E+00
  0
  0
  0
AR-41           1.827 H      18.
  0
  3   1   2
1.1983E+00 4.5930E-01 9.9170E-01 2.4920E+00 1.0767E+00 7.8000E-03
8.1500E-01 2.9400E-01 5.2000E-04
  0
  0
  2
1.2936E+00 9.9160E-01 1.6770E+00 5.2000E-04
CA-41           1.03E5 Y     20.
  0
  0
  0
  1
2.9700E-03 7.7028E-01
  1
3.3138E-03 1.2332E-01
CA-45           162.7 D      20.
  0
  2   1   2
2.5690E-01 7.7200E-02 9.9998E-01 2.4550E-01 9.2100E-02 1.7000E-05
  0
  0
  1
1.2400E-02 3.7281E-08
SC-46           83.80 D      21.
  0
  2
3.5734E-01 1.1200E-01 9.9996E-01 1.4778E+00 5.8090E-01 3.6000E-05
  0
  0
  3
8.8925E-01 9.9984E-01 1.1205E+00 9.9987E-01 2.0098E+00 1.2000E-07
```

```
CR-51         27.704 D     24.
  0
  0
  0
  2
4.7000E-04 1.4468E+00 4.3800E-03 6.6886E-01
  5
5.1000E-04 3.3352E-03 4.9446E-03 6.5943E-02 4.9522E-03 1.3084E-01
5.4300E-03 2.6172E-02 3.2008E-01 9.8300E-02
MN-54          312.7 D     25.
  0
  0
  0
  2
5.4000E-04 1.4203E+00 4.7800E-03 6.3866E-01
  5
5.7000E-04 3.7023E-03 5.4055E-03 7.4288E-02 5.4147E-03 1.4711E-01
5.9500E-03 2.9445E-02 8.3483E-01 9.9976E-01
MN-56         2.5785 H     25.
  0
  5
3.2563E-01 9.9100E-02 1.1600E-02 7.3553E-01 2.5520E-01 1.4600E-01
1.0379E+00 3.8190E-01 2.7800E-01 2.8486E+00 1.2167E+00 5.6200E-01
9.8780E-01 3.7314E-01 1.1890E-03
  0
  0
  8
8.4675E-01 9.8870E-01 1.8107E+00 2.7189E-01 2.1131E+00 1.4336E-01
2.5229E+00 9.8870E-03 2.6575E+00 6.5254E-03 2.9598E+00 3.0650E-03
3.3696E+00 1.6808E-03 1.3514E+00 1.6263E-03
FE-55            2.7 Y     26.
  0
  0
  0
  2
6.1000E-04 1.3948E+00 5.1900E-03 6.0738E-01
  4
6.4000E-04 4.1971E-03 5.8876E-03 8.2372E-02 5.8987E-03 1.6279E-01
6.4900E-03 3.2852E-02
FE-59          44.63 D     26.
  0
  5
1.3079E-01 3.5700E-02 1.3700E-02 2.7344E-01 8.1000E-02 4.5200E-01
4.6578E-01 1.4920E-01 5.3100E-01 1.5650E+00 6.1450E-01 1.8000E-03
8.4100E-02 2.2200E-02 9.1000E-04
  0
  0
  6
```

```
1.4265E-01 1.0300E-02 1.9234E-01 3.1100E-02 3.3480E-01 2.6000E-03
1.0992E+00 5.6500E-01 1.2916E+00 4.3200E-01 1.2279E+00 9.1000E-04
CO-57          270.9 D     27.
  0
  0
  0
  9
6.7000E-04 2.4934E+00 5.6200E-03 1.0548E+00 7.3007E-03 6.9505E-01
1.3567E-02 7.7842E-02 1.4320E-02 1.1496E-02 1.1495E-01 1.8385E-02
1.2122E-01 1.8299E-03 1.2936E-01 1.4208E-02 1.3563E-01 1.4739E-03
  9
7.0000E-04 7.7537E-03 6.3908E-03 1.6629E-01 6.4038E-03 3.2799E-01
7.0600E-03 6.6234E-02 1.4413E-02 9.5429E-02 1.2206E-01 8.5510E-01
1.3648E-01 1.0603E-01 6.9200E-01 1.5990E-03 5.3602E-01 2.8663E-04
CO-58          70.80 D     27.
  0
  0
  1
4.7504E-01 2.0120E-01 1.4930E-01
  2
6.7000E-04 1.1649E+00 5.6200E-03 4.9366E-01
  8
7.0000E-04 3.6223E-03 6.3908E-03 7.7827E-02 6.4038E-03 1.5350E-01
7.0600E-03 3.0998E-02 8.1076E-01 9.9430E-01 8.6394E-01 7.3578E-03
1.6747E+00 5.3692E-03 5.1100E-01 2.9860E-01
CO-60          5.271 Y     27.
  0
  1
3.1790E-01 9.5790E-02 1.0000E+00
  0
  0
  3
1.1732E+00 1.0000E+00 1.3325E+00 1.0000E+00 6.9382E-01 1.6312E-04
NI-59          7.5E4 Y     28.
  0
  0
  0
  2
7.5000E-04 1.3423E+00 6.0700E-03 5.4918E-01
  4
7.8000E-04 4.7146E-03 6.9153E-03 1.0019E-01 6.9303E-03 1.9762E-01
7.6500E-03 4.0205E-02
NI-63          100.1 Y     28.
  0
  1
6.5870E-02 1.7130E-02 1.0000E+00
  0
  0
```

ENERGY.DAT

```
  0
NI-65          2.520 H     28.
  0
  5
4.1206E-01 1.2870E-01 5.4000E-03 5.1356E-01 1.6610E-01 8.4000E-03
6.5517E-01 2.2090E-01 2.8100E-01 1.0215E+00 3.7200E-01 9.8000E-02
2.1370E+00 8.7570E-01 6.0700E-01
  0
  0
  8
3.6627E-01 4.6060E-02 5.0780E-01 2.8670E-03 6.0930E-01 1.4100E-03
1.1155E+00 1.4829E-01 1.4818E+00 2.3500E-01 1.6234E+00 4.7470E-03
1.7249E+00 3.8775E-03 8.1483E-01 1.7009E-03
CU-64         12.701 H     29.
  0
  1
5.7820E-01 1.9020E-01 3.7200E-01
  1
6.5290E-01 2.7810E-01 1.7870E-01
  2
8.4000E-04 5.9075E-01 6.5400E-03 2.3341E-01
  6
8.5000E-04 2.2534E-03 7.4609E-03 4.8943E-02 7.4781E-03 9.6344E-02
8.2600E-03 1.9614E-02 1.3459E+00 4.8984E-03 5.1100E-01 3.5740E-01
ZN-65          244.4 D     30.
  0
  0
  1
3.2990E-01 1.4300E-01 1.4150E-02
  2
9.2000E-04 1.2673E+00 7.0300E-03 4.8288E-01
  7
9.3000E-04 5.7287E-03 8.0278E-03 1.1506E-01 8.0478E-03 2.2606E-01
8.9100E-03 4.6052E-02 1.1155E+00 5.0750E-01 5.5775E-01 6.0000E-05
5.1100E-01 2.8300E-02
ZN-69M         13.76 H     30.
  0
  0
  0
  5
9.9000E-04 6.2752E-02 7.5300E-03 2.2864E-02 4.2898E-01 4.3886E-02
4.3744E-01 5.1383E-03 4.3850E-01 1.6994E-03
  5
1.0100E-03 3.1534E-04 8.6158E-03 6.2554E-03 8.6389E-03 1.2265E-02
9.5700E-03 2.5003E-03 4.3863E-01 9.4889E-01
ZN-69           55.6 M     30.
  0
  2
```

```
9.0450E-01 3.2090E-01 9.9999E-01 4.9060E-01 1.6091E-01 1.4500E-05
  0
  0
  1
4.1390E-01 1.4500E-05
GA-72           14.1 H     31.
  0
 17
2.3420E-01 6.7000E-02 1.2400E-03 3.1345E-01 9.3200E-02 7.6900E-03
4.2549E-01 1.3240E-01 2.2200E-03 5.3627E-01 1.7330E-01 3.4100E-03
5.5230E-01 1.7930E-01 3.1700E-03 6.4985E-01 2.1700E-01 1.5000E-01
6.6657E-01 2.2350E-01 2.1520E-01 9.5605E-01 3.4180E-01 2.7900E-01
1.0481E+00 3.8080E-01 1.8600E-02 1.4768E+00 5.6890E-01 8.9400E-02
1.5277E+00 5.9180E-01 1.4000E-03 1.5893E+00 6.1960E-01 2.4200E-03
1.9267E+00 7.7400E-01 3.0300E-02 2.2633E+00 9.3060E-01 8.1000E-03
2.5276E+00 1.0549E+00 8.0000E-02 3.1576E+00 1.3543E+00 1.0600E-01
6.6630E-01 2.3448E-01 2.4820E-03
  0
  3
1.1900E-03 5.2761E-03 8.5600E-03 1.9378E-03 6.8010E-01 4.2127E-03
 48
1.1900E-03 3.1848E-05 9.8553E-03 6.7101E-04 9.8864E-03 1.3106E-03
1.1000E-02 2.9327E-04 1.1252E-01 1.3582E-03 2.8950E-01 2.0087E-03
3.3660E-01 1.0713E-03 3.8120E-01 2.7643E-03 4.2840E-01 1.8365E-03
5.8740E-01 1.2435E-03 6.0085E-01 5.5860E-02 6.2986E-01 2.4391E-01
7.3560E-01 3.5964E-03 7.8643E-01 3.1660E-02 8.1024E-01 2.0087E-02
8.3400E-01 9.5650E-01 8.6111E-01 9.1154E-03 8.9422E-01 9.8520E-02
9.2410E-01 1.4252E-03 9.3935E-01 2.5921E-03 9.7054E-01 1.1048E-02
9.9986E-01 7.9581E-03 1.0508E+00 6.9251E-02 1.2151E+00 7.9676E-03
1.2309E+00 1.4443E-02 1.2601E+00 1.1478E-02 1.2768E+00 1.5591E-02
1.4640E+00 3.5582E-02 1.5682E+00 1.9895E-03 1.5717E+00 8.3502E-03
1.5967E+00 4.2373E-02 1.6808E+00 8.6755E-03 1.7109E+00 3.8260E-03
1.8378E+00 2.0278E-03 1.8611E+00 5.2321E-02 1.8780E+00 2.3147E-03
1.9202E+00 1.5878E-03 1.9911E+00 1.1191E-03 2.0291E+00 1.2435E-03
2.1095E+00 1.0340E-02 2.2017E+00 2.6112E-01 2.2141E+00 1.8556E-03
2.4910E+00 7.4798E-02 2.5078E+00 1.2817E-01 2.5154E+00 2.5252E-03
2.6215E+00 1.3104E-03 2.8441E+00 4.1034E-03 1.2747E+00 1.5545E-02
AS-76           26.32 H     33.
  0
  9   2   6   8
2.9880E-01 8.7800E-02 6.3000E-03 3.1310E-01 9.2600E-02 1.2000E-02
5.3980E-01 1.7370E-01 1.8800E-02 1.1809E+00 4.3620E-01 2.0800E-02
1.7525E+00 6.9150E-01 7.6000E-02 1.8462E+00 7.4910E-01 7.5000E-03
2.4095E+00 9.9630E-01 3.4700E-01 2.9686E+00 1.2669E+00 5.1000E-01
1.0043E+00 3.7381E-01 2.2100E-03
  0
  0
 18
```

```
5.5910E-01 4.4700E-01 5.6323E-01 1.1711E-02 5.7130E-01 1.3857E-03
6.5703E-01 6.0792E-02 6.6531E-01 3.9336E-03 7.4012E-01 1.1622E-03
7.7176E-01 1.1622E-03 8.6763E-01 1.2516E-03 1.1299E+00 1.4304E-03
1.2127E+00 1.6271E-02 1.2160E+00 3.8442E-02 1.2285E+00 1.3857E-02
1.4391E+00 3.2631E-03 1.4536E+00 1.2963E-03 1.7877E+00 3.3078E-03
2.0963E+00 6.6156E-03 2.1108E+00 3.9336E-03 1.1520E+00 6.5307E-03
SE-75          119.78 D     34.
  0
  0
  0
 13
1.2400E-03 1.2950E+00 9.1100E-03 4.1833E-01 1.2533E-02 5.0232E-02
2.2874E-02 9.8072E-03 2.4196E-02 2.0930E-03 5.4183E-02 3.5995E-03
8.4866E-02 2.6451E-02 9.5206E-02 3.5449E-03 1.0925E-01 6.2455E-03
1.2413E-01 1.5570E-02 1.3447E-01 1.6103E-03 2.5278E-01 3.8093E-03
2.6766E-01 1.7917E-03
 14
1.2800E-03 9.1288E-03 1.0508E-02 1.6109E-01 1.0544E-02 3.1401E-01
1.1700E-02 7.2690E-02 6.6050E-02 1.0226E-02 9.6733E-02 3.4086E-02
1.2112E-01 1.6744E-01 1.3600E-01 5.9202E-01 1.9860E-01 1.4472E-02
2.6465E-01 5.9800E-01 2.7953E-01 2.5236E-01 3.0391E-01 1.3216E-02
4.0065E-01 1.1422E-01 3.3265E-01 9.7156E-04
SE-79          6.5E4 Y      34.
  0
  1   1   1
1.4900E-01 5.2200E-02 1.0000E+00
  0
  0
  0
BR-82          35.30 H      35.
  0
  3
2.6458E-01 7.6200E-02 1.3590E-02 4.4434E-01 1.3780E-01 9.7900E-01
5.3650E-01 1.7160E-01 9.0000E-04
  0
  0
 20
9.2184E-02 7.1647E-03 1.3740E-01 1.4163E-03 2.2145E-01 2.2577E-02
2.7345E-01 7.9978E-03 5.5432E-01 7.0564E-01 6.0630E-01 1.1663E-02
6.1907E-01 4.3071E-01 6.9833E-01 2.8159E-01 7.7649E-01 8.3310E-01
8.2781E-01 2.4160E-01 9.5210E-01 3.6656E-03 1.0076E+00 1.2680E-02
1.0440E+00 2.7326E-01 1.0814E+00 6.2482E-03 1.3175E+00 2.6909E-01
1.4260E+00 1.0830E-03 1.4748E+00 1.6579E-01 1.6503E+00 7.4063E-03
1.7796E+00 1.1330E-03 7.4358E-01 7.5879E-03
BR-83           2.39 H      35.
  0
  3
3.8878E-01 1.1800E-01 1.3000E-02 9.1844E-01 3.2300E-01 9.8600E-01
```

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3.7300E-01 1.1275E-01 9.9000E-04
  0
  0
  2
5.2964E-01 1.3000E-02 5.3741E-01 1.0460E-03
KR-83M          1.83 H     36.
  0
  0
  0
  9
1.5000E-03 1.6517E+00 7.4690E-03 7.7700E-01 9.1020E-03 1.2700E-01
9.3660E-03 4.2000E-02 1.0800E-02 8.6022E-02 1.7834E-02 2.4300E-01
3.0239E-02 6.1700E-01 3.1872E-02 1.0400E-01 3.2136E-02 3.4400E-02
  6
1.5900E-03 2.1755E-02 9.3900E-03 5.4100E-02 1.2598E-02 4.5745E-02
1.2649E-02 8.8654E-02 1.4100E-02 2.2579E-02 3.2160E-02 5.0700E-04
BR-84          31.80 M     35.
  0
 19   1  18
4.8390E-01 1.5200E-01 2.2000E-03 5.5650E-01 1.7900E-01 2.1000E-02
5.8880E-01 1.9100E-01 4.9000E-03 7.4580E-01 2.5300E-01 1.1700E-01
7.9430E-01 2.7200E-01 2.9000E-03 8.0270E-01 2.7600E-01 1.8000E-03
9.6730E-01 3.4300E-01 2.5000E-02 1.1975E+00 4.4200E-01 4.9000E-03
1.3073E+00 4.9000E-01 9.5000E-02 1.5908E+00 6.1600E-01 3.9000E-02
1.9141E+00 7.6300E-01 1.1300E-02 1.9731E+00 7.9000E-01 7.4000E-02
2.0502E+00 8.2600E-01 1.9000E-02 2.1838E+00 8.8800E-01 3.4000E-03
2.3276E+00 9.5500E-01 1.6000E-02 2.7759E+00 1.1660E+00 1.2100E-01
3.7915E+00 1.6500E+00 1.3700E-01 4.6730E+00 2.0720E+00 3.2000E-01
2.8360E+00 1.1940E+00 6.3000E-04
  0
  0
 39
2.3020E-01 3.0806E-03 3.5470E-01 3.0806E-03 3.8200E-01 5.6970E-03
6.0480E-01 1.7724E-02 7.3650E-01 1.3082E-02 8.0220E-01 6.0768E-02
8.8150E-01 4.2200E-01 9.4750E-01 3.5870E-03 9.8730E-01 7.8070E-03
1.0057E+00 4.5998E-03 1.0159E+00 6.2456E-02 1.0826E+00 1.4348E-03
1.1191E+00 1.4348E-03 1.1850E+00 1.0972E-03 1.2133E+00 2.6164E-02
1.4638E+00 1.9834E-02 1.5347E+00 1.0128E-03 1.5781E+00 6.5832E-03
1.6076E+00 4.0090E-03 1.7412E+00 1.6458E-02 1.8187E+00 2.4476E-03
1.8775E+00 1.1394E-02 1.8973E+00 1.4939E-01 2.0296E+00 2.1100E-02
2.0942E+00 2.1522E-03 2.2007E+00 1.1816E-02 2.4841E+00 6.7520E-02
2.5937E+00 1.3926E-03 2.6229E+00 3.0384E-03 2.7587E+00 4.9374E-03
2.8241E+00 1.1394E-02 2.9887E+00 1.7724E-03 3.0454E+00 2.5320E-02
3.2021E+00 2.1100E-03 3.2353E+00 2.0678E-02 3.3658E+00 2.9118E-02
3.9275E+00 6.8786E-02 4.0846E+00 2.7852E-03 1.1229E+00 6.7490E-03
KR-85M          4.48 H     36.
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7.1084E-01 2.3820E-01 2.9000E-03 8.4069E-01 2.9040E-01 7.8600E-01
2.6000E-01 7.4600E-02 2.1000E-04
  0
 10
1.5000E-03 7.6149E-02 1.0800E-02 2.0989E-02 2.9054E-01 5.9291E-02
3.0295E-01 8.9675E-03 3.0458E-01 2.9540E-03 1.6800E-03 3.8472E-02
1.1400E-02 1.0415E-02 1.3598E-01 3.1466E-02 1.4911E-01 3.5004E-03
1.5086E-01 1.1518E-03
 12
1.5900E-03 1.0030E-03 1.2598E-02 1.1162E-02 1.2649E-02 2.1631E-02
1.4100E-02 5.5092E-03 3.0487E-01 1.3989E-01 1.6900E-03 5.8586E-04
1.3336E-02 6.1162E-03 1.3395E-02 1.1830E-02 1.5000E-02 3.1047E-03
1.2985E-01 3.0111E-03 1.5118E-01 7.5278E-01 5.8128E-01 2.1078E-04
KR-85          10.72 Y      36.
  0
  2   1   2
1.7301E-01 4.7500E-02 4.3700E-03 6.8700E-01 2.5140E-01 9.9563E-01
  0
  0
  1
5.1399E-01 4.3400E-03
KR-87            76.3 M      36.
  0
 13   1  11
5.8048E-01 1.8780E-01 5.0000E-03 8.3366E-01 2.8750E-01 1.0800E-03
9.2840E-01 3.2640E-01 4.4000E-02 1.0778E+00 3.8930E-01 5.8000E-03
1.3342E+00 5.0040E-01 9.5000E-02 1.4746E+00 5.6260E-01 5.5100E-02
1.5106E+00 5.7870E-01 4.2000E-03 2.1485E+00 8.7000E-01 6.2000E-03
2.3110E+00 9.4560E-01 1.6000E-03 2.4991E+00 1.0337E+00 1.2400E-03
3.0436E+00 1.2942E+00 6.9000E-02 3.4864E+00 1.5020E+00 4.0700E-01
3.8890E+00 1.6948E+00 3.0400E-01
  0
  3
1.6800E-03 1.9394E-03 1.1400E-02 5.7673E-04 3.8738E-01 1.7424E-03
 26
1.6900E-03 2.9534E-05 1.3336E-02 3.3867E-04 1.3395E-02 6.5507E-04
1.5000E-02 1.7192E-04 4.0258E-01 4.9500E-01 6.7387E-01 1.9058E-02
8.1425E-01 1.6830E-03 8.3637E-01 7.5240E-03 8.4543E-01 7.2765E-02
9.4664E-01 1.3860E-03 1.1754E+00 1.1237E-02 1.3380E+00 6.4845E-03
1.3825E+00 2.8710E-03 1.3899E+00 1.2375E-03 1.5312E+00 3.5640E-03
1.5780E+00 1.2870E-03 1.6112E+00 1.0395E-03 1.7405E+00 2.0493E-02
1.8426E+00 1.3860E-03 2.0119E+00 2.8957E-02 2.4085E+00 2.1285E-03
2.5548E+00 9.3060E-02 2.5581E+00 3.9105E-02 2.8114E+00 3.1680E-03
3.3085E+00 4.5045E-03 1.6201E+00 6.4993E-03
RB-87        4.73E10 Y      37.
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  1
2.7330E-01 7.8800E-02 1.0000E+00
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ENERGY.DAT

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KR-88          2.84 H      36.
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5.2085E-01 1.6500E-01 6.7000E-01 6.8124E-01 2.2700E-01 9.1000E-02
8.2392E-01 2.8400E-01 1.4000E-03 9.9748E-01 3.5500E-01 2.0400E-03
1.1983E+00 4.4100E-01 1.9200E-02 1.2519E+00 4.6400E-01 2.3000E-03
1.4715E+00 5.6100E-01 2.2000E-03 1.7309E+00 6.7800E-01 9.0000E-03
1.7716E+00 6.9700E-01 1.0000E-03 2.0507E+00 8.2500E-01 1.3000E-02
2.5225E+00 1.0520E+00 2.6000E-03 2.7167E+00 1.1360E+00 1.8000E-02
2.9130E+00 1.2330E+00 1.4000E-01 6.8700E-01 2.3383E-01 1.0100E-03
 0
 9
1.6800E-03 1.4931E-01 1.1400E-02 4.0387E-02 1.2313E-02 1.0717E-01
1.3060E-02 1.3286E-03 2.5448E-02 1.2332E-02 2.7191E-02 2.7294E-03
1.5078E-01 2.0794E-03 1.8112E-01 1.1433E-02 1.9425E-01 1.3772E-03
 55
1.6900E-03 2.2738E-03 1.3336E-02 2.3716E-02 1.3395E-02 4.5873E-02
1.5000E-02 1.2039E-02 2.7513E-02 2.0622E-02 1.2227E-01 1.9722E-03
1.6598E-01 3.1036E-02 1.9632E-01 2.5985E-01 2.4071E-01 2.5258E-03
3.1169E-01 1.0726E-03 3.3471E-01 1.4532E-03 3.6223E-01 2.2490E-02
3.9054E-01 6.4356E-03 4.2170E-01 1.2802E-03 4.7180E-01 7.2660E-03
6.7734E-01 2.3528E-03 7.8828E-01 5.3284E-03 7.9032E-01 1.2456E-03
8.3483E-01 1.2975E-01 8.5034E-01 1.7300E-03 8.6233E-01 6.7124E-03
9.4492E-01 2.9410E-03 9.8578E-01 1.3148E-02 9.9009E-01 1.4186E-03
1.0396E+00 4.8440E-03 1.0495E+00 1.4186E-03 1.1413E+00 1.2837E-02
1.1795E+00 9.9648E-03 1.1850E+00 6.8854E-03 1.2098E+00 1.4186E-03
1.2127E+00 1.3840E-03 1.2452E+00 3.6330E-03 1.2507E+00 1.1210E-02
1.3250E+00 1.5916E-03 1.3523E+00 1.5916E-03 1.3695E+00 1.4774E-02
1.4069E+00 2.1798E-03 1.4648E+00 1.1418E-03 1.5184E+00 2.1521E-02
1.5298E+00 1.0934E-01 1.6038E+00 4.5672E-03 1.6856E+00 6.6432E-03
1.8928E+00 1.3840E-03 1.9087E+00 1.0034E-03 2.0298E+00 4.5291E-02
2.0354E+00 3.7368E-02 2.1865E+00 2.8718E-03 2.1958E+00 1.3183E-01
2.2318E+00 3.3908E-02 2.3521E+00 7.3006E-03 2.3921E+00 3.4600E-01
2.4089E+00 1.0380E-03 2.5484E+00 6.2280E-03 2.7710E+00 1.4878E-03
1.0001E+00 1.8892E-02
RB-88          17.8 M      37.
 0
 10    1    9
4.6210E-01 1.4360E-01 6.6000E-03 4.6963E-01 1.4630E-01 3.6200E-03
5.7231E-01 1.8430E-01 1.4300E-03 8.0114E-01 2.7370E-01 2.1300E-02
9.0129E-01 3.1450E-01 2.1000E-03 2.0965E+00 8.4450E-01 9.8000E-03
2.5809E+00 1.0706E+00 1.3300E-01 3.4790E+00 1.4965E+00 4.1000E-02
5.3150E+00 2.3724E+00 7.8000E-01 1.3900E+00 5.2638E-01 6.2700E-04
 0
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 0
 15
8.9802E-01 1.4038E-01 1.3663E+00 1.0272E-03 1.3824E+00 7.4258E-03
1.7798E+00 2.1614E-03 1.8360E+00 2.1400E-01 2.1112E+00 1.1770E-03
2.1189E+00 4.2158E-03 2.5777E+00 1.7976E-03 2.6779E+00 1.9581E-02
2.7340E+00 1.0914E-03 3.0094E+00 2.4396E-03 3.2185E+00 2.1400E-03
3.4865E+00 1.3054E-03 4.7427E+00 1.4338E-03 1.4746E+00 3.3298E-03
KR-89          3.16 M     36.
 0
 48
3.3871E-01 1.0100E-01 5.7000E-03 4.8220E-01 1.5100E-01 3.6000E-03
4.9184E-01 1.5500E-01 3.2000E-03 5.6520E-01 1.8200E-01 1.7200E-03
6.0265E-01 1.9600E-01 5.9000E-03 6.2940E-01 2.0600E-01 2.1400E-03
6.3125E-01 2.0700E-01 1.5800E-03 6.6280E-01 2.1900E-01 1.4000E-03
7.3930E-01 2.4900E-01 2.0000E-03 7.5310E-01 2.5500E-01 1.8000E-03
8.2621E-01 2.8400E-01 5.8000E-03 8.8908E-01 3.1000E-01 6.8000E-03
9.2139E-01 3.2000E-01 4.9000E-03 9.9274E-01 3.5000E-01 4.5000E-03
1.0044E+00 3.6000E-01 2.0000E-03 1.0712E+00 3.9000E-01 1.7000E-03
1.2526E+00 4.6000E-01 2.3600E-02 1.2498E+00 4.6000E-01 3.3000E-03
1.4371E+00 5.5000E-01 1.4900E-02 1.5049E+00 5.8000E-01 3.1000E-03
1.6086E+00 6.2000E-01 1.5500E-02 1.5992E+00 6.2000E-01 2.0900E-02
1.6421E+00 6.4000E-01 2.0000E-02 1.7199E+00 6.7000E-01 2.7000E-03
1.9526E+00 7.8000E-01 8.5000E-03 2.1039E+00 8.5000E-01 4.0000E-02
2.1880E+00 8.9000E-01 1.5100E-02 2.1813E+00 8.9000E-01 2.8000E-03
2.3719E+00 9.7000E-01 1.4400E-01 2.5691E+00 1.0700E+00 5.7000E-02
2.5821E+00 1.0700E+00 3.1000E-03 2.6048E+00 1.0800E+00 1.9000E-03
2.7512E+00 1.1500E+00 2.2400E-03 2.8100E+00 1.1800E+00 3.0900E-02
2.9715E+00 1.2600E+00 2.5300E-02 3.1053E+00 1.3200E+00 4.7000E-03
3.1484E+00 1.3400E+00 1.7000E-03 3.2762E+00 1.4000E+00 1.0200E-01
3.4398E+00 1.4800E+00 2.9000E-02 3.6300E+00 1.5700E+00 6.2000E-03
3.6457E+00 1.5800E+00 3.6000E-02 3.9725E+00 1.7300E+00 1.3000E-02
4.0390E+00 1.7700E+00 4.4000E-03 4.3841E+00 1.9300E+00 2.3000E-02
4.3930E+00 1.9400E+00 4.4000E-02 4.4725E+00 1.9800E+00 1.2000E-02
4.9700E+00 2.2100E+00 2.3000E-01 1.2300E+00 4.7884E-01 2.8600E-03
 0
 3
1.6800E-03 6.9009E-03 1.1400E-02 2.0522E-03 2.0570E-01 6.2000E-03
145
1.6900E-03 1.0509E-04 1.3336E-02 1.2051E-03 1.3395E-02 2.3310E-03
1.5000E-02 6.1174E-04 1.9620E-01 2.2000E-03 1.9750E-01 1.8200E-02
2.0503E-01 1.2400E-03 2.2090E-01 2.0000E-01 2.6411E-01 6.6000E-03
3.3820E-01 3.4200E-03 3.4503E-01 1.1800E-02 3.5606E-01 4.1400E-02
3.6488E-01 9.0000E-03 3.6930E-01 1.3800E-02 4.0225E-01 3.1800E-03
4.1142E-01 2.5600E-02 4.3808E-01 9.6000E-03 4.6613E-01 8.0000E-03
4.9076E-01 3.2200E-03 4.9750E-01 6.6400E-02 4.9860E-01 1.1400E-02
5.5730E-01 1.6000E-03 5.7696E-01 5.6400E-02 5.8580E-01 1.6600E-01
6.2620E-01 6.0000E-03 6.2975E-01 3.4200E-03 6.6572E-01 1.1400E-03
6.7140E-01 1.0600E-03 6.7411E-01 2.3200E-03 6.9624E-01 1.7800E-02
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7.0701E-01 4.9800E-03 7.1005E-01 7.8000E-03 7.2963E-01 2.9600E-03
7.3839E-01 4.2000E-02 7.4740E-01 1.1400E-03 7.6290E-01 4.0000E-03
7.6290E-01 9.2000E-03 7.7649E-01 1.1200E-02 8.2675E-01 7.6000E-03
8.3553E-01 1.1000E-02 8.5737E-01 2.8600E-03 8.6708E-01 5.9200E-02
8.7042E-01 1.6000E-03 9.0427E-01 7.1800E-02 9.3095E-01 6.2000E-03
9.4419E-01 1.6400E-03 9.5318E-01 1.0600E-03 9.6042E-01 3.2200E-03
9.7439E-01 9.8000E-03 9.9737E-01 6.6000E-03 1.0108E+00 1.0800E-03
1.0444E+00 4.0800E-03 1.0765E+00 2.3600E-03 1.0881E+00 3.5800E-03
1.1032E+00 9.0000E-03 1.1078E+00 2.9200E-02 1.1166E+00 1.6600E-02
1.1315E+00 1.6000E-03 1.1625E+00 2.1400E-03 1.1723E+00 9.8000E-03
1.1824E+00 1.6600E-03 1.1865E+00 1.8400E-03 1.2288E+00 1.4400E-03
1.2356E+00 5.9400E-03 1.2737E+00 1.3600E-02 1.3027E+00 1.0000E-03
1.3243E+00 3.0600E-02 1.3354E+00 1.3200E-03 1.3406E+00 1.9400E-03
1.3675E+00 1.4800E-03 1.3722E+00 1.2600E-03 1.4126E+00 2.6400E-03
1.4216E+00 2.2400E-03 1.4613E+00 1.2200E-03 1.4642E+00 1.7800E-03
1.4685E+00 1.8800E-03 1.4728E+00 6.8800E-02 1.5010E+00 1.3200E-02
1.5062E+00 1.1200E-03 1.5300E+00 3.3200E-02 1.5337E+00 5.1200E-02
1.5553E+00 1.5200E-03 1.5738E+00 1.9000E-03 1.6341E+00 8.2000E-03
1.6438E+00 3.3800E-03 1.6675E+00 1.2800E-03 1.6769E+00 1.4000E-03
1.6838E+00 1.3200E-03 1.6920E+00 2.6000E-03 1.6937E+00 4.3800E-02
1.7213E+00 2.2400E-03 1.7776E+00 7.6000E-03 1.7882E+00 1.0600E-03
1.8107E+00 1.4000E-03 1.8375E+00 1.1800E-03 1.8397E+00 3.5000E-03
1.8685E+00 1.9600E-03 1.8798E+00 1.5800E-03 1.9034E+00 1.0400E-02
1.9391E+00 6.4000E-03 1.9666E+00 1.3200E-03 1.9986E+00 1.1800E-03
2.0122E+00 1.5600E-02 2.0210E+00 2.4400E-03 2.0465E+00 2.6200E-03
2.1006E+00 9.4000E-03 2.1600E+00 5.2800E-03 2.1958E+00 1.2800E-03
2.2802E+00 2.0400E-03 2.3774E+00 8.0000E-03 2.4010E+00 7.2000E-03
2.5979E+00 1.0800E-03 2.6453E+00 4.2000E-03 2.7509E+00 1.2400E-03
2.7821E+00 7.6000E-03 2.7938E+00 6.8000E-03 2.8196E+00 1.3200E-03
2.8533E+00 2.4000E-03 2.8662E+00 1.7400E-02 2.8787E+00 3.2400E-03
3.0179E+00 2.5400E-03 3.0292E+00 2.7000E-03 3.1073E+00 1.9400E-03
3.1403E+00 1.0400E-02 3.1721E+00 1.0000E-03 3.2198E+00 4.2800E-03
3.3617E+00 1.0400E-02 3.3711E+00 6.2000E-03 3.3999E+00 1.3600E-03
3.5329E+00 1.3400E-02 3.5839E+00 2.5800E-03 3.7178E+00 8.4000E-03
3.7325E+00 1.3800E-03 3.7814E+00 1.3200E-03 3.8274E+00 1.3800E-03
3.8427E+00 1.1000E-03 3.9018E+00 1.3400E-03 3.9230E+00 4.1400E-03
3.9655E+00 2.0800E-03 3.9775E+00 2.7000E-03 3.9960E+00 1.4200E-03
4.0480E+00 1.1600E-03 4.3411E+00 1.0400E-03 4.4892E+00 1.3400E-03
2.1811E+00 7.1180E-02
RB-89        15.44 M     37.
 0
 11   1   9
9.9434E-01 3.5320E-01 1.5200E-02 1.2751E+00 4.7360E-01 3.3000E-01
1.7958E+00 7.0640E-01 2.1900E-02 1.9329E+00 7.6910E-01 3.0000E-02
2.2229E+00 9.0310E-01 3.4000E-01 2.4456E+00 1.0071E+00 4.6000E-03
2.4954E+00 1.0304E+00 4.9000E-03 2.5628E+00 1.0620E+00 2.2000E-03
3.0296E+00 1.2848E+00 2.4000E-03 4.5030E+00 1.9874E+00 2.5000E-01
7.7600E-01 2.7239E-01 3.6900E-03
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2.7245E-01 1.4152E-02 2.8976E-01 5.3940E-03 6.5771E-01 9.9760E-02
7.6679E-01 1.6240E-03 9.4769E-01 9.2220E-02 1.0253E+00 2.2620E-03
1.0319E+00 5.8000E-01 1.2203E+00 2.2040E-03 1.2284E+00 1.2180E-03
1.2481E+00 4.2340E-01 1.4732E+00 3.5380E-03 1.5011E+00 1.9720E-03
1.5381E+00 2.5520E-02 1.9402E+00 3.3060E-03 2.0075E+00 2.3780E-02
2.0580E+00 2.3200E-03 2.1960E+00 1.3340E-01 2.2801E+00 1.7980E-03
2.5701E+00 9.8600E-02 2.7072E+00 2.0300E-02 3.5088E+00 1.1484E-02
1.9503E+00 1.1832E-02
SR-89         50.55 D     38. (No data for daughter, Y-89M)
  0
  2   1   1
1.4913E+00 5.8300E-01 9.9985E-01 5.8220E-01 1.8760E-01 1.5000E-04
  0
  0
  1
9.0910E-01 1.5000E-04
SR-87M        2.805 H     38.
  0
  0
  0
  7
1.7900E-03 1.7855E-01 1.2100E-02 4.4979E-02 3.7230E-01 1.4556E-01
3.8618E-01 2.1336E-02 3.8804E-01 7.0388E-03 1.6800E-03 3.2002E-03
1.1400E-02 8.4157E-04
  9
1.8100E-03 2.9033E-03 1.4098E-02 2.9161E-02 1.4165E-02 5.6296E-02
1.5800E-02 1.5126E-02 3.8840E-01 8.2253E-01 1.6900E-03 4.8734E-05
1.3336E-02 4.9419E-04 1.3395E-02 9.5588E-04 1.5000E-02 2.5086E-04
RB-86         18.66 D     37.
  0
  2   1   2
6.9764E-01 2.3250E-01 8.7800E-02 1.7744E+00 7.0930E-01 9.1220E-01
  0
  0
  1
1.0766E+00 8.7795E-02
SR-85         64.84 D     38.
  0
  0
  0
  3
1.6800E-03 1.0815E+00 1.1400E-02 2.9067E-01 4.9879E-01 6.2540E-03
  6
1.6900E-03 1.6470E-02 1.3336E-02 1.7069E-01 1.3395E-02 3.3015E-01
1.5000E-02 8.6645E-02 5.1399E-01 9.9270E-01 8.6850E-01 1.3898E-04
```

ENERGY.DAT

```
SR-90           28.6 Y     38.
  0
  1    1    1
5.4600E-01 1.9580E-01 1.0000E+00
  0
  0
  0
Y -90           64.1 H     39.
  0
  2    2    1    2
2.2839E+00 9.3480E-01 9.9989E-01 5.2320E-01 1.8650E-01 1.1500E-04
  0
  0
  0
SR-91            9.5 H     38.
  0
 12    1   11
4.0466E-01 1.2290E-01 2.3100E-03 4.7727E-01 1.4880E-01 1.4400E-02
6.1737E-01 2.0090E-01 2.0200E-02 7.0358E-01 2.3430E-01 3.6100E-03
1.1041E+00 3.9890E-01 3.3900E-01 1.1381E+00 4.1340E-01 1.7700E-02
1.2103E+00 4.4450E-01 1.8500E-03 1.3786E+00 5.1800E-01 2.4400E-01
1.4971E+00 5.7050E-01 6.4300E-03 2.0310E+00 8.1290E-01 3.3000E-02
2.6840E+00 1.1212E+00 3.0800E-01 3.5500E-01 1.1021E-01 1.2700E-03
  0
  0
 23
2.6120E-01 4.3550E-03 2.7270E-01 2.5350E-03 2.7470E-01 1.0043E-02
3.7990E-01 1.4300E-03 6.2010E-01 1.7225E-02 6.3130E-01 5.3950E-03
6.5230E-01 2.8925E-02 6.5290E-01 7.8000E-02 6.5300E-01 4.5500E-03
7.4980E-01 2.2978E-01 7.6140E-01 5.5900E-03 8.2080E-01 1.5600E-03
8.7970E-01 1.8200E-03 9.2580E-01 3.7375E-02 1.0243E+00 3.2500E-01
1.0546E+00 2.1775E-03 1.1408E+00 1.2350E-03 1.2809E+00 9.0675E-03
1.4134E+00 9.5225E-03 1.4738E+00 1.6250E-03 1.6514E+00 2.8275E-03
1.7240E+00 1.5600E-03 7.7634E-01 1.1908E-02
Y -91M          49.71 M    39.
  0
  0
  0
  5
1.9100E-03 4.9532E-02 1.2700E-02 1.2051E-02 5.4053E-01 4.1700E-02
5.5520E-01 5.6100E-03 5.5718E-01 1.8500E-03
  5
1.9200E-03 1.1142E-03 1.4883E-02 8.5776E-03 1.4958E-02 1.6527E-02
1.6700E-02 4.5440E-03 5.5757E-01 9.5080E-01
Y -91           58.51 D    39.
  0
  2    1    2
3.3810E-01 9.9900E-02 3.0000E-03 1.5430E+00 6.0380E-01 9.9700E-01
```

ENERGY.DAT

```
  0
  0
  1
1.2049E+00 3.0000E-03
SR-92           2.71 H     38.
  0
  4   1   4
5.4610E-01 1.7400E-01 9.6000E-01 9.7666E-01 3.4500E-01 3.0000E-03
1.0376E+00 3.7100E-01 2.1000E-03 1.9300E+00 7.7700E-01 4.0000E-02
  0
  0
  8
2.4152E-01 2.9700E-02 4.3056E-01 3.3300E-02 4.9130E-01 2.6100E-03
6.5070E-01 3.6900E-03 9.5332E-01 3.6000E-02 1.1423E+00 2.8800E-02
1.3839E+00 9.0000E-01 6.6462E-01 1.7100E-03
Y -92           3.54 H     39.
  0
  9   3   5   6   8
8.1440E-01 2.7800E-01 1.0000E-03 1.2941E+00 4.8000E-01 6.5000E-02
1.5671E+00 6.0100E-01 2.4000E-03 1.7867E+00 7.0000E-01 4.3000E-03
2.1384E+00 8.6900E-01 1.1600E-02 2.2510E+00 9.2000E-01 2.3000E-02
2.6995E+00 1.1230E+00 3.4000E-02 3.6340E+00 1.5630E+00 8.5700E-01
5.5800E-01 1.8340E-01 3.7200E-04
  0
  0
 10
4.4850E-01 2.3352E-02 4.9260E-01 4.8511E-03 5.6110E-01 2.4047E-02
8.4430E-01 1.2510E-02 9.1260E-01 6.2550E-03 9.3446E-01 1.3900E-01
1.1324E+00 2.4325E-03 1.4054E+00 4.7816E-02 1.8473E+00 3.6001E-03
1.6472E+00 1.5193E-03
Y -93           10.1 H     39.
  0
  9   1   8
4.3232E-01 1.3200E-01 1.8700E-03 7.0538E-01 2.3500E-01 1.6000E-02
1.4199E+00 5.3500E-01 1.4500E-03 1.4396E+00 5.4400E-01 3.7700E-03
1.4646E+00 5.5500E-01 2.6600E-03 1.9429E+00 7.7100E-01 2.5100E-02
2.6231E+00 1.0870E+00 4.6000E-02 2.8900E+00 1.2140E+00 9.0200E-01
8.9000E-01 3.1046E-01 1.1920E-03
  0
  3
2.0200E-03 1.5543E-03 1.3400E-02 4.0690E-04 2.4890E-01 1.5070E-03
 14
2.0400E-03 4.3132E-05 1.5691E-02 3.1761E-04 1.5775E-02 6.1078E-04
1.7700E-02 1.7175E-04 2.6690E-01 6.8502E-02 6.8020E-01 6.0813E-03
9.4710E-01 1.9502E-02 1.2033E+00 1.0275E-03 1.4254E+00 2.3766E-03
1.4505E+00 3.3552E-03 1.9178E+00 1.4050E-02 2.1846E+00 1.5518E-03
2.1908E+00 1.7126E-03 1.4133E+00 3.2573E-03
MO-93          3.5E3 Y     42.
```

91048 | 589

```
  0
  0
  0
  2
2.1500E-03 9.8138E-01 1.4000E-02 2.1183E-01
  4
2.1700E-03 3.0352E-02 1.6521E-02 1.8114E-01 1.6615E-02 3.4768E-01
1.8600E-02 9.9947E-02
ZR-93          1.53E6 Y     40.
  0
  1   1   1
6.1531E-02 1.9500E-02 1.0000E+00
  0
  0
  0
NB-93M           14.6 Y     41.
  0
  0
  0
  6
2.1500E-03 7.9394E-01 1.1784E-02 1.5000E-01 1.4000E-02 3.7800E-02
2.8072E-02 6.6100E-01 3.0302E-02 1.4200E-01 3.0712E-02 4.6900E-02
  4
2.1700E-03 2.4555E-02 1.6521E-02 3.2324E-02 1.6615E-02 6.2041E-02
1.8600E-02 1.7835E-02
ZR-95           64.02 D     40.
  0
  4   1   3
3.6638E-01 1.0930E-01 5.5400E-01 3.9891E-01 1.2040E-01 4.3700E-01
8.8741E-01 3.2700E-01 7.8000E-03 1.1231E+00 4.0540E-01 1.0000E-03
  0
  0
  2
7.2418E-01 4.3656E-01 7.5671E-01 5.5345E-01
NB-95M           86.6 H     41.
  0
  3   1   2
9.5717E-01 3.3497E-01 1.3400E-03 1.1613E+00 4.3780E-01 5.4000E-02
3.7490E-01 1.1196E-01 3.9260E-05
  0
  5
2.1500E-03 6.6553E-01 1.4000E-02 1.3836E-01 2.1670E-01 5.4905E-01
2.3299E-01 1.0962E-01 2.3522E-01 3.6193E-02
  7
2.1700E-03 2.0584E-02 1.6521E-02 1.1831E-01 1.6615E-02 2.2709E-01
1.8600E-02 6.5281E-02 2.3569E-01 2.5043E-01 2.0412E-01 1.2967E-03
6.2907E-01 3.9275E-05
NB-95           35.06 D     41.
```

```
  0
  2
1.5977E-01 4.3350E-02 9.9970E-01 9.2560E-01 3.2195E-01 3.0000E-04
  0
  3
2.2700E-03 1.2632E-03 1.4800E-02 3.0150E-04 7.4579E-01 1.2775E-03
  6
2.2900E-03 5.2635E-05 1.7374E-02 2.8060E-04 1.7479E-02 5.3754E-04
1.9600E-02 1.5790E-04 7.6579E-01 9.9808E-01 3.8917E-01 2.8944E-04
ZR-97          16.90 H     40.
  0
 10
4.0990E-01 1.2430E-01 4.9000E-03 5.5150E-01 1.7530E-01 5.5000E-02
8.9295E-01 3.0920E-01 1.8800E-02 9.0691E-01 3.1490E-01 5.0000E-03
1.0047E+00 3.5540E-01 1.8000E-03 1.1091E+00 3.9940E-01 3.8000E-03
1.1096E+00 3.9960E-01 6.5000E-03 1.3813E+00 5.1720E-01 2.1000E-03
1.4064E+00 5.2830E-01 4.4000E-02 1.9141E+00 7.5660E-01 8.6000E-01
  0
  0
 26
2.0220E-01 1.0212E-03 2.1868E-01 2.3210E-03 2.5415E-01 1.2533E-02
2.7227E-01 2.5067E-03 3.3043E-01 1.1141E-03 3.5539E-01 2.2746E-02
4.0039E-01 3.2494E-03 5.0763E-01 5.2919E-02 5.1347E-01 5.1062E-03
6.0252E-01 1.3926E-02 6.9063E-01 2.5067E-03 6.9920E-01 1.2069E-03
7.0380E-01 9.2840E-03 7.9570E-01 1.2069E-03 8.0453E-01 6.4988E-03
8.2980E-01 2.2282E-03 8.5490E-01 3.3422E-03 9.7139E-01 2.8780E-03
1.0213E+00 1.2069E-02 1.1191E+00 1.1141E-03 1.1480E+00 2.6459E-02
1.2761E+00 9.7482E-03 1.3627E+00 1.3462E-02 1.7505E+00 1.3462E-02
1.8516E+00 3.5279E-03 3.4409E-01 2.1353E-03
NB-97M           60 S      41.
  0
  0
  0
  4
2.1500E-03 1.9904E-02 1.4000E-02 4.3848E-03 7.2437E-01 1.7400E-02
7.4066E-01 2.2500E-03
  5
2.1700E-03 6.1560E-04 1.6521E-02 3.7495E-03 1.6615E-02 7.1968E-03
1.8600E-02 2.0689E-03 7.4336E-01 9.7960E-01
NB-97          72.1 M      41.
  0
  6
3.0381E-01 8.8200E-02 1.1800E-03 4.1734E-01 1.2660E-01 1.6700E-03
6.6426E-01 2.1760E-01 2.0600E-03 9.0840E-01 3.1490E-01 1.0800E-02
1.2749E+00 4.6980E-01 9.8300E-01 8.1590E-01 2.7730E-01 8.8000E-04
  0
  3
2.2700E-03 1.7458E-03 1.4800E-02 4.1669E-04 6.3790E-01 1.7656E-03
```

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 10
2.2900E-03 7.2744E-05 1.7374E-02 3.8780E-04 1.7479E-02 7.4291E-04
1.9600E-02 2.1823E-04 4.8090E-01 1.4714E-03 6.5790E-01 9.8090E-01
1.0245E+00 1.0790E-02 1.2686E+00 1.5694E-03 1.5156E+00 1.1771E-03
7.9826E-01 4.9045E-03
NB-94          2.03E4 Y     41.
 0
 1
4.7147E-01 1.4580E-01 1.0000E+00
 0
 3
2.2700E-03 1.5920E-03 1.4800E-02 3.7996E-04 6.8263E-01 1.6100E-03
 6
2.2900E-03 6.6332E-05 1.7374E-02 3.5362E-04 1.7479E-02 6.7743E-04
1.9600E-02 1.9899E-04 7.0263E-01 1.0000E+00 8.7110E-01 1.0000E+00
MO-99          66.02 H      42.
 0
 6
2.1459E-01 5.9800E-02 1.1300E-03 3.5265E-01 1.0420E-01 1.3600E-03
4.3604E-01 1.3300E-01 1.7300E-01 8.4760E-01 2.8960E-01 1.3600E-02
1.2140E+00 4.4270E-01 8.2700E-01 5.5930E-01 1.8089E-01 5.7800E-04
 0
 7
2.1700E-03 4.3503E-02 1.5500E-02 8.9457E-03 1.9540E-02 2.8881E-02
3.7542E-02 3.4975E-03 1.1946E-01 3.7433E-03 1.6002E-01 7.8543E-03
1.7802E-01 1.1719E-03
 12
2.4200E-03 2.0499E-03 1.8251E-02 9.0462E-03 1.8367E-02 1.7297E-02
2.0600E-02 5.1896E-03 4.0584E-02 8.8320E-03 1.4051E-01 3.7888E-02
1.8106E-01 6.2336E-02 3.6643E-01 1.3696E-02 7.3958E-01 1.2800E-01
7.7800E-01 4.4800E-02 8.2290E-01 1.3312E-03 6.8013E-01 2.5837E-03
TC-99M          6.02 H      43.
 0
 0
 0
 9
1.6260E-03 7.4546E-01 2.1020E-03 2.4584E-01 2.1700E-03 1.0268E-01
1.5500E-02 2.0788E-02 1.1946E-01 8.7928E-02 1.2159E-01 6.1335E-03
1.3747E-01 1.0607E-02 1.3959E-01 1.9053E-03 1.3996E-01 2.2998E-03
 6
2.4200E-03 4.8382E-03 1.8251E-02 2.1021E-02 1.8367E-02 4.0194E-02
2.0600E-02 1.2059E-02 1.4051E-01 8.9070E-01 1.4263E-01 2.1400E-04
TC-99          2.13E5 Y     43.
 0
 2
2.9360E-01 8.4600E-02 9.9999E-01 2.0420E-01 5.6500E-02 1.5000E-05
 0
 0
```

```
 1
8.9360E-02 5.8000E-06
TC-101          14.2 M     43.
 0
 7
6.2350E-01 2.0100E-01 1.2000E-02 6.8658E-01 2.2500E-01 8.2000E-03
6.9603E-01 2.2900E-01 3.0900E-03 7.8217E-01 2.6300E-01 1.9400E-02
9.0500E-01 3.1200E-01 1.6000E-03 1.0799E+00 3.8500E-01 6.5000E-02
1.3182E+00 4.8700E-01 8.9000E-01
 0
 6
2.5300E-03 1.9192E-02 1.6200E-02 3.8912E-03 1.0512E-01 5.5772E-03
1.6199E-01 1.2119E-03 2.8469E-01 1.2009E-02 3.0359E-01 1.4040E-03
 22
2.5600E-03 1.0101E-03 1.9150E-02 4.2730E-03 1.9279E-02 8.1390E-03
2.1700E-02 2.4948E-03 1.2724E-01 2.8168E-02 1.7957E-01 5.8278E-03
1.8411E-01 1.6159E-02 2.3371E-01 2.7461E-03 2.3826E-01 3.0728E-03
3.0681E-01 8.8300E-01 3.1150E-01 1.3951E-03 3.9333E-01 1.1214E-03
5.1595E-01 1.0861E-03 5.3149E-01 1.0243E-02 5.4514E-01 6.0044E-02
6.2705E-01 4.1501E-03 6.9470E-01 1.1479E-02 7.1552E-01 6.8874E-03
7.2000E-01 1.8543E-03 8.4279E-01 2.3046E-03 9.2871E-01 1.2715E-03
6.1783E-01 4.7797E-03
RU-103          39.35 D     44.
 0
 5
1.1282E-01 2.9800E-02 6.4000E-02 2.2607E-01 6.3200E-02 9.0000E-01
4.6792E-01 1.4380E-01 2.3800E-03 7.2315E-01 2.3920E-01 3.5000E-02
1.4090E-01 3.8725E-02 1.0230E-03
 0
 4
2.3900E-03 1.0117E-02 1.7000E-02 2.0974E-03 3.0055E-02 6.7955E-03
4.7386E-01 4.0716E-03
 11
2.7000E-03 5.3249E-04 2.0074E-02 2.5107E-03 2.0216E-02 4.7732E-03
2.2700E-02 1.4859E-03 5.3275E-02 3.7338E-03 2.9498E-01 2.4892E-03
4.4380E-01 3.2004E-03 4.9708E-01 8.8900E-01 5.5704E-01 8.2677E-03
6.1033E-01 5.6007E-02 4.8693E-01 1.2487E-03
PD-103          16.961 D     46.
 0
 0
 0
 2
2.3900E-03 9.0771E-01 1.7000E-02 1.6576E-01
 5
2.7000E-03 4.7774E-02 2.0074E-02 1.9843E-01 2.0216E-02 3.7724E-01
2.2700E-02 1.1744E-01 3.5961E-01 3.0837E-04
RH-103M         56.119 M     45.
 0
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```
  0
  0
  6
2.3900E-03 7.6598E-01 1.6528E-02 9.5200E-02 1.7000E-02 1.8374E-02
3.6336E-02 7.1300E-01 3.9121E-02 1.4400E-01 3.9667E-02 4.7500E-02
  5
2.7000E-03 4.0315E-02 2.0074E-02 2.1995E-02 2.0216E-02 4.1815E-02
2.2700E-02 1.3017E-02 3.9748E-02 7.0400E-04
RU-105          4.44 H      44.     (Includes daughter, RH-105M)
  0
 14
2.2017E-01 6.1300E-02 1.0800E-03 4.3118E-01 1.3080E-01 3.4000E-03
4.7570E-01 1.4700E-01 2.0000E-03 5.4072E-01 1.7010E-01 1.3200E-02
5.7251E-01 1.8180E-01 4.4700E-02 5.9649E-01 1.9070E-01 5.0000E-03
7.0254E-01 2.3110E-01 1.1300E-03 9.4822E-01 3.2930E-01 5.2200E-02
1.1117E+00 3.9750E-01 2.0000E-01 1.1319E+00 4.0600E-01 1.8100E-01
1.1559E+00 4.1620E-01 2.9000E-03 1.1933E+00 4.3220E-01 4.9900E-01
1.5252E+00 5.7680E-01 5.0000E-03 4.4700E-01 1.4031E-01 1.6300E-03
  0
 11
2.3900E-03 6.6620E-03 1.7000E-02 1.3811E-03 6.2680E-02 3.5200E-03
1.2598E-01 2.0374E-03 2.3968E-01 1.5984E-03
2.3900E-03 6.9517E-01 1.7000E-02 9.8816E-02 1.0635E-01 5.1200E-01
1.2616E-01 2.3000E-01 1.2894E-01 4.4800E-02 1.2949E-01 7.7700E-02
 47
2.7000E-03 3.5063E-04 2.0074E-02 1.6532E-03 2.0216E-02 3.1430E-03
2.2700E-02 9.7844E-04 8.5900E-02 3.2000E-03 1.4920E-01 1.6700E-02
1.6360E-01 1.4000E-03 1.8360E-01 1.0000E-03 2.2500E-01 1.5000E-03
2.6290E-01 7.2000E-02 3.1650E-01 1.1700E-01 3.2610E-01 1.1800E-02
3.3090E-01 7.9000E-03 3.5000E-01 3.0000E-03 3.5020E-01 1.1000E-02
3.9340E-01 4.2000E-02 4.0750E-01 1.8000E-03 4.1350E-01 2.4800E-02
4.6940E-01 1.7500E-01 4.7000E-01 1.3000E-02 4.8960E-01 5.9000E-03
4.9920E-01 2.4000E-02 5.0040E-01 3.0000E-03 5.1370E-01 3.6000E-03
5.3920E-01 1.3000E-03 5.7500E-01 1.3000E-03 5.7530E-01 1.0700E-02
6.3230E-01 2.3000E-03 6.3860E-01 2.8000E-03 6.5260E-01 3.5000E-03
6.5600E-01 2.0000E-03 6.5610E-01 2.4000E-02 6.7640E-01 1.6700E-01
7.2450E-01 4.9000E-01 8.2210E-01 1.9000E-03 8.4590E-01 7.3000E-03
8.7580E-01 3.4000E-02 9.0770E-01 5.9000E-03 9.6940E-01 2.3400E-02
1.0172E+00 3.4000E-03 1.3211E+00 2.3000E-03 7.0736E-01 1.2810E-02
2.7000E-03 3.6588E-02 2.0074E-02 1.1829E-01 2.0216E-02 2.2489E-01
2.2700E-02 7.0008E-02 1.2957E-01 2.0400E-01
RH-105          35.36 H     45.
  0
  4
2.4800E-01 6.9900E-02 1.9700E-01 2.6080E-01 7.3900E-02 5.2200E-02
5.6690E-01 1.7940E-01 7.5000E-01 1.2420E-01 3.3000E-02 4.0300E-04
  0
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2.5000E-03 3.8419E-03 1.4420E-02 1.3594E-03 1.7700E-02 7.6732E-04
2.9455E-01 2.8800E-03
  8
2.8400E-03 2.2791E-04 2.1020E-02 9.9195E-04 2.1177E-02 1.8823E-03
2.3800E-02 5.9783E-04 2.8010E-01 1.6704E-03 3.0610E-01 5.1264E-02
3.1890E-01 1.9200E-01 2.9492E-01 6.2976E-04
RU-106         368.2 D     44.  (Includes daughter, RH-106)
  0
  8
3.9401E-02 1.0030E-02 1.0000E+00
1.5395E+00 5.8200E-01 4.2700E-03 1.9788E+00 7.8000E-01 1.9200E-02
2.4073E+00 9.7700E-01 9.8000E-02 2.4130E+00 9.7900E-01 5.8000E-03
3.0292E+00 1.2670E+00 8.2000E-02 3.5410E+00 1.5090E+00 7.8700E-01
1.1180E+00 4.0471E-01 4.1674E-03
  0
  0
  8
5.1185E-01 2.0600E-01 6.1617E-01 7.0040E-03 6.2184E-01 9.8056E-02
8.7360E-01 4.1612E-03 1.0505E+00 1.7304E-02 1.1280E+00 3.9552E-03
1.5622E+00 1.5656E-03 1.3570E+00 5.7969E-03
PD-107         6.5E6 Y     46.
  0
  1   1   1
3.3101E-02 9.3000E-03 1.0000E+00
  0
  0
  0
PD-109        13.453 H     46. (Includes daughter, AG-109M)
  0
  2
1.0279E+00 3.6100E-01 9.9879E-01 4.5010E-01 1.3988E-01 1.1295E-03
  0
  6
2.6100E-03 7.8738E-01 1.8500E-02 7.0890E-02 6.2518E-02 4.1700E-01
8.4226E-02 4.4000E-01 8.7314E-02 8.9400E-02 8.7937E-02 1.6000E-02
  6
5.0860E-01 1.3536E-03
2.9800E-03 5.2940E-02 2.1990E-02 9.8760E-02 2.2163E-02 1.8705E-01
2.4900E-02 6.0305E-02 8.8032E-02 3.7200E-02
AG-110M       249.85 D     47. (Includes daughter, AG-110)  7/22/87 RAP
  0
  7
8.3866E-02 2.1800E-02 6.7300E-01 1.3381E-01 3.5700E-02 4.0700E-03
5.3067E-01 1.6560E-01 3.0500E-01 3.1530E-01 9.2836E-02 1.8630E-03
2.2350E+00 8.9410E-01 4.3537E-02 2.8928E+00 1.1993E+00 9.3762E-01
1.1248E+00 4.0685E-01 8.5301E-04
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5.6250E-04 1.3287E-02 2.6100E-03 1.1118E-02 1.8500E-02 1.4041E-03
9.0966E-02 8.2593E-03 1.1267E-01 3.9368E-03 2.7200E-03 2.2780E-03
1.9300E-02 4.1078E-04 6.3104E-01 2.5673E-03
2.5000E-03 2.6176E-03 1.7700E-02 4.6083E-04
 36
2.9800E-03 7.4754E-04 2.1990E-02 1.9561E-03 2.2163E-02 3.7047E-03
2.4900E-02 1.1944E-03 9.8856E-02 9.5627E-05 3.1300E-03 1.6097E-04
2.2984E-02 6.1536E-04 2.3174E-02 1.1611E-03 2.6100E-02 3.8015E-04
3.6544E-01 1.0571E-03 4.4680E-01 3.6434E-02 6.2035E-01 2.7656E-02
6.2625E-01 2.3408E-03 6.5775E-01 9.4388E-01 6.7660E-01 1.4158E-03
6.7761E-01 1.0675E-01 6.8699E-01 6.4656E-02 7.0667E-01 1.6678E-01
7.0812E-01 2.8316E-03 7.4426E-01 4.6439E-02 7.6393E-01 2.2276E-01
8.1802E-01 7.2773E-02 8.8467E-01 7.2584E-01 9.3748E-01 3.4187E-01
9.9723E-01 1.2459E-03 1.3343E+00 1.3214E-03 1.3843E+00 2.4258E-01
1.4758E+00 4.0020E-02 1.5050E+00 1.3063E-01 1.5623E+00 1.1798E-02
2.8400E-03 1.5529E-04 2.1020E-02 5.9574E-04 2.1177E-02 1.1304E-03
2.3800E-02 3.5904E-04 6.5775E-01 4.4192E-02 1.0460E+00 9.5454E-04
AG-111          7.46 D     47.
  0
  4   1   2
6.8590E-01 2.2350E-01 7.0000E-02 7.8261E-01 2.7890E-01 1.1000E-02
1.0280E+00 3.6040E-01 9.1900E-01 2.3700E-01 6.7793E-02 5.6000E-04
  0
  3
2.7200E-03 9.0686E-04 1.9300E-02 1.6353E-04 3.1542E-01 1.0220E-03
  8
3.1300E-03 6.4082E-05 2.2984E-02 2.4497E-04 2.3174E-02 4.6221E-04
2.6100E-02 1.5134E-04 9.6750E-02 1.2024E-03 2.4539E-01 1.2291E-02
3.4213E-01 6.6800E-02 6.5472E-01 5.5912E-04
CD-109           464 D     48.
  0
  0
  0
  2
2.6100E-03 8.6538E-01 1.8500E-02 1.3362E-01
  4
2.9800E-03 5.8184E-02 2.1990E-02 1.8615E-01 2.2163E-02 3.5256E-01
2.4900E-02 1.1367E-01
CD-113M         13.7 Y     48.
  0
  1
5.8570E-01 1.8540E-01 9.9977E-01
  0
  0
  0
CD-115M         44.6 D     48.
  0
  5   1   3
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2.0273E-01 5.5800E-02 1.9600E-03 3.3040E-01 9.6000E-02 6.0500E-03
6.8716E-01 2.4170E-01 1.1450E-02 1.6210E+00 6.1500E-01 9.8000E-01
4.1060E-01 1.2471E-01 5.5889E-04
  0
  0
  4
4.8447E-01 1.9285E-03 9.3384E-01 1.3300E-02 1.2906E+00 5.9185E-03
9.3273E-01 9.7248E-04
CD-115        53.46 H     48.
  0
  5
5.8343E-01 1.8460E-01 3.5200E-01 6.1895E-01 1.9780E-01 3.4000E-02
8.5040E-01 2.8750E-01 1.2500E-02 1.1113E+00 3.9440E-01 6.0100E-01
2.5000E-01 7.0404E-02 1.5225E-04
  0
  5
2.8400E-03 4.5725E-02 7.5741E-03 4.1413E-02 2.0100E-02 6.2119E-03
3.1277E-02 1.0398E-02 3.4688E-02 2.7222E-03
 10
3.2900E-03 3.6008E-03 2.4002E-02 1.0032E-02 2.4210E-02 1.8892E-02
2.7300E-02 6.2766E-03 3.5514E-02 4.4626E-03 2.3144E-01 7.8440E-03
2.6090E-01 2.0564E-02 4.9235E-01 8.5118E-02 5.2790E-01 2.9150E-01
2.9686E-01 1.1283E-03
IN-115M        4.36 H     49.
  0
  2
8.6130E-01 2.9100E-01 3.6000E-02 3.6390E-01 1.0700E-01 5.2000E-04
  0
  6
2.8400E-03 4.1821E-01 2.0100E-02 5.8791E-02 3.0836E-01 3.9194E-01
3.3206E-01 8.2722E-02 3.3548E-01 1.6853E-02 3.3618E-01 3.7268E-03
  6
3.2900E-03 3.2934E-02 2.4002E-02 9.4944E-02 2.4210E-02 1.7880E-01
2.7300E-02 5.9403E-02 3.3630E-01 4.6706E-01 4.9737E-01 5.1430E-04
IN-111         2.83 D     49.
  0
  0
  0
  8
2.7200E-03 1.0027E+00 1.9300E-02 1.5772E-01 1.4457E-01 8.4090E-02
1.6726E-01 1.0499E-02 1.7051E-01 2.4497E-03 2.1868E-01 5.0384E-02
2.4137E-01 7.8490E-03 2.4462E-01 1.8142E-03
  7
3.1300E-03 7.0853E-02 2.2984E-02 2.3628E-01 2.3174E-02 4.4581E-01
2.6100E-02 1.4597E-01 1.7128E-01 9.0240E-01 2.4539E-01 9.4000E-01
1.5081E-01 2.8200E-05
IN-114M       49.51 D     49. (Includes daughter, IN-114) 7/22/87 RAP
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  2
 6.8477E-01 2.2230E-01 1.9044E-03 1.9846E+00 7.7690E-01 9.4992E-01
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 10
 2.8400E-03 6.4176E-01 2.0100E-02 5.9878E-02 1.6233E-01 3.9919E-01
 1.8603E-01 3.1706E-01 1.8944E-01 6.6468E-02 1.9015E-01 1.3370E-02
 2.7200E-03 3.8953E-02 1.9300E-02 6.1042E-03
 2.7200E-03 7.8479E-03 1.9300E-02 1.2445E-03
 18
 3.2900E-03 5.0538E-02 2.4002E-02 9.6700E-02 2.4210E-02 1.8211E-01
 2.7300E-02 6.0502E-02 1.9027E-01 1.5949E-01 3.1300E-03 2.7526E-03
 2.2984E-02 9.1443E-03 2.3174E-02 1.7253E-02 2.6100E-02 5.6491E-03
 5.5843E-01 4.4779E-02 7.2524E-01 4.4887E-02
 3.1300E-03 5.5456E-04 2.2984E-02 1.8643E-03 2.3174E-02 3.5175E-03
 2.6100E-02 1.1517E-03 5.7580E-01 4.8453E-02 5.5843E-01 4.8453E-05
 1.2998E+00 1.9037E-03
 SN-113         115.1 D     50.
  0
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  2
 2.8400E-03 8.5194E-01 2.0100E-02 1.2811E-01
  6
 3.2900E-03 6.7089E-02 2.4002E-02 2.0689E-01 2.4210E-02 3.8962E-01
 2.7300E-02 1.2944E-01 2.5512E-01 1.9340E-02 6.3807E-01 9.7090E-06
 IN-113M        1.658 H     49.
  0
  0
  0
  6
 2.8400E-03 2.9653E-01 2.0100E-02 4.2300E-02 3.6375E-01 2.8200E-01
 3.8745E-01 5.4800E-02 3.9086E-01 1.1100E-02 3.9157E-01 2.4500E-03
  5
 3.2900E-03 2.3351E-02 2.4002E-02 6.8312E-02 2.4210E-02 1.2865E-01
 2.7300E-02 4.2740E-02 3.9169E-01 6.4900E-01
 SN-117M        13.60 D     50.
  0
  0
  0
  9
 2.9500E-03 9.0827E-01 2.1000E-02 1.0787E-01 1.2682E-01 6.4800E-01
 1.2936E-01 1.1700E-01 1.5156E-01 2.6100E-01 1.5410E-01 1.4800E-02
 1.5514E-01 5.6400E-02 1.5588E-01 1.3500E-02 1.5768E-01 3.5400E-03
  6
 3.4400E-03 7.8980E-02 2.5044E-02 1.8728E-01 2.5271E-02 3.5136E-01
 2.8500E-02 1.1850E-01 1.5602E-01 2.1100E-02 1.5856E-01 8.6400E-01
 SN-119M        293.0 D     50.
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ENERGY.DAT

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2.9500E-03 1.3694E+00 1.9405E-02 6.6600E-01 2.1000E-02 4.5402E-02
2.2986E-02 1.7300E-01 3.6460E-02 3.2200E-01 6.1195E-02 5.2300E-01
6.4776E-02 1.2400E-01 6.5524E-02 3.1000E-02
  6
3.4400E-03 1.1908E-01 2.3870E-02 1.6100E-01 2.5044E-02 7.8827E-02
2.5271E-02 1.4789E-01 2.8500E-02 4.9878E-02 6.5660E-02 2.0000E-04
SN-121M
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  0
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  0
  0
SN-121
  0
  0
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  0
SN-123          129.2 D      50.
  0
  3   1   2
3.0835E-01 8.8600E-02 6.0000E-03 1.3970E+00 5.2310E-01 9.9400E-01
3.4700E-01 1.0176E-01 3.4340E-04
  0
  0
  2
1.0886E+00 6.0000E-03 9.9290E-01 3.6276E-04
I -125          60.14 D      53.
  0
  0
  0
  6
3.1900E-03 1.5610E+00 3.6781E-03 7.7880E-01 2.2700E-02 1.9691E-01
3.0553E-02 1.2266E-01 3.4486E-02 2.4662E-02 3.5324E-02 8.1125E-03
  5
3.7700E-03 1.5438E-01 2.7202E-02 3.9233E-01 2.7472E-02 7.3196E-01
3.1000E-02 2.5409E-01 3.5492E-02 6.4900E-02
SN-125            9.64 D      50.
  0
 12   1  11
6.2200E-02 1.6000E-02 2.2000E-03 7.5101E-02 1.9500E-02 1.9000E-03
9.6300E-02 2.5200E-02 1.1000E-03 1.0960E-01 2.8900E-02 5.3000E-03
3.4840E-01 1.0170E-01 2.2000E-02 3.6730E-01 1.0800E-01 3.9000E-02
4.6039E-01 1.3980E-01 5.9000E-02 5.4400E-01 1.6960E-01 1.3000E-03
1.0010E+00 3.4730E-01 3.1000E-03 1.2605E+00 4.5600E-01 2.7000E-02
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2.3500E+00 9.3800E-01 8.3000E-01 3.6600E-01 1.1486E-01 7.8700E-04
  0
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3.3190E-01 1.2900E-02 3.5090E-01 2.2360E-03 4.6970E-01 1.2900E-02
8.0050E-01 9.4600E-03 8.2260E-01 3.7840E-02 8.9370E-01 2.3220E-03
9.1550E-01 3.7840E-02 9.3470E-01 1.4620E-03 1.0171E+00 2.5800E-03
1.0666E+00 8.6000E-02 1.0874E+00 9.4600E-03 1.0889E+00 4.0420E-02
1.1513E+00 1.0320E-03 1.1732E+00 1.8920E-03 1.2210E+00 2.1500E-03
1.4195E+00 4.6440E-03 1.8057E+00 1.4620E-03 2.0017E+00 2.0640E-02
2.2752E+00 1.8060E-03 8.3321E-01 7.0314E-03
SB-125          2.77 Y      51.
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  7   1   7
9.5387E-02 2.4900E-02 1.3600E-01 1.2465E-01 3.3100E-02 5.8100E-02
1.3078E-01 3.4800E-02 1.8100E-01 2.4160E-01 6.7500E-02 1.5900E-02
3.0342E-01 8.7000E-02 3.9900E-01 4.4571E-01 1.3450E-01 7.4000E-02
6.2204E-01 2.1550E-01 1.3500E-01
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3.1900E-03 5.0020E-01 3.6781E-03 4.9978E-01 1.4941E-02 1.8088E-03
2.2700E-02 6.4187E-02 3.0553E-02 7.8716E-02 3.4486E-02 1.5826E-02
3.5324E-02 5.2061E-03 1.4452E-01 1.0339E-02 1.7139E-01 1.8610E-03
3.9608E-01 3.3729E-03
 22
3.7700E-03 4.9470E-02 2.7202E-02 1.2789E-01 2.7472E-02 2.3860E-01
3.1000E-02 8.2825E-02 3.5492E-02 4.1649E-02 1.1695E-01 2.6104E-03
1.7262E-01 1.8126E-03 1.7633E-01 6.8926E-02 2.0413E-01 3.2263E-03
2.0809E-01 2.4315E-03 2.2791E-01 1.3140E-03 3.2103E-01 4.1707E-03
3.8044E-01 1.4958E-02 4.0801E-01 1.8185E-03 4.2789E-01 2.9330E-01
4.4350E-01 3.0210E-03 4.6338E-01 1.0353E-01 6.0056E-01 1.7774E-01
6.0664E-01 5.0213E-02 6.3589E-01 1.1321E-01 6.7141E-01 1.8126E-02
1.5903E-01 6.9720E-04
TE-125M           58 D      52.
  0
  0
  0
 10
3.1900E-03 8.8444E-01 2.2700E-02 7.0498E-02 5.6646E-02 4.2699E-01
3.0553E-02 1.2266E-01 3.4486E-02 2.4662E-02 3.5324E-02 8.1125E-03
7.7462E-02 5.1899E-01 1.0434E-01 3.7300E-01 1.0827E-01 8.5899E-02
1.0911E-01 2.2500E-02
  7
3.7700E-03 1.5090E-01 2.7202E-02 3.2322E-01 2.7472E-02 6.0302E-01
3.1000E-02 2.0933E-01 3.5492E-02 6.4900E-02 1.0928E-01 2.8300E-03
1.4478E-01 4.0000E-09
SN-126          1.0E5 Y     50.
  0
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  1
2.5010E-01 7.0000E-02 1.0000E+00
  0
 24
3.0700E-03 1.2013E+00 1.2149E-02 3.1718E-02 1.6952E-02 2.1071E-02
1.8002E-02 5.7822E-01 1.8582E-02 3.1685E-01 2.0706E-02 4.1151E-03
2.1498E-02 1.3635E-03 2.1756E-02 1.2378E-01 2.1800E-02 4.4915E-02
2.2336E-02 6.2538E-02 2.2548E-02 4.0859E-02 2.3128E-02 2.0611E-02
3.3789E-02 5.3856E-02 3.7942E-02 4.1159E-03 4.1696E-02 1.0789E-03
5.6449E-02 1.6407E-01 5.7079E-02 8.8060E-02 5.9582E-02 7.1872E-03
6.3336E-02 1.7058E-03 8.2242E-02 6.3400E-02 8.2872E-02 1.1322E-02
8.5996E-02 1.3019E-02 8.6626E-02 2.7010E-03 8.6788E-02 2.7999E-03
 11
3.6000E-03 1.1159E-01 2.1650E-02 1.2395E-02 2.3280E-02 6.4010E-02
2.6111E-02 8.3339E-02 2.6359E-02 1.5607E-01 2.9700E-02 5.3387E-02
4.2640E-02 4.9950E-03 6.4280E-02 9.5830E-02 8.6940E-02 8.9170E-02
8.7570E-02 3.7000E-01 2.2700E-02 9.9900E-04
SB-126M        19.0 M     51.
  0
  4
7.4520E-01 2.4500E-01 8.6000E-03 8.7840E-01 2.9700E-01 1.3000E-02
1.1865E+00 4.2400E-01 3.3000E-02 1.8066E+00 6.9400E-01 8.1000E-01
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3.0700E-03 9.7100E-02 1.3002E-02 1.0612E-01 1.6756E-02 2.5480E-02
1.7548E-02 8.4140E-03 3.1900E-03 1.4176E-02 2.2700E-02 1.9351E-03
3.8289E-01 1.0195E-02 4.0976E-01 1.4907E-03 6.3452E-01 2.7844E-03
6.6319E-01 2.5016E-03
 14
3.6000E-03 9.0202E-03 1.7700E-02 3.1348E-06 3.7700E-03 1.4021E-03
2.7202E-02 3.8556E-03 2.7472E-02 7.1932E-03 3.1000E-02 2.4970E-03
4.1470E-01 8.5672E-01 6.2000E-01 1.5421E-02 6.6633E-01 8.5672E-01
6.9500E-01 8.5672E-01 9.2820E-01 1.2851E-02 1.0348E+00 1.7991E-02
1.0613E+00 5.1403E-03 1.4762E+00 3.4269E-03
SB-126         12.4 D     51.
  0
 14   2   7  14
9.0401E-02 2.4000E-02 5.0000E-03 1.1430E-01 3.0000E-02 2.0900E-02
3.7140E-01 1.0900E-01 2.9000E-01 3.9350E-01 1.1700E-01 5.9000E-02
4.9470E-01 1.5200E-01 8.4000E-02 5.7590E-01 1.8100E-01 4.2000E-02
5.9100E-01 2.0400E-01 5.6000E-03 7.2510E-01 2.3700E-01 5.0000E-03
7.2750E-01 2.3800E-01 4.8000E-03 7.5390E-01 2.4800E-01 8.1000E-02
7.9960E-01 2.6600E-01 4.8000E-02 1.0684E+00 3.7400E-01 1.6000E-01
1.1688E+00 4.1600E-01 9.0000E-03 1.7889E+00 6.8900E-01 1.9000E-01
  0
  7
3.1900E-03 1.5803E-02 2.2700E-02 2.1864E-03 2.6469E-01 1.4345E-03
3.8289E-01 9.9105E-03 4.0976E-01 1.4491E-03 6.3452E-01 3.2376E-03
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6.6319E-01 2.9089E-03
 32
3.7700E-03 1.5630E-03 2.7202E-02 4.3563E-03 2.7472E-02 8.1274E-03
3.1000E-02 2.8213E-03 1.4930E-01 3.9848E-03 2.0860E-01 4.9809E-03
2.2380E-01 1.3947E-02 2.7860E-01 2.3909E-02 2.9650E-01 4.4829E-02
2.9710E-01 4.9809E-03 4.1470E-01 8.3281E-01 4.1530E-01 9.9619E-03
5.5520E-01 1.6935E-02 5.7380E-01 6.6745E-02 5.9300E-01 7.4714E-02
6.2020E-01 8.9657E-03 6.3970E-01 8.9657E-03 6.5630E-01 2.1916E-02
6.6633E-01 9.9619E-01 6.7500E-01 3.6859E-02 6.9500E-01 9.9619E-01
6.9700E-01 2.8890E-01 7.2050E-01 5.3794E-01 8.5680E-01 1.7633E-01
9.5400E-01 1.1954E-02 9.5960E-01 4.9809E-03 9.8930E-01 6.7741E-02
1.0348E+00 9.9619E-03 1.0613E+00 1.9924E-03 1.0639E+00 8.9657E-03
1.2130E+00 2.3909E-02 1.4762E+00 2.7893E-03
SB-122          2.70 D      51.
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 4   2   3   4
7.2381E-01 2.3650E-01 4.5000E-02 1.4169E+00 5.2240E-01 6.7300E-01
1.9809E+00 7.7210E-01 2.5700E-01 4.2300E-01 1.3877E-01 2.2300E-04
 0
 5
2.9500E-03 2.0176E-02 2.1000E-02 2.8963E-03 3.1900E-03 2.5292E-03
2.2700E-02 4.4155E-04 5.3212E-01 3.5324E-03
 13
3.4400E-03 1.7544E-03 2.5044E-02 5.0285E-03 2.5271E-02 9.4343E-03
2.8500E-02 3.1818E-03 1.1402E+00 7.7440E-03 3.7700E-03 2.8930E-04
2.7202E-02 8.7975E-04 2.7472E-02 1.6413E-03 3.1000E-02 5.6976E-04
5.6393E-01 7.0648E-01 6.9280E-01 3.7443E-02 1.2570E+00 7.7713E-03
1.1792E+00 2.1901E-04
SB-124         60.20 D      51.
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 13
1.3008E-01 3.4600E-02 5.2000E-03 2.0320E-01 5.5900E-02 5.0200E-03
2.1129E-01 5.8300E-02 8.7600E-02 4.2164E-01 1.2620E-01 3.7000E-03
6.1127E-01 1.9400E-01 5.2800E-01 7.2244E-01 2.3600E-01 2.5800E-03
8.1324E-01 2.7130E-01 6.4000E-03 8.6566E-01 2.9200E-01 4.0900E-02
9.4706E-01 3.2470E-01 2.1300E-02 1.5795E+00 5.9340E-01 5.1400E-02
1.6564E+00 6.2730E-01 2.5300E-02 2.3023E+00 9.1860E-01 2.1900E-01
4.4760E-01 1.3878E-01 3.8900E-03
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3.1900E-03 3.4039E-03 2.2700E-02 5.1382E-04 5.7089E-01 4.1105E-03
 29
3.7700E-03 3.3665E-04 2.7202E-02 1.0237E-03 2.7472E-02 1.9100E-03
3.1000E-02 6.6302E-04 4.0003E-01 1.2919E-03 4.4399E-01 2.0553E-03
5.2550E-01 1.6638E-03 6.0271E-01 9.7870E-01 6.3236E-01 1.4681E-03
6.4585E-01 7.2620E-02 7.0931E-01 1.4191E-02 7.1382E-01 2.3782E-02
7.2278E-01 1.1098E-01 7.3567E-01 1.2723E-03 7.9074E-01 7.4381E-03
9.6820E-01 1.9183E-02 1.0452E+00 1.8595E-02 1.3255E+00 1.4974E-02
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1.3552E+00 9.9827E-03 1.3682E+00 2.5055E-02 1.3763E+00 4.4041E-03
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1.5264E+00 4.0127E-03 1.5799E+00 1.9574E-03 1.6910E+00 4.9033E-01
2.0910E+00 5.7254E-02 1.2083E+00 1.3366E-02
SB-127          3.85 D     51.
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2.5830E-01 7.2700E-02 1.1000E-03 2.9070E-01 8.2900E-02 6.1000E-03
4.2520E-01 1.2750E-01 8.0000E-03 4.4080E-01 1.3280E-01 1.2500E-02
5.0434E-01 1.5510E-01 5.2200E-02 6.5700E-01 2.1110E-01 1.2500E-02
7.9483E-01 2.6400E-01 7.8000E-02 7.9751E-01 2.6510E-01 1.7200E-01
8.9590E-01 3.0410E-01 3.4900E-01 9.4965E-01 3.2580E-01 4.1000E-02
1.1080E+00 3.9090E-01 2.2800E-01 1.2401E+00 4.4650E-01 2.4000E-02
1.4928E+00 5.6190E-01 2.0000E-02 5.0800E-01 1.6435E-01 1.4000E-03
 0
 7
3.1900E-03 3.9206E-02 2.2700E-02 5.2955E-03 2.9286E-02 3.4669E-02
5.6161E-02 4.5325E-03 2.2059E-01 4.2786E-03 4.4119E-01 2.2023E-03
6.5339E-01 1.2138E-03
 38
3.7700E-03 3.8775E-03 2.7202E-02 1.0551E-02 2.7472E-02 1.9684E-02
3.1000E-02 6.8331E-03 6.1100E-02 1.4209E-02 1.5430E-01 1.1424E-03
2.5240E-01 8.3895E-02 2.8040E-01 5.3550E-03 2.9080E-01 1.8207E-02
2.9330E-01 2.8560E-03 3.1000E-01 2.0349E-03 3.9180E-01 9.2820E-03
4.0500E-01 1.1424E-03 4.1160E-01 3.4272E-02 4.4070E-01 2.4990E-03
4.4490E-01 4.2126E-02 4.5100E-01 1.7850E-03 4.5600E-01 1.0710E-03
4.7300E-01 2.5026E-01 5.0280E-01 6.0690E-03 5.4300E-01 2.6418E-02
5.8420E-01 3.2130E-03 6.0360E-01 4.2483E-02 6.3780E-01 3.5700E-03
6.5350E-01 2.4990E-03 6.6690E-01 5.3550E-03 6.8230E-01 5.3550E-03
6.8520E-01 3.5700E-01 6.9850E-01 3.3915E-02 7.2220E-01 1.7493E-02
7.4590E-01 1.0710E-03 7.8380E-01 1.4673E-01 8.1730E-01 2.6775E-03
8.2010E-01 1.1424E-03 9.2350E-01 4.6053E-03 1.1412E+00 3.5700E-03
1.2903E+00 3.4629E-03 7.3674E-01 5.3193E-03
TE-127M          109 D     52.
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 2   1   1
7.2465E-01 2.5290E-01 1.8200E-02 7.7000E-02 2.0075E-02 1.1264E-04
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3.1900E-03 7.4028E-01 2.2700E-02 5.2276E-02 5.6446E-02 4.1820E-01
8.3321E-02 4.3293E-01 8.7254E-02 1.0210E-01 8.8092E-02 2.7193E-02
3.3100E-03 1.1564E-02 2.3600E-02 1.4328E-03 2.4431E-02 1.2142E-02
5.2412E-02 1.7287E-03
 11
3.7700E-03 7.3215E-02 2.7202E-02 1.0415E-01 2.7472E-02 1.9432E-01
3.1000E-02 6.7455E-02 8.8260E-02 8.6684E-04 3.9400E-03 1.2139E-03
2.8317E-02 3.0470E-03 2.8612E-02 5.6740E-03 3.2300E-02 1.9884E-03
5.7600E-02 3.7826E-03 6.4861E-01 1.1269E-04
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TE-127          9.35 H      52.
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2.7609E-01 7.8200E-02 1.1840E-02 6.9400E-01 2.2470E-01 9.8789E-01
4.8500E-01 1.4827E-01 2.6728E-04
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 0
 3
3.6030E-01 1.3437E-03 4.1790E-01 9.8800E-03 1.7269E-01 1.3015E-03
TE-123M        119.7 D      52.
 0
 0
 0
 9
3.1900E-03 8.8444E-01 2.2700E-02 7.0498E-02 5.6646E-02 4.2699E-01
8.3521E-02 4.4099E-01 8.7454E-02 1.0400E-01 8.8292E-02 2.7599E-02
1.2719E-01 1.3700E-01 1.5406E-01 1.7699E-02 1.5799E-01 4.3599E-03
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3.7700E-03 8.7472E-02 2.7202E-02 1.4046E-01 2.7472E-02 2.6205E-01
3.1000E-02 9.0969E-02 1.5900E-01 8.4100E-01 8.9071E-02 8.9745E-04
TE-129M         33.6 D      52.
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 5   2   4   5
2.0211E-01 5.5500E-02 1.6600E-03 8.7394E-01 2.9480E-01 7.6000E-03
9.0763E-01 3.0830E-01 3.3000E-02 1.6035E+00 6.0730E-01 3.2800E-01
6.7400E-01 2.3254E-01 8.3910E-04
 0
 8
3.1900E-03 4.8065E-01 2.2700E-02 3.9548E-02 7.3686E-02 3.1639E-01
1.0056E-01 2.4028E-01 1.0449E-01 5.5604E-02 1.0533E-01 1.4593E-02
3.3100E-03 1.0538E-03 2.2582E-02 1.1644E-03
10
3.7700E-03 4.7537E-02 2.7202E-02 7.8797E-02 2.7472E-02 1.4701E-01
3.1000E-02 5.1032E-02 1.0550E-01 1.4719E-03 3.9400E-03 1.1062E-04
5.5665E-01 1.2902E-03 6.9588E-01 3.2716E-02 7.2957E-01 7.6285E-03
7.4252E-01 3.0842E-03
TE-129          69.6 M      52.
 0
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3.8632E-01 1.1410E-01 8.1000E-03 6.6807E-01 2.1490E-01 1.9600E-03
9.3835E-01 3.2060E-01 2.3000E-03 1.0106E+00 3.5000E-01 8.6000E-02
1.2196E+00 4.3700E-01 5.2000E-03 1.4702E+00 5.4450E-01 9.0000E-01
2.6200E-01 7.4546E-02 5.6460E-04
 0
 4
3.3100E-03 5.8710E-01 2.2582E-02 6.4873E-01 2.6698E-02 1.3007E-01
2.7584E-02 4.3086E-02
12
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3.9400E-03 6.1630E-02 2.7770E-02 1.6259E-01 2.0896E-01 1.6614E-03
2.5062E-01 3.5287E-03 2.7843E-01 5.2256E-03 2.8126E-01 1.5194E-03
4.5960E-01 7.1000E-02 4.8739E-01 1.3064E-02 8.0210E-01 1.7679E-03
1.0839E+00 4.5440E-03 1.1116E+00 1.7608E-03 6.5688E-01 3.7786E-03
I -129        1.57E7 Y     53.
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  1
1.5242E-01 4.0900E-02 1.0000E+00
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  6
3.4300E-03 7.3539E-01 5.0196E-03 7.8900E-01 2.4600E-02 8.7579E-02
3.4128E-02 1.0700E-01 3.8439E-02 2.1600E-02 3.9373E-02 7.1400E-03
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4.1100E-03 8.1710E-02 2.9458E-02 1.9956E-01 2.9779E-02 3.7024E-01
3.3600E-02 1.3162E-01 3.9581E-02 7.5200E-02
TE-131M           30 H     52.
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1.6061E-01 4.3300E-02 5.6000E-03 1.8957E-01 5.1800E-02 3.1000E-03
2.5462E-01 7.1500E-02 2.0000E-03 2.6052E-01 7.3300E-02 4.5000E-03
2.6280E-01 7.4000E-02 9.5000E-03 3.1703E-01 9.1300E-02 1.6500E-02
3.6793E-01 1.0800E-01 3.4100E-03 4.2021E-01 1.2560E-01 2.2700E-02
4.3024E-01 1.2900E-01 5.4000E-02 4.5098E-01 1.3620E-01 3.6900E-01
4.5705E-01 1.3830E-01 1.0000E-03 5.0668E-01 1.5570E-01 2.1400E-02
5.3211E-01 1.6480E-01 1.6600E-01 5.4360E-01 1.6900E-01 1.5000E-02
7.8525E-01 2.5990E-01 2.5000E-02 1.1161E+00 3.9400E-01 2.2000E-03
1.3715E+00 5.0200E-01 3.7000E-03 1.4255E+00 5.2500E-01 2.0000E-03
2.4313E+00 9.7000E-01 3.8000E-02 8.0000E-01 2.6913E-01 1.8170E-03
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6.8891E-02 4.8768E-02 7.5952E-02 6.3057E-03 8.0068E-02 1.5703E-03
9.6872E-02 6.3620E-03 1.0099E-01 1.5885E-03 1.1655E-01 1.0659E-02
1.4453E-01 1.3755E-03 1.6746E-01 1.9115E-03 2.0776E-01 1.1695E-03
3.0110E-01 2.3446E-03
 93
3.7700E-03 1.6695E-02 2.7202E-02 3.5883E-02 2.7472E-02 6.6946E-02
3.1000E-02 2.3239E-02 1.8225E-01 8.5470E-03 3.9400E-03 1.1091E-02
2.8317E-02 2.8320E-02 2.8612E-02 5.2738E-02 3.2300E-02 1.8481E-02
7.9190E-02 1.2786E-03 8.1140E-02 4.0682E-02 8.6430E-02 1.4723E-03
1.0160E-01 1.7048E-03 1.0206E-01 7.9426E-02 1.3486E-01 7.0902E-03
1.4972E-01 5.0755E-02 1.5966E-01 1.2786E-03 1.8225E-01 7.3614E-03
1.8311E-01 1.5498E-03 1.8813E-01 2.1309E-03 1.8976E-01 5.0368E-03
1.9052E-01 1.1623E-03 2.0063E-01 7.5552E-02 2.1398E-01 4.2619E-03
2.3065E-01 1.9372E-03 2.4093E-01 7.5939E-02 2.5317E-01 6.5091E-03
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3.3544E-01 1.3561E-03 3.4292E-01 3.8744E-03 3.5130E-01 2.0922E-03
3.5470E-01 2.2859E-03 3.6498E-01 1.2011E-02 3.8390E-01 2.0147E-03
4.1740E-01 2.7896E-03 4.3240E-01 6.6253E-03 4.5232E-01 1.5498E-02
4.6292E-01 1.8210E-02 4.6816E-01 3.1383E-03 4.9266E-01 2.3247E-03
5.2480E-01 1.3561E-03 5.3070E-01 1.0461E-03 5.4140E-01 1.1236E-03
5.8630E-01 1.9760E-02 6.0204E-01 3.0996E-03 6.0940E-01 1.3948E-03
6.6505E-01 4.3394E-02 6.8590E-01 1.5498E-03 6.9562E-01 3.9907E-03
7.0250E-01 3.9132E-03 7.1310E-01 1.4335E-02 7.4420E-01 1.5885E-02
7.7367E-01 3.8202E-01 7.7410E-01 5.4242E-03 7.8249E-01 7.7876E-02
7.9375E-01 1.3870E-01 8.2278E-01 6.1216E-02 8.4490E-01 1.5498E-03
8.5221E-01 3.8744E-03 8.5221E-01 2.0651E-01 8.5608E-01 6.1991E-03
8.6510E-01 1.9372E-03 8.7230E-01 1.0074E-03 9.1000E-01 3.2933E-02
9.2062E-01 1.2011E-02 9.2340E-01 1.1623E-03 9.4127E-01 7.8264E-03
9.8780E-01 1.5498E-03 9.9926E-01 1.7048E-03 1.0354E+00 1.0461E-03
1.0597E+00 1.5498E-02 1.1255E+00 1.1430E-01 1.1280E+00 9.6861E-03
1.1489E+00 1.5110E-02 1.1489E+00 3.8357E-03 1.1509E+00 6.5865E-03
1.1655E+00 1.3948E-03 1.2066E+00 9.7636E-02 1.2373E+00 6.5865E-03
1.3152E+00 6.9740E-03 1.3406E+00 1.0074E-03 1.3948E+00 1.0848E-03
1.6460E+00 1.2398E-02 1.8877E+00 1.3561E-02 2.0009E+00 2.0147E-02
2.1685E+00 3.4870E-03 2.2707E+00 3.8357E-03 6.3194E-01 3.5532E-02
TE-131          25.0 M     52.
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7.4838E-01 2.4560E-01 1.1990E-02 8.0495E-01 2.6760E-01 1.1860E-02
8.2185E-01 2.7420E-01 1.3400E-02 9.0252E-01 3.0620E-01 1.1900E-03
9.5078E-01 3.2560E-01 5.4000E-03 1.1021E+00 3.8770E-01 9.9900E-02
1.1507E+00 4.0800E-01 2.5900E-02 1.3723E+00 5.0200E-01 1.1780E-02
1.6470E+00 6.2200E-01 2.1800E-01 1.7563E+00 6.7000E-01 7.8000E-03
2.0993E+00 8.2500E-01 5.9200E-01 4.4600E-01 1.3604E-01 2.0900E-03
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3.3100E-03 1.3765E-01 2.3600E-02 1.7301E-02 1.1655E-01 1.4469E-01
1.4453E-01 1.8672E-02 1.4864E-01 4.6714E-03 4.1915E-01 1.9317E-03
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3.9400E-03 1.4449E-02 2.8317E-02 3.6793E-02 2.8612E-02 6.8516E-02
3.2300E-02 2.4011E-02 1.4972E-01 6.8900E-01 1.5110E-01 1.7225E-03
3.4295E-01 7.0278E-03 3.8406E-01 8.9570E-03 4.5232E-01 1.8224E-01
4.9266E-01 4.8368E-02 5.4488E-01 4.2718E-03 5.6733E-01 1.0266E-03
6.0204E-01 4.1960E-02 6.0555E-01 1.1713E-03 6.5426E-01 1.5296E-02
6.9619E-01 1.7914E-03 7.2700E-01 4.6852E-03 8.4199E-01 1.9981E-03
8.5608E-01 1.3091E-03 8.9854E-01 1.3780E-03 9.3448E-01 8.7503E-03
9.4854E-01 2.2599E-02 9.5139E-01 3.3072E-03 9.9725E-01 3.3416E-02
1.0080E+00 7.9924E-03 1.0983E+00 1.7225E-03 1.1470E+00 4.9608E-02
1.1485E+00 1.1024E-03 1.2774E+00 1.1782E-03 1.2943E+00 4.8230E-03
1.4271E+00 1.0542E-03 1.5006E+00 1.1506E-03 6.9601E-01 1.1932E-02
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3.3383E-01 9.6620E-02 7.3600E-02 6.0632E-01 1.9158E-01 8.9300E-01
8.0687E-01 2.8325E-01 3.9300E-03 6.2970E-01 2.0022E-01 6.9000E-04
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3.4300E-03 4.9501E-02 2.4600E-02 5.9106E-03 4.5622E-02 3.5346E-02
7.4730E-02 4.6342E-03 7.9041E-02 1.1756E-03 2.4974E-01 2.4813E-03
3.2992E-01 1.5421E-02 3.5903E-01 2.4430E-03
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4.1100E-03 5.5001E-03 2.9458E-02 1.3468E-02 2.9779E-02 2.4987E-02
3.3600E-02 8.8830E-03 8.0183E-02 2.6182E-02 1.7721E-01 2.6484E-03
2.8430E-01 6.0521E-02 3.2578E-01 2.5074E-03 3.6448E-01 8.1164E-01
5.0299E-01 3.6051E-03 6.3697E-01 7.2605E-02 6.4270E-01 2.1953E-03
7.2289E-01 1.8025E-02 3.2939E-01 2.3039E-03
XE-131M       11.84 D     54.
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3.4300E-03 7.5312E-01 2.4600E-02 6.7932E-02 1.2937E-01 6.1200E-01
1.5848E-01 2.8600E-01 1.6279E-01 6.5000E-02 1.6372E-01 1.7800E-02
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3.3600E-02 1.0210E-01 1.6393E-01 1.9600E-02
TE-132         78.2 H     52.
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2.1514E-01 5.9400E-02 1.0000E+00
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3.3100E-03 6.9159E-01 1.6551E-02 6.4152E-01 2.3600E-02 8.6081E-02
4.4532E-02 8.4744E-02 4.8648E-02 1.6984E-02 4.9534E-02 5.6056E-03
7.8591E-02 8.7595E-03 8.3131E-02 8.2086E-03 1.0657E-01 1.1439E-03
1.1111E-01 1.0706E-03 1.9499E-01 7.1016E-02 2.2297E-01 1.3376E-02
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3.9400E-03 7.2597E-02 2.8317E-02 1.8306E-01 2.8612E-02 3.4090E-01
3.2300E-02 1.1946E-01 4.9720E-02 1.3112E-01 1.1176E-01 1.8480E-02
1.1630E-01 1.9360E-02 2.2816E-01 8.8000E-01
I -132         2.30 H     53.
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 24
3.1910E-01 9.2000E-02 2.6000E-03 3.5320E-01 1.0300E-01 1.2000E-03
4.2440E-01 1.2700E-01 1.9000E-03 5.0332E-01 1.5400E-01 5.3000E-03
5.2176E-01 1.6100E-01 3.3000E-03 6.8919E-01 2.2300E-01 7.6000E-03
7.4114E-01 2.4200E-01 1.2400E-01 7.3974E-01 2.4200E-01 1.9000E-02
8.2557E-01 2.7500E-01 3.2000E-03 9.0999E-01 3.0900E-01 3.5500E-02
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9.6640E-01 3.3100E-01 8.1000E-02 9.9132E-01 3.4200E-01 2.7500E-02
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1.1851E+00 4.2200E-01 1.8900E-01 1.2291E+00 4.4000E-01 9.5000E-03
1.3927E+00 5.1000E-01 1.1300E-03 1.4126E+00 5.1900E-01 1.7000E-02
1.4698E+00 5.4300E-01 1.0100E-01 1.4680E+00 5.4300E-01 2.0000E-02
1.5396E+00 5.7400E-01 1.4000E-03 1.6169E+00 6.0800E-01 1.2400E-01
2.1396E+00 8.4100E-01 1.6900E-01 4.4000E-01 1.3448E-01 4.9540E-03
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3.4300E-03 5.5098E-03 2.4600E-02 7.5504E-04 4.8809E-01 1.3836E-03
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4.1100E-03 6.1220E-04 2.9458E-02 1.7205E-03 2.9779E-02 3.1919E-03
3.3600E-02 1.1348E-03 1.4720E-01 2.3688E-03 1.8330E-01 1.3818E-03
2.5480E-01 1.8753E-03 2.6270E-01 1.4410E-02 2.8480E-01 7.2051E-03
3.1650E-01 1.3818E-03 3.6350E-01 4.9350E-03 3.8780E-01 2.9610E-03
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4.7390E-01 1.7766E-03 4.7850E-01 1.4805E-03 4.8820E-01 4.1454E-03
5.0590E-01 5.0337E-02 5.2265E-01 1.6088E-01 5.3550E-01 5.2311E-03
5.4000E-01 1.0857E-03 5.4710E-01 1.2535E-02 6.0000E-01 1.3818E-03
6.2080E-01 3.9480E-03 6.2120E-01 1.5792E-02 6.3022E-01 1.3719E-01
6.5060E-01 2.6649E-02 6.5900E-01 3.9480E-03 6.6769E-01 9.8700E-01
6.6980E-01 4.9350E-02 6.7160E-01 5.2311E-02 7.2700E-01 3.1584E-02
7.2720E-01 2.1714E-02 7.2850E-01 1.0857E-02 7.6450E-01 3.9480E-03
7.7261E-01 7.6196E-01 7.8020E-01 1.2338E-02 7.8450E-01 4.2441E-03
8.0980E-01 2.8623E-02 8.1220E-01 5.6259E-02 8.6330E-01 5.8233E-03
8.7680E-01 1.0758E-02 9.1030E-01 9.1791E-03 9.2760E-01 4.1454E-03
9.5455E-01 1.8062E-01 9.8370E-01 5.6259E-03 1.0347E+00 4.7376E-03
1.1360E+00 2.9610E-02 1.1434E+00 1.3522E-02 1.1474E+00 2.7636E-03
1.1732E+00 1.0857E-02 1.2727E+00 1.7766E-03 1.2907E+00 1.1351E-02
1.2953E+00 1.9740E-02 1.2976E+00 8.8830E-03 1.3178E+00 1.1844E-03
1.3721E+00 2.4675E-02 1.3986E+00 7.1064E-02 1.4426E+00 1.4213E-02
1.4768E+00 1.3522E-03 1.7575E+00 2.9610E-03 1.9211E+00 1.1844E-02
2.0022E+00 1.0857E-02 2.0868E+00 2.3688E-03 2.1727E+00 1.9740E-03
2.2232E+00 1.1844E-03 2.3905E+00 1.6779E-03 1.0146E+00 3.1946E-02
TE-133M        55.4 M     52.
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1.5276E+00 5.7000E-01 1.9500E-01 1.7442E+00 6.7000E-01 2.9300E-01
2.3916E+00 9.6000E-01 3.8200E-01
 0
 14
3.1900E-03 6.0865E-02 2.2700E-02 7.3125E-03 3.0233E-01 5.8500E-02
3.2920E-01 1.3650E-02 3.3313E-01 3.5620E-03 3.3100E-03 1.5929E-01
2.3600E-02 1.6781E-02 4.0931E-02 7.9605E-02 4.8331E-02 4.8024E-03
5.4831E-02 1.6913E-02 6.1731E-02 4.0890E-02 6.8912E-02 2.3490E-02
8.2812E-02 3.9672E-03 8.9712E-02 1.9140E-02
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3.7700E-03 6.0196E-03 2.7202E-02 1.4570E-02 2.7472E-02 2.7182E-02
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2.8317E-02 3.5686E-02 2.8612E-02 6.6455E-02 3.2300E-02 2.3288E-02
7.4100E-02 1.3050E-02 8.1500E-02 6.9600E-03 8.8000E-02 2.0880E-02
9.4900E-02 8.7000E-02 1.6434E-01 2.3490E-02 1.6887E-01 1.1484E-01
1.7710E-01 1.4790E-02 1.7820E-01 8.7000E-03 1.8445E-01 3.4800E-03
1.9322E-01 6.0900E-03 1.9820E-01 5.2200E-03 2.1336E-01 2.8710E-02
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2.5149E-01 5.2200E-03 2.5764E-01 8.7000E-03 2.6155E-01 1.5660E-01
2.8570E-01 8.7000E-03 3.4450E-01 2.2620E-02 3.4722E-01 1.1310E-02
3.5557E-01 1.4790E-02 3.6281E-01 9.5700E-03 3.7683E-01 5.2200E-03
3.9696E-01 1.4790E-02 4.2902E-01 1.2180E-02 4.3540E-01 1.0440E-02
4.4490E-01 2.2620E-02 4.6211E-01 2.0010E-02 4.7185E-01 2.0010E-02
4.7859E-01 1.5660E-02 5.1960E-01 4.3500E-03 5.3485E-01 1.7400E-02
5.7404E-01 2.3490E-02 6.2203E-01 1.3920E-02 6.4740E-01 2.9319E-01
7.0275E-01 3.7410E-02 7.3169E-01 1.4790E-02 7.3389E-01 2.8710E-02
7.7975E-01 3.3930E-02 7.9570E-01 1.3050E-02 8.0051E-01 1.9140E-02
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9.1258E-01 8.7000E-01 9.1472E-01 1.6530E-01 9.3440E-01 1.3050E-02
9.7819E-01 9.4830E-02 9.8040E-01 2.3490E-02 9.8290E-01 1.1310E-02
1.0075E+00 1.0440E-02 1.0298E+00 1.3050E-02 1.3489E+00 2.5230E-02
1.4591E+00 2.1750E-02 1.5161E+00 9.5700E-03 1.5316E+00 8.7000E-03
1.6833E+00 5.7420E-02 1.7044E+00 9.5700E-03 1.8857E+00 1.1310E-02
2.0049E+00 3.3060E-02 2.0277E+00 2.0880E-02 2.0492E+00 1.0440E-02
TE-133       12.45 M     52.
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4.2970E-01 1.2900E-01 3.5000E-03 7.7640E-01 2.5600E-01 1.8000E-02
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1.4059E+00 5.2000E-01 4.4000E-02 1.5961E+00 6.0000E-01 5.0000E-03
1.6368E+00 6.2000E-01 1.3200E-01 1.6572E+00 6.3000E-01 7.0000E-02
2.1832E+00 8.6000E-01 1.3000E-02 2.2503E+00 8.9000E-01 3.3300E-01
2.6580E+00 1.0800E+00 2.8600E-01
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3.3100E-03 2.3367E-02 2.3600E-02 2.9533E-03 2.7882E-01 2.0815E-02
3.0680E-01 3.0444E-03 3.7446E-01 4.2126E-03
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3.9400E-03 2.4529E-03 2.8317E-02 6.2805E-03 2.8612E-02 1.1696E-02
3.2300E-02 4.0985E-03 3.1199E-01 7.0800E-01 3.8460E-01 2.8320E-03
3.9290E-01 5.6640E-03 4.0763E-01 3.0090E-01 4.7472E-01 1.2036E-02
5.4640E-01 5.6640E-03 5.8710E-01 4.9560E-03 6.1360E-01 2.8320E-03
7.1965E-01 6.6552E-02 7.8677E-01 5.5932E-02 8.4439E-01 3.2568E-02
9.3067E-01 4.4604E-02 1.0008E+00 6.2304E-02 1.0211E+00 2.6904E-02
1.0618E+00 1.2744E-02 1.2522E+00 1.1328E-02 1.3077E+00 9.2040E-03
1.3135E+00 7.7880E-03 1.3332E+00 9.9120E-02 1.4057E+00 5.6640E-03
1.4740E+00 3.5400E-03 1.5186E+00 4.9560E-03 1.5882E+00 2.8320E-03
1.7177E+00 3.3984E-02 1.8251E+00 5.6640E-03 1.8815E+00 1.4160E-02
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2.1365E+00 2.8320E-03 2.2280E+00 2.8320E-03 2.5406E+00 7.0800E-04
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4.0962E-01 1.2200E-01 3.9700E-03 4.6176E-01 1.4000E-01 3.7500E-02
5.2357E-01 1.6200E-01 3.1300E-02 7.0770E-01 2.3000E-01 5.4200E-03
8.8467E-01 2.9900E-01 4.1600E-02 1.0162E+00 3.5200E-01 1.8100E-02
1.2301E+00 4.4100E-01 8.3500E-01 1.5268E+00 5.7300E-01 1.0700E-02
8.5000E-01 2.8400E-01 2.7000E-04
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3.4300E-03 4.8454E-03 2.4600E-02 6.6400E-04 4.9531E-01 5.9820E-03
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4.1100E-03 5.3838E-04 2.9458E-02 1.5130E-03 2.9779E-02 2.8070E-03
3.3600E-02 9.9793E-04 2.6270E-01 3.5650E-03 2.6717E-01 1.1653E-03
3.4543E-01 1.0358E-03 3.6108E-01 1.1222E-03 4.1805E-01 1.5279E-03
4.2291E-01 3.0903E-03 5.1053E-01 1.8127E-02 5.2987E-01 8.6320E-01
6.1797E-01 5.3950E-03 6.8025E-01 6.4481E-03 7.0658E-01 1.4933E-02
7.6838E-01 4.5663E-03 8.2051E-01 1.5365E-03 8.5628E-01 1.2344E-02
8.7533E-01 4.4714E-02 9.0967E-01 2.1235E-03 1.0523E+00 5.5158E-03
1.0601E+00 1.3725E-03 1.2364E+00 1.4933E-02 1.2982E+00 2.3306E-02
1.3504E+00 1.4847E-03 5.3524E-01 6.0717E-03
XE-133M         2.19 D     54.
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3.4300E-03 6.9813E-01 2.4600E-02 7.0263E-02 1.9866E-01 6.3300E-01
2.2777E-01 2.0600E-01 2.3208E-01 4.5600E-02 2.3301E-01 1.2200E-02
  5
4.1100E-03 7.7570E-02 2.9458E-02 1.6010E-01 2.9779E-02 2.9704E-01
3.3600E-02 1.0560E-01 2.3322E-01 1.0300E-01
XE-133         5.245 D     54.
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  3
2.6668E-01 7.5100E-02 6.9000E-03 3.4630E-01 1.0060E-01 9.9300E-01
4.3500E-02 1.1100E-02 7.5900E-05
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3.5500E-03 4.9693E-01 2.5500E-02 5.6275E-02 4.3636E-02 3.2913E-03
4.5012E-02 5.3266E-01 7.5283E-02 8.1358E-02 7.9780E-02 1.6709E-02
8.0766E-02 4.3415E-03
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4.2900E-03 6.1419E-02 3.0625E-02 1.3641E-01 3.0973E-02 2.5262E-01
3.5000E-02 9.0644E-02 7.9621E-02 2.1653E-03 8.0997E-02 3.6483E-01
1.7770E-01 7.1180E-04
TE-134          41.8 M     52.
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3.3100E-03 3.3754E-01 2.3600E-02 4.1224E-02 4.3661E-02 5.5800E-03
4.6276E-02 2.7090E-01 6.8251E-02 2.9370E-03 7.1642E-02 2.2320E-03
7.4257E-02 4.1580E-02 7.8373E-02 8.4000E-03 7.9259E-02 2.0370E-03
1.4772E-01 2.6820E-02 1.6807E-01 9.3960E-03 1.7570E-01 4.8600E-03
1.7730E-01 2.0586E-02 1.7982E-01 1.2240E-03 1.9605E-01 1.5660E-03
2.0528E-01 3.5040E-03 2.4478E-01 8.7543E-03 2.7276E-01 1.3206E-03
4.0189E-01 2.1762E-03 4.2783E-01 1.0908E-03 5.3282E-01 1.1151E-03
 29
3.9400E-03 3.5433E-02 2.8317E-02 8.7667E-02 2.8612E-02 1.6325E-01
3.2300E-02 5.7210E-02 7.6830E-02 2.7900E-03 7.9445E-02 2.1000E-01
1.0142E-01 3.3000E-03 1.3105E-01 1.8000E-03 1.8089E-01 1.8000E-01
1.8305E-01 6.0000E-03 2.0124E-01 8.7000E-02 2.1047E-01 2.1900E-01
2.5980E-01 4.8000E-03 2.7795E-01 2.1300E-01 4.3506E-01 1.8600E-01
4.6100E-01 1.0800E-01 4.6464E-01 5.1000E-02 5.6599E-01 1.8900E-01
6.3626E-01 1.7100E-02 6.4540E-01 9.0000E-03 6.6585E-01 1.2000E-02
7.1297E-01 4.2000E-02 7.4259E-01 1.4700E-01 7.6720E-01 3.0000E-01
8.4406E-01 1.2000E-02 8.9602E-01 4.5000E-03 9.2555E-01 1.6500E-02
1.0270E+00 4.5000E-03 1.1014E-01 1.2000E-03
I -134         52.6 M     53.
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7.7458E-01 2.5500E-01 1.4800E-02 7.8956E-01 2.6100E-01 3.3000E-03
8.3550E-01 2.7900E-01 1.5300E-03 1.0662E+00 3.7200E-01 1.2200E-02
1.2826E+00 4.6000E-01 3.2500E-01 1.3771E+00 5.0000E-01 5.3000E-03
1.4962E+00 5.5000E-01 8.1000E-02 1.5615E+00 5.8000E-01 1.6300E-01
1.6024E+00 6.0000E-01 3.6700E-02 1.7415E+00 6.6000E-01 7.6000E-02
1.7970E+00 6.9000E-01 1.1200E-01 1.8479E+00 7.1000E-01 1.1200E-02
2.2304E+00 8.8000E-01 3.7000E-02 2.4188E+00 9.7000E-01 1.1500E-01
7.9500E-01 2.6355E-01 2.2600E-03
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3.4300E-03 1.5183E-02 2.4600E-02 1.8961E-03 1.0084E-01 1.1428E-02
1.2995E-01 1.4961E-03 2.0091E-01 1.4090E-03 3.7089E-01 1.1240E-03
8.1246E-01 1.9273E-03 8.4953E-01 1.1943E-03
 73
4.1100E-03 1.6870E-03 2.9458E-02 4.3206E-03 2.9779E-02 8.0159E-03
3.3600E-02 2.8497E-03 1.3540E-01 3.7592E-02 1.3903E-01 6.8695E-03
1.5198E-01 1.0591E-03 1.6248E-01 2.5761E-03 1.8847E-01 6.9649E-03
2.1700E-01 2.4807E-03 2.3547E-01 1.9845E-02 2.7880E-01 1.3071E-03
3.1981E-01 5.1521E-03 3.5108E-01 4.9613E-03 4.0545E-01 7.3466E-02
4.1100E-01 6.1062E-03 4.3335E-01 4.1885E-02 4.5892E-01 1.2976E-02
4.6550E-01 3.6256E-03 4.8888E-01 1.4121E-02 5.1440E-01 2.3375E-02
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5.4083E-01 7.8236E-02 5.6552E-01 8.7777E-03 5.7075E-01 2.0990E-03
5.9536E-01 1.1354E-01 6.2179E-01 1.0591E-01 6.2796E-01 2.3662E-02
6.7734E-01 8.4915E-02 7.0665E-01 8.3007E-03 7.3074E-01 1.9082E-02
7.3918E-01 7.6328E-03 7.6668E-01 4.1026E-02 8.1638E-01 5.2475E-03
8.4702E-01 9.5410E-01 8.5729E-01 6.9649E-02 8.6400E-01 1.9082E-03
8.8409E-01 6.5260E-01 9.2260E-01 1.4312E-03 9.4786E-01 4.0358E-02
9.6690E-01 3.5302E-03 9.7467E-01 4.6751E-02 1.0403E+00 1.9082E-02
1.0726E+00 1.5266E-01 1.1001E+00 6.8695E-03 1.1032E+00 7.2512E-03
1.1362E+00 9.7318E-02 1.1591E+00 3.5302E-03 1.1640E+00 1.3357E-03
1.1900E+00 3.5302E-03 1.2390E+00 2.0990E-03 1.2695E+00 5.6292E-03
1.3224E+00 1.0495E-03 1.3360E+00 1.4312E-03 1.3526E+00 4.4843E-03
1.4143E+00 2.1944E-03 1.4282E+00 1.7174E-03 1.4314E+00 1.7174E-03
1.4552E+00 2.2898E-02 1.4700E+00 7.7282E-03 1.5055E+00 1.1449E-03
1.5415E+00 5.0567E-03 1.6138E+00 4.3602E-02 1.6292E+00 2.5761E-03
1.6443E+00 4.0072E-03 1.6552E+00 2.2898E-03 1.7415E+00 2.6715E-02
1.8068E+00 5.7246E-02 1.9259E+00 1.8128E-03 2.0206E+00 1.7174E-03
2.1599E+00 2.0990E-03 2.3124E+00 2.3853E-03 2.4674E+00 1.5266E-03
1.7872E+00 1.3348E-02
CS-134M        2.90 H     55.
  0
  0
  0
 11
3.5500E-03 1.3280E+00 5.5457E-03 7.7277E-01 1.0043E-02 1.5872E-01
1.1029E-02 5.2278E-02 2.5500E-02 3.6921E-02 9.1435E-02 3.4720E-01
1.0270E-01 4.4240E-03 1.2171E-01 4.0374E-01 1.2620E-01 9.0074E-02
1.2719E-01 2.2717E-02 1.3297E-01 2.7040E-03
  7
4.2900E-03 1.6414E-01 1.1260E-02 9.4000E-03 3.0625E-02 8.9498E-02
3.0973E-02 1.6574E-01 3.5000E-02 5.9470E-02 1.2742E-01 1.2900E-01
1.3868E-01 6.2000E-05
CS-134         2.062 Y    55.
  0
  4
8.8543E-02 2.3060E-02 2.7400E-01 4.1509E-01 1.2340E-01 2.4800E-02
6.5786E-01 2.1011E-01 7.0100E-01 9.7550E-01 3.3529E-01 5.3000E-04
  0
  5
3.6700E-03 6.5531E-03 2.6400E-02 8.2834E-04 5.3187E-01 1.2545E-03
5.6726E-01 4.9093E-03 7.5840E-01 2.2033E-03
 14
4.4700E-03 8.9360E-04 3.1817E-02 2.1438E-03 3.2194E-02 3.9554E-03
3.6400E-02 1.4394E-03 4.7535E-01 1.4600E-02 5.6323E-01 8.3800E-02
5.6932E-01 1.5430E-01 6.0470E-01 9.7600E-01 7.9584E-01 8.5400E-01
8.0193E-01 8.7300E-02 1.0386E+00 1.0000E-02 1.1679E+00 1.8000E-02
1.3652E+00 3.0400E-02 2.7688E-01 3.5400E-04
I -130         12.36 H    53.
  0
```

ENERGY.DAT

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 10
2.3162E-01 6.4000E-02 3.1600E-03 3.5465E-01 1.0300E-01 3.2800E-03
3.7550E-01 1.1000E-01 4.9200E-03 5.5681E-01 1.7300E-01 1.8400E-03
6.2191E-01 1.9700E-01 4.6700E-01 8.1236E-01 2.7000E-01 2.1400E-02
9.0203E-01 3.0600E-01 1.7300E-03 1.0399E+00 3.6100E-01 4.7500E-01
1.1758E+00 4.1800E-01 1.4300E-02 3.0800E-01 9.1433E-02 2.7000E-03
 0
 6
3.4300E-03 1.3506E-02 2.4600E-02 1.8508E-03 3.8345E-01 4.7475E-03
5.0153E-01 6.2271E-03 6.3398E-01 3.4126E-03 7.0492E-01 2.2871E-03
 26
4.1100E-03 1.5007E-03 2.9458E-02 4.2174E-03 2.9779E-02 7.8244E-03
3.3600E-02 2.7817E-03 4.1801E-01 3.4155E-01 4.5772E-01 2.3661E-03
5.1035E-01 8.5239E-03 5.3609E-01 9.9000E-01 5.3910E-01 1.3959E-02
5.5390E-01 6.6231E-03 5.8605E-01 1.6929E-02 6.0353E-01 6.1479E-03
6.6854E-01 9.6129E-01 6.8599E-01 1.0692E-02 7.3948E-01 8.2269E-01
8.0023E-01 1.0098E-03 8.0829E-01 2.3562E-03 8.7735E-01 1.9107E-03
9.6702E-01 8.7714E-03 1.0965E+00 5.5242E-03 1.1222E+00 2.5344E-03
1.1575E+00 1.1306E-01 1.2226E+00 1.7919E-03 1.2721E+00 7.4844E-03
1.4039E+00 3.4452E-03 8.0994E-01 8.5378E-03
I -135        6.61 H      53.
 0
 21   1  20
2.3591E-01 6.6000E-02 1.4000E-03 2.4489E-01 6.8000E-02 1.2600E-03
2.6369E-01 7.4000E-02 1.4000E-03 3.0228E-01 8.6000E-02 1.0800E-02
3.3901E-01 9.8000E-02 9.1000E-03 3.5376E-01 1.0300E-01 1.3900E-02
4.5553E-01 1.3800E-01 4.7300E-02 4.7796E-01 1.4500E-01 7.3300E-02
6.1806E-01 1.9600E-01 1.5700E-02 6.6511E-01 2.1300E-01 1.1000E-02
7.4268E-01 2.4300E-01 7.9000E-02 8.1656E-01 2.7200E-01 6.1000E-03
9.1978E-01 3.1300E-01 8.7000E-02 1.0329E+00 3.5900E-01 2.1800E-01
1.1457E+00 4.0500E-01 7.9000E-02 1.2534E+00 4.5100E-01 7.4000E-02
1.2626E+00 4.5400E-01 1.0000E-03 1.4506E+00 5.3500E-01 2.3600E-01
1.5795E+00 5.9100E-01 1.2000E-02 2.1845E+00 8.5800E-01 1.9000E-02
6.4700E-01 2.0722E-01 1.5400E-03
 0
 4
3.4300E-03 2.1968E-03 2.4600E-02 3.0104E-04 1.8594E-01 1.5009E-03
2.5389E-01 1.2112E-03
 50
4.1100E-03 2.4409E-04 2.9458E-02 6.8596E-04 2.9779E-02 1.2727E-03
3.3600E-02 4.5244E-04 2.2050E-01 1.7452E-02 2.2972E-01 2.3174E-03
2.6426E-01 1.8396E-03 2.8845E-01 3.0899E-02 2.9027E-01 3.0327E-03
3.6185E-01 1.8597E-03 4.0303E-01 2.3174E-03 4.1483E-01 3.0040E-03
4.1763E-01 3.5190E-02 4.2993E-01 3.0327E-03 4.3374E-01 5.5217E-03
4.5163E-01 3.1471E-03 5.4656E-01 7.1239E-02 5.7597E-01 1.2875E-03
6.4985E-01 4.5490E-03 6.9013E-01 1.2875E-03 7.0792E-01 6.5803E-03
7.8548E-01 1.5163E-03 7.9771E-01 1.7166E-03 8.3680E-01 6.6661E-02
9.6146E-01 1.4591E-03 9.7196E-01 8.8691E-03 9.7261E-01 1.2016E-02
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9.9509E-01 1.5449E-03 1.0388E+00 7.9250E-02 1.1016E+00 1.6022E-02
1.1240E+00 3.6049E-02 1.1315E+00 2.2516E-01 1.1599E+00 1.0300E-03
1.1690E+00 8.7260E-03 1.2405E+00 9.0121E-03 1.2604E+00 2.8610E-01
1.3679E+00 6.0653E-03 1.4484E+00 3.1471E-03 1.4576E+00 8.6402E-02
1.5028E+00 1.0729E-02 1.5664E+00 1.2875E-02 1.6780E+00 9.5271E-02
1.7065E+00 4.0912E-02 1.7912E+00 7.6961E-02 1.8307E+00 5.7792E-03
1.9273E+00 2.9468E-03 2.0459E+00 8.6974E-03 2.2555E+00 6.1225E-03
2.4087E+00 9.5271E-03 1.0734E+00 1.4948E-02
XE-135M         15.36 M     54.
  0
  0
  0
  5
3.4300E-03 1.4912E-01 2.4600E-02 1.6871E-02 4.9200E-01 1.5199E-01
5.2111E-01 2.8899E-02 5.2542E-01 9.5197E-03
  5
4.1100E-03 1.6569E-02 2.9458E-02 3.8443E-02 2.9779E-02 7.1324E-02
3.3600E-02 2.5356E-02 5.2656E-01 8.0997E-01
XE-135           9.11 H     54.
  0
  5
9.6581E-02 2.5300E-02 1.2300E-03 5.5081E-01 1.7100E-01 3.1300E-02
7.5101E-01 2.4600E-01 5.8500E-03 9.0921E-01 3.0800E-01 9.6100E-01
1.7800E-01 4.8000E-02 7.5000E-04
  0
  5
3.5500E-03 5.3166E-02 2.5500E-02 5.9658E-03 2.1381E-01 5.6817E-02
2.4408E-01 9.1698E-03 2.4858E-01 2.3374E-03
 10
4.2900E-03 6.5710E-03 3.0625E-02 1.4461E-02 3.0973E-02 2.6780E-02
3.5000E-02 9.6093E-03 1.5820E-01 2.8858E-03 2.4979E-01 8.9900E-01
3.5839E-01 2.2025E-03 4.0799E-01 3.5780E-03 6.0819E-01 2.8948E-02
6.8433E-01 2.0929E-03
CS-135          2.3E6 Y     55.
  0
  1
2.0500E-01 5.6300E-02 1.0000E+00
  0
  0
  0
XE-137           3.83 M     54.
  0
  8
1.4940E+00 5.5300E-01 7.2000E-03 2.2760E+00 9.0200E-01 1.3600E-03
2.5605E+00 1.0320E+00 3.8000E-03 2.7692E+00 1.1280E+00 1.7200E-03
3.4951E+00 1.4650E+00 6.4000E-03 3.8885E+00 1.6490E+00 3.0000E-01
4.3440E+00 1.8620E+00 6.7000E-01 1.9910E+00 7.8350E-01 5.7320E-03
  0
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  3
3.5500E-03 2.8695E-03 2.5500E-02 3.8037E-04 4.1951E-01 3.6226E-03
 16
4.2900E-03 3.5465E-04 3.0625E-02 9.2205E-04 3.0973E-02 1.7075E-03
3.5000E-02 6.1268E-04 2.9800E-01 1.1666E-03 3.9335E-01 1.3815E-03
4.5549E-01 3.0700E-01 8.4895E-01 6.1400E-03 9.8225E-01 2.0569E-03
1.1193E+00 1.0530E-03 1.2732E+00 2.2411E-03 1.5768E+00 1.0131E-03
1.6125E+00 1.2280E-03 1.7834E+00 4.0831E-03 2.8498E+00 1.8113E-03
1.4906E+00 1.3150E-02
CS-137         30.17 Y      55. (Includes daughter, BA-137M) 7/22/87 RAP
  0
  2
5.1155E-01 1.5680E-01 9.4600E-01 1.1732E+00 4.1520E-01 5.4000E-02
  0
  5
3.6700E-03 7.2020E-02 2.6400E-02 7.5672E-03 6.2421E-01 7.6437E-02
6.5566E-01 1.3812E-02 6.6036E-01 4.5408E-03
  5
4.4700E-03 9.8204E-03 3.1817E-02 1.9585E-02 3.2194E-02 3.6134E-02
3.6400E-02 1.3149E-02 6.6165E-01 8.5121E-01
XE-138         14.13 M      54.
  0
 16   1  14
2.3162E-01 6.4000E-02 2.2700E-03 2.4903E-01 7.0000E-02 4.6000E-03
4.0242E-01 1.1900E-01 3.0600E-02 4.7694E-01 1.4500E-01 9.5000E-02
7.1332E-01 2.3100E-01 3.2600E-01 7.1788E-01 2.3300E-01 2.8000E-03
9.4599E-01 3.2300E-01 2.3000E-03 1.3679E+00 4.9800E-01 1.6000E-03
1.5348E+00 5.7100E-01 1.9000E-03 1.7880E+00 6.8200E-01 2.7000E-03
2.2898E+00 9.0800E-01 2.0100E-01 2.3279E+00 9.2500E-01 1.3800E-01
2.4816E+00 9.9600E-01 5.1000E-02 2.7292E+00 1.0990E+00 5.0000E-02
2.7243E+00 1.1070E+00 9.0000E-02 1.6800E+00 6.3717E-01 1.6800E-03
  0
 14
3.5500E-03 4.9107E-01 3.6329E-03 3.2089E-01 4.6192E-03 1.0587E-01
5.1357E-03 5.0958E-01 9.6329E-03 1.0373E-01 1.0619E-02 3.4251E-02
2.5500E-02 4.2346E-03 1.1777E-01 1.6074E-02 1.4804E-01 3.3935E-03
2.0658E-01 2.4056E-03 2.2233E-01 1.8050E-02 2.5260E-01 2.8980E-03
3.6045E-01 1.0773E-03 3.9851E-01 2.7225E-03
 49
4.2900E-03 6.0694E-02 4.8500E-03 1.9215E-03 1.0850E-02 6.9615E-03
3.0625E-02 1.0265E-02 3.0973E-02 1.9009E-02 3.5000E-02 6.8208E-03
1.5375E-01 5.9535E-02 2.4256E-01 3.4965E-02 2.5831E-01 3.1500E-01
2.8251E-01 4.2840E-03 3.3528E-01 1.0710E-03 3.7144E-01 5.0085E-03
3.9643E-01 6.3000E-02 4.0136E-01 2.1735E-02 4.3449E-01 2.0318E-01
5.0022E-01 3.6225E-03 5.3007E-01 2.5200E-03 5.3776E-01 1.1655E-03
5.5595E-01 1.1655E-03 5.6853E-01 3.0555E-03 5.8884E-01 1.2285E-03
6.5408E-01 1.4490E-03 8.6582E-01 2.9610E-03 8.6935E-01 6.2055E-03
8.9687E-01 1.3230E-03 9.1251E-01 3.2760E-03 9.1713E-01 9.1980E-03
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9.3636E-01 1.3545E-03 9.4125E-01 2.2995E-03 1.0939E+00 4.0950E-03
1.0988E+00 2.1420E-03 1.1022E+00 1.0710E-03 1.1143E+00 1.4742E-02
1.1416E+00 5.1345E-03 1.1454E+00 1.3230E-03 1.5718E+00 2.6460E-03
1.6146E+00 2.3625E-03 1.7683E+00 1.6727E-01 1.8125E+00 1.7955E-03
1.8509E+00 1.4238E-02 1.9254E+00 5.6385E-03 2.0048E+00 5.3550E-02
2.0158E+00 1.2254E-01 2.0792E+00 1.4427E-02 2.2523E+00 2.2869E-02
2.3219E+00 6.2055E-03 2.4753E+00 3.1185E-03 2.4976E+00 1.7325E-03
1.1186E+00 2.6586E-02
CS-138          32.2 M     55.
  0
 27
7.0012E-01 2.2600E-01 2.5700E-03 8.2190E-01 2.7300E-01 1.6300E-03
1.0875E+00 3.8000E-01 1.0000E-03 1.2499E+00 4.4700E-01 1.9000E-03
1.3947E+00 5.0900E-01 4.8000E-03 1.4074E+00 5.1400E-01 2.0400E-03
1.6360E+00 6.1400E-01 3.0000E-03 1.6829E+00 6.3400E-01 4.3000E-03
1.9630E+00 7.5900E-01 2.2700E-03 1.9909E+00 7.7100E-01 1.7100E-03
2.0873E+00 8.1500E-01 2.7300E-03 2.1664E+00 8.5000E-01 3.4000E-03
2.2800E+00 9.0200E-01 1.6900E-03 2.3388E+00 9.2900E-01 6.5000E-03
2.3985E+00 9.5600E-01 2.0000E-03 2.4490E+00 9.7900E-01 3.7000E-03
2.4783E+00 9.9200E-01 2.0000E-03 2.5505E+00 1.0250E+00 1.6000E-02
2.6904E+00 1.0900E+00 8.8000E-02 2.7468E+00 1.1150E+00 1.6800E-02
2.8843E+00 1.1790E+00 4.4100E-01 2.9145E+00 1.1930E+00 6.6000E-03
3.0223E+00 1.2430E+00 7.3000E-02 3.1120E+00 1.2840E+00 1.2800E-01
3.4313E+00 1.4330E+00 1.3800E-01 3.8941E+00 1.6490E+00 4.4000E-02
1.7800E+00 6.7955E-01 2.9130E-03
  0
  7
3.6700E-03 1.0053E-02 2.6400E-02 1.1169E-03 1.0066E-01 5.8026E-03
1.3211E-01 1.3837E-03 1.9032E-01 1.3264E-03 4.2534E-01 3.1671E-03
5.0950E-01 9.8546E-04
 52
4.4700E-03 1.3709E-03 3.1817E-02 2.8906E-03 3.2194E-02 5.3333E-03
3.6400E-02 1.9408E-03 1.1260E-01 1.2971E-03 1.3810E-01 1.4879E-02
1.9196E-01 5.0358E-03 1.9389E-01 3.2809E-03 2.1232E-01 1.7473E-03
2.2776E-01 1.5107E-02 3.2490E-01 2.8994E-03 3.6393E-01 2.4416E-03
3.6529E-01 1.9075E-03 4.0898E-01 4.6619E-02 4.2159E-01 4.2728E-03
4.6279E-01 3.0749E-01 5.1674E-01 4.2728E-03 5.4694E-01 1.0758E-01
6.8359E-01 1.0835E-03 7.6610E-01 1.4573E-03 7.7331E-01 2.3271E-03
7.8208E-01 3.2809E-03 8.7180E-01 5.1121E-02 8.8080E-01 1.1445E-03
9.3503E-01 1.8083E-03 1.0098E+00 2.9833E-01 1.0543E+00 1.5870E-03
1.1472E+00 1.2437E-02 1.1992E+00 1.6786E-03 1.2037E+00 3.9676E-03
1.2649E+00 1.3734E-03 1.3436E+00 1.1445E-02 1.4157E+00 3.6624E-03
1.4359E+00 7.6300E-01 1.4450E+00 9.6901E-03 1.4956E+00 1.8312E-03
1.5553E+00 3.6624E-03 1.6141E+00 1.3734E-03 1.7171E+00 1.0682E-03
1.7277E+00 1.1140E-03 1.7783E+00 1.3734E-03 2.0239E+00 1.1750E-03
2.0623E+00 1.1064E-03 2.2107E+00 2.1364E-03 2.2180E+00 1.5184E-01
2.4994E+00 1.6786E-03 2.5832E+00 2.3882E-03 2.6396E+00 7.6300E-02
2.7311E+00 1.1979E-03 3.3390E+00 1.5107E-03 3.3670E+00 2.2737E-03
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1.6132E+00 1.6214E-02
CS-139        9.40 M     55.
 0
 31
5.3833E-01 1.6600E-01 1.5000E-03 7.3969E-01 2.4100E-01 1.6000E-03
8.3967E-01 2.8000E-01 1.0000E-03 1.2067E+00 4.2900E-01 1.3000E-03
1.2096E+00 4.3000E-01 1.3000E-03 1.3563E+00 4.9300E-01 1.0000E-03
1.5547E+00 5.7800E-01 2.3000E-03 1.5983E+00 5.9700E-01 5.6000E-03
1.6721E+00 6.3000E-01 5.3000E-03 1.6743E+00 6.3100E-01 1.2000E-03
1.8233E+00 6.9600E-01 1.5000E-03 1.8542E+00 7.1000E-01 1.3000E-02
1.9851E+00 7.6900E-01 1.0000E-03 2.0301E+00 7.8900E-01 2.9000E-03
2.0931E+00 8.1700E-01 8.0000E-03 2.1141E+00 8.2700E-01 1.2000E-03
2.1661E+00 8.5000E-01 2.1000E-03 2.1831E+00 8.5800E-01 1.6000E-03
2.2549E+00 8.9000E-01 2.7000E-03 2.2705E+00 8.9800E-01 3.1000E-03
2.3165E+00 9.1800E-01 2.9000E-03 2.3266E+00 9.2300E-01 3.6000E-03
2.3530E+00 9.3500E-01 1.2000E-03 2.5053E+00 1.0050E+00 1.5000E-03
2.5232E+00 1.0130E+00 4.5000E-03 2.5833E+00 1.0400E+00 3.8000E-03
2.7833E+00 1.1320E+00 3.8000E-03 2.8958E+00 1.1840E+00 2.4000E-03
2.9207E+00 1.1960E+00 6.3000E-02 4.2040E+00 1.7940E+00 8.4000E-01
1.3570E+00 5.0841E-01 1.2740E-02
 0
 0
 34
4.5466E-01 1.3104E-03 5.3198E-01 2.1384E-03 5.6772E-01 1.3464E-03
6.2724E-01 1.5408E-02 8.2752E-01 1.0944E-03 9.2918E-01 2.3040E-03
9.4646E-01 1.0080E-03 1.1904E+00 1.8432E-03 1.2832E+00 7.2000E-02
1.3061E+00 1.0584E-03 1.3081E+00 3.7440E-03 1.3218E+00 2.3400E-03
1.4106E+00 1.5048E-03 1.4207E+00 7.9920E-03 1.6207E+00 4.1760E-03
1.6807E+00 6.0480E-03 1.6987E+00 1.7712E-03 1.8775E+00 3.4056E-03
1.8876E+00 2.1960E-03 1.9045E+00 1.2312E-03 1.9335E+00 2.4408E-03
2.0208E+00 1.2960E-03 2.0899E+00 1.3608E-03 2.1109E+00 6.5520E-03
2.1740E+00 2.0088E-03 2.3499E+00 5.6160E-03 2.3807E+00 1.8720E-03
2.5318E+00 4.1760E-03 2.6058E+00 2.4336E-03 2.6493E+00 1.6704E-03
2.8476E+00 1.0080E-03 3.4643E+00 1.0872E-03 3.6656E+00 1.3680E-03
1.5695E+00 3.8697E-02
BA-139        83.1 M     56.
 0
 4
8.8547E-01 2.9740E-01 3.2000E-03 2.1401E+00 8.3700E-01 2.2000E-01
2.3060E+00 9.1200E-01 7.8000E-01 9.0100E-01 3.0467E-01 6.1700E-04
 0
 5
3.8000E-03 3.2007E-02 2.7400E-02 3.4105E-03 1.2693E-01 3.6282E-02
1.5959E-01 4.8608E-03 1.6449E-01 1.2846E-03
 7
4.6500E-03 4.7826E-03 3.3034E-02 9.3441E-03 3.3442E-02 1.7208E-02
3.7800E-02 6.3195E-03 1.6585E-01 1.7360E-01 1.4205E+00 2.8000E-03
1.2711E+00 1.0532E-03
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BA-140         12.789 D      56.
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8.7232E-01 3.0600E-01 4.4000E-02 9.9117E-01 3.4000E-01 3.7000E-01
1.0050E+00 3.5700E-01 2.2000E-01
 0
 12
3.8000E-03 9.8464E-01 7.5837E-03 5.0556E-01 1.2489E-02 1.0440E-01
1.3580E-02 3.4486E-02 2.3704E-02 6.0588E-01 2.7400E-02 1.9417E-03
2.8609E-02 1.2482E-01 2.9700E-02 4.1233E-02 1.2372E-01 1.6022E-02
1.5637E-01 2.1542E-03 2.6592E-01 1.9826E-03 4.9840E-01 2.6520E-03
 14
4.6500E-03 1.4713E-01 1.3850E-02 1.1730E-02 2.9970E-02 1.4025E-01
3.3034E-02 5.3199E-03 3.3442E-02 9.7972E-03 3.7800E-02 3.5979E-03
1.3284E-01 2.1420E-03 1.6264E-01 6.7320E-02 3.0484E-01 4.5058E-02
4.2370E-01 3.2461E-02 4.3755E-01 1.9941E-02 4.6757E-01 1.5300E-03
5.3732E-01 2.5500E-01 1.1884E-01 7.1400E-04
LA-140          40.22 H      57.
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 10   1   1
1.2131E+00 4.3820E-01 6.4000E-03 1.2388E+00 4.4110E-01 1.1110E-01
1.2444E+00 4.4350E-01 5.8900E-02 1.2793E+00 4.5820E-01 1.1900E-02
1.2962E+00 4.6530E-01 5.6300E-02 1.3482E+00 4.8740E-01 4.4500E-01
1.4123E+00 5.1470E-01 5.0800E-02 1.6770E+00 6.2950E-01 2.0700E-01
2.1640E+00 8.4620E-01 5.2000E-02 9.5780E-01 3.2889E-01 1.6150E-03
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3.9400E-03 1.7058E-02 1.8046E-02 2.5032E-03 2.8400E-02 1.6214E-03
2.8473E-02 1.8558E-03 6.8974E-02 1.5126E-03 9.0678E-02 2.3815E-03
2.8832E-01 8.0684E-03 3.2222E-01 1.0717E-03 4.4659E-01 4.4000E-03
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4.8400E-03 2.5489E-03 3.4279E-02 4.7176E-03 3.4720E-02 8.6562E-03
3.9300E-02 3.2231E-03 1.0942E-01 1.9098E-03 1.3112E-01 5.5384E-03
1.7355E-01 1.2414E-03 2.4197E-01 4.2970E-03 2.6655E-01 4.8700E-03
3.2877E-01 2.0530E-01 4.3253E-01 2.9411E-02 4.8703E-01 4.5549E-01
7.5179E-01 4.4021E-02 8.1585E-01 2.3491E-01 8.6782E-01 5.6339E-02
9.1963E-01 2.8838E-02 9.2524E-01 7.0854E-02 9.5090E-01 5.3474E-03
1.5965E+00 9.5490E-01 2.3488E+00 8.5082E-03 2.5217E+00 3.4567E-02
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CS-136          13.16 D      55.
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1.7439E-01 4.7200E-02 2.4900E-02 1.9155E-01 5.2300E-02 2.1000E-03
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3.6700E-03 2.0665E-01 2.6400E-02 1.9108E-02 2.9469E-02 7.3155E-02
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1.1578E-01 2.3790E-02 1.2645E-01 4.9746E-02 1.2909E-01 1.4070E-03
1.3911E-01 5.5050E-03 1.4723E-01 6.7267E-03 1.5193E-01 1.8122E-03
1.5790E-01 3.9751E-02 1.6260E-01 8.8899E-03 1.6364E-01 2.3261E-03
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7.8106E-01 2.4127E-03 1.0106E+00 1.1218E-03
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3.6400E-02 3.3205E-02 6.6910E-02 1.2463E-01 8.6290E-02 6.2811E-02
1.0966E-01 4.0877E-03 1.5322E-01 7.4576E-02 1.6389E-01 4.6061E-02
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5.0721E-01 9.7706E-03 8.1850E-01 9.9700E-01 1.0481E+00 7.9561E-01
1.2353E+00 1.9741E-01 7.8724E-01 3.3001E-03
BA-141        18.27 M     56.
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5.6103E-01 1.7400E-01 6.2000E-03 5.8920E-01 1.8400E-01 2.4000E-03
6.4410E-01 2.0500E-01 1.7000E-03 6.5397E-01 2.0800E-01 8.2000E-03
8.1309E-01 2.6900E-01 6.5000E-03 8.4944E-01 2.8300E-01 4.8000E-03
1.1041E+00 3.8600E-01 2.2600E-02 1.1573E+00 4.0800E-01 4.1000E-02
1.1857E+00 4.2000E-01 2.6000E-02 1.2891E+00 4.6300E-01 2.5100E-02
1.4020E+00 5.1100E-01 2.3200E-02 1.4639E+00 5.3800E-01 2.1000E-03
1.5283E+00 5.6600E-01 6.7000E-02 1.6040E+00 5.9900E-01 3.9000E-03
1.8408E+00 7.0300E-01 3.4000E-03 1.8580E+00 7.1100E-01 1.5800E-02
1.9634E+00 7.5800E-01 3.7000E-02 2.0382E+00 7.9100E-01 1.9000E-03
2.1006E+00 8.1900E-01 1.2600E-01 2.1983E+00 8.6300E-01 2.1300E-02
2.2036E+00 8.6600E-01 5.4000E-03 2.3821E+00 9.4700E-01 2.4500E-01
2.5627E+00 1.0290E+00 1.9000E-01 2.8397E+00 1.1560E+00 1.2000E-01
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3.8000E-03 6.6797E-02 2.7400E-02 7.1267E-03 1.5130E-01 7.5816E-02
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4.6500E-03 9.9812E-03 3.3034E-02 1.9526E-02 3.3442E-02 3.5959E-02
3.7800E-02 1.3205E-02 1.1294E-01 9.8658E-03 1.6296E-01 4.6656E-03
1.8050E-01 5.2002E-03 1.9022E-01 4.8600E-01 2.7699E-01 2.4592E-01
3.0424E-01 2.6584E-01 3.4371E-01 1.5017E-01 3.4935E-01 3.0132E-03
3.6438E-01 6.1236E-03 3.8131E-01 1.2150E-03 3.8978E-01 1.3948E-02
4.5758E-01 5.0544E-02 4.6215E-01 5.0544E-02 4.6726E-01 5.7834E-02
5.2219E-01 4.5684E-03 5.2420E-01 4.2768E-03 5.2742E-01 3.9852E-03
5.6190E-01 1.0206E-03 5.7209E-01 2.6730E-03 5.7209E-01 2.6730E-03
5.9928E-01 2.4786E-03 6.0891E-01 2.5758E-03 6.2523E-01 3.4506E-02
6.3605E-01 2.9646E-03 6.4138E-01 3.8394E-03 6.4788E-01 5.9292E-02
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6.8570E-01 1.4094E-03 6.8780E-01 1.0692E-03 6.9850E-01 2.9646E-03
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8.3260E-01 1.7010E-03 8.6790E-01 1.5552E-03 8.7629E-01 3.5964E-02
8.8060E-01 2.0898E-03 9.0880E-01 1.3122E-03 9.2947E-01 7.3386E-03
9.4325E-01 7.6788E-03 9.8163E-01 8.2134E-03 9.9660E-01 1.3122E-03
1.0123E+00 1.0692E-03 1.0345E+00 3.1104E-03 1.0404E+00 1.0206E-03
1.0463E+00 3.6450E-03 1.0940E+00 2.3328E-03 1.1608E+00 2.5272E-03
1.1608E+00 9.7200E-03 1.1975E+00 4.8600E-02 1.2248E+00 4.3254E-03
1.2355E+00 1.5066E-03 1.2642E+00 8.6508E-03 1.2736E+00 5.4432E-03
1.2782E+00 6.9498E-03 1.3091E+00 2.4786E-03 1.3112E+00 6.3180E-03
1.3237E+00 9.9630E-03 1.3453E+00 2.3328E-03 1.3575E+00 1.6524E-03
1.3770E+00 7.4358E-03 1.4056E+00 2.8674E-03 1.4368E+00 8.6994E-03
1.4586E+00 7.1442E-03 1.5018E+00 3.2562E-03 1.5506E+00 3.2562E-03
1.5688E+00 2.6730E-03 1.6540E+00 7.8732E-03 1.6824E+00 1.4143E-02
1.7132E+00 1.7982E-03 1.7356E+00 1.9440E-03 1.7408E+00 3.3048E-03
1.7959E+00 5.1030E-03 1.9127E+00 1.3608E-03 1.9903E+00 1.9440E-03
2.0266E+00 3.9852E-03 2.1367E+00 1.1664E-03 2.1647E+00 1.6524E-03
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2.4300E+00 9.6700E-01 9.7000E-01 4.0000E-01 1.2545E-01 2.6180E-03
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1.3545E+00 2.6200E-02 1.6933E+00 1.1790E-03 1.6743E+00 3.1073E-03
CE-141         32.50 D     58.
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4.3456E-01 1.2960E-01 7.0500E-01 5.8000E-01 1.8070E-01 2.9500E-01
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4.0800E-03 1.6282E-01 2.9400E-02 1.5962E-02 1.0345E-01 1.8779E-01
1.3861E-01 2.5942E-02 1.4393E-01 5.4208E-03 1.4514E-01 1.4907E-03
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5.0300E-03 2.6505E-02 3.5550E-02 4.8821E-02 3.6026E-02 8.9416E-02
4.0700E-02 3.3592E-02 1.4544E-01 4.8400E-01
BA-142         10.70 M     56.
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7.4256E-01 2.4000E-01 1.2600E-01 9.1660E-01 3.1000E-01 1.6000E-03
9.9600E-01 3.4000E-01 4.0000E-01 1.1216E+00 3.9000E-01 1.8000E-01
1.3331E+00 4.8000E-01 4.4000E-03 1.3918E+00 5.1000E-01 3.0000E-03
1.4078E+00 5.1000E-01 7.1000E-03 1.6094E+00 6.0000E-01 3.7000E-03
1.7750E+00 6.7000E-01 4.6000E-02 1.7680E+00 6.7000E-01 3.1000E-02
1.8998E+00 7.3000E-01 2.7000E-03 2.0451E+00 7.9000E-01 1.6000E-03
2.1224E+00 8.3000E-01 1.8000E-01
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3.8000E-03 2.5683E-01 2.7400E-02 2.0239E-02 3.8675E-02 2.1531E-01
7.1334E-02 1.0573E-01 7.6239E-02 2.3069E-02 7.7330E-02 6.0556E-03
 58
4.6500E-03 3.8376E-02 3.3034E-02 5.5450E-02 3.3442E-02 1.0212E-01
3.7800E-02 3.7501E-02 6.9400E-02 3.5600E-03 7.6800E-02 8.9000E-03
7.7600E-02 9.6120E-02 1.2289E-01 9.2560E-03 1.5422E-01 5.1620E-03
1.6200E-01 1.0680E-03 1.7682E-01 1.4774E-02 2.1630E-01 1.9580E-03
2.2260E-01 2.6700E-03 2.3152E-01 1.0146E-01 2.4270E-01 1.6020E-03
2.5512E-01 1.7800E-01 2.6933E-01 6.7640E-03 2.8390E-01 1.7800E-03
2.8620E-01 9.2560E-03 3.0902E-01 2.2606E-02 3.3480E-01 1.2460E-02
3.3710E-01 2.4920E-03 3.4670E-01 1.4240E-03 3.6380E-01 3.9160E-02
3.7910E-01 4.6280E-03 4.1780E-01 3.3820E-03 4.2503E-01 4.9840E-02
4.3230E-01 9.7900E-03 4.3440E-01 3.0260E-03 4.4810E-01 2.1360E-03
4.5730E-01 3.9160E-03 4.7340E-01 3.0260E-03 4.8830E-01 1.0680E-03
5.1330E-01 2.3140E-03 5.3750E-01 1.0680E-03 5.5830E-01 3.0260E-03
5.9070E-01 2.4920E-03 5.9984E-01 1.6020E-02 6.0420E-01 3.2040E-03
7.6940E-01 6.0520E-03 7.8640E-01 2.4920E-03 7.9220E-01 2.1360E-03
8.2340E-01 4.0940E-03 8.4023E-01 3.0260E-02 8.9490E-01 1.1036E-01
9.4875E-01 8.9000E-02 1.0009E+00 7.8320E-02 1.0328E+00 4.8060E-03
1.0785E+00 9.2560E-02 1.0936E+00 2.2072E-02 1.1226E+00 3.0260E-03
1.1265E+00 1.5308E-02 1.1483E+00 3.9160E-03 1.2022E+00 5.3400E-02
1.2041E+00 1.3706E-01 1.2834E+00 1.6020E-03 1.3799E+00 3.3998E-02
6.8510E-01 1.6020E-03
LA-142          95.4 M      57.
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 25   1  25
4.7413E-01 1.4330E-01 1.5000E-02 5.4160E-01 1.6710E-01 1.0000E-03
6.6650E-01 2.1270E-01 2.6000E-03 7.9788E-01 2.6260E-01 5.8000E-03
7.9996E-01 2.6350E-01 5.8000E-03 8.4155E-01 2.7960E-01 1.2000E-02
8.8417E-01 2.9640E-01 1.5000E-02 9.0389E-01 3.0420E-01 4.3000E-02
9.0492E-01 3.0460E-01 1.7000E-02 1.0473E+00 3.6190E-01 6.3000E-03
1.0577E+00 3.6610E-01 1.8000E-02 1.0967E+00 3.8210E-01 2.5000E-02
1.5172E+00 5.6000E-01 1.3600E-02 1.7754E+00 6.7300E-01 1.3100E-02
1.8207E+00 6.9300E-01 8.1000E-02 1.8503E+00 7.0600E-01 3.7000E-02
1.9744E+00 7.6100E-01 2.0100E-01 2.1193E+00 8.2600E-01 2.1500E-01
2.1528E+00 8.4100E-01 2.0000E-02 2.3298E+00 9.2100E-01 6.9000E-02
2.5128E+00 1.0040E+00 2.1000E-02 2.8644E+00 1.1650E+00 8.0000E-03
2.9809E+00 1.2190E+00 3.0000E-02 3.8758E+00 1.6340E+00 5.2000E-02
4.5170E+00 1.9100E+00 7.0000E-02
  0
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3.9400E-03 1.9132E-03 2.8400E-02 2.2241E-04 6.0073E-01 2.4990E-03
125
4.8400E-03 2.8589E-04 3.4279E-02 6.4711E-04 3.4720E-02 1.1874E-03
3.9300E-02 4.4211E-04 1.0610E-01 1.5750E-03 1.7410E-01 1.0500E-03
3.6730E-01 1.0500E-03 3.9370E-01 1.0500E-03 4.2080E-01 2.6250E-03
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4.3334E-01 4.2000E-03 5.1470E-01 1.5750E-03 5.3200E-01 1.5750E-03
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8.6157E-01 1.9950E-02 8.7820E-01 2.1000E-03 8.9485E-01 9.3975E-02
9.4650E-01 1.0500E-03 9.6220E-01 4.2000E-03 9.9120E-01 1.0500E-03
1.0067E+00 2.6250E-03 1.0114E+00 4.3575E-02 1.0392E+00 1.0500E-03
1.0437E+00 3.0450E-02 1.0618E+00 1.5750E-03 1.0703E+00 1.5750E-03
1.0742E+00 1.0500E-03 1.0889E+00 2.6250E-03 1.1126E+00 1.0500E-03
1.1167E+00 1.0500E-03 1.1306E+00 5.2500E-03 1.1445E+00 1.5750E-03
1.1602E+00 1.9425E-02 1.1743E+00 1.5750E-03 1.1909E+00 4.2000E-03
1.2315E+00 3.1500E-03 1.2331E+00 2.0475E-02 1.2423E+00 2.1000E-03
1.2647E+00 1.0500E-03 1.2701E+00 1.0500E-03 1.2880E+00 1.0500E-03
1.3232E+00 3.6750E-03 1.3323E+00 1.0500E-03 1.3546E+00 1.0500E-03
1.3630E+00 2.3625E-02 1.3736E+00 2.1000E-03 1.3893E+00 4.7250E-03
1.3953E+00 2.1000E-03 1.4022E+00 1.5750E-03 1.4455E+00 1.5750E-03
1.4551E+00 1.0500E-03 1.4937E+00 1.5750E-03 1.5163E+00 4.7250E-03
1.5355E+00 2.6250E-03 1.5402E+00 5.2500E-03 1.5458E+00 3.3075E-02
1.6182E+00 3.1500E-03 1.6514E+00 2.1000E-03 1.6881E+00 2.6250E-03
1.7229E+00 1.6800E-02 1.7524E+00 1.0500E-03 1.7564E+00 3.3075E-02
1.7680E+00 2.1000E-03 1.7710E+00 2.1000E-03 1.7938E+00 1.0500E-03
1.8063E+00 1.5750E-03 1.8171E+00 1.0500E-03 1.8854E+00 5.7750E-03
1.9013E+00 8.7150E-02 1.9230E+00 2.6250E-03 1.9335E+00 1.5750E-03
1.9482E+00 5.2500E-03 1.9606E+00 1.5750E-03 2.0042E+00 1.0500E-02
2.0255E+00 1.3650E-02 2.0387E+00 1.1025E-02 2.0504E+00 5.2500E-03
2.0552E+00 2.9400E-02 2.0769E+00 7.3500E-03 2.0861E+00 4.2000E-03
2.1004E+00 1.0500E-02 2.1262E+00 3.6750E-03 2.1393E+00 5.7750E-03
2.1803E+00 5.7750E-03 2.1872E+00 5.8275E-02 2.2905E+00 3.6750E-03
2.3584E+00 8.4000E-03 2.3644E+00 4.7250E-03 2.3977E+00 1.6275E-01
2.4195E+00 2.1000E-03 2.4594E+00 4.2000E-03 2.5132E+00 1.5750E-03
2.5323E+00 1.0500E-03 2.5394E+00 7.8750E-03 2.5427E+00 1.1235E-01
2.6635E+00 7.8750E-03 2.6668E+00 1.8900E-02 2.6726E+00 2.1000E-03
2.7823E+00 3.1500E-03 2.8008E+00 6.3000E-03 2.8181E+00 8.4000E-03
2.8286E+00 2.6250E-03 2.9700E+00 7.8750E-03 2.9720E+00 3.3075E-02
2.9917E+00 1.0500E-03 2.9999E+00 5.2500E-03 3.0071E+00 2.1000E-03
3.0129E+00 7.3500E-03 3.0223E+00 1.0500E-03 3.0343E+00 5.7750E-03
3.0469E+00 4.2000E-03 3.0759E+00 1.5750E-03 3.1550E+00 2.1000E-03
3.1810E+00 3.1500E-03 3.2367E+00 3.1500E-03 3.2424E+00 2.1000E-03
3.2732E+00 1.5750E-03 3.3147E+00 1.3650E-02 3.4019E+00 3.1500E-03
3.4593E+00 3.6750E-03 3.6121E+00 8.9250E-03 3.6327E+00 1.1550E-02
3.7191E+00 3.1500E-03 3.8504E+00 2.6250E-03
CE-143          33.0 H      58.
 0
 8
5.7301E-02 1.4700E-02 3.8000E-03 2.9456E-01 8.3600E-02 5.1000E-03
5.1725E-01 1.5820E-01 1.4200E-02 5.6440E-01 1.7500E-01 3.9000E-03
7.3309E-01 2.3740E-01 1.2100E-01 1.1044E+00 3.8460E-01 4.8000E-01
1.3976E+00 5.0750E-01 3.8000E-01 1.8700E-01 5.1705E-02 1.9400E-03
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 9
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4.0800E-03 5.9167E-01 1.5374E-02 6.5621E-01 2.9400E-02 5.7818E-02
5.0530E-02 9.2786E-02 5.5854E-02 1.9522E-02 5.7061E-02 5.3273E-03
1.8957E-01 1.9958E-03 2.5127E-01 2.2008E-02 2.8643E-01 3.4230E-03
 20
5.0300E-03 9.6319E-02 3.5550E-02 1.7684E-01 3.6026E-02 3.2388E-01
4.0700E-02 1.2167E-01 5.7365E-02 1.1760E-01 1.6900E-01 2.9400E-03
2.1600E-01 2.0580E-03 2.3156E-01 2.0160E-02 2.9326E-01 4.2000E-01
3.3800E-01 2.8560E-03 3.5059E-01 3.3600E-02 4.3302E-01 1.3440E-03
4.3900E-01 1.1760E-03 4.9036E-01 1.9740E-02 5.8728E-01 2.4360E-03
6.6455E-01 5.2500E-02 7.2196E-01 5.1240E-02 8.8039E-01 9.2400E-03
1.1030E+00 3.6540E-03 6.1062E-01 8.9250E-03
PR-143          13.56 D     59.
  0
  2   1   2
9.3530E-01 3.1560E-01 1.0000E+00 1.9330E-01 6.2600E-02 1.2000E-08
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  0
  1
7.4198E-01 1.2000E-08
CE-144          284.3 D     58.
  0
  3
1.8466E-01 5.0200E-02 1.9600E-01 2.3809E-01 6.6100E-02 4.7000E-02
3.1820E-01 9.1100E-02 7.7200E-01
  0
 13
4.0800E-03 9.6963E-02 1.1441E-02 6.3809E-03 2.6785E-02 1.1234E-02
2.9400E-02 7.9484E-03 3.2109E-02 3.1409E-03 3.4095E-02 8.1648E-03
3.8115E-02 3.3886E-02 3.9419E-02 2.2667E-03 7.3271E-02 4.6833E-03
7.8595E-02 1.2499E-03 9.1553E-02 5.3244E-02 1.2671E-01 7.3116E-03
1.3203E-01 1.9548E-03
  9
5.0300E-03 1.5785E-02 3.3620E-02 2.8296E-03 3.5550E-02 2.4311E-02
3.6026E-02 4.4525E-02 4.0700E-02 1.6727E-02 4.0930E-02 3.8880E-03
8.0106E-02 1.5984E-02 1.3354E-01 1.0800E-01 6.7350E-02 1.3252E-03
PR-144M          7.2 M      59.
  0
  0
  0
  6
4.0800E-03 6.8121E-01 1.7039E-02 3.3380E-01 2.9400E-02 2.8373E-02
5.2195E-02 5.0170E-01 5.7519E-02 1.2493E-01 5.8726E-02 3.8277E-02
  5
5.0300E-03 1.1089E-01 3.5550E-02 8.6780E-02 3.6026E-02 1.5894E-01
4.0700E-02 5.9709E-02 5.9030E-02 8.1851E-04
PR-144          17.28 M     59.
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8.1032E-01 2.6660E-01 1.0800E-02 2.2995E+00 8.9440E-01 1.1700E-02
2.9960E+00 1.2214E+00 9.7740E-01 1.0440E-01 3.6919E-01 1.1320E-04
  0
  0
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6.9649E-01 1.4800E-02 1.4892E+00 3.0044E-03 2.1857E+00 7.7404E-03
1.0586E+00 2.0350E-04
PR-142          19.13 H       59.
  0
  3   1   2
5.8304E-01 1.8150E-01 3.7000E-02 2.1588E+00 8.3280E-01 9.6300E-01
7.4200E-02 1.9200E-02 2.5000E-04
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1.5758E+00 3.6994E-02 5.0880E-01 2.4786E-04
ND-147          10.98 D       60.
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2.0991E-01 5.7600E-02 2.2200E-02 3.6479E-01 1.0610E-01 1.5300E-01
4.0655E-01 1.1990E-01 8.1000E-03 4.8529E-01 1.4670E-01 5.8000E-03
8.0470E-01 2.6400E-01 8.1100E-01 2.1530E-01 5.9200E-02 6.6000E-04
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4.3800E-03 4.1601E-01 3.1500E-02 3.7481E-02 4.5922E-02 4.8720E-01
7.5296E-02 3.1212E-03 8.3678E-02 7.1120E-02 8.9457E-02 1.5204E-02
9.0776E-02 4.3120E-03 2.7423E-01 1.0231E-03 4.8583E-01 1.8253E-03
 17
5.4300E-03 7.9239E-02 3.8171E-02 1.2956E-01 3.8725E-02 2.3557E-01
4.3800E-02 9.0554E-02 9.1106E-02 2.8000E-01 1.2048E-01 3.9760E-03
1.9664E-01 2.0440E-03 2.7537E-01 8.0360E-03 3.1941E-01 1.9600E-02
3.9816E-01 8.7360E-03 4.1048E-01 1.4000E-03 4.3990E-01 1.2040E-02
4.8924E-01 1.5400E-03 5.3102E-01 1.3132E-01 5.9480E-01 2.6600E-03
6.8590E-01 8.1480E-03 6.1662E-01 6.5520E-04
PM-147          2.6234 Y      61.
  0
  2
2.2470E-01 6.1960E-02 9.9994E-01 1.0350E-01 2.7098E-02 5.7305E-05
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  0
  1
1.2126E-01 2.8503E-05
SM-147        1.069E11 Y      62.
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2.2476E+00 1.0000E+00
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PM-148M        41.3 D     61.
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4.0715E-01 1.2000E-01 5.4000E-01 5.0563E-01 1.5400E-01 1.8600E-01
6.9526E-01 2.2200E-01 2.2000E-01 1.0069E+00 3.4300E-01 9.2000E-03
 0
 21
4.3800E-03 4.9166E-02 3.0516E-02 2.7720E-02 3.1500E-02 2.1067E-03
5.4072E-02 3.0786E-02 5.9851E-02 8.7360E-03 6.1170E-02 2.3730E-03
6.8272E-02 3.9060E-03 7.4051E-02 1.0626E-03 4.5300E-03 5.2417E-02
3.2600E-02 4.5563E-03 5.1646E-02 3.7360E-02 9.0743E-02 6.0369E-03
9.6757E-02 1.6799E-03 1.4280E-01 2.3175E-03 2.4128E-01 8.0369E-03
2.8037E-01 1.3939E-03 3.6724E-01 1.0675E-03 5.0344E-01 7.8364E-03
5.4253E-01 1.2997E-03 5.8314E-01 5.2687E-03 6.7887E-01 1.3957E-03
 29
5.4300E-03 9.3650E-03 3.8171E-02 7.2825E-03 3.8725E-02 1.3241E-02
4.3800E-02 5.0898E-03 7.5700E-02 9.3240E-03 6.1500E-02 3.1920E-06
5.6400E-03 1.0736E-02 3.9522E-02 1.6710E-02 4.0118E-02 3.0271E-02
4.5400E-02 1.1745E-02 9.8480E-02 2.4741E-02 1.8963E-01 1.1036E-02
2.8811E-01 1.2558E-01 3.1163E-01 3.9159E-02 3.6209E-01 1.7800E-03
4.1407E-01 1.8663E-01 4.3278E-01 5.3488E-02 4.6057E-01 4.1829E-03
5.0126E-01 6.7461E-02 5.5027E-01 9.4872E-01 5.5324E-01 4.0049E-03
5.7195E-01 2.1360E-03 5.9974E-01 1.2540E-01 6.1126E-01 5.4823E-02
6.2997E-01 8.8998E-01 7.2570E-01 3.2840E-01 9.1533E-01 1.7168E-01
1.0138E+00 2.0283E-01 7.1479E-01 1.9313E-03
PM-148         5.37 D     61.
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4.0604E-01 1.2000E-01 1.3600E-02 9.9887E-01 3.4000E-01 3.3300E-01
1.0395E+00 3.5600E-01 2.3500E-03 1.9137E+00 7.2800E-01 9.4000E-02
2.4640E+00 9.7500E-01 5.5500E-01 5.8500E-01 1.9174E-01 2.2990E-03
 0
 3
4.5300E-03 1.2971E-03 3.2600E-02 1.3084E-04 5.0344E-01 1.8172E-03
 12
5.6400E-03 2.6568E-04 3.9522E-02 4.7984E-04 4.0118E-02 8.6927E-04
4.5400E-02 3.3728E-04 5.5027E-01 2.2000E-01 5.9283E-01 3.5298E-03
6.1126E-01 1.0212E-02 8.7418E-01 2.3532E-03 8.9642E-01 9.8124E-03
9.1485E-01 1.1455E-01 1.4651E+00 2.2200E-01 1.2939E+00 3.0481E-03
PM-149         53.08 H    61.
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 4
1.8920E-01 5.1400E-02 1.2600E-03 7.8510E-01 2.5610E-01 3.3900E-02
1.0710E+00 3.6900E-01 9.6230E-01 4.4100E-01 1.3345E-01 2.5480E-03
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 4
4.5300E-03 2.8659E-03 1.4757E-02 1.3521E-03 3.2600E-02 1.7588E-04
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2.3907E-01 2.4428E-03
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5.6400E-03 5.8699E-04 3.9522E-02 6.4502E-04 4.0118E-02 1.1685E-03
4.5400E-02 4.5338E-04 2.8590E-01 3.1000E-02 8.5940E-01 1.0230E-03
5.9833E-01 2.9852E-03
PM-151        28.40 H     61.
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2.2366E-01 6.2000E-02 1.5900E-03 2.3451E-01 6.5000E-02 1.0400E-02
3.0064E-01 8.5000E-02 3.2000E-03 3.1034E-01 8.8000E-02 2.3500E-02
3.6536E-01 1.0600E-01 6.2000E-02 4.1402E-01 1.2200E-01 1.1500E-02
4.4693E-01 1.3300E-01 3.1600E-02 5.2444E-01 1.6000E-01 2.0500E-03
6.6688E-01 2.1200E-01 7.5000E-03 6.9768E-01 2.2300E-01 4.4000E-03
7.4230E-01 2.4000E-01 7.1000E-02 7.9241E-01 2.5900E-01 1.9500E-02
8.4309E-01 2.7800E-01 4.2700E-01 8.6405E-01 2.8700E-01 3.3300E-02
8.8121E-01 2.9300E-01 1.8500E-02 8.8536E-01 2.9500E-01 1.9000E-03
9.7900E-01 3.3200E-01 2.4200E-02 1.0196E+00 3.4800E-01 1.4300E-02
1.0202E+00 3.4800E-01 8.5000E-02 1.0832E+00 3.7400E-01 3.3000E-02
1.1183E+00 3.8800E-01 2.7000E-02 1.1880E+00 4.1700E-01 1.0000E-01
6.0000E-01 1.9132E-01 3.2300E-03
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3.0982E-03 5.0787E-01 4.5300E-03 2.7460E-01 1.6069E-02 1.7469E-03
1.7943E-02 1.4929E-02 1.8053E-02 9.9849E-02 1.9000E-02 5.6877E-02
2.2884E-02 1.9859E-02 2.3957E-02 4.2532E-03 2.7413E-02 6.1715E-03
2.9385E-02 5.0563E-03 3.2600E-02 2.2004E-02 3.3427E-02 1.8755E-03
5.3183E-02 3.7446E-02 5.5099E-02 2.8978E-03 5.7150E-02 1.5401E-02
5.8005E-02 4.5079E-02 5.8097E-02 8.1636E-03 6.1981E-02 3.1746E-03
6.3164E-02 4.2342E-03 6.4111E-02 2.2307E-03 6.8482E-02 6.6575E-03
7.4496E-02 1.9530E-03 9.2280E-02 5.2835E-03 9.2451E-02 2.8645E-03
9.6337E-02 1.0225E-03 9.7102E-02 6.4956E-03 9.8294E-02 1.4568E-03
1.0312E-01 1.7960E-03 1.1676E-01 5.8858E-03 1.2093E-01 5.0739E-03
1.2155E-01 3.0411E-03 1.3032E-01 1.0952E-02 1.6218E-01 3.2866E-03
1.6942E-01 1.7338E-03 1.8559E-01 1.4537E-03 2.2838E-01 1.1182E-03
2.9325E-01 2.1068E-03
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5.6400E-03 5.6243E-02 2.5680E-02 9.3890E-03 3.9522E-02 8.0698E-02
4.0118E-02 1.4619E-01 4.5400E-02 5.6722E-02 6.2903E-02 2.1755E-03
6.4887E-02 1.9694E-02 6.5834E-02 1.1679E-02 6.9718E-02 4.8319E-03
7.6219E-02 2.1068E-03 9.8040E-02 3.6640E-03 1.0002E-01 2.5648E-02
1.0193E-01 1.3053E-02 1.0484E-01 3.5495E-02 1.3929E-01 5.0609E-03
1.4317E-01 2.1755E-03 1.4755E-01 1.4885E-03 1.5618E-01 1.5114E-03
1.6295E-01 8.9310E-03 1.6359E-01 1.6259E-02 1.6777E-01 8.7936E-02
1.6838E-01 9.1600E-03 1.7654E-01 8.7020E-03 1.7716E-01 3.8701E-02
1.8660E-01 1.6946E-03 2.0196E-01 9.4348E-03 2.0415E-01 1.3053E-03
2.0901E-01 1.7862E-02 2.2720E-01 3.4121E-03 2.3242E-01 1.0534E-02
2.3660E-01 1.6259E-03 2.3670E-01 1.9694E-03 2.3702E-01 5.2670E-03
2.4009E-01 3.8930E-02 2.5430E-01 1.6488E-03 2.5813E-01 5.9998E-03
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2.7521E-01 7.1677E-02 2.8010E-01 2.2671E-03 2.9076E-01 8.7936E-03
3.0674E-01 2.3587E-03 3.2395E-01 1.2137E-02 3.2580E-01 1.0763E-03
3.2976E-01 2.1068E-03 3.4008E-01 2.2900E-01 3.4491E-01 2.1755E-02
3.4983E-01 1.3511E-03 3.5332E-01 1.1450E-03 3.7987E-01 9.6638E-03
4.0702E-01 1.8778E-03 4.4088E-01 1.5343E-02 4.4569E-01 4.0762E-02
4.5142E-01 2.9999E-03 4.9030E-01 1.2824E-03 5.1625E-01 2.0152E-03
5.6501E-01 3.6182E-03 5.7497E-01 1.1679E-03 6.3623E-01 1.4656E-02
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6.7130E-01 9.2745E-03 7.0422E-01 3.5266E-03 7.0929E-01 1.4885E-03
7.1202E-01 1.0534E-03 7.1775E-01 4.1220E-02 7.3613E-01 4.8548E-03
7.5283E-01 1.3282E-02 7.6910E-01 1.0992E-03 7.7280E-01 9.5951E-03
7.8507E-01 2.2900E-03 8.0791E-01 5.2670E-03 8.1765E-01 1.7175E-03
8.4867E-01 2.9999E-03 8.7769E-01 1.0076E-03 9.4871E-01 3.6411E-03
4.2881E-01 4.3579E-02
SM-151          90 Y      62.
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5.4560E-02 1.3960E-02 8.8000E-03 7.6100E-02 1.9680E-02 9.9120E-01
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  3
4.6900E-03 4.8492E-03 1.3488E-02 5.9136E-03 1.9740E-02 2.0402E-03
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5.8500E-03 1.0644E-03 2.1540E-02 2.9568E-04
SM-153          46.7 H    62.
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6.3235E-01 1.9860E-01 3.4100E-01 7.0202E-01 2.2440E-01 4.4100E-01
7.0776E-01 2.2650E-01 5.5000E-03 8.0520E-01 2.6340E-01 2.1000E-01
2.6210E-01 8.0927E-02 1.4944E-03
  0
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4.6900E-03 5.4058E-01 1.1758E-02 3.2384E-03 2.1153E-02 2.3162E-01
3.3700E-02 4.4986E-02 3.4848E-02 4.7400E-03 4.0965E-02 3.4128E-03
4.8911E-02 1.8524E-03 5.4660E-02 4.1035E-01 6.1620E-02 3.7896E-02
6.7872E-02 8.2720E-03 6.9312E-02 2.3265E-03 7.5314E-02 2.2400E-03
8.1566E-02 1.3340E-03 9.5127E-02 6.1694E-02 1.0138E-01 1.3358E-02
1.0282E-01 3.8488E-03
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5.8500E-03 1.1866E-01 4.0902E-02 1.7263E-01 4.1542E-02 3.1218E-01
4.7000E-02 1.2217E-01 6.9672E-02 5.1700E-02 7.5422E-02 1.9400E-03
8.3366E-02 2.0000E-03 8.9484E-02 1.5800E-03 9.7430E-02 7.1800E-03
1.0318E-01 2.8300E-01 4.2266E-01 2.7746E-03
EU-152M         9.32 H    63.
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5.5013E-01 1.6890E-01 1.6700E-02 8.1695E-01 2.6750E-01 1.3100E-03
1.5205E+00 5.5410E-01 1.8000E-02 1.8648E+00 7.0410E-01 6.7000E-01
1.6810E-01 4.6697E-02 6.3800E-04
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ENERGY.DAT

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4.5300E-03 2.6792E-01 3.2600E-02 2.1502E-02 7.4945E-02 5.1029E-02
1.1404E-01 2.7861E-02 1.2006E-01 6.3693E-03 1.2143E-01 1.7506E-03
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5.6400E-03 5.4875E-02 3.9522E-02 7.8854E-02 4.0118E-02 1.4285E-01
4.5400E-02 5.5426E-02 1.2178E-01 7.4495E-02 5.6292E-01 2.3374E-03
8.4154E-01 1.5080E-01 9.6106E-01 2.1112E-03 9.6339E-01 1.2411E-01
1.3891E+00 8.8218E-03 7.9420E-01 4.1176E-03 3.4427E-01 2.4900E-02
9.7038E-01 6.1578E-03 1.3147E+00 9.7511E-03 6.7671E-01 3.2007E-03
EU-152          13.6 Y      63.
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1.7590E-01 4.7500E-02 1.7800E-02 3.8524E-01 1.1250E-01 2.4000E-02
6.9606E-01 2.2180E-01 1.3600E-01 7.1007E-01 2.2700E-01 2.3000E-03
8.8865E-01 2.9530E-01 2.9300E-03 1.0638E+00 3.6480E-01 8.9000E-03
1.4749E+00 5.3560E-01 8.4400E-02 2.5690E-01 7.4287E-02 1.8550E-03
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4.5300E-03 7.3378E-01 3.2600E-02 5.6787E-02 7.4945E-02 1.9476E-01
1.1404E-01 1.0633E-01 1.2006E-01 2.4309E-02 1.2143E-01 6.6815E-03
1.9786E-01 6.0922E-03 2.3696E-01 1.5586E-03 4.8400E-03 7.1349E-03
3.4900E-02 5.4369E-04 2.9403E-01 8.2377E-03 3.3590E-01 1.8065E-03
 52
5.6400E-03 1.5029E-01 3.9522E-02 2.0826E-01 4.0118E-02 3.7728E-01
4.5400E-02 1.4639E-01 1.2178E-01 2.8432E-01 2.4469E-01 7.4935E-02
2.9593E-01 4.2661E-03 3.2935E-01 1.2454E-03 4.1594E-01 1.0069E-03
4.4398E-01 2.8114E-02 4.4398E-01 3.0207E-03 4.8866E-01 4.1336E-03
5.6403E-01 4.8225E-03 5.6641E-01 1.2904E-03 6.5644E-01 1.4176E-03
6.7461E-01 1.4839E-03 6.8863E-01 8.3732E-03 7.1933E-01 2.6497E-03
8.1043E-01 3.1002E-03 8.4154E-01 1.6057E-03 8.6732E-01 4.1601E-02
9.1931E-01 4.0144E-03 9.2625E-01 2.5517E-03 9.6339E-01 1.1394E-03
9.6401E-01 1.4441E-01 1.0052E+00 6.5979E-03 1.0849E+00 2.4643E-03
1.0858E+00 9.9630E-02 1.1120E+00 1.3302E-01 1.2128E+00 1.3805E-02
1.2498E+00 1.7833E-03 1.2927E+00 1.0096E-03 1.4080E+00 2.0747E-01
1.4575E+00 4.8755E-03 1.5281E+00 2.5702E-03 6.8578E-01 8.6884E-03
6.0600E-03 1.6736E-03 4.2309E-02 2.1899E-03 4.2996E-02 3.9457E-03
4.8700E-02 1.5584E-03 3.4427E-01 2.6488E-01 3.6771E-01 8.5556E-03
4.1111E-01 2.2144E-02 5.0339E-01 1.5072E-03 5.8626E-01 4.5294E-03
6.7858E-01 4.6883E-03 7.6484E-01 1.6846E-03 7.7889E-01 1.2741E-01
1.0897E+00 1.6793E-02 1.1091E+00 1.6687E-03 1.2990E+00 1.6052E-02
6.3138E-01 7.1115E-03
EU-154           8.8 Y      63.
 0
 16
2.4741E-01 6.8800E-02 2.7900E-01 3.0608E-01 8.6900E-02 7.7000E-03
3.2121E-01 9.1700E-02 1.4900E-03 3.4983E-01 1.0090E-01 1.5800E-02
4.0740E-01 1.1980E-01 1.1700E-03 4.3566E-01 1.2930E-01 2.8100E-03
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5.4860E-01 1.6830E-01 1.8800E-03 5.6940E-01 1.7570E-01 3.6500E-01
7.0318E-01 2.2450E-01 6.4000E-03 7.1541E-01 2.2900E-01 2.4500E-03
8.3918E-01 2.7600E-01 1.7400E-01 9.7072E-01 3.2750E-01 2.0000E-02
1.1515E+00 4.0040E-01 2.9000E-03 1.5960E+00 5.8740E-01 2.4000E-03
1.8439E+00 6.9500E-01 1.1400E-01 4.1200E-01 1.3126E-01 2.1390E-03
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4.8400E-03 3.2536E-01 3.4900E-02 1.8034E-02 7.2831E-02 2.6787E-01
1.1469E-01 1.6793E-01 1.2119E-01 3.9048E-02 1.2269E-01 1.0966E-02
1.9770E-01 5.3741E-03 2.3956E-01 1.4921E-03
 38
6.0600E-03 7.6319E-02 4.2309E-02 7.2639E-02 4.2996E-02 1.3088E-01
4.8700E-02 5.1694E-02 1.2307E-01 4.0464E-01 1.8825E-01 2.2717E-03
2.4794E-01 6.6021E-02 4.0130E-01 2.0942E-03 4.4450E-01 5.0403E-03
4.7826E-01 2.1652E-03 5.5756E-01 2.5556E-03 5.8200E-01 8.4123E-03
5.9181E-01 4.8273E-02 6.2522E-01 3.0881E-03 6.7659E-01 1.3985E-03
6.9241E-01 1.6931E-02 7.1576E-01 1.7393E-03 7.2330E-01 1.9700E-01
7.5687E-01 4.3304E-02 8.1555E-01 4.6498E-03 8.4539E-01 5.5017E-03
8.5064E-01 2.3072E-03 8.7319E-01 1.1500E-01 8.9273E-01 4.6144E-03
9.0405E-01 8.2348E-03 9.9632E-01 1.0294E-01 1.0048E+00 1.7889E-01
1.0474E+00 1.4198E-03 1.1185E+00 1.0294E-03 1.1284E+00 2.6621E-03
1.1409E+00 2.1652E-03 1.2416E+00 1.3133E-03 1.2462E+00 8.9802E-03
1.2745E+00 3.5495E-01 1.4944E+00 6.4956E-03 1.5930E+00 1.0294E-02
1.5965E+00 1.8457E-02 7.1054E-01 1.5850E-02
EU-155          4.96 Y     63.
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9.9930E-02 2.6100E-02 7.2000E-03 1.2801E-01 3.3900E-02 2.2000E-02
1.4069E-01 3.7400E-02 4.6000E-01 1.5946E-01 4.2800E-02 2.6000E-01
1.8599E-01 5.0400E-02 7.7000E-02 2.4600E-01 6.8300E-02 1.8000E-01
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2.0244E-03 1.2054E-02 4.8400E-03 3.4150E-01 8.5192E-03 3.4880E-03
9.7709E-03 8.2763E-02 1.0374E-02 1.3763E-01 1.2644E-02 9.5184E-03
1.6869E-02 3.1518E-02 1.8137E-02 4.9332E-03 1.8374E-02 1.0401E-02
1.9139E-02 2.9395E-03 2.3054E-02 3.8378E-03 2.4632E-02 1.4290E-03
2.9549E-02 1.2082E-03 3.4900E-02 1.6063E-02 3.5823E-02 3.9972E-03
3.6306E-02 1.1217E-01 3.6922E-02 6.1998E-03 4.3416E-02 1.8083E-03
5.1634E-02 1.6686E-02 5.5069E-02 4.4445E-02 5.8129E-02 3.6932E-03
5.9634E-02 1.0501E-03 7.8169E-02 1.7242E-02 8.4664E-02 3.7080E-03
8.6169E-02 1.0413E-03 9.6932E-02 6.6357E-03 1.0343E-01 1.8357E-03
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6.0600E-03 8.0104E-02 2.6513E-02 3.1827E-03 4.2309E-02 6.4697E-02
4.2996E-02 1.1657E-01 4.5297E-02 1.2916E-02 4.8700E-02 4.6042E-02
6.0010E-02 1.1124E-02 8.6062E-02 1.5141E-03 8.6545E-02 3.0900E-01
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2.4950E-01 6.9000E-02 1.6000E-03 2.6627E-01 7.5000E-02 1.1300E-01
3.3158E-01 9.5000E-02 1.2700E-03 4.2641E-01 1.2600E-01 6.0000E-02
4.8709E-01 1.4700E-01 3.2000E-01 5.0063E-01 1.5200E-01 9.6000E-03
5.0662E-01 1.5400E-01 4.4000E-03 1.0866E+00 3.7400E-01 2.4000E-02
1.2106E+00 4.2500E-01 5.1000E-02 1.2849E+00 4.5600E-01 4.5000E-02
1.4036E+00 5.0500E-01 1.4500E-02 2.4530E+00 9.6600E-01 2.7000E-01
1.6400E-01 4.4555E-02 2.0300E-03
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4.8400E-03 2.3194E-01 3.4900E-02 9.5177E-03 3.8725E-02 1.4296E-01
8.0588E-02 1.6377E-01 8.7083E-02 3.8364E-02 8.8588E-02 1.0677E-02
1.4897E-01 1.2488E-03
 56
6.0600E-03 5.4406E-02 4.2309E-02 3.8335E-02 4.2996E-02 6.9073E-02
4.8700E-02 2.7282E-02 8.8964E-02 9.0480E-02 1.9921E-01 7.9040E-03
4.3440E-01 2.2048E-03 4.7270E-01 1.4664E-03 4.9034E-01 1.8200E-03
5.9947E-01 2.3088E-02 6.4629E-01 7.0928E-02 7.0986E-01 9.1520E-03
7.2347E-01 6.0216E-02 7.9773E-01 1.1024E-03 8.1177E-01 1.0400E-01
8.2036E-01 1.6016E-03 8.4110E-01 2.2568E-03 8.5836E-01 1.2584E-03
8.6598E-01 1.5600E-03 8.6701E-01 1.4040E-02 9.4435E-01 1.3936E-02
9.4746E-01 3.1200E-03 9.6050E-01 1.6224E-02 9.6100E-01 1.5600E-03
9.6983E-01 3.8688E-03 1.0119E+00 3.4008E-03 1.0274E+00 1.1960E-03
1.0404E+00 5.3040E-03 1.0651E+00 5.2416E-02 1.0760E+00 3.7440E-03
1.0792E+00 4.8880E-02 1.1295E+00 1.4248E-03 1.1405E+00 2.9640E-03
1.1535E+00 7.1760E-02 1.1541E+00 5.3040E-02 1.1560E+00 1.4040E-03
1.1691E+00 2.9328E-03 1.2307E+00 8.9440E-02 1.2424E+00 6.7600E-02
1.2774E+00 3.2136E-02 1.3664E+00 1.7576E-02 1.6821E+00 3.0160E-03
1.8574E+00 2.5480E-03 1.8770E+00 1.7264E-02 1.9377E+00 2.1424E-02
1.9463E+00 1.8928E-03 1.9660E+00 4.2016E-02 2.0266E+00 3.5360E-02
2.0325E+00 1.3000E-03 2.0977E+00 4.2744E-02 2.1165E+00 1.2584E-03
2.1809E+00 2.4336E-02 2.1867E+00 3.9520E-02 2.2054E+00 9.9840E-03
2.2699E+00 1.1232E-02 1.1027E+00 1.5851E-02
GD-153        241.6 D    64.
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 19
4.6900E-03 1.1350E+00 6.0180E-03 1.6263E-03 1.1758E-02 3.9594E-03
1.8010E-02 1.2066E-03 2.1153E-02 1.1498E-01 3.3700E-02 9.3261E-02
3.4848E-02 5.1927E-03 4.0965E-02 1.5550E-03 4.8911E-02 8.0754E-02
5.4660E-02 3.2223E-01 6.1620E-02 1.8813E-02 6.7872E-02 4.1066E-03
6.9312E-02 1.1550E-03 7.5314E-02 2.4539E-03 8.9378E-02 1.2019E-02
9.5127E-02 4.8446E-02 9.5630E-02 3.2865E-03 1.0138E-01 1.0489E-02
1.0282E-01 3.0223E-03
  9
5.8500E-03 2.4915E-01 4.0902E-02 3.5789E-01 4.1542E-02 6.4718E-01
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9104816 30

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4.7000E-02 2.5328E-01 6.9672E-02 2.5666E-02 8.3366E-02 2.1910E-03
9.7430E-02 3.1300E-01 1.0318E-01 2.2223E-01 9.5828E-02 2.1988E-03
GD-159        18.56 H     64.
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 5
6.1115E-01 1.9040E-01 9.0000E-02 6.2651E-01 1.9600E-01 2.2000E-03
9.1670E-01 3.0570E-01 2.1000E-01 9.7470E-01 3.2860E-01 7.0000E-01
3.3700E-01 9.7588E-02 8.0800E-04
 0
 7
5.0000E-03 1.3118E-01 6.0043E-03 1.5999E-01 2.7514E-02 1.1587E-03
3.6000E-02 1.0153E-02 4.9292E-02 2.6989E-02 5.6033E-02 5.9623E-03
5.7602E-02 1.6899E-03
 9
6.2700E-03 3.2794E-02 4.3744E-02 4.3043E-02 4.4482E-02 7.7276E-02
5.0400E-02 3.0681E-02 5.8000E-02 1.7640E-02 2.2600E-01 1.6464E-03
3.4817E-01 1.6800E-03 3.6356E-01 8.4000E-02 3.6404E-01 2.1129E-03
TB-160         72.3 D     65.
 0
 12
2.9901E-01 8.4600E-02 2.1800E-03 4.3446E-01 1.2860E-01 4.4000E-02
4.4703E-01 1.3280E-01 9.3000E-03 4.7483E-01 1.4230E-01 9.4000E-02
5.4581E-01 1.6690E-01 3.3100E-02 5.6873E-01 1.7500E-01 4.5600E-01
6.7766E-01 2.1440E-01 1.7000E-03 7.8437E-01 2.5430E-01 5.8000E-02
8.6730E-01 2.8600E-01 2.4600E-01 1.5496E+00 5.6520E-01 3.8000E-03
1.7466E+00 6.4990E-01 5.0000E-02 5.4780E-01 1.6760E-01 1.4200E-04
 0
 10
5.1600E-03 4.0181E-01 3.3000E-02 2.1147E-01 3.7200E-02 1.3495E-02
7.7742E-02 3.1654E-01 8.4741E-02 7.5411E-02 8.6372E-02 2.0748E-02
1.4325E-01 8.1863E-03 1.6186E-01 1.2555E-03 1.8799E-01 3.1520E-03
2.4478E-01 4.0071E-03
 25
6.5000E-03 1.0681E-01 4.5208E-02 6.0309E-02 4.5998E-02 1.0789E-01
5.2100E-02 4.3227E-02 8.6788E-02 1.3300E-01 1.9704E-01 4.9020E-02
2.1565E-01 3.7145E-02 2.9857E-01 2.7075E-01 3.0956E-01 8.1510E-03
3.3732E-01 3.3250E-03 3.9249E-01 1.2825E-02 6.8233E-01 5.5100E-03
7.6528E-01 1.9285E-02 8.7203E-01 1.7860E-03 8.7936E-01 2.8500E-01
9.6229E-01 9.0250E-02 9.6615E-01 2.4225E-01 1.0029E+00 9.6900E-03
1.1026E+00 5.2250E-03 1.1151E+00 1.5010E-02 1.1779E+00 1.4440E-01
1.1999E+00 2.3560E-02 1.2719E+00 7.0300E-02 1.3122E+00 2.8500E-02
6.5135E-01 5.0891E-03
TB-161                    65.
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0.59       0.0        1.0000E-01 0.52       0.0        5.5000E-01
0.46       0.0        3.5000E-01
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9 1 0 4 8 1 6 3 1

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0.026        2.1000E-01 0.049        1.9000E-01 0.057              0.05
0.075             0.1
DY-165          2.334 H     66.
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2.0547E-01 5.6100E-02 1.5200E-03 2.9001E-01 8.1700E-02 1.6700E-02
1.1904E+00 4.1410E-01 1.4600E-01 1.2851E+00 4.5310E-01 8.3400E-01
5.2770E-01 1.6540E-01 1.5050E-03
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2.2463E-03 1.4969E-03 5.3300E-03 7.4643E-02 3.8400E-02 5.4787E-03
3.9082E-02 9.2681E-02 8.5306E-02 1.4958E-02 9.2572E-02 4.2583E-03
3.0606E-01 1.9404E-03
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6.7200E-03 2.1053E-02 4.6700E-02 2.5873E-02 4.7547E-02 4.6120E-02
5.3900E-02 1.8646E-02 9.4700E-02 3.5784E-02 2.7976E-01 5.0484E-03
3.6168E-01 8.4000E-03 5.4583E-01 1.6212E-03 5.6572E-01 1.2768E-03
6.3341E-01 5.6784E-03 7.1533E-01 5.3424E-03 6.4145E-01 6.7034E-03
HO-166M        1.20E3 Y     67.
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3.1784E-02 8.0000E-03 1.7200E-01 7.2373E-02 1.8700E-02 7.3400E-01
3.0360E-01 8.5900E-02 4.0400E-03 4.8329E-01 1.4490E-01 9.0000E-03
6.4336E-01 2.0130E-01 2.1300E-02 9.4808E-01 3.1640E-01 1.1200E-02
1.3138E+00 4.6410E-01 3.4000E-02
 0
 24
5.5000E-03 7.0908E-01 2.3104E-02 2.1726E-01 3.7165E-02 3.3694E-03
3.9700E-02 2.2186E-02 6.1555E-02 1.7729E-03 6.3675E-02 2.4466E-03
7.0838E-02 5.0185E-01 7.8382E-02 1.2159E-01 8.0140E-02 3.3287E-02
8.4899E-02 1.7649E-03 1.1141E-01 1.0031E-03 1.2693E-01 1.5028E-01
1.5839E-01 3.3668E-03 1.7466E-01 7.0640E-02 1.8221E-01 1.6771E-02
1.8397E-01 4.6391E-03 2.0613E-01 1.3107E-03 2.2296E-01 1.8217E-02
2.4326E-01 1.8771E-03 2.7070E-01 5.4798E-03 2.7824E-01 1.6291E-03
4.7232E-01 1.0842E-03 6.5420E-01 1.2170E-03 7.5282E-01 2.4911E-03
 45
6.9500E-03 2.1180E-01 4.8221E-02 1.0889E-01 4.9128E-02 1.9341E-01
5.5700E-02 7.8899E-02 8.0589E-02 1.2705E-01 9.4650E-02 1.6045E-03
1.1904E-01 1.6117E-03 1.2116E-01 2.4466E-03 1.8442E-01 7.2600E-01
1.9071E-01 2.2070E-03 2.1476E-01 4.2544E-03 2.1588E-01 2.5700E-02
2.3128E-01 2.0618E-03 2.5972E-01 1.0527E-02 2.8045E-01 2.9621E-01
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4.1094E-01 1.1108E-01 4.5152E-01 2.9185E-02 4.6483E-01 1.1979E-02
4.9670E-01 2.1780E-03 5.2981E-01 9.5106E-02 5.7100E-01 5.4668E-02
5.9437E-01 5.5902E-03 6.1152E-01 1.4157E-02 6.4445E-01 1.5464E-03
6.7051E-01 5.3506E-02 6.9121E-01 1.3576E-02 7.1169E-01 5.4087E-01
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7.1240E-01 2.1780E-03 7.3667E-01 3.6736E-03 7.5227E-01 1.2052E-01
7.7882E-01 3.0274E-02 8.1031E-01 5.7136E-01 8.3056E-01 9.6558E-02
8.7564E-01 7.1874E-03 9.5094E-01 2.6935E-02 1.1203E+00 2.3740E-03
1.1468E+00 1.9675E-03 1.2414E+00 8.2764E-03 1.2821E+00 1.7860E-03
1.4007E+00 4.9804E-03 1.4271E+00 4.8424E-03 4.1661E-01 6.2856E-03
HO-166          26.80 H     67.
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1.9183E-01 5.2100E-02 3.0400E-03 3.9436E-01 1.1500E-01 9.5000E-03
1.7737E+00 6.5110E-01 4.8000E-01 1.8543E+00 6.9380E-01 5.1000E-01
2.3070E-01 7.7626E-02 4.4880E-04
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5.5000E-03 2.5715E-01 2.3104E-02 1.0602E-01 3.9700E-02 5.8311E-03
7.0838E-02 2.4490E-01 7.8382E-02 5.9334E-02 8.0140E-02 1.6244E-02
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6.9500E-03 7.6810E-02 4.8221E-02 2.8619E-02 4.9128E-02 5.0833E-02
5.5700E-02 2.0737E-02 8.0589E-02 6.2000E-02 1.3794E+00 9.3000E-03
1.5819E+00 1.8300E-03 1.6624E+00 1.2100E-03 1.1822E+00 7.9280E-04
ER-169           9.40 D     68.
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  3   1   3
3.4180E-01 9.7900E-02 4.5000E-01 3.5020E-01 1.0060E-01 5.5000E-01
2.3200E-01 7.3800E-02 4.8000E-05
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6.0942E-03 4.4865E-01
  2
8.4010E-03 1.5600E-03 1.1054E-01 1.4300E-05
ER-171           7.52 H     68.
  0
  7
2.0543E-01 5.6000E-02 3.3300E-03 4.9184E-01 1.4760E-01 5.0000E-03
5.7738E-01 1.7740E-01 2.1800E-02 8.1452E-01 2.6450E-01 1.8800E-03
1.0655E+00 3.6220E-01 9.4000E-01 1.4854E+00 5.3470E-01 2.3000E-02
5.6860E-01 1.8197E-01 1.7830E-03
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2.2693E-03 6.2289E-02 2.7182E-03 9.0609E-01 5.6700E-03 4.5514E-01
1.0078E-02 1.8387E-02 2.6210E-02 2.4240E-03 4.0900E-02 2.5090E-02
5.2231E-02 3.9155E-01 5.7266E-02 1.6859E-02 6.4627E-02 5.6966E-02
1.0151E-01 6.3550E-02 1.0654E-01 1.7779E-02 1.0931E-01 1.4227E-02
1.1115E-01 4.1410E-03 1.1390E-01 5.3326E-02 1.1435E-01 4.3010E-03
1.1618E-01 1.2052E-03 1.2171E-01 1.2922E-02 1.2355E-01 3.6036E-03
2.3651E-01 4.8552E-03 2.4890E-01 9.8532E-03 2.9818E-01 1.4426E-03
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7.1800E-03 1.4373E-01 4.9773E-02 1.3085E-01 5.0742E-02 2.3160E-01
5.7500E-02 9.4963E-02 1.1162E-01 2.0500E-01 1.1666E-01 2.3000E-02
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1.2402E-01 9.1000E-02 2.1060E-01 6.4200E-03 2.3714E-01 3.0200E-03
2.7743E-01 5.8000E-03 2.9590E-01 2.8900E-01 3.0829E-01 6.4400E-01
3.7196E-01 2.5700E-03 6.7070E-01 2.5200E-03 6.7610E-01 2.8500E-03
7.8410E-01 2.4000E-03 7.9660E-01 6.4000E-03 9.0770E-01 6.3500E-03
5.3518E-01 1.0894E-02
TA-182        114.74 D     73.
  0
  8
2.5808E-01 7.1600E-02 2.8900E-01 3.0109E-01 8.4800E-02 1.2800E-03
3.2380E-01 9.1900E-02 2.4000E-02 3.6842E-01 1.0600E-01 6.9600E-03
4.3747E-01 1.2860E-01 2.1000E-01 4.8018E-01 1.4290E-01 2.3000E-02
5.2215E-01 1.5720E-01 4.0800E-01 5.8990E-01 1.8070E-01 3.2000E-02
  0
 36
6.5300E-03 5.8865E-01 1.5155E-02 1.6313E-01 1.9637E-02 1.0259E-02
2.8917E-02 3.1419E-03 3.0579E-02 1.2565E-01 3.0614E-02 1.3818E-03
4.4144E-02 4.8843E-02 4.5700E-02 1.6271E-02 5.3621E-02 6.4960E-02
5.5649E-02 6.6913E-02 6.2901E-02 1.4840E-02 6.4929E-02 1.5246E-02
6.5126E-02 4.4800E-03 6.7154E-02 4.3620E-03 7.2580E-02 4.0781E-02
8.1860E-02 9.6342E-03 8.2903E-02 7.6055E-03 8.4085E-02 2.8738E-03
8.6858E-02 2.6767E-03 8.8004E-02 3.2502E-01 9.7284E-02 8.1606E-02
9.9509E-02 2.3919E-02 1.0157E-01 1.0320E-02 1.0987E-01 1.6562E-02
1.1085E-01 3.1358E-03 1.2882E-01 2.6248E-03 1.4033E-01 1.2556E-03
1.5258E-01 3.0391E-03 1.5979E-01 4.2952E-03 1.6729E-01 4.5864E-03
1.7657E-01 1.4205E-03 1.8625E-01 1.6744E-03 1.9454E-01 2.9338E-03
2.1722E-01 2.2277E-03 2.5197E-01 1.2740E-03 1.0518E+00 1.0430E-03
 37
8.4000E-03 2.5228E-01 3.1737E-02 8.0150E-03 4.2714E-02 2.4500E-03
5.7982E-02 1.0410E-01 5.9318E-02 1.8104E-01 6.5721E-02 2.8000E-02
6.7200E-02 7.6987E-02 6.7749E-02 4.2350E-01 8.4680E-02 2.7370E-02
1.0010E-01 1.4070E-01 1.1367E-01 1.9005E-02 1.1642E-01 4.4100E-03
1.5243E-01 7.1750E-02 1.5638E-01 2.7230E-02 1.7939E-01 3.1850E-02
1.9835E-01 1.5085E-02 2.2210E-01 7.5600E-02 2.2932E-01 3.6400E-02
2.6407E-01 3.6400E-02 9.2799E-01 6.2300E-03 9.5974E-01 3.5000E-03
1.0017E+00 2.0930E-02 1.0444E+00 2.3730E-03 1.1134E+00 4.4100E-03
1.1213E+00 3.5000E-01 1.1573E+00 6.3000E-03 1.1581E+00 3.5000E-03
1.1891E+00 1.6310E-01 1.2214E+00 2.7055E-01 1.2239E+00 2.1000E-03
1.2310E+00 1.1515E-01 1.2575E+00 1.4945E-02 1.2738E+00 6.5100E-03
1.2892E+00 1.3545E-02 1.3427E+00 2.5200E-03 1.3738E+00 2.1980E-03
9.4300E-01 3.9585E-03
W -181        120.95 D     74.
  0
  0
  0
  3
3.5020E-03 8.4882E-01 6.3500E-03 5.7346E-01 4.6200E-02 2.9952E-02
  6
6.2100E-03 9.8700E-03 8.1500E-03 2.2301E-01 5.6277E-02 1.8695E-01
```

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5.7532E-02 3.2627E-01 6.5200E-02 1.3754E-01 1.4769E-01 1.4015E-03
W -185         75.1 D     74.
  0
  2   1   2
4.3240E-01 1.2680E-01 9.9921E-01 3.0700E-01 9.6900E-02 7.9000E-04
  0
  0
  1
1.2536E-01 2.1014E-04
W -187         23.83 H     74.
  0
 11   1   9
4.3306E-01 1.2700E-01 4.8400E-03 4.4795E-01 1.3190E-01 6.7000E-03
4.9594E-01 1.4800E-01 2.0000E-03 5.3963E-01 1.6300E-01 4.3000E-02
6.2670E-01 1.9350E-01 5.8700E-01 6.8698E-01 2.1510E-01 5.5000E-02
6.9413E-01 2.1760E-01 3.5000E-02 8.0073E-01 2.5680E-01 1.0000E-03
1.1783E+00 4.0170E-01 2.3000E-02 1.3125E+00 4.5710E-01 2.5100E-01
1.9730E-01 5.5688E-02 2.1738E-04
  0
 19
3.8360E-04 8.6919E-02 4.1683E-03 3.5039E-02 6.7000E-03 1.9326E-01
1.6703E-02 1.0681E-03 2.3703E-02 4.2449E-03 3.1133E-02 1.3107E-03
3.3298E-02 1.3374E-03 4.2074E-02 2.5055E-03 4.7000E-02 1.1290E-02
5.9533E-02 1.6669E-02 6.2544E-02 1.7597E-01 6.9128E-02 4.9413E-03
1.2169E-01 2.9896E-02 1.3129E-01 6.8590E-03 1.3360E-01 2.1003E-03
1.3461E-01 3.9597E-03 4.0785E-01 4.2734E-03 4.6700E-01 1.0859E-03
5.4669E-01 1.7447E-03
 20
8.6500E-03 8.6825E-02 5.9718E-02 7.6022E-02 6.1140E-02 1.3175E-01
6.9300E-02 5.6307E-02 7.2060E-02 1.1907E-01 1.3422E-01 9.4608E-02
2.0629E-01 1.5230E-03 2.4618E-01 1.2737E-03 4.7953E-01 2.3352E-01
5.1176E-01 6.8948E-03 5.5155E-01 5.4365E-02 5.8909E-01 1.3014E-03
6.1837E-01 6.7102E-02 6.2552E-01 1.1630E-02 6.8581E-01 2.9167E-01
7.4521E-01 3.1843E-03 7.7287E-01 4.4027E-02 8.6455E-01 3.5905E-03
8.7943E-01 1.5137E-03 2.7622E-01 4.2302E-03
RE-187         4.7E10 Y     75.
  0
  1
2.6405E-03 6.6100E-04 1.0000E+00
  0
  0
  0
OS-185         93.6 D     76.
  0
  0
  0
 10
6.7000E-03 5.7194E-01 4.7000E-02 3.1172E-02 5.3682E-02 7.8120E-03
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5.8786E-02 5.0221E-03 6.8381E-02 1.4917E-03 9.1176E-02 6.1136E-03
1.1283E-01 1.3377E-03 1.6248E-01 1.5211E-03 5.7444E-01 7.5709E-03
6.3359E-01 1.5719E-03
 14
8.6500E-03 2.5696E-01 5.9718E-02 2.0989E-01 6.1140E-02 3.6377E-01
6.9300E-02 1.5546E-01 7.1313E-02 2.4862E-03 1.2536E-01 3.4566E-03
1.6285E-01 5.5579E-03 2.3416E-01 4.1223E-03 5.9207E-01 1.3153E-02
6.4612E-01 8.0200E-01 7.1742E-01 4.0822E-02 8.7481E-01 6.5443E-02
8.8027E-01 4.9483E-02 9.1003E-01 5.5779E-04
OS-191          15.4 D      76.
  0
  1
1.3875E-01 3.6700E-02 1.0000E+00
  0
 12
6.2870E-03 1.6656E-03 7.0600E-03 8.7471E-01 2.8431E-02 7.1100E-01
3.3632E-02 3.1054E-03 3.8676E-02 2.8900E-01 4.3876E-02 1.0570E-03
4.9600E-02 2.1913E-02 5.3289E-02 5.7498E-01 6.8979E-02 1.0643E-03
1.1598E-01 1.2328E-01 1.2623E-01 2.9267E-02 1.2871E-01 9.0909E-03
  6
9.1800E-03 4.3083E-01 6.3287E-02 1.6014E-01 6.4896E-02 2.7563E-01
7.3600E-02 1.1896E-01 1.2940E-01 2.5900E-01 7.3201E-02 3.6985E-04
IR-192          74.02 D     77.
  0
  5   1   4
2.5595E-01 7.0800E-02 5.6500E-02 5.3608E-01 1.6120E-01 4.1400E-01
6.7242E-01 2.0890E-01 4.8300E-01 8.4453E-01 2.7590E-01 4.0000E-03
9.3000E-02 2.4933E-02 9.8700E-04
  0
 22
6.8800E-03 3.1078E-02 4.8300E-02 1.5940E-03 1.3192E-01 5.2268E-03
1.9283E-01 3.6489E-03 2.0275E-01 1.1801E-03 7.2400E-03 7.6020E-02
5.1000E-02 3.5049E-03 5.7951E-02 1.1921E-03 1.2247E-01 1.3005E-03
2.1756E-01 1.9237E-02 2.3006E-01 1.7896E-02 2.3811E-01 4.4658E-02
2.8208E-01 8.7916E-03 2.9266E-01 2.8667E-03 2.9458E-01 7.7163E-03
3.0263E-01 1.9470E-02 3.0516E-01 2.5108E-03 3.1321E-01 4.8386E-03
3.1579E-01 1.4831E-03 3.8968E-01 1.0236E-02 4.5419E-01 2.9458E-03
5.2602E-01 1.5092E-03
 26
8.9100E-03 1.4625E-02 6.1487E-02 1.1323E-02 6.3001E-02 1.9555E-02
7.1400E-02 8.3988E-03 2.0131E-01 4.6736E-03 2.0580E-01 3.2873E-02
2.8326E-01 2.6149E-03 3.7448E-01 7.2636E-03 4.8458E-01 3.1628E-02
4.8906E-01 3.9846E-03 4.2307E-01 7.9692E-04 9.4400E-03 4.0934E-02
6.5122E-02 2.6350E-02 6.6832E-02 4.5197E-02 7.5700E-02 1.9675E-02
1.3635E-01 1.8062E-03 2.9596E-01 2.9015E-01 3.0846E-01 2.9678E-01
3.1651E-01 8.2853E-01 4.1646E-01 6.6448E-03 4.6807E-01 4.8055E-01
5.8858E-01 4.5735E-02 6.0441E-01 8.2024E-02 6.1246E-01 5.3357E-02
8.8451E-01 3.0158E-03 8.7173E-01 9.8595E-04
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ENERGY.DAT

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HG-203         46.60 D     80.
 0
 1
2.1221E-01 5.7700E-02 1.0000E+00
 0
 6
7.7800E-03 1.0823E-01 5.5200E-02 5.5770E-03 1.9366E-01 1.6900E-01
2.6384E-01 4.3500E-02 2.7548E-01 1.0600E-02 2.7834E-01 3.4000E-03
 5
1.0300E-02 7.2156E-02 7.0832E-02 4.7450E-02 7.2871E-02 8.0424E-02
8.2600E-02 3.5549E-02 2.7919E-01 7.7300E-01
TH-230         7.7E4 Y     90.
 4
4.4760E+00 1.2000E-03 4.6210E+00 2.3400E-01 4.6875E+00 7.6300E-01
4.3678E+00 3.1000E-03
 0
 0
 4
9.0900E-03 8.4298E-02 4.8435E-02 1.6860E-01 6.2850E-02 4.5506E-02
6.6464E-02 1.6412E-02
 3
1.2300E-02 8.4298E-02 6.7672E-02 3.7300E-03 1.6809E-01 6.8917E-04
RA-226          1600 Y     88.
 3
4.6019E+00 5.5500E-02 4.7845E+00 9.4550E-01 4.3146E+00 7.7700E-05
 0
 0
 6
8.7100E-03 9.0466E-03 6.2700E-02 1.7725E-04 8.7807E-02 6.3304E-03
1.6816E-01 1.2005E-02 1.8173E-01 3.1947E-03 1.8511E-01 1.1119E-03
 6
1.1700E-02 8.0225E-03 8.1070E-02 1.8022E-03 8.3780E-02 2.9937E-03
9.4900E-02 1.3572E-03 1.8621E-01 3.2800E-02 3.0970E-01 6.6700E-05
RN-222        3.8235 D     86. (PO-218, PB-214, BI-214, PO-214)
 6
5.4897E+00 9.9920E-01 4.9860E+00 7.8500E-04
6.0025E+00 9.9979E-01 5.1810E+00 1.0998E-05
7.6871E+00 9.9989E-01 6.8924E+00 1.0560E-04
 36
1.8494E-01 5.0000E-02 2.5500E-02 4.9046E-01 1.4500E-01 8.3000E-03
6.7208E-01 2.0700E-01 4.8000E-01 7.2880E-01 2.2700E-01 4.2500E-01
1.0240E+00 3.3700E-01 6.3000E-02
5.4141E-01 1.6200E-01 4.1000E-03 5.5076E-01 1.6500E-01 2.1100E-03
5.7530E-01 1.7300E-01 1.1800E-03 7.6180E-01 2.3900E-01 1.1000E-03
7.6439E-01 2.4000E-01 2.0500E-03 7.8757E-01 2.4800E-01 1.0700E-02
8.2227E-01 2.6100E-01 2.8100E-02 9.7668E-01 3.1800E-01 5.6000E-03
1.0033E+00 3.2800E-01 1.4000E-03 1.0614E+00 3.5000E-01 3.3600E-03
1.0657E+00 3.5200E-01 5.6100E-02 1.0774E+00 3.5700E-01 8.9000E-03
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1.1222E+00 3.7400E-01 4.3000E-03 1.1514E+00 3.8500E-01 4.4300E-02
1.1815E+00 3.9700E-01 1.4400E-03 1.2527E+00 4.2500E-01 2.5000E-02
1.2592E+00 4.2700E-01 1.5000E-02 1.2754E+00 4.3400E-01 1.1900E-02
1.3797E+00 4.7500E-01 1.5900E-02 1.4226E+00 4.9200E-01 8.3400E-02
1.5055E+00 5.2500E-01 1.7700E-01 1.5270E+00 5.3400E-01 2.5600E-03
1.5404E+00 5.3900E-01 1.7900E-01 1.6088E+00 5.6700E-01 8.8000E-03
1.7266E+00 6.1500E-01 3.3800E-02 1.8545E+00 6.6800E-01 1.0100E-02
1.8923E+00 6.8400E-01 7.8600E-02 1.9952E+00 7.2600E-01 2.2000E-03
2.6607E+00 1.0070E+00 6.0000E-03 3.2700E+00 1.2690E+00 1.7200E-01
5.2600E-01 1.5859E-01 3.6160E-03
  0
 23
8.1500E-03 1.8650E-01 3.6839E-02 1.0679E-01 4.9227E-02 2.5093E-02
5.2288E-02 8.4456E-03 5.8200E-02 6.8273E-03 1.5146E-01 5.2889E-02
1.6826E-01 1.8792E-03 2.0469E-01 7.4676E-02 2.2559E-01 9.2143E-03
2.3798E-01 2.8991E-03 2.6140E-01 9.0792E-02 2.7883E-01 1.3357E-02
2.9121E-01 3.1564E-03 2.9427E-01 1.0509E-03 3.3553E-01 1.6000E-02
3.4792E-01 3.7582E-03 3.5098E-01 1.2503E-03
8.3300E-03 6.9107E-03 5.9700E-02 3.8159E-04 5.1621E-01 6.9421E-03
5.9237E-01 1.9484E-03 1.0272E+00 1.9237E-03 1.3227E+00 3.8537E-03
 76
5.1200E-01 7.6000E-04
1.0800E-02 1.3505E-01 5.3226E-02 1.1054E-02 7.4815E-02 6.2130E-02
7.7108E-02 1.0460E-01 8.7300E-02 4.6683E-02 2.4198E-01 7.4913E-02
2.5879E-01 5.5272E-03 2.7453E-01 3.2571E-03 2.9521E-01 1.9247E-01
3.5192E-01 3.7210E-01 4.6210E-01 1.6779E-03 4.8042E-01 3.3953E-03
4.8708E-01 4.4119E-03 5.3369E-01 1.9049E-03 5.8015E-01 3.6519E-03
7.8591E-01 1.0956E-02 8.3902E-01 5.8924E-03 2.8068E-01 3.2670E-03
1.1100E-02 5.2133E-03 7.6862E-02 3.6005E-03 7.9290E-02 6.0310E-03
8.9800E-02 2.7064E-03 2.7370E-01 1.7762E-03 3.8700E-01 3.6511E-03
3.8910E-01 4.1445E-03 4.0574E-01 1.6775E-03 4.2650E-01 1.0855E-03
4.5477E-01 3.1972E-03 4.6969E-01 1.3322E-03 4.7438E-01 1.1842E-03
6.0931E-01 4.6281E-01 6.6545E-01 1.5690E-02 7.0311E-01 4.7366E-03
7.1986E-01 4.0459E-03 7.5284E-01 1.3322E-03 7.6836E-01 5.0425E-02
7.8610E-01 3.1577E-03 8.0617E-01 1.2335E-02 8.2118E-01 1.5098E-03
9.0425E-01 1.0559E-03 9.3406E-01 3.2071E-02 9.6408E-01 3.8485E-03
1.0520E+00 3.1676E-03 1.0700E+00 2.8617E-03 1.1203E+00 1.5147E-01
1.1337E+00 2.5558E-03 1.1552E+00 1.6973E-02 1.2077E+00 4.6182E-03
1.2381E+00 5.9405E-02 1.2810E+00 1.4802E-02 1.3038E+00 1.2138E-03
1.3777E+00 4.1051E-02 1.3853E+00 7.7957E-03 1.4015E+00 1.3914E-02
1.4080E+00 2.4867E-02 1.5092E+00 2.2203E-02 1.5385E+00 4.1445E-03
1.5433E+00 3.5525E-03 1.5832E+00 7.2036E-03 1.5947E+00 2.6643E-03
1.5993E+00 3.3551E-03 1.6613E+00 1.1545E-02 1.6840E+00 2.3683E-03
1.7296E+00 2.9702E-02 1.7645E+00 1.5838E-01 1.8384E+00 3.8485E-03
1.8474E+00 2.0920E-02 1.8732E+00 2.2696E-03 1.8963E+00 1.7762E-03
2.1186E+00 1.1743E-02 2.2042E+00 4.9833E-02 2.2934E+00 3.2564E-03
2.4479E+00 1.5591E-02 1.1580E+00 3.5073E-02
7.9730E-01 1.0450E-04
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PB-210          22.26 Y     82.
  0
  2
1.6498E-02 4.1400E-03 8.0200E-01 6.3001E-02 1.6130E-02 1.9800E-01
  0
  3
8.1500E-03 3.3591E-01 3.0116E-02 5.7915E-01 4.2504E-02 1.8104E-01
  2
1.0800E-02 2.4324E-01 4.6503E-02 4.0500E-02
BI-210          5.013 D     83.
  0
  1
1.1614E+00 3.8900E-01 1.0000E+00
  0
  0
  0
PO-210        138.378 D     84.
  2
5.3045E+00 9.9999E-01 4.5240E+00 1.0700E-05
  0
  0
  0
  1
8.0310E-01 1.0590E-05
U -232             72 Y     92.
  4
5.1390E+00 2.8000E-03 5.2635E+00 3.1200E-01 5.3203E+00 6.8600E-01
4.9831E+00 3.3598E-05
  0
  0
  5
9.4800E-03 1.1091E-01 3.7308E-02 2.2933E-01 5.2598E-02 6.2563E-02
5.6451E-02 2.2933E-02 1.0861E-01 1.7366E-03
  3
1.3000E-02 1.2016E-01 5.7780E-02 2.0117E-03 1.4198E-01 7.2871E-04
TH-232       1.405E10 Y     90.
  3
3.8300E+00 2.0000E-03 3.9530E+00 2.3000E-01 4.0100E+00 7.7000E-01
  0
  0
  5
9.0900E-03 8.3904E-02 3.9763E-02 1.6675E-01 5.4178E-02 4.5080E-02
5.7792E-02 1.6192E-02 1.0576E-01 1.0580E-03
  3
1.2300E-02 8.3904E-02 5.9000E-02 1.9000E-03 1.2500E-01 4.2000E-04
RA-228           5.75 Y     88.
  0
  1
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9104816 39

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3.8930E-02 9.9000E-03 1.0000E+00
  0
  1
1.6680E-03 1.0000E+00
  1
6.6700E-03 6.2112E-07
AC-228          6.13 H     89.
  0
 32   1  29
1.2680E-01 3.3300E-02 1.9700E-03 1.9254E-01 5.1700E-02 2.9000E-03
2.3711E-01 6.4600E-02 1.6000E-03 2.4427E-01 6.6700E-02 2.1500E-03
3.7700E-01 1.0720E-01 2.1600E-03 3.9330E-01 1.1230E-01 3.7000E-03
4.0140E-01 1.1490E-01 1.5800E-03 4.1290E-01 1.1850E-01 1.5900E-02
4.4870E-01 1.3000E-01 2.4200E-02 4.5395E-01 1.3170E-01 1.5400E-02
4.9106E-01 1.4380E-01 4.9000E-02 4.9439E-01 1.4490E-01 7.8000E-03
4.9900E-01 1.4640E-01 1.3000E-02 5.9820E-01 1.7960E-01 2.6000E-03
6.0563E-01 1.8210E-01 8.0000E-02 6.8678E-01 2.1000E-01 2.2000E-03
7.9260E-01 2.4700E-01 1.4000E-03 9.1039E-01 2.9000E-01 8.2000E-03
9.6231E-01 3.0900E-01 1.9000E-03 9.6871E-01 3.1100E-01 3.3000E-02
9.8348E-01 3.1700E-01 7.0000E-02 1.0144E+00 3.2800E-01 6.6000E-02
1.0460E+00 3.4000E-01 2.4000E-03 1.1146E+00 3.6600E-01 3.4000E-02
1.1210E+00 3.6800E-01 4.6000E-03 1.1577E+00 3.8200E-01 2.1000E-03
1.1681E+00 3.8600E-01 3.2000E-01 1.1932E+00 3.9600E-01 1.5000E-03
1.6178E+00 5.3800E-01 1.1000E-03 1.7409E+00 6.1100E-01 1.2000E-01
2.0792E+00 7.4800E-01 8.0000E-02 2.8300E-01 7.8844E-02 1.0300E-03
  0
 25
9.4800E-03 3.6100E-01 1.9429E-02 7.4513E-03 3.7308E-02 5.7156E-01
4.4549E-02 1.3091E-03 5.2598E-02 1.5593E-01 5.6451E-02 5.7156E-02
6.9200E-02 1.7777E-03 7.4849E-02 4.8475E-02 7.8978E-02 4.0099E-02
9.4268E-02 9.6601E-03 9.8120E-02 3.5542E-03 9.9629E-02 3.0005E-03
1.0861E-01 7.1466E-02 1.2390E-01 1.9584E-02 1.2775E-01 7.2851E-03
1.6058E-01 1.3648E-03 1.6403E-01 9.6950E-03 1.6935E-01 1.9324E-03
1.7932E-01 3.0054E-03 2.2867E-01 2.6235E-03 2.3145E-01 1.1634E-03
3.5335E-01 1.4005E-03 6.8505E-01 1.4803E-03 8.0142E-01 2.5179E-03
8.5946E-01 1.3529E-03
 71
1.3000E-02 3.9108E-01 5.7780E-02 5.0137E-03 8.9953E-02 2.1326E-02
9.3350E-02 3.4846E-02 9.9450E-02 1.3019E-02 1.0500E-01 1.6121E-02
1.2908E-01 2.7700E-02 1.4610E-01 2.1052E-03 1.5420E-01 9.4180E-03
1.9120E-01 1.1634E-03 1.9970E-01 3.3240E-03 2.0440E-01 1.6343E-03
2.0928E-01 4.4320E-02 2.1000E-01 2.1606E-03 2.7023E-01 3.6010E-02
2.7900E-01 2.2160E-03 3.2170E-01 2.4099E-03 3.2764E-01 3.2132E-02
3.3236E-01 4.4320E-03 3.3832E-01 1.1357E-01 3.4110E-01 4.1550E-03
4.0951E-01 2.1329E-02 4.4030E-01 1.3850E-03 4.6300E-01 4.4320E-02
4.7820E-01 2.2991E-03 5.0360E-01 2.0498E-03 5.0960E-01 4.7090E-03
5.2300E-01 1.1634E-03 5.4630E-01 2.1052E-03 5.6230E-01 9.4180E-03
5.7070E-01 1.7728E-03 5.7210E-01 1.5512E-03 5.8320E-01 1.4404E-03
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6.2380E-01 1.1357E-03 7.0150E-01 1.8836E-03 7.0710E-01 1.4958E-03
7.2700E-01 7.7560E-03 7.5518E-01 1.0526E-02 7.7217E-01 1.5512E-02
7.8200E-01 5.2630E-03 7.9470E-01 4.6259E-02 8.3050E-01 5.9001E-03
8.3550E-01 1.7451E-02 8.4000E-01 9.4180E-03 9.0450E-01 8.3100E-03
9.1107E-01 2.7700E-01 9.4410E-01 1.0249E-03 9.4800E-01 1.1634E-03
9.5850E-01 3.0193E-03 9.6460E-01 5.2076E-02 9.6911E-01 1.6620E-01
9.8780E-01 1.8282E-03 1.0332E+00 2.1606E-03 1.0651E+00 1.4127E-03
1.0957E+00 1.2742E-03 1.1104E+00 3.3240E-03 1.1536E+00 1.5235E-03
1.2464E+00 5.4015E-03 1.2875E+00 1.1357E-03 1.4593E+00 9.9720E-03
1.4958E+00 9.9720E-03 1.5015E+00 5.5400E-03 1.5569E+00 1.9390E-03
1.5802E+00 6.9250E-03 1.5880E+00 3.5456E-02 1.6247E+00 3.0470E-03
1.6304E+00 1.8614E-02 1.6380E+00 5.2630E-03 1.6663E+00 1.9944E-03
1.8870E+00 1.0526E-03 9.4777E-01 4.1168E-02
TH-228      1.9132 Y     90.
 5
5.1750E+00 1.8000E-03 5.2120E+00 3.6000E-03 5.3405E+00 2.6700E-01
5.4233E+00 7.2700E-01 5.1387E+00 5.0044E-04
 0
 0
 4
9.0900E-03 9.5590E-02 6.5134E-02 1.9118E-01 7.9549E-02 5.1909E-02
8.3163E-02 1.8755E-02
 5
1.2300E-02 9.5590E-02 8.4371E-02 1.2100E-02 1.3161E-01 1.2400E-03
2.1598E-01 2.3900E-03 1.7254E-01 1.1484E-03
RA-224        3.62 D     88. (Includes daughters, RN-220, PO-216)
 7
5.4490E+00 4.9000E-02 5.6856E+00 9.5100E-01 5.0936E+00 1.7600E-04
6.2883E+00 9.9903E-01 5.7470E+00 9.7000E-04
6.7785E+00 9.9998E-01 5.9850E+00 1.8000E-05
 0
 0
 5
8.7100E-03 4.4717E-03 6.2700E-02 1.2387E-04 1.4258E-01 4.4240E-03
2.2293E-01 4.8980E-03 2.3650E-01 1.7420E-03
 8
1.1700E-02 3.9655E-03 8.1070E-02 1.2595E-03 8.3780E-02 2.0921E-03
9.4900E-02 9.4851E-04 2.4098E-01 3.9500E-02 4.6495E-01 1.8000E-04
5.4973E-01 9.5000E-04
8.0490E-01 1.8000E-05
PB-212       10.643 H     82.
 0
 3
1.5752E-01 4.1900E-02 5.2200E-02 3.3418E-01 9.4400E-02 8.5100E-01
5.7280E-01 1.7270E-01 9.9000E-02
 0
 11
8.1500E-03 2.1394E-01 2.4664E-02 3.4821E-02 5.8200E-02 1.1751E-02
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9.8802E-02 6.1450E-03 1.1119E-01 1.9218E-03 1.4810E-01 3.3082E-01
2.0956E-01 1.3422E-02 2.2224E-01 5.7146E-02 2.3463E-01 1.3483E-02
2.3769E-01 4.5092E-03 2.8370E-01 2.3234E-03
 8
1.0800E-02 1.5493E-01 7.4815E-02 1.0694E-01 7.7108E-02 1.8003E-01
8.7300E-02 8.0351E-02 1.1519E-01 6.0245E-03 2.3863E-01 4.4646E-01
3.0009E-01 3.4067E-02 1.7667E-01 5.1997E-04
BI-212       60.55 M     83. (Includes daughters, PO-212, TL-208) 7/22/87
RAP
 6
5.6071E+00 4.0242E-03 5.7681E+00 6.0003E-03 6.0508E+00 2.5223E-01
6.0901E+00 9.6292E-02 5.6127E+00 6.5073E-04
8.7849E+00 6.4070E-01
 15
4.4015E-01 1.2810E-01 1.1700E-02 5.6667E-01 1.7030E-01 4.3000E-03
6.2536E-01 1.9060E-01 3.4400E-02 7.3330E-01 2.2870E-01 2.6100E-02
1.5188E+00 5.3070E-01 8.0000E-02 2.2460E+00 8.3160E-01 4.8400E-01
4.4500E-01 1.2970E-01 4.8000E-04
8.1154E-01 2.5780E-01 7.9765E-04 8.6664E-01 2.7820E-01 5.8925E-04
1.0310E+00 3.4020E-01 1.0492E-02 1.0721E+00 3.5600E-01 2.0839E-03
1.2835E+00 4.3870E-01 8.3576E-02 1.5168E+00 5.3250E-01 8.1561E-02
1.7942E+00 6.4650E-01 1.7713E-01 7.1200E-01 2.2352E-01 7.3297E-04
 0
 24
7.7800E-03 1.1530E-01 2.4510E-02 1.9121E-01 3.6153E-02 5.9203E-02
5.5200E-02 3.8864E-05 2.0254E-01 1.1777E-03 8.3300E-03 5.7178E-04
5.9700E-02 3.7617E-05 6.3406E-01 1.2539E-03
7.9700E-03 1.4917E-02 5.6700E-02 8.2977E-04 1.2340E-01 5.8095E-04
1.4536E-01 4.6687E-04 1.6461E-01 9.7536E-04 1.8935E-01 1.0973E-02
2.6149E-01 1.8824E-03 2.7350E-01 5.8275E-04 4.2284E-01 6.7541E-03
4.9498E-01 1.1385E-03 4.9513E-01 4.6001E-03 5.0699E-01 3.7486E-04
5.6728E-01 1.2590E-03 5.7929E-01 4.1463E-04 7.7237E-01 1.0069E-03
2.5267E+00 5.7373E-04
 41
1.0300E-02 7.6864E-02 3.9857E-02 1.0225E-02 7.0832E-02 3.3066E-04
7.2871E-02 5.6045E-04 8.2600E-02 2.4773E-04 2.8807E-01 3.1744E-03
3.2796E-01 1.2965E-03 4.5283E-01 3.4751E-03 3.7950E-01 9.4564E-04
1.1100E-02 4.3134E-04 7.6862E-02 3.5494E-04 7.9290E-02 5.9454E-04
8.9800E-02 2.6680E-04 7.2717E-01 1.1829E-01 7.8546E-01 1.9694E-02
8.9343E-01 6.5221E-03 9.5210E-01 3.1332E-03 1.0786E+00 9.5273E-03
1.5128E+00 5.5629E-03 1.6206E+00 2.7495E-02 1.6795E+00 1.2149E-03
1.8060E+00 1.9822E-03 1.0740E+00 2.8134E-04
1.0600E-02 1.0366E-02 7.2804E-02 7.2977E-03 7.4969E-02 1.2328E-02
8.4900E-02 5.4754E-03 2.1140E-01 6.0959E-04 2.3336E-01 1.1116E-03
2.5261E-01 2.8678E-03 2.7735E-01 2.4384E-02 5.1084E-01 7.7454E-02
5.8314E-01 3.0264E-01 7.2204E-01 7.2791E-04 7.6313E-01 5.8807E-03
8.6037E-01 4.4751E-02 9.2760E-01 4.4823E-04 9.8270E-01 7.0642E-04
1.0939E+00 1.3268E-03 2.6147E+00 3.5858E-01 8.4036E-01 1.2837E-03
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U -234       2.445E5 Y     92.
  4
4.6047E+00 2.4000E-03 4.7237E+00 2.7400E-01 4.7758E+00 7.2400E-01
4.2162E+00 7.3000E-07
  0
  0
  5
9.4800E-03 9.6954E-02 3.2728E-02 2.0060E-01 4.8018E-02 5.4634E-02
5.1870E-02 2.0178E-02 1.0043E-01 1.3880E-03
  3
1.3000E-02 1.0503E-01 5.3200E-02 1.1800E-03 1.2143E-01 4.0055E-04
U -236      2.3415E7 Y     92.
  3
4.3320E+00 2.6000E-03 4.4450E+00 2.6000E-01 4.4940E+00 7.4000E-01
  0
  0
  4
9.4800E-03 9.2116E-02 2.8897E-02 1.9032E-01 4.4187E-02 6.8900E-02
9.2278E-02 1.5886E-03
  2
1.3000E-02 9.9792E-02 6.8212E-02 1.1100E-03
U -235       7.038E8 Y     92.
 14
4.1500E+00 9.0000E-03 4.2170E+00 5.7000E-02 4.2190E+00 9.0000E-03
4.2710E+00 4.0000E-03 4.3250E+00 4.6000E-02 4.3440E+00 1.5000E-02
4.3640E+00 1.1000E-01 4.3700E+00 6.0000E-02 4.3960E+00 5.5000E-01
4.4140E+00 2.1000E-02 4.4350E+00 7.0000E-03 4.5020E+00 1.7000E-02
4.5560E+00 4.2000E-02 4.5980E+00 5.0000E-02
  0
  0
 38
9.4800E-03 2.8535E-01 1.1078E-02 1.7600E-01 1.4408E-02 6.8000E-01
2.0928E-02 1.2000E-02 2.1488E-02 1.9557E-01 2.6368E-02 6.5600E-02
3.0828E-02 4.0400E-02 3.3628E-02 1.7376E-02 3.4109E-02 1.7220E-02
3.6218E-02 3.8400E-03 3.6778E-02 6.6780E-02 4.1289E-02 1.9760E-03
4.6118E-02 1.1040E-02 4.8918E-02 4.4640E-03 4.9971E-02 4.0800E-03
5.2228E-02 4.1470E-02 5.2770E-02 1.6320E-03 5.3699E-02 5.6870E-03
6.7518E-02 1.1330E-02 6.9200E-02 2.2748E-03 7.1370E-02 4.1910E-03
7.3049E-02 6.0000E-03 7.4064E-02 4.9572E-02 7.5618E-02 8.6860E-03
8.8668E-02 1.0695E-03 9.0908E-02 3.2594E-03 9.2469E-02 1.1000E-02
9.5660E-02 3.3276E-03 9.9528E-02 5.2110E-03 1.1482E-01 1.9620E-03
1.2329E-01 3.6645E-03 1.3858E-01 1.1970E-03 1.4288E-01 1.1797E-03
1.6223E-01 2.1800E-03 1.6324E-01 1.0044E-02 1.7853E-01 3.2778E-03
1.8165E-01 3.8100E-03 1.9694E-01 1.3300E-03
 17
1.3000E-02 3.0913E-01 7.2700E-02 1.1000E-03 8.9953E-02 2.7289E-02
9.3350E-02 4.4590E-02 1.0500E-01 2.0629E-02 1.0914E-01 1.5000E-02
1.2000E-01 1.5000E-03 1.4077E-01 2.2000E-03 1.4376E-01 1.0500E-01
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1.6335E-01 4.7000E-02 1.8270E-01 4.0000E-03 1.8372E-01 5.4000E-01
1.9494E-01 5.9000E-03 2.0212E-01 1.0000E-02 2.0531E-01 4.7000E-02
2.2138E-01 1.0000E-03 1.9035E-01 9.1940E-03
TH-231          25.52 H      90.
 0
 9
1.4167E-01 3.7400E-02 2.7000E-02 1.7077E-01 4.5500E-02 3.2000E-03
2.0551E-01 5.5400E-02 1.5000E-01 2.1483E-01 5.8100E-02 1.2500E-02
2.8674E-01 7.9300E-02 9.0000E-02 2.8761E-01 7.9600E-02 4.1000E-01
3.0479E-01 8.4800E-02 3.5000E-01 3.1132E-01 8.6800E-02 4.1000E-03
1.2210E-01 3.3364E-02 1.1527E-03
 0
 33
3.8331E-03 4.9500E-03 4.5354E-03 4.8645E-01 4.8831E-03 7.5240E-03
9.6800E-03 6.0290E-01 1.1833E-02 4.5312E-01 1.2703E-02 1.9741E-01
2.0273E-02 1.6703E-01 2.2975E-02 1.7325E-03 2.3079E-02 5.0193E-03
3.3339E-02 1.1405E-03 3.7465E-02 5.4648E-01 4.2755E-02 5.9202E-03
4.7395E-02 3.0698E-03 5.0519E-02 5.9845E-03 5.3203E-02 1.5064E-01
5.7183E-02 5.5598E-02 5.8493E-02 2.0493E-03 6.0135E-02 7.9299E-02
6.1005E-02 2.3681E-02 6.3105E-02 1.4543E-01 6.3133E-02 1.1568E-03
6.8845E-02 1.1353E-03 7.0800E-02 2.7932E-04 7.5873E-02 2.0265E-02
7.6743E-02 5.7420E-03 7.8175E-02 5.4292E-03 7.8843E-02 3.6679E-02
7.9853E-02 7.9299E-03 8.0723E-02 2.1028E-03 8.2823E-02 8.3655E-03
9.3913E-02 1.8889E-03 1.1458E-01 1.1429E-03 1.4202E-01 1.2859E-03
 16
1.3300E-02 7.0775E-01 1.7200E-02 1.8810E-03 2.5640E-02 1.4652E-01
5.8570E-02 4.7520E-03 7.2780E-02 2.4849E-03 8.1240E-02 8.8110E-03
8.2110E-02 3.9600E-03 8.4210E-02 6.4350E-02 8.9950E-02 9.3060E-03
9.2287E-02 3.5072E-03 9.5868E-02 5.7120E-03 9.9280E-02 1.1880E-03
1.0227E-01 4.0590E-03 1.0800E-01 2.6459E-03 1.6312E-01 1.5345E-03
1.1427E-01 5.6896E-03
PA-231         3.276E4 Y      91.
 15
4.6310E+00 1.0000E-01 4.6420E+00 1.0000E-03 4.6800E+00 1.5000E-02
4.7120E+00 1.0000E-02 4.7360E+00 8.4000E-02 4.8510E+00 1.4000E-02
4.9330E+00 3.0000E-02 4.9500E+00 2.2800E-01 4.9740E+00 4.0000E-03
4.9840E+00 1.4000E-02 5.0110E+00 2.5400E-01 5.0280E+00 2.0000E-01
5.0305E+00 2.5000E-02 5.0573E+00 1.1000E-01 4.7062E+00 6.9800E-04
 0
 0
 40
3.7600E-03 7.5500E-03 4.8600E-03 6.6800E-03 5.7000E-03 1.3680E-01
7.5200E-03 2.5110E-01 9.2800E-03 4.1515E-01 1.0110E-02 2.0240E-01
1.3898E-02 4.1664E-01 1.8360E-02 7.9566E-02 1.8598E-02 2.4100E-03
1.9698E-02 2.1400E-03 2.0538E-02 4.3560E-02 2.2358E-02 8.4537E-02
2.4320E-02 1.8000E-02 2.4948E-02 6.9276E-02 2.6530E-02 1.4019E-03
3.2900E-02 1.5045E-02 3.3198E-02 2.5926E-02 3.7260E-02 6.6000E-03
3.7350E-02 4.2900E-02 3.9158E-02 5.7420E-03 4.3830E-02 3.2800E-02
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ENERGY.DAT

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4.7738E-02 3.6210E-03 5.1471E-02 1.3090E-03 5.2098E-02 2.5300E-03
5.2188E-02 1.1700E-02 5.4340E-02 7.9000E-03 5.5921E-02 4.2120E-03
5.7520E-02 3.9372E-03 5.8668E-02 8.9500E-03 6.2401E-02 3.2300E-03
6.7500E-02 5.4043E-04 6.9178E-02 2.9250E-03 7.7040E-02 7.8672E-03
8.1080E-02 2.3616E-03 8.2660E-02 3.0228E-03 9.1878E-02 2.9304E-03
1.9333E-01 1.5065E-02 2.2332E-01 6.5520E-03 2.8024E-01 2.8060E-03
3.1023E-01 1.2194E-03
 17
1.2700E-02 4.3210E-01 1.8900E-02 3.5000E-03 2.7360E-02 9.3000E-02
3.8200E-02 1.4900E-03 4.6370E-02 2.0800E-03 8.7670E-02 6.2033E-03
9.0884E-02 1.0186E-02 1.0200E-01 4.6873E-03 2.5580E-01 1.0100E-03
2.6022E-01 1.7300E-03 2.8367E-01 1.6000E-02 3.0008E-01 2.3000E-02
3.0267E-01 2.3000E-02 3.3007E-01 1.3000E-02 3.4081E-01 1.6500E-03
3.5716E-01 1.7300E-03 1.6552E-01 1.4489E-02
AC-227        21.773 Y      89.
  3
4.9381E+00 4.9680E-03 4.9505E+00 6.7620E-03 4.8368E+00 1.8754E-03
  3
1.9201E-02 4.8000E-03 1.0000E-01 3.4401E-02 8.7000E-03 3.5000E-01
4.3701E-02 1.1100E-02 5.4000E-01
  0
  6
8.0480E-03 5.0053E-03 4.0279E-03 2.2160E-02 4.1177E-03 4.1420E-01
9.4800E-03 1.0637E-02 1.0018E-02 6.8758E-02 1.9318E-02 7.3373E-03
  3
1.1535E-01 9.8234E-04 1.3000E-02 1.1523E-02 1.7357E-02 3.6223E-04
TH-227        18.718 D      90.
 20
5.5859E+00 1.7600E-03 5.6006E+00 1.7000E-03 5.6133E+00 2.1600E-03
5.6680E+00 2.0600E-02 5.6930E+00 1.5000E-02 5.7008E+00 3.6300E-02
5.7090E+00 8.2000E-02 5.7132E+00 4.8900E-02 5.7571E+00 2.0300E-01
5.7623E+00 2.2800E-03 5.7955E+00 3.1100E-03 5.8075E+00 1.2700E-02
5.8666E+00 2.4200E-02 5.9099E+00 1.7400E-03 5.9160E+00 7.8000E-03
5.9597E+00 3.0000E-02 5.9779E+00 2.3400E-01 6.0088E+00 2.9000E-02
6.0382E+00 2.4500E-01 5.5625E+00 1.9613E-03
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1.0633E-03 1.1480E-02 1.4780E-03 4.6000E-03 3.4780E-03 3.0800E-02
9.0900E-03 4.1800E-01 9.1780E-03 1.5228E-03 1.0363E-02 5.3220E-03
1.0673E-02 4.1800E-01 1.2393E-02 1.4480E-01 1.5478E-02 3.9800E-03
2.4463E-02 1.7687E-03 2.4778E-02 1.6920E-03 2.4863E-02 6.8600E-03
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4.3378E-02 7.5000E-03 4.3463E-02 1.1340E-03 4.5278E-02 1.0920E-02
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6.8878E-02 1.3000E-03 7.4763E-02 1.3958E-03 7.5963E-02 1.0728E-03
8.1163E-02 5.5760E-03 9.3863E-02 6.8170E-03 9.5578E-02 2.0720E-03
1.0108E-01 2.8220E-03 1.0828E-01 2.5160E-03 1.3098E-01 5.1520E-03
1.3208E-01 5.6695E-03 1.4618E-01 2.6950E-03 1.5228E-01 6.5520E-03
1.8218E-01 9.8400E-03 1.9268E-01 2.4360E-03 2.0048E-01 6.4260E-03
2.0868E-01 2.2059E-03 2.1676E-01 1.0684E-03 2.3028E-01 3.8180E-03
2.3696E-01 7.1820E-03 2.5138E-01 2.6019E-03 2.6686E-01 1.9200E-03
2.8516E-01 1.3041E-03
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8.3000E-03 1.4000E-03 1.2300E-02 4.1800E-01 2.0300E-02 2.0000E-03
2.9910E-02 1.0000E-03 4.3700E-02 2.3000E-03 4.9900E-02 2.0000E-03
5.0100E-02 8.4000E-02 6.2200E-02 2.4000E-03 7.9800E-02 2.0000E-02
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1.1720E-01 1.8000E-03 1.4120E-01 1.4000E-03 2.0430E-01 2.3000E-03
2.0500E-01 1.7000E-03 2.0600E-01 2.6000E-03 2.1060E-01 1.2600E-02
2.3490E-01 4.6000E-03 2.3600E-01 1.1500E-01 2.5010E-01 4.9000E-03
2.5250E-01 1.1000E-03 2.5470E-01 9.1000E-03 2.5620E-01 6.3000E-02
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2.8610E-01 1.6000E-02 2.9660E-01 4.2000E-03 2.9980E-01 1.8400E-02
3.0030E-01 2.8000E-03 3.0440E-01 1.3500E-02 3.1260E-01 4.3000E-03
3.1480E-01 4.2000E-03 3.2970E-01 2.9000E-02 3.3420E-01 1.1500E-02
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FR-223           21.8 M       87.
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3.4406E-01 9.7100E-02 1.0800E-03 7.7807E-01 2.4300E-01 1.3500E-02
8.1327E-01 2.5570E-01 1.5100E-03 9.1266E-01 2.9190E-01 1.0300E-01
1.0174E+00 3.3090E-01 1.7000E-01 1.0679E+00 3.4990E-01 1.2700E-01
1.0975E+00 3.6110E-01 5.7000E-01 6.7070E-01 2.0824E-01 3.8957E-03
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1.0633E-03 4.3667E-02 1.4780E-03 5.5408E-02 9.0900E-03 3.3681E-01
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2.6808E-02 1.3757E-02 3.0663E-02 4.1081E-03 3.0863E-02 1.6927E-01
4.2263E-02 1.8157E-02 4.5078E-02 1.0042E-03 4.5278E-02 4.1208E-02
4.8892E-02 1.3915E-02 4.9463E-02 5.0590E-02 5.6678E-02 4.9195E-03
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6.5900E-02 1.3361E-03 6.7492E-02 4.6026E-03 6.9478E-02 1.9019E-03
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7.9800E-02 7.6075E-02 8.5430E-02 1.4713E-02 8.8470E-02 2.4239E-02
1.0000E-01 1.1101E-02 1.0040E-01 9.5094E-03 1.3460E-01 5.0717E-03
1.7340E-01 1.2679E-03 1.8480E-01 2.8528E-03 2.0500E-01 1.0777E-02
2.3490E-01 2.8211E-02 2.8950E-01 2.2823E-03 3.1940E-01 5.1351E-03
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RA-223       11.434 D     88. (RN-219/PO-215/PB-211/BI-211/TL-207)
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5.2880E+00 1.6000E-03 5.3390E+00 1.3000E-03 5.3670E+00 1.3000E-03
5.3450E+00 2.2700E-02 5.5010E+00 1.0000E-02 5.5370E+00 9.1600E-02
5.6060E+00 2.4200E-01 5.7150E+00 5.2500E-01 5.7450E+00 9.5000E-02
5.8575E+00 3.2000E-03 5.8700E+00 8.5000E-03 5.3482E+00 2.9469E-03
6.4247E+00 7.5000E-02 6.5290E+00 1.2000E-03 6.5528E+00 1.2900E-01
6.8193E+00 7.9600E-01 6.2307E+00 8.8700E-04
7.3864E+00 9.9944E-01 6.9541E+00 5.6000E-04
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2.6357E-01 7.2800E-02 6.6000E-03 5.4107E-01 1.6190E-01 5.0000E-02
9.6816E-01 3.1560E-01 1.3000E-02 1.3730E+00 4.7330E-01 9.3000E-01
2.5300E-01 7.0858E-02 8.8000E-04
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3.3430E-03 5.1800E-01 5.5080E-03 1.2687E-01 8.3760E-03 1.7010E-03
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5.5805E-02 1.8079E-01 6.0230E-02 1.9739E-02 6.2700E-02 1.4625E-02
8.1116E-02 2.3664E-03 9.2808E-02 1.7568E-03 1.0427E-01 1.3804E-02
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1.3616E-01 3.2922E-02 1.3975E-01 5.5404E-03 1.4059E-01 3.7702E-03
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1.5415E-01 1.2157E-03 1.7106E-01 9.0440E-02 2.2547E-01 1.5404E-02
2.3988E-01 9.5004E-03 2.5141E-01 1.6592E-02 2.6498E-01 3.9168E-03
2.6836E-01 1.3450E-03 2.7327E-01 1.2650E-03 3.0582E-01 2.8052E-03
3.2023E-01 1.7390E-03 3.4663E-01 2.0532E-03
8.3300E-03 1.3793E-02 3.7485E-02 3.9672E-03 5.9700E-02 5.5693E-04
1.1365E-01 1.1101E-03 1.7813E-01 1.2296E-02 2.5429E-01 7.2292E-03
2.6708E-01 2.4910E-03 3.0871E-01 2.3010E-03 3.8487E-01 1.0075E-03
8.1500E-03 3.8422E-03 4.9033E-02 3.0870E-03 5.8200E-02 1.3707E-04
3.1432E-01 2.4108E-03 3.3655E-01 2.0110E-03
7.7800E-03 1.5707E-02 5.5200E-02 8.7813E-04 2.6554E-01 2.6610E-02
3.3572E-01 4.6243E-03 3.4737E-01 1.4230E-03
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1.1700E-02 2.4741E-01 8.0190E-02 2.0000E-03 8.1070E-02 1.4870E-01
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2.8818E-01 1.5100E-03 3.2387E-01 3.8800E-02 3.2838E-01 1.9500E-03
3.3828E-01 2.7300E-02 3.4290E-01 2.2000E-03 3.4980E-01 3.4000E-03
3.7168E-01 4.7200E-03 4.4503E-01 1.1800E-02 2.9205E-01 1.3533E-02
1.1100E-02 1.0405E-02 7.6862E-02 5.2549E-03 7.9290E-02 8.8023E-03
8.9800E-02 3.9501E-03 1.3059E-01 1.1600E-03 2.7123E-01 1.0600E-01
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4.3870E-01 3.4000E-04
1.0800E-02 2.7823E-03 7.4815E-02 1.2474E-03 7.7108E-02 2.1000E-03
8.7300E-02 9.3727E-04 4.0484E-01 2.9400E-02 4.2708E-01 1.3230E-02
7.0459E-01 3.6946E-03 7.6647E-01 5.3900E-03 8.3196E-01 2.8616E-02
5.1763E-01 4.7187E-03
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8.9783E-01 2.4000E-03 4.5907E-01 3.1440E-05
U -237         6.75 D     92.
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1.4847E-01 3.9200E-02 1.8500E-03 1.5079E-01 3.9900E-02 2.4800E-03
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2.5185E-01 6.8800E-02 4.3700E-01
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3.9182E-03 1.5259E-01 8.0868E-03 5.3357E-01 1.0100E-02 5.1515E-01
1.0778E-02 1.5876E-01 2.0622E-02 5.2381E-02 2.0996E-02 4.1013E-02
2.7482E-02 5.3185E-02 2.8583E-02 1.1933E-03 3.7110E-02 2.9257E-01
3.7700E-02 1.4454E-02 4.2403E-02 3.6146E-03 4.5932E-02 3.7047E-03
5.3814E-02 7.2463E-02 5.8036E-02 2.5515E-02 5.9107E-02 1.2049E-03
7.4300E-02 1.1780E-02 8.9327E-02 5.5046E-01 1.1572E-01 1.1594E-03
1.4218E-01 2.0850E-02 1.4886E-01 5.6388E-03 1.5889E-01 5.7525E-03
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2.0650E-01 1.0062E-02 2.4511E-01 1.8073E-03
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1.3810E-02 1.0301E-03 1.3900E-02 7.1139E-01 2.6345E-02 2.2774E-02
3.3205E-02 1.1340E-03 5.1010E-02 2.0790E-03 5.9537E-02 3.4020E-01
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2.6754E-01 7.2292E-03 3.3235E-01 1.2191E-02 3.7093E-01 1.1246E-03
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NP-237         2.14E6 Y    93.
 17
4.5811E+00 4.0000E-03 4.5987E+00 3.4000E-03 4.6395E+00 6.1800E-02
4.6592E+00 5.7000E-03 4.6641E+00 3.3200E-02 4.6945E+00 4.8000E-03
4.7083E+00 1.0000E-02 4.7124E+00 1.2600E-03 4.7661E+00 8.0000E-02
4.7711E+00 2.5000E-01 4.7881E+00 4.7000E-01 4.8034E+00 1.5600E-02
4.8174E+00 2.5000E-02 4.8629E+00 2.4000E-03 4.8710E+00 3.0000E-03
4.8731E+00 2.6000E-02 4.5873E+00 1.9400E-03
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2.1629E-02 2.6813E-03 2.4006E-02 1.1063E-01 3.0607E-02 2.4116E-02
3.6045E-02 5.4054E-01 3.8769E-02 1.1726E-02 4.1395E-02 6.3000E-03
4.2825E-02 1.2400E-02 4.9645E-02 4.5864E-03 5.1783E-02 1.4844E-01
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1.3300E-02 5.9193E-01 2.9373E-02 1.3986E-01 4.6530E-02 1.3986E-03
5.7150E-02 4.1580E-03 8.6503E-02 1.2600E-01 8.8040E-02 1.6002E-03
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1.6363E-01 1.0470E-02
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3.3495E-01 1.5807E-03
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1.3600E-02 4.8920E-01 7.5280E-02 1.2584E-02 8.6590E-02 1.8914E-02
9.4665E-02 1.0839E-01 9.8439E-02 1.7567E-01 1.0386E-01 7.4112E-03
1.1100E-01 8.1809E-02 2.7148E-01 3.0494E-03 3.0012E-01 6.6392E-02
3.1198E-01 3.8600E-01 3.4050E-01 4.5162E-02 3.7545E-01 6.1760E-03
3.9862E-01 1.2738E-02 4.1576E-01 1.6212E-02 1.2049E-01 2.0668E-03
U -233       1.592E5 Y     92.
 6
4.7290E+00 1.6100E-02 4.7540E+00 1.6300E-03 4.7835E+00 1.3200E-01
4.7960E+00 2.8000E-03 4.8242E+00 8.4400E-01 4.6736E+00 2.7970E-03
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3.7298E-02 2.0736E-02 4.9558E-02 1.9354E-03 5.1368E-02 1.0151E-03
7.6668E-02 2.0463E-03
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1.3000E-02 3.9226E-02 1.1451E-01 1.8182E-03
TH-229       7.34E3 Y     90.
 17
4.6880E+00 1.5000E-03 4.7610E+00 6.3000E-03 4.7978E+00 1.2700E-02
4.8090E+00 2.2000E-03 4.8146E+00 9.3000E-02 4.8330E+00 2.9000E-03
4.8370E+00 4.8000E-02 4.8453E+00 5.6200E-01 4.8610E+00 1.8000E-03
4.9010E+00 1.0200E-01 4.9290E+00 1.1000E-03 4.9675E+00 5.9700E-02
4.9785E+00 3.1700E-02 5.0330E+00 2.4000E-03 5.0500E+00 5.2000E-02
5.0520E+00 1.6000E-02 4.7655E+00 2.6700E-03
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3.2480E-03 9.1168E-02 6.1533E-03 4.8909E-01 9.0900E-03 8.1055E-01
1.2063E-02 7.5888E-02 1.2538E-02 2.4449E-01 2.0568E-02 1.7243E-01
2.0578E-02 8.6904E-02 2.0778E-02 4.3268E-02 2.3523E-02 1.0102E-01
2.6478E-02 2.5174E-02 2.8048E-02 1.9584E-02 3.3108E-02 8.8128E-02
3.7363E-02 4.2758E-02 3.7938E-02 3.4435E-02 3.9028E-02 2.0520E-02
4.4378E-02 2.0392E-03 4.8943E-02 1.0812E-02 4.9663E-02 4.6563E-02
5.0478E-02 2.5525E-02 5.1778E-02 1.0216E-02 5.2558E-02 4.1626E-02
5.5392E-02 3.6230E-03 5.5963E-02 1.4201E-01 6.3358E-02 3.6516E-03
6.4078E-02 1.2566E-02 6.5900E-02 1.4961E-02 6.7063E-02 2.7286E-02
6.7203E-02 1.1597E-01 6.7692E-02 4.5217E-03 6.8978E-02 6.2608E-03
7.0378E-02 3.8547E-02 7.3992E-02 1.3837E-02 8.0078E-02 3.2375E-03
8.1478E-02 7.0951E-03 8.1618E-02 2.7754E-02 8.5092E-02 2.5512E-03
8.5232E-02 9.9144E-03 8.7933E-02 1.7063E-02 8.9708E-02 9.3177E-02
1.0235E-01 4.0733E-03 1.0526E-01 1.6157E-02 1.0546E-01 8.0784E-03
1.0596E-01 1.4637E-03 1.0705E-01 5.1898E-02 1.1273E-01 3.6557E-03
1.1418E-01 2.0706E-03 1.1779E-01 1.6483E-02 1.1968E-01 3.8801E-03
1.1988E-01 2.6194E-03 1.2329E-01 1.3831E-03 1.2371E-01 3.8128E-03
1.2715E-01 1.1848E-03 1.3221E-01 3.9168E-03 1.3516E-01 4.7338E-03
1.3582E-01 1.4003E-03 1.3724E-01 7.7194E-03 1.3813E-01 1.2381E-03
1.4958E-01 1.5382E-03 1.5166E-01 2.5021E-03 1.5366E-01 1.1624E-03
1.6056E-01 2.5500E-03 1.6476E-01 1.0369E-03 1.7439E-01 1.7258E-02
1.8881E-01 4.1264E-03 1.9173E-01 9.6614E-03 1.9242E-01 1.4596E-03
2.0615E-01 3.1171E-03
 29
1.2300E-02 8.1055E-01 1.7360E-02 1.7340E-03 3.1300E-02 4.0800E-02
4.2760E-02 1.6320E-03 5.6600E-02 3.2640E-03 6.8180E-02 1.0200E-03
6.8900E-02 1.1220E-03 7.5200E-02 5.2020E-03 8.5430E-02 1.6474E-01
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1.0000E-01 1.2430E-01 1.0717E-01 8.3640E-03 1.2450E-01 1.2240E-02
1.2470E-01 6.1200E-03 1.3197E-01 3.2640E-03 1.3703E-01 1.6320E-02
1.4295E-01 4.2840E-03 1.4830E-01 1.3872E-02 1.5440E-01 6.6300E-03
1.5648E-01 1.1220E-02 1.7290E-01 2.2440E-03 1.7980E-01 5.1000E-03
1.8400E-01 2.3460E-03 1.9363E-01 4.5900E-02 2.1097E-01 3.2640E-02
2.1810E-01 1.4280E-03 1.3080E-01 7.1400E-04
RA-225        14.8 D     88.
 0
 2
3.2200E-01 9.0000E-02 7.2000E-01 3.6200E-01 1.0300E-01 2.8000E-01
 0
 3
9.2800E-03 1.5144E-01 2.0160E-02 3.0907E-01 3.4998E-02 1.0137E-01
 2
1.2700E-02 1.5763E-01 4.0000E-02 3.1000E-01
AC-225        10.0 D     89. (FR-221/AT-217/BI-213/PO-213/TL-209/PB-209)
7/22/87 RAP
 27
5.2860E+00 2.3000E-03 5.4440E+00 1.3000E-03 5.5530E+00 1.0000E-03
5.5790E+00 1.2000E-02 5.6080E+00 1.1000E-02 5.6362E+00 4.4000E-02
5.6810E+00 1.4000E-02 5.7226E+00 2.9000E-02 5.7310E+00 1.0000E-01
5.7910E+00 8.6000E-02 5.7920E+00 1.8100E-01 5.8290E+00 5.1600E-01
5.4504E+00 3.7800E-03
5.9380E+00 1.3000E-03 5.9650E+00 1.0000E-03 5.9790E+00 4.9000E-03
6.0750E+00 1.3000E-03 6.1255E+00 1.5100E-01 6.2418E+00 1.3500E-02
6.3398E+00 8.3400E-01 5.8332E+00 1.1500E-03
7.0660E+00 9.9934E-01 6.6223E+00 6.6000E-04
5.5490E+00 1.5984E-03 5.8700E+00 2.0002E-02
8.3770E+00 9.7836E-01 7.6120E+00 3.9136E-05
 6
3.1982E-01 9.0000E-02 1.0600E-02 9.7958E-01 3.1900E-01 3.2000E-01
1.1272E+00 3.7600E-01 7.0000E-03 1.4200E+00 4.9100E-01 6.4000E-01
1.8248E+00 6.5900E-01 0.0216E+00
6.4460E-01 1.9760E-01 1.0000E+00
 0
 71
7.2630E-03 2.1532E-02 7.3610E-03 6.7200E-02 8.9000E-03 2.2164E-01
1.7961E-02 1.3090E-01 1.9861E-02 6.4380E-02 2.1348E-02 2.3100E-02
2.3663E-02 1.7000E-03 3.1948E-02 4.6410E-02 3.3848E-02 2.2866E-02
4.4261E-02 4.8015E-02 4.5461E-02 9.4200E-03 4.8953E-02 1.0082E-03
5.1161E-02 1.5000E-03 5.3061E-02 2.9000E-03 5.4961E-02 4.8000E-03
5.5761E-02 1.2800E-02 5.6113E-02 9.6720E-03 5.6261E-02 6.0000E-03
5.8248E-02 1.1440E-02 5.9448E-02 3.2400E-03 6.1747E-02 4.0205E-03
6.4261E-02 1.5000E-02 6.4300E-02 9.6099E-04 6.7048E-02 1.0600E-03
6.8741E-02 9.6570E-03 6.8948E-02 1.7600E-03 6.9748E-02 3.3600E-03
7.0248E-02 2.2000E-03 7.3247E-02 1.2000E-03 7.6261E-02 4.3840E-03
7.7661E-02 1.5120E-03 7.8248E-02 3.9000E-03 8.0911E-02 1.5795E-02
8.1161E-02 1.4042E-03 8.1747E-02 1.3500E-03 8.2161E-02 1.8800E-03
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8.2728E-02 3.1320E-03 8.9761E-02 6.6080E-03 9.0248E-02 1.4240E-03
9.4553E-02 1.6800E-03 9.4898E-02 3.8155E-03 9.8397E-02 1.3520E-03
1.0375E-01 2.2512E-03 1.3861E-01 1.9530E-03
3.7700E-03 6.4000E-03 8.5200E-03 2.7697E-02 2.2470E-02 2.1600E-03
5.4270E-02 1.1000E-03 6.1200E-02 7.8764E-04 8.2007E-02 6.8800E-03
9.5183E-02 2.4000E-03 1.2187E-01 1.7500E-02 2.0011E-01 2.1750E-02
2.1328E-01 5.7500E-03 2.1656E-01 1.9625E-03
8.3300E-03 2.4264E-02 5.9700E-02 1.3268E-03 1.9976E-01 3.3951E-03
3.4731E-01 4.0831E-02 4.2348E-01 7.1874E-03 4.3627E-01 2.2625E-03
7.9700E-03 2.7097E-03 2.9207E-02 3.9528E-03 5.6700E-02 1.4442E-04
1.0135E-01 7.6464E-04 1.1336E-01 1.7949E-04 1.1632E-01 5.7456E-05
3.7706E-01 5.0976E-04 4.4920E-01 1.7258E-04 4.6121E-01 5.6808E-05
1.4789E+00 5.0544E-05
 51
1.2000E-02 2.1295E-01 6.2900E-02 5.5000E-03 7.3830E-02 3.2000E-03
8.2900E-02 1.5000E-03 8.3230E-02 1.0156E-02 8.6100E-02 1.6815E-02
8.7380E-02 2.9000E-03 9.4900E-02 1.6000E-03 9.7500E-02 7.6599E-03
9.9550E-02 6.5000E-03 9.9800E-02 1.7000E-02 1.0840E-01 2.8000E-03
1.1150E-01 3.2000E-03 1.2380E-01 1.9000E-03 1.3820E-01 2.0000E-03
1.4500E-01 1.3000E-03 1.5009E-01 7.1000E-03 1.5400E-01 1.9000E-03
1.5725E-01 3.1000E-03 1.8800E-01 4.6000E-03 1.9569E-01 1.4000E-03
2.5350E-01 1.0000E-03 4.5240E-01 1.1000E-03 1.6516E-01 9.2570E-03
1.1400E-02 2.2661E-02 7.8950E-02 7.7062E-03 8.1520E-02 1.2865E-02
9.2300E-02 5.8011E-03 9.9500E-02 1.6000E-03 2.1760E-01 1.2500E-01
4.1200E-01 1.0000E-03 2.1098E-01 3.3000E-03
5.9450E-01 4.0000E-04
3.2381E-01 1.3267E-03 1.1100E-02 1.8304E-02 7.6862E-02 1.2519E-02
7.9290E-02 2.0970E-02 8.9800E-02 9.4104E-03 2.9286E-01 7.3967E-03
4.4042E-01 2.7967E-01 6.5981E-01 1.4793E-03 8.0736E-01 4.4380E-03
1.1001E+00 4.7902E-03
7.7900E-01 3.8275E-05
1.0600E-02 1.8831E-03 7.2804E-02 1.2702E-03 7.4969E-02 2.1455E-03
8.4900E-02 9.5299E-04 1.1721E-01 1.6632E-02 4.6507E-01 2.0861E-02
1.5670E+00 2.1533E-02
U -238     4.468E9 Y    92.
 3
4.0390E+00 2.3000E-03 4.1470E+00 2.3000E-01 4.1960E+00 7.7000E-01
 0
 0
 4
9.4800E-03 8.1519E-02 2.9078E-02 1.6836E-01 4.4368E-02 6.0950E-02
8.9528E-02 1.4720E-03
 2
1.3000E-02 8.8313E-02 6.6376E-02 9.7000E-04
TH-234       24.10 D     90. (Includes daughter, PA-234M) 7/22/87  RAP
 0
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7.5770E-02 1.9500E-02 2.0000E-02 9.5780E-02 2.4800E-02 6.8000E-02
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9.6200E-02 2.4900E-02 1.8500E-01 1.8858E-01 5.0600E-02 7.2500E-01
1.2364E+00 4.1020E-01 7.3852E-03 1.4710E+00 5.0080E-01 6.1876E-03
2.2809E+00 8.2540E-01 9.8403E-01 7.4700E-01 2.0819E-01 1.8675E-03
 0
 20
8.3854E-03 4.3625E-02 9.6800E-03 8.1484E-02 1.4653E-02 1.6744E-02
2.4123E-02 1.5779E-02 4.1755E-02 3.4653E-03 4.2185E-02 1.1778E-02
5.7493E-02 1.2022E-03 5.7923E-02 2.8892E-03 6.1903E-02 1.0063E-03
7.1275E-02 1.1526E-01 7.1695E-02 3.0110E-03 8.7013E-02 2.7793E-02
9.0993E-02 1.0245E-02
9.6800E-03 5.0756E-04 5.2815E-02 1.1034E-03 9.8900E-03 3.4761E-03
2.1723E-02 4.7529E-03 3.7932E-02 1.7397E-03 7.2600E-02 8.7648E-05
6.9439E-01 3.9840E-03
 15
1.3300E-02 9.5655E-02 6.3290E-02 3.8116E-02 9.2380E-02 2.7248E-02
9.2800E-02 2.6884E-02 1.1281E-01 2.4180E-03 7.6765E-02 1.2841E-03
1.3300E-02 5.9583E-04 7.3920E-02 1.3525E-04 1.3600E-02 4.4241E-03
9.4665E-02 1.1543E-03 9.8439E-02 1.8709E-03 1.1100E-01 8.7123E-04
7.6641E-01 2.0626E-03 1.0010E+00 5.8788E-03 9.2618E-01 3.7320E-03
PA-234        6.70 H     91.
 0
 18
5.4774E-01 1.6300E-02 4.7000E-03 5.6395E-01 9.1000E-02 1.2000E-02
5.7709E-01 1.1270E-01 9.8000E-03 5.8339E-01 1.2190E-01 4.0000E-02
6.1739E-01 1.2860E-01 2.1000E-02 6.8069E-01 1.3630E-01 2.3000E-02
6.8869E-01 1.4100E-01 2.4000E-01 6.9264E-01 1.4120E-01 1.1000E-01
6.9439E-01 1.5080E-01 4.2000E-02 7.1069E-01 1.9810E-01 1.6000E-01
7.1124E-01 2.1760E-01 3.8000E-02 7.6763E-01 2.9660E-01 9.6000E-03
8.1039E-01 3.6430E-01 7.7000E-02 8.3339E-01 3.7290E-01 2.3000E-02
1.1830E+00 3.9000E-01 1.0000E-01 1.2378E+00 4.1070E-01 6.2000E-02
1.2444E+00 4.1330E-01 1.7000E-02 1.2592E+00 4.1890E-01 8.0000E-03
 0
114
9.7939E-03 3.1214E-03 9.8900E-03 1.0314E-03 1.2543E-02 1.3586E-03
1.5594E-02 4.0680E-03 1.8764E-02 6.7106E-03 2.1723E-02 1.4341E-03
2.3433E-02 1.8360E-03 2.4694E-02 1.8564E-03 2.8394E-02 1.5194E-03
2.8752E-02 1.3872E-03 3.6443E-02 1.2807E-03 3.7094E-02 1.2974E-03
3.7932E-02 1.0906E-03 3.9642E-02 1.9584E-03 4.1243E-02 0.0
4.5343E-02 2.4674E-02 5.2652E-02 3.1228E-03 5.5094E-02 2.0859E-02
5.6759E-02 1.1579E-03 5.7452E-02 3.4598E-03 5.7933E-02 3.5129E-02
5.8994E-02 4.0800E-03 6.1552E-02 6.7402E-03 6.5659E-02 2.4915E-03
7.0394E-02 6.5484E-02 7.2600E-02 1.1919E-02 7.4142E-02 9.7186E-03
7.7994E-02 1.7564E-02 7.8103E-02 4.8617E-01 7.8249E-02 3.6353E-03
8.0794E-02 9.9960E-03 8.1653E-02 1.0331E-02 8.4094E-02 1.2876E-02
8.5374E-02 1.7503E-03 8.7394E-02 1.0771E-02 9.4312E-02 1.3464E-01
9.7862E-02 2.8642E-03 9.8419E-02 5.0918E-02 1.0197E-01 1.0796E-03
1.0364E-01 3.5394E-02 1.0419E-01 4.1004E-03 1.0944E-01 9.5676E-03
1.1079E-01 5.4583E-02 1.1159E-01 1.0266E-01 1.1261E-01 3.3844E-03
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ENERGY.DAT

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1.2396E-01 3.6924E-03 1.2565E-01 3.1620E-03 1.2844E-01 3.1416E-03
1.2882E-01 1.1203E-03 1.2959E-01 1.3586E-02 1.3094E-01 9.7726E-02
1.3329E-01 1.3566E-03 1.3475E-01 4.4431E-03 1.3845E-01 2.0349E-03
1.3886E-01 1.6524E-03 1.4715E-01 2.7063E-02 1.4894E-01 4.0800E-03
1.5126E-01 1.0114E-02 1.5284E-01 1.5728E-03 1.5649E-01 1.1322E-02
1.5989E-01 1.5912E-03 1.6424E-01 1.2811E-02 1.6515E-01 1.3464E-03
1.7184E-01 3.4333E-03 1.7464E-01 1.9278E-03 1.7794E-01 2.5165E-03
1.7809E-01 1.7861E-02 1.7922E-01 4.8470E-03 1.8045E-01 3.1008E-03
1.8124E-01 5.3611E-03 1.8456E-01 1.1261E-03 1.8805E-01 1.1322E-03
1.9543E-01 1.8289E-03 1.9689E-01 1.2546E-03 1.9745E-01 1.9339E-03
2.0464E-01 1.8475E-02 2.0544E-01 2.0028E-02 2.1499E-01 2.2032E-03
2.2085E-01 4.7362E-03 2.2165E-01 4.8414E-03 2.2344E-01 2.6530E-03
2.2496E-01 1.7392E-03 2.2576E-01 1.7615E-03 2.5034E-01 2.2032E-03
2.5419E-01 1.4169E-02 2.5679E-01 5.0521E-03 2.7194E-01 5.1316E-03
2.8815E-01 1.7782E-03 3.4319E-01 1.8513E-03 3.4804E-01 2.7332E-03
3.5064E-01 1.0528E-03 3.9809E-01 1.4586E-03 4.1239E-01 1.1200E-03
4.5029E-01 1.5708E-03 4.5309E-01 4.5900E-03 4.5389E-01 1.6262E-02
4.9589E-01 1.0118E-03 1.3600E-02 1.1363E+00 4.3480E-02 1.2240E-03
6.3000E-02 3.2640E-02 6.9900E-02 2.3460E-03 7.9690E-02 1.2240E-03
9.4665E-02 1.5697E-01 9.8439E-02 2.5442E-01 9.9860E-02 4.8960E-02
1.0341E-01 1.2240E-03 1.1100E-01 1.1848E-01 1.2540E-01 1.0200E-02
1.3120E-01 2.0400E-01 1.3437E-01 2.1420E-03 1.3770E-01 1.5300E-03
187
1.3600E-02 1.1363E+00 4.3480E-02 1.2240E-03 6.3000E-02 3.2640E-02
6.9900E-02 2.3460E-03 7.9690E-02 1.2240E-03 9.4665E-02 1.5697E-01
9.8439E-02 2.5442E-01 9.9860E-02 4.8960E-02 1.0341E-01 1.2240E-03
1.1100E-01 1.1848E-01 1.2540E-01 1.0200E-02 1.3120E-01 2.0400E-01
1.3437E-01 2.1420E-03 1.3770E-01 1.5300E-03 1.4030E-01 9.1800E-03
1.4400E-01 3.5700E-03 1.5020E-01 2.0400E-03 1.5270E-01 6.8340E-02
1.5910E-01 7.1400E-03 1.7070E-01 5.1000E-03 1.7460E-01 2.0400E-03
1.8600E-01 2.0400E-02 1.9360E-01 6.1200E-03 1.9970E-01 4.8960E-03
2.0098E-01 1.1220E-02 2.0300E-01 1.2240E-02 2.1980E-01 2.0400E-03
2.2640E-01 6.0180E-02 2.2720E-01 5.6100E-02 2.4520E-01 9.1800E-03
2.4890E-01 2.8560E-02 2.6710E-01 1.7340E-03 2.7210E-01 1.0200E-02
2.7550E-01 2.6520E-03 2.8610E-01 1.4280E-03 2.8960E-01 1.1220E-03
2.9370E-01 3.9780E-02 3.0960E-01 1.0200E-03 3.1250E-01 3.0600E-03
3.1630E-01 1.2240E-03 3.2070E-01 1.2240E-03 3.2800E-01 3.0600E-03
3.3060E-01 6.1200E-03 3.5190E-01 6.1200E-03 3.6980E-01 2.9580E-02
3.7240E-01 1.3260E-02 4.0980E-01 4.0800E-03 4.1630E-01 1.0200E-03
4.2680E-01 6.1200E-03 4.4650E-01 1.2240E-03 4.5880E-01 1.5300E-02
4.6180E-01 1.6320E-03 4.6750E-01 4.0800E-03 4.7210E-01 2.4480E-03
4.7350E-01 1.8360E-03 4.7870E-01 3.0600E-03 4.8040E-01 4.0800E-03
4.8250E-01 3.0600E-03 4.9890E-01 1.0200E-03 5.0680E-01 1.6320E-02
5.1370E-01 1.3260E-02 5.2020E-01 6.1200E-03 5.2100E-01 9.1800E-03
5.2800E-01 6.1200E-03 5.3320E-01 2.0400E-03 5.3710E-01 1.6320E-03
5.5700E-01 2.6520E-03 5.6590E-01 1.4280E-02 5.6870E-01 3.0600E-02
5.6950E-01 1.0914E-01 5.7400E-01 2.0400E-02 5.8580E-01 1.5300E-03
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5.9660E-01 5.1000E-03 6.0280E-01 9.1800E-03 6.1150E-01 8.1600E-03
6.1620E-01 2.0400E-03 6.2360E-01 8.1600E-03 6.2750E-01 8.1600E-03
6.3060E-01 4.0800E-03 6.3450E-01 3.0600E-03 6.3970E-01 2.0400E-03
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6.8330E-01 2.4480E-03 6.8700E-01 2.8560E-03 6.9270E-01 1.5300E-02
6.9900E-01 4.6920E-02 7.0610E-01 3.1620E-02 7.1120E-01 2.0400E-03
7.1380E-01 1.6320E-03 7.3300E-01 8.7720E-02 7.3800E-01 1.0200E-02
7.4281E-01 2.4480E-02 7.4650E-01 1.3260E-03 7.5560E-01 1.4280E-02
7.6000E-01 1.6320E-03 7.6636E-01 3.0600E-03 7.6870E-01 5.7120E-03
7.7790E-01 2.0400E-03 7.8070E-01 1.1220E-02 7.8310E-01 5.1000E-03
7.8627E-01 1.4280E-02 7.9360E-01 1.5300E-02 7.9630E-01 3.8760E-02
8.0430E-01 4.0800E-03 8.0560E-01 3.3660E-02 8.1250E-01 5.1000E-03
8.1960E-01 2.6520E-02 8.2630E-01 4.0800E-02 8.3160E-01 5.6100E-02
8.4190E-01 1.4280E-03 8.4400E-01 5.1000E-03 8.5170E-01 1.2240E-03
8.7290E-01 1.2240E-03 8.7640E-01 4.0800E-02 8.8050E-01 1.0200E-02
8.8051E-01 1.2240E-01 8.8324E-01 1.2240E-01 8.9900E-01 4.1820E-02
9.0437E-01 5.1000E-03 9.2000E-01 4.0800E-03 9.2500E-01 2.9580E-02
9.2600E-01 1.1220E-01 9.2672E-01 9.1800E-02 9.4600E-01 1.2240E-01
9.4900E-01 8.1600E-02 9.6000E-01 1.0200E-03 9.6600E-01 6.1200E-03
9.7880E-01 1.4280E-02 9.8050E-01 3.0600E-02 9.8050E-01 2.0400E-02
9.8400E-01 1.9380E-02 1.0226E+00 6.1200E-03 1.0283E+00 8.1600E-03
1.0449E+00 5.1000E-03 1.0746E+00 2.5500E-03 1.0832E+00 7.6500E-03
1.1085E+00 3.0600E-03 1.1223E+00 5.1000E-03 1.1260E+00 8.1600E-03
1.1531E+00 3.0600E-03 1.1713E+00 2.4480E-03 1.2080E+00 3.0600E-03
1.2175E+00 3.7740E-03 1.2290E+00 3.0600E-03 1.2405E+00 5.1000E-03
1.2510E+00 3.0600E-03 1.2774E+00 2.0400E-03 1.2927E+00 6.1200E-03
1.3533E+00 1.7340E-02 1.3585E+00 1.2240E-03 1.3941E+00 3.0600E-02
1.3997E+00 2.3460E-03 1.4275E+00 2.0400E-03 1.4460E+00 4.0800E-03
1.4527E+00 1.0200E-02 1.4600E+00 3.0600E-03 1.4937E+00 2.0400E-03
1.5160E+00 4.0800E-03 1.5494E+00 1.0200E-03 1.5797E+00 1.7340E-03
1.5854E+00 2.5500E-03 1.5938E+00 6.1200E-03 1.6279E+00 1.5300E-03
1.6380E+00 4.0800E-03 1.6560E+00 1.5300E-03 1.6685E+00 1.2240E-02
1.6862E+00 5.1000E-03 1.6946E+00 1.2240E-02 1.6998E+00 1.5300E-03
1.7376E+00 1.0200E-03 1.7417E+00 1.0200E-03 1.7560E+00 2.5500E-03
1.7723E+00 1.0200E-03 1.7973E+00 3.0600E-03 1.8901E+00 1.9380E-03
1.8971E+00 1.5300E-03 1.9050E+00 2.8560E-03 1.9260E+00 5.1000E-03
9.5559E-01 1.0099E-02
PU-236          2.851 Y     94.
  4
5.6140E+00 1.8000E-03 5.7219E+00 3.1800E-01 5.7701E+00 6.8100E-01
5.3411E+00 2.5700E-05
  0
  0
  3
9.8900E-03 1.0246E-01 2.5893E-02 2.3287E-01 4.2102E-02 8.5492E-02
  2
```

```
1.3600E-02 1.3041E-01 6.0886E-02 8.2170E-04
PU-237          45.3 D     94.
  0
  0
  0
  9
3.9182E-03 1.6079E-02 1.0100E-02 3.8043E-01 1.0778E-02 1.1692E-01
2.0622E-02 5.5197E-03 2.7482E-02 3.9169E-02 3.7110E-02 2.8234E-02
5.3814E-02 6.9929E-03 5.8036E-02 2.4623E-03 7.4300E-02 9.2416E-03
  7
1.3900E-02 5.2536E-01 2.6345E-02 2.3999E-03 5.9537E-02 3.2830E-02
9.7080E-02 1.2779E-01 1.0107E-01 2.0645E-01 1.1400E-01 9.6595E-02
3.3205E-02 8.3516E-04
AM-242M          152 Y     95.
  2
5.2050E+00 4.2364E-03 5.2275E+00 5.4835E-04
  0
  0
  7
1.0500E-02 1.8342E-01 2.4824E-02 4.8269E-01 4.2505E-02 5.1255E-01
1.0100E-02 2.7866E-03 2.6943E-02 1.2198E-03 4.5473E-02 3.0464E-03
6.4273E-02 2.3686E-03
  5
1.4600E-02 2.9927E-01 4.8630E-02 1.4630E-06 1.3900E-02 3.8481E-03
4.9370E-02 1.9516E-03 1.0831E-01 1.6487E-03
AM-242         16.02 H     95.
  0
  2
6.1900E-01 1.8480E-01 4.2000E-01 6.6120E-01 1.9900E-01 4.1000E-01
  0
  7
1.0300E-02 8.4410E-02 2.1448E-02 7.7057E-02 3.8612E-02 2.8434E-02
7.6000E-02 2.5146E-03 1.0700E-02 1.1054E-01 1.7668E-02 3.0705E-01
3.5864E-02 1.1430E-01
  7
1.4300E-02 1.2662E-01 9.9550E-02 3.6628E-02 1.0376E-01 5.8888E-02
1.1700E-01 2.7700E-02 4.4545E-02 1.3840E-04 1.5000E-02 1.9651E-01
4.2200E-02 3.6388E-04
CM-242         163.2 D     96.
  3
6.0696E+00 2.5900E-01 6.1129E+00 7.4100E-01 5.9485E+00 3.9945E-04
  0
  0
  3
1.0300E-02 7.6956E-02 2.0983E-02 1.9239E-01 3.8147E-02 7.1280E-02
  2
1.4300E-02 1.1543E-01 5.9249E-02 3.8605E-04
PU-242       3.758E5 Y     94.
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  3
4.8563E+00 2.2400E-01 4.9006E+00 7.8000E-01 4.7525E+00 9.8300E-04
  0
  0
  3
9.8900E-03 7.1755E-02 2.3158E-02 1.6308E-01 3.9367E-02 5.9760E-02
  2
1.3600E-02 9.1325E-02 5.6454E-02 4.4280E-04
NP-238        2.117 D     93.
  0
  8
8.9250E-02 2.3000E-02 4.8000E-03 2.2197E-01 6.0000E-02 1.0800E-01
2.6336E-01 7.2200E-02 4.2400E-01 3.0644E-01 8.5100E-02 5.1000E-03
3.0893E-01 8.5800E-02 1.7000E-03 3.2912E-01 9.1900E-02 1.2100E-02
1.2478E+00 4.1240E-01 4.5000E-01 6.7470E-01 2.0440E-01 1.1700E-03
  0
 10
1.0300E-02 2.4926E-01 2.0983E-02 5.9511E-01 3.8147E-02 2.1960E-01
7.6000E-02 7.6327E-05 7.8783E-02 2.2410E-02 9.5947E-02 6.2623E-03
9.7043E-02 2.6151E-03 1.0032E-01 2.4086E-03 8.6263E-01 2.2753E-03
9.0672E-01 1.5411E-03
 17
1.4300E-02 3.7389E-01 4.4080E-02 1.0234E-03 9.9550E-02 1.1118E-03
1.0188E-01 2.0944E-03 1.0376E-01 1.7875E-03 1.1700E-01 8.4078E-04
5.6115E-01 1.0234E-03 8.8263E-01 7.5922E-03 9.1869E-01 5.1408E-03
9.2398E-01 2.4752E-02 9.3661E-01 3.3082E-03 9.4138E-01 4.5458E-03
9.6277E-01 6.0928E-03 9.8445E-01 2.3800E-01 1.0259E+00 8.2110E-02
1.0285E+00 1.7374E-01 5.0394E-01 5.4454E-03
PU-238        87.75 Y     94.
  4
5.3577E+00 1.0000E-03 5.4565E+00 2.8300E-01 5.4992E+00 7.1600E-01
5.1875E+00 3.1080E-05
  0
  0
  3
9.8900E-03 9.0948E-02 2.1723E-02 2.0670E-01 3.7932E-02 7.5660E-02
  2
1.3600E-02 1.1575E-01 5.5303E-02 4.7308E-04
CM-244        18.11 Y     96.
  3
5.7628E+00 2.3600E-01 5.8050E+00 7.6400E-01 5.6330E+00 2.5950E-04
  0
  0
  3
1.0300E-02 6.8710E-02 1.9727E-02 1.7178E-01 3.6891E-02 6.3488E-02
  2
1.4300E-02 1.0307E-01 5.6867E-02 2.8408E-04
PU-244        8.26E7 Y    94.
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  2
4.5460E+00 1.9736E-01 4.5890E+00 8.0499E-01
  0
  0
  3
9.8900E-03 6.2320E-02 2.2243E-02 1.4164E-01 3.8452E-02 5.1927E-02
  2
1.3600E-02 7.9317E-02 4.4000E-02 2.8265E-04
U -240          14.1 H      92. (Includes daughter, NP-240M)
  0
 16
4.3600E-01 1.2500E-01 1.0000E+00
4.7672E-01 1.3800E-01 2.3500E-03 5.5105E-01 1.6300E-01 3.4200E-03
5.7033E-01 1.6900E-01 2.2200E-02 5.8405E-01 1.7400E-01 2.0500E-03
6.2183E-01 1.8600E-01 5.7000E-03 6.7152E-01 2.0300E-01 3.7800E-03
6.9921E-01 2.1300E-01 2.1000E-03 1.0203E+00 3.2700E-01 6.2000E-03
1.1511E+00 3.7600E-01 1.1800E-02 1.1719E+00 3.8400E-01 1.4500E-02
1.2097E+00 3.9800E-01 3.5000E-02 1.2493E+00 4.1300E-01 2.6500E-02
1.5126E+00 5.1400E-01 3.1900E-01 2.0672E+00 7.3300E-01 5.2000E-01
6.9000E-01 2.1475E-01 3.3400E-03
  0
 15
1.0100E-02 3.1206E-01 2.1673E-02 7.4300E-01 3.8377E-02 2.4000E-01
1.4277E-02 1.1000E-03 1.0300E-02 2.2490E-01 1.9727E-02 5.3621E-01
3.6891E-02 1.9818E-01 7.5763E-02 2.0887E-02 7.6000E-02 8.8672E-05
9.2927E-02 5.8416E-03 9.7301E-02 2.2415E-03 1.6640E-01 1.6432E-03
4.3278E-01 2.1346E-03 4.7558E-01 1.0364E-03 7.3888E-01 1.2626E-03
 36
1.3900E-02 4.3094E-01 4.4100E-02 1.6500E-02
2.0000E-02 6.1111E-13 1.4300E-02 3.3735E-01 6.6500E-02 2.6970E-03
9.8860E-02 1.6981E-03 9.9550E-02 1.2916E-03 1.0376E-01 2.0765E-03
1.1700E-01 9.7676E-04 1.8950E-01 2.4973E-03 2.5146E-01 9.5894E-03
2.6335E-01 1.1687E-02 3.0298E-01 1.1188E-02 5.0720E-01 7.8913E-03
5.5460E-01 2.2375E-01 5.9740E-01 1.2486E-01 6.0610E-01 7.3919E-03
7.5862E-01 1.1887E-02 7.8959E-01 2.0977E-03 8.1343E-01 2.1077E-03
8.1788E-01 1.2386E-02 8.4111E-01 1.6582E-03 8.5746E-01 4.6948E-03
9.0046E-01 1.2986E-03 9.1009E-01 1.6981E-03 9.1598E-01 1.0389E-02
9.2859E-01 1.6981E-03 9.3804E-01 1.2886E-02 9.4237E-01 1.0988E-03
9.6164E-01 1.4384E-03 1.4453E+00 3.5960E-03 1.4882E+00 2.0977E-03
1.4969E+00 1.3086E-02 1.5396E+00 7.8913E-03 1.6333E+00 1.4384E-03
1.0200E+00 1.2628E-02
PU-240          6537 Y      94.
  3
5.1234E+00 2.6390E-01 5.1683E+00 7.3500E-01 5.0170E+00 7.3021E-04
  0
  0
  3
9.8900E-03 8.6526E-02 2.3485E-02 1.9665E-01 3.9694E-02 7.2000E-02
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  2
 1.3600E-02 1.1012E-01 5.4327E-02 5.2466E-04
 CM-245          8.5E3 Y     96.
  6
 5.2346E+00 3.2000E-03 5.3038E+00 4.9700E-02 5.3620E+00 9.3180E-01
 5.4887E+00 8.3000E-03 5.5292E+00 5.8000E-03 5.3189E+00 1.1900E-03
  0
  0
 12
 1.0300E-02 4.2409E-01 1.1182E-02 3.1360E-01 1.8903E-02 4.6784E-01
 3.6067E-02 1.7088E-01 5.2182E-02 1.5360E-01 7.6000E-02 9.3440E-03
 1.0990E-01 1.6307E-01 1.2707E-01 4.2650E-02 1.3144E-01 1.6307E-02
 1.5090E-01 6.0224E-02 1.6807E-01 1.5744E-02 1.7244E-01 5.9520E-03
  7
 1.4300E-02 6.3613E-01 4.2000E-02 1.1520E-03 9.9550E-02 1.3611E-01
 1.0376E-01 2.1882E-01 1.1700E-01 1.0293E-01 1.3300E-01 6.2720E-02
 1.7400E-01 6.4000E-02
 PU-241          14.4 Y      94.
  0
  1
 2.0811E-02 5.2300E-03 9.9998E-01
  0
  0
  0
 AM-241         432.2 Y      95.
  6
 5.3880E+00 1.4000E-02 5.4430E+00 1.2800E-01 5.4857E+00 8.5200E-01
 5.5120E+00 2.0000E-03 5.5443E+00 3.4000E-03 5.3082E+00 3.3926E-04
  0
  0
 16
 3.9182E-03 1.6080E-01 1.0100E-02 3.0921E-01 1.0778E-02 1.4840E-01
 2.0303E-02 1.6170E-02 2.0622E-02 5.5200E-02 2.0996E-02 9.0520E-02
 2.7482E-02 4.9714E-02 3.3133E-02 8.8690E-03 3.7007E-02 5.8850E-03
 3.7110E-02 3.0874E-01 3.7700E-02 3.1901E-02 4.9837E-02 3.2580E-03
 5.3814E-02 7.6467E-02 5.8036E-02 2.6925E-02 7.6543E-02 2.7120E-03
 9.3247E-02 1.0392E-03
  5
 1.3900E-02 4.2700E-01 2.6345E-02 2.4000E-02 3.3205E-02 1.0600E-03
 5.9537E-02 3.5900E-01 6.9231E-02 1.7932E-03
 CM-246         4.75E3 Y     96.
  2
 5.3430E+00 2.0995E-01 5.3860E+00 7.8979E-01
  0
  0
  3
 1.0300E-02 6.1220E-02 2.1448E-02 1.5305E-01 3.8612E-02 5.6475E-02
  2
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1.4300E-02 9.1830E-02 4.4545E-02 2.7593E-04
CM-247        1.56E7 Y     96.
 7
4.8180E+00 4.7000E-02 4.8680E+00 7.1000E-01 4.9410E+00 1.6000E-02
4.9830E+00 2.0000E-02 5.1450E+00 1.2000E-02 5.2100E+00 5.7000E-02
5.2650E+00 1.3800E-01
 0
 0
14
1.0300E-02 3.9516E-02 3.4803E-02 5.8320E-02 5.1967E-02 1.5957E-02
5.6341E-02 6.0750E-03 7.6000E-02 8.2489E-04 1.5328E-01 3.6400E-03
1.5618E-01 1.3226E-03 1.6558E-01 2.2000E-02 2.1118E-01 1.3940E-03
2.5200E-01 1.0400E-03 2.6430E-01 4.4000E-03 2.8078E-01 1.2888E-02
2.8147E-01 1.4000E-03 3.7950E-01 2.4480E-03
11
1.4300E-02 5.9275E-02 9.9550E-02 1.2016E-02 1.0376E-01 1.9318E-02
1.1700E-01 9.0866E-03 2.7510E-01 5.2000E-03 2.7800E-01 3.4000E-02
2.8740E-01 2.0000E-02 3.3300E-01 3.4000E-03 3.4600E-01 1.3000E-02
4.0260E-01 7.2000E-01 1.1611E-01 1.0600E-03
CM-243          28.5 Y     96.
11
5.6390E+00 1.3966E-03 5.6820E+00 1.9952E-03 5.6860E+00 1.5962E-02
5.7416E+00 1.1472E-01 5.7845E+00 7.3324E-01 5.8760E+00 5.9856E-03
5.9930E+00 5.5866E-02 6.0100E+00 9.9760E-03 6.0570E+00 4.6887E-02
6.0670E+00 1.4964E-02 5.7001E+00 3.4107E-03
 0
 0
32
1.9271E-03 6.7837E-01 1.0300E-02 4.0539E-01 1.2467E-02 6.9832E-02
2.1566E-02 8.4996E-02 2.6315E-02 9.4772E-02 3.4176E-02 2.2905E-01
3.4203E-02 1.7957E-02 3.8730E-02 2.8851E-02 4.3479E-02 3.3918E-02
4.4744E-02 9.9860E-02 5.1340E-02 6.3826E-02 5.1367E-02 5.1875E-03
5.5714E-02 2.4302E-02 5.5741E-02 1.9952E-03 6.1908E-02 2.7933E-02
6.6282E-02 1.0587E-02 7.6000E-02 9.8077E-03 8.3403E-02 1.4755E-03
8.7932E-02 8.9874E-02 1.0637E-01 2.2735E-01 1.3259E-01 1.7229E-03
1.5102E-01 1.0455E-03 1.5579E-01 1.7039E-01 1.8665E-01 1.8041E-02
2.0382E-01 4.3785E-03 2.0509E-01 4.5576E-02 2.0819E-01 1.6329E-03
2.2225E-01 1.1103E-02 2.2663E-01 4.1347E-03 2.5451E-01 3.4357E-02
2.7167E-01 8.3938E-03 2.7605E-01 3.1285E-03
14
1.4300E-02 6.0809E-01 4.4663E-02 1.1971E-03 5.7273E-02 1.3966E-03
6.7841E-02 1.3966E-03 9.9550E-02 1.4286E-01 1.0376E-01 2.2968E-01
1.0613E-01 2.5938E-03 1.1700E-01 1.0804E-01 2.0975E-01 3.2921E-02
2.2818E-01 1.0575E-01 2.5441E-01 1.0974E-03 2.7760E-01 1.3966E-01
2.8541E-01 7.2825E-03 1.6697E-01 3.3417E-03
PU-243         4.956 H     94.
 0
 7
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1.1628E-01 3.0300E-02 1.2300E-02 4.7270E-01 1.3690E-01 2.5000E-03
4.8560E-01 1.4100E-01 4.4000E-02 4.9800E-01 1.4510E-01 2.9000E-01
5.3979E-01 1.5870E-01 6.0000E-02 5.8200E-01 1.7270E-01 5.9000E-01
5.4000E-02 1.3880E-02 2.3900E-04
 0
 16
1.0194E-02 2.1735E-02 1.0500E-02 7.2835E-02 1.7994E-02 7.6659E-03
1.8394E-02 9.0321E-02 2.7875E-02 8.0275E-03 3.0194E-02 2.9900E-02
3.5675E-02 2.5806E-03 3.6075E-02 3.1423E-02 4.7875E-02 8.5100E-03
5.2384E-02 3.2200E-03 6.0194E-02 3.7490E-02 7.2594E-02 2.0700E-03
7.7800E-02 6.3038E-05 7.7875E-02 9.2690E-03 8.2384E-02 3.3350E-03
2.5670E-01 3.1519E-03
 11
1.4600E-02 1.1884E-01 4.1800E-02 7.5900E-03 6.7000E-02 2.3000E-03
8.4000E-02 2.3000E-01 1.0205E-01 9.1933E-04 1.0649E-01 1.4733E-03
1.0930E-01 1.6100E-03 1.2000E-01 6.9625E-04 3.5640E-01 1.3110E-03
3.8170E-01 5.5200E-03 1.3717E-01 1.7922E-03
AM-243       7.38E3 Y     95.
 6
5.1810E+00 1.1000E-02 5.2335E+00 1.0600E-01 5.2754E+00 8.7900E-01
5.3210E+00 1.2000E-03 5.3500E+00 1.6000E-03 5.0320E+00 1.5505E-04
 0
 0
 13
8.6732E-03 3.9930E-01 1.0100E-02 2.8277E-01 2.0673E-02 7.7616E-02
2.1107E-02 4.8233E-02 2.5377E-02 1.4520E-01 3.2973E-02 8.4564E-03
3.7377E-02 2.7350E-02 3.7811E-02 1.6078E-02 4.9677E-02 3.1712E-03
5.2243E-02 1.3860E-01 6.8947E-02 3.4188E-02 7.3169E-02 1.2078E-02
7.6073E-02 1.0626E-03
 7
1.3900E-02 3.9050E-01 4.3534E-02 5.5440E-02 7.4670E-02 6.6000E-01
8.6720E-02 3.3660E-03 1.1766E-01 5.5440E-03 1.4218E-01 1.2540E-03
4.8438E-02 1.6445E-03
NP-239         2.355 D     93.
 0
 6
2.0957E-01 5.6500E-02 1.9600E-02 3.2981E-01 9.2100E-02 3.5000E-01
3.9129E-01 1.1120E-01 7.1000E-02 4.3595E-01 1.2530E-01 5.2000E-01
7.1354E-01 2.1780E-01 4.0000E-02 2.1940E-01 5.9819E-02 3.4120E-04
 0
 40
1.9271E-03 6.2040E-01 2.5980E-03 1.1940E-03 1.0300E-02 4.1192E-01
1.2467E-02 7.3320E-02 2.1566E-02 6.4070E-02 2.6315E-02 9.5105E-02
3.4176E-02 2.4743E-01 3.4203E-02 1.0152E-03 3.8383E-02 3.4421E-03
3.8730E-02 2.1748E-02 4.3479E-02 3.4037E-02 4.4744E-02 6.5604E-02
5.1340E-02 6.8948E-02 5.5547E-02 1.1601E-03 5.5714E-02 2.6251E-02
5.9897E-02 4.4890E-03 6.1908E-02 1.8319E-02 6.6282E-02 6.9665E-03
7.6000E-02 1.0101E-02 8.3033E-02 4.9942E-02 8.3403E-02 4.1708E-03
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8.7932E-02 8.8534E-02 1.0020E-01 1.3621E-02 1.0057E-01 1.6156E-03
1.0457E-01 5.8205E-03 1.0457E-01 4.9942E-03 1.0637E-01 2.3039E-01
1.3259E-01 1.5717E-03 1.5102E-01 1.0159E-03 1.5579E-01 1.7202E-01
1.8665E-01 1.7772E-02 2.0329E-01 1.3908E-03 2.0382E-01 4.3132E-03
2.0509E-01 4.6186E-02 2.0819E-01 1.6085E-03 2.2225E-01 1.1252E-02
2.2663E-01 4.1900E-03 2.5451E-01 3.4686E-02 2.7167E-01 8.4741E-03
2.7605E-01 3.1584E-03
 18
1.4300E-02 6.1788E-01 4.9412E-02 1.0011E-03 5.7273E-02 1.5087E-03
6.1480E-02 9.5880E-03 9.9550E-02 1.4713E-01 1.0376E-01 2.3654E-01
1.0613E-01 2.2701E-01 1.1700E-01 1.1127E-01 1.8172E-01 1.1139E-03
2.0975E-01 3.2430E-02 2.2638E-01 3.3840E-03 2.2818E-01 1.0716E-01
2.5441E-01 1.0011E-03 2.7760E-01 1.4100E-01 2.8541E-01 7.7550E-03
3.1588E-01 1.5933E-02 3.3430E-01 2.0304E-02 1.5151E-01 3.9326E-03
PU-239        24131 Y     94.
  4
5.1046E+00 1.1500E-01 5.1429E+00 1.5100E-01 5.1554E+00 7.3300E-01
5.0075E+00 1.0940E-03
  0
  0
  9
7.3920E-03 1.9000E-01 8.3326E-03 1.7850E-03 9.8900E-03 3.4683E-02
1.6933E-02 2.8128E-02 2.4463E-02 1.0710E-03 2.9863E-02 4.7840E-02
3.3142E-02 9.9620E-03 4.6072E-02 1.3208E-02 5.0179E-02 4.9296E-03
  2
1.3600E-02 4.4141E-02 1.1291E-01 4.7583E-04
CM-248       3.39E5 Y     96.
  3
5.0351E+00 1.6541E-01 5.0786E+00 7.5135E-01 4.9311E+00 6.9722E-04
  0
  0
  3
1.0300E-02 4.8447E-02 2.1103E-02 1.2112E-01 3.8267E-02 4.4858E-02
  2
1.4300E-02 7.2670E-02 5.6242E-02 2.6238E-04
CF-252        2.639 Y     98.
  4
5.9766E+00 2.3258E-03 6.0757E+00 1.5215E-01 6.1183E+00 8.1597E-01
5.8202E+00 1.9963E-05
  0
  0
  4
1.0700E-02 4.0952E-02 1.8868E-02 1.1217E-01 3.7064E-02 4.1757E-02
7.6068E-02 1.5839E-03
  2
1.5000E-02 7.2804E-02 6.8180E-02 2.6844E-04
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DITTY Internal Dose Factors - 30-Aug-88 (RAP)
H 3     Class: D F1:   1.00000     08/17/88  17:40:28.8   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 1.2E-09 6.9E-10 1.2E-09 1.2E-09 1.2E-09 5.8E-10 1.2E-09 1.2E-09 1.2E-09 1.2E-09 1.2E-09
H 70 1.8E-09 1.0E-09 1.9E-09 1.9E-09 1.9E-09 8.9E-10 1.8E-09 1.8E-09 1.8E-09 1.8E-09 1.8E-09
C 14    Class: D F1:   1.00000     08/17/88  17:43:58.7   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 4.0E-08 2.3E-08 4.3E-08 4.3E-08 4.3E-08 2.1E-08 4.0E-08 4.0E-08 4.0E-08 4.1E-08 4.0E-08
H 70 4.1E-08 2.3E-08 4.3E-08 4.3E-08 4.3E-08 2.1E-08 4.0E-08 4.1E-08 4.1E-08 4.1E-08 4.1E-08
NA24    Class: D F1:   1.00000     08/17/88  17:47:32.0   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 1.9E-08 8.1E-08 2.3E-08 2.3E-08 2.5E-08 3.5E-08 2.7E-08 2.1E-08 2.5E-08 2.0E-08 1.9E-08
H 70 8.1E-08 1.9E-08 1.2E-08 1.2E-08 1.3E-08 1.9E-08 1.5E-08 1.0E-08 1.3E-08 1.1E-08 1.1E-08
P 32    Class: D F1:   0.80000     08/17/88  17:50:32.3   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 4.7E-08 8.0E-08 5.1E-08 1.8E-07 4.9E-07 5.6E-07 5.9E-07 4.8E-08 4.7E-08 4.8E-08 4.8E-08
H 70 1.3E-07 2.5E-08 2.1E-08 3.8E-08 8.6E-08 4.0E-07 4.2E-07 3.4E-08 3.4E-08 3.4E-08 3.4E-08
CR51    Class: Y F1:   0.10000     08/17/88  17:54:37.1   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 3.1E-10 1.2E-09 3.2E-09 7.6E-09 1.7E-08 5.5E-10 8.8E-10 4.8E-10 2.7E-09 5.3E-10 2.7E-10
H 70 3.5E-08 1.7E-09 1.6E-09 3.6E-09 7.9E-09 9.3E-10 1.2E-09 2.4E-10 1.3E-09 1.1E-09 7.4E-10
CO60    Class: Y F1:   0.05000     08/17/88  17:58:43.2   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 5.9E-08 1.0E-07 2.4E-07 3.9E-07 7.8E-07 5.7E-08 8.7E-08 7.9E-08 2.2E-07 7.7E-08 5.6E-08 1.6E-07
H 70 2.2E-05 1.8E-06 4.5E-07 6.1E-07 5.2E-07 8.6E-07 1.1E-06 1.1E-07 3.1E-07 1.1E-06 1.0E-06 2.2E-06
ZN65    Class: Y F1:   0.50000     08/17/88  18:03:24.9   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 2.1E-07 2.1E-07 2.7E-07 2.6E-07 3.3E-07 3.1E-07 3.1E-07 2.5E-07 2.3E-07 2.3E-07 2.2E-07
H 70 1.4E-06 2.4E-07 1.6E-07 1.6E-07 1.7E-07 2.2E-07 2.4E-07 1.3E-07 1.3E-07 2.1E-07 2.0E-07
SR89    Class: D F1:   0.30000     08/17/88  18:08:07.0   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 8.5E-09 5.3E-08 8.7E-08 4.8E-07 1.5E-06 3.4E-07 2.1E-07 8.7E-09 8.5E-09 8.6E-09 8.5E-09
H 70 1.1E-07 1.4E-08 1.9E-08 7.6E-08 2.2E-07 5.6E-07 3.5E-07 1.5E-08 1.4E-08 1.4E-08 1.4E-08
SR90    Class: D F1:   0.30000     08/17/88  18:12:49.3   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 1.5E-08 2.4E-08 4.0E-08 2.9E-07 1.3E-06 2.2E-05 1.0E-05 1.5E-08 1.5E-08 1.5E-08 1.5E-08
H 70 7.2E-08 1.5E-08 1.7E-08 5.3E-08 2.0E-07 3.7E-05 1.7E-05 2.6E-08 2.5E-08 2.5E-08 2.5E-08
Y 90    Class: Y F1:   0.00010     08/17/88  18:22:06.6   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 9.2E-13 7.6E-08 1.8E-07 9.2E-07 2.3E-06 2.8E-11 2.7E-11 9.2E-13 1.0E-12 9.1E-13 9.2E-13 2.7E-11
H 70 6.4E-07 2.9E-08 7.1E-08 3.6E-07 8.8E-07 1.1E-09 1.1E-09 3.7E-11 3.7E-11 3.6E-11 3.7E-11 1.1E-09
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9/30/88

DSFCT30.DAT

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ZR95    Class: W F1:   0.00200     08/17/88  18:26:18.4   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 1.7E-09 2.5E-08 7.8E-08 2.1E-07 5.5E-07 3.5E-08 1.5E-08 5.7E-09 5.7E-08 7.4E-09 5.7E-10
H 70 1.2E-06 7.2E-08 6.5E-08 1.3E-07 2.8E-07 1.5E-06 2.2E-07 2.0E-08 5.6E-08 6.3E-08 5.2E-08
NB95M   Class: Y F1:   0.01000     08/17/88  18:39:40.4   ChronicSv per 70 yr/Bq/yr for 70 yr
 13  1  3  4  5  6  7  8 11 12 13 14 16 19
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Kidneys Spleen
G 70 1.9E-10 1.5E-08 3.8E-08 1.8E-07 4.6E-07 3.0E-09 2.3E-09 5.7E-10 6.5E-09 7.3E-10 1.1E-10 1.3E-09 1.1E-09
H 70 2.0E-07 9.7E-09 1.6E-08 7.5E-08 1.9E-07 4.3E-09 3.8E-09 3.6E-10 3.3E-09 2.9E-09 2.4E-09 2.7E-09 4.7E-09
NB95    Class: Y F1:   0.01000     08/17/88  18:47:36.6   ChronicSv per 70 yr/Bq/yr for 70 yr
 13  1  3  4  5  6  7  8 11 12 13 14 16 19
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Kidneys Spleen
G 70 1.9E-09 2.0E-08 6.4E-08 1.3E-07 2.8E-07 2.1E-08 1.4E-08 5.7E-09 5.6E-08 7.5E-09 8.2E-10 9.7E-09 7.9E-09
H 70 5.5E-07 4.3E-08 3.5E-08 6.5E-08 1.3E-07 3.4E-08 3.0E-08 3.5E-09 2.9E-08 2.7E-08 2.4E-08 2.3E-08 4.2E-08
TC99    Class: W F1:   0.80000     08/17/88  18:52:17.3   ChronicSv per 70 yr/Bq/yr for 70 yr
 13  1  3  4  5  6  7  8 11 12 13 14 22 16
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid S Wall  Kidneys
G 70 4.4E-09 2.4E-07 6.7E-09 2.6E-08 7.6E-08 2.1E-09 4.2E-09 4.4E-09 4.4E-09 4.4E-09 5.1E-07 2.4E-07 9.8E-08
H 70 1.1E-06 1.5E-07 3.7E-09 1.3E-08 3.8E-08 1.4E-09 2.7E-09 2.8E-09 2.8E-09 2.8E-09 3.2E-07 1.5E-07 6.2E-08
I 129   Class: D F1:   1.00000     08/17/88  18:56:58.3   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 15
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Bladder
G 70 1.1E-08 1.2E-08 9.9E-09 9.7E-09 1.0E-08 8.7E-08 4.5E-08 8.4E-09 9.7E-09 2.2E-08 1.5E-04 2.7E-08
H 70 1.6E-08 4.6E-09 6.0E-09 6.0E-09 6.3E-09 5.3E-08 2.7E-08 5.1E-09 5.9E-09 1.3E-08 9.3E-05 1.7E-08
I 131   Class: D F1:   1.00000     08/17/88  19:01:24.2   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 15
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Bladder
G 70 8.4E-09 2.2E-08 5.0E-09 4.7E-09 5.3E-09 2.6E-07 3.0E-08 4.3E-09 4.9E-09 9.8E-09 3.1E-05 4.5E-08
H 70 4.3E-08 5.2E-09 3.0E-09 2.8E-09 3.1E-09 1.6E-07 1.8E-08 2.5E-09 2.9E-09 6.1E-09 1.8E-05 2.7E-08
I 132   Class: D F1:   1.00000     08/17/88  19:06:59.1   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 15
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Bladder
G 70 2.6E-09 4.6E-08 3.2E-09 3.2E-09 3.2E-09 1.0E-08 1.0E-08 2.5E-09 2.7E-09 2.7E-09 2.0E-07 1.5E-08
H 70 1.8E-08 6.9E-09 1.3E-09 1.2E-09 1.3E-09 4.7E-09 4.7E-09 1.1E-09 1.2E-09 1.4E-09 8.5E-08 6.5E-09
I 133   Class: D F1:   1.00000     08/17/88  19:10:01.4   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 15
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Bladder
G 70 4.6E-09 3.9E-08 4.7E-09 4.6E-09 5.1E-09 3.7E-08 2.8E-08 4.3E-09 4.6E-09 4.9E-09 5.7E-06 6.1E-08
H 70 5.5E-08 7.3E-09 2.4E-09 2.4E-09 2.6E-09 1.9E-08 1.5E-08 2.3E-09 2.4E-09 2.8E-09 2.9E-06 3.1E-08
RU103   Class: Y F1:   0.05000     08/17/88  19:16:01.2   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 5.3E-09 2.1E-08 5.8E-08 1.8E-07 4.6E-07 5.4E-09 1.1E-08 8.8E-09 3.9E-08 8.5E-09 4.5E-09
H 70 1.0E-06 3.3E-08 3.1E-08 8.7E-08 2.1E-07 1.5E-08 2.1E-08 4.9E-09 2.0E-08 2.1E-08 1.7E-08
PD103   Class: Y F1:   0.00500     08/17/88  19:27:49.7   ChronicSv per 70 yr/Bq/yr for 70 yr
 13  1  3  4  5  6  7  8 11 12 13 14 17 16
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver   Kidneys
G 70 8.9E-12 2.4E-09 1.1E-08 5.8E-08 1.6E-07 1.4E-10 4.7E-10 1.1E-11 2.9E-09 1.1E-10 3.1E-12 8.0E-10 1.5E-09
H 70 1.8E-07 2.0E-09 5.3E-09 2.6E-08 7.2E-08 3.1E-10 4.7E-10 7.2E-12 1.3E-09 5.9E-10 9.7E-12 1.4E-09 1.9E-09
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9/30/88

DSFCT30.DAT

DSFCT30.DAT

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RH103M  Class: Y F1:   0.05000    08/17/88  19:35:01.2  ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 3.7E-13 1.8E-09 1.2E-09 6.8E-10 1.1E-10 2.7E-13 7.4E-13 2.5E-13 3.0E-12 6.4E-13 2.5E-13
H 70 6.6E-10 7.3E-11 4.6E-11 2.7E-11 4.5E-12 1.7E-13 2.5E-13 1.0E-13 2.1E-13 3.9E-13 1.1E-13
RU106   Class: Y F1:   0.05000    08/17/88  19:37:22.6  ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 9.9E-08 1.8E-07 3.5E-07 1.7E-06 5.0E-06 5.0E-08 1.0E-07 1.1E-07 1.1E-07 1.0E-07 9.8E-08
H 70 6.7E-05 1.6E-07 2.0E-07 8.6E-07 2.5E-06 7.0E-08 1.2E-07 7.9E-08 8.7E-08 1.2E-07 1.1E-07
CS134   Class: D F1:   1.00000    08/17/88  19:42:08.8  ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 1.2E-06 1.2E-06 1.7E-06 1.5E-06 1.7E-06 9.1E-07 1.2E-06 1.5E-06 1.2E-06 1.2E-06 1.2E-06
H 70 5.4E-07 6.9E-07 1.0E-06 9.2E-07 1.0E-06 5.5E-07 7.2E-07 9.4E-07 7.3E-07 7.3E-07 7.5E-07
CS137   Class: D F1:   1.00000    08/17/88  19:46:54.6  ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 9.0E-07 7.5E-07 1.1E-06 1.0E-06 1.1E-06 5.0E-07 7.6E-07 1.0E-06 9.0E-07 8.8E-07 8.9E-07
H 70 2.7E-07 4.5E-07 6.5E-07 6.4E-07 6.5E-07 3.0E-07 4.6E-07 6.2E-07 5.5E-07 5.4E-07 5.4E-07
CE144   Class: Y F1:   0.00030    08/17/88  19:52:32.9  ChronicSv per 70 yr/Bq/yr for 70 yr
 13  1  3  4  5  6  7  8 11 12 13 14 17 19
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver   Spleen
G 70 4.6E-10 7.7E-08 2.6E-07 1.5E-06 4.7E-06 9.1E-09 6.3E-09 7.1E-10 4.9E-09 8.5E-10 3.6E-10 4.8E-08 4.0E-08
H 70 5.1E-05 7.3E-08 1.4E-07 7.6E-07 2.3E-06 3.1E-07 1.9E-07 1.3E-08 1.6E-08 2.3E-08 1.9E-08 1.7E-06 1.4E-06
PR144M  Class: Y F1:   0.00030    08/17/88  20:07:00.1  ChronicSv per 70 yr/Bq/yr for 70 yr
 13  1  3  4  5  6  7  8 11 12 13 14 17 16
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver   Kidneys
G 70 1.4E-12 1.1E-08 3.8E-09 8.3E-10 4.9E-11 8.2E-13 1.7E-12 2.4E-13 3.7E-12 1.7E-12 1.0E-13 1.9E-12 3.1E-12
H 70 2.7E-09 2.1E-10 5.8E-11 1.2E-11 8.4E-13 1.0E-12 1.2E-12 3.2E-13 4.0E-13 8.6E-13 5.9E-13 1.6E-12 8.0E-13
PR144   Class: Y F1:   0.00030    08/17/88  20:12:06.7  ChronicSv per 70 yr/Bq/yr for 70 yr
 13  1  3  4  5  6  7  8 11 12 13 14 17 16
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver   Kidneys
G 70 2.3E-12 2.9E-08 7.1E-09 1.3E-09 7.7E-11 1.1E-12 2.4E-12 5.0E-13 5.5E-12 2.5E-12 2.7E-13 3.4E-12 5.3E-12
H 70 6.5E-09 3.9E-10 9.5E-11 1.8E-11 1.4E-12 1.4E-12 1.8E-12 6.1E-13 7.6E-13 1.3E-12 1.2E-12 2.5E-12 1.5E-12
PM151   Class: Y F1:   0.00030    08/17/88  20:15:11.9  ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 3.0E-10 2.9E-08 7.2E-08 2.7E-07 5.1E-07 1.1E-09 3.5E-09 1.2E-09 1.5E-08 1.7E-09 3.3E-11 1.6E-09
H 70 1.1E-07 1.0E-08 2.4E-08 9.0E-08 1.7E-07 1.2E-09 1.9E-09 4.0E-10 5.0E-09 1.1E-09 4.3E-10 2.0E-09
SM151   Class: W F1:   0.00030    08/17/88  20:22:24.8  ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 6.8E-14 1.6E-09 4.0E-09 2.4E-08 7.1E-08 2.0E-08 1.6E-09 3.6E-14 1.5E-12 9.8E-14 3.2E-14 5.4E-09
H 70 2.2E-07 8.0E-10 2.0E-09 1.2E-08 3.4E-08 7.8E-06 6.3E-07 1.2E-11 1.4E-11 2.0E-11 1.2E-11 2.1E-06
EU152   Class: W F1:   0.00100    08/17/88  20:27:25.8  ChronicSv per 70 yr/Bq/yr for 70 yr
 13  1  3  4  5  6  7  8 11 12 13 14 16 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Kidneys Liver
G 70 1.5E-08 4.4E-08 1.2E-07 2.9E-07 7.0E-07 1.3E-07 6.0E-08 1.1E-08 9.3E-08 1.9E-08 4.2E-09 3.1E-08 1.8E-07
H 70 3.7E-06 1.2E-06 1.1E-06 1.5E-06 9.4E-07 1.4E-05 4.8E-06 3.9E-07 7.9E-07 1.1E-06 5.0E-07 2.2E-06 2.0E-05
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9 1 0 4 8 1 6 9 5

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EU154   Class: W F1:   0.00100    08/17/88  20:32:35.8   ChronicSv per 70 yr/Bq/yr for 70 yr
 13  1  3  4  5  6  7  8 11 12 13 14 16 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Kidneys Liver
G 70 1.4E-08 5.6E-08 1.6E-07 4.8E-07 1.3E-06 2.8E-07 7.5E-08 1.1E-08 9.5E-08 1.9E-08 3.6E-09 3.0E-08 2.3E-07
H 70 5.1E-06 1.1E-06 1.0E-06 1.5E-06 1.1E-06 3.2E-05 6.5E-06 3.6E-07 7.3E-07 9.5E-07 4.4E-07 2.1E-06 2.6E-05
EU155   Class: W F1:   0.00100    08/17/88  20:37:49.0   ChronicSv per 70 yr/Bq/yr for 70 yr
 13  1  3  4  5  6  7  8 11 12 13 14 16 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Kidneys Liver
G 70 6.4E-10 7.1E-09 2.0E-08 8.7E-08 2.4E-07 8.2E-08 1.1E-08 5.2E-10 6.9E-09 9.8E-10 1.2E-10 1.6E-09 2.7E-08
H 70 7.8E-07 4.8E-08 4.8E-08 9.8E-08 1.4E-07 9.3E-06 9.1E-07 1.1E-08 2.3E-08 3.9E-08 1.6E-08 1.1E-07 3.0E-06
TH230   Class: Y F1:   0.00020    08/17/88  20:44:34.9   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 4.8E-08 1.2E-07 2.4E-07 1.2E-06 3.4E-06 1.8E-04 1.5E-05 4.8E-08 4.8E-08 4.8E-08 4.8E-08 4.0E-07
H 70 1.7E-02 1.1E-05 1.1E-05 1.1E-05 1.3E-05 4.0E-02 3.3E-03 1.1E-05 1.1E-05 1.1E-05 1.1E-05 9.0E-05
RA226   Class: W F1:   0.20000    08/17/88  21:19:50:0   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 2.0E-07 2.6E-07 3.5E-07 1.1E-06 3.0E-06 3.6E-04 3.2E-05 1.9E-07 2.0E-07 2.0E-07 1.9E-07
H 70 1.1E-03 2.4E-07 2.8E-07 6.4E-07 1.6E-06 3.8E-04 3.4E-05 2.1E-07 2.1E-07 2.2E-07 2.1E-07
PB210   Class: D F1:   0.20000    08/17/88  21:48:05.7   ChronicSv per 70 yr/Bq/yr for 70 yr
 13  1  3  4  5  6  7  8 11 12 13 14 17 16
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver   Kidneys
G 70 7.8E-06 7.4E-06 7.4E-06 7.5E-06 7.7E-06 1.2E-03 8.3E-05 7.7E-06 7.7E-06 7.8E-06 7.7E-06 3.5E-04 1.6E-04
H 70 3.1E-08 1.8E-05 1.8E-05 1.8E-05 1.8E-05 2.9E-03 2.0E-04 1.9E-05 1.9E-05 1.9E-05 1.9E-05 8.5E-04 4.0E-04
BI210   Class: W F1:   0.05000    08/17/88  22:02:54.4   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 16
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Kidneys
G 70 1.4E-09 3.3E-08 7.5E-08 4.0E-07 1.1E-06 7.1E-10 1.4E-09 1.4E-09 1.4E-09 1.4E-09 1.4E-09 4.1E-07
H 70 2.9E-05 1.7E-08 3.2E-08 1.6E-07 4.0E-07 2.5E-09 4.5E-09 4.5E-09 4.4E-09 4.5E-09 4.5E-09 1.3E-06
PO210   Class: W F1:   0.10000    08/17/88  22:09:56.9   ChronicSv per 70 yr/Bq/yr for 70 yr
 14  1  3  4  5  6  7  8 11 12 13 14 17 16 19
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver   Kidneys Spleen
G 70 6.0E-06 6.7E-06 6.8E-06 7.7E-06 9.9E-06 3.0E-06 5.9E-06 5.9E-06 5.8E-06 5.9E-06 5.9E-06 3.1E-05 1.8E-04 3.1E-04
H 70 8.7E-04 9.9E-06 9.9E-06 1.0E-05 1.1E-05 4.4E-06 8.7E-06 8.8E-06 8.7E-06 8.8E-06 8.7E-06 4.5E-05 2.6E-04 4.5E-04
U 234   Class: Y F1:   0.00200    08/17/88  22:14:33.8   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 16
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Kidneys
G 70 7.2E-09 8.4E-08 2.0E-07 1.2E-06 3.5E-06 2.5E-06 1.6E-07 7.2E-09 7.3E-09 7.2E-09 7.2E-09 1.2E-06
H 70 1.7E-02 2.1E-07 2.7E-07 8.0E-07 2.1E-06 5.6E-05 3.6E-06 1.6E-07 1.6E-07 1.7E-07 1.6E-07 2.8E-05
U 236   Class: Y F1:   0.00200    08/17/88  22:19:09.6   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 16
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Kidneys
G 70 6.7E-09 7.9E-08 1.8E-07 1.1E-06 3.3E-06 2.4E-06 1.5E-07 6.6E-09 6.8E-09 6.8E-09 6.7E-09 1.2E-06
H 70 1.6E-02 1.9E-07 2.5E-07 7.3E-07 2.0E-06 5.3E-05 3.4E-06 1.5E-07 1.5E-07 1.6E-07 1.5E-07 2.7E-05
U 235   Class: Y F1:   0.00200    08/17/88  22:27:17.0   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 16
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Kidneys
G 70 7.0E-09 8.6E-08 2.2E-07 1.2E-06 3.8E-06 2.3E-06 1.6E-07 8.0E-09 2.3E-08 8.4E-09 6.8E-09 1.2E-06
H 70 1.6E-02 4.0E-07 3.0E-07 8.6E-07 2.3E-06 5.2E-05 3.6E-06 1.6E-07 1.8E-07 3.2E-07 2.5E-07 2.6E-05
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TH231   Class: Y F1:    0.00020      08/18/88  01:59:34.5   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung     Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 1.0E-11 1.4E-08 3.2E-08 1.3E-07 2.4E-07 2.0E-10 3.7E-10 3.7E-11 1.5E-09 1.0E-10 6.1E-13 6.9E-11
H 70 5.5E-08 4.3E-09 1.0E-08 4.2E-08 7.5E-08 1.3E-08 1.2E-09 2.0E-11 4.7E-10 9.5E-11 2.0E-11 1.2E-10
PA231   Class: Y F1:    0.00100      08/18/88  02:31:52.8   ChronicSv per 70 yr/Bq/yr for 70 yr
 13  1  3  4  5  6  7  8 11 12 13 14 17 16
     Lung     Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver   Kidneys
G 70 3.6E-09 8.8E-08 2.2E-07 1.2E-06 3.8E-06 3.4E-03 2.7E-04 2.7E-09 7.6E-09 4.2E-09 3.4E-09 3.3E-07 4.8E-07
H 70 3.9E-02 3.0E-07 2.9E-07 8.7E-07 2.4E-06 1.6E-01 1.2E-02 1.3E-07 1.7E-07 3.0E-07 2.4E-07 2.6E-05 3.7E-05
AC227   Class: Y F1:    0.00100      08/18/88  03:01:33.5   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung     Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 1.2E-08 1.1E-08 1.8E-08 1.0E-07 5.4E-07 3.6E-03 2.9E-04 3.9E-05 5.3E-09 7.7E-09 4.1E-09 8.5E-04
H 70 9.3E-02 8.7E-07 6.2E-07 1.4E-06 2.9E-06 1.4E-01 1.1E-02 1.5E-03 3.2E-07 6.9E-07 4.7E-07 3.3E-02
TH227   Class: Y F1:    0.00020      08/18/88  03:23:32.1   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung     Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 8.9E-09 1.2E-07 2.9E-07 1.8E-06 6.4E-06 4.9E-06 4.0E-07 9.7E-09 2.1E-08 1.0E-08 8.8E-09 7.4E-08
H 70 2.4E-03 2.7E-07 3.5E-07 1.1E-06 3.5E-06 1.1E-04 8.9E-06 2.0E-07 2.1E-07 2.1E-07 2.0E-07 1.6E-06
FR223   Class: D F1:    1.00000      08/18/88  03:37:56.0   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung     Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 1.4E-07 1.7E-07 1.6E-07 1.6E-07 1.6E-07 6.8E-08 1.4E-07 1.4E-07 1.4E-07 1.4E-07 1.4E-07
H 70 1.3E-07 9.5E-08 9.4E-08 9.4E-08 9.4E-08 4.1E-08 8.1E-08 8.2E-08 8.3E-08 8.2E-08 8.2E-08
RA223   Class: W F1:    0.20000      08/18/88  03:46:07.8   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung     Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 8.2E-07 1.3E-06 1.8E-06 6.5E-06 1.7E-05 7.9E-05 5.4E-06 8.2E-07 8.5E-07 8.2E-07 8.1E-07
H 70 1.1E-03 8.4E-07 1.0E-06 2.9E-06 7.1E-06 6.1E-05 4.2E-06 6.4E-07 6.6E-07 6.5E-07 6.4E-07
U 237   Class: Y F1:    0.00200      08/18/88  03:53:54.8   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 16
     Lung     Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Kidneys
G 70 1.5E-10 1.9E-08 5.2E-08 2.4E-07 6.2E-07 2.5E-09 4.0E-09 8.5E-10 1.3E-08 1.3E-09 1.6E-11 2.1E-09
H 70 3.2E-07 9.8E-09 2.2E-08 1.0E-07 2.7E-07 4.8E-09 3.6E-09 3.8E-10 5.7E-09 1.7E-09 6.9E-10 2.9E-09
NP237   Class: W F1:    0.00100      08/18/88  04:38:31.4   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung     Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 9.5E-09 9.2E-08 2.2E-07 1.2E-06 3.7E-06 1.6E-03 1.3E-04 1.0E-05 1.1E-08 8.8E-09 6.5E-09 7.0E-05
H 70 1.1E-03 7.7E-07 9.4E-07 1.5E-06 2.7E-06 1.8E-01 1.5E-02 1.2E-03 7.1E-07 9.9E-07 7.7E-07 8.2E-03
PA233   Class: Y F1:    0.00100      08/18/88  05:16:53.6   ChronicSv per 70 yr/Bq/yr for 70 yr
 13  1  3  4  5  6  7  8 11 12 13 14 17 16
     Lung     Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver   Kidneys
G 70 2.6E-10 2.0E-08 5.6E-08 2.5E-07 7.2E-07 7.1E-09 4.9E-09 1.5E-09 1.8E-08 1.9E-09 3.5E-11 1.7E-09 2.4E-09
H 70 1.1E-06 1.6E-08 2.6E-08 1.2E-07 3.3E-07 4.8E-08 1.2E-08 7.6E-10 8.6E-09 6.2E-09 3.8E-09 1.2E-08 6.1E-09
U 233   Class: Y F1:    0.00200      08/18/88  05:45:18.5   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 16
     Lung     Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Kidneys
G 70 7.2E-09 8.4E-08 2.0E-07 1.2E-06 3.5E-06 2.6E-06 1.7E-07 7.2E-09 7.3E-09 7.2E-09 7.2E-09 1.3E-06
H 70 1.8E-02 2.1E-07 2.7E-07 8.0E-07 2.1E-06 5.7E-05 3.7E-06 1.6E-07 1.6E-07 1.7E-07 1.7E-07 2.9E-05
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TH229   Class: Y F1:   0.00020    08/18/88  06:06:43.7   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 3.1E-07 4.0E-07 5.4E-07 1.6E-06 4.5E-06 1.2E-03 1.0E-04 3.1E-07 3.3E-07 3.1E-07 3.1E-07 2.7E-06
H 70 1.1E-01 7.2E-05 7.2E-05 7.3E-05 7.6E-05 2.7E-01 2.2E-02 7.2E-05 7.3E-05 7.2E-05 7.2E-05 6.1E-04
RA225   Class: W F1:   0.20000    08/18/88  06:22:15.2   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 1.3E-07 1.3E-07 1.6E-07 4.8E-07 2.2E-06 1.1E-04 6.6E-06 1.3E-07 1.3E-07 1.3E-07 1.3E-07
H 70 1.1E-03 1.8E-07 2.1E-07 5.1E-07 1.6E-06 9.0E-05 5.5E-06 1.6E-07 1.7E-07 1.6E-07 1.6E-07
AC225   Class: Y F1:   0.00100    08/18/88  06:32:37.4   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 3.0E-09 5.1E-07 1.3E-06 6.9E-06 2.0E-05 7.2E-06 5.9E-07 8.3E-08 2.0E-08 4.6E-09 2.7E-09 2.0E-06
H 70 1.2E-03 2.4E-07 5.6E-07 3.0E-06 8.7E-06 3.2E-05 2.6E-06 3.6E-07 2.0E-08 1.5E-08 1.4E-08 8.6E-06
U 238   Class: Y F1:   0.00200    08/18/88  06:37:49.7   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 16
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Kidneys
G 70 6.3E-09 7.5E-08 1.9E-07 1.0E-06 3.3E-06 2.3E-06 1.5E-07 6.3E-09 7.0E-09 6.3E-09 6.3E-09 1.1E-06
H 70 1.5E-02 2.2E-07 2.6E-07 8.1E-07 2.2E-06 5.1E-05 3.4E-06 1.4E-07 1.5E-07 1.7E-07 1.6E-07 2.6E-05
TH234   Class: Y F1:   0.00020    08/18/88  06:51:40.6   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 4.7E-11 7.0E-08 1.7E-07 1.0E-06 3.0E-06 1.4E-09 1.2E-09 1.6E-10 2.0E-09 2.3E-10 2.0E-11 2.8E-10
H 70 4.2E-06 3.2E-08 7.9E-08 4.7E-07 1.3E-06 2.7E-08 1.6E-08 4.4E-10 1.3E-09 1.0E-09 7.9E-10 3.8E-09
PA234   Class: Y F1:   0.00100    08/18/88  06:58:40.5   ChronicSv per 70 yr/Bq/yr for 70 yr
 13  1  3  4  5  6  7  8 11 12 13 14 17 16
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver   Kidneys
G 70 1.1E-09 5.4E-08 1.1E-07 2.3E-07 1.8E-07 2.0E-09 5.7E-09 1.7E-09 2.4E-08 3.6E-09 1.3E-10 4.3E-09 6.0E-09
H 70 6.1E-08 1.1E-08 1.9E-08 4.1E-08 3.3E-08 1.3E-09 1.9E-09 3.4E-10 4.5E-09 1.5E-09 8.5E-10 2.4E-09 1.8E-09
PU238   Class: Y F1:   0.00010    08/18/88  16:15:31.3   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 5.9E-11 8.9E-08 2.3E-07 1.3E-06 4.0E-06 8.2E-05 6.6E-06 1.0E-06 2.8E-10 6.5E-11 5.6E-11 1.6E-05
H 70 1.8E-02 7.4E-08 1.5E-07 7.4E-07 2.2E-06 3.4E-02 2.7E-03 4.1E-04 2.5E-08 2.7E-08 2.4E-08 6.6E-03
PU240   Class: Y F1:   0.00010    08/18/88  16:20:02.2   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 5.6E-11 8.5E-08 2.1E-07 1.2E-06 3.8E-06 9.1E-05 7.0E-06 1.1E-06 2.6E-10 6.1E-11 5.3E-11 1.7E-05
H 70 1.8E-02 7.1E-08 1.4E-07 6.9E-07 2.1E-06 3.8E-02 3.0E-03 4.7E-04 2.4E-08 2.7E-08 2.4E-08 7.1E-03
PU239   Class: Y F1:   0.00010    08/18/88  16:24:29.0   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 5.4E-11 8.5E-08 2.1E-07 1.2E-06 3.7E-06 9.1E-05 7.0E-06 1.1E-06 1.4E-10 5.6E-11 5.3E-11 1.7E-05
H 70 1.8E-02 7.1E-08 1.4E-07 6.9E-07 2.0E-06 3.8E-02 3.0E-03 4.7E-04 2.4E-08 2.5E-08 2.4E-08 7.1E-03
PU241   Class: Y F1:   0.00010    08/18/88  16:28:59.5   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 2.1E-12 4.1E-10 1.1E-09 6.3E-09 1.8E-08 1.6E-06 1.3E-07 2.1E-08 8.4E-13 1.2E-12 4.6E-13 2.6E-07
H 70 1.5E-04 1.2E-09 1.3E-09 4.7E-09 1.2E-08 7.7E-04 8.0E-05 9.8E-06 4.6E-10 1.0E-09 4.4E-10 1.3E-04
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9 1 0 4 8 1 6 9 8

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AM241   Class: W F1:   0.00100     08/18/88  16:36:50.2   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 1.9E-09 9.5E-08 2.3E-07 1.3E-06 4.1E-06 9.2E-04 7.2E-05 1.1E-05 4.8E-09 1.6E-09 8.2E-10 1.7E-04
H 70 1.2E-03 1.9E-07 2.5E-07 8.2E-07 2.1E-06 1.1E-01 8.4E-03 1.3E-03 1.1E-07 1.5E-07 9.7E-08 2.0E-02
BE10    Class: Y F1:   0.00500     08/18/88  16:41:00.4   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 1.6E-09 2.1E-08 5.2E-08 3.0E-07 9.0E-07 1.4E-07 4.7E-08 1.6E-09 1.6E-09 1.6E-09 1.6E-09
H 70 4.5E-05 1.9E-08 3.6E-08 1.7E-07 5.0E-07 1.3E-06 4.4E-07 1.5E-08 1.5E-08 1.5E-08 1.6E-08
F 18    Class: D F1:   1.00000     08/18/88  16:45:12.8   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 5.6E-10 2.0E-08 6.2E-10 6.8E-10 5.0E-10 3.7E-09 3.7E-09 2.9E-10 4.5E-10 5.3E-10 4.1E-10
H 70 7.4E-09 2.9E-09 2.1E-10 2.2E-10 1.9E-10 1.6E-09 1.7E-09 1.3E-10 1.9E-10 3.0E-10 2.8E-10
NA22    Class: D F1:   1.00000     08/18/88  16:47:45.7   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 2.4E-07 2.3E-07 3.0E-07 2.8E-07 3.0E-07 4.4E-07 3.6E-07 2.6E-07 2.7E-07 2.4E-07 2.4E-07
H 70 1.6E-07 1.3E-07 1.8E-07 1.7E-07 1.8E-07 2.6E-07 2.2E-07 1.6E-07 1.7E-07 1.5E-07 1.5E-07
P 33    Class: D F1:   0.80000     08/18/88  16:51:58.4   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 6.7E-09 9.5E-09 6.5E-09 2.1E-08 5.5E-08 9.4E-08 3.7E-08 6.7E-09 6.7E-09 6.7E-09 6.7E-09
H 70 1.5E-08 3.4E-09 2.9E-09 4.8E-09 1.0E-08 6.7E-08 2.6E-08 4.9E-09 4.9E-09 4.9E-09 4.9E-09
S 35    Class: W F1:   0.80000     08/18/88  16:55:59.1   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 5.4E-09 7.1E-09 5.1E-09 1.4E-08 3.8E-08 2.7E-09 5.5E-09 5.4E-09 5.5E-09 5.5E-09 5.5E-09
H 70 3.3E-07 3.6E-09 2.7E-09 6.8E-09 1.7E-08 1.5E-09 3.2E-09 3.2E-09 3.2E-09 3.2E-09 3.2E-09
CL36    Class: D F1:   1.00000     08/18/88  17:00:01.1   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 5.6E-08 5.4E-08 6.0E-08 6.0E-08 6.0E-08 2.8E-08 5.5E-08 5.6E-08 5.6E-08 5.6E-08 5.8E-08
H 70 5.4E-08 2.3E-08 3.7E-08 3.7E-08 3.7E-08 1.7E-08 3.4E-08 3.4E-08 3.5E-08 3.4E-08 3.5E-08
K 40    Class: D F1:   1.00000     08/18/88  17:03:52.9   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 3.4E-07 2.4E-07 3.8E-07 3.7E-07 3.8E-07 1.7E-07 3.3E-07 3.5E-07 3.6E-07 3.5E-07 3.4E-07
H 70 1.2E-07 1.3E-07 2.3E-07 2.3E-07 2.3E-07 1.1E-07 2.0E-07 2.1E-07 2.2E-07 2.1E-07 2.1E-07
CA41    Class: W F1:   0.30000     08/18/88  17:07:36.0   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 1.1E-10 2.6E-10 4.1E-10 2.1E-09 6.0E-09 2.2E-07 9.9E-08 9.9E-11 1.1E-10 1.3E-10 1.1E-10
H 70 2.9E-08 1.5E-10 2.2E-10 1.0E-09 3.0E-09 1.9E-07 8.6E-08 8.8E-11 9.4E-11 1.2E-10 9.8E-11
CA45    Class: W F1:   0.30000     08/18/88  17:12:17.8   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 1.7E-09 6.9E-09 1.2E-08 6.7E-08 2.0E-07 3.6E-07 2.5E-07 1.7E-09 1.7E-09 1.7E-09 1.7E-09
H 70 6.3E-07 3.5E-09 5.7E-09 3.1E-08 9.1E-08 2.9E-07 2.0E-07 1.4E-09 1.4E-09 1.4E-09 1.4E-09
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DSFCT30.DAT

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9/30/88

9 1 0 4 8 1 6 9 6

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SC46    Class: Y F1:   0.00010     08/18/88  17:16:51.5   ChronicSv per 70 yr/Bq/yr for 70 yr
 13  1  3  4  5  6  7  8 11 12 13 14 17 19
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver   Spleen
G 70 3.5E-09 4.8E-08 1.6E-07 3.2E-07 7.3E-07 9.7E-09 2.8E-08 1.2E-08 1.4E-07 1.8E-08 5.4E-10 1.4E-08 1.7E-08
H 70 3.0E-06 2.2E-07 1.1E-07 2.0E-07 3.5E-07 1.1E-07 1.4E-07 1.2E-08 8.8E-08 1.4E-07 1.3E-07 2.7E-07 3.0E-07
MN54    Class: W F1:   0.10000     08/18/88  17:21:01.3   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 1.6E-08 2.8E-08 6.8E-08 9.5E-08 1.6E-07 4.0E-08 3.4E-08 1.5E-08 6.6E-08 1.9E-08 9.5E-09 7.1E-08
H 70 4.4E-07 7.5E-08 5.5E-08 7.1E-08 9.0E-08 8.3E-08 7.3E-08 1.9E-08 4.7E-08 5.7E-08 4.9E-08 1.7E-07
MN56    Class: W F1:   0.10000     08/18/88  17:25:13.8   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 6.4E-10 6.3E-08 7.6E-08 1.0E-07 4.0E-08 7.7E-10 1.8E-09 5.6E-10 6.2E-09 1.3E-09 1.8E-10 2.0E-09
H 70 3.6E-08 5.2E-09 5.8E-09 7.6E-09 3.1E-09 5.9E-10 7.7E-10 2.3E-10 6.7E-10 5.4E-10 4.4E-10 1.3E-09
FE55    Class: W F1:   0.10000     08/18/88  17:28:00.6   ChronicSv per 70 yr/Bq/yr for 70 yr
 13  1  3  4  5  6  7  8 11 12 13 14 17 19
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver   Spleen
G 70 7.0E-09 5.5E-09 5.7E-09 9.3E-09 1.9E-08 3.1E-09 6.4E-09 7.2E-09 7.6E-09 7.2E-09 7.7E-09 2.3E-08 3.8E-08
H 70 5.9E-08 8.6E-09 8.4E-09 9.8E-09 1.5E-08 5.0E-09 1.0E-08 1.2E-08 1.2E-08 1.2E-08 1.3E-08 3.7E-08 6.2E-08
FE59    Class: W F1:   0.10000     08/18/88  17:32:23.2   ChronicSv per 70 yr/Bq/yr for 70 yr
 13  1  3  4  5  6  7  8 11 12 13 14 17 19
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver   Spleen
G 70 4.5E-08 7.1E-08 1.4E-07 2.7E-07 5.8E-07 3.7E-08 5.4E-08 5.5E-08 1.1E-07 5.3E-08 4.5E-08 1.1E-07 1.3E-07
H 70 9.0E-07 1.0E-07 1.1E-07 1.6E-07 3.0E-07 6.3E-08 8.2E-08 6.9E-08 9.3E-08 8.7E-08 8.3E-08 1.8E-07 2.0E-07
CO57    Class: Y F1:   0.05000     08/18/88  17:36:43.6   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 2.0E-09 6.2E-09 1.6E-08 3.7E-08 8.8E-08 3.0E-09 6.0E-09 2.3E-09 1.3E-08 2.9E-09 1.4E-09 6.3E-09
H 70 1.1E-06 3.6E-08 1.1E-08 2.2E-08 4.5E-08 2.9E-08 3.8E-08 1.6E-09 8.3E-09 2.5E-08 1.8E-08 4.6E-08
CO58    Class: Y F1:   0.05000     08/18/88  17:41:08.3   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 6.0E-09 2.7E-08 7.9E-08 1.4E-07 2.8E-07 8.2E-09 1.8E-08 1.2E-08 7.3E-08 1.3E-08 4.7E-09 1.7E-08
H 70 1.1E-06 9.3E-08 5.0E-08 8.1E-08 1.3E-07 4.5E-08 6.2E-08 7.4E-09 4.1E-08 6.2E-08 5.8E-08 1.1E-07
NI59    Class: W F1:   0.05000     08/18/88  17:45:28.6   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 16
     Lung    Stomach S Int.  UL Int.,LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Kidneys
G 70 2.4E-09 2.2E-09 2.7E-09 7.2E-09 1.8E-08 1.0E-09 2.0E-09 2.4E-09 2.6E-09 2.4E-09 2.7E-09 3.1E-11
H 70 7.3E-08 5.3E-09 5.3E-09 7.1E-09 1.3E-08 3.0E-09 5.8E-09 6.9E-09 7.3E-09 7.0E-09 7.6E-09 8.9E-11
NI63    Class: W F1:   0.05000     08/18/88  17:49:44.7   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 16
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Kidneys
G 70 5.6E-09 4.5E-09 6.4E-09 2.2E-08 6.1E-08 2.8E-09 5.5E-09 5.7E-09 5.8E-09 5.7E-09 5.7E-09 2.0E-11
H 70 1.8E-07 9.7E-09 1.1E-08 1.7E-08 3.7E-08 8.1E-09 1.6E-08 1.6E-08 1.7E-08 1.6E-08 1.6E-08 5.5E-11
NI65    Class: W F1:   0.05000     08/18/88  17:54:03.3   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 16
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Kidneys
G 70 2.0E-10 4.5E-08 5.2E-08 6.9E-08 2.7E-08 2.1E-10 5.4E-10 1.6E-10 1.7E-09 4.0E-10 4.9E-11 7.6E-10
H 70 2.6E-08 3.5E-09 3.9E-09 5.1E-09 2.1E-09 1.8E-10 2.5E-10 1.1E-10 2.3E-10 2.1E-10 1.6E-10 3.0E-10
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CU64    Class: D F1:  0.50000    08/18/88  17:56:49.9  ChronicSv per 70 yr/Bq/yr for 70 yr
 14  1  3  4  5  6  7  8 11 12 13 14 17 21 18
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver   Brain   Pancreas
G 70 9.6E-10 1.2E-08 1.5E-08 4.4E-08 5.5E-08 1.8E-09 1.4E-09 1.1E-09 3.4E-09 1.2E-09 8.4E-10 2.7E-09 2.7E-09 3.1E-09
H 70 1.3E-08 2.4E-09 2.7E-09 6.8E-09 8.4E-09 1.6E-09 9.6E-10 8.7E-10 1.1E-09 8.8E-10 8.3E-10 2.3E-09 2.5E-09 2.4E-09
ZN69M   Class: Y F1:  0.50000    08/18/88  18:00:28.6  ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 2.6E-09 1.8E-08 3.3E-08 1.2E-07 1.7E-07 5.5E-09 7.3E-09 2.9E-09 8.6E-09 3.2E-09 2.3E-09
H 70 6.6E-08 8.4E-09 1.0E-08 3.2E-08 4.3E-08 1.7E-09 2.3E-09 7.8E-10 2.2E-09 1.2E-09 9.2E-10
ZN69    Class: Y F1:  0.50000    08/18/88  18:06:17.6  ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 3.0E-11 1.5E-08 7.7E-09 4:4E-09 7.4E-10 4.7E-11 6.2E-11 3.0E-11 3.0E-11 3.1E-11 3.0E-11
H 70 5.4E-09 6.0E-10 3.1E-10 1.7E-10 3.0E-11 3.1E-12 4.0E-12 2.0E-12 2.0E-12 2.0E-12 2.0E-12
AS76    Class: W F1:  0.50000    08/18/88  18:08:53.4  ChronicSv per 70 yr/Bq/yr for 70 yr
 14  1  3  4  5  6  7  8 11 12 13 14 17 16 19
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver   Kidneys Spleen
G 70 7.0E-09 9.3E-08 1.2E-07 4.7E-07 8.5E-07 5.8E-09 1.0E-08 7.9E-09 1.6E-08 7.9E-09 6.7E-09 2.6E-08 3.0E-08 2.0E-08
H 70 3.4E-07 2.7E-08 3.2E-08 1.3E-07 2.3E-07 2.8E-09 4.5E-09 3.3E-09 5.4E-09 3.8E-09 3.4E-09 1.2E-08 1.3E-08 9.1E-09
SE75    Class: W F1:  0.80000    08/18/88  18:12:23.7  ChronicSv per 70 yr/Bq/yr for 70 yr
 14  1  3  4  5  6  7  8 11 12 13 14 17 16 19
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver   Kidneys Spleen
G 70 1.2E-07 1.4E-07 1.4E-07 1.4E-07 1.3E-07 1.0E-07 1.3E-07 8.3E-08 1.2E-07 1.0E-07 8.2E-08 4.0E-07 5.0E-07 2.5E-07
H 70 3.5E-07 1.0E-07 8.2E-08 8.4E-08 7.3E-08 7.4E-08 9.5E-08 4.9E-08 7.2E-08 7.3E-08 5.8E-08 2.6E-07 3.0E-07 1.7E-07
SE79    Class: W F1:  0.80000    08/18/88  18:17:03.9  ChronicSv per 70 yr/Bq/yr for 70 yr
 14  1  3  4  5  6  7  8 11 12 13 14 17 16 19
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver   Kidneys Spleen
G 70 6.4E-08 4.2E-08 3.9E-08 4.5E-08 7.7E-08 3.3E-08 6.3E-08 6.4E-08 6.4E-08 6.4E-08 6.4E-08 4.5E-07 8.7E-07 3.0E-07
H 70 6.1E-07 2.6E-08 2.5E-08 2.7E-08 4.3E-08 2.1E-08 4.1E-08 4.1E-08 4.1E-08 4.1E-08 4.1E-08 2.9E-07 5.5E-07 1.9E-07
BR82    Class: D F1:  1.00000    08/17/88  18:16:17.8  ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 2.9E-08 5.7E-08 3.8E-08 3.6E-08 3.7E-08 1.1E-08 2.6E-08 3.5E-08 3.0E-08 2.9E-08 2.9E-08
H 70 4.9E-08 2.2E-08 2.1E-08 2.0E-08 2.0E-08 6.9E-09 1.6E-08 1.9E-08 1.6E-08 1.7E-08 1.7E-08
BR83    Class: D F1:  1.00000    08/17/88  18:20:54.0  ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 5.9E-10 2.1E-08 6.3E-10 6.2E-10 6.3E-10 3.0E-10 5.7E-10 5.9E-10 5.9E-10 6.1E-10 5.9E-10
H 70 1.1E-08 2.9E-09 2.8E-10 2.7E-10 2.8E-10 1.3E-10 2.5E-10 2.6E-10 2.6E-10 2.7E-10 2.6E-10
BR84    Class: D F1:  1.00000    08/17/88  18:28:03.2  ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 5.1E-10 4.8E-08 6.5E-10 6.8E-10 5.4E-10 2.2E-10 3.9E-10 3.9E-10 5.0E-10 4.8E-10 3.9E-10
H 70 1.1E-08 5.0E-09 2.4E-10 2.4E-10 2.1E-10 1.2E-10 2.0E-10 1.8E-10 2.0E-10 2.3E-10 2.2E-10
RB87    Class: D F1:  1.00000    08/17/88  18:31:50.8  ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 8.0E-08 5.0E-08 8.0E-08 8.0E-08 8.0E-08 2.8E-07 1.6E-07 8.0E-08 8.0E-08 8.0E-08 8.0E-08
H 70 2.3E-08 2.6E-08 4.9E-08 4.9E-08 4.9E-08 1.7E-07 9.7E-08 4.9E-08 4.9E-08 4.9E-08 4.9E-08
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RB88    Class: D F1:   1.00000     08/17/88  18:37:38.9   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 2.1E-10 5.2E-08 2.4E-10 2.5E-10 2.2E-10 2.3E-10 2.4E-10 1.8E-10 2.0E-10 2.1E-10 1.8E-10
H 70 1.0E-08 4.3E-09 9.8E-11 1.0E-10 9.6E-11 1.2E-10 1.2E-10 9.1E-11 9.4E-11 1.0E-10 9.7E-11
RB89    Class: D F1:   1.00000     08/17/88  18:41:19.4   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 2.7E-10 2.6E-08 3.4E-10 3.8E-10 2.6E-10 3.2E-10 2.7E-10 1.7E-10 2.5E-10 2.5E-10 1.6E-10
H 70 4.7E-09 2.1E-09 1.1E-10 1.1E-10 9.9E-11 1.8E-10 1.5E-10 8.6E-11 9.7E-11 1.2E-10 1.1E-10
RB86    Class: D F1:   1.00000     08/17/88  18:48:42.5   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 1.5E-07 1.3E-07 1.5E-07 1.5E-07 1.5E-07 5.2E-07 3.0E-07 1.5E-07 1.5E-07 1.5E-07 1.5E-07
H 70 1.3E-07 5.5E-08 9.3E-08 9.3E-08 9.3E-08 3.1E-07 1.8E-07 9.2E-08 9.3E-08 9.3E-08 9.2E-08
SR85    Class: D F1:   0.30000     08/17/88  18:54:26.8   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 1.1E-08 1.7E-08 3.9E-08 5.5E-08 1.0E-07 4.1E-08 4.0E-08 1.1E-08 4.0E-08 1.5E-08 1.1E-08
H 70 2.5E-08 1.4E-08 2.0E-08 2.1E-08 3.1E-08 6.6E-08 5.8E-08 1.4E-08 2.4E-08 2.0E-08 1.9E-08
SR91    Class: D F1:   0.30000     08/17/88  19:01:29.3   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 1.9E-09 5.8E-08 9.4E-08 2.6E-07 2.7E-07 5.3E-09 7.0E-09 2.5E-09 1.4E-08 3.3E-09 1.5E-09
H 70 5.9E-08 1.0E-08 1.5E-08 3.8E-08 4.0E-08 7.2E-09 7.3E-09 2.3E-09 4.0E-09 2.7E-09 2.4E-09
Y 91M   Class: Y F1:   0.00010     08/17/88  19:18:34.1   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 9.3E-11 3.5E-09 2.2E-09 2.3E-09 1.7E-09 6.3E-11 1.6E-10 2.4E-11 5.1E-10 1.3E-10 8.4E-12 1.8E-10
H 70 4.6E-09 1.9E-10 1.2E-10 2.8E-10 5.9E-10 4.3E-11 5.4E-11 2.3E-12 2.3E-11 4.2E-11 3.4E-11 8.4E-11
Y 91    Class: Y F1:   0.00010     08/17/88  19:26:18.9   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 1.4E-11 4.8E-08 1.2E-07 7.3E-07 2.1E-06 4.4E-10 4.6E-10 2.9E-11 2.5E-10 3.9E-11 9.1E-12 4.3E-10
H 70 6.5E-06 2.3E-08 5.6E-08 3.4E-07 9.7E-07 2.2E-08 2.1E-08 4.4E-10 5.7E-10 6.2E-10 5.8E-10 2.1E-08
SR92    Class: D F1:   0.30000     08/17/88  19:32:04.5   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 1.2E-09 3.6E-08 7.3E-08 2.1E-07 1.6E-07 1.7E-09 2.5E-09 1.2E-09 5.7E-09 1.8E-09 8.4E-10
H 70 4.7E-08 6.6E-09 1.2E-08 3.0E-08 2.3E-08 2.1E-09 2.0E-09 1.2E-09 1.9E-09 1.5E-09 1.3E-09
Y 92    Class: Y F1:   0.00010     08/17/88  19:39:39.1   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 1.0E-10 9.9E-08 1.4E-07 2.4E-07 1.3E-07 1.3E-10 3.6E-10 1.0E-10 1.5E-09 2.6E-10 1.3E-11 3.3E-10
H 70 8.8E-08 1.2E-08 1.7E-08 2.9E-08 1.6E-08 1.1E-10 1.5E-10 2.5E-11 1.9E-10 1.1E-10 7.1E-11 2.0E-10
Y 93    Class: Y F1:   0.00010     08/17/88  19:44:30.5   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 6.1E-11 9.1E-08 1.8E-07 5.7E-07 6.6E-07 1.3E-10 3.6E-10 1.3E-10 1.6E-09 2.3E-10 9.0E-12 2.5E-10
H 70 1.8E-07 2.0E-08 4.0E-08 1.3E-07 1.5E-07 2.3E-10 3.0E-10 4.7E-11 3.8E-10 1.2E-10 6.4E-11 3.1E-10
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M093    Class: D F1:   0.80000     08/17/88  20:03:15.9   ChronicSv per 70 yr/Bq/yr for 70 yr
 13  1  3  4  5  6  7  8 11 12 13 14 17 16
     Lung     Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver   Kidneys
G 70 7.6E-09 5.5E-09 5.0E-09 6.3E-09 1.1E-08 1.0E-07 2.0E-08 5.9E-09 8.9E-09 7.0E-09 6.7E-09 1.3E-07 1.1E-07
H 70 4.3E-09 3.6E-09 3.3E-09 3.2E-09 4.2E-09 7.2E-08 1.5E-08 4.3E-09 6.3E-09 5.1E-09 4.9E-09 9.0E-08 8.2E-08
ZR93    Class: W F1:   0.00200     08/17/88  20:19:53.6   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung     Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 6.3E-12 1.6E-09 3.9E-09 2.4E-08 7.1E-08 4.5E-07 3.6E-08 3.2E-12 5.4E-12 1.0E-11 4.5E-12
H 70 2.2E-07 9.5E-10 2.1E-09 1.2E-08 3.5E-08 2.6E-05 2.1E-06 1.9E-10 3.2E-10 6.0E-10 2.7E-10
NB93M   Class: Y F1:   0.01000     08/17/88  20:30:53.5   ChronicSv per 70 yr/Bq/yr for 70 yr
 13  1  3  4  5  6  7  8 11 12 13 14 16 19
     Lung     Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Kidneys Spleen
G 70 1.7E-10 2.4E-09 6.2E-09 3.5E-08 1.1E-07 4.1E-09 1.6E-09 1.7E-10 4.1E-10 1.8E-10 1.7E-10 2.4E-09 2.3E-09
H 70 4.1E-06 2.1E-09 3.7E-09 1.9E-08 5.8E-08 1.8E-08 7.3E-09 7.3E-10 8.9E-10 2.8E-09 7.5E-10 1.0E-08 1.1E-08
ZR97    Class: W F1:   0.00200     08/17/88  20:38:09.8   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung     Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 1.2E-09 8.4E-08 2.4E-07 8.6E-07 1.3E-06 3.2E-09 9.1E-09 3.6E-09 4.4E-08 5.7E-09 1.9E-10
H 70 2.6E-07 2.7E-08 6.0E-08 2.0E-07 2.9E-07 8.7E-09 1.0E-08 2.1E-09 1.1E-08 3.9E-09 2.6E-09
NB97M   Class: Y F1:   0.01000     08/17/88  20:52:20.6   ChronicSv per 70 yr/Bq/yr for 70 yr
 13  1  3  4  5  6  7  8 11 12 13 14 16 19
     Lung     Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Kidneys Spleen
G 70 6.2E-12 5.1E-10 3.0E-10 2.3E-10 5.2E-11 3.1E-12 6.7E-12 1.0E-12 1.7E-11 6.6E-12 6.0E-13 1.5E-11 3.2E-11
H 70 1.6E-10 2.1E-11 1.5E-11 1.1E-11 2.5E-12 1.5E-12 2.1E-12 1.1E-13 9.4E-13 2.1E-12 1.9E-12 1.9E-12 3.6E-12
NB97    Class: Y F1:   0.01000     08/17/88  20:58:59.4   ChronicSv per 70 yr/Bq/yr for 70 yr
 13  1  3  4  5  6  7  8 11 12 13 14 16 19
     Lung     Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Kidneys Spleen
G 70 1.4E-10 2.6E-08 2.1E-08 1.7E-08 3.7E-09 1.2E-10 3.1E-10 5.7E-11 1.1E-09 2.4E-10 1.5E-11 5.0E-10 7.0E-10
H 70 1.1E-08 1.4E-09 1.1E-09 8.7E-10 1.9E-10 5.8E-11 8.1E-11 6.5E-12 6.2E-11 7.9E-11 6.3E-11 7.9E-11 1.4E-10
NB94    Class: Y F1:   0.01000     08/17/88  21:03:01.5   ChronicSv per 70 yr/Bq/yr for 70 yr
 13  1  3  4  5  6  7  8 11 12 13 14 16 19
     Lung     Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Kidneys Spleen
G 70 1.2E-08 5.3E-08 1.6E-07 3.7E-07 8.8E-07 5.3E-08 5.1E-08 1.9E-08 1.3E-07 2.4E-08 8.4E-09 4.8E-08 4.4E-08
H 70 4.3E-05 1.8E-06 4.1E-07 6.1E-07 6.1E-07 1.2E-06 1.3E-06 7.7E-08 2.7E-07 1.3E-06 1.3E-06 1.1E-06 2.1E-06
M099    Class: D F1:   0.80000     08/17/88  21:10:25.9   ChronicSv per 70 yr/Bq/yr for 70 yr
 13  1  3  4  5  6  7  8 11 12 13 14 17 16
     Lung     Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver   Kidneys
G 70 1.4E-08 4.2E-08 2.8E-08 9.5E-08 2.2E-07 6.5E-08 4.1E-08 1.2E-08 1.6E-08 1.3E-08 1.2E-08 1.9E-07 1.8E-07
H 70 7.1E-08 1.1E-08 8.9E-09 1.9E-08 3.6E-08 4.4E-08 2.8E-08 8.2E-09 9.0E-09 8.8E-09 8.2E-09 1.3E-07 1.2E-07
TC99M   Class: W F1:   0.80000     08/17/88  21:27:42.7   ChronicSv per 70 yr/Bq/yr for 70 yr
 13  1  3  4  5  6  7  8 11 12 13 14 22 16
     Lung     Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid S Wall  Kidneys
G 70 2.4E-10 5.1E-09 1.6E-09 2.6E-09 1.9E-09 2.0E-10 4.5E-10 1.7E-10 7.1E-10 2.7E-10 6.1E-09 5.1E-09 1.6E-09
H 70 2.1E-09 1.1E-09 2.5E-10 3.9E-10 2.8E-10 1.0E-10 1.7E-10 3.9E-11 1.2E-10 1.1E-10 1.5E-09 1.1E-09 3.9E-10
TC101   Class: W F1:   0.80000     08/17/88  21:35:49.3   ChronicSv per 70 yr/Bq/yr for 70 yr
 13  1  3  4  5  6  7  8 11 12 13 14 22 16
     Lung     Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid S Wall  Kidneys
G 70 3.1E-11 1.1E-08 1.7E-09 3.6E-10 5.4E-11 1.9E-11 3.5E-11 9.4E-12 4.5E-11 3.0E-11 3.1E-10 1.1E-08 1.0E-10
H 70 2.1E-09 1.6E-10 1.8E-11 7.3E-12 3.8E-12 9.6E-12 1.3E-11 4.3E-12 5.3E-12 1.1E-11 1.7E-10 1.6E-10 3.4E-11
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RU105   Class: Y F1:   0.05000     08/17/88  21:40:15.9   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 4.7E-10 4.2E-08 6.8E-08 1.4E-07 1.1E-07 6.3E-10 1.8E-09 5.8E-10 7.5E-09 1.2E-09 1.5E-10
H 70 4.7E-08 6.7E-09 1.0E-08 2.3E-08 2.3E-08 3.3E-10 5.7E-10 1.1E-10 1.2E-09 4.8E-10 3.0E-10
RH105   Class: Y F1:   0.05000     08/17/88  21:47:43.8   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 2.8E-10 1.4E-08 3.1E-08 1.3E-07 2.7E-07 3.8E-10 1.0E-09 5.3E-10 4.1E-09 6.4E-10 2.2E-10
H 70 6.6E-08 4.9E-09 1.1E-08 4.6E-08 9.4E-08 2.6E-10 5.3E-10 2.0E-10 1.5E-09 3.9E-10 2.1E-10
PD107   Class: Y F1:   0.00500     08/17/88  21:51:53.0   ChronicSv per 70 yr/Bq/yr for 70 yr
 13  1  3  4  5  6  7  8 11 12 13 14 17 16
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver   Kidneys
G 70 7.0E-13 7.7E-10 1.9E-09 1.1E-08 3.3E-08 1.0E-11 4.0E-12 7.2E-13 7.0E-13 7.0E-13 7.0E-13 2.5E-10 4.7E-10
H 70 1.7E-06 4.3E-10 1.1E-09 6.0E-09 1.8E-08 9.7E-11 3.8E-11 6.8E-12 6.7E-12 6.7E-12 6.7E-12 2.3E-09 4.4E-09
PD109   Class: Y F1:   0.00500     08/17/88  21:57:29.4   ChronicSv per 70 yr/Bq/yr for 70 yr
 13  1  3  4  5  6  7  8 11 12 13 14 17 16
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver   Kidneys
G 70 1.5E-11 4.0E-08 8.4E-08 3.0E-07 4.0E-07 8.9E-11 2.7E-10 2.5E-11 1.1E-09 8.3E-11 8.1E-12 3.4E-10 6.0E-10
H 70 9.7E-08 1.0E-08 2.1E-08 7.6E-08 1.0E-07 6.7E-11 1.1E-10 1.4E-11 2.9E-10 6.4E-11 1.5E-11 4.0E-10 6.6E-10
AG110M  Class: D F1:   0.05000     08/17/88  22:02:44.4   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 6.8E-08 2.1E-07 4.7E-07 1.7E-06 4.7E-06 3.6E-08 7.2E-08 4.1E-08 2.2E-07 6.2E-08 2.3E-08 2.0E-06
H 70 7.7E-07 5.0E-07 4.8E-07 8.1E-07 8.9E-07 2.2E-07 3.3E-07 2.2E-07 3.0E-07 3.7E-07 2.1E-07 1.8E-05
AG111   Class: D F1:   0.05000     08/17/88  22:08:18.2   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 6.4E-10 2.9E-08 7.0E-08 3.8E-07 1.0E-06 5.1E-10 1.1E-09 7.2E-10 2.5E-09 7.9E-10 5.5E-10 6.7E-08
H 70 6.8E-08 7.8E-09 1.4E-08 5.9E-08 1.5E-07 3.4E-09 6.0E-09 5.0E-09 5.3E-09 5.3E-09 5.0E-09 6.1E-07
CD109   Class: D F1:   0.05000     08/17/88  22:13:22.9   ChronicSv per 70 yr/Bq/yr for 70 yr
 13  1  3  4  5  6  7  8 11 12 13 14 17 16
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver   Kidneys
G 70 2.2E-08 2.1E-08 3.4E-08 1.2E-07 3.2E-07 1.0E-08 2.2E-08 1.8E-08 2.4E-08 2.2E-08 1.9E-08 5.1E-07 2.8E-06
H 70 6.7E-08 1.3E-07 1.2E-07 1.3E-07 1.6E-07 9.3E-08 2.0E-07 1.7E-07 1.8E-07 2.1E-07 1.8E-07 4.7E-06 2.6E-05
CD113M  Class: D F1:   0.05000     08/17/88  22:19:00.1   ChronicSv per 70 yr/Bq/yr for 70 yr
 13  1  3  4  5  6  7  8 11 12 13 14 17 16
     Lung    Stomach S Int.  UL Int.. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver   Kidneys
G 70 2.0E-07 1.3E-07 1.5E-07 3.1E-07 7.5E-07 1.0E-07 2.0E-07 2.0E-07 2.1E-07 2.0E-07 2.0E-07 5.5E-06 3.3E-05
H 70 6.0E-08 1.1E-06 1.1E-06 9.6E-07 1.2E-06 9.6E-07 1.9E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06 5.1E-05 3.1E-04
CD115M  Class: D F1:   0.05000     08/17/88  22:24:26.3   ChronicSv per 70 yr/Bq/yr for 70 yr
 13  1  3  4  5  6  7  8 11 12 13 14 17 16
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver   Kidneys
G 70 1.2E-08 5.6E-08 1.2E-07 7.0E-07 2.0E-06 5.9E-09 1.2E-08 1.2E-08 1.3E-08 1.2E-08 1.2E-08 3.1E-07 1.8E-06
H 70 1.2E-07 7.4E-08 8.3E-08 1.6E-07 3.6E-07 5.5E-08 1.1E-07 1.1E-07 1.1E-07 1.1E-07 1.1E-07 2.9E-06 1.7E-05
CD115   Class: D F1:   0.05000     08/17/88  22:39:43.9   ChronicSv per 70 yr/Bq/yr for 70 yr
 13  1  3  4  5  6  7  8 11 12 13 14 17 16
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver   Kidneys
G 70 1.2E-09 3.2E-08 9.0E-08 4.4E-07 1.1E-06 2.1E-09 5.3E-09 2.5E-09 2.2E-08 3.2E-09 6.8E-10 1.4E-08 6.9E-08
H 70 7.5E-08 1.2E-08 1.9E-08 7.1E-08 1.6E-07 6.0E-09 8.3E-09 6.1E-09 9.5E-09 7.3E-09 5.8E-09 1.1E-07 5.8E-07
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IN115M  Class: D F1:   0.02000     08/17/88  22:48:57.3   ChronicSv per 70 yr/Bq/yr for 70 yr
 14  1  3  4  5  6  7  8 11 12 13 14 17 16 19
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver   Kidneys Spleen
G 70 7.1E-11 1.4E-08 2.2E-08 4.1E-08 2.5E-08 1.4E-10 4.0E-10 8.4E-11 1.6E-09 2.2E-10 1.2E-11 2.9E-10 4.3E-10 3.7E-10
H 70 8.9E-09 2.1E-09 3.1E-09 5.7E-09 3.6E-09 4.4E-10 3.4E-10 1.5E-10 3.7E-10 2.1E-10 1.7E-10 9.2E-10 1.5E-09 5.7E-10
IN111   Class: D F1:   0.02000     08/18/88  16:59:35.4   ChronicSv per 70 yr/Bq/yr for 70 yr
 14  1  3  4  5  6  7  8 11 12 13 14 17 16 19
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver   Kidneys Spleen
G 70 5.1E-10 1.1E-08 3.4E-08 7.5E-08 1.4E-07 2.4E-09 6.9E-09 2.1E-09 2.9E-08 3.0E-09 8.3E-11 3.3E-09 4.7E-09 2.9E-09
H 70 1.2E-08 4.4E-09 7.2E-09 1.4E-08 2.2E-08 7.1E-09 6.6E-09 1.1E-09 5.7E-09 2.6E-09 1.3E-09 2.1E-08 3.0E-08 1.0E-08
IN114M  Class: D F1:   0.02000     08/18/88  17:06:12.9   ChronicSv per 70 yr/Bq/yr for 70 yr
 14  1  3  4  5  6  7  8 11 12 13 14 17 16 19
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver   Kidneys Spleen
G 70 6.2E-10 7.2E-08 1.8E-07 1.1E-06 3.1E-06 5.3E-08 2.0E-08 8.4E-10 9.2E-09 1.3E-09 2.5E-10 1.4E-07 2.8E-07 7.0E-08
H 70 1.8E-07 2.1E-08 3.6E-08 1.7E-07 4.6E-07 1.2E-06 4.1E-07 4.4E-09 8.0E-09 9.3E-09 5.4E-09 3.2E-06 6.4E-06 1.6E-06
SN117M  Class: W F1:   0.02000     08/18/88  17:12:02.5   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 4.0E-10 1.7E-08 4.6E-08 2.0E-07 5.6E-07 3.6E-08 7.5E-09 1.2E-09 1.5E-08 1.7E-09 2.2E-10
H 70 4.1E-07 1.0E-08 1.9E-08 8.2E-08 2.2E-07 1.5E-07 1.8E-08 1.3E-09 7.1E-09 3.6E-09 2.1E-09
SN119M  Class: W F1:   0.02000     08/18/88  17:17:23.2   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 6.7E-10 7.0E-09 1.8E-08 9.4E-08 2.8E-07 1.3E-08 5.7E-09 6.2E-10 2.9E-09 7.2E-10 6.2E-10
H 70 7.6E-07 5.9E-09 1.0E-08 4.6E-08 1.4E-07 7.6E-08 3.2E-08 3.6E-09 5.0E-09 4.7E-09 3.7E-09
SN121M  Class: W F1:   0.02000     08/18/88  17:23:45.6   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 2.0E-09 4.2E-09 1.1E-08 7.8E-08 3.0E-07 4.2E-08 1.6E-08 2.0E-09 3.0E-09 2.1E-09 2.0E-09
H 70 1.3E-06 9.7E-09 1.5E-08 5.8E-08 1.8E-07 2.6E-07 1.0E-07 1.3E-08 1.3E-08 1.3E-08 1.3E-08
SN121   Class: W F1:   0.02000     08/18/88  17:34:50.2   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 1.4E-11 9.1E-09 2.0E-08 9.0E-08 1.7E-07 1.4E-10 5.9E-11 1.5E-11 1.4E-11 1.4E-11 1.4E-11
H 70 3.5E-08 2.5E-09 5.4E-09 2.5E-08 4.6E-08 5.8E-10 2.5E-10 6.2E-11 6.0E-11 6.1E-11 6.1E-11
SN123   Class: W F1:   0.02000     08/18/88  17:39:19.2   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 2.2E-09 4.2E-08 1.0E-07 6.2E-07 1.8E-06 4.7E-08 1.7E-08 2.3E-09 2.7E-09 2.3E-09 2.2E-09
H 70 4.0E-06 2.5E-08 5.4E-08 2.9E-07 8.3E-07 2.6E-07 9.4E-08 1.2E-08 1.3E-08 1.3E-08 1.3E-08
I 125   Class: D F1:   1.00000     08/18/88  17:45:33.3   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 15
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Bladder
G 70 3.1E-09 4.4E-09 2.4E-09 2.4E-09 2.6E-09 1.8E-08 1.3E-08 1.8E-09 2.5E-09 9.8E-09 2.2E-05 9.7E-09
H 70 7.3E-09 1.4E-09 1.5E-09 1.5E-09 1.6E-09 1.1E-08 8.0E-09 1.1E-09 1.5E-09 6.0E-09 1.3E-05 5.8E-09
SN125   Class: W F1:   0.02000     08/18/88  17:51:21.5   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 1.1E-09 7.2E-08 1.7E-07 9.4E-07 2.5E-06 1.7E-08 1.5E-08 2.4E-09 2.1E-08 3.1E-09 7.0E-10
H 70 1.5E-06 3.3E-08 6.9E-08 3.7E-07 9.9E-07 7.6E-08 5.1E-08 3.6E-09 1.1E-08 6.4E-09 5.3E-09
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SB125  Class: W F1:   0.01000    08/18/88  18:08:36.3   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 9.5E-10 1.8E-08 5.4E-08 1.7E-07 4.5E-07 6.9E-09 8.4E-09 3.6E-09 3.7E-08 4.3E-09 3.8E-10 4.4E-09
H 70 1.5E-06 4.1E-08 3.4E-08 9.2E-08 2.2E-07 7.3E-08 3.5E-08 5.9E-09 2.4E-08 2.7E-08 2.1E-08 5.7E-08
TE125M Class: W F1:   0.20000    08/18/88  18:19:35.1   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 3.1E-09 1.2E-08 2.5E-08 1.2E-07 3.3E-07 9.2E-07 8.6E-08 2.7E-09 8.9E-09 3.2E-09 2.8E-09
H 70 6.9E-07 7.4E-09 1.2E-08 5.2E-08 1.5E-07 8.2E-07 7.9E-08 2.5E-09 5.4E-09 4.7E-09 2.7E-09
SN126  Class: W F1:   0.02000    08/18/88  18:25:57.5   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 4.1E-08 1.0E-07 3.0E-07 1.1E-06 3.1E-06 3.5E-07 1.8E-07 4.7E-08 1.7E-07 5.5E-08 3.8E-08
H 70 9.9E-06 3.5E-07 3.6E-07 7.5E-07 1.7E-06 2.2E-06 1.1E-06 2.3E-07 3.3E-07 3.6E-07 3.3E-07
SB126M Class: W F1:   0.01000    08/18/88  18:44:25.8   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 1.4E-10 1.8E-08 5.2E-09 2.0E-09 5.5E-10 7.0E-11 1.6E-10 2.2E-11 3.9E-10 1.5E-10 1.2E-11 2.1E-10
H 70 3.9E-09 2.8E-10 9.2E-11 7.7E-11 9.6E-11 5.2E-11 6.5E-11 1.6E-11 3.3E-11 5.8E-11 5.2E-11 1.1E-10
SB126  Class: W F1:   0.01000    08/18/88  18:51:07.2   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 4.8E-09 8.1E-08 2.5E-07 5.7E-07 1.3E-06 1.6E-08 4.2E-08 2.0E-08 2.1E-07 2.5E-08 1.2E-09 2.1E-08
H 70 9.3E-07 7.7E-08 1.1E-07 2.4E-07 5.4E-07 4.7E-08 5.4E-08 1.4E-08 9.0E-08 4.4E-08 3.2E-08 7.9E-08
SB124  Class: W F1:   0.01000    08/18/88  18:56:23.5   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 3.8E-09 6.8E-08 2.0E-07 6.1E-07 1.6E-06 1.4E-08 2.7E-08 1.3E-08 1.3E-07 1.6E-08 1.2E-09 1.5E-08
H 70 2.7E-06 1.0E-07 1.1E-07 2.9E-07 7.2E-07 8.8E-08 7.3E-08 1.5E-08 6.9E-08 5.9E-08 4.5E-08 1.2E-07
SB127  Class: W F1:   0.01000    08/18/88  19:02:47.6   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 1.1E-09 3.9E-08 1.2E-07 5.1E-07 1.4E-06 3.8E-09 9.3E-09 4.1E-09 4.3E-08 5.4E-09 3.1E-10 5.2E-09
H 70 4.6E-07 2.1E-08 4.7E-08 2.0E-07 5.0E-07 9.5E-09 1.1E-08 3.0E-09 1.7E-08 6.0E-09 4.0E-09 1.4E-08
TE127M Class: W F1:   0.20000    08/18/88  19:19:09.8   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 6.8E-09 1.2E-08 2.8E-08 2.1E-07 7.8E-07 1.5E-06 3.8E-07 6.7E-09 8.8E-09 6.9E-09 6.7E-09
H 70 2.2E-06 1.3E-08 2.2E-08 1.2E-07 3.8E-07 1.4E-06 3.6E-07 6.5E-09 7.6E-09 7.6E-09 6.7E-09
TE127  Class: W F1:   0.20000    08/18/88  19:30:16.0   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 2.1E-10 1.7E-08 2.8E-08 8.4E-08 9.3E-08 5.6E-10 6.5E-10 2.1E-10 2.9E-10 2.2E-10 2.1E-10
H 70 2.9E-08 3.0E-09 4.9E-09 1.5E-08 1.6E-08 3.5E-10 4.0E-10 1.3E-10 1.5E-10 1.4E-10 1.3E-10
TE123M Class: W F1:   0.20000    08/18/88  19:34:28.8   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 7.7E-09 1.6E-08 3.2E-08 1.1E-07 3.2E-07 1.7E-06 1.6E-07 6.7E-09 2.0E-08 8.9E-09 6.7E-09
H 70 8.4E-07 1.7E-08 1.8E-08 5.6E-08 1.5E-07 1.6E-06 1.6E-07 6.0E-09 1.3E-08 1.4E-08 9.9E-09
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TE129M  Class: W F1:   0.20000     08/18/88  19:41:20.8   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 15
    Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Bladder
G 70 1.1E-08 3.8E-08 9.6E-08 5.6E-07 1.7E-06 5.7E-07 2.4E-07 4.0E-05 1.7E-08 1.2E-08 8.7E-07 1.0E-08
H 70 2.6E-06 2.8E-08 4.9E-08 2.4E-07 7.2E-07 4.8E-07 2.1E-07 3.4E-05 1.2E-08 1.2E-08 8.7E-07 8.2E-09
TE129   Class: W F1:   0.20000     08/18/88  20:01:09.4   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 15
    Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Bladder
G 70 3.6E-11 2.8E-08 2.0E-08 1.3E-08 2.8E-09 5.7E-11 7.6E-11 4.2E-09 1.2E-10 4.5E-11 1.1E-05 1.5E-09
H 70 1.1E-08 1.1E-09 7.7E-10 5.2E-10 1.2E-10 6.7E-11 7.0E-11 5.5E-09 3.7E-11 3.9E-11 1.1E-05 1.5E-09
TE131M  Class: W F1:   0.20000     08/18/88  20:12:54.3   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 15
    Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Bladder
G 70 3.7E-09 4.6E-08 1.1E-07 3.3E-07 5.7E-07 2.6E-08 1.7E-08 7.1E-07 5.1E-08 9.0E-09 2.8E-06 2.2E-08
H 70 1.5E-07 1.8E-08 3.3E-08 9.3E-08 1.6E-07 1.7E-08 9.5E-09 4.6E-07 1.5E-08 5.8E-09 2.3E-06 9.7E-09
TE131   Class: W F1:   0.20000     08/18/88  20:35:17.3   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 15
    Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Bladder
G 70 4.8E-11 2.3E-08 7.7E-09 2.4E-09 2.7E-10 3.3E-11 7.2E-11 5.2E-10 1.6E-10 5.5E-11 5.6E-07 8.5E-10
H 70 5.3E-09 3.7E-10 1.2E-10 4.6E-11 1.4E-11 3.3E-11 4.0E-11 1.8E-09 1.8E-11 2.8E-11 5.3E-07 7.7E-10
TE132   Class: W F1:   0.20000     08/18/88  20:47:26.0   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 15
    Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Bladder
G 70 1.3E-09 1.4E-08 3.2E-08 1.1E-07 2.4E-07 4.1E-08 8.6E-09 6.3E-07 1.6E-08 2.8E-09 2.9E-06 2.0E-07
H 70 8.9E-08 6.1E-09 1.1E-08 3.7E-08 8.3E-08 3.0E-08 5.8E-09 4.4E-07 6.1E-09 2.3E-09 2.9E-06 2.0E-07
TE133M  Class: W F1:   0.20000     08/18/88  20:58:20.5   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 15
    Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Bladder
G 70 4.4E-10 4.7E-08 2.9E-08 1.9E-08 3.9E-09 3.4E-10 8.1E-10 4.0E-09 2.5E-09 6.7E-10 2.8E-07 3.7E-09
H 70 1.4E-08 1.8E-09 9.8E-10 6.9E-10 1.9E-10 2.1E-10 2.7E-10 6.3E-09 1.6E-10 2.5E-10 1.8E-07 2.0E-09
TE133   Class: W F1:   0.20000     08/18/88  21:21:43.7   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 15
    Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Bladder
G 70 5.5E-11 1.7E-08 3.1E-09 6.9E-10 1.1E-10 2.6E-11 5.5E-11 1.0E-10 1.1E-10 5.6E-11 7.7E-08 8.6E-10
H 70 3.2E-09 1.5E-10 3.1E-11 1.3E-11 6.8E-12 1.9E-11 2.5E-11 7.4E-10 9.4E-12 2.2E-11 5.5E-08 5.9E-10
TE134   Class: W F1:   0.20000     08/18/88  21:34:47.4   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 15
    Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Bladder
G 70 1.4E-10 1.6E-08 8.0E-09 4.5E-09 8.5E-10 1.1E-10 2.5E-10 8.4E-10 6.7E-10 1.9E-10 4.1E-08 4.4E-09
H 70 4.1E-09 4.6E-10 2.1E-10 1.3E-10 4.0E-11 7.9E-11 8.0E-11 1.7E-09 4.0E-11 7.2E-11 2.5E-08 2.6E-09
I 134   Class: D F1:   1.00000     08/18/88  21:42:19.9   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 15
    Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Bladder
G 70 1.1E-09 4.0E-08 1.5E-09 1.5E-09 1.3E-09 4.1E-09 4.1E-09 9.0E-10 1.1E-09 1.1E-09 3.1E-08 3.9E-09
H 70 9.7E-09 4.9E-09 5.2E-10 5.2E-10 5.1E-10 1.9E-09 1.9E-09 4.0E-10 4.4E-10 5.5E-10 1.4E-08 1.7E-09
CS134M  Class: D F1:   1.00000     08/18/88  21:46:27.8   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
    Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 2.6E-10 7.7E-09 3.0E-10 2.8E-10 2.7E-10 1.2E-10 2.6E-10 2.6E-10 2.6E-10 2.6E-10 2.6E-10
H 70 4.3E-09 1.1E-09 1.3E-10 1.2E-10 1.2E-10 6.1E-11 1.2E-10 1.1E-10 1.1E-10 1.2E-10 1.1E-10
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I 130   Class: D F1:   1.00000    08/18/88  21:50:35.3   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 15
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Bladder
G 70 7.8E-09 4.3E-08 8.4E-09 8.3E-09 9.9E-09 7.3E-08 2.5E-08 7.6E-09 8.4E-09 8.7E-09 2.3E-06 5.5E-08
H 70 4.1E-08 9.4E-09 4.1E-09 4.1E-09 4.8E-09 3.6E-08 1.3E-08 3.8E-09 4.2E-09 5.0E-09 1.1E-06 2.7E-08
I 135   Class: D F1:   1.00000    08/18/88  21:55:13.3   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 15
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Bladder
G 70 4.0E-09 3.9E-08 4.7E-09 4.5E-09 5.2E-09 2.6E-08 1.8E-08 4.3E-09 4.7E-09 4.3E-09 1.0E-06 3.5E-08
H 70 3.0E-08 7.0E-09 2.1E-09 2.0E-09 2.3E-09 1.2E-08 8.6E-09 2.0E-09 2.1E-09 2.3E-09 4.6E-07 1.6E-08
CS135   Class: D F1:   1.00000    08/18/88  22:05:22.7   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 1.3E-07 8.4E-08 1.4E-07 1.4E-07 1.4E-07 6.5E-08 1.3E-07 1.3E-07 1.3E-07 1.3E-07 1.3E-07
H 70 1.4E-08 4.9E-08 8.8E-08 8.7E-08 8.8E-08 4.0E-08 8.2E-08 8.2E-08 8.2E-08 8.2E-08 8.2E-08
CS138   Class: D F1:   1.00000    08/18/88  22:12:09.0   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 6.2E-10 5.1E-08 7.9E-10 8.8E-10 6.6E-10 2.8E-10 4.5E-10 4.4E-10 5.8E-10 5.8E-10 4.3E-10
H 70 1.1E-08 5.3E-09 2.7E-10 2.8E-10 2.5E-10 1.6E-10 2.4E-10 2.0E-10 2.4E-10 2.9E-10 2.6E-10
BA139   Class: D F1:   0.10000    08/18/88  22:19:20.6   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 2.2E-11 4.9E-08 3.9E-08 3.4E-08 7.8E-09 3.3E-11 5.9E-11 1.6E-11 1.1E-10 3.1E-11 1.3E-11
H 70 1.7E-08 6.2E-09 5.0E-09 4.2E-09 1.0E-09 1.8E-10 2.0E-10 1.1E-10 1.2E-10 1.2E-10 1.1E-10
BA140   Class: D F1:   0.10000    08/18/88  22:23:41.0   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 2.7E-09 3.8E-08 1.1E-07 5.2E-07 1.8E-06 3.7E-08 2.7E-08 7.9E-09 6.6E-08 8.9E-09 1.7E-09
H 70 9.7E-08 1.1E-08 2.3E-08 8.3E-08 2.8E-07 1.5E-07 7.0E-08 8.2E-09 1.8E-08 9.8E-09 8.0E-09
LA140   Class: D F1:   0.00100    08/18/88  22:34:33.9   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 2.9E-09 7.5E-08 2.1E-07 6.4E-07 1.2E-06 6.9E-09 2.0E-08 8.9E-09 9.6E-08 1.3E-08 4.5E-10 1.2E-08
H 70 1.1E-07 2.5E-08 4.3E-08 1.1E-07 1.9E-07 2.9E-08 3.2E-08 9.1E-09 2.5E-08 1.4E-08 8.6E-09 2.5E-07
CS136   Class: D F1:   1.00000    08/18/88  22:39:40.2   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 1.9E-07 2.2E-07 2.6E-07 2.4E-07 2.6E-07 7.5E-08 1.9E-07 2.3E-07 2.0E-07 1.9E-07 2.1E-07
H 70 1.3E-07 1.2E-07 1.6E-07 1.5E-07 1.6E-07 4.6E-08 1.2E-07 1.4E-07 1.2E-07 1.1E-07 1.3E-07
BA141   Class: D F1:   0.10000    08/18/88  22:45:47.9   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 7.6E-11 2.8E-08 1.3E-08 1.6E-08 8.2E-09 8.1E-11 1.0E-10 1.9E-11 2.1E-10 8.5E-11 1.3E-11
H 70 7.8E-09 2.6E-09 1.6E-09 2.1E-09 1.2E-09 2.5E-10 1.2E-10 5.5E-11 7.5E-11 7.9E-11 7.0E-11
LA141   Class: D F1:   0.00100    08/18/88  22:58:40.9   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 2.0E-11 6.6E-08 9.9E-08 1.8E-07 1.1E-07 4.5E-11 7.8E-11 2.3E-11 2.7E-10 5.2E-11 3.8E-12 9.1E-11
H 70 4.3E-08 9.4E-09 1.4E-08 2.6E-08 1.5E-08 8.9E-09 2.5E-09 6.7E-10 7.2E-10 7.1E-10 6.8E-10 1.5E-08
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CE141   Class: Y F1:   0.00030     08/18/88  23:08:02.3   ChronicSv per 70 yr/Bq/yr for 70 yr
 13  1  3  4  5  6  7  8 11 12 13 14 17 19
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver   Spleen
G 70 1.0E-10 1.6E-08 4.1E-08 2.1E-07 6.1E-07 1.7E-09 2.4E-09 5.4E-10 7.5E-09 7.8E-10 1.3E-11 1.4E-09 1.3E-09
H 70 1.1E-06 1.1E-08 1.9E-08 9.6E-08 2.8E-07 1.8E-08 6.0E-09 3.7E-10 3.7E-09 3.0E-09 1.7E-09 1.7E-08 1.5E-08
BA142   Class: D F1:   0.10000     08/18/88  23:14:32.7   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 1.2E-10 1.4E-08 8.0E-09 6.6E-09 1.8E-09 8.7E-11 2.1E-10 5.7E-11 7.1E-10 1.8E-10 1.7E-11
H 70 3.7E-09 1.4E-09 9.8E-10 8.6E-10 2.6E-10 8.0E-11 1.0E-10 4.5E-11 1.3E-10 9.3E-11 7.0E-11
LA142   Class: D F1:   0.00100     08/18/88  23:21:49.3   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 6.2E-10 6.2E-08 5.8E-08 5.5E-08 1.6E-08 5.6E-10 1.5E-09 4.1E-10 5.3E-09 1.1E-09 8.5E-11 1.6E-09
H 70 2.1E-08 8.5E-09 7.9E-09 7.4E-09 2.4E-09 8.4E-10 1.1E-09 5.1E-10 1.2E-09 8.3E-10 6.3E-10 2.8E-09
CE143   Class: Y F1:   0.00030     08/18/88  23:26:16.8   ChronicSv per 70 yr/Bq/yr for 70 yr
 13  1  3  4  5  6  7  8 11 12 13 14 17 19
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver   Spleen
G 70 2.7E-10 3.9E-08 9.7E-08 3.9E-07 8.6E-07 1.2E-09 3.6E-09 1.1E-09 1.5E-08 1.7E-09 3.1E-11 1.6E-09 1.6E-09
H 70 2.6E-07 1.4E-08 3.4E-08 1.4E-07 3.0E-07 1.1E-09 2.1E-09 4.1E-10 5.3E-09 1.1E-09 4.3E-10 3.3E-09 3.0E-09
PR143   Class: Y F1:   0.00030     08/18/88  23:36:08.6   ChronicSv per 70 yr/Bq/yr for 70 yr
 13  1  3  4  5  6  7  8 11 12 13 14 17 16
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver   Kidneys
G 70 4.6E-13 2.5E-08 6.2E-08 3.6E-07 1.1E-06 7.4E-11 7.2E-11 4.6E-13 4.6E-13 4.6E-13 4.7E-13 5.8E-10 1.2E-10
H 70 8.9E-07 1.1E-08 2.8E-08 1.6E-07 4.7E-07 1.0E-09 1.0E-09 6.5E-12 6.6E-12 6.5E-12 6.6E-12 8.1E-09 1.7E-09
ND147   Class: Y F1:   0.00030     08/18/88  23:42:14.3   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 1.7E-10 2.5E-08 6.7E-08 3.3E-07 8.7E-07 1.6E-09 3.5E-09 9.6E-10 1.3E-08 1.3E-09 1.9E-11 1.4E-09
H 70 7.2E-07 1.3E-08 3.0E-08 1.4E-07 3.9E-07 2.1E-08 6.2E-09 4.6E-10 5.7E-09 2.3E-09 1.2E-09 1.2E-08
PM147   Class: Y F1:   0.00030     08/18/88  23:59:17.1   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 1.1E-13 4.8E-09 1.3E-08 7.3E-08 2.2E-07 1.8E-08 1.4E-09 1.3E-13 5.8E-13 1.5E-13 9.5E-14 4.6E-09
H 70 5.0E-06 2.5E-09 6.5E-09 3.8E-08 1.2E-07 1.2E-06 1.0E-07 6.9E-12 7.2E-12 9.0E-12 7.9E-12 3.3E-07
SM147   Class: W F1:   0.00030     08/19/88  00:10:11.9   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 6.9E-11 3.6E-08 9.1E-08 5.3E-07 1.6E-06 5.0E-05 4.0E-06 6.9E-11 6.9E-11 6.9E-11 6.9E-11 1.4E-05
H 70 5.0E-04 4.5E-08 7.1E-08 2.8E-07 8.3E-07 1.9E-02 1.5E-03 2.7E-08 2.7E-08 2.7E-08 2.7E-08 5.3E-03
PM148M  Class: Y F1:   0.00030     08/19/88  00:18:10.1   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 3.1E-09 5.5E-08 1.8E-07 4.1E-07 9.5E-07 1.2E-08 3.1E-08 1.5E-08 1.5E-07 1.9E-08 4.5E-10 1.6E-08
H 70 2.4E-06 1.3E-07 1.0E-07 2.1E-07 4.5E-07 9.1E-08 9.0E-08 8.9E-09 8.0E-08 8.2E-08 6.9E-08 1.7E-07
PM148   Class: Y F1:   0.00030     08/19/88  00:29:00.0   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 8.4E-10 6.7E-08 1.8E-07 8.3E-07 2.2E-06 2.4E-09 6.9E-09 3.0E-09 3.3E-08 4.3E-09 1.3E-10 4.0E-09
H 70 9.3E-07 3.3E-08 7.5E-08 3.5E-07 9.3E-07 4.9E-09 7.4E-09 1.4E-09 1.5E-08 4.9E-09 2.6E-09 1.3E-08
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PM149   Class: Y F1:    0.00030     08/19/88  00:34:53.8   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 1.2E-11 2.9E-08 7.0E-08 3.5E-07 8.4E-07 6.9E-11 1.6E-10 5.4E-11 6.5E-10 7.3E-11 1.7E-12 1.3E-10
H 70 2.1E-07 1.1E-08 2.6E-08 1.3E-07 3.2E-07 3.6E-10 3.9E-10 2.7E-11 2.6E-10 6.2E-11 2.9E-11 1.1E-09
SM153   Class: W F1:    0.00030     08/19/88  00:40:16.7   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 5.1E-11 2.3E-08 5.7E-08 2.7E-07 5.7E-07 5.9E-10 1.9E-09 2.6E-10 5.1E-09 4.9E-10 2.0E-12 4.1E-10
H 70 1.4E-07 7.6E-09 1.8E-08 8.3E-08 1.8E-07 1.1E-08 4.9E-09 1.9E-10 1.7E-09 4.8E-10 2.0E-10 1.3E-08
EU156   Class: W F1:    0.00100     08/19/88  00:45:46.6   ChronicSv per 70 yr/Bq/yr for 70 yr
 13  1  3  4  5  6  7  8 11 12 13 14 16 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Kidneys Liver
G 70 2.3E-09 5.6E-08 1.7E-07 5.9E-07 1.6E-06 8.2E-09 1.8E-08 8.2E-09 8.6E-08 1.1E-08 3.7E-10 1.3E-08 1.1E-08
H 70 1.2E-06 5.2E-08 7.9E-08 2.5E-07 6.6E-07 1.9E-07 7.8E-08 7.1E-09 4.2E-08 2.5E-08 1.5E-08 9.1E-08 2.6E-07
GD153   Class: D F1:    0.00030     08/19/88  00:52:14.8   ChronicSv per 70 yr/Bq/yr for 70 yr
 13  1  3  4  5  6  7  8 11 12 13 14 16 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Kidneys Liver
G 70 1.5E-10 6.8E-09 2.2E-08 7.3E-08 1.9E-07 5.5E-09 5.7E-09 7.3E-10 1.4E-08 1.3E-09 1.5E-11 1.2E-09 1.9E-09
H 70 9.2E-08 4.6E-08 4.7E-08 7.3E-08 5.8E-08 6.1E-06 7.2E-07 1.4E-08 2.9E-08 4.6E-08 1.9E-08 1.3E-07 1.8E-06
TB160   Class: W F1:    0.00030     08/19/88  00:59:05.7   ChronicSv per 70 yr/Bq/yr for 70 yr
 13  1  3  4  5  6  7  8 11 12 13 14 16 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Kidneys Liver
G 70 1.9E-09 4.3E-08 1.3E-07 4.1E-07 1.1E-06 1.1E-08 1.8E-08 7.1E-09 8.2E-08 1.0E-08 3.0E-10 1.1E-08 9.4E-09
H 70 2.0E-06 9.2E-08 9.5E-08 2.3E-07 5.0E-07 1.7E-06 3.0E-07 1.8E-08 6.3E-08 6.5E-08 4.4E-08 1.4E-07 6.3E-07
HO166M  Class: W F1:    0.00030     08/17/88  17:55:37.7   ChronicSv per 70 yr/Bq/yr for 70 yr
 13  1  3  4  5  6  7  8 11 12 13 14 17 18
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver   Pancreas
G 70 1.3E-08 6.1E-08 1.7E-07 3.4E-07 7.9E-07 1.4E-07 5.3E-08 1.5E-08 1.4E-07 2.3E-08 3.3E-09 1.2E-07 1.8E-07
H 70 6.5E-06 5.2E-06 2.9E-06 4.0E-06 1.9E-06 5.0E-05 9.0E-06 8.7E-07 1.7E-06 2.7E-06 1.2E-06 4.1E-05 6.5E-05
W 181   Class: D F1:    0.30000     08/17/88  18:02:31.3   ChronicSv per 70 yr/Bq/yr for 70 yr
 14  1  3  4  5  6  7  8 11 12 13 14 16 17 19
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Kidneys Liver   Spleen
G 70 3.0E-10 2.2E-09 5.4E-09 1.4E-08 3.6E-08 3.3E-09 3.5E-09 3.3E-10 3.8E-09 5.7E-10 1.4E-10 5.2E-09 1.4E-09 4.6E-09
H 70 3.6E-09 7.9E-10 1.1E-09 2.4E-09 5.6E-09 4.9E-09 3.6E-09 2.1E-10 8.3E-10 4.8E-10 2.6E-10 8.2E-09 2.2E-09 7.3E-09
W 185   Class: D F1:    0.30000     08/17/88  18:09:28.0   ChronicSv per 70 yr/Bq/yr for 70 yr
 14  1  3  4  5  6  7  8 11 12 13 14 16 17 19
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Kidneys Liver   Spleen
G 70 1.9E-10 1.0E-08 1.8E-08 1.1E-07 3.1E-07 1.1E-08 3.7E-09 1.9E-10 2.0E-10 1.9E-10 1.9E-10 2.8E-08 5.1E-09 2.4E-08
H 70 2.6E-08 1.7E-09 2.8E-09 1.6E-08 4.7E-08 1.8E-08 6.2E-09 3.2E-10 3.3E-10 3.2E-10 3.2E-10 4.7E-08 8.5E-09 4.0E-08
W 187   Class: D F1:    0.30000     08/17/88  18:16:23.7   ChronicSv per 70 yr/Bq/yr for 70 yr
 14  1  3  4  5  6  7  8 11 12 13 14 16 17 19
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Kidneys Liver   Spleen
G 70 9.1E-10 3.0E-08 5.4E-08 1.8E-07 3.2E-07 5.7E-09 4.2E-09 1.7E-09 1.4E-08 2.2E-09 5.6E-10 6.2E-09 3.1E-09 5.3E-09
H 70 4.1E-08 5.3E-09 8.5E-09 2.7E-08 4.8E-08 7.4E-09 2.5E-09 1.0E-09 2.8E-09 1.3E-09 1.0E-09 6.5E-09 3.1E-09 5.9E-09
RE187   Class: W F1:    0.80000     08/17/88  18:25:27.6   ChronicSv per 70 yr/Bq/yr for 70 yr
 13  1  3  4  5  6  7  8 11 12 13 14 22 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid S Wall  Liver
G 70 2.8E-11 1.5E-09 4.3E-11 1.7E-10 5.0E-10 1.4E-11 2.8E-11 2.8E-11 2.8E-11 2.8E-11 7.4E-10 1.5E-09 3.8E-11
H 70 7.2E-09 9.7E-10 2.3E-11 8.6E-11 2.5E-10 9.0E-12 1.8E-11 1.8E-11 1.8E-11 1.8E-11 4.7E-10 9.7E-10 2.4E-11
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OS185   Class: D F1:   0.01000    08/17/88  18:32:07.0   ChronicSv per 70 yr/Bq/yr for 70 yr
 14  1  3  4  5  6  7  8 11 12 13 14 17 16 19
    Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver   Kidneys Spleen
G 70 3.8E-09 2.0E-08 6.1E-08 1.0E-07 2.0E-07 6.1E-09 1.5E-08 7.3E-09 5.9E-08 8.8E-09 2.0E-09 1.7E-08 1.8E-08 1.4E-08
H 70 1.2E-07 1.4E-07 1.4E-07 1.5E-07 1.3E-07 9.0E-08 1.1E-07 1.0E-07 9.5E-08 1.0E-07 8.4E-08 5.8E-07 4.8E-07 4.1E-07
OS191   Class: D F1:   0.01000    08/17/88  18:39:02.7   ChronicSv per 70 yr/Bq/yr for 70 yr
 14  1  3  4  5  6  7  8 11 12 13 14 17 16 19
    Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver   Kidneys Spleen
G 70 3.6E-10 1.3E-08 3.5E-08 1.6E-07 4.6E-07 1.1E-09 3.4E-09 7.7E-10 8.2E-09 1.1E-09 2.5E-10 3.5E-09 4.2E-09 3.5E-09
H 70 3.1E-08 1.1E-08 1.4E-08 3.3E-08 7.7E-08 9.5E-09 1.3E-08 1.1E-08 1.3E-08 1.2E-08 1.1E-08 1.3E-07 1.5E-07 1.3E-07
IR192   Class: Y F1:   0.01000    08/17/88  18:45:39.0   ChronicSv per 70 yr/Bq/yr for 70 yr
 14  1  3  4  5  6  7  8 11 12 13 14 17 16 19
    Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver   Kidneys Spleen
G 70 4.7E-09 3.9E-08 1.1E-07 3.5E-07 9.1E-07 6.9E-09 1.7E-08 9.1E-09 7.3E-08 1.1E-08 2.8E-09 3.1E-08 3.5E-08 2.8E-08
H 70 3.5E-06 9.1E-08 6.3E-08 1.8E-07 4.3E-07 4.6E-08 6.2E-08 6.7E-09 4.1E-08 5.7E-08 4.3E-08 1.2E-07 6.8E-08 1.1E-07
HG203   Class: D F1:   1.00000    08/17/88  18:52:35.5   ChronicSv per 70 yr/Bq/yr for 70 yr
 13  1  3  4  5  6  7  8 11 12 13 14 21 16
    Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Brain   Kidneys
G 70 8.6E-08 9.3E-08 1.1E-07 1.1E-07 9.8E-08 6.8E-08 1.0E-07 8.0E-08 9.5E-08 8.8E-08 9.1E-08 8.1E-07 1.3E-06
H 70 4.4E-08 5.2E-08 6.8E-08 6.5E-08 6.0E-08 4.1E-08 6.2E-08 4.9E-08 5.8E-08 5.3E-08 5.5E-08 4.9E-07 8.0E-07
U 232   Class: Y F1:   0.00200    08/17/88  19:02:30.1   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 16
    Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Kidneys
G 70 2.2E-08 1.1E-07 2.5E-07 1.3E-06 3.9E-06 1.4E-05 9.1E-07 2.2E-08 2.2E-08 2.1E-08 2.1E-08 4.0E-06
H 70 8.3E-02 1.9E-06 1.2E-06 2.1E-06 4.0E-06 3.5E-04 2.3E-05 9.4E-07 1.0E-06 1.5E-06 1.4E-06 1.6E-04
TH232   Class: Y F1:   0.00020    08/17/88  20:28:00.1   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
    Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 8.4E-08 1.5E-07 2.4E-07 1.0E-06 3.0E-06 9.0E-04 7.2E-05 8.2E-08 8.4E-08 8.4E-08 8.1E-08 6.7E-07
H 70 4.8E-02 3.5E-05 3.5E-05 3.5E-05 3.7E-05 2.2E-01 1.8E-02 3.5E-05 3.6E-05 3.6E-05 3.5E-05 2.9E-04
RA228   Class: W F1:   0.20000    08/17/88  21:35:38.4   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
    Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 4.6E-08 4.3E-08 1.1E-07 4.3E-07 1.5E-06 3.4E-04 3.4E-05 4.3E-08 9.1E-08 5.4E-08 3.3E-08
H 70 4.7E-04 1.6E-07 1.4E-07 3.7E-07 9.4E-07 3.6E-04 3.7E-05 7.4E-08 1.1E-07 1.3E-07 1.1E-07
AC228   Class: Y F1:   0.00100    08/17/88  22:31:14.7   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
    Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 5.2E-10 4.3E-08 7.9E-08 1.7E-07 1.3E-07 2.0E-07 1.9E-08 3.0E-09 1.0E-08 1.6E-09 6.8E-11 5.5E-08
H 70 1.7E-05 8.0E-09 1.3E-08 2.9E-08 2.4E-08 3.7E-06 3.0E-07 4.0E-08 1.8E-09 8.7E-10 5.4E-10 9.8E-07
TH228   Class: Y F1:   0.00020    08/17/88  23:03:56.5   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
    Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 1.6E-07 2.5E-07 4.3E-07 2.2E-06 9.4E-06 1.6E-04 1.3E-05 1.6E-07 1.8E-07 1.6E-07 1.6E-07 1.4E-06
H 70 4.5E-02 1.5E-05 1.5E-05 1.7E-05 2.1E-05 1.4E-02 1.2E-03 1.5E-05 1.5E-05 1.5E-05 1.5E-05 1.3E-04
RA224   Class: W F1:   0.20000    08/17/88  23:31:40.9   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
    Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 6.1E-07 9.1E-07 1.3E-06 4.8E-06 1.3E-05 2.2E-05 1.9E-06 6.1E-07 6.6E-07 6.0E-07 6.0E-07
H 70 4.4E-04 5.9E-07 7.4E-07 2.1E-06 5.0E-06 1.6E-05 1.4E-06 4.5E-07 4.8E-07 4.5E-07 4.5E-07
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DSFCT30.DAT

5.886

9/30/88

9 1 0 4 8 1 6 8 1

9 1 0 4 8 1 6 8 2

5.887

9/30/88

DSFCT30.DAT

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PB212  Class: D F1:   0.20000    08/17/88  23:46:48.0   ChronicSv per 70 yr/Bq/yr for 70 yr
 13  1  3  4  5  6  7  8 11 12 13 14 17 16
      Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver   Kidneys
G 70 1.2E-07 2.0E-07 4.0E-07 1.2E-06 1.4E-06 1.3E-05 1.2E-06 1.2E-07 1.4E-07 1.2E-07 1.1E-07 1.7E-06 9.3E-07
H 70 1.3E-05 2.5E-07 2.8E-07 3.9E-07 4.2E-07 2.8E-05 2.5E-06 2.4E-07 2.4E-07 2.4E-07 2.4E-07 3.7E-06 2.0E-06
BI212  Class: W F1:   0.05000    08/17/88  23:55:31.6   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 16
      Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Kidneys
G 70 7.4E-10 1.1E-07 7.9E-08 5.0E-08 9.8E-09 2.7E-09 1.1E-09 6.2E-10 2.0E-09 8.8E-10 5.4E-10 8.4E-08
H 70 2.7E-06 7.8E-09 6.5E-09 5.6E-09 4.2E-09 1.7E-08 4.7E-09 3.4E-09 3.5E-09 3.5E-09 3.5E-09 5.5E-07
PU236  Class: Y F1:   0.00010    08/17/88  23:59:26.4   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
      Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 6.1E-11 9.3E-08 2.4E-07 1.4E-06 4.2E-06 1.4E-05 1.1E-06 1.5E-07 3.1E-10 6.8E-11 5.9E-11 3.5E-06
H 70 1.0E-02 6.2E-08 1.4E-07 7.2E-07 2.2E-06 3.1E-03 2.4E-04 3.4E-05 1.4E-08 1.5E-08 1.3E-08 7.7E-04
PU237  Class: Y F1:   0.00010    08/18/88  00:05:41.3   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
      Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 5.4E-11 2.7E-09 8.6E-09 2.8E-08 7.2E-08 6.3E-10 1.7E-09 3.1E-10 5.0E-09 4.9E-10 2.7E-12 4.0E-10
H 70 2.4E-07 4.2E-09 4.3E-09 1.3E-08 3.3E-08 9.2E-09 5.0E-09 2.5E-10 2.5E-09 2.7E-09 1.5E-09 6.9E-09
AM242M Class: W F1:   0.00100    08/18/88  00:14:01.0   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
      Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 8.0E-10 5.2E-09 1.9E-08 1.7E-07 6.8E-07 8.7E-04 7.1E-05 1.1E-05 2.2E-09 6.1E-10 1.7E-10 1.6E-04
H 70 2.7E-04 6.3E-08 7.6E-08 2.1E-07 5.0E-07 1.0E-01 8.3E-03 1.3E-03 3.5E-08 6.5E-08 2.8E-08 1.9E-02
AM242  Class: W F1:   0.00100    08/18/88  01:02:51.8   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
      Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 1.1E-11 1.4E-08 3.1E-08 1.2E-07 1.8E-07 9.9E-08 8.3E-09 1.1E-09 7.2E-10 6.7E-11 1.8E-12 2.6E-08
H 70 3.3E-06 3.5E-09 7.4E-09 2.8E-08 4.5E-08 1.0E-05.8.5E-07 1.2E-07'3.3E-10 2.0E-10 1.7E-10 2.7E-06
CM242  Class: W F1:   0.00100    08/18/88  01:35:31.5   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
      Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 6.3E-10 1.0E-07 2.4E-07 1.4E-06 4.4E-06 2.9E-05 2.4E-06 3.3E-07 8.7E-10 6.4E-10 6.3E-10 7.6E-06
H 70 9.9E-04 1.1E-07 1.8E-07 7.2E-07 2.1E-06 3.1E-03 2.5E-04 3.4E-05 6.6E-08 6.6E-08 6.6E-08 8.0E-04
PU242  Class: Y F1:   0.00010    08/18/88  02:00:07.8   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
      Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 5.5E-11 8.1E-08 1.9E-07 1.2E-06 3.6E-06 8.3E-05 6.8E-06 1.0E-06 2.7E-10 6.6E-11 5.1E-11 1.6E-05
H 70 1.8E-02 6.9E-08 1.3E-07 6.6E-07 2.0E-06 3.5E-02 2.9E-03 4.4E-04 2.3E-08 2.7E-08 2.3E-08 6.8E-03
NP238  Class: W F1:   0.00100    08/18/88  02:15:22.4   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
      Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 7.2E-10 3.0E-08 8.0E-08 3.0E-07 6.5E-07 1.1E-07 1.4E-08 2.9E-09 2.7E-08 3.4E-09 1.1E-10 7.6E-09
H 70 2.3E-07 1.2E-08 2.6E-08 9.5E-08 2.1E-07 1.2E-05 9.7E-07 7.9E-08 9.1E-09 2.9E-09 1.7E-09 5.5E-07
CM244  Class: W F1:   0.00100    08/18/88  02:26:54.2   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
      Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 6.2E-10 9.4E-08 2.4E-07 1.4E-06 4.2E-06 5.4E-04 4.4E-05 6.5E-06 8.5E-10 6.2E-10 6.0E-10 1.1E-04
H 70 1.3E-03 1.2E-07 1.9E-07 7.3E-07 2.1E-06 6.2E-02 5.1E-03 7.5E-04 7.2E-08 7.2E-08 7.0E-08 1.3E-02
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PU244   Class: Y F1:   0.00010     08/18/88  02:51:27.2   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 2.1E-09 9.0E-08 2.5E-07 1.7E-06 5.9E-06 8.3E-05 6.7E-06 1.1E-06 3.3E-08 4.9E-09 8.3E-10 1.6E-05
H 70 1.7E-02 1.3E-06 8.3E-07 1.9E-06 3.8E-06 3.5E-02 2.8E-03 4.4E-04 4.2E-07 1.0E-06 6.5E-07 6.7E-03
U 240   Class: Y F1:   0.00200     08/18/88  03:07:59.1   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 16
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Kidneys
G 70 2.7E-10 6.7E-08 1.4E-07 5.0E-07 7.0E-07 7.6E-10 1.9E-09 7.0E-10 9.0E-09 1.1E-09 4.1E-11 1.9E-09
H 70 1.7E-07 1.8E-08 3.7E-08 1.3E-07 1.8E-07 9.7E-10 8.8E-10 2.0E-10 2.4E-09 6.2E-10 2.8E-10 1.4E-09
CM245   Class: W F1:   0.00100     08/18/88  03:17:29.9   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 4.5E-09 9.7E-08 2.4E-07 1.4E-06 4.1E-06 9.2E-04 7.5E-05 1.2E-05 1.1E-08 3.9E-09 1.7E-09 1.8E-04
H 70 1.2E-03 4.1E-07 4.8E-07 1.1E-06 2.2E-06 1.1E-01 8.7E-03 1.4E-03 2.3E-07 3.5E-07 2.0E-07 2.0E-02
CM246   Class: W F1:   0.00100     08/18/88  03:34:45.5   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 1.5E-09 9.1E-08 2.3E-07 1.3E-06 4.0E-06 9.5E-04 7.4E-05 1.2E-05 4.6E-09 2.3E-09 1.1E-09 1.7E-04
H 70 1.2E-03 2.4E-07 2.9E-07 8.2E-07 2.1E-06 1.1E-01 8.6E-03 1.4E-03 1.3E-07 2.2E-07 1.3E-07 2.0E-02
CM247   Class: W F1:   0.00100     08/18/88  03:43:44.2   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 1.4E-08 1.0E-07 2.6E-07 1.4E-06 4.3E-06 8.7E-04 6.9E-05 1.1E-05 3.6E-08 1.3E-08 6.5E-09 1.6E-04
H 70 1.1E-03 1.2E-06 1.3E-06 2.2E-06 2.8E-06 1.0E-01 8.0E-03 1.3E-03 7.1E-07 1.1E-06 7.6E-07 1.9E-02
CM243   Class: W F1:   0.00100     08/18/88  07:10:49.6   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 4.4E-09 1.1E-07 2.7E-07 1.5E-06 4.7E-06 6.5E-04 5.3E-05 8.0E-06 1.5E-08 4.3E-09 1.9E-09 1.4E-04
H 70 1.3E-03 4.2E-07 4.9E-07 1.2E-06 2.5E-06 7.6E-02 6.1E-03 9.3E-04 2.4E-07 3.5E-07 2.2E-07 1.6E-02
PU243   Class: Y F1:   0.00010     08/18/88  16:38:14.8   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 1.0E-11 1.2E-08 2.0E-08 4.0E-08 2.7E-08 4.6E-11 1.2E-10 1.1E-11 3.1E-10 4.0E-11 4.0E-13 4.8E-11
H 70 1.4E-08 1.8E-09 2.8E-09 5.7E-09 3.8E-09 2.9E-09 2.6E-10 3.8E-11 4.6E-11 1.8E-11 7.4E-12 5.7E-10
AM243   Class: W F1:   0.00100     08/18/88  16:57:39.0   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 1.0E-08 9.8E-08 2.4E-07 1.3E-06 4.2E-06 9.1E-04 7.2E-05 1.2E-05 1.6E-08 7.7E-09 3.6E-09 1.7E-04
H 70 1.2E-03 8.8E-07 9.3E-07 1.7E-06 2.7E-06 1.1E-01 8.4E-03 1.3E-03 4.8E-07 7.8E-07 4.2E-07 2.0E-02
NP239   Class: W F1:   0.00100     08/18/88  17:14:39.2   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 1.7E-10 2.4E-08 6.2E-08 2.7E-07 6.2E-07 2.5E-09 3.3E-09 8.0E-10 1.2E-08 1.2E-09 1.4E-11 1.1E-09
H 70 1.6E-07 8.7E-09 2.0E-08 8.8E-08 2.0E-07 1.3E-07 1.4E-08 1.4E-09 4.0E-09 1.1E-09 5.3E-10 9.0E-09
CM248   Class: W F1:   0.00100     08/18/88  17:24:15.0   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 3.4E-07 1.1E-06 2.6E-06 7.1E-06 2.0E-05 3.4E-03 2.7E-04 4.1E-05 1.4E-06 6.1E-07 2.0E-07 6.3E-04
H 70 4.4E-03 4.6E-05 4.2E-05 5.3E-05 3.3E-05 3.9E-01 3.1E-02 4.8E-03 2.2E-05 5.3E-05 2.3E-05 7.3E-02
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DSFCT30.DAT

5.888

9/30/88

3891 8401 6

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CF252   Class: W F1:   0.00100     08/18/88  17:30:49.5   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 3.1E-08 3.8E-07 1.1E-06 3.7E-06 1.1E-05 3.9E-04 3.1E-05 3.1E-06 5.7E-07 1.0E-07 1.8E-08 3.7E-05
H 70 2.5E-03 3.2E-06 2.9E-06 4.5E-06 7.1E-06 4.4E-02 3.5E-03 3.4E-04 1.7E-06 4.3E-06 2.2E-06 4.2E-03
SI31    Class: W F1:   0.01000     08/29/88  17:30:24.7   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 5.6E-12 3.9E-08 4.7E-08 6.7E-08 2.7E-08 3.0E-12 6.2E-12 5.6E-12 8.4E-12 6.0E-12 5.4E-12
H 70 2.4E-08 2.9E-09 3.6E-09 5.0E-09 2.1E-09 4.4E-11 8.8E-11 8.7E-11 8.7E-11 8.7E-11 8.8E-11
GA72    Class: W F1:   0.00100     08/29/88  17:34:35.6   ChronicSv per 70 yr/Bq/yr for 70 yr
 13  1  3  4  5  6  7  8 11 12 13 14 17 19
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver   Spleen
G 70 2.3E-09 6.9E-08 1.6E-07 4.2E-07 5.1E-07 4.5E-09 1.3E-08 5.3E-09 6.0E-08 8.4E-09 3.6E-10 8.9E-09 9.6E-09
H 70 1.1E-07 1.9E-08 3.6E-08 9.2E-08 1.1E-07 4.3E-09 6.6E-09 2.2E-09 1.4E-08 4.7E-09 2.8E-09 7.8E-09 7.6E-09
SR87M   Class: D F1:   0.30000     08/29/88  17:39:23.4   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 1.5E-10 6.7E-09 7.6E-09 1.0E-08 4.4E-09 1.8E-10 4.3E-10 1.2E-10 1.5E-09 2.9E-10 5.8E-11
H 70 3.0E-09 1.0E-09 1.1E-09 1.5E-09 6.7E-10 1.5E-10 2.1E-10 1.1E-10 2.9E-10 1.7E-10 1.3E-10
SN113   Class: W F1:   0.02000     08/29/88  17:45:33.2   ChronicSv per 70 yr/Bq/yr for 70 yr
 11  1  3  4  5  6  7  8 11 12 13 14
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid
G 70 1.8E-09 9.6E-09 4.5E-08 1.9E-07 5.6E-07 1.6E-08 1.3E-08 3.3E-09 2.7E-08 3.9E-09 1.5E-09
H 70 1.2E-06 2.6E-08 3.2E-08 1.0E-07 2.6E-07 8.8E-08 5.2E-08 8.2E-09 2.1E-08 2.0E-08 1.5E-08
IN113M  Class: D F1:   0.02000     08/29/88  17:57:32.7   ChronicSv per 70 yr/Bq/yr for 70 yr
 14  1  3  4  5  6  7  8 11 12 13 14 17 16 19
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver   Kidneys Spleen
G 70 6.6E-11 9.4E-09 9.2E-09 9.0E-09 2.5E-09 7.3E-11 2.0E-10 3.2E-11 7.0E-10 1.4E-10 7.0E-12 1.8E-10 2.7E-10 3.4E-10
H 70 3.4E-09 1.3E-09 1.2E-09 1.2E-09 3.7E-10 1.2E-10 1.3E-10 6.5E-11 1.5E-10 1.0E-10 7.9E-11 2.3E-10 2.9E-10 1.9E-10
SB122   Class: W F1:   0.01000     08/29/88  18:02:15.7   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 6.8E-10 5.3E-08 1.3E-07 6.2E-07 1.4E-06 2.3E-09 5.7E-09 2.5E-09 2.6E-08 3.2E-09 2.2E-10 3.4E-09
H 70 3.9E-07 2.0E-08 4.5E-08 2.1E-07 4.7E-07 5.8E-09 7.6E-09 2.1E-09 9.8E-09 3.5E-09 2.4E-09 1.0E-08
PR142   Class: Y F1:   0.00030     08/29/88  18:07:57.7   ChronicSv per 70 yr/Bq/yr for 70 yr
 13  1  3  4  5  6  7  8 11 12 13 14 17 16
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver   Kidneys
G 70 5.8E-11 6.3E-08 1.4E-07 5.5E-07 9.2E-07 1.2E-10 3.4E-10 1.3E-10 1.4E-09 2.2E-10 9.9E-12 2.8E-10 3.3E-10
H 70 2.0E-07 1.8E-08 4.0E-08 1.6E-07 2.7E-07 2.2E-10 2.8E-10 5.2E-11 4.4E-10 1.3E-10 5.5E-11 1.1E-09 5.5E-10
EU152M  Class: W F1:   0.00100     08/29/88  18:13:15.9   ChronicSv per 70 yr/Bq/yr for 70 yr
 13  1  3  4  5  6  7  8 11 12 13 14 16 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Kidneys Liver
G 70 2.0E-10 4.3E-08 8.3E-08 2.4E-07 2.5E-07 4.2E-10 1.2E-09 3.8E-10 5.2E-09 7.5E-10 2.6E-11 1.2E-09 8.3E-10
H 70 6.8E-08 7.8E-09 1.5E-08 4.2E-08 4.5E-08 1.4E-09 1.4E-09 2.1E-10 1.1E-09 4.5E-10 3.1E-10 2.8E-09 3.5E-09
GD159   Class: D F1:   0.00030     08/29/88  18:18:26.6   ChronicSv per 70 yr/Bq/yr for 70 yr
 13  1  3  4  5  6  7  8 11 12 13 14 16 17
     Lung    Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Kidneys Liver
G 70 3.8E-11 2.5E-08 5.5E-08 2.1E-07 3.3E-07 1.8E-10 5.7E-10 1.3E-10 2.1E-09 2.3E-10 3.8E-12 3.0E-10 2.2E-10
H 70 3.6E-08 3.9E-09 8.2E-09 3.1E-08 4.8E-08 1.4E-08 7.7E-09 4.7E-10 7.8E-10 5.5E-10 4.8E-10 8.9E-09 1.6E-08
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9/30/88

DSFCT30.DAT

9 1 0 4 8 1 6 8 4

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TB161   Class: W F1:   0.00030    08/29/88  18:23:56.4   ChronicSv per 70 yr/Bq/yr for 70 yr
 13  1  3  4  5  6  7  8 11 12 13 14 16 17
     Lung     Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Kidneys Liver
G 70 2.7E-11 1.7E-08 4.3E-08 2.3E-07 6.2E-07 1.1E-09 1.7E-09 2.1E-10 4.5E-09 3.7E-10 8.6E-13 3.7E-10 3.1E-10
H 70 2.8E-07 7.0E-09 1.6E-08 8.5E-08 2.3E-07 1.5E-07 1.4E-08 1.8E-10 1.8E-09 6.5E-10 2.1E-10 1.4E-08 2.2E-08
HO166   Class: W F1:   0.00030    08/29/88  18:30:04.9   ChronicSv per 70 yr/Bq/yr for 70 yr
 13  1  3  4  5  6  7  8 11 12 13 14 17 18
     Lung     Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver   Pancreas
G 70 2.9E-11 5.5E-08 1.3E-07 5.6E-07 1.1E-06 1.5E-10 4.3E-10 8.8E-11 1.3E-09 1.5E-10 4.2E-12 1.9E-10 3.2E-10
H 70 2.2E-07 1.5E-08 3.4E-08 1.5E-07 2.9E-07 6.9E-09 4.8E-09 2.3E-10 5.5E-10 3.0E-10 2.3E-10 1.5E-08 3.3E-08
ER169   Class: W F1:   0.00030    08/29/88  18:35:35.4   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung     Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 8.1E-13 8.5E-09 2.1E-08 1.2E-07 3.3E-07 5.2E-10 4.2E-11 8.1E-13 1.2E-12 8.1E-13 8.1E-13 1.1E-11
H 70 1.8E-07 3.4E-09 8.1E-09 4.6E-08 1.3E-07 1.3E-07 1.1E-08 2.1E-10 2.1E-10 2.1E-10 2.1E-10 2.9E-09
ER171   Class: W F1:   0.00030    08/29/88  18:41:52.4   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 17
     Lung     Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Liver
G 70 2.0E-10 3.5E-08 6.8E-08 1.7E-07 1.6E-07 5.9E-10 1.8E-09 4.0E-10 6.7E-09 8.5E-10 1.8E-11 9.9E-10
H 70 4.7E-08 5.9E-09 1.1E-08 2.6E-08 2.4E-08 2.5E-09 1.5E-09 1.9E-10 1.2E-09 4.6E-10 2.8E-10 8.7E-10
TA182   Class: Y F1:   0.00100    08/29/88  18:46:58.5   ChronicSv per 70 yr/Bq/yr for 70 yr
 12  1  3  4  5  6  7  8 11 12 13 14 16
     Lung     Stomach S Int.  UL Int. LL Int. Bone SurR MarrowTestes  Ovaries Muscle  Thyroid Kidneys
G 70 2.4E-09 4.3E-08 1.4E-07 3.8E-07 9.7E-07 8.1E-09 2.1E-08 8.2E-09 9.2E-08 1.2E-08 6.4E-10 1.5E-08
H 70 5.5E-06 1.8E-07 9.2E-08 2.2E-07 4.7E-07 1.0E-07 1.3E-07 9.1E-09 6.0E-08 1.2E-07 1.0E-07 1.1E-07
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DSFCT30.DAT

9/30/88

ISOLIB.DAT

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100
 20       PHOTON ATTENUATION LIBRARY  20 SHIELD MATERIALS    12-Jul-88 RAP
H2O       11 3.5694  .5280  .2900  .2280  .2040  .1910  .1828  .1723  .1698 4   6 1
          12  .1500  .1275  .1130  .1015  .0832  .0775  .0705  .0635  .0508       2
          13  .0537  .0505  .0480  .0457  .0436  .0418  .0395                     3
TISSUE    21 2.5497  .4690  .2920  .2320  .2060  .1910  .1800  .1720  .1660 4   6 4
          22  .1455  .1225  .1080  .0995  .0835  .0750  .0685  .0615  .0555       5
          23  .0520  .0493  .0465  .0443  .0425  .0418  .0395                     6
AIR       31 3.4220  .5060  .2710  .2100  .1860  .1738  .1653  .1585  .1535 7  14 7
          32  .1334  .1140  .1015  .0915  .0865  .0695  .0635  .0573  .0515       8
          33  .0478  .0450  .0425  .0407  .0387  .0370  .0339                     9
H         41  .3770  .3630  .3510  .3400  .3305  .3223  .3128  .3053  .2978 1   110
          42  .2650  .2440  .1975  .1750  .1570  .1385  .1260  .1125  .1025      11
          43  .0950  .0892  .0835  .0800  .0765  .0730  .0688                    12
LITHIUM   51  .2680  .1720  .1580  .1510  .1455  .1410  .1370  .1333  .1298 3   713
          52  .1150  .0990  .0880  .0775  .0685  .0605  .0550  .0505  .0447      14
          53  .0420  .0390  .0375  .0360  .0350  .0335  .0304                    15
CARBON    61 1.4520  .3055  .2110  .1855  .1735  .1660  .1600  .1550  .1510 6  1216
          62  .1350  .1150  .1015  .0915  .0865  .0695  .0635  .0573  .0515      17
          63  .0478  .0450  .0425  .0407  .0387  .0370  .0339                    18
AL        71 17.907 2.1100  .7610  .4055  .3555  .2308  .2003  .1788  .166313  2719
          72  .1340  .1280  .0990  .0868  .0755  .0676  .0615  .0553  .0498      20
          73  .0467  .0438  .0414  .0390  .0375  .0365  .0357                    21
TI        81 37.000 10.617 3.6200 1.7050  .9800  .6698  .4893  .3673  .303822  4822
          82  .1630  .1200  .0970  .0840  .0730  .0640  .0585  .0530  .0478      23
          83  .0455  .0435  .0410  .0400  .0390  .0375  .0350                    24
IRON      91 44.165 12.277  5.685  2.635  1.455  .9710  .6930  .5023  .398826  5625
          92  .2040  .1370  .0998  .0875  .0720  .0637  .0588  .0513  .0470      26
          93  .0446  .0415  .0402  .0381  .0378  .0366  .0355                    27
NICKEL   101 47.543 13.170  7.535  3.500  1.970  1.316  .9265  .6603  .516828  5928
         102  .2210  .1400  .1100  .0880  .0780  .0680  .0614  .0610  .0500      29
         103  .0485  .0445  .0430  .0420  .0410  .0380  .0372                    30
ZR       111 47.267 12.190 10.71   7.342  4.559  2.999  2.082  1.510  1.13540  9131
         112  .3780  .1950  .1200  .0905  .0750  .0640  .0579  .0540  .0468      32
         113  .0440  .0425  .0405  .0400  .0395  .0380  .0363                    33
SN       121 87.223 13.670  8.748  8.166  6.125  4.607  3.273  2.399  1.8155011934
         122  .6400  .2200  .1300  .0935  .0720  .0620  .0550  .0490  .0445      35
         123  .0415  .0405  .0390  .0380  .0365  .0365  .0360                    36
W        131 94.667 36.000 12.890  6.230  3.485  3.016  3.313  3.241  3.1347418437
         132  1.477  .4399  .2750  .1450  .0950  .0775  .0655  .0600  .0498      38
         133  .0480  .0450  .0440  .0435  .0430  .0420  .0408                    39
LEAD     141 72.317 47.750 17.000  8.115  4.640  3.077  2.133  2.211  2.5168220740
         142  1.379  .5590  .3065  .1775  .1280  .0875  .0726  .0618  .0534      41
         143  .0488  .0463  .0443  .0428  .0419  .0413  .0411                    42
URANIUM151 95.850 51.550 23.100 11.050  6.260  4.105  2.850  1.988  1.5039223843
         152  2.116  .7174  .3880  .2275  .1370  .0995  .0815  .0670  .0560      44
         153  .0515  .0483  .0462  .0450  .0441  .0436  .0432                    45
ORDCONC161 21.533  3.506  .9744  .6748  .4345  .3315  .2703  .2280  .204610  1946
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CONCRET162  .1780  .1280  .0990  .0890  .0860  .0750  .0637  .0610  .0550      47
       163  .0520  .0460  .0440  .0430  .0410  .0395  .0336                    48
HVYCONC171 28.073  7.901  2.994  1.364  .7915  .5368  .3891  .2877  .232512 2449
CONCRET172  .1800  .1220  .0945  .0870  .0830  .0750  .0618  .0600  .0550      50
       173  .0520  .0470  .0430  .0420  .0410  .0395  .0364                    51
STRONT 181 24.755 16.026 11.080  6.017  3.575  2.311  1.593  1.154  .871038 8852
       182  .3360  .1600  .1109  .0875  .0724  .0623  .0569  .0547  .0466      53
       183  .0439  .0417  .0401  .0391  .0381  .0370  .0355                    54
PROMETH191 71.000 21.000  7.430  6.296  5.705  5.367  4.738  3.839  2.9926114555
       192  .9418  .3550  .1815  .1153  .0849  .0682  .0605  .0546  .0481      56
       193  .0454  .0433  .0419  .0412  .0404  .0396  .0385                    57
CURIUM 201 48.000 39.800 20.450  7.430 12.800  7.210  3.270  2.270  1.7109624558
       202  1.477  .7998  .4250  .2330  .1440  .1020  .0848  .0735  .0610      59
       203  .0566  .0535  .0516  .0507  .0499  .0491  .0478                    60
DOSE    11 24.    24.    24.    24.    19.    14.9   11.0   8.9    4
BUILD-UP12 7.8    8.2    7.8    7.4    7.0    6.7    6.5    6.2
FACTOR  13 -0.14  -0.14  -0.14  -0.14  -0.122 -0.114 -0.104 -0.095
DATA,   14 -0.088 -0.082 -0.078 -0.074 -0.070 -0.068 -0.065 -0.062
WATER   15 0.0    0.0    0.0    0.0    0.0    0.0    0.03   0.06
        16 0.074  0.083  0.088  0.094  0.097  0.102  0.104  0.108
DOSE    21 9.0    9.0    9.0    9.0    9.0    8.2    8.0    7.3    13
BUILD-UP22 6.4    5.95   5.65   5.3    5.15   4.95   4.75   4.5
FACTOR  23 -0.15  -0.15  -0.15  -0.15  -0.15  -0.12  -0.11  -0.10
DATA,   24 -0.091 -0.087 -0.084 -0.081 -0.079 -0.077 -0.076 -0.074
ALUMINUM25 0.00   0.00   0.00   0.00   0.00   0.025  0.044  0.055
        26 0.075  0.084  0.09   0.096  0.101  0.106  0.11   0.115
DOSE    31 11.2   10.8   10.7   10.2   9.5    9.1    8.6    8.0    26
BUILD-UP32 7.5    7.1    6.7    6.5    6.1    5.8    5.5    5.0
FACTOR  33 -0.099 -0.097 -0.097 -0.095 -0.092 -0.09  -0.088 -0.081
DATA,   34 -0.080 -0.077 -0.075 -0.073 -0.072 -0.072 -0.072 -0.072
IRON    35 0.0    0.001  0.004  0.009  0.016  0.022  0.028  0.034
        36 0.039  0.044  0.048  0.05   0.054  0.056  0.059  0.062
DOSE    41 4.8    4.7    4.7    4.65   4.6    4.55   4.5    4.4    50
BUILD-UP42 4.3    4.1    4.05   3.95   3.8    3.65   3.5    3.3
FACTOR  43 -0.088 -0.086 -0.085 -0.084 -0.082 -0.081 -0.08  -0.079
DATA,   44 -0.078 -0.078 -0.079 -0.08  -0.082 -0.084 -0.086 -0.09
TIN     45 0.1    0.105  0.11   0.114  0.12   0.125  0.13   0.134
        46 0.139  0.141  0.142  0.141  0.14   0.137  0.135  0.13
DOSE    51 3.6    3.6    3.5    3.5    3.44   3.4    3.3    3.18   74
BUILD-UP52 3.05   2.95   2.93   2.88   2.84   2.8    2.78   2.70
FACTOR  53 -0.00  -0.008 -0.01  -0.02  -0.028 -0.035 -0.042 -0.05
DATA,   54 -0.058 -0.063 -0.068 -0.07  -0.074 -0.076 -0.08  -0.086
TUNGSTEN55 0.06   0.07   0.08   0.10   0.12   0.13   0.146  0.164
        56 0.18   0.184  0.187  0.187  0.184  0.176  0.166  0.135
DOSE    61 1.0    1.2    1.3    1.5    1.7    2.5    2.9    2.6    82
BUILD-UP62 2.65   2.65   2.6    2.55   2.5    2.35   2.3    2.1
FACTOR  63 -0.01  -0.015 -0.02  -0.03  -0.03  -0.04  -0.04  -0.05
DATA,   64 -0.055 -0.06  -0.07  -0.075 -0.08  -0.08  -0.085 -0.095
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ISOLIB.DAT

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LEAD      65  0.37    0.37    0.35    0.29    0.25    0.20    0.17    0.15
          66  0.13    0.12    0.11    0.10    0.09    0.08    0.075   0.07
DOSE      71  1.141   1.096   1.146   1.394   1.775   1.842   1.830   2.215 92
BUILD-UP72    2.501   2.896   2.763   2.598   3.086   4.099   3.022   2.297
FACTOR    73 -0.008  -0.012  -0.022  -0.024  -0.025  -0.036  -0.047  -0.043
DATA,     74 -0.042  -0.039  -0.046  -0.053  -0.049  -0.043  -0.059  -0.077
URANIUM 75    0.030   0.610   0.710   0.385   0.272   0.291   0.313   0.203
          76  0.161   0.120   0.121   0.126   0.082   0.043   0.060   0.085        1
04 1 2 1.200 1.400 2.300 3.650 3.200 5.000 6.600 9.700 11.00 8.000
04 4 7 18.00 24.00 36.00 43.00 27.00 47.00 64.00 100.0 130.0 89.00
041015 86.00 140.0 360.0 700.0 280.0 160.0 310.0 1500. 4800. 1050.
0420   580.0 1000. 4300. 1.9E4 2700.
13 1 2 1.007 1.058 2.060 2.820 2.710 1.014 1.110 3.190 5.640 5.350
13 4 7 1.027 1.210 4.870 12.90 13.20 1.043 1.340 9.390 40.60 45.30
131015 1.058 1.450 14.30 91.00 117.0 1.078 1.590 24.00 245.0 345.0
1320   1.095 1.720 34.80 457.  718.
26 1 2 1.001 1.007 1.086 1.350 1.710 1.002 1.013 1.160 1.670 2.620
26 4 7 1.004 1.024 1.270 2.280 4.880 1.006 1.037 1.390 3.070 9.250
261015 1.008 1.047 1.480 3.830 14.80 1.011 1.060 1.600 5.040 24.20
2620   1.013 1.070 1.700 6.250 37.3
50 1 2 1.002 1.009 1.013 1.054 1.200 1.003 1.017 1.023 1.093 1.350
50 4 7 1.006 1.031 1.038 1.150 1.580 1.009 1.048 1.054 1.200 1.870
501015 1.012 1.062 1.065 1.250 2.110 1.016 1.080 1.078 1.300 2.460
5020   1.021 1.094 1.089 1.350 2.76
74 1 2 1.001 1.003 1.030 1.019 1.073 1.001 1.006 1.054 1.033 1.120
74 4 7 1.002 1.012 1.090 1.052 1.190 1.004 1.018 1.130 1.073 1.260
741015 1.005 1.023 1.160 1.090 1.320 1.006 1.030 1.190 1.120 1.390
7420   1.008 1.035 1.220 1.15  1.450
82 1 2 1.000 1.002 1.022 1.018 1.055 1.001 1.005 1.039 1.033 1.091
82 4 7 1.002 1.009 1.066 1.062 1.140 1.003 1.013 1.093 1.100 1.200
821015 1.004 1.017 1.110 1.140 1.230 1.005 1.022 1.140 1.220 1.290
8220   1.006 1.026 1.160 1.300 1.330
92 1 2 1.000 1.002 1.016 1.058 1.042 1.001 1.004 1.029 1.100 1.069
92 4 7 1.001 1.006 1.048 1.160 1.110 1.002 1.010 1.069 1.230 1.150
921015 1.003 1.013 1.083 1.280 1.180 1.004 1.017 1.100 1.340 1.230
9220   1.004 1.020 1.120 1.390 1.280
```

910481638

```
Internal Yearly Dose Increments  (Sv/Bq)  12-Jul-88  RAP
! H 3     Class: D F1:   1.00000     03/17/88  12:51:12.5   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  1  1  1  1  1  1  1  1  1  1  1
G 1.7E-11
G 9.8E-12
G 1.8E-11
G 1.8E-11
G 1.8E-11
G 8.3E-12
G 1.7E-11
G 1.7E-11
G 1.7E-11
G 1.7E-11
G 1.7E-11
  1  1  1  1  1  1  1  1  1  1  1
H 2.5E-11
H 1.5E-11
H 2.7E-11
H 2.7E-11
H 2.7E-11
H 1.3E-11
H 2.5E-11
H 2.5E-11
H 2.5E-11
H 2.5E-11
H 2.5E-11
! C 14    Class: D F1:   1.00000     02/19/88  12:19:43.8   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  2  1  2  2  2  1  2  2  2  2  2
G 5.7E-10 1.0E-12
G 3.3E-10
G 6.1E-10 1.1E-12
G 6.1E-10 1.1E-12
G 6.2E-10 1.1E-12
G 2.9E-10
G 5.7E-10 1.0E-12
G 5.7E-10 1.0E-12
G 5.7E-10 1.0E-12
G 5.8E-10 1.0E-12
G 5.8E-10 1.0E-12
  2  1  2  2  2  1  2  2  2  2  2
H 5.8E-10 1.0E-12
H 3.3E-10
H 6.2E-10 1.1E-12
H 6.1E-10 1.1E-12
H 6.2E-10 1.1E-12
H 3.0E-10
H 5.8E-10 1.0E-12
H 5.8E-10 1.0E-12
H 5.8E-10 1.0E-12
```

```
H 5.9E-10 1.1E-12
H 5.8E-10 1.0E-12
! NA24     Class: D F1:    1.00000      12/05/87  13:20:15.3   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  1  1  1  1  1  1  1  1  1  1  1
G 2.7E-10
G 1.2E-09
G 3.3E-10
G 3.3E-10
G 3.6E-10
G 5.0E-10
G 3.9E-10
G 2.9E-10
G 3.6E-10
G 2.8E-10
G 2.7E-10
  1  1  1  1  1  1  1  1  1  1  1
H 1.2E-09
H 2.9E-10
H 1.8E-10
H 1.7E-10
H 1.9E-10
H 2.8E-10
H 2.2E-10
H 1.5E-10
H 1.9E-10
H 1.7E-10
H 1.6E-10
! P 32     Class: D F1:    0.80000      12/05/87  13:26:21.5   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  1  1  1  1  1  1  1  1  1  1  1
G 6.7E-10
G 1.1E-09
G 7.3E-10
G 2.6E-09
G 7.0E-09
G 8.0E-09
G 8.4E-09
G 6.8E-10
G 6.7E-10
G 6.8E-10
G 6.8E-10
  1  1  1  1  1  1  1  1  1  1  1
H 2.0E-09
H 3.7E-10
H 3.1E-10
H 5.7E-10
H 1.3E-09
H 5.9E-09
H 6.2E-09
H 5.1E-10
```

```
H 5.0E-10
H 5.1E-10
H 5.1E-10
! CR51    Class: Y F1:   0.10000     12/05/87  13:34:21.3   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  1  1  1  1  1  1  1  1  1  1  1
G 4.4E-12
G 1.8E-11
G 4.6E-11
G 1.1E-10
G 2.5E-10
G 7.8E-12
G 1.3E-11
G 6.8E-12
G 3.9E-11
G 7.5E-12
G 3.8E-12
  1  1  1  1  1  1  1  1  1  1  1
H 5.3E-10
H 2.5E-11
H 2.4E-11
H 5.4E-11
H 1.2E-10
H 1.4E-11
H 1.9E-11
H 3.6E-12
H 2.0E-11
H 1.6E-11
H 1.1E-11
! CO60    Class: Y F1:   0.05000     12/05/87  13:42:07.1   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  8  7  8  8  8  7  8  8  8  8  8 10
G 4.2E-10 1.7E-10 1.1E-10 6.7E-11 4.3E-11 2.7E-11 1.8E-11 1.1E-11
G 1.1E-09 1.5E-10 9.7E-11 6.2E-11 4.0E-11 2.5E-11 1.6E-11
G 3.0E-09 2.0E-10 1.3E-10 8.1E-11 5.2E-11 3.3E-11 2.1E-11 1.4E-11
G 5.1E-09 1.8E-10 1.2E-10 7.5E-11 4.8E-11 3.1E-11 2.0E-11 1.2E-11
G 1.1E-08 2.0E-10 1.3E-10 8.0E-11 5.1E-11 3.3E-11 2.1E-11 1.3E-11
G 4.6E-10 1.4E-10 8.8E-11 5.6E-11 3.6E-11 2.3E-11 1.5E-11
G 8.1E-10 1.6E-10 1.0E-10 6.6E-11 4.2E-11 2.7E-11 1.7E-11 1.1E-11
G 6.2E-10 2.0E-10 1.2E-10 7.9E-11 5.1E-11 3.2E-11 2.1E-11 1.3E-11
G 2.6E-09 1.8E-10 1.2E-10 7.4E-11 4.8E-11 3.0E-11 1.9E-11 1.2E-11
G 6.6E-10 1.7E-10 1.1E-10 6.9E-11 4.4E-11 2.8E-11 1.8E-11 1.1E-11
G 3.7E-10 1.7E-10 1.1E-10 6.7E-11 4.3E-11 2.7E-11 1.8E-11 1.1E-11
G 1.2E-09 4.3E-10 2.7E-10 1.8E-10 1.1E-10 7.2E-11 4.6E-11 2.9E-11 1.9E-11 1.2E-11
 26 12  8  8  6 10 10  5  6 11 10 13
H 1.3E-07 7.7E-08 4.8E-08 3.0E-08 2.0E-08 1.3E-08 9.0E-09 6.3E-09 4.4E-09 3.2E-09 2.4E-09 1.8E-09 1.4E-09 1.1E-09 8.7E-10
  7.1E-10 5.8E-10 4.9E-10 4.1E-10 3.5E-10 3.0E-10 2.5E-10 2.2E-10 1.9E-10 1.6E-10 1.4E-10
H 1.0E-08 6.0E-09 3.8E-09 2.4E-09 1.6E-09 1.1E-09 7.3E-10 5.1E-10 3.6E-10 2.6E-10 1.9E-10 1.5E-10
H 3.2E-09 1.2E-09 8.0E-10 5.3E-10 3.6E-10 2.5E-10 1.8E-10 1.3E-10
H 4.8E-09 1.5E-09 9.9E-10 6.5E-10 4.4E-10 3.0E-10 2.1E-10 1.5E-10
H 5.9E-09 6.4E-10 4.2E-10 2.8E-10 1.9E-10 1.4E-10
```

DOSINC.DAT

5.897

9/30/88

9 1 0 4 8 1 6 9 2

5.898

9/30/88

DOSINC.DAT

```
H 4.8E-09 2.9E-09 1.8E-09 1.2E-09 7.9E-10 5.3E-10 3.7E-10 2.6E-10 1.8E-10 1.3E-10
H 6.2E-09 3.7E-09 2.3E-09 1.5E-09 9.9E-10 6.7E-10 4.6E-10 3.2E-10 2.3E-10 1.7E-10
H 5.8E-10 3.1E-10 2.3E-10 1.8E-10 1.3E-10
H 2.3E-09 7.7E-10 5.1E-10 3.5E-10 2.4E-10 1.7E-10
H 6.4E-09 3.8E-09 2.4E-09 1.6E-09 1.0E-09 6.9E-10 4.8E-10 3.3E-10 2.4E-10 1.7E-10 1.3E-10
H 5.7E-09 3.5E-09 2.2E-09 1.4E-09 9.5E-10 6.4E-10 4.4E-10 3.1E-10 2.2E-10 1.6E-10
H 1.2E-08 7.3E-09 4.7E-09 3.0E-09 2.0E-09 1.4E-09 9.4E-10 6.6E-10 4.7E-10 3.4E-10 2.5E-10 1.9E-10 1.5E-10
! ZN65    Class: Y F1:   0.50000     12/05/87  13:50:31.5   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  4  4  4  4  4  5  5  4  4  4  4
G 2.6E-09 4.5E-10 8.5E-11 1.6E-11
G 2.5E-09 4.3E-10 8.1E-11 1.5E-11
G 3.2E-09 5.2E-10 9.9E-11 1.9E-11
G 3.1E-09 4.8E-10 9.0E-11 1.7E-11
G 4.0E-09 5.7E-10 1.1E-10 2.0E-11
G 3.7E-09 6.7E-10 1.3E-10 2.4E-11 4.5E-12
G 3.7E-09 6.6E-10 1.3E-10 2.4E-11 4.5E-12
G 3.0E-09 5.3E-10 1.0E-10 1.9E-11
G 2.8E-09 4.5E-10 8.4E-11 1.6E-11
G 2.7E-09 4.8E-10 9.1E-11 1.7E-11
G 2.7E-09 4.7E-10 8.9E-11 1.7E-11
  6  4  4  4  4  4  4  4  4  4  4
H 1.6E-08 3.8E-09 9.6E-10 2.5E-10 6.5E-11 1.7E-11
H 2.8E-09 6.3E-10 1.5E-10 3.7E-11
H 1.9E-09 3.8E-10 8.6E-11 2.0E-11
H 1.9E-09 3.7E-10 8.5E-11 2.0E-11
H 2.1E-09 3.6E-10 8.1E-11 1.9E-11
H 2.6E-09 5.8E-10 1.3E-10 3.2E-11
H 2.8E-09 6.2E-10 1.5E-10 3.5E-11
H 1.6E-09 3.3E-10 7.3E-11 1.7E-11
H 1.6E-09 3.0E-10 6.8E-11 1.6E-11
H 2.4E-09 5.4E-10 1.3E-10 3.1E-11
H 2.4E-09 5.3E-10 1.3E-10 3.1E-11
! SR89    Class: D F1:   0.30000     12/05/87  13:59:25.3   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  1  1  1  1  1  2  1  1  1  1  1
G 1.2E-10
G 7.5E-10
G 1.2E-09
G 6.8E-09
G 2.1E-08
G 4.8E-09 2.4E-11
G 3.0E-09
G 1.2E-10
G 1.2E-10
G 1.2E-10
G 1.2E-10
  1  1  1  1  1  2  2  1  1  1  1
H 1.7E-09
H 2.1E-10
H 2.9E-10
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```
H 1.1E-09
H 3.3E-09
H 8.3E-09 4.2E-11
H 5.2E-09 2.7E-11
H 2.2E-10
H 2.1E-10
H 2.2E-10
H 2.1E-10
! SR90    Class: D F1:   0.30000    12/05/87  14:08:12.4   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  1  1  1  1  1 50 49  1  1  1  1
G 1.9E-10
G 3.2E-10
G 5.7E-10
G 4.1E-09
G 1.8E-08
G 4.2E-08 3.2E-08 2.7E-08 2.4E-08 2.1E-08 1.9E-08 1.7E-08 1.5E-08 1.4E-08 1.3E-08 1.2E-08 1.1E-08 9.6E-09 8.9E-09 8.1E-09
  7.5E-09 6.9E-09 6.4E-09 5.9E-09 5.5E-09 5.1E-09 4.8E-09 4.5E-09 4.2E-09 3.9E-09 3.6E-09 3.4E-09 3.2E-09 3.0E-09 2.8E-09
  2.6E-09 2.5E-09 2.3E-09 2.2E-09 2.1E-09 2.0E-09 1.8E-09 1.7E-09 1.6E-09 1.6E-09 1.5E-09 1.4E-09 1.3E-09 1.2E-09 1.2E-09
  1.1E-09 1.0E-09 9.8E-10 9.3E-10 8.8E-10
G 2.5E-08 2.0E-08 1.7E-08 1.5E-08 1.3E-08 1.1E-08 9.2E-09 7.9E-09 6.7E-09 5.8E-09 4.9E-09 4.2E-09 3.6E-09 3.1E-09 2.7E-09
  2.3E-09 2.0E-09 1.7E-09 1.5E-09 1.3E-09 1.1E-09 9.5E-10 8.2E-10 7.1E-10 6.2E-10 5.4E-10 4.7E-10 4.1E-10 3.6E-10 3.2E-10
  2.8E-10 2.5E-10 2.2E-10 1.9E-10 1.7E-10 1.5E-10 1.4E-10 1.2E-10 1.1E-10 9.9E-11 8.9E-11 8.1E-11 7.3E-11 6.7E-11 6.1E-11
  5.6E-11 5.1E-11 4.7E-11 4.3E-11
G 1.9E-10
G 1.9E-10
G 1.8E-10
G 1.9E-10
  1  1  1  1  1 50 49  1  1  1  1
H 1.1E-09
H 2.0E-10
H 2.3E-10
H 7.7E-10
H 2.9E-09
H 7.3E-08 5.5E-08 4.7E-08 4.1E-08 3.7E-08 3.3E-08 3.0E-08 2.7E-08 2.4E-08 2.2E-08 2.0E-08 1.8E-08 1.7E-08 1.5E-08 1.4E-08
  1.3E-08 1.2E-08 1.1E-08 1.0E-08 9.6E-09 8.9E-09 8.3E-09 7.8E-09 7.2E-09 6.8E-09 6.3E-09 5.9E-09 5.6E-09 5.2E-09 4.9E-09
  4.6E-09 4.3E-09 4.1E-09 3.8E-09 3.6E-09 3.4E-09 3.2E-09 3.0E-09 2.9E-09 2.7E-09 2.6E-09 2.4E-09 2.3E-09 2.1E-09 2.0E-09
  1.9E-09 1.8E-09 1.7E-09 1.6E-09 1.5E-09
H 4.3E-08 3.5E-08 3.0E-08 2.6E-08 2.2E-08 1.9E-08 1.6E-08 1.4E-08 1.2E-08 1.0E-08 8.6E-09 7.4E-09 6.3E-09 5.4E-09 4.7E-09
  4.0E-09 3.4E-09 3.0E-09 2.6E-09 2.2E-09 1.9E-09 1.7E-09 1.4E-09 1.2E-09 1.1E-09 9.4E-10 8.2E-10 7.2E-10 6.3E-10 5.5E-10
  4.8E-10 4.3E-10 3.8E-10 3.3E-10 3.0E-10 2.7E-10 2.4E-10 2.1E-10 1.9E-10 1.7E-10 1.6E-10 1.4E-10 1.3E-10 1.2E-10 1.1E-10
  9.7E-11 8.9E-11 8.2E-11 7.5E-11
H 3.4E-10
H 3.4E-10
H 3.3E-10
H 3.4E-10
! Y 90    Class: Y F1:   0.00010    12/05/87  14:25:37.6   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1  1  1  1  1  1  1  1
G 1.3E-14
G 1.1E-09
```

DOSINC.DAT

5.899

9/30/88

4691 8401 6

5.900

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G 2.6E-09
G 1.3E-08
G 3.2E-08
G 4.0E-13
G 3.9E-13
G 1.3E-14
G 1.5E-14
G 1.3E-14
G 1.3E-14
G 3.8E-13
  1  1  1  1  1  1  1  1  1  1  1  1
H 9.7E-09
H 4.4E-10
H 1.1E-09
H 5.3E-09
H 1.3E-08
H 1.6E-11
H 1.6E-11
H 5.6E-13
H 5.4E-13
H 5.4E-13
H 5.5E-13
H 1.6E-11
! ZR95    Class: W F1:   0.00200     12/05/87  14:33:32.3   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  1  1  1  1  1  2  1  1  1  1  1
G 2.3E-11
G 3.6E-10
G 1.1E-09
G 3.1E-09
G 7.9E-09
G 4.8E-10 1.1E-11
G 2.1E-10
G 8.1E-11
G 8.1E-10
G 1.1E-10
G 8.1E-12
  1  1  1  1  1  2  2  1  1  1  1
H 1.8E-08
H 1.1E-09
H 9.6E-10
H 1.9E-09
H 4.2E-09
H 2.2E-08 6.6E-10
H 3.2E-09 8.7E-11
H 3.0E-10
H 8.3E-10
H 9.3E-10
H 7.7E-10
! NB95M   Class: Y F1:   0.01000     12/05/87  14:59:17.5   Acute  Sv/Bq
 13  1  3  4  5  6  7  8 11 12 13 14 16 19
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9/30/88

```
  1  1  1  1  1  1  1  1  1  1  1  1  1
G 2.8E-12
G 2.2E-10
G 5.5E-10
G 2.6E-09
G 6.6E-09
G 4.2E-11
G 3.3E-11
G 8.2E-12
G 9.3E-11
G 1.0E-11
G 1.6E-12
G 1.8E-11
G 1.5E-11
  1  1  1  1  1  1  1  1  1  1  1  1  1
H 3.1E-09
H 1.5E-10
H 2.4E-10
H 1.1E-09
H 2.8E-09
H 6.4E-11
H 5.7E-11
H 5.4E-12
H 4.9E-11
H 4.3E-11
H 3.7E-11
H 4.0E-11
H 7.1E-11
! NB95    Class: Y F1:   0.01000     12/05/87  15:14:44.1   Acute  Sv/Bq
 13  1  3  4  5  6  7  8 11 12 13 14 16 19
  1  1  1  1  1  1  1  1  1  1  1  1  1
G 2.8E-11
G 2.8E-10
G 9.2E-10
G 1.8E-09
G 4.0E-09
G 3.0E-10
G 2.0E-10
G 8.2E-11
G 8.1E-10
G 1.1E-10
G 1.2E-11
G 1.4E-10
G 1.1E-10
  1  1  1  1  1  1  1  1  1  1  1  1  1
H 8.4E-09
H 6.4E-10
H 5.2E-10
H 9.7E-10
H 1.9E-09
H 5.2E-10
```

```
H 4.5E-10
H 5.2E-11
H 4.3E-10
H 4.1E-10
H 3.6E-10
H 3.5E-10
H 6.4E-10
! TC99    Class: W F1:   0.80000     12/05/87  15:23:09.9   Acute  Sv/Bq
 13  1  3  4  5  6  7  8 11 12 13 14 22 16
  1  1  1  1  1  1  1  1  1  1  3  1  1
G 6.3E-11
G 3.4E-09
G 9.6E-11
G 3.8E-10
G 1.1E-09
G 3.1E-11
G 6.0E-11
G 6.3E-11
G 6.3E-11
G 6.3E-11
G 6.9E-09 4.2E-10 3.3E-11
G 3.4E-09
G 1.4E-09
  2  1  1  1  1  1  1  1  1  1  3  1  1
H 1.6E-08 1.4E-10
H 2.2E-09
H 5.5E-11
H 2.0E-10
H 5.6E-10
H 2.1E-11
H 4.0E-11
H 4.2E-11
H 4.2E-11
H 4.2E-11
H 4.5E-09 3.5E-10 2.9E-11
H 2.2E-09
H 9.2E-10
! I 129   Class: D F1:   1.00000     12/05/87  15:32:30.7   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 15
  1  1  1  1  1  1  1  1  1  1  4  1
G 1.4E-10
G 1.6E-10
G 1.3E-10
G 1.2E-10
G 1.3E-10
G 1.1E-09
G 5.7E-10
G 1.1E-10
G 1.2E-10
G 2.8E-10
G 2.0E-06 2.2E-07 2.4E-08 2.6E-09
```

DOSINC.DAT

5.902

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9 6 9 1 8 4 0 1 6

DOSINC.DAT

```
G 3.7E-10
  1  1  1  1  1  1  1  1  1  1  4  1
H 2.4E-10
H 6.2E-11
H 8.1E-11
H 7.9E-11
H 8.4E-11
H 7.0E-10
H 3.6E-10
H 6.8E-11
H 7.9E-11
H 1.8E-10
H 1.2E-06 1.4E-07 1.5E-08 1.6E-09
H 2.3E-10
! I 131   Class: D F1:    1.00000     12/05/87  15:40:41.2   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 15
  1  1  1  1  1  1  1  1  1  1  1  1
G 1.2E-10
G 3.1E-10
G 7.1E-11
G 6.8E-11
G 7.6E-11
G 3.8E-09
G 4.3E-10
G 6.1E-11
G 7.0E-11
G 1.4E-10
G 4.4E-07
G 6.5E-10
  1  1  1  1  1  1  1  1  1  1  1  1
H 6.5E-10
H 7.8E-11
H 4.4E-11
H 4.2E-11
H 4.7E-11
H 2.3E-09
H 2.7E-10
H 3.8E-11
H 4.4E-11
H 9.0E-11
H 2.7E-07
H 4.0E-10
! I 132   Class: D F1:    1.00000     12/05/87  15:50:30.4   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 15
  1  1  1  1  1  1  1  1  1  1  1  1
G 3.8E-11
G 6.5E-10
G 4.5E-11
G 4.5E-11
G 4.6E-11
G 1.5E-10
```

5.903

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9 1 0 4 8 1 6 9 7

DOSINC.DAT

```
G 1.5E-10
G 3.6E-11
G 3.9E-11
G 3.9E-11
G 2.8E-09
G 2.2E-10
  1  1  1  1  1  1  1  1  1  1  1  1
H 2.8E-10
H 1.0E-10
H 1.9E-11
H 1.8E-11
H 2.0E-11
H 6.9E-11
H 7.0E-11
H 1.6E-11
H 1.7E-11
H 2.0E-11
H 1.3E-09
H 9.6E-11
! I 133   Class: D F1:   1.00000     12/05/87  15:56:05.9   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 15
  1  1  1  1  1  1  1  1  1  1  1  1
G 6.5E-11
G 5.6E-10
G 6.7E-11
G 6.6E-11
G 7.3E-11
G 5.3E-10
G 4.1E-10
G 6.2E-11
G 6.6E-11
G 7.0E-11
G 8.1E-08
G 8.7E-10
  1  1  1  1  1  1  1  1  1  1  1  1
H 8.3E-10
H 1.1E-10
H 3.6E-11
H 3.6E-11
H 3.9E-11
H 2.9E-10
H 2.2E-10
H 3.4E-11
H 3.6E-11
H 4.2E-11
H 4.3E-08
H 4.7E-10
! RU103   Class: Y F1:   0.05000     12/05/87  16:07:26.7   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  1  1  1  1  1  1  1  1  1  1  1
G 7.5E-11
```

5.904

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8691 8401 6

```
G 3.0E-10
G 8.2E-10
G 2.5E-09
G 6.5E-09
G 7.7E-11
G 1.6E-10
G 1.3E-10
G 5.6E-10
G 1.2E-10
G 6.4E-11
  2  1  1  1  1  1  1  1  1  1  1
H 1.6E-08 1.7E-11
H 5.0E-10
H 4.6E-10
H 1.3E-09
H 3.1E-09
H 2.2E-10
H 3.1E-10
H 7.3E-11
H 3.0E-10
H 3.2E-10
H 2.5E-10
! PD103   Class: Y F1:   0.00500    12/05/87  16:30:41.1   Acute  Sv/Bq
 13  1  3  4  5  6  7  8 11 12 13 14 17 16
  1  1  1  1  1  1  1  1  1  1  1  1  1
G 1.3E-13
G 3.4E-11
G 1.5E-10
G 8.3E-10
G 2.3E-09
G 2.0E-12
G 6.6E-12
G 1.6E-13
G 4.1E-11
G 1.6E-12
G 4.5E-14
G 1.1E-11
G 2.1E-11
  1  1  1  1  1  1  1  1  1  1  1  1  1
H 2.7E-09
H 3.0E-11
H 7.9E-11
H 3.9E-10
H 1.1E-09
H 4.7E-12
H 7.1E-12
H 1.1E-13
H 1.9E-11
H 9.0E-12
H 1.5E-13
H 2.1E-11
```

9104816 99

9 1 0 4 8 1 7 0 0

5.906

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DOSINC.DAT

```
H 2.8E-11
! RH103M  Class: Y F1:   0.05000     12/05/87  16:44:51.7   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  1  1  1  1  1  1  1  1  1  1  1
G 5.2E-15
G 2.6E-11
G 1.7E-11
G 9.8E-12
G 1.6E-12
G 3.8E-15
G 1.1E-14
G 3.5E-15
G 4.3E-14
G 9.1E-15
G 3.6E-15
  1  1  1  1  1  1  1  1  1  1  1
H 9.9E-12
H 1.1E-12
H 6.8E-13
H 4.0E-13
H 6.6E-14
H 2.6E-15
H 3.8E-15
H 1.5E-15
H 3.2E-15
H 5.8E-15
H 1.6E-15
! RU106   Class: Y F1:   0.05000     12/05/87  16:49:22.4   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  3  2  2  2  2  2  3  3  3  3  3
G 9.8E-10 2.8E-10 1.1E-10
G 2.3E-09 1.6E-10
G 4.7E-09 1.7E-10
G 2.4E-08 1.6E-10
G 7.1E-08 1.7E-10
G 5.0E-10 1.4E-10
G 1.0E-09 2.7E-10 1.1E-10
G 1.0E-09 2.9E-10 1.1E-10
G 1.2E-09 2.8E-10 1.1E-10
G 1.0E-09 2.8E-10 1.1E-10
G 9.7E-10 2.7E-10 1.1E-10
  8  1  1  1  2  1  1  1  1  1  1
H 6.6E-07 2.3E-07 8.3E-08 3.0E-08 1.1E-08 4.3E-09 1.7E-09 6.7E-10
H 1.8E-09
H 2.6E-09
H 1.2E-08
H 3.6E-08 8.0E-10
H 6.4E-10
H 1.1E-09
H 6.9E-10
H 7.9E-10
```

```
H 1.1E-09
H 1.0E-09
! CS134    Class: D F1:    1.00000      12/05/87  16:58:11.2   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  3  3  3  3  3  3  3  3  3  3  3
G 1.6E-08 1.2E-09 8.3E-11
G 1.6E-08 1.1E-09 7.8E-11
G 2.2E-08 1.6E-09 1.1E-10
G 2.0E-08 1.4E-09 1.0E-10
G 2.2E-08 1.6E-09 1.1E-10
G 1.2E-08 8.7E-10 6.2E-11
G 1.6E-08 1.1E-09 8.1E-11
G 2.0E-08 1.5E-09 1.0E-10
G 1.6E-08 1.1E-09 8.1E-11
G 1.6E-08 1.2E-09 8.3E-11
G 1.6E-08 1.2E-09 8.4E-11
  3  3  3  3  3  3  3  3  3  3  3
H 7.6E-09 4.9E-10 3.5E-11
H 9.7E-09 6.9E-10 4.9E-11
H 1.4E-08 1.0E-09 7.2E-11
H 1.3E-08 9.2E-10 6.6E-11
H 1.4E-08 1.0E-09 7.2E-11
H 7.7E-09 5.5E-10 4.0E-11
H 1.0E-08 7.1E-10 5.1E-11
H 1.3E-08 9.4E-10 6.7E-11
H 1.0E-08 7.3E-10 5.2E-11
H 1.0E-08 7.3E-10 5.2E-11
H 1.0E-08 7.5E-10 5.4E-11
! CS137    Class: D F1:    1.00000      12/05/87  17:06:46.3   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  3  3  3  3  3  3  3  3  3  3  3
G 1.2E-08 1.1E-09 1.1E-10
G 9.8E-09 9.2E-10 9.1E-11
G 1.4E-08 1.4E-09 1.3E-10
G 1.4E-08 1.3E-09 1.3E-10
G 1.4E-08 1.3E-09 1.3E-10
G 6.4E-09 6.3E-10 6.2E-11
G 9.9E-09 9.7E-10 9.5E-11
G 1.3E-08 1.3E-09 1.3E-10
G 1.2E-08 1.1E-09 1.1E-10
G 1.1E-08 1.1E-09 1.1E-10
G 1.2E-08 1.1E-09 1.1E-10
  3  3  3  3  3  3  3  3  3  3  3
H 3.7E-09 2.8E-10 2.8E-11
H 6.0E-09 5.9E-10 5.7E-11
H 8.8E-09 8.7E-10 8.5E-11
H 8.7E-09 8.5E-10 8.3E-11
H 8.8E-09 8.6E-10 8.5E-11
H 4.1E-09 4.0E-10 3.9E-11
H 6.3E-09 6.1E-10 6.0E-11
H 8.4E-09 8.2E-10 8.1E-11
```

9 1 0 4 8 1 7 0 1

5.907

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DOSINC.DAT

```
H 7.4E-09 7.3E-10 7.2E-11
H 7.3E-09 7.1E-10 7.0E-11
H 7.3E-09 7.2E-10 7.0E-11
! CE144   Class: Y F1:   0.00030     12/05/87  17:16:52.4   Acute  Sv/Bq
 13  1  3  4  5  6  7  8 11 12 13 14 17 19
  1  1  1  1  1  1  1  1  1  1  1  2  2
G 4.5E-12
G 1.1E-09
G 3.7E-09
G 2.2E-08
G 6.7E-08
G 8.3E-11
G 6.3E-11
G 8.2E-12
G 6.8E-11
G 1.0E-11
G 3.3E-12
G 4.3E-10 1.6E-10
G 3.6E-10 1.3E-10
  6  1  1  1  1  3  2  1  1  1  1  5  5
H 5.6E-07 1.6E-07 4.6E-08 1.4E-08 4.2E-09 1.3E-09
H 9.5E-10
H 2.0E-09
H 1.1E-08
H 3.4E-08
H 1.9E-09 1.4E-09 8.2E-10
H 1.2E-09 8.4E-10
H 7.6E-11
H 1.2E-10
H 1.9E-10
H 1.5E-10
H 9.7E-09 7.6E-09 4.4E-09 2.2E-09 1.0E-09
H 8.1E-09 6.3E-09 3.7E-09 1.9E-09 8.7E-10
! PR144M  Class: Y F1:   0.00030     12/05/87  17:45:48.4   Acute  Sv/Bq
 13  1  3  4  5  6  7  8 11 12 13 14 17 16
  1  1  1  1  1  1  1  1  1  1  1  1  1
G 2.0E-14
G 1.5E-10
G 5.5E-11
G 1.2E-11
G 7.0E-13
G 1.2E-14
G 2.5E-14
G 3.4E-15
G 5.2E-14
G 2.4E-14
G 1.5E-15
G 2.7E-14
G 4.4E-14
  1  1  1  1  1  1  1  1  1  1  1  1  1
H 4.0E-11
```

DOSINC.DAT

5.908

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9 1 0 4 8 1 7 0 2

```
H 3.1E-12
H 8.5E-13
H 1.7E-13
H 1.2E-14
H 1.5E-14
H 1.8E-14
H 4.7E-15
H 5.9E-15
H 1.3E-14
H 8.7E-15
H 2.3E-14
H 1.2E-14
! PR144   Class: Y F1:   0.00030     12/05/87  17:55:44.9   Acute  Sv/Bq
 13  1  3  4  5  6  7  8 11 12 13 14 17 18
  1  1  1  1  1  1  1  1  1  1  1  1  1
G 3.2E-14
G 4.2E-10
G 1.0E-10
G 1.9E-11
G 1.1E-12
G 1.6E-14
G 3.4E-14
G 7.1E-15
G 7.8E-14
G 3.6E-14
G 3.8E-15
G 4.9E-14
G 7.5E-14
  1  1  1  1  1  1  1  1  1  1  1  1  1
H 9.7E-11
H 5.7E-12
H 1.4E-12
H 2.7E-13
H 2.0E-14
H 2.1E-14
H 2.7E-14
H 9.1E-15
H 1.1E-14
H 2.0E-14
H 1.8E-14
H 3.7E-14
H 2.2E-14
! PM151   Class: Y F1:   0.00030     12/05/87  18:01:07.3   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1  1  1  1  1  1  1  1
G 4.3E-12
G 4.2E-10
G 1.0E-09
G 3.9E-09
G 7.3E-09
G 1.6E-11
```

9 1 0 4 8 1 7 0 3

5.909

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DOSINC.DAT

DOSINC.DAT

```
G 5.0E-11
G 1.7E-11
G 2.2E-10
G 2.5E-11
G 4.7E-13
G 2.2E-11
  1  1  1  1  1  1  1  1  1  1  1  1
H 1.7E-09
H 1.5E-10
H 3.5E-10
H 1.3E-09
H 2.5E-09
H 1.7E-11
H 2.8E-11
H 5.9E-12
H 7.4E-11
H 1.6E-11
H 6.6E-12
H 2.9E-11
! SM151   Class: W F1:   0.00030     12/05/87  18:14:12.0   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1 42 10  1  1  1  1 25
G 4.9E-16
G 2.3E-11
G 5.8E-11
G 3.4E-10
G 1.0E-09
G 2.7E-11 2.5E-11 2.3E-11 2.1E-11 2.0E-11 1.8E-11 1.7E-11 1.5E-11 1.4E-11 1.3E-11 1.2E-11 1.1E-11 1.0E-11 9.5E-12 8.8E-12
  8.1E-12 7.5E-12 6.9E-12 6.4E-12 5.9E-12 5.4E-12 5.0E-12 4.6E-12 4.3E-12 3.9E-12 3.6E-12 3.4E-12 3.1E-12 2.9E-12 2.6E-12
  2.4E-12 2.3E-12 2.1E-12 1.9E-12 1.8E-12 1.6E-12 1.5E-12 1.4E-12 1.3E-12 1.2E-12 1.1E-12 1.0E-12
G 2.2E-12 2.0E-12 1.8E-12 1.7E-12 1.6E-12 1.5E-12 1.3E-12 1.2E-12 1.1E-12 1.1E-12
G 5.0E-16
G 2.1E-14
G 1.1E-15
G 4.3E-16
G 7.2E-12 6.7E-12 6.1E-12 5.7E-12 5.2E-12 4.8E-12 4.5E-12 4.1E-12 3.8E-12 3.5E-12 3.2E-12 3.0E-12 2.8E-12 2.6E-12 2.4E-12
  2.2E-12 2.0E-12 1.9E-12 1.7E-12 1.6E-12 1.5E-12 1.3E-12 1.2E-12 1.1E-12 1.1E-12
  2  1  1  1  1 50 50  1  1  1  1 50
H 3.3E-09 2.8E-11
H 1.2E-11
H 2.9E-11
H 1.7E-10
H 5.1E-10
H 9.7E-09 1.0E-08 9.2E-09 8.5E-09 7.9E-09 7.3E-09 6.7E-09 6.2E-09 5.7E-09 5.3E-09 4.9E-09 4.5E-09 4.2E-09 3.8E-09 3.5E-09
  3.3E-09 3.0E-09 2.8E-09 2.6E-09 2.4E-09 2.2E-09 2.0E-09 1.9E-09 1.7E-09 1.6E-09 1.5E-09 1.4E-09 1.3E-09 1.2E-09 1.1E-09
  9.9E-10 9.1E-10 8.4E-10 7.8E-10 7.2E-10 6.6E-10 6.1E-10 5.6E-10 5.2E-10 4.8E-10 4.4E-10 4.1E-10 3.8E-10 3.5E-10 3.2E-10
  3.0E-10 2.7E-10 2.5E-10 2.3E-10 2.2E-10
H 7.8E-10 8.1E-10 7.4E-10 6.9E-10 6.3E-10 5.9E-10 5.4E-10 5.0E-10 4.6E-10 4.3E-10 3.9E-10 3.6E-10 3.3E-10 3.1E-10 2.9E-10
  2.6E-10 2.4E-10 2.2E-10 2.1E-10 1.9E-10 1.8E-10 1.6E-10 1.5E-10 1.4E-10 1.3E-10 1.2E-10 1.1E-10 1.0E-10 9.3E-11 8.6E-11
  7.9E-11 7.3E-11 6.8E-11 6.2E-11 5.8E-11 5.3E-11 4.9E-11 4.5E-11 4.2E-11 3.9E-11 3.6E-11 3.3E-11 3.0E-11 2.8E-11 2.6E-11
  2.4E-11 2.2E-11 2.0E-11 1.9E-11 1.7E-11
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5.910

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91048 1704

```
H 1.7E-13
H 1.8E-13
H 1.9E-13
H 1.7E-13
H 2.6E-09 2.7E-09 2.5E-09 2.3E-09 2.1E-09 2.0E-09 1.8E-09 1.7E-09 1.5E-09 1.4E-09 1.3E-09 1.2E-09 1.1E-09 1.0E-09 9.5E-10
  8.8E-10 8.1E-10 7.5E-10 6.9E-10 6.4E-10 5.9E-10 5.4E-10 5.0E-10 4.6E-10 4.3E-10 3.9E-10 3.6E-10 3.4E-10 3.1E-10 2.9E-10
  2.6E-10 2.4E-10 2.3E-10 2.1E-10 1.9E-10 1.8E-10 1.6E-10 1.5E-10 1.4E-10 1.3E-10 1.2E-10 1.1E-10 1.0E-10 9.3E-11 8.6E-11
  8.0E-11 7.4E-11 6.8E-11 6.3E-11 5.8E-11
! EU152   Class: W F1:   0.00100     12/05/87  18:22:49.8   Acute  Sv/Bq
 13  1  3  4  5  6  7  8 11 12 13 14 16 17
  8  5  5  7  1 26 17  1  2  4  1 11 29
G 5.1E-11 2.2E-11 2.0E-11 1.7E-11 1.5E-11 1.4E-11 1.2E-11 1.1E-11
G 5.1E-10 1.6E-11 1.4E-11 1.2E-11 1.1E-11
G 1.6E-09 1.5E-11 1.4E-11 1.2E-11 1.1E-11
G 4.1E-09 2.0E-11 1.8E-11 1.6E-11 1.4E-11 1.2E-11 1.1E-11
G 1.0E-08
G 3.2E-10 2.1E-10 1.8E-10 1.6E-10 1.4E-10 1.3E-10 1.1E-10 9.9E-11 8.7E-11 7.7E-11 6.8E-11 6.0E-11 5.3E-11 4.7E-11 4.2E-11
  3.7E-11 3.3E-11 2.9E-11 2.5E-11 2.2E-11 2.0E-11 1.8E-11 1.6E-11 1.4E-11 1.2E-11 1.1E-11
G 3.5E-10 6.8E-11 6.0E-11 5.3E-11 4.7E-11 4.1E-11 3.7E-11 3.2E-11 2.9E-11 2.5E-11 2.2E-11 2.0E-11 1.7E-11 1.5E-11 1.4E-11
  1.2E-11 1.1E-11
G 1.1E-10
G 1.3E-09 1.1E-11
G 1.6E-10 1.4E-11 1.3E-11 1.1E-11
G 1.1E-11
G 2.1E-10 3.0E-11 2.7E-11 2.4E-11 2.1E-11 1.9E-11 1.6E-11 1.5E-11 1.3E-11 1.1E-11 1.0E-11
G 4.4E-10 2.9E-10 2.6E-10 2.3E-10 2.0E-10 1.8E-10 1.6E-10 1.4E-10 1.2E-10 1.1E-10 9.6E-11 8.5E-11 7.5E-11 6.6E-11 5.8E-11
  5.2E-11 4.6E-11 4.0E-11 3.6E-11 3.2E-11 2.8E-11 2.5E-11 2.2E-11 1.9E-11 1.7E-11 1.5E-11 1.3E-11 1.2E-11 1.0E-11
 36 34 33 35 29 50 45 25 30 33 26 39 50
H 3.5E-08 3.0E-09 2.4E-09 2.1E-09 1.9E-09 1.7E-09 1.5E-09 1.3E-09 1.1E-09 1.0E-09 9.0E-10 7.9E-10 7.0E-10 6.2E-10 5.5E-10
  4.8E-10 4.3E-10 3.8E-10 3.3E-10 3.0E-10 2.6E-10 2.3E-10 2.0E-10 1.8E-10 1.6E-10 1.4E-10 1.2E-10 1.1E-10 9.7E-11 8.6E-11
  7.6E-11 6.7E-11 5.9E-11 5.3E-11 4.6E-11 4.1E-11
H 3.4E-09 1.9E-09 1.7E-09 1.5E-09 1.3E-09 1.2E-09 1.0E-09 9.3E-10 8.2E-10 7.2E-10 6.4E-10 5.7E-10 5.0E-10 4.4E-10 3.9E-10
  3.5E-10 3.1E-10 2.7E-10 2.4E-10 2.1E-10 1.9E-10 1.6E-10 1.5E-10 1.3E-10 1.1E-10 1.0E-10 8.9E-11 7.9E-11 7.0E-11 6.1E-11
  5.4E-11 4.8E-11 4.2E-11 3.8E-11
H 2.9E-09 1.9E-09 1.7E-09 1.5E-09 1.3E-09 1.1E-09 1.0E-09 9.0E-10 7.9E-10 7.0E-10 6.2E-10 5.5E-10 4.8E-10 4.3E-10 3.8E-10
  3.3E-10 3.0E-10 2.6E-10 2.3E-10 2.0E-10 1.8E-10 1.6E-10 1.4E-10 1.2E-10 1.1E-10 9.7E-11 8.6E-11 7.6E-11 6.7E-11 6.0E-11
  5.3E-11 4.7E-11 4.1E-11
H 4.7E-09 2.4E-09 2.1E-09 1.9E-09 1.7E-09 1.5E-09 1.3E-09 1.2E-09 1.0E-09 9.0E-10 7.9E-10 7.0E-10 6.2E-10 5.5E-10 4.9E-10
  4.3E-10 3.8E-10 3.4E-10 3.0E-10 2.6E-10 2.3E-10 2.0E-10 1.8E-10 1.6E-10 1.4E-10 1.3E-10 1.1E-10 9.8E-11 8.6E-11 7.6E-11
  6.8E-11 6.0E-11 5.3E-11 4.7E-11 4.1E-11
H 6.2E-09 1.0E-09 9.2E-10 8.1E-10 7.2E-10 6.4E-10 5.6E-10 5.0E-10 4.4E-10 3.9E-10 3.4E-10 3.0E-10 2.7E-10 2.4E-10 2.1E-10
  1.9E-10 1.6E-10 1.4E-10 1.3E-10 1.1E-10 1.0E-10 8.8E-11 7.8E-11 6.9E-11 6.1E-11 5.4E-11 4.8E-11 4.2E-11 3.7E-11
H 2.6E-08 2.5E-08 2.2E-08 2.0E-08 1.7E-08 1.5E-08 1.4E-08 1.2E-08 1.1E-08 9.4E-09 8.3E-09 7.3E-09 6.5E-09 5.7E-09 5.1E-09
  4.5E-09 4.0E-09 3.5E-09 3.1E-09 2.7E-09 2.4E-09 2.1E-09 1.9E-09 1.7E-09 1.5E-09 1.3E-09 1.2E-09 1.0E-09 9.0E-10 8.0E-10
  7.0E-10 6.2E-10 5.5E-10 4.9E-10 4.3E-10 3.8E-10 3.4E-10 3.0E-10 2.6E-10 2.3E-10 2.1E-10 1.8E-10 1.6E-10 1.4E-10 1.3E-10
  1.1E-10 9.8E-11 8.7E-11 7.7E-11 6.8E-11
H 9.3E-09 8.2E-09 7.3E-09 6.4E-09 5.7E-09 5.0E-09 4.4E-09 3.9E-09 3.5E-09 3.1E-09 2.7E-09 2.4E-09 2.1E-09 1.9E-09 1.7E-09
  1.5E-09 1.3E-09 1.1E-09 1.0E-09 8.9E-10 7.9E-10 7.0E-10 6.2E-10 5.5E-10 4.8E-10 4.3E-10 3.8E-10 3.3E-10 2.9E-10 2.6E-10
  2.3E-10 2.0E-10 1.8E-10 1.6E-10 1.4E-10 1.2E-10 1.1E-10 9.7E-11 8.6E-11 7.6E-11 6.7E-11 5.9E-11 5.2E-11 4.6E-11 4.1E-11

H 7.6E-10 6.8E-10 6.0E-10 5.3E-10 4.7E-10 4.1E-10 3.6E-10 3.2E-10 2.9E-10 2.5E-10 2.2E-10 2.0E-10 1.7E-10 1.5E-10 1.4E-10
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9 1 0 4 8 1 7 0 9

5.912

9/30/88

DOSINC.DAT

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  1.2E-10 1.1E-10 9.4E-11 8.3E-11 7.3E-11 6.5E-11 5.7E-11 5.1E-11 4.5E-11 4.0E-11
H 2.0E-09 1.3E-09 1.1E-09 1.0E-09 8.9E-10 7.9E-10 6.9E-10 6.1E-10 5.4E-10 4.8E-10 4.2E-10 3.8E-10 3.3E-10 2.9E-10 2.6E-10
  2.3E-10 2.0E-10 1.8E-10 1.6E-10 1.4E-10 1.2E-10 1.1E-10 9.7E-11 8.5E-11 7.6E-11 6.7E-11 5.9E-11 5.2E-11 4.6E-11 4.1E-11

H 2.7E-09 1.7E-09 1.5E-09 1.4E-09 1.2E-09 1.1E-09 9.4E-10 8.3E-10 7.3E-10 6.5E-10 5.7E-10 5.1E-10 4.5E-10 4.0E-10 3.5E-10
  3.1E-10 2.7E-10 2.4E-10 2.1E-10 1.9E-10 1.7E-10 1.5E-10 1.3E-10 1.2E-10 1.0E-10 9.0E-11 8.0E-11 7.0E-11 6.2E-11 5.5E-11
  4.9E-11 4.3E-11 3.8E-11
H 1.5E-09 7.9E-10 7.0E-10 6.2E-10 5.4E-10 4.8E-10 4.3E-10 3.8E-10 3.3E-10 2.9E-10 2.6E-10 2.3E-10 2.0E-10 1.8E-10 1.6E-10
  1.4E-10 1.2E-10 1.1E-10 9.7E-11 8.6E-11 7.6E-11 6.7E-11 5.9E-11 5.2E-11 4.6E-11 4.1E-11
H 5.5E-09 3.7E-09 3.3E-09 2.9E-09 2.6E-09 2.3E-09 2.0E-09 1.8E-09 1.6E-09 1.4E-09 1.2E-09 1.1E-09 9.5E-10 8.4E-10 7.4E-10
  6.6E-10 5.8E-10 5.1E-10 4.5E-10 4.0E-10 3.6E-10 3.1E-10 2.8E-10 2.5E-10 2.2E-10 1.9E-10 1.7E-10 1.5E-10 1.3E-10 1.2E-10
  1.0E-10 9.2E-11 8.1E-11 7.2E-11 6.3E-11 5.6E-11 4.9E-11 4.4E-11 3.9E-11
H 3.7E-08 3.5E-08 3.1E-08 2.8E-08 2.4E-08 2.2E-08 1.9E-08 1.7E-08 1.5E-08 1.3E-08 1.2E-08 1.0E-08 9.1E-09 8.0E-09 7.1E-09
  6.3E-09 5.6E-09 4.9E-09 4.3E-09 3.8E-09 3.4E-09 3.0E-09 2.6E-09 2.3E-09 2.1E-09 1.8E-09 1.6E-09 1.4E-09 1.3E-09 1.1E-09
  9.9E-10 8.7E-10 7.7E-10 6.8E-10 6.0E-10 5.3E-10 4.7E-10 4.2E-10 3.7E-10 3.3E-10 2.9E-10 2.5E-10 2.3E-10 2.0E-10 1.8E-10
  1.6E-10 1.4E-10 1.2E-10 1.1E-10 9.5E-11
! EU154   Class: W F1:   0.00100     12/05/87  18:31:52.1   Acute  Sv/Bq
 13  1  3  4  5  6  7  8 11 12 13 14 16 17
  3  1  1  2  1 24 13  1  1  1  1  5 22
G 5.5E-11 2.3E-11 1.9E-11
G 7.0E-10
G 2.1E-09
G 6.8E-09 2.0E-11
G 1.8E-08
G 7.1E-10 5.3E-10 4.6E-10 3.9E-10 3.4E-10 2.9E-10 2.5E-10 2.1E-10 1.8E-10 1.6E-10 1.4E-10 1.2E-10 1.0E-10 8.6E-11 7.4E-11
  6.4E-11 5.5E-11 4.7E-11 4.1E-11 3.5E-11 3.0E-11 2.6E-11 2.2E-11 1.9E-11
G 3.9E-10 1.1E-10 9.1E-11 7.8E-11 6.7E-11 5.8E-11 5.0E-11 4.3E-11 3.7E-11 3.2E-11 2.7E-11 2.3E-11 2.0E-11
G 1.2E-10
G 1.3E-09
G 1.7E-10
G 1.2E-11
G 2.3E-10 3.1E-11 2.7E-11 2.3E-11 2.0E-11
G 6.1E-10 4.2E-10 3.6E-10 3.1E-10 2.7E-10 2.3E-10 2.0E-10 1.7E-10 1.5E-10 1.3E-10 1.1E-10 9.4E-11 8.1E-11 6.9E-11 6.0E-11
  5.1E-11 4.4E-11 3.8E-11 3.3E-11 2.8E-11 2.4E-11 2.1E-11
 26 24 24 25 20 47 36 17 21 23 18 28 45
H 5.9E-08 3.2E-09 2.4E-09 2.0E-09 1.7E-09 1.5E-09 1.3E-09 1.1E-09 9.5E-10 8.2E-10 7.0E-10 6.1E-10 5.2E-10 4.5E-10 3.8E-10
  3.3E-10 2.8E-10 2.4E-10 2.1E-10 1.8E-10 1.6E-10 1.3E-10 1.1E-10 9.9E-11 8.5E-11 7.3E-11
H 3.7E-09 2.0E-09 1.7E-09 1.5E-09 1.3E-09 1.1E-09 9.4E-10 8.1E-10 6.9E-10 6.0E-10 5.1E-10 4.4E-10 3.8E-10 3.3E-10 2.8E-10
  2.4E-10 2.1E-10 1.8E-10 1.5E-10 1.3E-10 1.1E-10 9.7E-11 8.4E-11 7.2E-11
H 3.3E-09 1.9E-09 1.7E-09 1.4E-09 1.2E-09 1.0E-09 9.0E-10 7.8E-10 6.7E-10 5.7E-10 4.9E-10 4.2E-10 3.6E-10 3.1E-10 2.7E-10
  2.3E-10 2.0E-10 1.7E-10 1.5E-10 1.3E-10 1.1E-10 9.4E-11 8.0E-11 6.9E-11
H 6.3E-09 2.5E-09 2.1E-09 1.8E-09 1.6E-09 1.3E-09 1.2E-09 1.0E-09 8.6E-10 7.4E-10 6.3E-10 5.4E-10 4.7E-10 4.0E-10 3.5E-10
  3.0E-10 2.6E-10 2.2E-10 1.9E-10 1.6E-10 1.4E-10 1.2E-10 1.0E-10 8.9E-11 7.6E-11
H 1.0E-08 1.1E-09 9.1E-10 7.8E-10 6.7E-10 5.8E-10 5.0E-10 4.3E-10 3.7E-10 3.2E-10 2.7E-10 2.3E-10 2.0E-10 1.7E-10 1.5E-10
  1.3E-10 1.1E-10 9.4E-11 8.1E-11 7.0E-11
H 6.7E-08 6.4E-08 5.5E-08 4.8E-08 4.1E-08 3.5E-08 3.0E-08 2.6E-08 2.2E-08 1.9E-08 1.7E-08 1.4E-08 1.2E-08 1.0E-08 9.0E-09
  7.8E-09 6.7E-09 5.7E-09 4.9E-09 4.2E-09 3.6E-09 3.1E-09 2.7E-09 2.3E-09 2.0E-09 1.7E-09 1.5E-09 1.3E-09 1.1E-09 9.4E-10
  8.0E-10 6.9E-10 5.9E-10 5.1E-10 4.4E-10 3.8E-10 3.2E-10 2.8E-10 2.4E-10 2.1E-10 1.8E-10 1.5E-10 1.3E-10 1.1E-10 9.7E-11
  8.3E-11 7.2E-11
H 1.4E-08 1.3E-08 1.1E-08 9.5E-09 8.2E-09 7.0E-09 6.1E-09 5.2E-09 4.5E-09 3.9E-09 3.3E-09 2.8E-09 2.4E-09 2.1E-09 1.8E-09
  1.6E-09 1.3E-09 1.1E-09 9.9E-10 8.5E-10 7.3E-10 6.3E-10 5.4E-10 4.6E-10 4.0E-10 3.4E-10 3.0E-10 2.5E-10 2.2E-10 1.9E-10
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1.6E-10 1.4E-10 1.2E-10 1.0E-10 8.8E-11 7.6E-11
H 8.2E-10 7.1E-10 6.1E-10 5.3E-10 4.5E-10 3.9E-10 3.3E-10 2.9E-10 2.5E-10 2.1E-10 1.8E-10 1.6E-10 1.3E-10 1.2E-10 1.0E-10
8.6E-11 7.4E-11
H 2.2E-09 1.4E-09 1.2E-09 1.0E-09 8.6E-10 7.4E-10 6.4E-10 5.5E-10 4.7E-10 4.0E-10 3.5E-10 3.0E-10 2.6E-10 2.2E-10 1.9E-10
1.6E-10 1.4E-10 1.2E-10 1.0E-10 8.9E-11 7.7E-11
H 2.8E-09 1.8E-09 1.5E-09 1.3E-09 1.1E-09 9.7E-10 8.4E-10 7.2E-10 6.2E-10 5.3E-10 4.6E-10 3.9E-10 3.4E-10 2.9E-10 2.5E-10
2.2E-10 1.8E-10 1.6E-10 1.4E-10 1.2E-10 1.0E-10 8.7E-11 7.5E-11
H 1.6E-09 7.7E-10 6.6E-10 5.7E-10 4.9E-10 4.2E-10 3.6E-10 3.1E-10 2.7E-10 2.3E-10 2.0E-10 1.7E-10 1.5E-10 1.3E-10 1.1E-10
9.3E-11 8.0E-11 6.8E-11
H 6.4E-09 3.8E-09 3.3E-09 2.8E-09 2.4E-09 2.1E-09 1.8E-09 1.5E-09 1.3E-09 1.1E-09 9.8E-10 8.4E-10 7.3E-10 6.2E-10 5.4E-10
4.6E-10 4.0E-10 3.4E-10 2.9E-10 2.5E-10 2.2E-10 1.9E-10 1.6E-10 1.4E-10 1.2E-10 1.0E-10 8.7E-11 7.5E-11
H 5.5E-08 5.1E-08 4.4E-08 3.8E-08 3.3E-08 2.8E-08 2.4E-08 2.1E-08 1.8E-08 1.5E-08 1.3E-08 1.1E-08 9.8E-09 8.4E-09 7.2E-09
6.2E-09 5.3E-09 4.6E-09 4.0E-09 3.4E-09 2.9E-09 2.5E-09 2.2E-09 1.9E-09 1.6E-09 1.4E-09 1.2E-09 1.0E-09 8.7E-10 7.5E-10
6.4E-10 5.5E-10 4.8E-10 4.1E-10 3.5E-10 3.0E-10 2.6E-10 2.2E-10 1.9E-10 1.7E-10 1.4E-10 1.2E-10 1.1E-10 9.0E-11 7.8E-11

! EU155 Class: W F1: 0.00100 12/05/87 18:40:52.2 Acute Sv/Bq
13 1 3 4 5 6 7 8 11 12 13 14 16 17
1 1 1 1 1 20 9 1 1 1 1 1 15
G 2.6E-12
G 9.7E-11
G 2.8E-10
G 1.2E-09
G 3.5E-09
G 2.5E-10 1.9E-10 1.6E-10 1.3E-10 1.0E-10 8.2E-11 6.7E-11 5.4E-11 4.4E-11 3.5E-11 2.9E-11 2.3E-11 1.9E-11 1.5E-11 1.2E-11
9.9E-12 8.0E-12 6.5E-12 5.2E-12 4.2E-12
G 6.0E-11 1.9E-11 1.5E-11 1.2E-11 9.9E-12 8.0E-12 6.5E-12 5.2E-12 4.2E-12
G 6.4E-12
G 9.6E-11
G 1.1E-11
G 3.8E-13
G 1.4E-11
G 8.3E-11 6.2E-11 5.0E-11 4.1E-11 3.3E-11 2.7E-11 2.2E-11 1.7E-11 1.4E-11 1.1E-11 9.2E-12 7.5E-12 6.0E-12 4.9E-12 3.9E-12

10 8 8 9 5 34 23 2 4 7 3 11 28
H 1.1E-08 2.5E-10 1.3E-10 1.1E-10 8.7E-11 7.1E-11 5.7E-11 4.6E-11 3.7E-11 3.0E-11
H 2.4E-10 1.0E-10 8.1E-11 6.6E-11 5.3E-11 4.3E-11 3.5E-11 2.8E-11
H 2.5E-10 9.7E-11 7.8E-11 6.3E-11 5.1E-11 4.1E-11 3.3E-11 2.7E-11
H 7.8E-10 1.4E-10 1.1E-10 9.1E-11 7.4E-11 6.0E-11 4.8E-11 3.9E-11 3.2E-11
H 1.8E-09 5.2E-11 4.1E-11 3.3E-11 2.7E-11
H 2.6E-08 2.3E-08 1.9E-08 1.5E-08 1.2E-08 1.0E-08 8.1E-09 6.5E-09 5.3E-09 4.3E-09 3.5E-09 2.8E-09 2.3E-09 1.8E-09 1.5E-09
1.2E-09 9.7E-10 7.8E-10 6.3E-10 5.1E-10 4.2E-10 3.4E-10 2.7E-10 2.2E-10 1.8E-10 1.4E-10 1.2E-10 9.4E-11 7.6E-11 6.2E-11
5.0E-11 4.0E-11 3.3E-11 2.6E-11
H 2.6E-09 2.3E-09 1.8E-09 1.5E-09 1.2E-09 9.7E-10 7.9E-10 6.4E-10 5.2E-10 4.2E-10 3.4E-10 2.7E-10 2.2E-10 1.8E-10 1.4E-10
1.2E-10 9.5E-11 7.6E-11 6.2E-11 5.0E-11 4.0E-11 3.3E-11 2.6E-11
H 3.3E-11 2.7E-11
H 1.1E-10 4.9E-11 3.9E-11 3.2E-11
H 1.6E-10 8.8E-11 7.1E-11 5.7E-11 4.6E-11 3.8E-11 3.0E-11
H 7.0E-11 3.4E-11 2.7E-11
H 5.8E-10 2.1E-10 1.7E-10 1.4E-10 1.1E-10 9.0E-11 7.3E-11 5.9E-11 4.8E-11 3.9E-11 3.1E-11
H 8.4E-09 7.5E-09 6.1E-09 4.9E-09 4.0E-09 3.2E-09 2.6E-09 2.1E-09 1.7E-09 1.4E-09 1.1E-09 9.1E-10 7.3E-10 5.9E-10 4.8E-10
3.9E-10 3.1E-10 2.5E-10 2.1E-10 1.7E-10 1.3E-10 1.1E-10 8.8E-11 7.1E-11 5.8E-11 4.7E-11 3.8E-11 3.0E-11

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9/30/88

DOSINC.DAT

DOSINC.DAT

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! TH230   Class: Y F1:   0.00020     12/05/87  18:52:00.3   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  2  2  2  2  2 50 50  2  2  2  2  8
G 2.2E-10 1.5E-10
G 1.3E-09 1.5E-10
G 3.0E-09 1.5E-10
G 1.6E-08 1.5E-10
G 4.9E-08 1.5E-10
G 1.3E-07 1.3E-07 1.3E-07 1.2E-07 1.2E-07 1.1E-07 1.1E-07 1.1E-07 1.0E-07 1.0E-07 9.9E-08 9.6E-08 9.3E-08 9.1E-08 8.8E-08
  8.5E-08 8.3E-08 8.1E-08 7.8E-08 7.6E-08 7.4E-08 7.2E-08 7.0E-08 6.8E-08 6.6E-08 6.4E-08 6.2E-08 6.0E-08 5.8E-08 5.7E-08
  5.5E-08 5.3E-08 5.2E-08 5.0E-08 4.9E-08 4.8E-08 4.6E-08 4.5E-08 4.4E-08 4.2E-08 4.1E-08 4.0E-08 3.9E-08 3.8E-08 3.7E-08
  3.5E-08 3.4E-08 3.3E-08 3.3E-08 3.2E-08
G 1.1E-08 1.1E-08 1.0E-08 1.0E-08 9.7E-09 9.4E-09 9.1E-09 8.8E-09 8.6E-09 8.3E-09 8.1E-09 7.8E-09 7.6E-09 7.4E-09 7.2E-09
  7.0E-09 6.8E-09 6.6E-09 6.4E-09 6.2E-09 6.0E-09 5.8E-09 5.7E-09 5.5E-09 5.3E-09 5.2E-09 5.0E-09 4.9E-09 4.8E-09 4.6E-09
  4.5E-09 4.4E-09 4.2E-09 4.1E-09 4.0E-09 3.9E-09 3.8E-09 3.7E-09 3.5E-09 3.4E-09 3.3E-09 3.2E-09 3.2E-09 3.1E-09 3.0E-09
  2.9E-09 2.8E-09 2.7E-09 2.6E-09 2.6E-09
G 2.2E-10 1.5E-10
G 2.2E-10 1.5E-10
G 2.2E-10 1.5E-10
G 2.2E-10 1.5E-10
G 1.8E-09 1.3E-09 8.8E-10 6.2E-10 4.3E-10 3.0E-10 2.1E-10 1.5E-10
 50  1  1  1  1 50 50  1  1  1  1 11
H 6.0E-05 4.2E-05 3.0E-05 2.2E-05 1.6E-05 1.2E-05 9.6E-06 7.7E-06 6.2E-06 5.2E-06 4.4E-06 3.8E-06 3.3E-06 3.0E-06 2.7E-06
  2.5E-06 2.4E-06 2.3E-06 2.2E-06 2.1E-06 2.1E-06 2.0E-06 2.0E-06 2.0E-06 2.0E-06 2.0E-06 2.0E-06 2.0E-06 1.9E-06 1.9E-06
  1.9E-06 1.9E-06 1.9E-06 2.0E-06 2.0E-06 2.0E-06 2.0E-06 2.0E-06 2.0E-06 2.0E-06 2.0E-06 2.0E-06 2.0E-06 2.0E-06 2.0E-06
  2.0E-06 2.0E-06 2.0E-06 2.0E-06 2.0E-06
H 8.7E-09
H 9.6E-09
H 1.6E-08
H 3.3E-08
H 4.8E-06 9.1E-06 1.3E-05 1.6E-05 1.9E-05 2.1E-05 2.3E-05 2.4E-05 2.5E-05 2.5E-05 2.5E-05 2.5E-05 2.5E-05 2.5E-05 2.4E-05
  2.4E-05 2.3E-05 2.3E-05 2.2E-05 2.2E-05 2.1E-05 2.1E-05 2.0E-05 2.0E-05 1.9E-05 1.9E-05 1.8E-05 1.7E-05 1.7E-05 1.7E-05
  1.6E-05 1.6E-05 1.5E-05 1.5E-05 1.4E-05 1.4E-05 1.3E-05 1.3E-05 1.3E-05 1.2E-05 1.2E-05 1.2E-05 1.1E-05 1.1E-05 1.1E-05
  1.0E-05 1.0E-05 9.8E-06 9.5E-06 9.2E-06
H 4.0E-07 7.5E-07 1.1E-06 1.4E-06 1.6E-06 1.8E-06 1.9E-06 2.0E-06 2.0E-06 2.1E-06 2.1E-06 2.1E-06 2.0E-06 2.0E-06 2.0E-06
  1.9E-06 1.9E-06 1.9E-06 1.8E-06 1.8E-06 1.7E-06 1.7E-06 1.6E-06 1.6E-06 1.6E-06 1.5E-06 1.5E-06 1.4E-06 1.4E-06 1.3E-06
  1.3E-06 1.3E-06 1.2E-06 1.2E-06 1.2E-06 1.1E-06 1.1E-06 1.1E-06 1.0E-06 1.0E-06 9.8E-07 9.5E-07 9.2E-07 8.9E-07 8.7E-07
  8.4E-07 8.2E-07 8.0E-07 7.7E-07 7.5E-07
H 8.2E-09
H 8.2E-09
H 8.2E-09
H 8.2E-09
H 6.7E-08 1.1E-07 1.3E-07 1.4E-07 1.4E-07 1.4E-07 1.2E-07 1.1E-07 9.6E-08 8.2E-08 6.9E-08
! RA226   Class: W F1:   0.20000     12/05/87  19:52:17.7   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  1  1  1  1  1 50 50  1  1  1  1
G 2.5E-09
G 3.6E-09
G 4.7E-09
G 1.5E-08
G 4.2E-08
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5.914

9/30/88

8 0 7 1 8 4 0 1 6

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G 5.7E-07 4.5E-07 3.8E-07 3.3E-07 2.9E-07 2.7E-07 2.4E-07 2.2E-07 2.0E-07 1.9E-07 1.8E-07 1.7E-07 1.6E-07 1.5E-07 1.4E-07
  1.3E-07 1.2E-07 1.2E-07 1.1E-07 1.1E-07 1.0E-07 9.7E-08 9.3E-08 8.9E-08 8.5E-08 8.2E-08 7.8E-08 7.5E-08 7.2E-08 6.9E-08
  6.7E-08 6.4E-08 6.2E-08 5.9E-08 5.7E-08 5.5E-08 5.3E-08 5.1E-08 4.9E-08 4.7E-08 4.6E-08 4.4E-08 4.3E-08 4.1E-08 4.0E-08
  3.8E-08 3.7E-08 3.6E-08 3.5E-08 3.3E-08
G 6.0E-08 5.0E-08 4.3E-08 3.7E-08 3.2E-08 2.8E-08 2.5E-08 2.2E-08 2.0E-08 1.7E-08 1.6E-08 1.4E-08 1.3E-08 1.2E-08 1.1E-08
  9.7E-09 8.9E-09 8.2E-09 7.6E-09 7.0E-09 6.5E-09 6.0E-09 5.6E-09 5.2E-09 4.8E-09 4.5E-09 4.2E-09 3.9E-09 3.6E-09 3.4E-09
  3.2E-09 2.9E-09 2.8E-09 2.6E-09 2.4E-09 2.2E-09 2.1E-09 2.0E-09 1.8E-09 1.7E-09 1.6E-09 1.5E-09 1.4E-09 1.3E-09 1.2E-09
  1.1E-09 1.1E-09 1.0E-09 9.4E-10 8.8E-10
G 2.5E-09
G 2.5E-09
G 2.5E-09
G 2.5E-09
  2  1  1  1  1 50 11  1  1  1  1
H 1.6E-05 1.4E-07
H 3.3E-09
H 3.9E-09
H 9.2E-09
H 2.3E-08
H 5.9E-07 5.0E-07 4.2E-07 3.7E-07 3.3E-07 3.0E-07 2.7E-07 2.5E-07 2.3E-07 2.1E-07 2.0E-07 1.8E-07 1.7E-07 1.6E-07 1.5E-07
  1.5E-07 1.4E-07 1.3E-07 1.2E-07 1.2E-07 1.1E-07 1.1E-07 1.0E-07 9.9E-08 9.5E-08 9.1E-08 8.7E-08 8.4E-08 8.0E-08 7.7E-08
  7.4E-08 7.1E-08 6.9E-08 6.6E-08 6.4E-08 6.1E-08 5.9E-08 5.7E-08 5.5E-08 5.3E-08 5.1E-08 4.9E-08 4.7E-08 4.6E-08 4.4E-08
  4.3E-08 4.1E-08 4.0E-08 3.8E-08 3.7E-08
H 6.2E-08 5.6E-08 4.8E-08 4.2E-08 3.6E-08 3.2E-08 2.8E-08 2.5E-08 2.2E-08 2.0E-08 1.8E-08
H 2.8E-09
H 2.8E-09
H 2.8E-09
H 2.8E-09
! PB210   Class: D F1:   0.20000     12/05/87  20:45:04.7   Acute  Sv/Bq
 13  1  3  4  5  6  7  8 11 12 13 14 17 16
 37 36 36 36 36 50 50 37 36 37 36 50 50
G 1.7E-08 1.2E-08 7.5E-09 5.9E-09 5.3E-09 5.0E-09 4.7E-09 4.5E-09 4.2E-09 4.0E-09 3.8E-09 3.6E-09 3.4E-09 3.3E-09 3.1E-09
  2.9E-09 2.8E-09 2.7E-09 2.5E-09 2.4E-09 2.3E-09 2.2E-09 2.0E-09 1.9E-09 1.8E-09 1.7E-09 1.7E-09 1.6E-09 1.5E-09 1.4E-09
  1.3E-09 1.3E-09 1.2E-09 1.1E-09 1.1E-09 1.0E-09 9.8E-10
G 1.6E-08 1.2E-08 7.1E-09 5.6E-09 5.1E-09 4.7E-09 4.5E-09 4.2E-09 4.0E-09 3.8E-09 3.6E-09 3.4E-09 3.3E-09 3.1E-09 2.9E-09
  2.8E-09 2.6E-09 2.5E-09 2.4E-09 2.3E-09 2.1E-09 2.0E-09 1.9E-09 1.8E-09 1.7E-09 1.7E-09 1.6E-09 1.5E-09 1.4E-09 1.3E-09
  1.3E-09 1.2E-09 1.1E-09 1.1E-09 1.0E-09 9.8E-10
G 1.6E-08 1.2E-08 7.1E-09 5.6E-09 5.1E-09 4.7E-09 4.5E-09 4.2E-09 4.0E-09 3.8E-09 3.6E-09 3.4E-09 3.3E-09 3.1E-09 2.9E-09
  2.8E-09 2.6E-09 2.5E-09 2.4E-09 2.3E-09 2.1E-09 2.0E-09 1.9E-09 1.8E-09 1.7E-09 1.7E-09 1.6E-09 1.5E-09 1.4E-09 1.3E-09
  1.3E-09 1.2E-09 1.1E-09 1.1E-09 1.0E-09 9.8E-10
G 1.7E-08 1.2E-08 7.1E-09 5.6E-09 5.0E-09 4.7E-09 4.5E-09 4.2E-09 4.0E-09 3.8E-09 3.6E-09 3.4E-09 3.3E-09 3.1E-09 2.9E-09
  2.8E-09 2.6E-09 2.5E-09 2.4E-09 2.3E-09 2.1E-09 2.0E-09 1.9E-09 1.8E-09 1.7E-09 1.7E-09 1.6E-09 1.5E-09 1.4E-09 1.3E-09
  1.3E-09 1.2E-09 1.1E-09 1.1E-09 1.0E-09 9.8E-10
G 2.1E-08 1.2E-08 7.1E-09 5.6E-09 5.1E-09 4.7E-09 4.5E-09 4.2E-09 4.0E-09 3.8E-09 3.6E-09 3.4E-09 3.3E-09 3.1E-09 2.9E-09
  2.8E-09 2.6E-09 2.5E-09 2.4E-09 2.3E-09 2.2E-09 2.0E-09 1.9E-09 1.8E-09 1.7E-09 1.7E-09 1.6E-09 1.5E-09 1.4E-09 1.3E-09
  1.3E-09 1.2E-09 1.1E-09 1.1E-09 1.0E-09 9.8E-10
G 9.7E-07 1.3E-06 1.2E-06 1.1E-06 1.0E-06 9.6E-07 9.0E-07 8.5E-07 8.1E-07 7.6E-07 7.2E-07 6.8E-07 6.4E-07 6.1E-07 5.8E-07
  5.4E-07 5.1E-07 4.9E-07 4.6E-07 4.3E-07 4.1E-07 3.9E-07 3.7E-07 3.5E-07 3.3E-07 3.1E-07 2.9E-07 2.8E-07 2.6E-07 2.5E-07
  2.3E-07 2.2E-07 2.1E-07 2.0E-07 1.9E-07 1.8E-07 1.7E-07 1.6E-07 1.5E-07 1.4E-07 1.3E-07 1.3E-07 1.2E-07 1.1E-07 1.1E-07
  1.0E-07 9.5E-08 8.9E-08 8.5E-08 8.0E-08
G 7.9E-08 9.1E-08 8.0E-08 7.3E-08 6.9E-08 6.5E-08 6.1E-08 5.8E-08 5.5E-08 5.2E-08 4.9E-08 4.6E-08 4.4E-08 4.1E-08 3.9E-08
  3.7E-08 3.5E-08 3.3E-08 3.1E-08 2.9E-08 2.8E-08 2.6E-08 2.5E-08 2.4E-08 2.2E-08 2.1E-08 2.0E-08 1.9E-08 1.8E-08 1.7E-08
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  1.6E-08 1.5E-08 1.4E-08 1.3E-08 1.3E-08 1.2E-08 1.1E-08 1.1E-08 1.0E-08 9.6E-09 9.1E-09 8.6E-09 8.1E-09 7.7E-09 7.2E-09
  6.9E-09 6.5E-09 6.1E-09 5.8E-09 5.5E-09
G 1.7E-08 1.2E-08 7.4E-09 5.8E-09 5.3E-09 4.9E-09 4.7E-09 4.4E-09 4.2E-09 4.0E-09 3.8E-09 3.6E-09 3.4E-09 3.2E-09 3.1E-09
  2.9E-09 2.8E-09 2.6E-09 2.5E-09 2.4E-09 2.2E-09 2.1E-09 2.0E-09 1.9E-09 1.8E-09 1.7E-09 1.6E-09 1.6E-09 1.5E-09 1.4E-09
  1.3E-09 1.3E-09 1.2E-09 1.1E-09 1.1E-09 1.0E-09 9.7E-10
G 1.7E-08 1.2E-08 7.3E-09 5.8E-09 5.2E-09 4.9E-09 4.6E-09 4.4E-09 4.2E-09 3.9E-09 3.7E-09 3.6E-09 3.4E-09 3.2E-09 3.0E-09
  2.9E-09 2.7E-09 2.6E-09 2.5E-09 2.3E-09 2.2E-09 2.1E-09 2.0E-09 1.9E-09 1.8E-09 1.7E-09 1.6E-09 1.5E-09 1.5E-09 1.4E-09
  1.3E-09 1.3E-09 1.2E-09 1.1E-09 1.1E-09 1.0E-09
G 1.7E-08 1.2E-08 7.4E-09 5.9E-09 5.3E-09 5.0E-09 4.7E-09 4.4E-09 4.2E-09 4.0E-09 3.8E-09 3.6E-09 3.4E-09 3.2E-09 3.1E-09
  2.9E-09 2.8E-09 2.6E-09 2.5E-09 2.4E-09 2.3E-09 2.1E-09 2.0E-09 1.9E-09 1.8E-09 1.7E-09 1.6E-09 1.6E-09 1.5E-09 1.4E-09
  1.3E-09 1.3E-09 1.2E-09 1.1E-09 1.1E-09 1.0E-09 9.8E-10
G 1.7E-08 1.2E-08 7.3E-09 5.8E-09 5.2E-09 4.9E-09 4.6E-09 4.4E-09 4.2E-09 4.0E-09 3.8E-09 3.6E-09 3.4E-09 3.2E-09 3.0E-09
  2.9E-09 2.7E-09 2.6E-09 2.5E-09 2.3E-09 2.2E-09 2.1E-09 2.0E-09 1.9E-09 1.8E-09 1.7E-09 1.6E-09 1.5E-09 1.5E-09 1.4E-09
  1.3E-09 1.3E-09 1.2E-09 1.1E-09 1.1E-09 1.0E-09
G 8.2E-07 5.8E-07 3.5E-07 2.7E-07 2.5E-07 2.3E-07 2.2E-07 2.0E-07 1.9E-07 1.8E-07 1.7E-07 1.6E-07 1.5E-07 1.4E-07 1.4E-07
  1.3E-07 1.2E-07 1.2E-07 1.1E-07 1.0E-07 9.7E-08 9.2E-08 8.7E-08 8.2E-08 7.8E-08 7.3E-08 6.9E-08 6.6E-08 6.2E-08 5.9E-08
  5.5E-08 5.2E-08 5.0E-08 4.7E-08 4.4E-08 4.2E-08 4.0E-08 3.7E-08 3.5E-08 3.3E-08 3.2E-08 3.0E-08 2.8E-08 2.7E-08 2.5E-08
  2.4E-08 2.2E-08 2.1E-08 2.0E-08 1.9E-08
G 3.8E-07 2.7E-07 1.6E-07 1.3E-07 1.1E-07 1.1E-07 1.0E-07 9.5E-08 9.0E-08 8.5E-08 8.0E-08 7.6E-08 7.1E-08 6.8E-08 6.4E-08
  6.0E-08 5.7E-08 5.4E-08 5.1E-08 4.8E-08 4.5E-08 4.3E-08 4.1E-08 3.8E-08 3.6E-08 3.4E-08 3.2E-08 3.1E-08 2.9E-08 2.7E-08
  2.6E-08 2.4E-08 2.3E-08 2.2E-08 2.1E-08 1.9E-08 1.8E-08 1.7E-08 1.6E-08 1.6E-08 1.5E-08 1.4E-08 1.3E-08 1.2E-08 1.2E-08
  1.1E-08 1.0E-08 9.9E-09 9.4E-09 8.8E-09
  1 36 36 36 36 50 50 37 37 37 37 50 50
H 4.3E-10
H 4.2E-08 3.0E-08 1.8E-08 1.4E-08 1.3E-08 1.2E-08 1.2E-08 1.1E-08 1.0E-08 9.8E-09 9.3E-09 8.9E-09 8.4E-09 8.0E-09 7.6E-09
  7.2E-09 6.8E-09 6.5E-09 6.1E-09 5.8E-09 5.5E-09 5.3E-09 5.0E-09 4.7E-09 4.5E-09 4.3E-09 4.0E-09 3.8E-09 3.6E-09 3.5E-09
  3.3E-09 3.1E-09 3.0E-09 2.8E-09 2.7E-09 2.5E-09
H 4.2E-08 3.0E-08 1.8E-08 1.4E-08 1.3E-08 1.2E-08 1.2E-08 1.1E-08 1.0E-08 9.8E-09 9.3E-09 8.9E-09 8.4E-09 8.0E-09 7.6E-09
  7.2E-09 6.8E-09 6.5E-09 6.1E-09 5.8E-09 5.5E-09 5.3E-09 5.0E-09 4.7E-09 4.5E-09 4.3E-09 4.0E-09 3.8E-09 3.6E-09 3.5E-09
  3.3E-09 3.1E-09 3.0E-09 2.8E-09 2.7E-09 2.5E-09
H 4.2E-08 3.0E-08 1.8E-08 1.4E-08 1.3E-08 1.2E-08 1.2E-08 1.1E-08 1.0E-08 9.8E-09 9.3E-09 8.9E-09 8.4E-09 8.0E-09 7.6E-09
  7.2E-09 6.8E-09 6.5E-09 6.1E-09 5.8E-09 5.5E-09 5.3E-09 5.0E-09 4.7E-09 4.5E-09 4.3E-09 4.0E-09 3.8E-09 3.6E-09 3.5E-09
  3.3E-09 3.1E-09 3.0E-09 2.8E-09 2.7E-09 2.5E-09
H 4.3E-08 3.0E-08 1.8E-08 1.4E-08 1.3E-08 1.2E-08 1.2E-08 1.1E-08 1.0E-08 9.8E-09 9.3E-09 8.9E-09 8.4E-09 8.0E-09 7.6E-09
  7.2E-09 6.8E-09 6.5E-09 6.1E-09 5.8E-09 5.5E-09 5.3E-09 5.0E-09 4.7E-09 4.5E-09 4.3E-09 4.0E-09 3.8E-09 3.6E-09 3.5E-09
  3.3E-09 3.1E-09 3.0E-09 2.8E-09 2.7E-09 2.5E-09
H 2.5E-06 3.2E-06 2.9E-06 2.7E-06 2.6E-06 2.4E-06 2.3E-06 2.2E-06 2.0E-06 1.9E-06 1.8E-06 1.7E-06 1.6E-06 1.5E-06 1.5E-06
  1.4E-06 1.3E-06 1.2E-06 1.2E-06 1.1E-06 1.0E-06 9.8E-07 9.3E-07 8.8E-07 8.3E-07 7.8E-07 7.4E-07 7.0E-07 6.6E-07 6.3E-07
  5.9E-07 5.6E-07 5.3E-07 5.0E-07 4.7E-07 4.5E-07 4.2E-07 4.0E-07 3.8E-07 3.6E-07 3.4E-07 3.2E-07 3.0E-07 2.8E-07 2.7E-07
  2.5E-07 2.4E-07 2.3E-07 2.1E-07 2.0E-07
H 2.0E-07 2.3E-07 2.0E-07 1.9E-07 1.7E-07 1.6E-07 1.6E-07 1.5E-07 1.4E-07 1.3E-07 1.2E-07 1.2E-07 1.1E-07 1.0E-07 9.9E-08
  9.4E-08 8.8E-08 8.4E-08 7.9E-08 7.5E-08 7.1E-08 6.7E-08 6.3E-08 6.0E-08 5.6E-08 5.3E-08 5.0E-08 4.8E-08 4.5E-08 4.3E-08
  4.0E-08 3.8E-08 3.6E-08 3.4E-08 3.2E-08 3.0E-08 2.9E-08 2.7E-08 2.6E-08 2.4E-08 2.3E-08 2.2E-08 2.1E-08 1.9E-08 1.8E-08
  1.7E-08 1.6E-08 1.6E-08 1.5E-08 1.4E-08
H 4.4E-08 3.1E-08 1.9E-08 1.5E-08 1.4E-08 1.3E-08 1.2E-08 1.1E-08 1.1E-08 1.0E-08 9.7E-09 9.2E-09 8.7E-09 8.3E-09 7.9E-09
  7.5E-09 7.1E-09 6.7E-09 6.4E-09 6.1E-09 5.8E-09 5.5E-09 5.2E-09 4.9E-09 4.7E-09 4.4E-09 4.2E-09 4.0E-09 3.8E-09 3.6E-09
  3.4E-09 3.2E-09 3.1E-09 2.9E-09 2.8E-09 2.6E-09 2.5E-09
H 4.4E-08 3.1E-08 1.9E-08 1.5E-08 1.3E-08 1.3E-08 1.2E-08 1.1E-08 1.1E-08 1.0E-08 9.7E-09 9.2E-09 8.7E-09 8.3E-09 7.8E-09
  7.4E-09 7.1E-09 6.7E-09 6.4E-09 6.0E-09 5.7E-09 5.4E-09 5.2E-09 4.9E-09 4.6E-09 4.4E-09 4.2E-09 4.0E-09 3.8E-09 3.6E-09
  3.4E-09 3.2E-09 3.1E-09 2.9E-09 2.8E-09 2.6E-09 2.5E-09
H 4.4E-08 3.2E-08 1.9E-08 1.5E-08 1.4E-08 1.3E-08 1.2E-08 1.1E-08 1.1E-08 1.0E-08 9.8E-09 9.3E-09 8.8E-09 8.4E-09 7.9E-09
```

DOSINC.DAT

```
  7.5E-09 7.1E-09 6.8E-09 6.4E-09 6.1E-09 5.8E-09 5.5E-09 5.2E-09 5.0E-09 4.7E-09 4.5E-09 4.2E-09 4.0E-09 3.8E-09 3.6E-09
  3.4E-09 3.3E-09 3.1E-09 2.9E-09 2.8E-09 2.6E-09 2.5E-09
H 4.4E-08 3.1E-08 1.9E-08 1.5E-08 1.3E-08 1.3E-08 1.2E-08 1.1E-08 1.1E-08 1.0E-08 9.7E-09 9.2E-09 8.7E-09 8.3E-09 7.8E-09
  7.4E-09 7.1E-09 6.7E-09 6.4E-09 6.0E-09 5.7E-09 5.4E-09 5.2E-09 4.9E-09 4.7E-09 4.4E-09 4.2E-09 4.0E-09 3.8E-09 3.6E-09
  3.4E-09 3.2E-09 3.1E-09 2.9E-09 2.8E-09 2.6E-09 2.5E-09
H 2.1E-06 1.5E-06 8.8E-07 6.9E-07 6.2E-07 5.8E-07 5.5E-07 5.1E-07 4.9E-07 4.6E-07 4.3E-07 4.1E-07 3.9E-07 3.7E-07 3.5E-07
  3.3E-07 3.1E-07 2.9E-07 2.8E-07 2.6E-07 2.5E-07 2.3E-07 2.2E-07 2.1E-07 2.0E-07 1.9E-07 1.8E-07 1.7E-07 1.6E-07 1.5E-07
  1.4E-07 1.3E-07 1.3E-07 1.2E-07 1.1E-07 1.1E-07 1.0E-07 9.5E-08 8.9E-08 8.5E-08 8.0E-08 7.5E-08 7.1E-08 6.7E-08 6.4E-08
  6.0E-08 5.7E-08 5.4E-08 5.1E-08 4.8E-08
H 9.7E-07 6.9E-07 4.1E-07 3.2E-07 2.9E-07 2.7E-07 2.5E-07 2.4E-07 2.3E-07 2.1E-07 2.0E-07 1.9E-07 1.8E-07 1.7E-07 1.6E-07
  1.5E-07 1.4E-07 1.4E-07 1.3E-07 1.2E-07 1.2E-07 1.1E-07 1.0E-07 9.7E-08 9.2E-08 8.7E-08 8.2E-08 7.8E-08 7.3E-08 6.9E-08
  6.6E-08 6.2E-08 5.9E-08 5.5E-08 5.2E-08 4.9E-08 4.7E-08 4.4E-08 4.2E-08 3.9E-08 3.7E-08 3.5E-08 3.3E-08 3.1E-08 3.0E-08
  2.8E-08 2.7E-08 2.5E-08 2.4E-08 2.2E-08
! BI210   Class: W F1:   0.05000     12/05/87  21:12:09.1   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 16
  1  1  1  1  1  1  1  1  1  1  1  1
G 2.0E-11
G 4.7E-10
G 1.1E-09
G 5.8E-09
G 1.5E-08
G 1.0E-11
G 2.0E-11
G 2.0E-11
G 2.0E-11
G 2.0E-11
G 2.0E-11
G 5.8E-09
  2  1  1  1  1  1  1  1  1  1  1  1
H 4.3E-07 6.9E-10
H 2.5E-10
H 4.8E-10
H 2.3E-09
H 6.0E-09
H 3.8E-11
H 6.7E-11
H 6.7E-11
H 6.6E-11
H 6.7E-11
H 6.6E-11
H 1.9E-08
! PO210   Class: W F1:   0.10000     12/05/87  21:26:32.5   Acute  Sv/Bq
 14  1  3  4  5  6  7  8 11 12 13 14 17 16 19
  1  1  1  1  1  1  1  1  1  1  1  1  1  2
G 8.5E-08
G 9.5E-08
G 9.7E-08
G 1.1E-07
G 1.4E-07
G 4.2E-08
G 8.4E-08
```

5.917

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9 1 0 4 8 1 7 1 1

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G 8.4E-08
G 8.4E-08
G 8.5E-08
G 8.4E-08
G 4.4E-07
G 2.6E-06
G 4.4E-06 4.5E-09
  2  1  1  1  1  1  1  1  1  1  1  1  2  2
H 1.3E-05 1.8E-08
H 1.5E-07
H 1.5E-07
H 1.5E-07
H 1.7E-07
H 6.5E-08
H 1.3E-07
H 1.3E-07
H 1.3E-07
H 1.3E-07
H 1.3E-07
H 6.7E-07
H 3.9E-06 1.6E-08
H 6.7E-06 2.7E-08
! U 234   Class: Y F1:   0.00200     12/05/87  21:34:56.5   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 16
  1  1  1  1  1 50 22  1  1  1  1 21
G 6.6E-11
G 1.2E-09
G 2.8E-09
G 1.7E-08
G 5.0E-08
G 4.0E-09 2.2E-09 2.1E-09 2.0E-09 1.9E-09 1.8E-09 1.7E-09 1.6E-09 1.6E-09 1.5E-09 1.4E-09 1.3E-09 1.3E-09 1.2E-09 1.2E-09
  1.1E-09 1.0E-09 9.9E-10 9.4E-10 8.9E-10 8.5E-10 8.1E-10 7.7E-10 7.3E-10 6.9E-10 6.6E-10 6.3E-10 6.0E-10 5.7E-10 5.4E-10
  5.1E-10 4.9E-10 4.6E-10 4.4E-10 4.2E-10 4.0E-10 3.8E-10 3.6E-10 3.4E-10 3.3E-10 3.1E-10 2.9E-10 2.8E-10 2.7E-10 2.5E-10
  2.4E-10 2.3E-10 2.2E-10 2.1E-10 2.0E-10
G 3.1E-10 1.4E-10 1.4E-10 1.3E-10 1.2E-10 1.2E-10 1.1E-10 1.0E-10 9.9E-11 9.4E-11 8.9E-11 8.4E-11 8.0E-11 7.6E-11 7.2E-11
  6.9E-11 6.5E-11 6.2E-11 5.9E-11 5.6E-11 5.3E-11 5.0E-11
G 6.6E-11
G 6.8E-11
G 6.6E-11
G 6.6E-11
G 1.0E-08 1.3E-09 1.1E-09 9.0E-10 7.6E-10 6.5E-10 5.5E-10 4.6E-10 3.9E-10 3.3E-10 2.8E-10 2.3E-10 2.0E-10 1.7E-10 1.4E-10
  1.2E-10 1.0E-10 8.5E-11 7.2E-11 6.1E-11 5.1E-11
 50  1  1  1  1  1  1  1  1  1  1  1
H 6.2E-05 4.3E-05 3.0E-05 2.2E-05 1.6E-05 1.3E-05 9.7E-06 7.7E-06 6.2E-06 5.2E-06 4.4E-06 3.8E-06 3.3E-06 3.0E-06 2.7E-06
  2.5E-06 2.4E-06 2.2E-06 2.1E-06 2.1E-06 2.0E-06 2.0E-06 2.0E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06
  1.9E-06 1.9E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06
  1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06
H 9.3E-10
H 1.8E-09
H 8.9E-09
H 2.6E-08
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DOSINC.DAT

5.918

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9 1 0 4 8 1 7 1 2

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H 1.9E-08
H 1.5E-09
H 3.7E-10
H 3.7E-10
H 3.7E-10
H 3.7E-10
H 5.7E-08
! U 236   Class: Y F1:   0.00200     12/05/87  21:43:08.9   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 16
  1  1  1  1  1 50 22  1  1  1  1 21
G 6.2E-11
G 1.1E-09
G 2.6E-09
G 1.5E-08
G 4.7E-08
G 3.8E-09 2.1E-09 2.0E-09 1.9E-09 1.8E-09 1.7E-09 1.6E-09 1.6E-09 1.5E-09 1.4E-09 1.3E-09 1.3E-09 1.2E-09 1.2E-09 1.1E-09
  1.0E-09 9.9E-10 9.4E-10 8.9E-10 8.5E-10 8.1E-10 7.7E-10 7.3E-10 6.9E-10 6.6E-10 6.3E-10 6.0E-10 5.7E-10 5.4E-10 5.1E-10
  4.9E-10 4.6E-10 4.4E-10 4.2E-10 4.0E-10 3.8E-10 3.6E-10 3.4E-10 3.2E-10 3.1E-10 2.9E-10 2.8E-10 2.7E-10 2.5E-10 2.4E-10
  2.3E-10 2.2E-10 2.1E-10 2.0E-10 1.9E-10
G 2.9E-10 1.4E-10 1.3E-10 1.2E-10 1.1E-10 1.1E-10 1.0E-10 9.8E-11 9.3E-11 8.8E-11 8.3E-11 7.9E-11 7.5E-11 7.1E-11 6.8E-11
  6.4E-11 6.1E-11 5.8E-11 5.5E-11 5.2E-11 5.0E-11 4.7E-11
G 6.1E-11
G 6.4E-11
G 6.2E-11
G 6.2E-11
G 1.0E-08 1.2E-09 1.0E-09 8.8E-10 7.4E-10 6.2E-10 5.3E-10 4.5E-10 3.8E-10 3.2E-10 2.7E-10 2.3E-10 1.9E-10 1.6E-10 1.4E-10
  1.2E-10 9.8E-11 8.3E-11 7.0E-11 5.9E-11 5.0E-11
 50  1  1  1  1  1  1  1  1  1  1  1
H 5.8E-05 4.1E-05 2.9E-05 2.1E-05 1.6E-05 1.2E-05 9.2E-06 7.3E-06 5.9E-06 4.9E-06 4.1E-06 3.6E-06 3.1E-06 2.8E-06 2.6E-06
  2.4E-06 2.2E-06 2.1E-06 2.0E-06 2.0E-06 1.9E-06 1.9E-06 1.9E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06
  1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.7E-06 1.7E-06 1.7E-06 1.7E-06 1.7E-06 1.7E-06 1.7E-06 1.7E-06 1.7E-06 1.7E-06 1.7E-06
  1.7E-06 1.7E-06 1.7E-06 1.7E-06 1.7E-06
H 8.8E-10
H 1.6E-09
H 8.1E-09
H 2.5E-08
H 1.8E-08
H 1.4E-09
H 3.4E-10
H 3.4E-10
H 3.5E-10
H 3.4E-10
H 5.5E-08
! U 235   Class: Y F1:   0.00200     12/05/87  21:56:02.7   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 16
  1  1  1  1  1 50 19  1  1  1  1 20
G 6.4E-11
G 1.2E-09
G 3.0E-09
G 1.7E-08
G 5.4E-08
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DOSINC.DAT

5.919

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91048 1713

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G 3.7E-09 2.0E-09 1.9E-09 1.8E-09 1.8E-09 1.7E-09 1.6E-09 1.5E-09 1.4E-09 1.4E-09 1.3E-09 1.2E-09 1.2E-09 1.1E-09 1.1E-09
  1.0E-09 9.6E-10 9.1E-10 8.6E-10 8.2E-10 7.8E-10 7.4E-10 7.1E-10 6.7E-10 6.4E-10 6.1E-10 5.8E-10 5.5E-10 5.2E-10 5.0E-10
  4.7E-10 4.5E-10 4.3E-10 4.1E-10 3.9E-10 3.7E-10 3.5E-10 3.3E-10 3.1E-10 3.0E-10 2.8E-10 2.7E-10 2.6E-10 2.4E-10 2.3E-10
  2.2E-10 2.1E-10 2.0E-10 1.9E-10 1.8E-10
G 3.5E-10 1.3E-10 1.3E-10 1.2E-10 1.1E-10 1.1E-10 1.0E-10 9.6E-11 9.1E-11 8.7E-11 8.2E-11 7.8E-11 7.4E-11 7.0E-11 6.7E-11
  6.3E-11 6.0E-11 5.7E-11 5.4E-11
G 7.9E-11
G 3.0E-10
G 8.4E-11
G 6.2E-11
G 9.8E-09 1.2E-09 1.0E-09 8.5E-10 7.2E-10 6.1E-10 5.1E-10 4.3E-10 3.7E-10 3.1E-10 2.6E-10 2.2E-10 1.9E-10 1.6E-10 1.3E-10
  1.1E-10 9.5E-11 8.0E-11 6.8E-11 5.7E-11
 50  1  1  1  1  1  1  1  1  1  1  1
H 5.7E-05 4.0E-05 2.8E-05 2.1E-05 1.5E-05 1.2E-05 9.0E-06 7.2E-06 5.8E-06 4.8E-06 4.1E-06 3.5E-06 3.1E-06 2.8E-06 2.5E-06
  2.3E-06 2.2E-06 2.1E-06 2.0E-06 1.9E-06 1.9E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.7E-06 1.7E-06 1.7E-06
  1.7E-06 1.7E-06 1.7E-06 1.7E-06 1.7E-06 1.7E-06 1.7E-06 1.7E-06 1.7E-06 1.7E-06 1.7E-06 1.7E-06 1.7E-06 1.7E-06 1.7E-06
  1.7E-06 1.7E-06 1.7E-06 1.7E-06 1.7E-06
H 1.7E-09
H 2.0E-09
H 9.5E-09
H 2.9E-08
H 1.8E-08
H 2.1E-09
H 3.6E-10
H 5.1E-10
H 9.4E-10
H 6.7E-10
H 5.4E-08
! TH231   Class: Y F1:    0.00020     12/05/87  23:56:01.6    Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1  1  1  1  1  1  1
G 1.4E-13
G 1.9E-10
G 4.6E-10
G 1.9E-09
G 3.4E-09
G 2.1E-12
G 5.2E-12
G 5.3E-13
G 2.1E-11
G 1.4E-12
G 8.7E-15
G 9.9E-13
 10  1  1  1  1 50  1  1  1  1  1  1
H 7.9E-10 4.4E-12 3.6E-12 3.0E-12 2.4E-12 2.0E-12 1.7E-12 1.5E-12 1.3E-12 1.1E-12
H 6.4E-11
H 1.5E-10
H 6.2E-10
H 1.1E-09
H 1.6E-11 0.0E+00 1.6E-12 2.3E-12 3.0E-12 3.6E-12 4.2E-12 4.8E-12 5.2E-12 5.6E-12 6.0E-12 6.2E-12 6.5E-12 6.7E-12 6.8E-12
  6.9E-12 7.0E-12 7.1E-12 7.1E-12 7.1E-12 7.1E-12 7.1E-12 7.0E-12 7.0E-12 6.9E-12 6.9E-12 6.8E-12 6.7E-12 6.6E-12 6.5E-12
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91048 1714

5.920

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DOSINC.DAT

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  6.4E-12 6.3E-12 6.2E-12 6.1E-12 6.0E-12 5.9E-12 5.8E-12 5.6E-12 5.5E-12 5.4E-12 5.3E-12 5.2E-12 5.1E-12 5.0E-12 4.9E-12
  4.7E-12 4.6E-12 4.5E-12 4.4E-12 4.3E-12
H 3.7E-12
H 2.7E-13
H 6.9E-12
H 1.4E-12
H 2.8E-13
H 1.5E-12
! PA231   Class: Y F1:   0.00100    12/06/87  00:51:59.6   Acute  Sv/Bq
 13  1  3  4  5  6  7  8 11 12 13 14 17 16
  1  1  1  1  1 50 50  1  1  1  1  1  1
G 8.1E-12
G 1.2E-09
G 3.0E-09
G 1.7E-08
G 5.4E-08
G 4.6E-07 5.4E-07 6.1E-07 6.9E-07 7.6E-07 8.2E-07 8.9E-07 9.5E-07 1.0E-06 1.1E-06 1.1E-06 1.2E-06 1.2E-06 1.2E-06 1.3E-06
  1.3E-06 1.4E-06 1.4E-06 1.4E-06 1.5E-06 1.5E-06 1.5E-06 1.6E-06 1.6E-06 1.6E-06 1.6E-06 1.6E-06 1.7E-06 1.7E-06 1.7E-06
  1.7E-06 1.7E-06 1.7E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06
  1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06
G 3.6E-08 4.2E-08 4.8E-08 5.4E-08 6.0E-08 6.5E-08 7.0E-08 7.5E-08 8.0E-08 8.4E-08 8.8E-08 9.2E-08 9.6E-08 9.9E-08 1.0E-07
  1.1E-07 1.1E-07 1.1E-07 1.1E-07 1.2E-07 1.2E-07 1.2E-07 1.2E-07 1.3E-07 1.3E-07 1.3E-07 1.3E-07 1.3E-07 1.3E-07 1.3E-07
  1.4E-07 1.4E-07 1.4E-07 1.4E-07 1.4E-07 1.4E-07 1.4E-07 1.4E-07 1.4E-07 1.4E-07 1.4E-07 1.4E-07 1.4E-07 1.5E-07 1.5E-07
  1.5E-07 1.5E-07 1.5E-07 1.5E-07 1.5E-07
G 1.1E-11
G 7.1E-11
G 1.3E-11
G 7.6E-12
G 4.7E-09
G 6.7E-09
 50  1  1  1  1 50 50  1  1  1  1  1  1
H 6.8E-05 5.7E-05 4.6E-05 3.8E-05 3.2E-05 2.6E-05 2.2E-05 1.9E-05 1.6E-05 1.4E-05 1.3E-05 1.2E-05 1.1E-05 1.0E-05 9.6E-06
  9.2E-06 9.0E-06 8.8E-06 8.7E-06 8.7E-06 8.7E-06 8.7E-06 8.8E-06 8.9E-06 9.0E-06 9.1E-06 9.2E-06 9.3E-06 9.5E-06 9.6E-06
  9.7E-06 9.9E-06 1.0E-05 1.0E-05 1.0E-05 1.0E-05 1.0E-05 1.1E-05 1.1E-05 1.1E-05 1.1E-05 1.1E-05 1.1E-05 1.1E-05 1.1E-05
  1.1E-05 1.2E-05 1.2E-05 1.2E-05 1.2E-05
H 9.0E-10
H 1.7E-09
H 9.1E-09
H 2.8E-08
H 3.5E-06 7.8E-06 1.3E-05 1.8E-05 2.4E-05 2.9E-05 3.5E-05 4.0E-05 4.4E-05 4.8E-05 5.2E-05 5.6E-05 5.9E-05 6.2E-05 6.5E-05
  6.7E-05 7.0E-05 7.2E-05 7.4E-05 7.6E-05 7.8E-05 7.9E-05 8.1E-05 8.2E-05 8.3E-05 8.5E-05 8.6E-05 8.7E-05 8.8E-05 8.9E-05
  8.9E-05 9.0E-05 9.1E-05 9.1E-05 9.2E-05 9.3E-05 9.3E-05 9.4E-05 9.4E-05 9.4E-05 9.5E-05 9.5E-05 9.5E-05 9.5E-05 9.5E-05
  9.6E-05 9.6E-05 9.6E-05 9.6E-05 9.6E-05
H 2.8E-07 6.1E-07 1.0E-06 1.4E-06 1.9E-06 2.3E-06 2.7E-06 3.1E-06 3.5E-06 3.8E-06 4.1E-06 4.4E-06 4.7E-06 4.9E-06 5.2E-06
  5.4E-06 5.5E-06 5.7E-06 5.9E-06 6.0E-06 6.2E-06 6.3E-06 6.4E-06 6.5E-06 6.6E-06 6.7E-06 6.8E-06 6.9E-06 7.0E-06 7.0E-06
  7.1E-06 7.2E-06 7.2E-06 7.3E-06 7.3E-06 7.4E-06 7.4E-06 7.4E-06 7.5E-06 7.5E-06 7.5E-06 7.5E-06 7.6E-06 7.6E-06 7.6E-06
  7.6E-06 7.6E-06 7.6E-06 7.6E-06 7.6E-06
H 9.0E-11
H 1.3E-10
H 2.6E-10
H 1.7E-10
```

DOSINC.DAT

5.921

9/30/88

9 1 0 4 8 1 7 1 5

```
H 4.8E-08
H 6.6E-08
! AC227   Class: Y F1:   0.00100     12/06/87  01:45:43.4   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1 50 50 50  1  1  1 50
G 1.0E-11
G 4.9E-11
G 1.5E-10
G 1.3E-09
G 7.6E-09
G 2.7E-06 2.9E-06 2.8E-06 2.7E-06 2.6E-06 2.5E-06 2.4E-06 2.3E-06 2.2E-06 2.1E-06 2.1E-06 2.0E-06 1.9E-06 1.8E-06 1.8E-06
  1.7E-06 1.6E-06 1.6E-06 1.5E-06 1.4E-06 1.4E-06 1.3E-06 1.3E-06 1.2E-06 1.2E-06 1.1E-06 1.1E-06 1.1E-06 1.0E-06 9.8E-07
  9.5E-07 9.1E-07 8.7E-07 8.4E-07 8.1E-07 7.8E-07 7.5E-07 7.2E-07 6.9E-07 6.7E-07 6.4E-07 6.2E-07 5.9E-07 5.7E-07 5.5E-07
  5.3E-07 5.1E-07 4.9E-07 4.7E-07 4.5E-07
G 2.1E-07 2.3E-07 2.2E-07 2.1E-07 2.1E-07 2.0E-07 1.9E-07 1.8E-07 1.8E-07 1.7E-07 1.6E-07 1.6E-07 1.5E-07 1.5E-07 1.4E-07
  1.3E-07 1.3E-07 1.2E-07 1.2E-07 1.2E-07 1.1E-07 1.1E-07 1.0E-07 9.9E-08 9.5E-08 9.1E-08 8.8E-08 8.5E-08 8.1E-08 7.8E-08
  7.5E-08 7.2E-08 7.0E-08 6.7E-08 6.5E-08 6.2E-08 6.0E-08 5.7E-08 5.5E-08 5.3E-08 5.1E-08 4.9E-08 4.7E-08 4.6E-08 4.4E-08
  4.2E-08 4.1E-08 3.9E-08 3.8E-08 3.6E-08
G 2.9E-08 3.1E-08 3.0E-08 2.9E-08 2.8E-08 2.7E-08 2.6E-08 2.5E-08 2.4E-08 2.3E-08 2.2E-08 2.1E-08 2.0E-08 2.0E-08 1.9E-08
  1.8E-08 1.8E-08 1.7E-08 1.6E-08 1.6E-08 1.5E-08 1.4E-08 1.4E-08 1.3E-08 1.3E-08 1.2E-08 1.2E-08 1.1E-08 1.1E-08 1.1E-08
  1.0E-08 9.8E-09 9.4E-09 9.1E-09 8.7E-09 8.4E-09 8.1E-09 7.8E-09 7.5E-09 7.2E-09 6.9E-09 6.7E-09 6.4E-09 6.2E-09 5.9E-09
  5.7E-09 5.5E-09 5.3E-09 5.1E-09 4.9E-09
G 1.5E-11
G 7.4E-12
G 3.4E-12
G 7.2E-07 7.8E-07 7.4E-07 7.0E-07 6.7E-07 6.4E-07 6.1E-07 5.8E-07 5.5E-07 5.3E-07 5.0E-07 4.8E-07 4.5E-07 4.3E-07 4.1E-07
  3.9E-07 3.7E-07 3.6E-07 3.4E-07 3.2E-07 3.1E-07 2.9E-07 2.8E-07 2.7E-07 2.5E-07 2.4E-07 2.3E-07 2.2E-07 2.1E-07 2.0E-07
  1.9E-07 1.8E-07 1.7E-07 1.6E-07 1.6E-07 1.5E-07 1.4E-07 1.3E-07 1.3E-07 1.2E-07 1.2E-07 1.1E-07 1.1E-07 1.0E-07 9.6E-08
  9.1E-08 8.7E-08 8.3E-08 7.9E-08 7.5E-08
 50  1  1  1  1 50 50 41  1  1  1 50
H 3.6E-04 2.8E-04 1.9E-04 1.4E-04 9.8E-05 7.2E-05 5.4E-05 4.1E-05 3.3E-05 2.6E-05 2.1E-05 1.8E-05 1.5E-05 1.3E-05 1.2E-05
  1.0E-05 9.5E-06 8.8E-06 8.2E-06 7.6E-06 7.2E-06 6.8E-06 6.5E-06 6.2E-06 6.0E-06 5.7E-06 5.5E-06 5.3E-06 5.1E-06 5.0E-06
  4.8E-06 4.6E-06 4.5E-06 4.3E-06 4.2E-06 4.1E-06 3.9E-06 3.8E-06 3.7E-06 3.6E-06 3.5E-06 3.4E-06 3.3E-06 3.2E-06 3.1E-06
  3.0E-06 2.9E-06 2.8E-06 2.7E-06 2.6E-06
H 2.1E-09
H 1.4E-09
H 5.9E-09
H 1.9E-08
H 2.1E-05 4.2E-05 5.8E-05 7.2E-05 8.2E-05 8.9E-05 9.3E-05 9.6E-05 9.7E-05 9.7E-05 9.7E-05 9.5E-05 9.3E-05 9.1E-05 8.8E-05
  8.6E-05 8.3E-05 8.0E-05 7.7E-05 7.5E-05 7.2E-05 6.9E-05 6.7E-05 6.4E-05 6.2E-05 6.0E-05 5.8E-05 5.5E-05 5.3E-05 5.1E-05
  4.9E-05 4.7E-05 4.6E-05 4.4E-05 4.2E-05 4.1E-05 3.9E-05 3.8E-05 3.6E-05 3.5E-05 3.4E-05 3.2E-05 3.1E-05 3.0E-05 2.9E-05
  2.8E-05 2.7E-05 2.6E-05 2.5E-05 2.4E-05
H 1.7E-06 3.3E-06 4.6E-06 5.7E-06 6.5E-06 7.1E-06 7.5E-06 7.7E-06 7.8E-06 7.8E-06 7.7E-06 7.6E-06 7.4E-06 7.2E-06 7.0E-06
  6.8E-06 6.6E-06 6.4E-06 6.2E-06 6.0E-06 5.7E-06 5.5E-06 5.3E-06 5.1E-06 5.0E-06 4.8E-06 4.6E-06 4.4E-06 4.2E-06 4.1E-06
  3.9E-06 3.8E-06 3.6E-06 3.5E-06 3.4E-06 3.2E-06 3.1E-06 3.0E-06 2.9E-06 2.8E-06 2.7E-06 2.6E-06 2.5E-06 2.4E-06 2.3E-06
  2.2E-06 2.1E-06 2.0E-06 2.0E-06 1.9E-06
H 2.3E-07 4.5E-07 6.3E-07 7.7E-07 8.8E-07 9.6E-07 1.0E-06 1.0E-06 1.1E-06 1.1E-06 1.0E-06 1.0E-06 1.0E-06 9.8E-07 9.5E-07
  9.2E-07 9.0E-07 8.7E-07 8.4E-07 8.1E-07 7.8E-07 7.5E-07 7.2E-07 7.0E-07 6.7E-07 6.4E-07 6.2E-07 6.0E-07 5.7E-07 5.5E-07
  5.3E-07 5.1E-07 4.9E-07 4.7E-07 4.6E-07 4.4E-07 4.2E-07 4.1E-07 3.9E-07 3.8E-07 3.6E-07
H 4.4E-10
H 1.4E-09
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H 1.1E-09
H 5.7E-06 1.1E-05 1.6E-05 1.9E-05 2.2E-05 2.3E-05 2.4E-05 2.5E-05 2.5E-05 2.5E-05 2.4E-05 2.4E-05 2.3E-05 2.2E-05 2.2E-05
  2.1E-05 2.0E-05 1.9E-05 1.8E-05 1.7E-05 1.7E-05 1.6E-05 1.5E-05 1.4E-05 1.4E-05 1.3E-05 1.3E-05 1.2E-05 1.1E-05 1.1E-05
  1.0E-05 9.8E-06 9.4E-06 8.9E-06 8.5E-06 8.1E-06 7.7E-06 7.4E-06 7.0E-06 6.7E-06 6.4E-06 6.1E-06 5.8E-06 5.5E-06 5.2E-06
  5.0E-06 4.7E-06 4.5E-06 4.3E-06 4.1E-06
! TH227   Class: Y F1:   0.00020     12/06/87  02:26:31.1   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1  1  1  1  1  1  1  1
G 1.3E-10
G 1.7E-09
G 4.1E-09
G 2.5E-08
G 9.2E-08
G 7.0E-08
G 5.7E-09
G 1.4E-10
G 3.0E-10
G 1.4E-10
G 1.3E-10
G 1.1E-09
  1  1  1  1  1  1  1  1  1  1  1  1
H 3.6E-05
H 4.0E-09
H 5.3E-09
H 1.7E-08
H 5.3E-08
H 1.6E-06
H 1.3E-07
H 3.0E-09
H 3.1E-09
H 3.1E-09
H 3.0E-09
H 2.4E-08
! FR223   Class: D F1:   1.00000     12/06/87  02:51:46.2   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  1  1  1  1  1  1  1  1  1  1  1
G 1.9E-09
G 2.4E-09
G 2.2E-09
G 2.2E-09
G 2.2E-09
G 9.7E-10
G 1.9E-09
G 1.9E-09
G 2.0E-09
G 1.9E-09
G 1.9E-09
  1  1  1  1  1  1  1  1  1  1  1
H 2.0E-09
H 1.4E-09
H 1.4E-09
```

5.923

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DOSINC.DAT

910481717

```
H 1.4E-09
H 1.4E-09
H 6.1E-10
H 1.2E-09
H 1.2E-09
H 1.2E-09
H 1.2E-09
H 1.2E-09
! RA223   Class: W F1:   0.20000     12/06/87  03:07:01.8   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  1  1  1  1  1  1  1  1  1  1  1
G 1.2E-08
G 1.9E-08
G 2.6E-08
G 9.3E-08
G 2.5E-07
G 1.1E-06
G 7.7E-08
G 1.2E-08
G 1.2E-08
G 1.2E-08
G 1.2E-08
  1  1  1  1  1  1  1  1  1  1  1
H 1.7E-05
H 1.2E-08
H 1.5E-08
H 4.3E-08
H 1.1E-07
H 9.0E-07
H 6.2E-08
H 9.5E-09
H 9.8E-09
H 9.5E-09
H 9.5E-09
! U 237   Class: Y F1:   0.00200     12/06/87  03:19:56.5   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 16
  1  1  1  1  1  1  1  1  1  1  1  1
G 2.2E-12
G 2.8E-10
G 7.4E-10
G 3.4E-09
G 8.9E-09
G 3.5E-11
G 5.8E-11
G 1.2E-11
G 1.9E-10
G 1.8E-11
G 2.3E-13
G 3.0E-11
  1  1  1  1  1  1  1  1  1  1  1  1
H 4.9E-09
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9 1 0 4 8 1 7 1 8

5.924

9/30/88

DOSINC.DAT

9 1 7 1 8 4 0 1 9

5.925

9/30/88

DOSINC.DAT

```
H 1.5E-10
H 3.3E-10
H 1.5E-09
H 4.0E-09
H 7.2E-11
H 5.5E-11
H 5.7E-12
H 8.4E-11
H 2.6E-11
H 1.1E-11
H 4.4E-11
! NP237   Class: W F1:   0.00100     12/06/87 04:39:24.9   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1 50 50 50  1  1  1 50
G 1.2E-11
G 1.2E-09
G 3.1E-09
G 1.7E-08
G 5.3E-08
G 7.6E-07 7.5E-07 7.5E-07 7.4E-07 7.4E-07 7.3E-07 7.3E-07 7.2E-07 7.2E-07 7.1E-07 7.1E-07 7.0E-07 7.0E-07 6.9E-07 6.9E-07
  6.8E-07 6.8E-07 6.7E-07 6.7E-07 6.6E-07 6.6E-07 6.5E-07 6.5E-07 6.5E-07 6.4E-07 6.4E-07 6.3E-07 6.3E-07 6.2E-07 6.2E-07
  6.1E-07 6.1E-07 6.1E-07 6.0E-07 6.0E-07 5.9E-07 5.9E-07 5.9E-07 5.8E-07 5.8E-07 5.7E-07 5.7E-07 5.7E-07 5.6E-07 5.6E-07
  5.5E-07 5.5E-07 5.5E-07 5.4E-07 5.4E-07
G 6.1E-08 6.0E-08 6.0E-08 5.9E-08 5.9E-08 5.9E-08 5.8E-08 5.8E-08 5.7E-08 5.7E-08 5.7E-08 5.6E-08 5.6E-08 5.5E-08 5.5E-08
  5.5E-08 5.4E-08 5.4E-08 5.3E-08 5.3E-08 5.3E-08 5.2E-08 5.2E-08 5.2E-08 5.1E-08 5.1E-08 5.1E-08 5.0E-08 5.0E-08 5.0E-08
  4.9E-08 4.9E-08 4.9E-08 4.8E-08 4.8E-08 4.8E-08 4.7E-08 4.7E-08 4.7E-08 4.6E-08 4.6E-08 4.6E-08 4.5E-08 4.5E-08 4.5E-08
  4.4E-08 4.4E-08 4.4E-08 4.3E-08 4.3E-08
G 5.0E-09 4.9E-09 4.9E-09 4.8E-09 4.8E-09 4.8E-09 4.7E-09 4.7E-09 4.7E-09 4.7E-09 4.6E-09 4.6E-09 4.6E-09 4.5E-09 4.5E-09
  4.5E-09 4.4E-09 4.4E-09 4.4E-09 4.3E-09 4.3E-09 4.3E-09 4.2E-09 4.2E-09 4.2E-09 4.2E-09 4.1E-09 4.1E-09 4.1E-09 4.0E-09
  4.0E-09 4.0E-09 4.0E-09 3.9E-09 3.9E-09 3.9E-09 3.9E-09 3.8E-09 3.8E-09 3.8E-09 3.8E-09 3.7E-09 3.7E-09 3.7E-09 3.6E-09
  3.6E-09 3.6E-09 3.6E-09 3.5E-09 3.5E-09
G 7.7E-11
G 1.6E-11
G 9.6E-12
G 4.1E-08 4.0E-08 3.9E-08 3.9E-08 3.8E-08 3.7E-08 3.7E-08 3.6E-08 3.6E-08 3.5E-08 3.4E-08 3.4E-08 3.3E-08 3.3E-08 3.2E-08
  3.2E-08 3.1E-08 3.1E-08 3.0E-08 3.0E-08 2.9E-08 2.9E-08 2.8E-08 2.8E-08 2.7E-08 2.7E-08 2.6E-08 2.6E-08 2.5E-08 2.5E-08
  2.5E-08 2.4E-08 2.4E-08 2.3E-08 2.3E-08 2.3E-08 2.2E-08 2.2E-08 2.1E-08 2.1E-08 2.1E-08 2.0E-08 2.0E-08 2.0E-08 1.9E-08
  1.9E-08 1.9E-08 1.8E-08 1.8E-08 1.8E-08
  2  1  1  1  1 50 50 50  1  1  1 50
H 1.6E-05 1.4E-07
H 2.0E-09
H 2.8E-09
H 1.0E-08
H 2.9E-08
H 8.2E-05 9.1E-05 9.0E-05 8.9E-05 8.9E-05 8.8E-05 8.8E-05 8.7E-05 8.6E-05 8.6E-05 8.5E-05 8.5E-05 8.4E-05 8.3E-05 8.3E-05
  8.2E-05 8.2E-05 8.1E-05 8.1E-05 8.0E-05 7.9E-05 7.9E-05 7.8E-05 7.8E-05 7.7E-05 7.7E-05 7.6E-05 7.6E-05 7.5E-05 7.5E-05
  7.4E-05 7.4E-05 7.3E-05 7.3E-05 7.2E-05 7.2E-05 7.1E-05 7.1E-05 7.0E-05 7.0E-05 6.9E-05 6.9E-05 6.8E-05 6.8E-05 6.7E-05
  6.7E-05 6.6E-05 6.6E-05 6.5E-05 6.5E-05
H 6.6E-06 7.2E-06 7.2E-06 7.2E-06 7.1E-06 7.1E-06 7.0E-06 7.0E-06 6.9E-06 6.9E-06 6.8E-06 6.8E-06 6.7E-06 6.7E-06 6.6E-06
  6.6E-06 6.5E-06 6.5E-06 6.5E-06 6.4E-06 6.4E-06 6.3E-06 6.3E-06 6.2E-06 6.2E-06 6.1E-06 6.1E-06 6.1E-06 6.0E-06 6.0E-06
  5.9E-06 5.9E-06 5.9E-06 5.8E-06 5.8E-06 5.7E-06 5.7E-06 5.7E-06 5.6E-06 5.6E-06 5.5E-06 5.5E-06 5.5E-06 5.4E-06 5.4E-06
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  5.4E-06 5.3E-06 5.3E-06 5.2E-06 5.2E-06
H 5.4E-07 5.9E-07 5.9E-07 5.8E-07 5.8E-07 5.8E-07 5.7E-07 5.7E-07 5.6E-07 5.6E-07 5.6E-07 5.5E-07 5.5E-07 5.5E-07 5.4E-07
  5.4E-07 5.3E-07 5.3E-07 5.3E-07 5.2E-07 5.2E-07 5.2E-07 5.1E-07 5.1E-07 5.1E-07 5.0E-07 5.0E-07 5.0E-07 4.9E-07 4.9E-07
  4.8E-07 4.8E-07 4.8E-07 4.7E-07 4.7E-07 4.7E-07 4.7E-07 4.6E-07 4.6E-07 4.6E-07 4.5E-07 4.5E-07 4.5E-07 4.4E-07 4.4E-07
  4.4E-07 4.3E-07 4.3E-07 4.3E-07 4.3E-07
H 1.2E-09
H 1.4E-09
H 1.2E-09
H 4.4E-06 4.8E-06 4.8E-06 4.7E-06 4.6E-06 4.5E-06 4.4E-06 4.4E-06 4.3E-06 4.2E-06 4.2E-06 4.1E-06 4.0E-06 3.9E-06 3.9E-06
  3.8E-06 3.8E-06 3.7E-06 3.6E-06 3.6E-06 3.5E-06 3.4E-06 3.4E-06 3.3E-06 3.3E-06 3.2E-06 3.2E-06 3.1E-06 3.1E-06 3.0E-06
  3.0E-06 2.9E-06 2.9E-06 2.8E-06 2.8E-06 2.7E-06 2.7E-06 2.6E-06 2.6E-06 2.5E-06 2.5E-06 2.5E-06 2.4E-06 2.4E-06 2.3E-06
  2.3E-06 2.3E-06 2.2E-06 2.2E-06 2.2E-06
! PA233   Class: Y F1:   0.00100     12/06/87  05:46:46.6   Acute  Sv/Bq
 13  1  3  4  5  6  7  8 11 12 13 14 17 16
  1  1  1  1  1  1  1  1  1  1  1  1  1
G 3.7E-12
G 2.9E-10
G 8.0E-10
G 3.6E-09
G 1.0E-08
G 9.5E-11
G 6.9E-11
G 2.1E-11
G 2.5E-10
G 2.7E-11
G 5.0E-13
G 2.4E-11
G 3.4E-11
  2  1  1  1  1  1  1  1  1  1  1  1  1
H 1.7E-08 2.2E-11
H 2.4E-10
H 3.9E-10
H 1.7E-09
H 4.8E-09
H 4.6E-10
H 1.6E-10
H 1.1E-11
H 1.3E-10
H 9.4E-11
H 5.7E-11
H 1.8E-10
H 9.1E-11
! U 233   Class: Y F1:   0.00200     12/06/87  06:36:17.1   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 16
  1  1  1  1  1 50 22  1  1  1  1 21
G 6.6E-11
G 1.2E-09
G 2.8E-09
G 1.7E-08
G 5.0E-08
G 4.1E-09 2.2E-09 2.1E-09 2.0E-09 1.9E-09 1.8E-09 1.7E-09 1.7E-09 1.6E-09 1.5E-09 1.4E-09 1.4E-09 1.3E-09 1.2E-09 1.2E-09
```

9104817 20

5.926

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DOSINC.DAT

```
  1.1E-09 1.1E-09 1.0E-09 9.6E-10 9.1E-10 8.7E-10 8.3E-10 7.9E-10 7.5E-10 7.1E-10 6.8E-10 6.4E-10 6.1E-10 5.8E-10 5.5E-10
  5.3E-10 5.0E-10 4.8E-10 4.5E-10 4.3E-10 4.1E-10 3.9E-10 3.7E-10 3.5E-10 3.4E-10 3.2E-10 3.0E-10 2.9E-10 2.8E-10 2.6E-10
  2.5E-10 2.4E-10 2.3E-10 2.1E-10 2.0E-10
G 3.1E-10 1.4E-10 1.4E-10 1.3E-10 1.2E-10 1.2E-10 1.1E-10 1.0E-10 9.9E-11 9.4E-11 8.9E-11 8.5E-11 8.1E-11 7.7E-11 7.3E-11
  6.9E-11 6.6E-11 6.3E-11 5.9E-11 5.6E-11 5.4E-11 5.1E-11
G 6.6E-11
G 6.8E-11
G 6.6E-11
G 6.6E-11
G 1.1E-08 1.3E-09 1.1E-09 9.4E-10 7.9E-10 6.7E-10 5.7E-10 4.8E-10 4.0E-10 3.4E-10 2.9E-10 2.4E-10 2.1E-10 1.7E-10 1.5E-10
  1.2E-10 1.1E-10 8.9E-11 7.5E-11 6.4E-11 5.4E-11
 50  1  1  1  1  1  1  1  1  1  1  1
H 6.2E-05 4.3E-05 3.1E-05 2.2E-05 1.7E-05 1.3E-05 9.8E-06 7.8E-06 6.3E-06 5.2E-06 4.4E-06 3.8E-06 3.4E-06 3.0E-06 2.8E-06
  2.6E-06 2.4E-06 2.3E-06 2.2E-06 2.1E-06 2.1E-06 2.0E-06 2.0E-06 2.0E-06 2.0E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06
  1.9E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06
  1.9E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06
H 9.3E-10
H 1.8E-09
H 8.9E-09
H 2.6E-08
H 1.9E-08
H 1.5E-09
H 3.7E-10
H 3.7E-10
H 3.7E-10
H 3.7E-10
H 5.9E-08
! TH229   Class: Y F1:   0.00020    12/06/87  07:13:23.1   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  2  2  2  2  2 50 50  2  2  2  2  8
G 1.3E-09 1.0E-09
G 2.6E-09 1.0E-09
G 4.6E-09 1.0E-09
G 2.0E-08 1.0E-09
G 6.1E-08 1.0E-09
G 8.5E-07 9.0E-07 8.8E-07 8.5E-07 8.2E-07 8.0E-07 7.7E-07 7.5E-07 7.2E-07 7.0E-07 6.8E-07 6.6E-07 6.4E-07 6.2E-07 6.0E-07
  5.8E-07 5.6E-07 5.4E-07 5.3E-07 5.1E-07 4.9E-07 4.8E-07 4.6E-07 4.5E-07 4.4E-07 4.2E-07 4.1E-07 4.0E-07 3.8E-07 3.7E-07
  3.6E-07 3.5E-07 3.4E-07 3.3E-07 3.2E-07 3.1E-07 3.0E-07 2.9E-07 2.8E-07 2.7E-07 2.6E-07 2.5E-07 2.5E-07 2.4E-07 2.3E-07
  2.2E-07 2.2E-07 2.1E-07 2.0E-07 2.0E-07
G 7.6E-08 7.4E-08 7.1E-08 6.9E-08 6.7E-08 6.4E-08 6.2E-08 6.0E-08 5.8E-08 5.7E-08 5.5E-08 5.3E-08 5.1E-08 5.0E-08 4.8E-08
  4.7E-08 4.5E-08 4.4E-08 4.2E-08 4.1E-08 4.0E-08 3.9E-08 3.7E-08 3.6E-08 3.5E-08 3.4E-08 3.3E-08 3.2E-08 3.1E-08 3.0E-08
  2.9E-08 2.8E-08 2.7E-08 2.6E-08 2.6E-08 2.5E-08 2.4E-08 2.3E-08 2.3E-08 2.2E-08 2.1E-08 2.0E-08 2.0E-08 1.9E-08 1.9E-08
  1.8E-08 1.7E-08 1.7E-08 1.6E-08 1.6E-08
G 1.3E-09 1.0E-09
G 1.5E-09 1.0E-09
G 1.3E-09 1.0E-09
G 1.3E-09 1.0E-09
G 1.1E-08 8.7E-09 6.0E-09 4.2E-09 2.9E-09 2.0E-09 1.4E-09 9.9E-10
 50  1  1  1  1 50 50  1  1  1  1 12
H 3.8E-04 2.9E-04 2.1E-04 1.5E-04 1.1E-04 8.5E-05 6.6E-05 5.2E-05 4.2E-05 3.5E-05 3.0E-05 2.6E-05 2.2E-05 2.0E-05 1.8E-05
  1.7E-05 1.6E-05 1.5E-05 1.5E-05 1.4E-05 1.4E-05 1.3E-05 1.3E-05 1.3E-05 1.3E-05 1.3E-05 1.3E-05 1.3E-05 1.3E-05 1.3E-05
```

DOSINC.DAT

5.927

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9 1 0 4 8 1 7 2 1

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  1.3E-05 1.3E-05 1.3E-05 1.2E-05 1.2E-05 1.2E-05 1.2E-05 1.2E-05 1.2E-05 1.2E-05 1.2E-05 1.2E-05 1.2E-05 1.2E-05 1.2E-05
  1.2E-05 1.2E-05 1.2E-05 1.2E-05 1.2E-05
H 5.3E-08
H 5.4E-08
H 6.5E-08
H 9.4E-08
H 3.2E-05 6.4E-05 9.2E-05 1.1E-04 1.3E-04 1.5E-04 1.6E-04 1.7E-04 1.7E-04 1.7E-04 1.7E-04 1.7E-04 1.7E-04 1.7E-04 1.7E-04
  1.6E-04 1.6E-04 1.5E-04 1.5E-04 1.5E-04 1.4E-04 1.4E-04 1.3E-04 1.3E-04 1.3E-04 1.2E-04 1.2E-04 1.2E-04 1.1E-04 1.1E-04
  1.0E-04 1.0E-04 9.9E-05 9.6E-05 9.3E-05 9.0E-05 8.7E-05 8.4E-05 8.2E-05 7.9E-05 7.7E-05 7.4E-05 7.2E-05 7.0E-05 6.7E-05
  6.5E-05 6.3E-05 6.1E-05 5.9E-05 5.8E-05
H 2.6E-06 5.2E-06 7.5E-06 9.4E-06 1.1E-05 1.2E-05 1.3E-05 1.3E-05 1.4E-05 1.4E-05 1.4E-05 1.4E-05 1.4E-05 1.4E-05 1.3E-05
  1.3E-05 1.3E-05 1.2E-05 1.2E-05 1.2E-05 1.1E-05 1.1E-05 1.1E-05 1.1E-05 1.0E-05 9.9E-06 9.6E-06 9.3E-06 9.0E-06 8.7E-06
  8.5E-06 8.2E-06 8.0E-06 7.7E-06 7.5E-06 7.2E-06 7.0E-06 6.8E-06 6.6E-06 6.4E-06 6.2E-06 6.0E-06 5.8E-06 5.6E-06 5.4E-06
  5.3E-06 5.1E-06 4.9E-06 4.8E-06 4.6E-06
H 5.2E-08
H 5.3E-08
H 5.3E-08
H 5.2E-08
H 4.3E-07 7.4E-07 9.1E-07 9.8E-07 9.8E-07 9.3E-07 8.5E-07 7.5E-07 6.5E-07 5.5E-07 4.7E-07 3.9E-07
! RA225   Class: W F1:   0.20000     12/06/87  07:41:10.4   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  1  1  1  1  1  1  1  1  1  1  1
G 1.8E-09
G 1.9E-09
G 2.2E-09
G 6.9E-09
G 3.1E-08
G 1.5E-06
G 9.4E-08
G 1.8E-09
G 1.9E-09
G 1.8E-09
G 1.8E-09
  1  1  1  1  1  1  1  1  1  1  1
H 1.6E-05
H 2.8E-09
H 3.1E-09
H 7.6E-09
H 2.3E-08
H 1.3E-06
H 8.2E-08
H 2.4E-09
H 2.5E-09
H 2.4E-09
H 2.4E-09
! AC225   Class: Y F1:   0.00100     12/06/87  07:59:40.2   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1  1  1  1  1  1  1  1
G 4.3E-11
G 7.2E-09
G 1.8E-08
```

DOSINC.DAT

9 1 0 4 8 1 7 2 2

5.928

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DOSINC.DAT

5.929

```
G 9.9E-08
G 2.8E-07
G 1.0E-07
G 8.4E-09
G 1.2E-09
G 2.9E-10
G 6.6E-11
G 3.9E-11
G 2.8E-08
  1  1  1  1  1  1  1  1  1  1  1  1
H 1.8E-05
H 3.5E-09
H 8.4E-09
H 4.5E-08
H 1.3E-07
H 4.7E-07
H 3.8E-08
H 5.3E-09
H 3.0E-10
H 2.3E-10
H 2.1E-10
H 1.3E-07
! U 238   Class: Y F1:   0.00200     12/07/87  12:18:34.7   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 16
  1  1  1  1  1 50 22  1  1  1  1 21
G 5.7E-11
G 1.0E-09
G 2.6E-09
G 1.5E-08
G 4.6E-08
G 3.6E-09 2.0E-09 1.9E-09 1.8E-09 1.7E-09 1.6E-09 1.6E-09 1.5E-09 1.4E-09 1.3E-09 1.3E-09 1.2E-09 1.2E-09 1.1E-09 1.0E-09
  9.9E-10 9.4E-10 8.9E-10 8.5E-10 8.1E-10 7.7E-10 7.3E-10 6.9E-10 6.6E-10 6.3E-10 6.0E-10 5.7E-10 5.4E-10 5.1E-10 4.9E-10
  4.6E-10 4.4E-10 4.2E-10 4.0E-10 3.8E-10 3.6E-10 3.4E-10 3.3E-10 3.1E-10 2.9E-10 2.8E-10 2.7E-10 2.5E-10 2.4E-10 2.3E-10
  2.2E-10 2.1E-10 2.0E-10 1.9E-10 1.8E-10
G 2.9E-10 1.4E-10 1.3E-10 1.2E-10 1.1E-10 1.1E-10 1.0E-10 9.8E-11 9.3E-11 8.8E-11 8.3E-11 7.9E-11 7.5E-11 7.1E-11 6.8E-11
  6.4E-11 6.1E-11 5.8E-11 5.5E-11 5.2E-11 5.0E-11 4.7E-11
G 5.8E-11
G 6.8E-11
G 5.8E-11
G 5.8E-11
G 9.5E-09 1.2E-09 9.8E-10 8.3E-10 7.0E-10 5.9E-10 5.0E-10 4.2E-10 3.6E-10 3.0E-10 2.5E-10 2.1E-10 1.8E-10 1.5E-10 1.3E-10
  1.1E-10 9.2E-11 7.8E-11 6.6E-11 5.6E-11 4.7E-11
 50  1  1  1  1  1  1  1  1  1  1  1
H 5.5E-05 3.8E-05 2.7E-05 2.0E-05 1.5E-05 1.1E-05 8.6E-06 6.8E-06 5.5E-06 4.6E-06 3.9E-06 3.3E-06 2.9E-06 2.6E-06 2.4E-06
  2.2E-06 2.1E-06 2.0E-06 1.9E-06 1.8E-06 1.8E-06 1.8E-06 1.7E-06 1.7E-06 1.7E-06 1.7E-06 1.7E-06 1.7E-06 1.6E-06 1.6E-06
  1.6E-06 1.6E-06 1.6E-06 1.6E-06 1.6E-06 1.6E-06 1.6E-06 1.6E-06 1.6E-06 1.6E-06 1.6E-06 1.6E-06 1.6E-06 1.6E-06 1.6E-06
  1.6E-06 1.6E-06 1.6E-06 1.6E-06 1.6E-06
H 9.9E-10
H 1.8E-09
H 8.5E-09
H 2.6E-08
```

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9 1 0 4 8 1 7 2 3

```
H 1.7E-08
H 1.5E-09
H 3.2E-10
H 3.4E-10
H 4.1E-10
H 3.9E-10
H 5.2E-08
! TH234   Class: Y F1:    0.00020      12/07/87  12:44:27.1    Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1  1  1  1  1  1  1  1
G 6.6E-13
G 9.9E-10
G 2.5E-09
G 1.5E-08
G 4.2E-08
G 2.0E-11
G 1.8E-11
G 2.3E-12
G 2.8E-11
G 3.3E-12
G 2.9E-13
G 4.0E-12
  1  1  1  1  1  1  1  1  1  1  1  1
H 6.4E-08
H 4.8E-10
H 1.2E-09
H 7.0E-09
H 2.0E-08
H 4.1E-10
H 2.4E-10
H 6.6E-12
H 2.0E-11
H 1.6E-11
H 1.2E-11
H 5.7E-11
! PA234   Class: Y F1:    0.00100      12/07/87  12:58:50.0    Acute  Sv/Bq
 13  1  3  4  5  6  7  8 11 12 13 14 17 16
  1  1  1  1  1  1  1  1  1  1  1  1  1
G 1.5E-11
G 7.8E-10
G 1.5E-09
G 3.2E-09
G 2.6E-09
G 2.8E-11
G 8.2E-11
G 2.5E-11
G 3.5E-10
G 5.2E-11
G 1.9E-12
G 6.2E-11
G 8.6E-11
```

DOSINC.DAT

5.930

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9 1 0 4 8 1 7 2 4

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  1  1  1  1  1  1  1  1  1  1  1  1  1
H 9.2E-10
H 1.6E-10
H 2.8E-10
H 6.0E-10
H 4.9E-10
H 1.9E-11
H 2.9E-11
H 5.1E-12
H 6.6E-11
H 2.3E-11
H 1.3E-11
H 3.6E-11
H 2.6E-11
! PU238   Class: Y F1:   0.00010    12/07/87  13:05:01.9   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1 50 50 50  1  1  1 50
G 8.0E-13
G 1.3E-09
G 3.2E-09
G 1.9E-08
G 5.7E-08
G 5.2E-08 5.1E-08 5.0E-08 4.8E-08 4.7E-08 4.6E-08 4.5E-08 4.4E-08 4.3E-08 4.3E-08 4.2E-08 4.1E-08 4.0E-08 3.9E-08 3.8E-08
  3.7E-08 3.7E-08 3.6E-08 3.5E-08 3.4E-08 3.3E-08 3.3E-08 3.2E-08 3.1E-08 3.1E-08 3.0E-08 2.9E-08 2.9E-08 2.8E-08 2.8E-08
  2.7E-08 2.6E-08 2.6E-08 2.5E-08 2.5E-08 2.4E-08 2.4E-08 2.3E-08 2.3E-08 2.2E-08 2.2E-08 2.1E-08 2.1E-08 2.0E-08 2.0E-08
  1.9E-08 1.9E-08 1.9E-08 1.8E-08 1.8E-08
G 4.2E-09 4.1E-09 4.0E-09 3.9E-09 3.8E-09 3.7E-09 3.7E-09 3.6E-09 3.5E-09 3.4E-09 3.3E-09 3.3E-09 3.2E-09 3.1E-09 3.1E-09
  3.0E-09 2.9E-09 2.9E-09 2.8E-09 2.8E-09 2.7E-09 2.6E-09 2.6E-09 2.5E-09 2.5E-09 2.4E-09 2.4E-09 2.3E-09 2.3E-09 2.2E-09
  2.2E-09 2.1E-09 2.1E-09 2.0E-09 2.0E-09 1.9E-09 1.9E-09 1.9E-09 1.8E-09 1.8E-09 1.7E-09 1.7E-09 1.7E-09 1.6E-09 1.6E-09
  1.6E-09 1.5E-09 1.5E-09 1.5E-09 1.4E-09
G 5.6E-10 5.5E-10 5.5E-10 5.4E-10 5.3E-10 5.2E-10 5.1E-10 5.1E-10 5.0E-10 4.9E-10 4.8E-10 4.8E-10 4.7E-10 4.6E-10 4.6E-10
  4.5E-10 4.4E-10 4.4E-10 4.3E-10 4.2E-10 4.2E-10 4.1E-10 4.1E-10 4.0E-10 3.9E-10 3.9E-10 3.8E-10 3.8E-10 3.7E-10 3.7E-10
  3.6E-10 3.5E-10 3.5E-10 3.4E-10 3.4E-10 3.3E-10 3.3E-10 3.2E-10 3.2E-10 3.2E-10 3.1E-10 3.1E-10 3.0E-10 3.0E-10 2.9E-10
  2.9E-10 2.8E-10 2.8E-10 2.8E-10 2.7E-10
G 3.9E-12
G 9.0E-13
G 8.0E-13
G 1.4E-08 1.3E-08 1.3E-08 1.2E-08 1.2E-08 1.1E-08 1.1E-08 1.0E-08 9.8E-09 9.4E-09 9.0E-09 8.6E-09 8.3E-09 7.9E-09 7.6E-09
  7.3E-09 7.0E-09 6.7E-09 6.4E-09 6.2E-09 5.9E-09 5.6E-09 5.4E-09 5.2E-09 5.0E-09 4.8E-09 4.6E-09 4.4E-09 4.2E-09 4.0E-09
  3.9E-09 3.7E-09 3.5E-09 3.4E-09 3.2E-09 3.1E-09 3.0E-09 2.9E-09 2.7E-09 2.6E-09 2.5E-09 2.4E-09 2.3E-09 2.2E-09 2.1E-09
  2.0E-09 1.9E-09 1.9E-09 1.8E-09 1.7E-09
 50  1  1  1  1 50 50 50  1  1  1 50
H 7.0E-05 4.8E-05 3.4E-05 2.4E-05 1.8E-05 1.4E-05 1.0E-05 8.2E-06 6.6E-06 5.4E-06 4.6E-06 3.9E-06 3.4E-06 3.0E-06 2.7E-06
  2.5E-06 2.3E-06 2.2E-06 2.1E-06 2.0E-06 2.0E-06 1.9E-06 1.9E-06 1.8E-06 1.8E-06 1.8E-06 1.7E-06 1.7E-06 1.7E-06 1.7E-06
  1.7E-06 1.6E-06 1.6E-06 1.6E-06 1.6E-06 1.6E-06 1.6E-06 1.6E-06 1.5E-06 1.5E-06 1.5E-06 1.5E-06 1.5E-06 1.5E-06 1.5E-06
  1.5E-06 1.4E-06 1.4E-06 1.4E-06 1.4E-06
H 7.4E-10
H 1.8E-09
H 9.8E-09
H 2.9E-08
H 3.7E-06 7.1E-06 1.0E-05 1.3E-05 1.5E-05 1.7E-05 1.8E-05 1.9E-05 1.9E-05 2.0E-05 2.0E-05 2.0E-05 2.0E-05 2.0E-05 2.0E-05
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DOSINC.DAT

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  1.9E-05 1.9E-05 1.9E-05 1.8E-05 1.8E-05 1.8E-05 1.7E-05 1.7E-05 1.7E-05 1.6E-05 1.6E-05 1.6E-05 1.5E-05 1.5E-05 1.5E-05
  1.4E-05 1.4E-05 1.4E-05 1.3E-05 1.3E-05 1.3E-05 1.3E-05 1.2E-05 1.2E-05 1.2E-05 1.2E-05 1.1E-05 1.1E-05 1.1E-05 1.1E-05
  1.0E-05 1.0E-05 9.9E-06 9.7E-06 9.5E-06
H 3.0E-07 5.7E-07 8.2E-07 1.0E-06 1.2E-06 1.3E-06 1.4E-06 1.5E-06 1.6E-06 1.6E-06 1.6E-06 1.6E-06 1.6E-06 1.6E-06 1.6E-06
  1.6E-06 1.5E-06 1.5E-06 1.5E-06 1.5E-06 1.4E-06 1.4E-06 1.4E-06 1.3E-06 1.3E-06 1.3E-06 1.3E-06 1.2E-06 1.2E-06 1.2E-06
  1.2E-06 1.1E-06 1.1E-06 1.1E-06 1.1E-06 1.0E-06 1.0E-06 9.9E-07 9.7E-07 9.5E-07 9.3E-07 9.1E-07 8.9E-07 8.7E-07 8.5E-07
  8.4E-07 8.2E-07 8.0E-07 7.8E-07 7.7E-07
H 4.0E-08 7.7E-08 1.1E-07 1.4E-07 1.6E-07 1.8E-07 2.0E-07 2.1E-07 2.2E-07 2.2E-07 2.3E-07 2.3E-07 2.3E-07 2.3E-07 2.3E-07
  2.3E-07 2.2E-07 2.2E-07 2.2E-07 2.2E-07 2.1E-07 2.1E-07 2.1E-07 2.1E-07 2.0E-07 2.0E-07 2.0E-07 1.9E-07 1.9E-07 1.9E-07
  1.9E-07 1.8E-07 1.8E-07 1.8E-07 1.8E-07 1.7E-07 1.7E-07 1.7E-07 1.7E-07 1.6E-07 1.6E-07 1.6E-07 1.6E-07 1.5E-07 1.5E-07
  1.5E-07 1.5E-07 1.4E-07 1.4E-07 1.4E-07
H 8.7E-11
H 9.4E-11
H 8.5E-11
H 9.9E-07 1.9E-06 2.7E-06 3.3E-06 3.8E-06 4.2E-06 4.4E-06 4.6E-06 4.7E-06 4.7E-06 4.6E-06 4.6E-06 4.5E-06 4.4E-06 4.3E-06
  4.1E-06 4.0E-06 3.9E-06 3.7E-06 3.6E-06 3.4E-06 3.3E-06 3.2E-06 3.1E-06 2.9E-06 2.8E-06 2.7E-06 2.6E-06 2.5E-06 2.4E-06
  2.3E-06 2.2E-06 2.1E-06 2.0E-06 1.9E-06 1.8E-06 1.8E-06 1.7E-06 1.6E-06 1.6E-06 1.5E-06 1.4E-06 1.4E-06 1.3E-06 1.3E-06
  1.2E-06 1.2E-06 1.1E-06 1.1E-06 1.0E-06
! PU240   Class: Y F1:   0.00010     12/07/87  13:12:52.5   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1 50 50 50  1  1  1 50
G 7.5E-13
G 1.2E-09
G 3.0E-09
G 1.7E-08
G 5.4E-08
G 5.0E-08 4.9E-08 4.8E-08 4.8E-08 4.7E-08 4.6E-08 4.6E-08 4.5E-08 4.4E-08 4.4E-08 4.3E-08 4.3E-08 4.2E-08 4.1E-08 4.1E-08
  4.0E-08 4.0E-08 3.9E-08 3.9E-08 3.8E-08 3.8E-08 3.7E-08 3.7E-08 3.6E-08 3.6E-08 3.5E-08 3.5E-08 3.4E-08 3.4E-08 3.3E-08
  3.3E-08 3.2E-08 3.2E-08 3.1E-08 3.1E-08 3.0E-08 3.0E-08 3.0E-08 2.9E-08 2.9E-08 2.8E-08 2.8E-08 2.8E-08 2.7E-08 2.7E-08
  2.7E-08 2.6E-08 2.6E-08 2.5E-08 2.5E-08
G 3.8E-09 3.8E-09 3.7E-09 3.7E-09 3.6E-09 3.6E-09 3.5E-09 3.5E-09 3.4E-09 3.4E-09 3.3E-09 3.3E-09 3.2E-09 3.2E-09 3.2E-09
  3.1E-09 3.1E-09 3.0E-09 3.0E-09 2.9E-09 2.9E-09 2.9E-09 2.8E-09 2.8E-09 2.7E-09 2.7E-09 2.7E-09 2.6E-09 2.6E-09 2.6E-09
  2.5E-09 2.5E-09 2.5E-09 2.4E-09 2.4E-09 2.4E-09 2.3E-09 2.3E-09 2.3E-09 2.2E-09 2.2E-09 2.2E-09 2.1E-09 2.1E-09 2.1E-09
  2.0E-09 2.0E-09 2.0E-09 2.0E-09 1.9E-09
G 5.3E-10 5.3E-10 5.2E-10 5.2E-10 5.1E-10 5.1E-10 5.1E-10 5.0E-10 5.0E-10 5.0E-10 4.9E-10 4.9E-10 4.9E-10 4.8E-10 4.8E-10
  4.8E-10 4.7E-10 4.7E-10 4.7E-10 4.6E-10 4.6E-10 4.6E-10 4.5E-10 4.5E-10 4.5E-10 4.4E-10 4.4E-10 4.4E-10 4.3E-10 4.3E-10
  4.3E-10 4.3E-10 4.2E-10 4.2E-10 4.2E-10 4.1E-10 4.1E-10 4.1E-10 4.0E-10 4.0E-10 4.0E-10 4.0E-10 3.9E-10 3.9E-10 3.9E-10
  3.9E-10 3.8E-10 3.8E-10 3.8E-10 3.7E-10
G 3.7E-12
G 8.4E-13
G 7.5E-13
G 1.3E-08 1.3E-08 1.2E-08 1.2E-08 1.1E-08 1.1E-08 1.1E-08 1.0E-08 9.8E-09 9.5E-09 9.2E-09 8.8E-09 8.5E-09 8.3E-09 8.0E-09
  7.7E-09 7.4E-09 7.2E-09 6.9E-09 6.7E-09 6.5E-09 6.2E-09 6.0E-09 5.8E-09 5.6E-09 5.4E-09 5.3E-09 5.1E-09 4.9E-09 4.7E-09
  4.6E-09 4.4E-09 4.3E-09 4.1E-09 4.0E-09 3.8E-09 3.7E-09 3.6E-09 3.5E-09 3.3E-09 3.2E-09 3.1E-09 3.0E-09 2.9E-09 2.8E-09
  2.7E-09 2.6E-09 2.5E-09 2.4E-09 2.4E-09
 50  1  1  1  1 50 50 50  1  1  1 50
H 6.4E-05 4.4E-05 3.1E-05 2.3E-05 1.7E-05 1.3E-05 1.0E-05 7.9E-06 6.4E-06 5.3E-06 4.5E-06 3.9E-06 3.4E-06 3.1E-06 2.8E-06
  2.6E-06 2.4E-06 2.3E-06 2.2E-06 2.1E-06 2.1E-06 2.0E-06 2.0E-06 2.0E-06 2.0E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06
  1.9E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06
  1.9E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06
H 7.1E-10
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9 1 0 4 8 1 7 2 6

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H 1.6E-09
H 9.0E-09
H 2.8E-08
H 3.5E-06 6.8E-06 9.9E-06 1.3E-05 1.5E-05 1.7E-05 1.8E-05 1.9E-05 2.0E-05 2.0E-05 2.1E-05 2.1E-05 2.1E-05 2.1E-05 2.1E-05
  2.1E-05 2.1E-05 2.1E-05 2.0E-05 2.0E-05 2.0E-05 2.0E-05 1.9E-05 1.9E-05 1.9E-05 1.9E-05 1.8E-05 1.8E-05 1.8E-05 1.8E-05
  1.7E-05 1.7E-05 1.7E-05 1.7E-05 1.7E-05 1.6E-05 1.6E-05 1.6E-05 1.6E-05 1.5E-05 1.5E-05 1.5E-05 1.5E-05 1.5E-05 1.4E-05
  1.4E-05 1.4E-05 1.4E-05 1.4E-05 1.3E-05
H 2.7E-07 5.3E-07 7.7E-07 9.7E-07 1.1E-06 1.3E-06 1.4E-06 1.5E-06 1.5E-06 1.6E-06 1.6E-06 1.6E-06 1.6E-06 1.6E-06 1.6E-06
  1.6E-06 1.6E-06 1.6E-06 1.6E-06 1.6E-06 1.5E-06 1.5E-06 1.5E-06 1.5E-06 1.5E-06 1.4E-06 1.4E-06 1.4E-06 1.4E-06 1.4E-06
  1.3E-06 1.3E-06 1.3E-06 1.3E-06 1.3E-06 1.3E-06 1.2E-06 1.2E-06 1.2E-06 1.2E-06 1.2E-06 1.2E-06 1.1E-06 1.1E-06 1.1E-06
  1.1E-06 1.1E-06 1.1E-06 1.0E-06 1.0E-06
H 3.8E-08 7.3E-08 1.1E-07 1.4E-07 1.6E-07 1.8E-07 2.0E-07 2.1E-07 2.2E-07 2.2E-07 2.3E-07 2.3E-07 2.4E-07 2.4E-07 2.4E-07
  2.4E-07 2.4E-07 2.4E-07 2.4E-07 2.4E-07 2.4E-07 2.3E-07 2.3E-07 2.3E-07 2.3E-07 2.3E-07 2.3E-07 2.3E-07 2.2E-07 2.2E-07
  2.2E-07 2.2E-07 2.2E-07 2.2E-07 2.2E-07 2.1E-07 2.1E-07 2.1E-07 2.1E-07 2.1E-07 2.1E-07 2.0E-07 2.0E-07 2.0E-07 2.0E-07
  2.0E-07 2.0E-07 2.0E-07 2.0E-07 1.9E-07
H 8.1E-11
H 8.8E-11
H 8.0E-11
H 9.3E-07 1.8E-06 2.5E-06 3.2E-06 3.7E-06 4.1E-06 4.4E-06 4.5E-06 4.7E-06 4.7E-06 4.7E-06 4.7E-06 4.6E-06 4.6E-06 4.5E-06
  4.4E-06 4.2E-06 4.1E-06 4.0E-06 3.9E-06 3.8E-06 3.7E-06 3.5E-06 3.4E-06 3.3E-06 3.2E-06 3.1E-06 3.0E-06 2.9E-06 2.8E-06
  2.7E-06 2.6E-06 2.5E-06 2.4E-06 2.4E-06 2.3E-06 2.2E-06 2.1E-06 2.1E-06 2.0E-06 1.9E-06 1.8E-06 1.8E-06 1.7E-06 1.7E-06
  1.6E-06 1.6E-06 1.5E-06 1.4E-06 1.4E-06
! PU239   Class: Y F1:   0.00010     12/07/87  13:20:41.9   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1 50 50 50  1  1  1 50
G 7.5E-13
G 1.2E-09
G 3.0E-09
G 1.7E-08
G 5.3E-08
G 5.0E-08 4.9E-08 4.8E-08 4.8E-08 4.7E-08 4.6E-08 4.6E-08 4.5E-08 4.4E-08 4.4E-08 4.3E-08 4.3E-08 4.2E-08 4.1E-08 4.1E-08
  4.0E-08 4.0E-08 3.9E-08 3.9E-08 3.8E-08 3.8E-08 3.7E-08 3.7E-08 3.6E-08 3.6E-08 3.5E-08 3.5E-08 3.4E-08 3.4E-08 3.3E-08
  3.3E-08 3.2E-08 3.2E-08 3.1E-08 3.1E-08 3.1E-08 3.0E-08 3.0E-08 2.9E-08 2.9E-08 2.9E-08 2.8E-08 2.8E-08 2.7E-08 2.7E-08
  2.7E-08 2.6E-08 2.6E-08 2.6E-08 2.5E-08
G 3.8E-09 3.8E-09 3.7E-09 3.7E-09 3.6E-09 3.6E-09 3.5E-09 3.5E-09 3.4E-09 3.4E-09 3.3E-09 3.3E-09 3.3E-09 3.2E-09 3.2E-09
  3.1E-09 3.1E-09 3.0E-09 3.0E-09 2.9E-09 2.9E-09 2.9E-09 2.8E-09 2.8E-09 2.8E-09 2.7E-09 2.7E-09 2.6E-09 2.6E-09 2.6E-09
  2.5E-09 2.5E-09 2.5E-09 2.4E-09 2.4E-09 2.4E-09 2.3E-09 2.3E-09 2.3E-09 2.2E-09 2.2E-09 2.2E-09 2.1E-09 2.1E-09 2.1E-09
  2.1E-09 2.0E-09 2.0E-09 2.0E-09 1.9E-09
G 5.3E-10 5.3E-10 5.2E-10 5.2E-10 5.1E-10 5.1E-10 5.1E-10 5.0E-10 5.0E-10 5.0E-10 4.9E-10 4.9E-10 4.9E-10 4.8E-10 4.8E-10
  4.8E-10 4.7E-10 4.7E-10 4.7E-10 4.6E-10 4.6E-10 4.6E-10 4.5E-10 4.5E-10 4.5E-10 4.4E-10 4.4E-10 4.4E-10 4.4E-10 4.3E-10
  4.3E-10 4.3E-10 4.2E-10 4.2E-10 4.2E-10 4.1E-10 4.1E-10 4.1E-10 4.1E-10 4.0E-10 4.0E-10 4.0E-10 3.9E-10 3.9E-10 3.9E-10
  3.9E-10 3.8E-10 3.8E-10 3.8E-10 3.8E-10
G 2.0E-12
G 7.9E-13
G 7.5E-13
G 1.3E-08 1.3E-08 1.2E-08 1.2E-08 1.1E-08 1.1E-08 1.1E-08 1.0E-08 9.8E-09 9.5E-09 9.2E-09 8.9E-09 8.6E-09 8.3E-09 8.0E-09
  7.7E-09 7.4E-09 7.2E-09 6.9E-09 6.7E-09 6.5E-09 6.3E-09 6.0E-09 5.8E-09 5.6E-09 5.4E-09 5.3E-09 5.1E-09 4.9E-09 4.7E-09
  4.6E-09 4.4E-09 4.3E-09 4.1E-09 4.0E-09 3.9E-09 3.7E-09 3.6E-09 3.5E-09 3.4E-09 3.2E-09 3.1E-09 3.0E-09 2.9E-09 2.8E-09
  2.7E-09 2.6E-09 2.5E-09 2.5E-09 2.4E-09
 50  1  1  1  1 50 50 50  1  1  1 50
H 6.4E-05 4.4E-05 3.1E-05 2.3E-05 1.7E-05 1.3E-05 1.0E-05 7.9E-06 6.4E-06 5.3E-06 4.5E-06 3.9E-06 3.4E-06 3.1E-06 2.8E-06
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 2.6E-06 2.4E-06 2.3E-06 2.2E-06 2.1E-06 2.1E-06 2.0E-06 2.0E-06 2.0E-06 2.0E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06
 1.9E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06
 1.9E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06
H 7.1E-10
H 1.6E-09
H 9.0E-09
H 2.7E-08
H 3.5E-06 6.8E-06 9.9E-06 1.3E-05 1.5E-05 1.7E-05 1.8E-05 1.9E-05 2.0E-05 2.0E-05 2.1E-05 2.1E-05 2.1E-05 2.1E-05 2.1E-05
 2.1E-05 2.1E-05 2.1E-05 2.0E-05 2.0E-05 2.0E-05 2.0E-05 1.9E-05 1.9E-05 1.9E-05 1.9E-05 1.8E-05 1.8E-05 1.8E-05 1.8E-05
 1.7E-05 1.7E-05 1.7E-05 1.7E-05 1.7E-05 1.6E-05 1.6E-05 1.6E-05 1.6E-05 1.5E-05 1.5E-05 1.5E-05 1.5E-05 1.5E-05 1.4E-05
 1.4E-05 1.4E-05 1.4E-05 1.4E-05 1.3E-05
H 2.7E-07 5.3E-07 7.7E-07 9.7E-07 1.1E-06 1.3E-06 1.4E-06 1.5E-06 1.5E-06 1.6E-06 1.6E-06 1.6E-06 1.6E-06 1.6E-06 1.6E-06
 1.6E-06 1.6E-06 1.6E-06 1.6E-06 1.6E-06 1.5E-06 1.5E-06 1.5E-06 1.5E-06 1.5E-06 1.4E-06 1.4E-06 1.4E-06 1.4E-06 1.4E-06
 1.4E-06 1.3E-06 1.3E-06 1.3E-06 1.3E-06 1.3E-06 1.2E-06 1.2E-06 1.2E-06 1.2E-06 1.2E-06 1.2E-06 1.1E-06 1.1E-06 1.1E-06
 1.1E-06 1.1E-06 1.1E-06 1.1E-06 1.0E-06
H 3.8E-08 7.3E-08 1.1E-07 1.4E-07 1.6E-07 1.8E-07 2.0E-07 2.1E-07 2.2E-07 2.2E-07 2.3E-07 2.3E-07 2.4E-07 2.4E-07 2.4E-07
 2.4E-07 2.4E-07 2.4E-07 2.4E-07 2.4E-07 2.4E-07 2.3E-07 2.3E-07 2.3E-07 2.3E-07 2.3E-07 2.3E-07 2.3E-07 2.2E-07 2.2E-07
 2.2E-07 2.2E-07 2.2E-07 2.2E-07 2.2E-07 2.1E-07 2.1E-07 2.1E-07 2.1E-07 2.1E-07 2.1E-07 2.1E-07 2.0E-07 2.0E-07 2.0E-07
 2.0E-07 2.0E-07 2.0E-07 2.0E-07 1.9E-07
H 8.1E-11
H 8.3E-11
H 8.0E-11
H 9.3E-07 1.8E-06 2.5E-06 3.2E-06 3.7E-06 4.1E-06 4.4E-06 4.5E-06 4.7E-06 4.7E-06 4.7E-06 4.7E-06 4.6E-06 4.6E-06 4.5E-06
 4.4E-06 4.3E-06 4.1E-06 4.0E-06 3.9E-06 3.8E-06 3.7E-06 3.5E-06 3.4E-06 3.3E-06 3.2E-06 3.1E-06 3.0E-06 2.9E-06 2.8E-06
 2.7E-06 2.6E-06 2.5E-06 2.4E-06 2.4E-06 2.3E-06 2.2E-06 2.1E-06 2.1E-06 2.0E-06 1.9E-06 1.9E-06 1.8E-06 1.7E-06 1.7E-06
 1.6E-06 1.6E-06 1.5E-06 1.5E-06 1.4E-06
! PU241    Class: Y F1:    0.00010     12/07/87  13:28:35.6   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1 50 50 50  1  1  1 50
G 1.7E-16
G 5.8E-12
G 1.5E-11
G 9.0E-11
G 2.6E-10
G 4.4E-11 1.2E-10 1.9E-10 2.6E-10 3.2E-10 3.8E-10 4.3E-10 4.7E-10 5.2E-10 5.6E-10 5.9E-10 6.3E-10 6.6E-10 6.8E-10 7.1E-10
 7.3E-10 7.5E-10 7.7E-10 7.8E-10 8.0E-10 8.1E-10 8.2E-10 8.3E-10 8.3E-10 8.4E-10 8.4E-10 8.5E-10 8.5E-10 8.5E-10 8.5E-10
 8.5E-10 8.5E-10 8.5E-10 8.5E-10 8.4E-10 8.4E-10 8.4E-10 8.3E-10 8.3E-10 8.2E-10 8.2E-10 8.1E-10 8.0E-10 8.0E-10 7.9E-10
 7.8E-10 7.8E-10 7.7E-10 7.6E-10 7.5E-10
G 3.5E-12 9.5E-12 1.5E-11 2.0E-11 2.5E-11 2.9E-11 3.3E-11 3.7E-11 4.1E-11 4.4E-11 4.6E-11 4.9E-11 5.1E-11 5.3E-11 5.5E-11
 5.7E-11 5.9E-11 6.0E-11 6.1E-11 6.2E-11 6.3E-11 6.4E-11 6.5E-11 6.5E-11 6.6E-11 6.6E-11 6.6E-11 6.7E-11 6.7E-11 6.7E-11
 6.7E-11 6.7E-11 6.7E-11 6.6E-11 6.6E-11 6.6E-11 6.6E-11 6.5E-11 6.5E-11 6.4E-11 6.4E-11 6.3E-11 6.3E-11 6.2E-11 6.2E-11
 6.1E-11 6.1E-11 6.0E-11 6.0E-11 5.9E-11
G 4.8E-13 1.3E-12 2.1E-12 2.9E-12 3.6E-12 4.2E-12 4.8E-12 5.4E-12 5.9E-12 6.4E-12 6.9E-12 7.3E-12 7.7E-12 8.1E-12 8.5E-12
 8.8E-12 9.1E-12 9.4E-12 9.6E-12 9.9E-12 1.0E-11 1.0E-11 1.0E-11 1.1E-11 1.1E-11 1.1E-11 1.1E-11 1.1E-11 1.1E-11 1.1E-11
 1.1E-11 1.1E-11 1.2E-11 1.2E-11 1.2E-11 1.2E-11 1.2E-11 1.2E-11 1.2E-11 1.2E-11 1.2E-11 1.2E-11 1.2E-11 1.2E-11 1.2E-11
 1.2E-11 1.2E-11 1.2E-11 1.2E-11 1.2E-11
G 2.8E-15
G 3.7E-16
G 7.1E-17
G 1.2E-11 3.2E-11 4.9E-11 6.5E-11 7.8E-11 9.0E-11 1.0E-10 1.1E-10 1.2E-10 1.2E-10 1.3E-10 1.3E-10 1.4E-10 1.4E-10 1.4E-10
 1.4E-10 1.4E-10 1.4E-10 1.4E-10 1.4E-10 1.4E-10 1.4E-10 1.4E-10 1.4E-10 1.4E-10 1.3E-10 1.3E-10 1.3E-10 1.3E-10 1.2E-10
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5.934

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DOSINC.DAT

```
 1.2E-10 1.2E-10 1.2E-10 1.1E-10 1.1E-10 1.1E-10 1.1E-10 1.0E-10 1.0E-10 9.8E-11 9.5E-11 9.2E-11 9.0E-11 8.7E-11 8.5E-11
 8.2E-11 8.0E-11 7.7E-11 7.5E-11 7.3E-11
50  1  1  1  1 50 50 50  1  1  1 50
H 5.6E-08 1.1E-07 1.3E-07 1.3E-07 1.2E-07 1.1E-07 9.8E-08 8.8E-08 7.9E-08 7.1E-08 6.5E-08 6.0E-08 5.6E-08 5.3E-08 5.1E-08
 4.9E-08 4.8E-08 4.7E-08 4.7E-08 4.7E-08 4.7E-08 4.7E-08 4.8E-08 4.8E-08 4.9E-08 4.9E-08 5.0E-08 5.0E-08 5.1E-08 5.2E-08
 5.2E-08 5.3E-08 5.3E-08 5.4E-08 5.4E-08 5.5E-08 5.5E-08 5.6E-08 5.6E-08 5.7E-08 5.7E-08 5.7E-08 5.8E-08 5.8E-08 5.8E-08
 5.9E-08 5.9E-08 5.9E-08 5.9E-08 6.0E-08
H 3.2E-12
H 8.0E-12
H 4.7E-11
H 1.4E-10
H 3.6E-09 1.7E-08 4.0E-08 6.9E-08 1.0E-07 1.3E-07 1.7E-07 2.0E-07 2.3E-07 2.6E-07 2.8E-07 3.1E-07 3.3E-07 3.5E-07 3.6E-07
 3.8E-07 3.9E-07 4.0E-07 4.1E-07 4.2E-07 4.3E-07 4.3E-07 4.4E-07 4.4E-07 4.5E-07 4.5E-07 4.5E-07 4.5E-07 4.5E-07 4.5E-07
 4.6E-07 4.5E-07 4.5E-07 4.5E-07 4.5E-07 4.5E-07 4.5E-07 4.4E-07 4.4E-07 4.4E-07 4.4E-07 4.3E-07 4.3E-07 4.3E-07 4.2E-07
 4.2E-07 4.2E-07 4.1E-07 4.1E-07 4.0E-07
H 2.8E-10 1.4E-09 3.1E-09 5.4E-09 7.9E-09 1.1E-08 1.3E-08 1.6E-08 1.8E-08 2.0E-08 2.2E-08 2.4E-08 2.6E-08 2.7E-08 2.8E-08
 3.0E-08 3.1E-08 3.1E-08 3.2E-08 3.3E-08 3.3E-08 3.4E-08 3.4E-08 3.5E-08 3.5E-08 3.5E-08 3.5E-08 3.5E-08 3.6E-08 3.6E-08
 3.6E-08 3.6E-08 3.6E-08 3.5E-08 3.5E-08 3.5E-08 3.5E-08 3.5E-08 3.5E-08 3.4E-08 3.4E-08 3.4E-08 3.4E-08 3.3E-08 3.3E-08
 3.3E-08 3.2E-08 3.2E-08 3.2E-08 3.2E-08
H 3.9E-11 1.9E-10 4.4E-10 7.5E-10 1.1E-09 1.5E-09 1.9E-09 2.2E-09 2.6E-09 2.9E-09 3.2E-09 3.5E-09 3.8E-09 4.0E-09 4.2E-09
 4.4E-09 4.6E-09 4.8E-09 4.9E-09 5.0E-09 5.2E-09 5.3E-09 5.4E-09 5.5E-09 5.5E-09 5.6E-09 5.7E-09 5.7E-09 5.8E-09 5.8E-09
 5.9E-09 5.9E-09 6.0E-09 6.0E-09 6.0E-09 6.0E-09 6.0E-09 6.0E-09 6.0E-09 6.1E-09 6.1E-09 6.1E-09 6.0E-09 6.0E-09 6.0E-09
 6.0E-09 6.0E-09 6.0E-09 6.0E-09 5.9E-09
H 5.6E-14
H 1.5E-13
H 8.0E-14
H 9.7E-10 4.6E-09 1.0E-08 1.8E-08 2.6E-08 3.4E-08 4.2E-08 4.9E-08 5.5E-08 6.1E-08 6.6E-08 7.0E-08 7.4E-08 7.7E-08 7.9E-08
 8.1E-08 8.2E-08 8.3E-08 8.3E-08 8.3E-08 8.3E-08 8.3E-08 8.2E-08 8.1E-08 8.0E-08 7.9E-08 7.8E-08 7.6E-08 7.5E-08 7.4E-08
 7.2E-08 7.1E-08 6.9E-08 6.7E-08 6.6E-08 6.4E-08 6.3E-08 6.1E-08 5.9E-08 5.8E-08 5.6E-08 5.5E-08 5.3E-08 5.2E-08 5.0E-08
 4.9E-08 4.7E-08 4.6E-08 4.4E-08 4.3E-08
! AM241   Class: W F1:   0.00100     12/07/87  13:42:35.3   Acute  Sv/Bq
12  1  3  4  5  6  7  8 11 12 13 14 17
 1  1  1  1  1 50 50 50  1  1  1 50
G 9.3E-12
G 1.3E-09
G 3.3E-09
G 1.9E-08
G 5.8E-08
G 5.2E-07 5.1E-07 5.0E-07 5.0E-07 4.9E-07 4.8E-07 4.7E-07 4.7E-07 4.6E-07 4.5E-07 4.4E-07 4.4E-07 4.3E-07 4.2E-07 4.2E-07
 4.1E-07 4.1E-07 4.0E-07 3.9E-07 3.9E-07 3.8E-07 3.8E-07 3.7E-07 3.6E-07 3.6E-07 3.5E-07 3.5E-07 3.4E-07 3.4E-07 3.3E-07
 3.3E-07 3.2E-07 3.2E-07 3.1E-07 3.1E-07 3.0E-07 3.0E-07 2.9E-07 2.9E-07 2.8E-07 2.8E-07 2.8E-07 2.7E-07 2.7E-07 2.6E-07
 2.6E-07 2.5E-07 2.5E-07 2.5E-07 2.4E-07
G 4.1E-08 4.0E-08 3.9E-08 3.9E-08 3.8E-08 3.8E-08 3.7E-08 3.6E-08 3.6E-08 3.5E-08 3.5E-08 3.4E-08 3.4E-08 3.3E-08 3.3E-08
 3.2E-08 3.2E-08 3.1E-08 3.1E-08 3.0E-08 3.0E-08 2.9E-08 2.9E-08 2.8E-08 2.8E-08 2.8E-08 2.7E-08 2.7E-08 2.6E-08 2.6E-08
 2.6E-08 2.5E-08 2.5E-08 2.4E-08 2.4E-08 2.4E-08 2.3E-08 2.3E-08 2.3E-08 2.2E-08 2.2E-08 2.2E-08 2.1E-08 2.1E-08 2.1E-08
 2.0E-08 2.0E-08 2.0E-08 1.9E-08 1.9E-08
G 5.6E-09 5.6E-09 5.5E-09 5.5E-09 5.4E-09 5.4E-09 5.4E-09 5.3E-09 5.3E-09 5.2E-09 5.2E-09 5.1E-09 5.1E-09 5.0E-09 5.0E-09
 5.0E-09 4.9E-09 4.9E-09 4.8E-09 4.8E-09 4.8E-09 4.7E-09 4.7E-09 4.6E-09 4.6E-09 4.6E-09 4.5E-09 4.5E-09 4.4E-09 4.4E-09
 4.4E-09 4.3E-09 4.3E-09 4.3E-09 4.2E-09 4.2E-09 4.1E-09 4.1E-09 4.1E-09 4.0E-09 4.0E-09 4.0E-09 3.9E-09 3.9E-09 3.9E-09
 3.8E-09 3.8E-09 3.8E-09 3.7E-09 3.7E-09
G 6.3E-11
```

DOSINC.DAT

5.935

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9 1 0 4 8 1 7 2 9

```
G 1.3E-11
G 8.1E-12
G 1.4E-07 1.3E-07 1.3E-07 1.2E-07 1.2E-07 1.2E-07 1.1E-07 1.1E-07 1.0E-07 1.0E-07 9.6E-08 9.3E-08 9.0E-08 8.6E-08 8.3E-08
  8.0E-08 7.8E-08 7.5E-08 7.2E-08 7.0E-08 6.7E-08 6.5E-08 6.2E-08 6.0E-08 5.8E-08 5.6E-08 5.4E-08 5.2E-08 5.0E-08 4.8E-08
  4.7E-08 4.5E-08 4.3E-08 4.2E-08 4.0E-08 3.9E-08 3.8E-08 3.6E-08 3.5E-08 3.4E-08 3.2E-08 3.1E-08 3.0E-08 2.9E-08 2.8E-08
  2.7E-08 2.6E-08 2.5E-08 2.4E-08 2.3E-08
  2  1  1  1  1 50 50 50  1  1  1 50
H 1.8E-05 1.6E-07
H 1.7E-09
H 2.7E-09
H 1.1E-08
H 3.1E-08
H 5.6E-05 6.2E-05 6.1E-05 6.0E-05 5.9E-05 5.8E-05 5.7E-05 5.6E-05 5.5E-05 5.5E-05 5.4E-05 5.3E-05 5.2E-05 5.1E-05 5.0E-05
  5.0E-05 4.9E-05 4.8E-05 4.7E-05 4.7E-05 4.6E-05 4.5E-05 4.5E-05 4.4E-05 4.3E-05 4.3E-05 4.2E-05 4.1E-05 4.1E-05 4.0E-05
  3.9E-05 3.9E-05 3.8E-05 3.8E-05 3.7E-05 3.6E-05 3.6E-05 3.5E-05 3.5E-05 3.4E-05 3.4E-05 3.3E-05 3.3E-05 3.2E-05 3.2E-05
  3.1E-05 3.1E-05 3.0E-05 3.0E-05 2.9E-05
H 4.4E-06 4.8E-06 4.8E-06 4.7E-06 4.6E-06 4.5E-06 4.5E-06 4.4E-06 4.3E-06 4.3E-06 4.2E-06 4.1E-06 4.1E-06 4.0E-06 3.9E-06
  3.9E-06 3.8E-06 3.8E-06 3.7E-06 3.7E-06 3.6E-06 3.5E-06 3.5E-06 3.4E-06 3.4E-06 3.3E-06 3.3E-06 3.2E-06 3.2E-06 3.1E-06
  3.1E-06 3.0E-06 3.0E-06 2.9E-06 2.9E-06 2.9E-06 2.8E-06 2.8E-06 2.7E-06 2.7E-06 2.6E-06 2.6E-06 2.6E-06 2.5E-06 2.5E-06
  2.4E-06 2.4E-06 2.4E-06 2.3E-06 2.3E-06
H 6.1E-07 6.7E-07 6.7E-07 6.6E-07 6.6E-07 6.5E-07 6.5E-07 6.4E-07 6.4E-07 6.3E-07 6.2E-07 6.2E-07 6.1E-07 6.1E-07 6.0E-07
  6.0E-07 5.9E-07 5.9E-07 5.8E-07 5.8E-07 5.7E-07 5.7E-07 5.6E-07 5.6E-07 5.5E-07 5.5E-07 5.4E-07 5.4E-07 5.4E-07 5.3E-07
  5.3E-07 5.2E-07 5.2E-07 5.1E-07 5.1E-07 5.0E-07 5.0E-07 5.0E-07 4.9E-07 4.9E-07 4.8E-07 4.8E-07 4.8E-07 4.7E-07 4.7E-07
  4.6E-07 4.6E-07 4.6E-07 4.5E-07 4.5E-07
H 1.0E-09
H 1.1E-09
H 1.0E-09
H 1.5E-05 1.6E-05 1.6E-05 1.5E-05 1.4E-05 1.4E-05 1.3E-05 1.3E-05 1.3E-05 1.2E-05 1.2E-05 1.1E-05 1.1E-05 1.0E-05 1.0E-05
  9.7E-06 9.4E-06 9.0E-06 8.7E-06 8.4E-06 8.1E-06 7.8E-06 7.5E-06 7.3E-06 7.0E-06 6.8E-06 6.5E-06 6.3E-06 6.1E-06 5.9E-06
  5.6E-06 5.4E-06 5.3E-06 5.1E-06 4.9E-06 4.7E-06 4.5E-06 4.4E-06 4.2E-06 4.1E-06 3.9E-06 3.8E-06 3.7E-06 3.5E-06 3.4E-06
  3.3E-06 3.2E-06 3.0E-06 2.9E-06 2.8E-06
! BE10    Class: Y F1:    0.00500    12/07/87  13:50:01.7   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  1  1  1  1  1 20 13  1  1  1  1
G 4.7E-12
G 3.0E-10
G 7.4E-10
G 4.3E-09
G 1.3E-08
G 3.3E-10 2.8E-10 2.4E-10 2.0E-10 1.7E-10 1.4E-10 1.2E-10 1.0E-10 8.6E-11 7.3E-11 6.1E-11 5.2E-11 4.4E-11 3.7E-11 3.1E-11
  2.6E-11 2.2E-11 1.9E-11 1.6E-11 1.3E-11
G 1.1E-10 9.6E-11 8.1E-11 6.8E-11 5.8E-11 4.9E-11 4.1E-11 3.5E-11 2.9E-11 2.5E-11 2.1E-11 1.8E-11 1.5E-11
G 4.7E-12
G 4.7E-12
G 4.7E-12
G 4.8E-12
 50  1  1  1  3 25 18  1  1  1  1
H 1.6E-07 1.1E-07 7.9E-08 5.7E-08 4.2E-08 3.2E-08 2.5E-08 2.0E-08 1.6E-08 1.3E-08 1.1E-08 9.7E-09 8.5E-09 7.7E-09 7.0E-09
  6.5E-09 6.1E-09 5.8E-09 5.5E-09 5.4E-09 5.2E-09 5.1E-09 5.0E-09 5.0E-09 4.9E-09 4.9E-09 4.8E-09 4.8E-09 4.8E-09 4.8E-09
  4.8E-09 4.8E-09 4.8E-09 4.8E-09 4.8E-09 4.7E-09 4.7E-09 4.7E-09 4.7E-09 4.7E-09 4.7E-09 4.7E-09 4.7E-09 4.7E-09 4.7E-09
  4.7E-09 4.7E-09 4.7E-09 4.7E-09 4.7E-09
```

```
H 1.0E-10
H 3.8E-10
H 2.2E-09
H 6.6E-09 3.1E-10 1.9E-10
H 6.4E-10 1.0E-09 1.3E-09 1.4E-09 1.5E-09 1.6E-09 1.5E-09 1.5E-09 1.4E-09 1.3E-09 1.2E-09 1.0E-09 9.4E-10 8.4E-10 7.4E-10
  6.5E-10 5.7E-10 4.9E-10 4.3E-10 3.7E-10 3.2E-10 2.8E-10 2.4E-10 2.0E-10 1.8E-10
H 2.2E-10 3.4E-10 4.4E-10 5.0E-10 5.3E-10 5.4E-10 5.3E-10 5.0E-10 4.7E-10 4.4E-10 4.0E-10 3.6E-10 3.2E-10 2.9E-10 2.5E-10
  2.2E-10 1.9E-10 1.7E-10
H 9.8E-12
H 9.9E-12
H 9.8E-12
H 1.0E-11
! F 18     Class: D F1:   1.00000     12/07/87  13:57:40.9   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  1  1  1  1  1  1  1  1  1  1  1
G 8.0E-12
G 2.9E-10
G 8.8E-12
G 9.7E-12
G 7.2E-12
G 5.2E-11
G 5.2E-11
G 4.2E-12
G 6.4E-12
G 7.6E-12
G 5.8E-12
  1  1  1  1  1  1  1  1  1  1  1
H 1.1E-10
H 4.3E-11
H 3.1E-12
H 3.3E-12
H 2.8E-12
H 2.4E-11
H 2.5E-11
H 1.9E-12
H 2.9E-12
H 4.5E-12
H 4.1E-12
! NA22     Class: D F1:   1.00000     12/07/87  14:02:48.8   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  4  3  4  3  4  6  6  3  4  4  4
G 3.3E-09 3.5E-11 1.6E-11 7.4E-12
G 3.2E-09 2.1E-11 9.5E-12
G 4.2E-09 2.8E-11 1.3E-11 6.0E-12
G 3.9E-09 2.6E-11 1.2E-11
G 4.3E-09 3.5E-11 1.6E-11 7.5E-12
G 5.8E-09 2.5E-10 1.2E-10 5.4E-11 2.5E-11 1.2E-11
G 4.9E-09 1.5E-10 7.0E-11 3.2E-11 1.5E-11 6.9E-12
G 3.7E-09 2.3E-11 1.1E-11
G 3.8E-09 3.5E-11 1.6E-11 7.5E-12
G 3.4E-09 4.0E-11 1.8E-11 8.4E-12
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DOSINC.DAT

5.937

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9 1 0 4 8 1 7 3 1

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G 3.3E-09 3.5E-11 1.6E-11 7.4E-12
  4  3  4  3  4  6  6  3  4  4  4
H 2.4E-09 2.2E-11 1.0E-11 4.7E-12
H 1.9E-09 1.3E-11 6.0E-12
H 2.7E-09 1.8E-11 8.3E-12 3.8E-12
H 2.5E-09 1.6E-11 7.5E-12
H 2.7E-09 2.2E-11 1.0E-11 4.7E-12
H 3.7E-09 1.6E-10 7.4E-11 3.4E-11 1.6E-11 7.3E-12
H 3.1E-09 9.5E-11 4.4E-11 2.0E-11 9.4E-12 4.3E-12
H 2.4E-09 1.5E-11 6.8E-12
H 2.4E-09 2.2E-11 1.0E-11 4.7E-12
H 2.2E-09 2.5E-11 1.2E-11 5.3E-12
H 2.1E-09 2.2E-11 1.0E-11 4.7E-12
! P 33    Class: D F1:   0.80000     12/07/87  14:10:39.6   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  1  1  1  1  1  1  1  1  1  1  1
G 9.6E-11
G 1.4E-10
G 9.2E-11
G 2.9E-10
G 7.9E-10
G 1.3E-09
G 5.3E-10
G 9.6E-11
G 9.6E-11
G 9.6E-11
G 9.6E-11
  1  1  1  1  1  1  1  1  1  1  1
H 2.3E-10
H 5.1E-11
H 4.3E-11
H 7.1E-11
H 1.5E-10
H 1.0E-09
H 3.9E-10
H 7.3E-11
H 7.3E-11
H 7.3E-11
H 7.3E-11
! S 35    Class: W F1:   0.80000     12/07/87  14:10:40.6   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  2  2  2  2  2  2  2  2  2  2  2
G 7.6E-11 2.2E-12
G 1.0E-10 1.3E-12
G 7.2E-11 1.3E-12
G 2.0E-10 1.1E-12
G 5.4E-10 1.3E-12
G 3.7E-11 1.1E-12
G 7.6E-11 2.3E-12
G 7.6E-11 2.2E-12
G 7.6E-11 2.2E-12
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5.938

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91048 1732

9 1 0 4 8 1 7 3 3

5.939

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G 7.6E-11 2.2E-12
G 7.6E-11 2.2E-12
  1  1  1  1  1  1  1  1  1  1  1
H 5.1E-09
H 5.3E-11
H 4.0E-11
H 1.0E-10
H 2.6E-10
H 2.2E-11
H 4.6E-11
H 4.5E-11
H 4.6E-11
H 4.6E-11
H 4.6E-11
! CL36    Class: D F1:   1.00000     12/07/87  14:26:35.3   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  1  1  1  1  1  1  1  1  1  1  1
G 8.0E-10
G 7.7E-10
G 8.6E-10
G 8.5E-10
G 8.6E-10
G 4.0E-10
G 7.9E-10
G 8.0E-10
G 8.1E-10
G 8.1E-10
G 8.2E-10
  1  1  1  1  1  1  1  1  1  1  1
H 8.2E-10
H 3.4E-10
H 5.5E-10
H 5.5E-10
H 5.5E-10
H 2.6E-10
H 5.1E-10
H 5.1E-10
H 5.2E-10
H 5.1E-10
H 5.3E-10
! K 40    Class: D F1:   1.00000     12/07/87  14:33:38.1   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  1  1  1  1  1  1  1  1  1  1  1
G 4.9E-09
G 3.5E-09
G 5.4E-09
G 5.3E-09
G 5.4E-09
G 2.5E-09
G 4.7E-09
G 5.0E-09
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DOSINC.DAT

```
G 5.1E-09
G 5.0E-09
G 4.9E-09
  1  1  1  1  1  1  1  1  1  1  1
H 1.8E-09
H 1.9E-09
H 3.5E-09
H 3.4E-09
H 3.5E-09
H 1.6E-09
H 3.0E-09
H 3.2E-09
H 3.3E-09
H 3.2E-09
H 3.1E-09
! CA41    Class: W F1:   0.30000     12/07/87  14:40:49.1   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  1  1  1  1  1 50 50  1  1  1  1
G 9.7E-13
G 3.3E-12
G 5.4E-12
G 2.9E-11
G 8.5E-11
G 2.6E-10 2.2E-10 2.0E-10 1.8E-10 1.6E-10 1.5E-10 1.4E-10 1.3E-10 1.3E-10 1.2E-10 1.1E-10 1.1E-10 1.0E-10 9.6E-11 9.1E-11
  8.7E-11 8.3E-11 8.0E-11 7.6E-11 7.3E-11 7.0E-11 6.8E-11 6.5E-11 6.3E-11 6.1E-11 5.9E-11 5.7E-11 5.5E-11 5.3E-11 5.1E-11
  4.9E-11 4.8E-11 4.6E-11 4.5E-11 4.4E-11 4.2E-11 4.1E-11 4.0E-11 3.9E-11 3.7E-11 3.6E-11 3.5E-11 3.4E-11 3.3E-11 3.2E-11
  3.1E-11 3.0E-11 2.9E-11 2.9E-11 2.8E-11
G 1.9E-10 1.6E-10 1.3E-10 1.1E-10 9.9E-11 8.7E-11 7.7E-11 6.8E-11 6.1E-11 5.5E-11 4.9E-11 4.4E-11 4.0E-11 3.6E-11 3.3E-11
  3.0E-11 2.7E-11 2.5E-11 2.3E-11 2.1E-11 1.9E-11 1.8E-11 1.7E-11 1.5E-11 1.4E-11 1.3E-11 1.3E-11 1.2E-11 1.1E-11 1.0E-11
  9.9E-12 9.4E-12 8.9E-12 8.5E-12 8.1E-12 7.7E-12 7.4E-12 7.1E-12 6.8E-12 6.5E-12 6.3E-12 6.0E-12 5.8E-12 5.6E-12 5.4E-12
  5.2E-12 5.0E-12 4.9E-12 4.7E-12 4.5E-12
G 9.8E-13
G 1.1E-12
G 9.9E-13
G 1.0E-12
  2  1  1  1  1 50 50  1  1  1  1
H 4.4E-10 3.9E-12
H 1.9E-12
H 3.0E-12
H 1.5E-11
H 4.4E-11
H 2.2E-10 2.0E-10 1.8E-10 1.6E-10 1.5E-10 1.4E-10 1.3E-10 1.2E-10 1.1E-10 1.1E-10 1.0E-10 9.7E-11 9.2E-11 8.7E-11 8.3E-11
  7.9E-11 7.6E-11 7.3E-11 7.0E-11 6.7E-11 6.4E-11 6.2E-11 6.0E-11 5.7E-11 5.5E-11 5.3E-11 5.2E-11 5.0E-11 4.8E-11 4.7E-11
  4.5E-11 4.4E-11 4.2E-11 4.1E-11 4.0E-11 3.9E-11 3.7E-11 3.6E-11 3.5E-11 3.4E-11 3.3E-11 3.2E-11 3.1E-11 3.0E-11 2.9E-11
  2.8E-11 2.8E-11 2.7E-11 2.6E-11 2.5E-11
H 1.6E-10 1.5E-10 1.2E-10 1.1E-10 9.1E-11 8.0E-11 7.1E-11 6.3E-11 5.6E-11 5.0E-11 4.5E-11 4.0E-11 3.7E-11 3.3E-11 3.0E-11
  2.7E-11 2.5E-11 2.3E-11 2.1E-11 1.9E-11 1.8E-11 1.6E-11 1.5E-11 1.4E-11 1.3E-11 1.2E-11 1.1E-11 1.1E-11 1.0E-11 9.6E-12
  9.0E-12 8.6E-12 8.1E-12 7.8E-12 7.4E-12 7.1E-12 6.7E-12 6.5E-12 6.2E-12 5.9E-12 5.7E-12 5.5E-12 5.3E-12 5.1E-12 4.9E-12
  4.7E-12 4.6E-12 4.4E-12 4.3E-12 4.1E-12
H 9.0E-13
H 9.6E-13
```

```
H 9.9E-13
H 9.1E-13
! CA45    Class: W F1:   0.30000     12/07/87  14:49:38.8   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  1  1  1  1  1  5  4  1  1  1  1
G 2.4E-11
G 9.9E-11
G 1.7E-10
G 9.5E-10
G 2.8E-09
G 4.2E-09 7.8E-10 1.5E-10 2.8E-11 5.5E-12
G 2.9E-09 5.6E-10 9.9E-11 1.8E-11
G 2.4E-11
G 2.4E-11
G 2.4E-11
G 2.4E-11
  2  1  1  1  1  4  4  1  1  1  1
H 9.6E-09 1.8E-11
H 5.2E-11
H 8.5E-11
H 4.7E-10
H 1.4E-09
H 3.4E-09 7.1E-10 1.3E-10 2.6E-11
H 2.4E-09 5.2E-10 9.1E-11 1.6E-11
H 2.0E-11
H 2.0E-11
H 2.0E-11
H 2.0E-11
! SC46    Class: Y F1:   0.00010     12/07/87  14:58:24.8   Acute  Sv/Bq
 13  1  3  4  5  6  7  8 11 12 13 14 17 19
  1  1  1  1  1  1  1  1  1  1  1  1  1
G 5.0E-11
G 6.8E-10
G 2.3E-09
G 4.6E-09
G 1.0E-08
G 1.4E-10
G 4.0E-10
G 1.7E-10
G 2.0E-09
G 2.5E-10
G 7.7E-12
G 2.6E-10
G 2.4E-10
  3  2  1  1  1  2  2  1  1  2  2  2  2
H 4.4E-08 1.5E-09 5.3E-11
H 3.3E-09 1.1E-10
H 1.6E-09
H 3.0E-09
H 5.2E-09
H 1.6E-09 6.2E-11
```

9 1 0 4 8 1 7 3 5

5.941

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DOSINC.DAT

DOSINC.DAT

```
H 2.1E-09 7.2E-11
H 1.8E-10
H 1.3E-09
H 2.1E-09 7.1E-11
H 2.0E-09 6.9E-11
H 3.9E-09 1.7E-10
H 4.3E-09 2.2E-10
! MN54    Class: W F1:   0.10000     12/07/87  15:06:16.1   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1  1  1  1  1  1  1  1
G 2.3E-10
G 4.0E-10
G 9.7E-10
G 1.4E-09
G 2.3E-09
G 5.7E-10
G 4.9E-10
G 2.1E-10
G 9.5E-10
G 2.8E-10
G 1.4E-10
G 1.0E-09
  2  1  1  1  1  2  1  1  1  1  1  2
H 6.7E-09 2.7E-11
H 1.1E-09
H 8.2E-10
H 1.1E-09
H 1.3E-09
H 1.2E-09 7.0E-12
H 1.1E-09
H 2.8E-10
H 7.0E-10
H 8.6E-10
H 7.4E-10
H 2.5E-09 1.3E-11
! MN56    Class: W F1:   0.10000     12/07/87  15:14:20.0   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1  1  1  1  1  1  1  1
G 9.1E-12
G 9.0E-10
G 1.1E-09
G 1.4E-09
G 5.7E-10
G 1.1E-11
G 2.5E-11
G 8.1E-12
G 8.9E-11
G 1.8E-11
G 2.5E-12
G 2.8E-11
  1  1  1  1  1  1  1  1  1  1  1  1
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5.942

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```
H 5.5E-10
H 7.7E-11
H 8.6E-11
H 1.1E-10
H 4.6E-11
H 8.6E-12
H 1.1E-11
H 3.3E-12
H 9.9E-12
H 8.1E-12
H 6.5E-12
H 2.0E-11
! FE55    Class: W F1:   0.10000     12/07/87  15:19:36.2   Acute  Sv/Bq
 13  1  3  4  5  6  7  8 11 12 13 14 17 19
 14 13 13 12 13 11 13 14 14 14 14 17 18
G 3.3E-11 2.3E-11 1.5E-11 1.0E-11 7.1E-12 4.9E-12 3.3E-12 2.3E-12 1.5E-12 1.1E-12 7.2E-13 4.9E-13 3.3E-13 2.3E-13
G 2.9E-11 1.7E-11 1.1E-11 7.7E-12 5.3E-12 3.6E-12 2.5E-12 1.7E-12 1.1E-12 7.8E-13 5.3E-13 3.6E-13 2.5E-13
G 3.5E-11 1.6E-11 1.1E-11 7.3E-12 5.0E-12 3.4E-12 2.3E-12 1.6E-12 1.1E-12 7.3E-13 5.0E-13 3.4E-13 2.3E-13
G 9.0E-11 1.5E-11 1.0E-11 6.9E-12 4.7E-12 3.2E-12 2.2E-12 1.5E-12 1.0E-12 6.9E-13 4.7E-13 3.2E-13
G 2.2E-10 1.7E-11 1.2E-11 7.9E-12 5.4E-12 3.7E-12 2.5E-12 1.7E-12 1.2E-12 7.9E-13 5.4E-13 3.7E-13 2.5E-13
G 1.4E-11 9.8E-12 6.7E-12 4.6E-12 3.1E-12 2.1E-12 1.5E-12 9.9E-13 6.7E-13 4.6E-13 3.1E-13
G 3.0E-11 2.1E-11 1.4E-11 9.6E-12 6.5E-12 4.4E-12 3.0E-12 2.1E-12 1.4E-12 9.6E-13 6.6E-13 4.5E-13 3.0E-13
G 3.4E-11 2.3E-11 1.6E-11 1.1E-11 7.4E-12 5.0E-12 3.4E-12 2.3E-12 1.6E-12 1.1E-12 7.4E-13 5.1E-13 3.5E-13 2.4E-13
G 3.6E-11 2.4E-11 1.7E-11 1.1E-11 7.7E-12 5.3E-12 3.6E-12 2.4E-12 1.7E-12 1.1E-12 7.8E-13 5.3E-13 3.6E-13 2.5E-13
G 3.4E-11 2.3E-11 1.6E-11 1.1E-11 7.4E-12 5.0E-12 3.4E-12 2.3E-12 1.6E-12 1.1E-12 7.4E-13 5.1E-13 3.5E-13 2.4E-13
G 3.6E-11 2.5E-11 1.7E-11 1.1E-11 7.8E-12 5.3E-12 3.6E-12 2.5E-12 1.7E-12 1.2E-12 7.9E-13 5.4E-13 3.7E-13 2.5E-13
G 1.1E-10 7.4E-11 5.0E-11 3.4E-11 2.3E-11 1.6E-11 1.1E-11 7.4E-12 5.1E-12 3.5E-12 2.4E-12 1.6E-12 1.1E-12 7.5E-13 5.1E-13
  3.5E-13 2.4E-13
G 1.8E-10 1.2E-10 8.4E-11 5.7E-11 3.9E-11 2.7E-11 1.8E-11 1.2E-11 8.5E-12 5.8E-12 3.9E-12 2.7E-12 1.8E-12 1.2E-12 8.5E-13
  5.8E-13 4.0E-13 2.7E-13
  2 11 10 10 11  9 11 11 12 11 12 14 16
H 8.9E-10 6.7E-12
H 4.1E-11 2.9E-11 2.0E-11 1.4E-11 9.3E-12 6.3E-12 4.3E-12 2.9E-12 2.0E-12 1.4E-12 9.3E-13
H 4.3E-11 2.7E-11 1.9E-11 1.3E-11 8.7E-12 5.9E-12 4.0E-12 2.8E-12 1.9E-12 1.3E-12
H 6.9E-11 2.6E-11 1.8E-11 1.2E-11 8.2E-12 5.6E-12 3.8E-12 2.6E-12 1.8E-12 1.2E-12
H 1.4E-10 3.0E-11 2.0E-11 1.4E-11 9.4E-12 6.4E-12 4.4E-12 3.0E-12 2.0E-12 1.4E-12 9.5E-13
H 2.3E-11 1.7E-11 1.2E-11 8.0E-12 5.5E-12 3.7E-12 2.5E-12 1.7E-12 1.2E-12
H 4.8E-11 3.6E-11 2.5E-11 1.7E-11 1.1E-11 7.8E-12 5.3E-12 3.6E-12 2.5E-12 1.7E-12 1.2E-12
H 5.4E-11 4.1E-11 2.8E-11 1.9E-11 1.3E-11 8.8E-12 6.0E-12 4.1E-12 2.8E-12 1.9E-12 1.3E-12
H 5.7E-11 4.3E-11 2.9E-11 2.0E-11 1.4E-11 9.2E-12 6.3E-12 4.3E-12 2.9E-12 2.0E-12 1.4E-12 9.3E-13
H 5.5E-11 4.1E-11 2.8E-11 1.9E-11 1.3E-11 8.8E-12 6.0E-12 4.1E-12 2.8E-12 1.9E-12 1.3E-12
H 5.7E-11 4.3E-11 3.0E-11 2.0E-11 1.4E-11 9.4E-12 6.4E-12 4.4E-12 3.0E-12 2.0E-12 1.4E-12 9.4E-13
H 1.7E-10 1.3E-10 8.7E-11 5.9E-11 4.0E-11 2.8E-11 1.9E-11 1.3E-11 8.7E-12 6.0E-12 4.1E-12 2.8E-12 1.9E-12 1.3E-12
H 2.8E-10 2.1E-10 1.5E-10 9.9E-11 6.8E-11 4.6E-11 3.1E-11 2.1E-11 1.5E-11 1.0E-11 6.8E-12 4.6E-12 3.2E-12 2.2E-12 1.5E-12
  1.0E-12
! FE59    Class: W F1:   0.10000     12/07/87  15:27:39.2   Acute  Sv/Bq
 13  1  3  4  5  6  7  8 11 12 13 14 17 19
  1  1  1  1  1  1  1  1  1  1  1  1  1
G 6.5E-10
G 1.0E-09
G 2.0E-09
```

9 1 0 4 8 1 7 3 7

5.943

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DOSINC.DAT

```
G 3.6E-09
G 8.3E-09
G 5.2E-10
G 7.7E-10
G 7.9E-10
G 1.6E-09
G 7.5E-10
G 6.4E-10
G 1.6E-09
G 1.8E-09
  1  1  1  1  1  1  1  1  1  1  1  1  1
H 1.4E-08
H 1.6E-09
H 1.6E-09
H 2.4E-09
H 4.4E-09
H 9.3E-10
H 1.2E-09
H 1.0E-09
H 1.4E-09
H 1.3E-09
H 1.2E-09
H 2.7E-09
H 2.9E-09
! C057    Class: Y F1:    0.05000     12/07/87  15:35:59.0   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  2  2  2  2  2  2  3  2  3  2  2  3
G 2.4E-11 4.2E-12
G 8.3E-11 3.9E-12
G 2.2E-10 4.2E-12
G 5.2E-10 4.2E-12
G 1.3E-09 3.7E-12
G 3.8E-11 4.2E-12
G 7.9E-11 5.4E-12 1.5E-12
G 2.9E-11 3.4E-12
G 1.8E-10 4.6E-12 1.3E-12
G 3.6E-11 3.8E-12
G 1.5E-11 3.0E-12
G 7.4E-11 1.2E-11 3.4E-12
  6  3  2  2  2  3  3  1  1  3  3  3
H 1.2E-08 3.4E-09 9.4E-10 2.7E-10 7.9E-11 2.4E-11
H 4.1E-10 1.0E-10 2.9E-11
H 1.5E-10 1.5E-11
H 3.0E-10 1.9E-11
H 6.5E-10 1.5E-11
H 3.3E-10 8.8E-11 2.5E-11
H 4.3E-10 1.1E-10 3.2E-11
H 1.8E-11
H 1.1E-10
H 2.8E-10 7.3E-11 2.1E-11
H 2.0E-10 5.4E-11 1.5E-11
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DOSINC.DAT

5.944

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9 1 0 4 8 1 7 3 8

DOSINC.DAT

```
H 5.1E-10 1.4E-10 4.0E-11
! C058    Class: Y F1:   0.05000     12/07/87  15:43:59.1   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1  1  1  1  1  1  1  1
G 8.6E-11
G 3.8E-10
G 1.1E-09
G 2.0E-09
G 3.9E-09
G 1.2E-10
G 2.6E-10
G 1.7E-10
G 1.0E-09
G 1.8E-10
G 6.6E-11
G 2.5E-10
  2  2  1  1  1  1  2  1  1  2  2  2
H 1.6E-08 3.1E-10
H 1.4E-09 2.4E-11
H 7.5E-10
H 1.2E-09
H 2.0E-09
H 6.8E-10
H 9.2E-10 1.6E-11
H 1.1E-10
H 6.1E-10
H 9.2E-10 1.7E-11
H 8.6E-10 1.7E-11
H 1.6E-09 3.1E-11
! NI59    Class: W F1:   0.05000     12/07/87  15:52:00.0   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 16
 16 15 15 14 15 12 16 16 17 16 17  1
G 6.9E-12 5.6E-12 4.5E-12 3.6E-12 3.0E-12 2.4E-12 1.9E-12 1.6E-12 1.3E-12 1.0E-12 8.3E-13 6.7E-13 5.5E-13 4.4E-13 3.6E-13
  2.9E-13
G 1.1E-11 4.2E-12 3.4E-12 2.8E-12 2.2E-12 1.8E-12 1.5E-12 1.2E-12 9.6E-13 7.8E-13 6.3E-13 5.1E-13 4.1E-13 3.3E-13 2.7E-13

G 2.0E-11 3.9E-12 3.2E-12 2.6E-12 2.1E-12 1.7E-12 1.4E-12 1.1E-12 9.0E-13 7.3E-13 5.9E-13 4.8E-13 3.9E-13 3.1E-13 2.5E-13

G 8.5E-11 3.7E-12 3.0E-12 2.4E-12 1.9E-12 1.6E-12 1.3E-12 1.0E-12 8.4E-13 6.8E-13 5.5E-13 4.4E-13 3.6E-13 2.9E-13
G 2.4E-10 4.2E-12 3.4E-12 2.8E-12 2.2E-12 1.8E-12 1.5E-12 1.2E-12 9.6E-13 7.8E-13 6.3E-13 5.1E-13 4.2E-13 3.4E-13 2.7E-13

G 3.1E-12 2.5E-12 2.0E-12 1.6E-12 1.3E-12 1.1E-12 8.6E-13 6.9E-13 5.6E-13 4.5E-13 3.7E-13 3.0E-13
G 6.0E-12 4.8E-12 3.9E-12 3.1E-12 2.5E-12 2.1E-12 1.7E-12 1.4E-12 1.1E-12 8.9E-13 7.2E-13 5.8E-13 4.7E-13 3.8E-13 3.1E-13
  2.5E-13
G 7.0E-12 5.7E-12 4.6E-12 3.7E-12 3.0E-12 2.4E-12 2.0E-12 1.6E-12 1.3E-12 1.1E-12 8.5E-13 6.9E-13 5.6E-13 4.5E-13 3.7E-13
  3.0E-13
G 8.6E-12 6.0E-12 4.9E-12 3.9E-12 3.2E-12 2.6E-12 2.1E-12 1.7E-12 1.4E-12 1.1E-12 9.0E-13 7.3E-13 5.9E-13 4.8E-13 3.9E-13
  3.1E-13 2.5E-13
G 7.1E-12 5.7E-12 4.6E-12 3.7E-12 3.0E-12 2.5E-12 2.0E-12 1.6E-12 1.3E-12 1.1E-12 8.6E-13 6.9E-13 5.6E-13 4.6E-13 3.7E-13
  3.0E-13
G 7.8E-12 6.3E-12 5.1E-12 4.1E-12 3.3E-12 2.7E-12 2.2E-12 1.8E-12 1.4E-12 1.2E-12 9.4E-13 7.7E-13 6.2E-13 5.0E-13 4.1E-13
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9 1 0 4 8 1 7 3 9

5.945

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 3.3E-13 2.7E-13
G 1.9E-13
 2 13 13 12 13 11 14 15 15 15 15  1
H 1.1E-09 1.0E-11
H 1.7E-11 1.3E-11 1.0E-11 8.3E-12 6.7E-12 5.4E-12 4.4E-12 3.6E-12 2.9E-12 2.3E-12 1.9E-12 1.5E-12 1.2E-12
H 2.1E-11 1.2E-11 9.6E-12 7.8E-12 6.3E-12 5.1E-12 4.1E-12 3.3E-12 2.7E-12 2.2E-12 1.8E-12 1.4E-12 1.2E-12
H 5.3E-11 1.1E-11 8.9E-12 7.2E-12 5.9E-12 4.7E-12 3.8E-12 3.1E-12 2.5E-12 2.0E-12 1.7E-12 1.3E-12
H 1.3E-10 1.3E-11 1.0E-11 8.3E-12 6.8E-12 5.5E-12 4.4E-12 3.6E-12 2.9E-12 2.4E-12 1.9E-12 1.5E-12 1.3E-12
H 8.3E-12 7.4E-12 6.0E-12 4.9E-12 3.9E-12 3.2E-12 2.6E-12 2.1E-12 1.7E-12 1.4E-12 1.1E-12
H 1.6E-11 1.4E-11 1.2E-11 9.5E-12 7.7E-12 6.2E-12 5.0E-12 4.1E-12 3.3E-12 2.7E-12 2.2E-12 1.8E-12 1.4E-12 1.2E-12
H 1.9E-11 1.7E-11 1.4E-11 1.1E-11 9.1E-12 7.4E-12 6.0E-12 4.8E-12 3.9E-12 3.2E-12 2.6E-12 2.1E-12 1.7E-12 1.4E-12 1.1E-12

H 2.1E-11 1.8E-11 1.5E-11 1.2E-11 9.6E-12 7.8E-12 6.3E-12 5.1E-12 4.1E-12 3.4E-12 2.7E-12 2.2E-12 1.8E-12 1.4E-12 1.2E-12

H 2.0E-11 1.7E-11 1.4E-11 1.1E-11 9.1E-12 7.4E-12 6.0E-12 4.9E-12 3.9E-12 3.2E-12 2.6E-12 2.1E-12 1.7E-12 1.4E-12 1.1E-12

H 2.1E-11 1.9E-11 1.5E-11 1.2E-11 1.0E-11 8.2E-12 6.6E-12 5.4E-12 4.3E-12 3.5E-12 2.8E-12 2.3E-12 1.9E-12 1.5E-12 1.2E-12

H 5.2E-13
! NI63    Class: W F1:   0.05000     12/07/87  15:59:38.9   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 16
 14 12 12 11 12 11 14 14 14 14 14  1
G 1.7E-11 1.4E-11 1.1E-11 8.8E-12 7.1E-12 5.7E-12 4.6E-12 3.7E-12 3.0E-12 2.4E-12 1.9E-12 1.5E-12 1.2E-12 1.0E-12
G 2.9E-11 7.6E-12 6.1E-12 4.9E-12 4.0E-12 3.2E-12 2.6E-12 2.1E-12 1.7E-12 1.3E-12 1.1E-12 8.6E-13
G 5.6E-11 7.7E-12 6.2E-12 5.0E-12 4.0E-12 3.2E-12 2.6E-12 2.1E-12 1.7E-12 1.4E-12 1.1E-12 8.8E-13
G 2.9E-10 6.5E-12 5.2E-12 4.2E-12 3.4E-12 2.7E-12 2.2E-12 1.8E-12 1.4E-12 1.1E-12 9.1E-13
G 8.4E-10 7.6E-12 6.1E-12 4.9E-12 4.0E-12 3.2E-12 2.6E-12 2.1E-12 1.7E-12 1.3E-12 1.1E-12 8.6E-13
G 8.5E-12 6.8E-12 5.5E-12 4.4E-12 3.6E-12 2.9E-12 2.3E-12 1.8E-12 1.5E-12 1.2E-12 9.6E-13
G 1.6E-11 1.3E-11 1.1E-11 8.5E-12 6.9E-12 5.5E-12 4.4E-12 3.6E-12 2.9E-12 2.3E-12 1.9E-12 1.5E-12 1.2E-12 9.7E-13
G 1.7E-11 1.4E-11 1.1E-11 8.9E-12 7.1E-12 5.7E-12 4.6E-12 3.7E-12 3.0E-12 2.4E-12 1.9E-12 1.6E-12 1.2E-12 1.0E-12
G 1.8E-11 1.4E-11 1.1E-11 9.1E-12 7.3E-12 5.9E-12 4.7E-12 3.8E-12 3.1E-12 2.5E-12 2.0E-12 1.6E-12 1.3E-12 1.0E-12
G 1.7E-11 1.4E-11 1.1E-11 8.8E-12 7.1E-12 5.7E-12 4.6E-12 3.7E-12 3.0E-12 2.4E-12 1.9E-12 1.5E-12 1.2E-12 1.0E-12
G 1.7E-11 1.4E-11 1.1E-11 8.9E-12 7.1E-12 5.7E-12 4.6E-12 3.7E-12 3.0E-12 2.4E-12 1.9E-12 1.6E-12 1.3E-12 1.0E-12
G 2.8E-13
 2 11 11 10 11 11 14 14 14 14 14  1
H 2.8E-09 2.4E-11
H 3.6E-11 2.3E-11 1.8E-11 1.5E-11 1.2E-11 9.6E-12 7.7E-12 6.2E-12 5.0E-12 4.0E-12 3.2E-12
H 4.9E-11 2.3E-11 1.9E-11 1.5E-11 1.2E-11 9.7E-12 7.8E-12 6.3E-12 5.1E-12 4.1E-12 3.3E-12
H 1.6E-10 2.0E-11 1.6E-11 1.3E-11 1.0E-11 8.2E-12 6.6E-12 5.3E-12 4.3E-12 3.4E-12
H 4.5E-10 2.3E-11 1.8E-11 1.5E-11 1.2E-11 9.6E-12 7.7E-12 6.2E-12 5.0E-12 4.0E-12 3.2E-12
H 2.3E-11 2.1E-11 1.7E-11 1.3E-11 1.1E-11 8.6E-12 6.9E-12 5.6E-12 4.5E-12 3.6E-12 2.9E-12
H 4.4E-11 4.0E-11 3.2E-11 2.6E-11 2.1E-11 1.7E-11 1.3E-11 1.1E-11 8.6E-12 7.0E-12 5.6E-12 4.5E-12 3.6E-12 2.9E-12
H 4.6E-11 4.1E-11 3.3E-11 2.7E-11 2.1E-11 1.7E-11 1.4E-11 1.1E-11 9.0E-12 7.2E-12 5.8E-12 4.7E-12 3.8E-12 3.0E-12
H 4.7E-11 4.2E-11 3.4E-11 2.7E-11 2.2E-11 1.8E-11 1.4E-11 1.1E-11 9.2E-12 7.4E-12 6.0E-12 4.8E-12 3.9E-12 3.1E-12
H 4.6E-11 4.1E-11 3.3E-11 2.7E-11 2.1E-11 1.7E-11 1.4E-11 1.1E-11 8.9E-12 7.2E-12 5.8E-12 4.7E-12 3.7E-12 3.0E-12
H 4.6E-11 4.1E-11 3.3E-11 2.7E-11 2.2E-11 1.7E-11 1.4E-11 1.1E-11 9.0E-12 7.2E-12 5.8E-12 4.7E-12 3.8E-12 3.0E-12
H 8.1E-13
! NI65    Class: W F1:   0.05000     12/07/87  16:07:18.5   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 16
  1  1  1  1  1  1  1  1  1  1  1  1
G 2.8E-12
```

9 1 0 4 8 1 7 4 0

5.946

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DOSINC.DAT

DOSINC.DAT

5.947

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9 1 0 4 8 1 7 4 1

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G 6.5E-10
G 7.5E-10
G 9.8E-10
G 3.9E-10
G 3.0E-12
G 7.7E-12
G 2.3E-12
G 2.5E-11
G 5.8E-12
G 7.0E-13
G 1.1E-11
  1  1  1  1  1  1  1  1  1  1  1  1
H 4.0E-10
H 5.2E-11
H 5.7E-11
H 7.5E-11
H 3.1E-11
H 2.6E-12
H 3.8E-12
H 1.6E-12
H 3.4E-12
H 3.2E-12
H 2.4E-12
H 4.4E-12
! CU64    Class: D F1:   0.50000     12/07/87  16:12:38.7   Acute  Sv/Bq
 14  1  3  4  5  6  7  8 11 12 13 14 17 21 18
  1  1  1  1  1  1  1  1  1  1  1  1  1  1
G 1.4E-11
G 1.7E-10
G 2.1E-10
G 6.2E-10
G 7.8E-10
G 2.6E-11
G 2.0E-11
G 1.6E-11
G 4.9E-11
G 1.7E-11
G 1.2E-11
G 3.9E-11
G 3.9E-11
G 4.4E-11
  1  1  1  1  1  1  1  1  1  1  1  1  1  1
H 2.0E-10
H 3.5E-11
H 3.9E-11
H 1.0E-10
H 1.3E-10
H 2.3E-11
H 1.4E-11
H 1.3E-11
H 1.7E-11
```

DOSINC.DAT

H 1.3E-11
H 1.2E-11
H 3.5E-11
H 3.7E-11
H 3.6E-11
! ZN69M Class: Y F1: 0.50000 12/07/87 16:19:35.3 Acute Sv/Bq
11 1 3 4 5 6 7 8 11 12 13 14
1 1 1 1 1 1 1 1 1 1 1
G 3.7E-11
G 2.5E-10
G 4.8E-10
G 1.8E-09
G 2.4E-09
G 7.9E-11
G 1.0E-10
G 4.2E-11
G 1.2E-10
G 4.6E-11
G 3.3E-11
1 1 1 1 1 1 1 1 1 1 1
H 1.0E-09
H 1.2E-10
H 1.5E-10
H 4.7E-10
H 6.3E-10
H 2.6E-11
H 3.3E-11
H 1.1E-11
H 3.3E-11
H 1.8E-11
H 1.4E-11
! ZN69 Class: Y F1: 0.50000 12/07/87 16:31:15.1 Acute Sv/Bq
11 1 3 4 5 6 7 8 11 12 13 14
1 1 1 1 1 1 1 1 1 1 1
G 4.3E-13
G 2.1E-10
G 1.1E-10
G 6.3E-11
G 1.1E-11
G 6.8E-13
G 8.9E-13
G 4.3E-13
G 4.3E-13
G 4.5E-13
G 4.3E-13
1 1 1 1 1 1 1 1 1 1 1
H 8.1E-11
H 8.8E-12
H 4.5E-12
H 2.6E-12
H 4.4E-13

5.948

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9 1 0 4 8 1 7 4 2

```
H 4.5E-14
H 5.9E-14
H 2.9E-14
H 2.9E-14
H 3.0E-14
H 2.9E-14
! AS76     Class: W F1:   0.50000     12/07/87  16:36:06.4   Acute  Sv/Bq
 14  1  3  4  5  6  7  8 11 12 13 14 17 16 19
  1  1  1  1  1  1  1  1  1  1  1  1  1  1
G 1.0E-10
G 1.3E-09
G 1.7E-09
G 6.7E-09
G 1.2E-08
G 8.3E-11
G 1.4E-10
G 1.1E-10
G 2.2E-10
G 1.1E-10
G 9.6E-11
G 3.7E-10
G 4.3E-10
G 2.9E-10
  1  1  1  1  1  1  1  1  1  1  1  1  1  1
H 5.2E-09
H 4.0E-10
H 4.8E-10
H 1.9E-09
H 3.4E-09
H 4.2E-11
H 6.7E-11
H 4.8E-11
H 8.0E-11
H 5.6E-11
H 5.0E-11
H 1.7E-10
H 1.9E-10
H 1.3E-10
! SE75     Class: W F1:   0.80000     12/07/87  16:43:06.7   Acute  Sv/Bq
 14  1  3  4  5  6  7  8 11 12 13 14 17 16 19
  2  2  2  2  2  2  2  2  2  2  2  2  2  2
G 1.7E-09 2.9E-11
G 2.0E-09 3.3E-11
G 1.9E-09 3.2E-11
G 2.0E-09 3.2E-11
G 1.8E-09 2.5E-11
G 1.5E-09 2.5E-11
G 1.9E-09 3.3E-11
G 1.2E-09 2.0E-11
G 1.7E-09 2.8E-11
G 1.4E-09 2.5E-11
```

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G 1.2E-09 2.0E-11
G 5.7E-09 9.8E-11
G 7.0E-09 1.2E-10
G 3.5E-09 6.1E-11
  2  2  2  2  2  2  2  2  2  2  2  2  2  2
H 5.3E-09 2.2E-11
H 1.5E-09 2.5E-11
H 1.2E-09 2.4E-11
H 1.2E-09 2.4E-11
H 1.1E-09 1.9E-11
H 1.1E-09 1.9E-11
H 1.4E-09 2.5E-11
H 7.2E-10 1.5E-11
H 1.0E-09 2.1E-11
H 1.1E-09 1.9E-11
H 8.5E-10 1.5E-11
H 3.8E-09 7.4E-11
H 4.4E-09 9.2E-11
H 2.5E-09 4.6E-11
! SE79    Class: W F1:   0.80000     12/07/87  16:52:07.5   Acute  Sv/Bq
 14  1  3  4  5  6  7  8 11 12 13 14 17 16 19
  3  3  3  3  3  3  3  3  3  3  3  4  4  4
G 7.7E-10 1.2E-10 2.2E-11
G 5.2E-10 7.0E-11 1.3E-11
G 4.8E-10 6.9E-11 1.3E-11
G 5.7E-10 5.8E-11 1.1E-11
G 1.0E-09 6.8E-11 1.3E-11
G 3.9E-10 6.0E-11 1.1E-11
G 7.6E-10 1.2E-10 2.2E-11
G 7.7E-10 1.2E-10 2.2E-11
G 7.7E-10 1.2E-10 2.2E-11
G 7.7E-10 1.2E-10 2.2E-11
G 7.7E-10 1.2E-10 2.2E-11
G 5.5E-09 8.4E-10 1.6E-10 2.9E-11
G 1.1E-08 1.6E-09 3.0E-10 5.6E-11
G 3.6E-09 5.6E-10 1.0E-10 1.9E-11
  2  3  3  2  3  2  3  3  3  3  3  4  4  4
H 9.2E-09 8.0E-11
H 3.3E-10 5.4E-11 1.0E-11
H 3.1E-10 5.3E-11 9.8E-12
H 3.4E-10 4.4E-11
H 5.8E-10 5.2E-11 9.7E-12
H 2.6E-10 4.6E-11
H 5.0E-10 9.0E-11 1.7E-11
H 5.0E-10 9.1E-11 1.7E-11
H 5.0E-10 9.1E-11 1.7E-11
H 5.0E-10 9.1E-11 1.7E-11
H 5.0E-10 9.1E-11 1.7E-11
H 3.5E-09 6.3E-10 1.2E-10 2.2E-11
H 6.8E-09 1.2E-09 2.3E-10 4.2E-11
H 2.3E-09 4.2E-10 7.9E-11 1.5E-11
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DOSINC.DAT

5.950

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9 1 0 4 8 1 7 4 4

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! BR82    Class: D F1:   1.00000     12/10/87  16:32:44.9   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  1  1  1  1  1  1  1  1  1  1  1
G 4.1E-10
G 8.1E-10
G 5.4E-10
G 5.1E-10
G 5.3E-10
G 1.5E-10
G 3.8E-10
G 5.0E-10
G 4.3E-10
G 4.1E-10
G 4.1E-10
  1  1  1  1  1  1  1  1  1  1  1
H 7.4E-10
H 3.3E-10
H 3.1E-10
H 2.9E-10
H 3.0E-10
H 1.0E-10
H 2.4E-10
H 2.9E-10
H 2.4E-10
H 2.6E-10
H 2.5E-10
! BR83    Class: D F1:   1.00000     12/10/87  16:39:40.7   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  1  1  1  1  1  1  1  1  1  1  1
G 8.4E-12
G 3.0E-10
G 9.0E-12
G 8.9E-12
G 9.0E-12
G 4.3E-12
G 8.2E-12
G 8.4E-12
G 8.4E-12
G 8.7E-12
G 8.4E-12
  1  1  1  1  1  1  1  1  1  1  1
H 1.6E-10
H 4.4E-11
H 4.1E-12
H 4.0E-12
H 4.1E-12
H 1.9E-12
H 3.7E-12
H 3.8E-12
H 3.8E-12
H 4.0E-12
```

DOSINC.DAT

5.951

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9 1 0 4 8 1 7 4 5

```
H 3.8E-12
! BR84     Class: D F1:    1.00000      12/10/87  16:50:04.1   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  1  1  1  1  1  1  1  1  1  1  1
G 7.3E-12
G 6.9E-10
G 9.3E-12
G 9.8E-12
G 7.7E-12
G 3.2E-12
G 5.6E-12
G 5.5E-12
G 7.1E-12
G 6.9E-12
G 5.5E-12
  1  1  1  1  1  1  1  1  1  1  1
H 1.6E-10
H 7.5E-11
H 3.5E-12
H 3.5E-12
H 3.1E-12
H 1.8E-12
H 3.0E-12
H 2.6E-12
H 3.0E-12
H 3.5E-12
H 3.3E-12
! RB87     Class: D F1:    1.00000      12/10/87  16:54:56.9   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  1  1  1  1  1  2  2  1  1  1  1
G 1.1E-09
G 7.1E-10
G 1.1E-09
G 1.1E-09
G 1.1E-09
G 4.0E-09 1.3E-11
G 2.3E-09 7.3E-12
G 1.1E-09
G 1.1E-09
G 1.1E-09
G 1.1E-09
  1  1  1  1  1  2  2  1  1  1  1
H 3.5E-10
H 3.9E-10
H 7.3E-10
H 7.3E-10
H 7.3E-10
H 2.5E-09 8.2E-12
H 1.4E-09 4.6E-12
H 7.3E-10
H 7.3E-10
```

9 1 0 4 8 1 7 4 6

5.952

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DOSINC.DAT

```
H 7.3E-10
H 7.3E-10
! RB88    Class: D F1:    1.00000     12/10/87  17:02:35.1   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  1  1  1  1  1  1  1  1  1  1  1
G 3.1E-12
G 7.5E-10
G 3.4E-12
G 3.6E-12
G 3.1E-12
G 3.3E-12
G 3.4E-12
G 2.6E-12
G 2.9E-12
G 3.0E-12
G 2.5E-12
  1  1  1  1  1  1  1  1  1  1  1
H 1.5E-10
H 6.4E-11
H 1.5E-12
H 1.5E-12
H 1.4E-12
H 1.8E-12
H 1.8E-12
H 1.3E-12
H 1.4E-12
H 1.5E-12
H 1.4E-12
! RB89    Class: D F1:    1.00000     12/10/87  17:07:25.5   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  1  1  1  1  1  1  1  1  1  1  1
G 3.8E-12
G 3.7E-10
G 4.9E-12
G 5.4E-12
G 3.8E-12
G 4.5E-12
G 3.8E-12
G 2.4E-12
G 3.5E-12
G 3.6E-12
G 2.3E-12
  1  1  1  1  1  1  1  1  1  1  1
H 7.0E-11
H 3.1E-11
H 1.6E-12
H 1.7E-12
H 1.5E-12
H 2.7E-12
H 2.2E-12
H 1.3E-12
```

9 1 0 4 8 1 7 4 7

5.953

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DOSINC.DAT

```
H 1.4E-12
H 1.8E-12
H 1.7E-12
! RB86     Class: D F1:    1.00000     12/10/87  17:18:33.0   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  1  1  1  1  1  1  1  1  1  1  1
G 2.2E-09
G 1.9E-09
G 2.2E-09
G 2.2E-09
G 2.2E-09
G 7.4E-09
G 4.3E-09
G 2.2E-09
G 2.2E-09
G 2.2E-09
G 2.2E-09
  1  1  1  1  1  1  1  1  1  1  1
H 2.0E-09
H 8.2E-10
H 1.4E-09
H 1.4E-09
H 1.4E-09
H 4.6E-09
H 2.7E-09
H 1.4E-09
H 1.4E-09
H 1.4E-09
H 1.4E-09
! SR85     Class: D F1:    0.30000     12/10/87  17:26:03.0   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  2  1  1  1  2  2  2  1  2  2  2
G 1.6E-10 1.7E-12
G 2.4E-10
G 5.5E-10
G 7.8E-10
G 1.4E-09 1.6E-12
G 5.8E-10 8.0E-12
G 5.6E-10 6.9E-12
G 1.6E-10
G 5.7E-10 1.9E-12
G 2.1E-10 1.9E-12
G 1.6E-10 1.9E-12
  2  2  2  2  2  2  2  2  2  2  2
H 3.7E-10 2.9E-12
H 2.1E-10 1.7E-12
H 3.0E-10 2.4E-12
H 3.1E-10 2.1E-12
H 4.6E-10 2.7E-12
H 9.8E-10 1.4E-11
H 8.6E-10 1.2E-11
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8471 84016

5.954

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DOSINC.DAT

```
H 2.1E-10 1.7E-12
H 3.5E-10 3.2E-12
H 2.9E-10 3.2E-12
H 2.9E-10 3.2E-12
! SR91    Class: D F1:   0.30000     12/10/87   17:35:28.6    Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  1  1  1  1  1  1  1  1  1  1  1
G 2.8E-11
G 8.3E-10
G 1.3E-09
G 3.7E-09
G 3.9E-09
G 7.5E-11
G 1.0E-10
G 3.5E-11
G 2.1E-10
G 4.7E-11
G 2.1E-11
  1  1  1  1  1  1  1  1  1  1  1
H 9.0E-10
H 1.5E-10
H 2.2E-10
H 5.7E-10
H 6.0E-10
H 1.1E-10
H 1.1E-10
H 3.4E-11
H 5.9E-11
H 4.0E-11
H 3.6E-11
! Y 91M   Class: Y F1:   0.00010     12/10/87   17:59:54.2    Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1  1  1  1  1  1  1  1
G 1.3E-12
G 5.0E-11
G 3.2E-11
G 3.2E-11
G 2.4E-11
G 9.0E-13
G 2.3E-12
G 3.4E-13
G 7.3E-12
G 1.9E-12
G 1.2E-13
G 2.6E-12
  2  1  1  1  1  1  1  1  1  1  1  1
H 7.0E-11 5.2E-13
H 2.8E-12
H 1.8E-12
H 4.1E-12
H 8.8E-12
```

9 1 0 4 8 1 7 4 9

5.955

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DOSINC.DAT

```
H 6.3E-13
H 8.0E-13
H 3.4E-14
H 3.4E-13
H 6.2E-13
H 5.1E-13
H 1.3E-12
! Y 91     Class: Y F1:   0.00010     12/10/87  18:11:06.3   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1  1  1  1  1  1  1  1
G 2.0E-13
G 6.9E-10
G 1.7E-09
G 1.0E-08
G 3.0E-08
G 6.2E-12
G 6.5E-12
G 4.1E-13
G 3.5E-12
G 5.5E-13
G 1.3E-13
G 6.0E-12
  2  1  1  1  1  1  1  1  1  1  1  1
H 9.8E-08 9.1E-10
H 3.4E-10
H 8.4E-10
H 5.0E-09
H 1.4E-08
H 3.2E-10
H 3.1E-10
H 6.4E-12
H 8.3E-12
H 9.0E-12
H 8.5E-12
H 3.0E-10
! SR92     Class: D F1:   0.30000     12/10/87  18:10:59.8   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  1  1  1  1  1  1  1  1  1  1  1
G 1.7E-11
G 5.2E-10
G 1.0E-09
G 3.0E-09
G 2.2E-09
G 2.4E-11
G 3.5E-11
G 1.7E-11
G 8.1E-11
G 2.6E-11
G 1.2E-11
  1  1  1  1  1  1  1  1  1  1
H 7.1E-10
```

DOSINC.DAT

5.956

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91048 1750

```
H 9.9E-11
H 1.7E-10
H 4.5E-10
H 3.4E-10
H 3.1E-11
H 3.0E-11
H 1.8E-11
H 2.8E-11
H 2.2E-11
H 2.0E-11
! Y 92    Class: Y F1:   0.00010    12/10/87  18:30:26.0   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1  1  1  1  1  1  1  1
G 1.5E-12
G 1.4E-09
G 2.0E-09
G 3.5E-09
G 1.9E-09
G 1.8E-12
G 5.1E-12
G 1.5E-12
G 2.1E-11
G 3.8E-12
G 1.9E-13
G 4.6E-12
  1  1  1  1  1  1  1  1  1  1  1  1
H 1.3E-09
H 1.7E-10
H 2.5E-10
H 4.2E-10
H 2.3E-10
H 1.6E-12
H 2.3E-12
H 3.7E-13
H 2.8E-12
H 1.6E-12
H 1.1E-12
H 2.9E-12
! Y 93    Class: Y F1:   0.00010    12/10/87  18:30:55.9   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1  1  1  1  1  1  1  1
G 8.8E-13
G 1.3E-09
G 2.6E-09
G 8.1E-09
G 9.4E-09
G 1.8E-12
G 5.1E-12
G 1.8E-12
G 2.3E-11
G 3.2E-12
```

5.957

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DOSINC.DAT

9 1 0 4 8 1 7 5 1

DOSINC.DAT

```
G 1.3E-13
G 3.6E-12
  1  1  1  1  1  1  1  1  1  1  1  1
H 2.7E-09
H 3.0E-10
H 5.9E-10
H 1.9E-09
H 2.2E-09
H 3.4E-12
H 4.4E-12
H 6.9E-13
H 5.6E-12
H 1.8E-12
H 9.6E-13
H 4.5E-12
! M093    Class: D F1:   0.80000     12/10/87  19:02:35.1   Acute  Sv/Bq
 13  1  3  4  5  6  7  8 11 12 13 14 17 16
  1  1  1  1  1  2  2  1  1  1  1  2  2
G 1.1E-10
G 7.9E-11
G 7.1E-11
G 9.0E-11
G 1.6E-10
G 1.4E-09 1.1E-11
G 2.9E-10 2.0E-12
G 8.3E-11
G 1.3E-10
G 1.0E-10
G 9.6E-11
G 1.8E-09 1.2E-11
G 1.6E-09 1.1E-11
  1  1  1  1  1  2  2  1  1  1  1  2  2
H 6.4E-11
H 5.3E-11
H 4.9E-11
H 4.8E-11
H 6.3E-11
H 1.1E-09 8.3E-12
H 2.2E-10 1.5E-12
H 6.4E-11
H 9.4E-11
H 7.6E-11
H 7.3E-11
H 1.3E-09 9.4E-12
H 1.2E-09 8.6E-12
! ZR93    Class: W F1:   0.00200     12/10/87  19:26:09.9   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  1  1  1  1  1 50 50  1  1  1  1
G 4.7E-14
G 2.3E-11
G 5.5E-11
```

5.958

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9 1 0 4 8 1 7 5 2

```
G 3.4E-10
G 1.0E-09
G 2.1E-10 2.2E-10 2.2E-10 2.3E-10 2.3E-10 2.3E-10 2.3E-10 2.3E-10 2.3E-10 2.3E-10 2.3E-10 2.3E-10 2.3E-10 2.3E-10 2.2E-10
  2.2E-10 2.2E-10 2.2E-10 2.1E-10 2.1E-10 2.1E-10 2.0E-10 2.0E-10 1.9E-10 1.9E-10 1.9E-10 1.8E-10 1.8E-10 1.7E-10 1.7E-10
  1.7E-10 1.6E-10 1.6E-10 1.5E-10 1.5E-10 1.5E-10 1.4E-10 1.4E-10 1.4E-10 1.3E-10 1.3E-10 1.2E-10 1.2E-10 1.2E-10 1.1E-10
  1.1E-10 1.1E-10 1.1E-10 1.0E-10 1.0E-10
G 1.7E-11 1.7E-11 1.8E-11 1.8E-11 1.8E-11 1.9E-11 1.9E-11 1.9E-11 1.9E-11 1.9E-11 1.9E-11 1.9E-11 1.8E-11 1.8E-11 1.8E-11
  1.8E-11 1.8E-11 1.7E-11 1.7E-11 1.7E-11 1.7E-11 1.6E-11 1.6E-11 1.6E-11 1.5E-11 1.5E-11 1.5E-11 1.4E-11 1.4E-11 1.4E-11
  1.3E-11 1.3E-11 1.3E-11 1.3E-11 1.2E-11 1.2E-11 1.2E-11 1.1E-11 1.1E-11 1.1E-11 1.0E-11 1.0E-11 9.9E-12 9.6E-12 9.3E-12
  9.1E-12 8.8E-12 8.6E-12 8.3E-12 8.1E-12
G 4.6E-14
G 4.7E-14
G 4.6E-14
G 4.6E-14
  2  1  1  1  1 50 50  1  1  1  1
H 3.3E-09 3.1E-11
H 1.3E-11
H 3.0E-11
H 1.7E-10
H 5.2E-10
H 1.1E-08 1.3E-08 1.3E-08 1.4E-08 1.4E-08 1.4E-08 1.4E-08 1.4E-08 1.4E-08 1.4E-08 1.4E-08 1.4E-08 1.4E-08 1.4E-08 1.4E-08
  1.3E-08 1.3E-08 1.3E-08 1.3E-08 1.3E-08 1.2E-08 1.2E-08 1.2E-08 1.2E-08 1.2E-08 1.1E-08 1.1E-08 1.1E-08 1.1E-08 1.0E-08
  1.0E-08 9.8E-09 9.6E-09 9.4E-09 9.1E-09 8.9E-09 8.7E-09 8.4E-09 8.2E-09 8.0E-09 7.8E-09 7.6E-09 7.4E-09 7.2E-09 7.0E-09
  6.8E-09 6.6E-09 6.4E-09 6.2E-09 6.1E-09
H 9.2E-10 1.0E-09 1.1E-09 1.1E-09 1.1E-09 1.1E-09 1.1E-09 1.1E-09 1.1E-09 1.1E-09 1.1E-09 1.1E-09 1.1E-09 1.1E-09 1.1E-09
  1.1E-09 1.1E-09 1.1E-09 1.0E-09 1.0E-09 1.0E-09 9.9E-10 9.7E-10 9.5E-10 9.3E-10 9.1E-10 9.0E-10 8.8E-10 8.6E-10 8.4E-10
  8.2E-10 8.0E-10 7.8E-10 7.6E-10 7.4E-10 7.2E-10 7.0E-10 6.9E-10 6.7E-10 6.5E-10 6.3E-10 6.2E-10 6.0E-10 5.8E-10 5.7E-10
  5.5E-10 5.4E-10 5.2E-10 5.1E-10 4.9E-10
H 2.8E-12
H 2.8E-12
H 2.9E-12
H 2.8E-12
! NB93M   Class: Y F1:   0.01000     12/10/87  19:41:13.4   Acute  Sv/Bq
 13  1  3  4  5  6  7  8 11 12 13 14 16 19
  1  1  1  1  1  3  2  1  1  1  1  3  3
G 1.9E-12
G 3.5E-11
G 8.8E-11
G 4.9E-10
G 1.5E-09
G 4.4E-11 1.1E-11 3.1E-12
G 1.7E-11 4.4E-12
G 1.8E-12
G 5.2E-12
G 2.0E-12
G 1.9E-12
G 2.5E-11 6.6E-12 1.8E-12
G 2.5E-11 6.5E-12 1.7E-12
 50  1  1  1  3  6  1  1  1  1  3  3
H 1.9E-08 1.2E-08 8.4E-09 5.8E-09 4.1E-09 3.0E-09 2.2E-09 1.7E-09 1.3E-09 1.0E-09 8.2E-10 6.7E-10 5.7E-10 4.8E-10 4.2E-10
  3.7E-10 3.3E-10 3.0E-10 2.8E-10 2.6E-10 2.4E-10 2.2E-10 2.1E-10 2.0E-10 1.8E-10 1.7E-10 1.7E-10 1.6E-10 1.5E-10 1.4E-10
```

DOSINC.DAT

5.959

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91048 1753

DOSINC.DAT

5.960

9/30/88

9104817154

```
 1.3E-10 1.3E-10 1.2E-10 1.2E-10 1.1E-10 1.1E-10 1.0E-10 9.6E-11 9.2E-11 8.7E-11 8.3E-11 7.9E-11 7.6E-11 7.2E-11 6.9E-11
 6.6E-11 6.3E-11 6.0E-11 5.7E-11 5.4E-11
H 2.1E-11
H 4.6E-11
H 2.5E-10
H 7.8E-10 3.5E-11 2.0E-11
H 5.6E-11 4.5E-11 3.8E-11 3.2E-11 2.6E-11 2.0E-11
H 2.4E-11
H 2.4E-12
H 4.2E-12
H 1.2E-11
H 2.4E-12
H 3.3E-11 2.5E-11 2.1E-11
H 3.5E-11 2.7E-11 2.2E-11
! ZR97    Class: W F1:   0.00200     12/10/87  19:50:37.7   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  1  1  1  1  1  1  1  1  1  1  1
G 1.8E-11
G 1.2E-09
G 3.4E-09
G 1.2E-08
G 1.8E-08
G 4.6E-11
G 1.3E-10
G 5.2E-11
G 6.2E-10
G 8.1E-11
G 2.7E-12
  1  1  1  1  1  1  1  1  1  1  1
H 4.0E-09
H 4.1E-10
H 8.6E-10
H 3.0E-09
H 4.3E-09
H 1.3E-10
H 1.5E-10
H 3.0E-11
H 1.7E-10
H 5.9E-11
H 3.8E-11
! NB97M   Class: Y F1:   0.01000     12/10/87  20:16:06.4   Acute  Sv/Bq
 13  1  3  4  5  6  7  8 11 12 13 14 16 19
  1  1  1  1  1  1  1  1  1  1  1  1  1
G 8.9E-14
G 7.3E-12
G 4.3E-12
G 3.3E-12
G 7.4E-13
G 4.4E-14
G 9.6E-14
G 1.5E-14
```

```
G 2.4E-13
G 9.5E-14
G 8.6E-15
G 2.1E-13
G 4.6E-13
  1  1  1  1  1  1  1  1  1  1  1  1  1
H 2.4E-12
H 3.0E-13
H 2.1E-13
H 1.7E-13
H 3.6E-14
H 2.3E-14
H 3.1E-14
H 1.6E-15
H 1.4E-14
H 3.1E-14
H 2.8E-14
H 2.8E-14
H 5.4E-14
! NB97    Class: Y F1:   0.01000     12/10/87  20:27:18.9   Acute  Sv/Bq
 13  1  3  4  5  6  7  8 11 12 13 14 16 19
  1  1  1  1  1  1  1  1  1  1  1  1  1
G 2.0E-12
G 3.8E-10
G 3.1E-10
G 2.4E-10
G 5.3E-11
G 1.6E-12
G 4.4E-12
G 8.2E-13
G 1.5E-11
G 3.4E-12
G 2.2E-13
G 7.1E-12
G 1.0E-11
  1  1  1  1  1  1  1  1  1  1  1  1  1
H 1.6E-10
H 2.1E-11
H 1.6E-11
H 1.3E-11
H 2.8E-12
H 8.6E-13
H 1.2E-12
H 9.5E-14
H 9.2E-13
H 1.2E-12
H 9.5E-13
H 1.2E-12
H 2.1E-12
! NB94    Class: Y F1:   0.01000     12/10/87  20:32:44.9   Acute  Sv/Bq
 13  1  3  4  5  6  7  8 11 12 13 14 16 19
```

DOSINC.DAT

5.962

```
  2  2  2  2  2  3  3  2  2  2  2  3  3
G 1.3E-10 2.7E-11
G 7.3E-10 2.2E-11
G 2.2E-09 2.6E-11
G 5.2E-09 2.3E-11
G 1.3E-08 2.8E-11
G 5.8E-10 1.3E-10 3.6E-11
G 6.3E-10 7.9E-11 2.2E-11
G 2.4E-10 2.3E-11
G 1.8E-09 2.6E-11
G 3.1E-10 2.9E-11
G 8.9E-11 2.3E-11
G 5.7E-10 9.3E-11 2.6E-11
G 5.0E-10 8.9E-11 2.5E-11
 50 50  8  9  6 16 18  2  6 19 19 16 50
H 1.5E-07 1.1E-07 7.6E-08 5.5E-08 4.1E-08 3.1E-08 2.4E-08 1.9E-08 1.5E-08 1.3E-08 1.1E-08 9.3E-09 8.2E-09 7.4E-09 6.7E-09
  6.2E-09 5.8E-09 5.5E-09 5.3E-09 5.1E-09 5.0E-09 4.9E-09 4.8E-09 4.8E-09 4.7E-09 4.7E-09 4.6E-09 4.6E-09 4.6E-09 4.6E-09
  4.6E-09 4.6E-09 4.6E-09 4.6E-09 4.6E-09 4.6E-09 4.6E-09 4.6E-09 4.5E-09 4.5E-09 4.5E-09 4.5E-09 4.5E-09 4.5E-09 4.5E-09
  4.5E-09 4.5E-09 4.5E-09 4.5E-09 4.5E-09
H 6.8E-09 4.5E-09 3.2E-09 2.4E-09 1.8E-09 1.3E-09 1.0E-09 8.3E-10 6.7E-10 5.5E-10 4.7E-10 4.0E-10 3.5E-10 3.1E-10 2.9E-10
  2.6E-10 2.5E-10 2.3E-10 2.2E-10 2.2E-10 2.1E-10 2.1E-10 2.0E-10 2.0E-10 2.0E-10 2.0E-10 1.9E-10 1.9E-10 1.9E-10 1.9E-10
  1.9E-10 1.9E-10 1.9E-10 1.9E-10 1.9E-10 1.9E-10 1.9E-10 1.9E-10 1.9E-10 1.9E-10 1.9E-10 1.9E-10 1.9E-10 1.9E-10 1.9E-10
  1.9E-10 1.9E-10 1.9E-10 1.9E-10 1.9E-10
H 2.2E-09 8.6E-10 6.2E-10 4.6E-10 3.5E-10 2.7E-10 2.1E-10 1.7E-10
H 4.1E-09 1.1E-09 8.1E-10 5.9E-10 4.4E-10 3.4E-10 2.6E-10 2.1E-10 1.6E-10
H 6.8E-09 6.2E-10 4.3E-10 3.0E-10 2.2E-10 1.6E-10
H 4.0E-09 2.8E-09 2.1E-09 1.6E-09 1.2E-09 9.5E-10 7.5E-10 5.9E-10 4.8E-10 3.9E-10 3.2E-10 2.7E-10 2.3E-10 2.0E-10 1.8E-10
  1.6E-10
H 4.7E-09 3.2E-09 2.3E-09 1.7E-09 1.3E-09 1.0E-09 7.9E-10 6.3E-10 5.1E-10 4.2E-10 3.5E-10 3.0E-10 2.6E-10 2.3E-10 2.0E-10
  1.8E-10 1.7E-10 1.6E-10
H 3.0E-10 1.7E-10
H 1.5E-09 5.3E-10 3.9E-10 2.9E-10 2.2E-10 1.7E-10
H 4.7E-09 3.2E-09 2.3E-09 1.7E-09 1.3E-09 9.7E-10 7.5E-10 6.0E-10 4.8E-10 4.0E-10 3.4E-10 2.9E-10 2.5E-10 2.2E-10 2.0E-10
  1.9E-10 1.7E-10 1.7E-10 1.6E-10
H 4.6E-09 3.2E-09 2.3E-09 1.7E-09 1.2E-09 9.5E-10 7.4E-10 5.9E-10 4.8E-10 3.9E-10 3.3E-10 2.8E-10 2.5E-10 2.2E-10 2.0E-10
  1.9E-10 1.7E-10 1.6E-10 1.6E-10
H 3.9E-09 2.7E-09 2.0E-09 1.5E-09 1.1E-09 8.8E-10 6.9E-10 5.5E-10 4.5E-10 3.7E-10 3.0E-10 2.6E-10 2.2E-10 1.9E-10 1.7E-10
  1.6E-10
H 7.5E-09 5.2E-09 3.8E-09 2.8E-09 2.1E-09 1.6E-09 1.3E-09 1.0E-09 8.1E-10 6.7E-10 5.6E-10 4.8E-10 4.2E-10 3.7E-10 3.3E-10
  3.0E-10 2.8E-10 2.7E-10 2.5E-10 2.4E-10 2.3E-10 2.3E-10 2.2E-10 2.2E-10 2.2E-10 2.2E-10 2.1E-10 2.1E-10 2.1E-10 2.1E-10
  2.1E-10 2.1E-10 2.1E-10 2.1E-10 2.1E-10 2.1E-10 2.1E-10 2.1E-10 2.1E-10 2.1E-10 2.1E-10 2.1E-10 2.1E-10 2.1E-10 2.1E-10
  2.1E-10 2.1E-10 2.1E-10 2.1E-10 2.1E-10
! M099    Class: D F1:   0.80000     12/10/87  20:42:21.8   Acute  Sv/Bq
 13  1  3  4  5  6  7  8 11 12 13 14 17 16
  1  1  1  1  1  1  1  1  1  1  1  1  1
G 2.0E-10
G 6.0E-10
G 3.9E-10
G 1.4E-09
G 3.1E-09
G 9.3E-10
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9 1 0 4 8 1 7 5 6

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G 5.9E-10
G 1.7E-10
G 2.2E-10
G 1.9E-10
G 1.7E-10
G 2.7E-09
G 2.5E-09
  1  1  1  1  1  1  1  1  1  1  1  1  1
H 1.1E-09
H 1.7E-10
H 1.3E-10
H 2.8E-10
H 5.4E-10
H 6.6E-10
H 4.1E-10
H 1.2E-10
H 1.3E-10
H 1.3E-10
H 1.2E-10
H 1.9E-09
H 1.8E-09
! TC99M   Class: W F1:   0.80000      12/10/87  21:06:11.0   Acute  Sv/Bq
 13  1  3  4  5  6  7  8 11 12 13 14 22 16
  1  1  1  1  1  1  1  1  1  1  1  1  1
G 3.4E-12
G 7.3E-11
G 2.3E-11
G 3.8E-11
G 2.7E-11
G 2.8E-12
G 6.4E-12
G 2.4E-12
G 1.0E-11
G 3.9E-12
G 8.7E-11
G 7.3E-11
G 2.3E-11
  1  1  1  1  1  1  1  1  1  1  1  1  1
H 3.1E-11
H 1.6E-11
H 3.7E-12
H 5.8E-12
H 4.1E-12
H 1.5E-12
H 2.5E-12
H 5.7E-13
H 1.8E-12
H 1.6E-12
H 2.2E-11
H 1.6E-11
H 5.8E-12
```

5.963

9/30/88

9104817557

```
! TC101   Class: W F1:   0.80000    12/10/87  21:18:07.7   Acute  Sv/Bq
 13  1  3  4  5  6  7  8 11 12 13 14 22 16
  1  1  1  1  1  1  1  1  1  1  1  1  1
G 4.4E-13
G 1.5E-10
G 2.4E-11
G 5.2E-12
G 7.7E-13
G 2.7E-13
G 5.0E-13
G 1.3E-13
G 6.5E-13
G 4.2E-13
G 4.4E-12
G 1.5E-10
G 1.5E-12
  1  1  1  1  1  1  1  1  1  1  1  1  1
H 3.1E-11
H 2.4E-12
H 2.7E-13
H 1.1E-13
H 5.6E-14
H 1.4E-13
H 1.9E-13
H 6.3E-14
H 7.8E-14
H 1.6E-13
H 2.5E-12
H 2.4E-12
H 4.9E-13
! RU105   Class: Y F1:   0.05000    12/10/87  21:24:02.2   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  1  1  1  1  1  1  1  1  1  1  1
G 6.7E-12
G 6.0E-10
G 9.7E-10
G 1.9E-09
G 1.6E-09
G 9.0E-12
G 2.6E-11
G 8.2E-12
G 1.1E-10
G 1.7E-11
G 2.1E-12
  1  1  1  1  1  1  1  1  1  1  1
H 7.0E-10
H 9.8E-11
H 1.5E-10
H 3.3E-10
H 3.4E-10
H 4.9E-12
```

5.964

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DOSINC.DAT

9 1 0 4 8 1 7 5 8

```
H 8.5E-12
H 1.7E-12
H 1.8E-11
H 7.2E-12
H 4.4E-12
! RH105   Class: Y F1:   0.05000     12/10/87  21:35:21.1   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  1  1  1  1  1  1  1  1  1  1  1
G 4.0E-12
G 1.9E-10
G 4.4E-10
G 1.9E-09
G 3.9E-09
G 5.4E-12
G 1.5E-11
G 7.5E-12
G 5.9E-11
G 9.2E-12
G 3.1E-12
  1  1  1  1  1  1  1  1  1  1  1
H 1.0E-09
H 7.3E-11
H 1.6E-10
H 6.8E-10
H 1.4E-09
H 3.9E-12
H 7.8E-12
H 3.0E-12
H 2.2E-11
H 5.8E-12
H 3.1E-12
! PD107   Class: Y F1:   0.00500     12/10/87  21:41:37.2   Acute  Sv/Bq
 13  1  3  4  5  6  7  8 11 12 13 14 17 16
  1  1  1  1  1  1  1  1  1  1  1  1  1
G 1.0E-14
G 1.1E-11
G 2.8E-11
G 1.6E-10
G 4.7E-10
G 1.5E-13
G 5.7E-14
G 1.0E-14
G 1.0E-14
G 1.0E-14
G 1.0E-14
G 3.5E-12
G 6.7E-12
 50  1  1  1  3  1  1  1  1  1  1  1  5
H 5.9E-09 4.1E-09 2.9E-09 2.1E-09 1.6E-09 1.2E-09 9.3E-10 7.4E-10 6.0E-10 4.9E-10 4.2E-10 3.6E-10 3.2E-10 2.8E-10 2.6E-10
  2.4E-10 2.3E-10 2.1E-10 2.1E-10 2.0E-10 1.9E-10 1.9E-10 1.9E-10 1.8E-10 1.8E-10 1.8E-10 1.8E-10 1.8E-10 1.8E-10 1.8E-10
  1.8E-10 1.8E-10 1.8E-10 1.8E-10 1.8E-10 1.8E-10 1.8E-10 1.8E-10 1.8E-10 1.8E-10 1.8E-10 1.8E-10 1.8E-10 1.8E-10 1.8E-10
```

DOSINC.DAT

5.965

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9 1 0 4 8 1 7 5 9

DOSINC.DAT

```
  1.8E-10 1.8E-10 1.8E-10 1.8E-10 1.8E-10
H 5.7E-12
H 1.4E-11
H 8.1E-11
H 2.4E-10 1.1E-11 6.8E-12
H 3.7E-13
H 1.4E-13
H 2.7E-14
H 2.6E-14
H 2.6E-14
H 2.6E-14
H 8.9E-12
H 1.7E-11 9.1E-12 8.3E-12 7.2E-12 6.0E-12
! PD109   Class: Y F1:   0.00500     12/10/87  21:49:16.6   Acute  Sv/Bq
 13  1  3  4  5  6  7  8 11 12 13 14 17 16
  1  1  1  1  1  1  1  1  1  1  1  1  1
G 2.2E-13
G 5.7E-10
G 1.2E-09
G 4.3E-09
G 5.7E-09
G 1.3E-12
G 3.9E-12
G 3.6E-13
G 1.6E-11
G 1.2E-12
G 1.2E-13
G 4.9E-12
G 8.6E-12
  1  1  1  1  1  1  1  1  1  1  1  1  1
H 1.5E-09
H 1.5E-10
H 3.1E-10
H 1.1E-09
H 1.5E-09
H 1.0E-12
H 1.6E-12
H 2.0E-13
H 4.3E-12
H 9.5E-13
H 2.2E-13
H 5.9E-12
H 9.7E-12
! AG110M  Class: D F1:   0.05000     12/10/87  21:56:18.2   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1  1  1  1  1  1  1  1
G 9.7E-10
G 2.9E-09
G 6.7E-09
G 2.5E-08
G 6.7E-08
```

5.966

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0 9 7 1 8 4 0 1 6

```
G 5.2E-10
G 1.0E-09
G 5.8E-10
G 3.2E-09
G 8.8E-10
G 3.3E-10
G 2.8E-08
  1  1  1  1  1  1  1  1  1  1  1  2
H 1.1E-08
H 7.5E-09
H 7.2E-09
H 1.2E-08
H 1.3E-08
H 3.3E-09
H 4.9E-09
H 3.3E-09
H 4.5E-09
H 5.5E-09
H 3.1E-09
H 2.7E-07 6.2E-10
! AG111   Class: D F1:   0.05000     12/10/87  22:04:12.0   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1  1  1  1  1  1  1  1
G 9.2E-12
G 4.2E-10
G 9.9E-10
G 5.4E-09
G 1.5E-08
G 7.2E-12
G 1.5E-11
G 1.0E-11
G 3.6E-11
G 1.1E-11
G 7.8E-12
G 9.6E-10
  1  1  1  1  1  1  1  1  1  1  1  1
H 1.0E-09
H 1.2E-10
H 2.0E-10
H 8.8E-10
H 2.3E-09
H 5.1E-11
H 9.0E-11
H 7.5E-11
H 8.0E-11
H 7.9E-11
H 7.5E-11
H 9.0E-09
! CD109   Class: D F1:   0.05000     12/10/87  22:11:45.4   Acute  Sv/Bq
 13  1  3  4  5  6  7  8 11 12 13 14 17 16
  4  3  3  3  3  3  4  4  4  4  4 10 13
```

DOSINC.DAT

5.967

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9 1 0 4 8 1 7 6 1

```
G 1.4E-10 7.9E-11 4.4E-11 2.5E-11
G 2.0E-10 5.0E-11 2.8E-11
G 3.9E-10 4.6E-11 2.6E-11
G 1.6E-09 4.2E-11 2.4E-11
G 4.4E-09 4.5E-11 2.5E-11
G 6.7E-11 3.6E-11 2.0E-11
G 1.5E-10 7.6E-11 4.3E-11 2.4E-11
G 1.1E-10 6.4E-11 3.6E-11 2.0E-11
G 1.9E-10 6.8E-11 3.8E-11 2.2E-11
G 1.4E-10 7.9E-11 4.5E-11 2.5E-11
G 1.2E-10 6.9E-11 3.9E-11 2.2E-11
G 3.2E-09 1.8E-09 1.0E-09 5.8E-10 3.3E-10 1.9E-10 1.0E-10 5.9E-11 3.3E-11 1.9E-11
G 1.8E-08 1.0E-08 5.7E-09 3.2E-09 1.8E-09 1.0E-09 5.8E-10 3.2E-10 1.8E-10 1.0E-10 5.8E-11 3.3E-11 1.9E-11
  2  3  3  3  3  3  4  4  4  4  4 10 13
H 6.0E-10 1.8E-10
H 8.9E-10 4.9E-10 2.8E-10
H 8.5E-10 4.5E-10 2.6E-10
H 9.7E-10 4.2E-10 2.3E-10
H 1.4E-09 4.4E-10 2.5E-10
H 6.2E-10 3.5E-10 2.0E-10
H 1.3E-09 7.4E-10 4.2E-10 2.4E-10
H 1.1E-09 6.3E-10 3.5E-10 2.0E-10
H 1.2E-09 6.7E-10 3.8E-10 2.1E-10
H 1.4E-09 7.7E-10 4.4E-10 2.5E-10
H 1.2E-09 6.8E-10 3.8E-10 2.1E-10
H 3.1E-08 1.8E-08 1.0E-08 5.6E-09 3.2E-09 1.8E-09 1.0E-09 5.7E-10 3.2E-10 1.8E-10
H 1.7E-07 9.8E-08 5.5E-08 3.1E-08 1.8E-08 9.9E-09 5.6E-09 3.1E-09 1.8E-09 1.0E-09 5.6E-10 3.2E-10 1.8E-10
! CD113M  Class: D F1:   0.05000     12/10/87  22:19:43.6   Acute  Sv/Bq
 13  1  3  4  5  6  7  8 11 12 13 14 17 16
 23 16 16 14 16 15 23 24 24 24 24 50 50
G 2.7E-10 2.5E-10 2.3E-10 2.1E-10 1.9E-10 1.8E-10 1.7E-10 1.5E-10 1.4E-10 1.3E-10 1.2E-10 1.1E-10 1.0E-10 9.5E-11 8.8E-11
  8.1E-11 7.5E-11 7.0E-11 6.4E-11 5.9E-11 5.5E-11 5.1E-11 4.7E-11
G 3.6E-10 1.4E-10 1.3E-10 1.2E-10 1.1E-10 1.0E-10 9.4E-11 8.7E-11 8.0E-11 7.4E-11 6.9E-11 6.4E-11 5.9E-11 5.4E-11 5.0E-11
  4.6E-11
G 6.6E-10 1.4E-10 1.3E-10 1.2E-10 1.1E-10 1.0E-10 9.5E-11 8.8E-11 8.1E-11 7.5E-11 6.9E-11 6.4E-11 5.9E-11 5.5E-11 5.0E-11
  4.7E-11
G 3.1E-09 1.2E-10 1.1E-10 1.0E-10 9.5E-11 8.8E-11 8.1E-11 7.5E-11 6.9E-11 6.4E-11 5.9E-11 5.5E-11 5.1E-11 4.7E-11
G 9.2E-09 1.4E-10 1.3E-10 1.2E-10 1.1E-10 1.0E-10 9.3E-11 8.6E-11 8.0E-11 7.4E-11 6.8E-11 6.3E-11 5.8E-11 5.4E-11 5.0E-11
  4.6E-11
G 1.4E-10 1.3E-10 1.2E-10 1.1E-10 9.9E-11 9.1E-11 8.4E-11 7.8E-11 7.2E-11 6.7E-11 6.2E-11 5.7E-11 5.3E-11 4.9E-11 4.5E-11

G 2.6E-10 2.4E-10 2.2E-10 2.1E-10 1.9E-10 1.8E-10 1.6E-10 1.5E-10 1.4E-10 1.3E-10 1.2E-10 1.1E-10 1.0E-10 9.4E-11 8.7E-11
  8.0E-11 7.4E-11 6.9E-11 6.4E-11 5.9E-11 5.4E-11 5.0E-11 4.6E-11
G 2.7E-10 2.5E-10 2.3E-10 2.1E-10 2.0E-10 1.8E-10 1.7E-10 1.6E-10 1.4E-10 1.3E-10 1.2E-10 1.1E-10 1.0E-10 9.7E-11 9.0E-11
  8.3E-11 7.7E-11 7.1E-11 6.5E-11 6.0E-11 5.6E-11 5.2E-11 4.8E-11 4.4E-11
G 2.7E-10 2.5E-10 2.3E-10 2.1E-10 2.0E-10 1.8E-10 1.7E-10 1.6E-10 1.4E-10 1.3E-10 1.2E-10 1.1E-10 1.1E-10 9.8E-11 9.0E-11
  8.4E-11 7.7E-11 7.1E-11 6.6E-11 6.1E-11 5.6E-11 5.2E-11 4.8E-11 4.5E-11
G 2.7E-10 2.5E-10 2.3E-10 2.1E-10 2.0E-10 1.8E-10 1.7E-10 1.5E-10 1.4E-10 1.3E-10 1.2E-10 1.1E-10 1.0E-10 9.7E-11 8.9E-11
  8.3E-11 7.6E-11 7.1E-11 6.5E-11 6.0E-11 5.6E-11 5.1E-11 4.8E-11 4.4E-11
G 2.7E-10 2.5E-10 2.3E-10 2.1E-10 2.0E-10 1.8E-10 1.7E-10 1.6E-10 1.4E-10 1.3E-10 1.2E-10 1.1E-10 1.1E-10 9.7E-11 9.0E-11
  8.3E-11 7.7E-11 7.1E-11 6.6E-11 6.1E-11 5.6E-11 5.2E-11 4.8E-11 4.4E-11
```

```
G 7.3E-09 6.7E-09 6.2E-09 5.8E-09 5.3E-09 4.9E-09 4.6E-09 4.2E-09 3.9E-09 3.6E-09 3.3E-09 3.1E-09 2.8E-09 2.6E-09 2.4E-09
  2.2E-09 2.1E-09 1.9E-09 1.8E-09 1.6E-09 1.5E-09 1.4E-09 1.3E-09 1.2E-09 1.1E-09 1.0E-09 9.4E-10 8.7E-10 8.1E-10 7.4E-10
  6.9E-10 6.4E-10 5.9E-10 5.4E-10 5.0E-10 4.6E-10 4.3E-10 4.0E-10 3.7E-10 3.4E-10 3.1E-10 2.9E-10 2.7E-10 2.5E-10 2.3E-10
  2.1E-10 2.0E-10 1.8E-10 1.7E-10 1.5E-10
G 4.4E-08 4.0E-08 3.7E-08 3.5E-08 3.2E-08 3.0E-08 2.7E-08 2.5E-08 2.3E-08 2.2E-08 2.0E-08 1.8E-08 1.7E-08 1.6E-08 1.5E-08
  1.3E-08 1.2E-08 1.1E-08 1.1E-08 9.8E-09 9.1E-09 8.4E-09 7.7E-09 7.2E-09 6.6E-09 6.1E-09 5.7E-09 5.2E-09 4.8E-09 4.5E-09
  4.1E-09 3.8E-09 3.5E-09 3.3E-09 3.0E-09 2.8E-09 2.6E-09 2.4E-09 2.2E-09 2.0E-09 1.9E-09 1.7E-09 1.6E-09 1.5E-09 1.4E-09
  1.3E-09 1.2E-09 1.1E-09 1.0E-09 9.3E-10
  1 16 17 15 16 15 23 24 24 24 24 50 50
H 5.8E-10
H 1.5E-09 1.4E-09 1.3E-09 1.2E-09 1.1E-09 1.0E-09 9.2E-10 8.5E-10 7.9E-10 7.3E-10 6.7E-10 6.2E-10 5.8E-10 5.3E-10 4.9E-10
  4.6E-10
H 1.6E-09 1.4E-09 1.3E-09 1.2E-09 1.1E-09 1.0E-09 9.3E-10 8.6E-10 7.9E-10 7.3E-10 6.8E-10 6.3E-10 5.8E-10 5.4E-10 5.0E-10
  4.6E-10 4.2E-10
H 1.7E-09 1.2E-09 1.1E-09 1.0E-09 9.3E-10 8.6E-10 8.0E-10 7.4E-10 6.8E-10 6.3E-10 5.8E-10 5.4E-10 5.0E-10 4.6E-10 4.2E-10

H 2.9E-09 1.4E-09 1.3E-09 1.2E-09 1.1E-09 9.9E-10 9.2E-10 8.5E-10 7.8E-10 7.2E-10 6.7E-10 6.2E-10 5.7E-10 5.3E-10 4.9E-10
  4.5E-10
H 1.3E-09 1.2E-09 1.1E-09 1.0E-09 9.7E-10 9.0E-10 8.3E-10 7.7E-10 7.1E-10 6.5E-10 6.0E-10 5.6E-10 5.2E-10 4.8E-10 4.4E-10

H 2.6E-09 2.4E-09 2.2E-09 2.0E-09 1.9E-09 1.7E-09 1.6E-09 1.5E-09 1.4E-09 1.3E-09 1.2E-09 1.1E-09 1.0E-09 9.2E-10 8.5E-10
  7.9E-10 7.3E-10 6.7E-10 6.2E-10 5.8E-10 5.3E-10 4.9E-10 4.6E-10
H 2.6E-09 2.4E-09 2.3E-09 2.1E-09 1.9E-09 1.8E-09 1.7E-09 1.5E-09 1.4E-09 1.3E-09 1.2E-09 1.1E-09 1.0E-09 9.5E-10 8.8E-10
  8.1E-10 7.5E-10 7.0E-10 6.4E-10 5.9E-10 5.5E-10 5.1E-10 4.7E-10 4.3E-10
H 2.7E-09 2.5E-09 2.3E-09 2.1E-09 1.9E-09 1.8E-09 1.7E-09 1.5E-09 1.4E-09 1.3E-09 1.2E-09 1.1E-09 1.0E-09 9.6E-10 8.9E-10
  8.2E-10 7.6E-10 7.0E-10 6.5E-10 6.0E-10 5.5E-10 5.1E-10 4.7E-10 4.4E-10
H 2.6E-09 2.4E-09 2.3E-09 2.1E-09 1.9E-09 1.8E-09 1.6E-09 1.5E-09 1.4E-09 1.3E-09 1.2E-09 1.1E-09 1.0E-09 9.5E-10 8.8E-10
  8.1E-10 7.5E-10 6.9E-10 6.4E-10 5.9E-10 5.5E-10 5.1E-10 4.7E-10 4.3E-10
H 2.7E-09 2.5E-09 2.3E-09 2.1E-09 1.9E-09 1.8E-09 1.7E-09 1.5E-09 1.4E-09 1.3E-09 1.2E-09 1.1E-09 1.0E-09 9.6E-10 8.8E-10
  8.2E-10 7.5E-10 7.0E-10 6.4E-10 6.0E-10 5.5E-10 5.1E-10 4.7E-10 4.3E-10
H 7.0E-08 6.5E-08 6.0E-08 5.6E-08 5.2E-08 4.8E-08 4.4E-08 4.1E-08 3.8E-08 3.5E-08 3.2E-08 3.0E-08 2.7E-08 2.5E-08 2.3E-08
  2.2E-08 2.0E-08 1.9E-08 1.7E-08 1.6E-08 1.5E-08 1.4E-08 1.2E-08 1.2E-08 1.1E-08 9.9E-09 9.1E-09 8.4E-09 7.8E-09 7.2E-09
  6.7E-09 6.2E-09 5.7E-09 5.3E-09 4.9E-09 4.5E-09 4.2E-09 3.8E-09 3.5E-09 3.3E-09 3.0E-09 2.8E-09 2.6E-09 2.4E-09 2.2E-09
  2.0E-09 1.9E-09 1.7E-09 1.6E-09 1.5E-09
H 4.2E-07 3.9E-07 3.6E-07 3.3E-07 3.1E-07 2.9E-07 2.6E-07 2.4E-07 2.3E-07 2.1E-07 1.9E-07 1.8E-07 1.6E-07 1.5E-07 1.4E-07
  1.3E-07 1.2E-07 1.1E-07 1.0E-07 9.5E-08 8.8E-08 8.1E-08 7.5E-08 6.9E-08 6.4E-08 5.9E-08 5.5E-08 5.1E-08 4.7E-08 4.3E-08
  4.0E-08 3.7E-08 3.4E-08 3.2E-08 2.9E-08 2.7E-08 2.5E-08 2.3E-08 2.1E-08 2.0E-08 1.8E-08 1.7E-08 1.6E-08 1.4E-08 1.3E-08
  1.2E-08 1.1E-08 1.0E-08 9.7E-09 9.0E-09
! CD115M  Class: D F1:   0.05000    12/10/87  22:26:54.2   Acute  Sv/Bq
 13  1  3  4  5  6  7  8 11 12 13 14 17 16
  1  1  1  1  1  1  1  1  1  1  1  1  2
G 1.7E-10
G 8.0E-10
G 1.8E-09
G 1.0E-08
G 2.8E-08
G 8.5E-11
G 1.7E-10
G 1.7E-10
G 1.9E-10
G 1.7E-10
```

9 1 0 4 8 1 7 6 3

5.969

9/30/88

DOSINC.DAT

```
G 1.6E-10
G 4.5E-09
G 2.6E-08 8.9E-11
  1  1  1  1  1  1  1  1  1  1  1  1  2
H 1.9E-09
H 1.1E-09
H 1.2E-09
H 2.4E-09
H 5.3E-09
H 8.2E-10
H 1.6E-09
H 1.6E-09
H 1.6E-09
H 1.6E-09
H 1.6E-09
H 4.3E-08
H 2.5E-07 8.6E-10
! CD115    Class: D F1:    0.05000     12/10/87  22:48:34.7   Acute  Sv/Bq
 13  1  3  4  5  6  7  8 11 12 13 14 17 16
  1  1  1  1  1  1  1  1  1  1  1  1  1
G 1.7E-11
G 4.6E-10
G 1.3E-09
G 6.3E-09
G 1.5E-08
G 3.0E-11
G 7.5E-11
G 3.6E-11
G 3.2E-10
G 4.5E-11
G 9.7E-12
G 2.1E-10
G 9.8E-10
  1  1  1  1  1  1  1  1  1  1  1  1  1
H 1.1E-09
H 1.7E-10
H 2.9E-10
H 1.1E-09
H 2.4E-09
H 9.0E-11
H 1.2E-10
H 9.2E-11
H 1.4E-10
H 1.1E-10
H 8.7E-11
H 1.7E-09
H 8.6E-09
! IN115M  Class: D F1:    0.02000     12/10/87  23:02:05.5   Acute  Sv/Bq
 14  1  3  4  5  6  7  8 11 12 13 14 17 16 19
  1  1  1  1  1  1  1  1  1  1  1  1  1  1
G 1.0E-12
```

5.970

9/30/88

DOSINC.DAT

91048 1764

G 2.0E-10
G 3.1E-10
G 5.8E-10
G 3.6E-10
G 2.0E-12
G 5.7E-12
G 1.2E-12
G 2.2E-11
G 3.2E-12
G 1.6E-13
G 4.2E-12
G 6.1E-12
G 5.3E-12
1 1 1 1 1 1 1 1 1 1 1 1 1
H 1.3E-10
H 3.1E-11
H 4.7E-11
H 8.5E-11
H 5.4E-11
H 6.5E-12
H 5.1E-12
H 2.2E-12
H 5.4E-12
H 3.2E-12
H 2.5E-12
H 1.4E-11
H 2.2E-11
H 8.5E-12
! IN111 Class: D F1: 0.02000 12/10/87 23:07:48.5 Acute Sv/Bq
14 1 3 4 5 6 7 8 11 12 13 14 17 16 19
1 1 1 1 1 1 1 1 1 1 1 1 1
G 7.3E-12
G 1.6E-10
G 4.9E-10
G 1.1E-09
G 2.0E-09
G 3.5E-11
G 9.9E-11
G 3.0E-11
G 4.2E-10
G 4.2E-11
G 1.2E-12
G 4.7E-11
G 6.7E-11
G 4.1E-11
1 1 1 1 1 1 1 1 1 1 1 1 1
H 1.9E-10
H 6.6E-11
H 1.1E-10
H 2.0E-10
H 3.3E-10

9 1 0 4 8 1 7 6 5
5.971
9/30/88
DOSINC.DAT

DOSINC.DAT

```
H 1.1E-10
H 9.8E-11
H 1.6E-11
H 8.4E-11
H 3.9E-11
H 1.9E-11
H 3.2E-10
H 4.4E-10
H 1.5E-10
! IN114M  Class: D F1:   0.02000     12/10/87  23:16:20.2   Acute  Sv/Bq
 14  1  3  4  5  6  7  8 11 12 13 14 17 18 19
  1  1  1  1  1  1  1  1  1  1  1  1  1  1
G 8.8E-12
G 1.0E-09
G 2.6E-09
G 1.5E-08
G 4.4E-08
G 7.6E-10
G 2.8E-10
G 1.2E-11
G 1.3E-10
G 1.8E-11
G 3.5E-12
G 2.0E-09
G 4.0E-09
G 1.0E-09
  1  1  1  1  1  2  1  1  1  1  1  2  2  2
H 2.8E-09
H 3.1E-10
H 5.3E-10
H 2.5E-09
H 6.9E-09
H 1.8E-08 1.2E-10
H 6.1E-09
H 6.6E-11
H 1.2E-10
H 1.4E-10
H 8.0E-11
H 4.7E-08 3.0E-10
H 9.6E-08 6.2E-10
H 2.4E-08 1.5E-10
! SN117M  Class: W F1:   0.02000     12/10/87  23:24:23.7   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  1  1  1  1  1  1  1  1  1  1  1
G 5.7E-12
G 2.4E-10
G 8.5E-10
G 2.9E-09
G 8.0E-09
G 5.2E-10
G 1.1E-10
```

5.972

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```
G 1.7E-11
G 2.2E-10
G 2.4E-11
G 3.2E-12
  1  1  1  1  1  1  1  1  1  1  1
H 6.2E-09
H 1.5E-10
H 2.8E-10
H 1.2E-09
H 3.4E-09
H 2.2E-09
H 2.7E-10
H 1.9E-11
H 1.1E-10
H 5.4E-11
H 3.1E-11
! SN119M  Class: W F1:   0.02000     12/10/87  23:31:59.2  Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  1  1  1  1  1  3  2  1  1  1  1
G 7.6E-12
G 9.9E-11
G 2.5E-10
G 1.3E-09
G 4.1E-09
G 1.5E-10 3.1E-11 6.9E-12
G 6.7E-11 1.2E-11
G 7.1E-12
G 4.0E-11
G 8.5E-12
G 7.0E-12
  2  1  1  1  1  3  3  1  1  1  1
H 1.1E-08 4.3E-11
H 8.0E-11
H 1.5E-10
H 6.8E-10
H 2.0E-09
H 8.6E-10 2.1E-10 4.8E-11
H 3.6E-10 8.7E-11 2.0E-11
H 4.0E-11
H 6.0E-11
H 5.7E-11
H 4.2E-11
! SN121M  Class: W F1:   0.02000     12/10/87  23:40:46.8  Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  2  1  1  1  1  7  6  2  2  2  2
G 1.4E-11 7.1E-12
G 5.3E-11
G 1.5E-10
G 1.1E-09
G 4.3E-09
G 3.0E-10 1.5E-10 7.8E-11 4.1E-11 2.2E-11 1.1E-11 5.9E-12
```

9 1 0 4 8 1 7 6 7

5.973

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DOSINC.DAT

```
G 1.2E-10 5.8E-11 3.0E-11 1.6E-11 8.3E-12 4.4E-12
G 1.4E-11 7.1E-12
G 2.8E-11 7.1E-12
G 1.5E-11 7.2E-12
G 1.4E-11 7.1E-12
  2  2  2  2  2  8  6  3  3  3  3
H 2.0E-08 1.7E-10
H 9.5E-11 2.5E-11
H 1.7E-10 2.6E-11
H 8.2E-10 2.3E-11
H 2.7E-09 3.0E-11
H 1.8E-09 1.0E-09 5.5E-10 2.9E-10 1.5E-10 7.9E-11 4.1E-11 2.2E-11
H 7.0E-10 4.0E-10 2.1E-10 1.1E-10 5.8E-11 3.1E-11
H 8.7E-11 5.0E-11 2.6E-11
H 9.4E-11 5.0E-11 2.6E-11
H 9.6E-11 5.1E-11 2.7E-11
H 8.8E-11 5.0E-11 2.6E-11
! SN121   Class: W F1:    0.02000     12/10/87  23:56:00.7   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  1  1  1  1  1  1  1  1  1  1  1
G 2.0E-13
G 1.3E-10
G 2.8E-10
G 1.3E-09
G 2.4E-09
G 2.0E-12
G 8.5E-13
G 2.1E-13
G 2.0E-13
G 2.1E-13
G 2.1E-13
  1  1  1  1  1  1  1  1  1  1  1
H 5.3E-10
H 3.7E-11
H 8.0E-11
H 3.7E-10
H 6.8E-10
H 8.5E-12
H 3.6E-12
H 9.0E-13
H 8.7E-13
H 8.9E-13
H 8.8E-13
! SN123   Class: W F1:    0.02000     12/11/87  00:02:29.0   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  1  1  1  1  1  2  1  1  1  1  1
G 3.0E-11
G 5.9E-10
G 1.5E-09
G 8.8E-09
G 2.6E-08
```

DOSINC.DAT

5.974

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9 1 0 4 8 1 7 6 8

9104817769

5.975

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DOSINC.DAT

```
G 6.3E-10 4.3E-11
G 2.3E-10
G 3.1E-11
G 3.7E-11
G 3.1E-11
G 3.0E-11
  2  1  1  1  1  2  2  1  1  1  1
H 6.1E-08 7.5E-11
H 3.7E-10
H 7.9E-10
H 4.3E-09
H 1.2E-08
H 3.5E-09 3.0E-10
H 1.3E-09 1.1E-10
H 1.7E-10
H 1.7E-10
H 1.8E-10
H 1.7E-10
! I 125   Class: D F1:    1.00000     12/11/87  00:10:55.5   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 15
  1  1  1  1  1  1  1  1  1  1  2  1
G 4.5E-11
G 6.2E-11
G 3.5E-11
G 3.4E-11
G 3.8E-11
G 2.6E-10
G 1.9E-10
G 2.6E-11
G 3.5E-11
G 1.4E-10
G 3.2E-07 5.3E-10
G 1.4E-10
  1  1  1  1  1  1  1  1  1  1  2  1
H 1.1E-10
H 2.1E-11
H 2.2E-11
H 2.2E-11
H 2.4E-11
H 1.6E-10
H 1.2E-10
H 1.7E-11
H 2.2E-11
H 8.9E-11
H 2.0E-07 3.3E-10
H 8.7E-11
! SN125   Class: W F1:    0.02000     12/11/87  00:19:05.8   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  1  1  1  1  1  1  1  1  1  1  1
G 1.6E-11
G 1.0E-09
```

```
G 2.4E-09
G 1.3E-08
G 3.6E-08
G 2.3E-10
G 2.1E-10
G 3.5E-11
G 2.9E-10
G 4.4E-11
G 9.8E-12
  1  1  1  1  1  3  1  1  1  1  1
H 2.3E-08
H 5.0E-10
H 1.0E-09
H 5.4E-09
H 1.5E-08
H 9.8E-10 8.1E-11 3.4E-11
H 7.3E-10
H 5.1E-11
H 1.6E-10
H 9.4E-11
H 7.7E-11
! SB125   Class: W F1:   0.01000     12/11/87  00:43:23.9   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1  1  1  1  1  1  1  1
G 1.3E-11
G 2.5E-10
G 7.7E-10
G 2.4E-09
G 6.4E-09
G 9.7E-11
G 1.2E-10
G 5.1E-11
G 5.3E-10
G 6.2E-11
G 5.4E-12
G 6.2E-11
  2  1  1  1  1  2  1  1  1  1  1  1
H 2.2E-08 1.7E-10
H 6.2E-10
H 5.0E-10
H 1.4E-09
H 3.4E-09
H 1.0E-09 4.6E-11
H 5.2E-10
H 8.5E-11
H 3.5E-10
H 4.0E-10
H 3.2E-10
H 8.4E-10
! TE125M  Class: W F1:   0.20000     12/11/87  00:58:34.7   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
```

DOSINC.DAT

5.976

9/30/88

9 1 0 4 8 1 7 7 0

```
  1  1  1  1  1  2  2  1  1  1  1
G 4.4E-11
G 1.7E-10
G 3.6E-10
G 1.7E-09
G 4.7E-09
G 1.3E-08 1.6E-10
G 1.2E-09 1.5E-11
G 3.9E-11
G 1.3E-10
G 4.6E-11
G 4.0E-11
  1  1  1  1  1  2  2  1  1  1  1
H 1.0E-08
H 1.1E-10
H 1.8E-10
H 7.7E-10
H 2.2E-09
H 1.2E-08 1.8E-10
H 1.2E-09 1.6E-11
H 3.6E-11
H 8.0E-11
H 7.1E-11
H 4.0E-11
! SN126   Class: W F1:   0.02000      12/11/87  01:07:00.6    Acute   Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  3  3  3  3  3  7  6  3  3  3  3
G 3.0E-10 1.4E-10 7.3E-11
G 1.3E-09 9.7E-11 5.2E-11
G 4.1E-09 1.1E-10 6.1E-11
G 1.6E-08 1.0E-10 5.5E-11
G 4.4E-08 1.3E-10 6.7E-11
G 2.5E-09 1.2E-09 6.4E-10 3.4E-10 1.8E-10 9.6E-11 5.1E-11
G 1.5E-09 5.7E-10 3.0E-10 1.6E-10 8.5E-11 4.5E-11
G 4.2E-10 1.3E-10 6.7E-11
G 2.1E-09 1.4E-10 7.5E-11
G 4.9E-10 1.4E-10 7.7E-11
G 2.7E-10 1.3E-10 7.1E-11
  4  4  4  4  4  8  7  4  5  5  4
H 1.5E-07 1.9E-09 3.4E-10 1.7E-10
H 3.9E-09 7.0E-10 3.6E-10 1.9E-10
H 3.7E-09 8.1E-10 4.3E-10 2.3E-10
H 9.6E-09 7.4E-10 3.9E-10 2.1E-10
H 2.4E-08 9.2E-10 4.7E-10 2.5E-10
H 1.5E-08 8.4E-09 4.5E-09 2.4E-09 1.3E-09 6.7E-10 3.6E-10 1.9E-10
H 8.3E-09 4.0E-09 2.1E-09 1.1E-09 5.9E-10 3.1E-10 1.7E-10
H 1.6E-09 8.9E-10 4.7E-10 2.5E-10
H 2.8E-09 1.0E-09 5.3E-10 2.8E-10 1.5E-10
H 3.3E-09 1.0E-09 5.4E-10 2.9E-10 1.5E-10
H 2.9E-09 9.5E-10 5.0E-10 2.7E-10
! SB126M  Class: W F1:   0.01000      12/11/87  01:35:39.8    Acute   Sv/Bq
```

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5.977

9/30/88

DOSINC.DAT

```
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1  1  1  1  1  1  1  1
G 1.9E-12
G 2.6E-10
G 7.4E-11
G 2.8E-11
G 7.9E-12
G 9.9E-13
G 2.2E-12
G 3.1E-13
G 5.6E-12
G 2.1E-12
G 1.8E-13
G 3.0E-12
  1  1  1  1  1  1  1  1  1  1  1  1
H 5.8E-11
H 4.1E-12
H 1.4E-12
H 1.1E-12
H 1.4E-12
H 7.8E-13
H 9.6E-13
H 2.3E-13
H 4.9E-13
H 8.7E-13
H 7.7E-13
H 1.6E-12
! SB126   Class: W F1:   0.01000     12/11/87  01:46:06.3   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1  1  1  1  1  1  1  1
G 6.8E-11
G 1.2E-09
G 3.6E-09
G 8.1E-09
G 1.9E-08
G 2.3E-10
G 6.0E-10
G 2.8E-10
G 2.9E-09
G 3.5E-10
G 1.7E-11
G 3.0E-10
  1  1  1  1  1  1  1  1  1  1  1  1
H 1.4E-08
H 1.2E-09
H 1.7E-09
H 3.6E-09
H 8.0E-09
H 7.0E-10
H 8.0E-10
H 2.1E-10
```

DOSINC.DAT

5.978

9/30/88

9 1 0 4 8 1 7 7 2

DOSINC.DAT

```
H 1.3E-09
H 6.6E-10
H 4.8E-10
H 1.2E-09
! SB124    Class: W F1:    0.01000      12/11/87  01:53:51.3   Acute  Sv/Bq
  12  1  3  4  5  6  7  8 11 12 13 14 17
   1  1  1  1  1  1  1  1  1  1  1  1
G 5.4E-11
G 9.7E-10
G 2.8E-09
G 8.7E-09
G 2.3E-08
G 2.0E-10
G 3.8E-10
G 1.9E-10
G 1.8E-09
G 2.3E-10
G 1.7E-11
G 2.2E-10
   1  1  1  1  1  1  1  1  1  1  1  1
H 4.2E-08
H 1.5E-09
H 1.6E-09
H 4.3E-09
H 1.1E-08
H 1.3E-09
H 1.1E-09
H 2.2E-10
H 1.0E-09
H 8.9E-10
H 6.8E-10
H 1.8E-09
! SB127    Class: W F1:    0.01000      12/11/87  02:02:35.7   Acute  Sv/Bq
  12  1  3  4  5  6  7  8 11 12 13 14 17
   1  1  1  1  1  1  1  1  1  1  1  1
G 1.6E-11
G 5.6E-10
G 1.6E-09
G 7.3E-09
G 2.0E-08
G 5.4E-11
G 1.3E-10
G 5.8E-11
G 6.1E-10
G 7.7E-11
G 4.4E-12
G 7.4E-11
   1  1  1  1  1  1  1  1  1  1  1  1
H 6.9E-09
H 3.2E-10
H 7.1E-10
```

5.979

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9 1 0 4 8 1 7 7 3

DOSINC.DAT

```
H 2.9E-09
H 7.5E-09
H 1.4E-10
H 1.6E-10
H 4.4E-11
H 2.5E-10
H 9.0E-11
H 6.0E-11
H 2.1E-10
! TE127M  Class: W F1:   0.20000     12/11/87  02:26:17.4   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  1  1  1  1  1  3  3  1  1  1  1
G 9.7E-11
G 1.7E-10
G 3.9E-10
G 3.0E-09
G 1.1E-08
G 1.9E-08 1.8E-09 1.7E-10
G 5.0E-09 4.6E-10 4.3E-11
G 9.5E-11
G 1.3E-10
G 9.9E-11
G 9.6E-11
  1  1  1  1  1  3  3  1  1  1  1
H 3.3E-08
H 1.9E-10
H 3.3E-10
H 1.8E-09
H 5.7E-09
H 1.9E-08 2.0E-09 1.9E-10
H 4.8E-09 5.1E-10 4.8E-11
H 9.6E-11
H 1.1E-10
H 1.1E-10
H 1.0E-10
! TE127   Class: W F1:   0.20000     12/11/87  02:42:13.3   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  1  1  1  1  1  1  1  1  1  1  1
G 3.0E-12
G 2.4E-10
G 4.0E-10
G 1.2E-09
G 1.3E-09
G 8.0E-12
G 9.2E-12
G 3.0E-12
G 4.2E-12
G 3.1E-12
G 3.0E-12
  1  1  1  1  1  1  1  1  1  1  1
H 4.3E-10
```

5.980

9/30/88

9 1 0 4 8 1 7 7 4

```
H 4.5E-11
H 7.3E-11
H 2.2E-10
H 2.4E-10
H 5.1E-12
H 5.8E-12
H 1.9E-12
H 2.1E-12
H 2.0E-12
H 1.9E-12
! TE123M  Class: W F1:   0.20000     12/11/87  02:48:13.7   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  1  1  1  1  1  4  3  1  1  1  1
G 1.0E-10
G 2.2E-10
G 4.6E-10
G 1.6E-09
G 4.5E-09
G 2.2E-08 2.5E-09 2.9E-10 3.4E-11
G 2.1E-09 2.3E-10 2.7E-11
G 9.1E-11
G 2.8E-10
G 1.2E-10
G 9.1E-11
  1  1  1  1  1  4  3  1  1  1  1
H 1.3E-08
H 2.5E-10
H 2.7E-10
H 8.2E-10
H 2.2E-09
H 2.1E-08 2.8E-09 3.3E-10 3.8E-11
H 2.1E-09 2.6E-10 3.0E-11
H 8.5E-11
H 1.9E-10
H 2.0E-10
H 1.4E-10
! TE129M  Class: W F1:   0.20000     12/11/87  02:57:24.0   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 15
  1  1  1  1  1  1  1  1  1  1  1  1
G 1.6E-10
G 5.5E-10
G 1.4E-09
G 8.0E-09
G 2.4E-08
G 8.1E-09
G 3.5E-09
G 5.7E-07
G 2.4E-10
G 1.8E-10
G 1.6E-11
G 1.4E-10
```

5.981

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DOSINC.DAT

9 1 0 4 8 1 7 7 5

```
  1  1  1  1  1  1  1  1  1  1  1  1
H 3.9E-08
H 4.1E-10
H 7.3E-10
H 3.6E-09
H 1.1E-08
H 7.1E-09
H 3.1E-09
H 5.1E-07
H 1.8E-10
H 1.8E-10
H 3.1E-11
H 1.2E-10
! TE129   Class: W F1:   0.20000     12/11/87  03:26:14.7   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 15
  1  1  1  1  1  1  1  1  1  1  1  1
G 5.2E-13
G 4.0E-10
G 2.8E-10
G 1.9E-10
G 4.0E-11
G 8.1E-13
G 1.1E-12
G 5.9E-11
G 1.7E-12
G 6.4E-13
G 3.2E-14
G 5.5E-13
  1  1  1  1  1  1  1  1  1  1  1  1
H 1.6E-10
H 1.6E-11
H 1.1E-11
H 7.7E-12
H 1.8E-12
H 9.8E-13
H 1.0E-12
H 8.0E-11
H 5.4E-13
H 5.7E-13
H 8.6E-14
H 2.7E-13
! TE131M  Class: W F1:   0.20000     12/11/87  03:37:22.5   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 15
  1  1  1  1  1  1  1  1  1  1  1  1
G 5.4E-11
G 6.5E-10
G 1.6E-09
G 4.7E-09
G 8.1E-09
G 3.7E-10
G 2.4E-10
```

DOSINC.DAT

5.982

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91048 1776

```
G 1.0E-08
G 7.3E-10
G 1.3E-10
G 3.8E-08
G 3.1E-10
  1  1  1  1  1  1  1  1  1  1  1  1
H 2.2E-09
H 2.7E-10
H 4.9E-10
H 1.4E-09
H 2.4E-09
H 2.5E-10
H 1.4E-10
H 6.8E-09
H 2.3E-10
H 8.7E-11
H 3.2E-08
H 1.4E-10
! TE131   Class: W F1:   0.20000     12/11/87  04:09:40.5   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 15
  1  1  1  1  1  1  1  1  1  1  1  1
G 6.9E-13
G 3.3E-10
G 1.1E-10
G 3.4E-11
G 3.9E-12
G 4.8E-13
G 1.0E-12
G 7.4E-12
G 2.2E-12
G 7.9E-13
G 9.0E-10
G 2.0E-12
  1  1  1  1  1  1  1  1  1  1  1  1
H 8.0E-11
H 5.4E-12
H 1.8E-12
H 6.8E-13
H 2.0E-13
H 4.9E-13
H 5.9E-13
H 2.6E-11
H 2.6E-13
H 4.1E-13
H 5.7E-10
H 9.7E-13
! TE132   Class: W F1:   0.20000     12/11/87  04:26:05.6   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 15
  1  1  1  1  1  1  1  1  1  1  1  1
G 1.8E-11
G 1.9E-10
```

DOSINC.DAT

5.984

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9 1 0 4 8 1 7 7 8

G 4.5E-10
G 1.5E-09
G 3.4E-09
G 5.9E-10
G 1.2E-10
G 8.9E-09
G 2.3E-10
G 3.9E-11
G 4.1E-08
G 2.8E-09
1 1 1 1 1 1 1 1 1 1 1 1
H 1.4E-09
H 9.2E-11
H 1.7E-10
H 5.5E-10
H 1.2E-09
H 4.4E-10
H 8.6E-11
H 6.5E-09
H 9.1E-11
H 3.4E-11
H 4.3E-08
H 2.9E-09
I TE133M Class: W F1: 0.20000 12/11/87 04:41:54.6 Acute Sv/Bq
12 1 3 4 5 6 7 8 11 12 13 14 15
1 1 1 1 1 1 1 1 1 1 1 1
G 6.3E-12
G 6.7E-10
G 4.1E-10
G 2.8E-10
G 5.5E-11
G 4.9E-12
G 1.2E-11
G 5.8E-11
G 3.6E-11
G 9.6E-12
G 3.5E-09
G 4.8E-11
1 1 1 1 1 1 1 1 1 1 1 1
H 2.1E-10
H 2.6E-11
H 1.4E-11
H 1.0E-11
H 2.8E-12
H 3.1E-12
H 4.0E-12
H 9.2E-11
H 2.4E-12
H 3.7E-12
H 2.2E-09
H 2.5E-11

```
! TE133   Class: W F1:   0.20000     12/11/87  05:16:44.0   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 15
  1  1  1  1  1  1  1  1  1  1  1  1
G 7.9E-13
G 2.5E-10
G 4.4E-11
G 9.9E-12
G 1.6E-12
G 3.8E-13
G 7.8E-13
G 1.5E-12
G 1.6E-12
G 7.9E-13
G 8.0E-10
G 9.0E-12
  1  1  1  1  1  1  1  1  1  1  1  1
H 4.8E-11
H 2.3E-12
H 4.5E-13
H 2.0E-13
H 1.0E-13
H 2.8E-13
H 3.7E-13
H 1.1E-11
H 1.4E-13
H 3.2E-13
H 5.0E-10
H 5.4E-12
! TE134   Class: W F1:   0.20000     12/11/87  05:36:53.9   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 15
  1  1  1  1  1  1  1  1  1  1  1  1
G 2.0E-12
G 2.3E-10
G 1.1E-10
G 6.4E-11
G 1.2E-11
G 1.6E-12
G 3.5E-12
G 1.2E-11
G 9.6E-12
G 2.8E-12
G 5.8E-10
G 6.3E-11
  1  1  1  1  1  1  1  1  1  1  1  1
H 6.2E-11
H 6.8E-12
H 3.2E-12
H 2.0E-12
H 5.9E-13
H 1.2E-12
H 1.2E-12
```

DOSINC.DAT

5.985

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9104817779

```
H 2.5E-11
H 5.9E-13
H 1.1E-12
H 3.6E-10
H 3.8E-11
! I 134   Class: D F1:    1.00000     12/11/87  05:47:46.3   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 15
  1  1  1  1  1  1  1  1  1  1  1  1
G 1.6E-11
G 5.6E-10
G 2.1E-11
G 2.2E-11
G 1.9E-11
G 5.8E-11
G 5.9E-11
G 1.3E-11
G 1.6E-11
G 1.6E-11
G 4.4E-10
G 5.5E-11
  1  1  1  1  1  1  1  1  1  1  1  1
H 1.5E-10
H 7.4E-11
H 7.7E-12
H 7.7E-12
H 7.5E-12
H 2.8E-11
H 2.8E-11
H 5.9E-12
H 6.4E-12
H 8.2E-12
H 2.0E-10
H 2.5E-11
! CS134M  Class: D F1:    1.00000     12/11/87  05:53:13.8   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  1  1  1  1  1  1  1  1  1  1  1
G 3.7E-12
G 1.1E-10
G 4.2E-12
G 4.0E-12
G 3.9E-12
G 1.8E-12
G 3.6E-12
G 3.7E-12
G 3.7E-12
G 3.7E-12
G 3.6E-12
  1  1  1  1  1  1  1  1  1  1  1
H 6.5E-11
H 1.6E-11
H 1.9E-12
```

5.986

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DOSINC.DAT

```
H 1.8E-12
H 1.8E-12
H 9.0E-13
H 1.8E-12
H 1.7E-12
H 1.7E-12
H 1.8E-12
H 1.7E-12
! I 130   Class: D F1:   1.00000     12/11/87  05:59:01.6   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 15
  1  1  1  1  1  1  1  1  1  1  1  1
G 1.1E-10
G 6.1E-10
G 1.2E-10
G 1.2E-10
G 1.4E-10
G 1.0E-09
G 3.6E-10
G 1.1E-10
G 1.2E-10
G 1.2E-10
G 3.2E-08
G 7.8E-10
  1  1  1  1  1  1  1  1  1  1  1  1
H 6.2E-10
H 1.4E-10
H 6.1E-11
H 6.0E-11
H 7.1E-11
H 5.4E-10
H 1.9E-10
H 5.6E-11
H 6.2E-11
H 7.5E-11
H 1.6E-08
H 4.0E-10
! I 135   Class: D F1:   1.00000     12/11/87  06:05:25.6   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 15
  1  1  1  1  1  1  1  1  1  1  1  1
G 5.7E-11
G 5.5E-10
G 6.7E-11
G 6.4E-11
G 7.4E-11
G 3.7E-10
G 2.6E-10
G 6.1E-11
G 6.7E-11
G 6.1E-11
G 1.4E-08
G 4.9E-10
```

DOSINC.DAT

5.987

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9 1 0 4 8 1 7 8 1

```
  1  1  1  1  1  1  1  1  1  1  1  1
H 4.6E-10
H 1.0E-10
H 3.2E-11
H 3.0E-11
H 3.5E-11
H 1.8E-10
H 1.3E-10
H 2.9E-11
H 3.2E-11
H 3.5E-11
H 6.8E-09
H 2.3E-10
! CS136   Class: D F1:   1.00000     12/11/87  06:19:11.0   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  3  3  4  3  4  3  3  3  3  3  3
G 1.7E-09 1.7E-10 1.7E-11
G 1.1E-09 1.0E-10 1.0E-11
G 1.9E-09 1.9E-10 1.9E-11 1.9E-12
G 1.8E-09 1.8E-10 1.8E-11
G 1.9E-09 1.9E-10 1.9E-11 1.9E-12
G 8.5E-10 8.5E-11 8.5E-12
G 1.7E-09 1.7E-10 1.7E-11
G 1.7E-09 1.7E-10 1.7E-11
G 1.7E-09 1.7E-10 1.7E-11
G 1.7E-09 1.7E-10 1.7E-11
G 1.7E-09 1.7E-10 1.7E-11
  1  3  4  3  4  3  3  3  3  3  3
H 2.1E-10
H 6.7E-10 6.6E-11 6.6E-12
H 1.2E-09 1.2E-10 1.2E-11 1.2E-12
H 1.2E-09 1.2E-10 1.2E-11
H 1.2E-09 1.2E-10 1.2E-11 1.2E-12
H 5.4E-10 5.4E-11 5.4E-12
H 1.1E-09 1.1E-10 1.1E-11
H 1.1E-09 1.1E-10 1.1E-11
H 1.1E-09 1.1E-10 1.1E-11
H 1.1E-09 1.1E-10 1.1E-11
H 1.1E-09 1.1E-10 1.1E-11
! CS138   Class: D F1:   1.00000     12/11/87  06:27:57.7   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  1  1  1  1  1  1  1  1  1  1  1
G 8.9E-12
G 7.2E-10
G 1.1E-11
G 1.3E-11
G 9.5E-12
G 3.9E-12
G 6.4E-12
G 6.4E-12
G 8.3E-12
```

```
G 8.3E-12
G 6.1E-12
 1  1  1  1  1  1  1  1  1  1  1
H 1.6E-10
H 7.9E-11
H 4.1E-12
H 4.2E-12
H 3.7E-12
H 2.4E-12
H 3.5E-12
H 3.0E-12
H 3.5E-12
H 4.2E-12
H 3.8E-12
! BA139   Class: D F1:   0.10000     12/11/87  06:35:53.0   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
 1  1  1  1  1  1  1  1  1  1  1
G 3.1E-13
G 7.0E-10
G 5.6E-10
G 4.8E-10
G 1.1E-10
G 4.7E-13
G 8.4E-13
G 2.3E-13
G 1.5E-12
G 4.5E-13
G 1.9E-13
 1  1  1  1  1  1  1  1  1  1  1
H 2.6E-10
H 9.2E-11
H 7.4E-11
H 6.3E-11
H 1.5E-11
H 2.6E-12
H 2.9E-12
H 1.6E-12
H 1.8E-12
H 1.7E-12
H 1.7E-12
! BA140   Class: D F1:   0.10000     12/11/87  06:41:47.8   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
 1  1  1  1  1  1  1  1  1  1  1
G 3.8E-11
G 5.4E-10
G 1.6E-09
G 7.4E-09
G 2.6E-08
G 5.3E-10
G 3.8E-10
G 1.1E-10
```

5.989

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9 1 0 4 8 1 7 8 3

DOSINC.DAT

```
G 9.4E-10
G 1.3E-10
G 2.5E-11
  1  1  1  1  1  1  1  1  1  1  1
H 1.5E-09
H 1.7E-10
H 3.5E-10
H 1.2E-09
H 4.1E-09
H 2.3E-09
H 1.1E-09
H 1.2E-10
H 2.6E-10
H 1.5E-10
H 1.2E-10
! LA140   Class: D F1:   0.00100     12/11/87  06:57:06.8   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1  1  1  1  1  1  1  1
G 4.1E-11
G 1.1E-09
G 3.0E-09
G 9.1E-09
G 1.7E-08
G 9.9E-11
G 2.8E-10
G 1.3E-10
G 1.4E-09
G 1.8E-10
G 6.5E-12
G 1.7E-10
  1  1  1  1  1  1  1  1  1  1  1  1
H 1.7E-09
H 3.7E-10
H 6.4E-10
H 1.6E-09
H 2.8E-09
H 4.3E-10
H 4.8E-10
H 1.4E-10
H 3.7E-10
H 2.1E-10
H 1.3E-10
H 3.7E-09
! CS136   Class: D F1:   1.00000     12/11/87  07:04:18.4   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  1  1  1  1  1  1  1  1  1  1  1
G 2.7E-09
G 3.1E-09
G 3.7E-09
G 3.5E-09
G 3.7E-09
```

DOSINC.DAT

5.990

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9 1 0 4 8 1 7 8 4

9 1 0 4 8 1 7 8 5

5.991

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DOSINC.DAT

```
G 1.1E-09
G 2.7E-09
G 3.2E-09
G 2.9E-09
G 2.7E-09
G 3.0E-09
  1  1  1  1  1  1  1  1  1  1  1
H 1.9E-09
H 1.8E-09
H 2.3E-09
H 2.2E-09
H 2.3E-09
H 6.8E-10
H 1.7E-09
H 2.0E-09
H 1.8E-09
H 1.7E-09
H 1.9E-09
! BA141    Class: D F1:   0.10000     12/11/87  07:12:48.0   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  1  1  1  1  1  1  1  1  1  1  1
G 1.1E-12
G 3.9E-10
G 1.9E-10
G 2.2E-10
G 1.2E-10
G 1.2E-12
G 1.4E-12
G 2.7E-13
G 2.9E-12
G 1.2E-12
G 1.8E-13
  1  1  1  1  1  1  1  1  1  1  1
H 1.2E-10
H 3.9E-11
H 2.3E-11
H 3.1E-11
H 1.7E-11
H 3.8E-12
H 1.8E-12
H 8.2E-13
H 1.1E-12
H 1.2E-12
H 1.0E-12
! LA141    Class: D F1:   0.00100     12/11/87  07:32:34.5   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1  1  1  1  1  1  1  1
G 2.8E-13
G 9.4E-10
G 1.4E-09
G 2.6E-09
```

```
G 1.6E-09
G 6.4E-13
G 1.1E-12
G 3.3E-13
G 3.9E-12
G 7.4E-13
G 5.5E-14
G 1.3E-12
 1  1  1  1  1  1  1  1  1  1  1  1
H 6.6E-10
H 1.4E-10
H 2.1E-10
H 3.8E-10
H 2.3E-10
H 1.3E-10
H 3.7E-11
H 1.0E-11
H 1.1E-11
H 1.0E-11
H 1.0E-11
H 2.2E-10
! CE141   Class: Y F1:   0.00030    12/11/87  07:45:49.7   Acute  Sv/Bq
 13  1  3  4  5  6  7  8 11 12 13 14 17 19
  1  1  1  1  1  1  1  1  1  1  1  1  1
G 1.4E-12
G 2.3E-10
G 5.8E-10
G 3.0E-09
G 8.7E-09
G 2.4E-11
G 3.4E-11
G 7.7E-12
G 1.1E-10
G 1.1E-11
G 1.8E-13
G 1.9E-11
G 1.8E-11
  1  1  1  1  1  1  1  1  1  1  1  1  1
H 1.6E-08
H 1.6E-10
H 2.8E-10
H 1.4E-09
H 4.1E-09
H 2.7E-10
H 9.0E-11
H 5.5E-12
H 5.5E-11
H 4.5E-11
H 2.6E-11
H 2.6E-10
H 2.2E-10
```

9 1 0 4 8 1 7 8 6

5.992

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DOSINC.DAT

```
! BA142    Class: D F1:   0.10000     12/11/87  07:53:57.6   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  1  1  1  1  1  1  1  1  1  1  1
G 1.7E-12
G 2.0E-10
G 1.1E-10
G 9.5E-11
G 2.6E-11
G 1.2E-12
G 3.0E-12
G 8.1E-13
G 1.0E-11
G 2.5E-12
G 2.5E-13
  1  1  1  1  1  1  1  1  1  1  1
H 5.6E-11
H 2.1E-11
H 1.5E-11
H 1.3E-11
H 3.9E-12
H 1.2E-12
H 1.5E-12
H 6.6E-13
H 1.9E-12
H 1.4E-12
H 1.0E-12
! LA142    Class: D F1:   0.00100     12/11/87  08:04:52.0   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1  1  1  1  1  1  1  1
G 8.8E-12
G 8.8E-10
G 8.4E-10
G 7.8E-10
G 2.2E-10
G 8.0E-12
G 2.1E-11
G 5.8E-12
G 7.6E-11
G 1.6E-11
G 1.2E-12
G 2.2E-11
  1  1  1  1  1  1  1  1  1  1  1  1
H 3.2E-10
H 1.3E-10
H 1.2E-10
H 1.1E-10
H 3.6E-11
H 1.3E-11
H 1.6E-11
H 7.5E-12
H 1.8E-11
```

9 1 0 4 8 1 7 8 7

5.993

9/30/88

DOSINC.DAT

```
H 1.2E-11
H 9.3E-12
H 4.1E-11
! CE143   Class: Y F1:   0.00030     12/11/87  08:10:45.1   Acute  Sv/Bq
 13  1  3  4  5  6  7  8 11 12 13 14 17 19
  1  1  1  1  1  1  1  1  1  1  1  1  1
G 3.9E-12
G 5.6E-10
G 1.4E-09
G 5.6E-09
G 1.2E-08
G 1.7E-11
G 5.2E-11
G 1.6E-11
G 2.2E-10
G 2.4E-11
G 4.4E-13
G 2.2E-11
G 2.3E-11
  1  1  1  1  1  1  1  1  1  1  1  1  1
H 4.0E-09
H 2.1E-10
H 5.0E-10
H 2.1E-09
H 4.5E-09
H 1.7E-11
H 3.1E-11
H 6.0E-12
H 7.9E-11
H 1.7E-11
H 6.5E-12
H 5.0E-11
H 4.4E-11
! PR143   Class: Y F1:   0.00030     12/11/87  08:24:53.6   Acute  Sv/Bq
 13  1  3  4  5  6  7  8 11 12 13 14 17 16
  1  1  1  1  1  1  1  1  1  1  1  1  1
G 6.6E-15
G 3.6E-10
G 8.9E-10
G 5.1E-09
G 1.5E-08
G 1.1E-12
G 1.0E-12
G 6.6E-15
G 6.6E-15
G 6.6E-15
G 6.7E-15
G 8.3E-12
G 1.7E-12
  1  1  1  1  1  1  1  1  1  1  1  1  1
H 1.3E-08
```

DOSINC.DAT

5.994

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9 1 0 4 8 1 7 8 8

```
H 1.7E-10
H 4.1E-10
H 2.4E-09
H 7.0E-09
H 1.5E-11
H 1.5E-11
H 9.6E-14
H 9.7E-14
H 9.6E-14
H 9.8E-14
H 1.2E-10
H 2.5E-11
! ND147   Class: Y F1:   0.00030     12/11/87  08:32:59.7   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1  1  1  1  1  1  1  1
G 2.4E-12
G 3.6E-10
G 9.5E-10
G 4.6E-09
G 1.2E-08
G 2.0E-11
G 5.0E-11
G 1.4E-11
G 1.8E-10
G 1.9E-11
G 2.7E-13
G 1.9E-11
  7  1  1  1  1  9  1  1  1  1  1  1
H 1.0E-08 2.2E-10 1.2E-10 6.6E-11 3.8E-11 2.2E-11 1.3E-11
H 2.0E-10
H 4.4E-10
H 2.1E-09
H 5.7E-09
H 1.2E-10 3.0E-11 3.2E-11 3.1E-11 2.7E-11 2.2E-11 1.8E-11 1.4E-11 1.1E-11
H 7.7E-11
H 6.8E-12
H 8.5E-11
H 3.5E-11
H 1.9E-11
H 1.3E-10
! PM147   Class: Y F1:   0.00030     12/11/87  08:55:50.4   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1 10  2  1  1  1  1  6
G 1.4E-15
G 6.9E-11
G 1.8E-10
G 1.0E-09
G 3.2E-09
G 7.5E-11 5.4E-11 3.8E-11 2.7E-11 2.0E-11 1.4E-11 1.0E-11 7.2E-12 5.1E-12 3.7E-12
G 6.1E-12 4.3E-12
G 1.8E-15
```

DOSINC.DAT

5.995

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9 1 0 4 8 1 7 8 9

```
G 8.2E-15
G 2.0E-15
G 1.3E-15
G 2.0E-11 1.4E-11 1.0E-11 7.2E-12 5.1E-12 3.7E-12
 15  1  1  1  2 19 11  1  1  1  1 15
H 3.5E-08 1.9E-08 1.0E-08 5.7E-09 3.2E-09 1.9E-09 1.1E-09 6.8E-10 4.3E-10 2.7E-10 1.8E-10 1.2E-10 7.9E-11 5.4E-11 3.8E-11

H 3.5E-11
H 9.2E-11
H 5.4E-10
H 1.6E-09 5.2E-11
H 1.8E-09 2.6E-09 2.8E-09 2.6E-09 2.3E-09 1.9E-09 1.5E-09 1.2E-09 9.2E-10 6.9E-10 5.2E-10 3.9E-10 2.8E-10 2.1E-10 1.5E-10
  1.1E-10 8.0E-11 5.8E-11 4.2E-11
H 1.4E-10 2.1E-10 2.2E-10 2.1E-10 1.9E-10 1.5E-10 1.2E-10 9.7E-11 7.4E-11 5.6E-11 4.2E-11
H 4.5E-14
H 4.9E-14
H 5.9E-14
H 5.2E-14
H 4.7E-10 6.7E-10 7.3E-10 6.9E-10 6.0E-10 5.0E-10 4.0E-10 3.1E-10 2.4E-10 1.8E-10 1.4E-10 1.0E-10 7.4E-11 5.4E-11 4.0E-11

! SM147   Class: W F1:   0.00030     12/11/87  09:10:21.2   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1 50 50  1  1  1  1 50
G 9.9E-13
G 5.2E-10
G 1.3E-09
G 7.5E-09
G 2.4E-08
G 6.2E-08 5.8E-08 5.4E-08 5.0E-08 4.6E-08 4.3E-08 4.0E-08 3.7E-08 3.5E-08 3.2E-08 3.0E-08 2.8E-08 2.6E-08 2.4E-08 2.2E-08
  2.1E-08 1.9E-08 1.8E-08 1.7E-08 1.6E-08 1.5E-08 1.4E-08 1.3E-08 1.2E-08 1.1E-08 1.0E-08 9.5E-09 8.8E-09 8.2E-09 7.6E-09
  7.1E-09 6.6E-09 6.1E-09 5.7E-09 5.3E-09 4.9E-09 4.6E-09 4.3E-09 4.0E-09 3.7E-09 3.4E-09 3.2E-09 3.0E-09 2.8E-09 2.6E-09
  2.4E-09 2.2E-09 2.1E-09 1.9E-09 1.8E-09
G 4.9E-09 4.6E-09 4.3E-09 4.0E-09 3.7E-09 3.4E-09 3.2E-09 3.0E-09 2.8E-09 2.6E-09 2.4E-09 2.2E-09 2.1E-09 1.9E-09 1.8E-09
  1.7E-09 1.6E-09 1.4E-09 1.3E-09 1.3E-09 1.2E-09 1.1E-09 1.0E-09 9.4E-10 8.7E-10 8.1E-10 7.5E-10 7.0E-10 6.5E-10 6.1E-10
  5.6E-10 5.3E-10 4.9E-10 4.5E-10 4.2E-10 3.9E-10 3.7E-10 3.4E-10 3.2E-10 2.9E-10 2.7E-10 2.6E-10 2.4E-10 2.2E-10 2.1E-10
  1.9E-10 1.8E-10 1.7E-10 1.5E-10 1.4E-10
G 9.9E-13
G 9.9E-13
G 9.9E-13
G 9.9E-13
G 1.7E-08 1.6E-08 1.5E-08 1.4E-08 1.3E-08 1.2E-08 1.1E-08 1.0E-08 9.6E-09 8.9E-09 8.3E-09 7.7E-09 7.2E-09 6.7E-09 6.2E-09
  5.8E-09 5.4E-09 5.0E-09 4.7E-09 4.3E-09 4.0E-09 3.8E-09 3.5E-09 3.2E-09 3.0E-09 2.8E-09 2.6E-09 2.4E-09 2.3E-09 2.1E-09
  2.0E-09 1.8E-09 1.7E-09 1.6E-09 1.5E-09 1.4E-09 1.3E-09 1.2E-09 1.1E-09 1.0E-09 9.5E-10 8.8E-10 8.2E-10 7.7E-10 7.1E-10
  6.6E-10 6.2E-10 5.7E-10 5.3E-10 5.0E-10
  2  1  1  1  1 50 50  1  1  1  1 50
H 7.5E-06 6.5E-08
H 6.6E-10
H 1.1E-09
H 4.2E-09
H 1.2E-08
H 2.2E-05 2.3E-05 2.2E-05 2.0E-05 1.9E-05 1.7E-05 1.6E-05 1.5E-05 1.4E-05 1.3E-05 1.2E-05 1.1E-05 1.0E-05 9.8E-06 9.1E-06
```

DOSINC.DAT

8.4E-06 7.9E-06 7.3E-06 6.8E-06 6.3E-06 5.9E-06 5.5E-06 5.1E-06 4.7E-06 4.4E-06 4.1E-06 3.8E-06 3.5E-06 3.3E-06 3.1E-06
2.9E-06 2.7E-06 2.5E-06 2.3E-06 2.1E-06 2.0E-06 1.9E-06 1.7E-06 1.6E-06 1.5E-06 1.4E-06 1.3E-06 1.2E-06 1.1E-06 1.0E-06
9.7E-07 9.0E-07 8.4E-07 7.8E-07 7.2E-07
H 1.8E-06 1.9E-06 1.7E-06 1.6E-06 1.5E-06 1.4E-06 1.3E-06 1.2E-06 1.1E-06 1.0E-06 9.7E-07 9.0E-07 8.4E-07 7.8E-07 7.2E-07
6.7E-07 6.3E-07 5.8E-07 5.4E-07 5.0E-07 4.7E-07 4.4E-07 4.1E-07 3.8E-07 3.5E-07 3.3E-07 3.0E-07 2.8E-07 2.6E-07 2.4E-07
2.3E-07 2.1E-07 2.0E-07 1.8E-07 1.7E-07 1.6E-07 1.5E-07 1.4E-07 1.3E-07 1.2E-07 1.1E-07 1.0E-07 9.6E-08 8.9E-08 8.3E-08
7.7E-08 7.2E-08 6.7E-08 6.2E-08 5.8E-08
H 4.0E-10
H 4.0E-10
H 4.0E-10
H 4.0E-10
H 6.2E-06 6.4E-06 6.0E-06 5.6E-06 5.2E-06 4.8E-06 4.5E-06 4.2E-06 3.9E-06 3.6E-06 3.4E-06 3.1E-06 2.9E-06 2.7E-06 2.5E-06
2.3E-06 2.2E-06 2.0E-06 1.9E-06 1.7E-06 1.6E-06 1.5E-06 1.4E-06 1.3E-06 1.2E-06 1.1E-06 1.1E-06 9.8E-07 9.1E-07 8.5E-07
7.9E-07 7.3E-07 6.8E-07 6.4E-07 5.9E-07 5.5E-07 5.1E-07 4.8E-07 4.4E-07 4.1E-07 3.8E-07 3.6E-07 3.3E-07 3.1E-07 2.9E-07
2.7E-07 2.5E-07 2.3E-07 2.2E-07 2.0E-07
! PM148M Class: Y F1: 0.00030 12/11/87 09:19:51.1 Acute Sv/Bq
12 1 3 4 5 6 7 8 11 12 13 14 17
1 1 1 1 1 1 1 1 1 1 1 1
G 4.4E-11
G 7.9E-10
G 2.6E-09
G 5.8E-09
G 1.4E-08
G 1.8E-10
G 4.4E-10
G 2.1E-10
G 2.2E-09
G 2.7E-10
G 6.4E-12
G 2.3E-10
2 1 1 1 1 1 1 1 1 1 1 1
H 3.6E-08 5.6E-11
H 2.0E-09
H 1,5E-09
H 3.2E-09
H 6.7E-09
H 1.4E-09
H 1.4E-09
H 1.3E-10
H 1.2E-09
H 1.2E-09
H 1.0E-09
H 2.6E-09
! PM148 Class: Y F1: 0.00030 12/11/87 09:34:49.5 Acute Sv/Bq
12 1 3 4 5 6 7 8 11 12 13 14 17
1 1 1 1 1 1 1 1 1 1 1 1
G 1.2E-11
G 9.5E-10
G 2.5E-09
G 1.2E-08
G 3.2E-08

5.997

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9 1 0 4 8 1 7 9

DOSINC.DAT

G 3.5E-11
G 9.9E-11
G 4.3E-11
G 4.8E-10
G 6.1E-11
G 1.9E-12
G 5.6E-11
1 1 1 1 1 1 1 1 1 1 1 1
H 1.4E-08
H 4.8E-10
H 1.1E-09
H 5.2E-09
H 1.4E-08
H 7.4E-11
H 1.1E-10
H 2.1E-11
H 2.2E-10
H 7.3E-11
H 3.9E-11
H 1.9E-10
! PM149 Class: Y F1: 0.00030 12/11/87 09:42:41.3 Acute Sv/Bq
12 1 3 4 5 6 7 8 11 12 13 14 17
1 1 1 1 1 1 1 1 1 1 1 1
G 1.7E-13
G 4.2E-10
G 1.0E-09
G 5.0E-09
G 1.2E-08
G 9.9E-13
G 2.3E-12
G 7.6E-13
G 9.3E-12
G 1.0E-12
G 2.5E-14
G 1.9E-12
1 1 1 1 1 1 1 1 1 1 1 1
H 3.2E-09
H 1.6E-10
H 3.9E-10
H 2.0E-09
H 4.7E-09
H 5.3E-12
H 5.8E-12
H 4.0E-13
H 3.8E-12
H 9.3E-13
H 4.4E-13
H 1.6E-11
! SM153 Class: W F1: 0.00030 12/11/87 09:50:00.7 Acute Sv/Bq
12 1 3 4 5 6 7 8 11 12 13 14 17
1 1 1 1 1 1 1 1 1 1 1 1

5.998

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9 1 0 4 8 1 7 9 2

DOSINC.DAT

```
G 7.2E-13
G 3.3E-10
G 8.1E-10
G 3.8E-09
G 8.1E-09
G 8.5E-12
G 2.8E-11
G 3.7E-12
G 7.3E-11
G 7.0E-12
G 2.9E-14
G 5.9E-12
  1  1  1  1  1  1  1  1  1  1  1  1
H 2.1E-09
H 1.1E-10
H 2.7E-10
H 1.2E-09
H 2.6E-09
H 1.6E-10
H 7.1E-11
H 2.7E-12
H 2.6E-11
H 7.2E-12
H 2.9E-12
H 1.9E-10
! EU156    Class: W F1:   0.00100     12/11/87  09:57:37.8   Acute  Sv/Bq
 13  1  3  4  5  6  7  8 11 12 13 14 16 17
  1  1  1  1  1  1  1  1  1  1  1  1  1
G 3.3E-11
G 8.0E-10
G 2.4E-09
G 8.4E-09
G 2.3E-08
G 1.2E-10
G 2.5E-10
G 1.2E-10
G 1.2E-09
G 1.5E-10
G 5.3E-12
G 1.8E-10
G 1.6E-10
  1  1  1  1  1  1  1  1  1  1  1  1  1
H 1.9E-08
H 7.8E-10
H 1.2E-09
H 3.7E-09
H 9.8E-09
H 2.8E-09
H 1.2E-09
H 1.1E-10
H 6.2E-10
```

5.999

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9 1 0 4 8 1 7 9 3

```
H 3.8E-10
H 2.3E-10
H 1.3E-09
H 3.8E-09
! GD153    Class: D F1:   0.00030     12/11/87  10:06:12.1   Acute  Sv/Bq
 13  1  3  4  5  6  7  8 11 12 13 14 16 17
  1  1  1  1  1  3  1  1  1  1  1  1  2
G 1.9E-12
G 9.7E-11
G 3.2E-10
G 1.0E-09
G 2.8E-09
G 6.1E-11 1.3E-11 4.2E-12
G 7.9E-11
G 1.0E-11
G 1.9E-10
G 1.8E-11
G 1.6E-13
G 1.6E-11
G 2.3E-11 3.7E-12
  3  2  2  3  2  7  5  1  2  2  2  3  6
H 9.9E-10 2.7E-10 8.9E-11
H 4.7E-10 1.5E-10
H 5.0E-10 1.5E-10
H 8.0E-10 2.1E-10 6.8E-11
H 7.2E-10 9.6E-11
H 6.2E-08 2.0E-08 6.7E-09 2.2E-09 7.2E-10 2.3E-10 7.7E-11
H 7.3E-09 2.4E-09 7.9E-10 2.6E-10 8.4E-11
H 1.5E-10
H 3.1E-10 9.0E-11
H 4.7E-10 1.5E-10
H 2.0E-10 6.3E-11
H 1.5E-09 3.2E-10 1.1E-10
H 1.8E-08 5.9E-09 1.9E-09 6.3E-10 2.1E-10 6.8E-11
! TB160    Class: W F1:   0.00030     12/11/87  10:15:10.4   Acute  Sv/Bq
 13  1  3  4  5  6  7  8 11 12 13 14 16 17
  1  1  1  1  1  1  1  1  1  1  1  1  1
G 2.7E-11
G 6.1E-10
G 1.9E-09
G 5.9E-09
G 1.5E-08
G 1.5E-10
G 2.6E-10
G 1.0E-10
G 1.2E-09
G 1.4E-10
G 4.3E-12
G 1.6E-10
G 1.3E-10
  1  1  1  1  1  2  2  1  1  1  1  1  2
```

DOSINC.DAT

5.1000

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9 1 0 4 8 1 7 9 4

9 1 0 4 8 1 7 9 5

5.1001

9/30/88

DOSINC.DAT

```
H 3.0E-08
H 1.4E-09
H 1.4E-09
H 3.4E-09
H 7.4E-09
H 2.4E-08 8.5E-10
H 4.4E-09 1.4E-10
H 2.6E-10
H 9.3E-10
H 9.5E-10
H 6.5E-10
H 2.1E-09
H 9.0E-09 2.9E-10
! H0166M  Class: W F1:   0.00030     12/11/87  10:24:20.7   Acute  Sv/Bq
 13  1  3  4  5  6  7  8 11 12 13 14 17 18
  3  6  1  2  1 37 13  1  1  1  1 34 41
G 5.0E-11 1.2E-11 1.1E-11
G 7.0E-10 1.5E-11 1.4E-11 1.3E-11 1.2E-11 1.1E-11
G 2.3E-09
G 4.8E-09 1.1E-11
G 1.1E-08
G 3.0E-10 1.5E-10 1.4E-10 1.3E-10 1.2E-10 1.1E-10 1.0E-10 9.7E-11 9.0E-11 8.4E-11 7.8E-11 7.2E-11 6.7E-11 6.2E-11 5.8E-11
  5.4E-11 5.0E-11 4.7E-11 4.3E-11 4.0E-11 3.8E-11 3.5E-11 3.2E-11 3.0E-11 2.8E-11 2.6E-11 2.4E-11 2.3E-11 2.1E-11 1.9E-11
  1.8E-11 1.7E-11 1.6E-11 1.5E-11 1.4E-11 1.3E-11 1.2E-11
G 4.5E-10 2.7E-11 2.5E-11 2.3E-11 2.1E-11 2.0E-11 1.8E-11 1.7E-11 1.6E-11 1.5E-11 1.4E-11 1.3E-11 1.2E-11
G 1.8E-10
G 2.0E-09
G 2.4E-10
G 8.5E-12
G 3.1E-10 1.2E-10 1.1E-10 1.1E-10 9.9E-11 9.2E-11 8.6E-11 8.0E-11 7.4E-11 6.9E-11 6.4E-11 6.0E-11 5.5E-11 5.2E-11 4.8E-11
  4.5E-11 4.1E-11 3.9E-11 3.6E-11 3.3E-11 3.1E-11 2.9E-11 2.7E-11 2.5E-11 2.3E-11 2.2E-11 2.0E-11 1.9E-11 1.7E-11 1.6E-11
  1.5E-11 1.4E-11 1.3E-11 1.2E-11
G 4.4E-10 1.9E-10 1.8E-10 1.7E-10 1.6E-10 1.4E-10 1.3E-10 1.3E-10 1.2E-10 1.1E-10 1.0E-10 9.4E-11 8.7E-11 8.1E-11 7.5E-11
  7.0E-11 6.5E-11 6.0E-11 5.6E-11 5.2E-11 4.9E-11 4.5E-11 4.2E-11 3.9E-11 3.6E-11 3.4E-11 3.1E-11 2.9E-11 2.7E-11 2.5E-11
  2.3E-11 2.2E-11 2.0E-11 1.9E-11 1.8E-11 1.6E-11 1.5E-11 1.4E-11 1.3E-11 1.2E-11 1.1E-11
 50 50 50 50 45 50 50 37 46 50 41 50 50
H 4.1E-08 5.3E-09 4.6E-09 4.3E-09 4.0E-09 3.7E-09 3.5E-09 3.2E-09 3.0E-09 2.8E-09 2.6E-09 2.4E-09 2.2E-09 2.1E-09 1.9E-09
  1.8E-09 1.7E-09 1.5E-09 1.4E-09 1.3E-09 1.2E-09 1.2E-09 1.1E-09 1.0E-09 9.3E-10 8.7E-10 8.0E-10 7.5E-10 7.0E-10 6.5E-10
  6.0E-10 5.6E-10 5.2E-10 4.8E-10 4.5E-10 4.2E-10 3.9E-10 3.6E-10 3.4E-10 3.1E-10 2.9E-10 2.7E-10 2.5E-10 2.3E-10 2.2E-10
  2.0E-10 1.9E-10 1.7E-10 1.6E-10 1.5E-10
H 8.0E-09 6.1E-09 5.7E-09 5.3E-09 4.9E-09 4.6E-09 4.3E-09 4.0E-09 3.7E-09 3.4E-09 3.2E-09 3.0E-09 2.7E-09 2.6E-09 2.4E-09
  2.2E-09 2.1E-09 1.9E-09 1.8E-09 1.7E-09 1.5E-09 1.4E-09 1.3E-09 1.2E-09 1.1E-09 1.1E-09 9.9E-10 9.2E-10 8.6E-10 8.0E-10
  7.4E-10 6.9E-10 6.4E-10 6.0E-10 5.5E-10 5.1E-10 4.8E-10 4.4E-10 4.1E-10 3.8E-10 3.6E-10 3.3E-10 3.1E-10 2.9E-10 2.7E-10
  2.5E-10 2.3E-10 2.1E-10 2.0E-10 1.9E-10
H 4.7E-09 3.4E-09 3.2E-09 3.0E-09 2.8E-09 2.6E-09 2.4E-09 2.2E-09 2.1E-09 1.9E-09 1.8E-09 1.7E-09 1.5E-09 1.4E-09 1.3E-09
  1.2E-09 1.2E-09 1.1E-09 1.0E-09 9.3E-10 8.6E-10 8.0E-10 7.5E-10 6.9E-10 6.4E-10 6.0E-10 5.6E-10 5.2E-10 4.8E-10 4.5E-10
  4.2E-10 3.9E-10 3.6E-10 3.3E-10 3.1E-10 2.9E-10 2.7E-10 2.5E-10 2.3E-10 2.2E-10 2.0E-10 1.9E-10 1.7E-10 1.6E-10 1.5E-10
  1.4E-10 1.3E-10 1.2E-10 1.1E-10 1.0E-10
H 7.2E-09 4.6E-09 4.3E-09 4.0E-09 3.7E-09 3.4E-09 3.2E-09 3.0E-09 2.8E-09 2.6E-09 2.4E-09 2.2E-09 2.1E-09 1.9E-09 1.8E-09
  1.7E-09 1.5E-09 1.4E-09 1.3E-09 1.2E-09 1.2E-09 1.1E-09 1.0E-09 9.3E-10 8.6E-10 8.0E-10 7.5E-10 6.9E-10 6.5E-10 6.0E-10
  5.6E-10 5.2E-10 4.8E-10 4.5E-10 4.2E-10 3.9E-10 3.6E-10 3.4E-10 3.1E-10 2.9E-10 2.7E-10 2.5E-10 2.3E-10 2.2E-10 2.0E-10
```

```
 1.9E-10 1.7E-10 1.6E-10 1.5E-10 1.4E-10
H 7.5E-09 1.8E-09 1.7E-09 1.6E-09 1.4E-09 1.3E-09 1.3E-09 1.2E-09 1.1E-09 1.0E-09 9.4E-10 8.7E-10 8.1E-10 7.5E-10 7.0E-10
  6.5E-10 6.0E-10 5.6E-10 5.2E-10 4.9E-10 4.5E-10 4.2E-10 3.9E-10 3.6E-10 3.4E-10 3.1E-10 2.9E-10 2.7E-10 2.5E-10 2.3E-10
  2.2E-10 2.0E-10 1.9E-10 1.8E-10 1.6E-10 1.5E-10 1.4E-10 1.3E-10 1.2E-10 1.1E-10 1.1E-10 9.8E-11 9.1E-11 8.5E-11 7.9E-11

H 5.9E-08 6.0E-08 5.6E-08 5.2E-08 4.9E-08 4.5E-08 4.2E-08 3.9E-08 3.6E-08 3.4E-08 3.1E-08 2.9E-08 2.7E-08 2.5E-08 2.3E-08
  2.2E-08 2.0E-08 1.9E-08 1.8E-08 1.6E-08 1.5E-08 1.4E-08 1.3E-08 1.2E-08 1.1E-08 1.1E-08 9.8E-09 9.1E-09 8.5E-09 7.9E-09
  7.3E-09 6.8E-09 6.3E-09 5.9E-09 5.5E-09 5.1E-09 4.7E-09 4.4E-09 4.1E-09 3.8E-09 3.5E-09 3.3E-09 3.0E-09 2.8E-09 2.6E-09
  2.4E-09 2.3E-09 2.1E-09 2.0E-09 1.8E-09
H 1.2E-08 1.1E-08 1.0E-08 9.3E-09 8.6E-09 8.0E-09 7.5E-09 6.9E-09 6.4E-09 6.0E-09 5.6E-09 5.2E-09 4.8E-09 4.5E-09 4.2E-09
  3.9E-09 3.6E-09 3.3E-09 3.1E-09 2.9E-09 2.7E-09 2.5E-09 2.3E-09 2.2E-09 2.0E-09 1.9E-09 1.7E-09 1.6E-09 1.5E-09 1.4E-09
  1.3E-09 1.2E-09 1.1E-09 1.0E-09 9.7E-10 9.0E-10 8.4E-10 7.8E-10 7.2E-10 6.7E-10 6.3E-10 5.8E-10 5.4E-10 5.0E-10 4.7E-10
  4.3E-10 4.0E-10 3.8E-10 3.5E-10 3.2E-10
H 1.1E-09 1.0E-09 9.7E-10 9.0E-10 8.4E-10 7.8E-10 7.3E-10 6.7E-10 6.3E-10 5.8E-10 5.4E-10 5.0E-10 4.7E-10 4.4E-10 4.1E-10
  3.8E-10 3.5E-10 3.3E-10 3.0E-10 2.8E-10 2.6E-10 2.4E-10 2.3E-10 2.1E-10 2.0E-10 1.8E-10 1.7E-10 1.6E-10 1.5E-10 1.4E-10
  1.3E-10 1.2E-10 1.1E-10 1.0E-10 9.4E-11 8.8E-11 8.2E-11
H 3.1E-09 2.0E-09 1.9E-09 1.7E-09 1.6E-09 1.5E-09 1.4E-09 1.3E-09 1.2E-09 1.1E-09 1.0E-09 9.6E-10 8.9E-10 8.3E-10 7.7E-10
  7.2E-10 6.7E-10 6.2E-10 5.8E-10 5.4E-10 5.0E-10 4.6E-10 4.3E-10 4.0E-10 3.7E-10 3.5E-10 3.2E-10 3.0E-10 2.8E-10 2.6E-10
  2.4E-10 2.2E-10 2.1E-10 1.9E-10 1.8E-10 1.7E-10 1.6E-10 1.4E-10 1.3E-10 1.3E-10 1.2E-10 1.1E-10 1.0E-10 9.3E-11 8.7E-11
  8.1E-11
H 4.5E-09 3.2E-09 3.0E-09 2.7E-09 2.6E-09 2.4E-09 2.2E-09 2.1E-09 1.9E-09 1.8E-09 1.6E-09 1.5E-09 1.4E-09 1.3E-09 1.2E-09
  1.1E-09 1.1E-09 9.9E-10 9.2E-10 8.6E-10 8.0E-10 7.4E-10 6.9E-10 6.4E-10 5.9E-10 5.5E-10 5.1E-10 4.8E-10 4.4E-10 4.1E-10
  3.8E-10 3.6E-10 3.3E-10 3.1E-10 2.9E-10 2.7E-10 2.5E-10 2.3E-10 2.1E-10 2.0E-10 1.9E-10 1.7E-10 1.6E-10 1.5E-10 1.4E-10
  1.3E-10 1.2E-10 1.1E-10 1.0E-10 9.6E-11
H 2.5E-09 1.4E-09 1.3E-09 1.2E-09 1.1E-09 1.0E-09 9.6E-10 8.9E-10 8.3E-10 7.7E-10 7.2E-10 6.7E-10 6.2E-10 5.8E-10 5.4E-10
  5.0E-10 4.6E-10 4.3E-10 4.0E-10 3.7E-10 3.5E-10 3.2E-10 3.0E-10 2.8E-10 2.6E-10 2.4E-10 2.2E-10 2.1E-10 1.9E-10 1.8E-10
  1.7E-10 1.6E-10 1.4E-10 1.3E-10 1.2E-10 1.2E-10 1.1E-10 1.0E-10 9.3E-11 8.7E-11 8.1E-11
H 5.0E-08 5.0E-08 4.6E-08 4.3E-08 4.0E-08 3.7E-08 3.5E-08 3.2E-08 3.0E-08 2.8E-08 2.6E-08 2.4E-08 2.2E-08 2.1E-08 1.9E-08
  1.8E-08 1.7E-08 1.6E-08 1.4E-08 1.3E-08 1.2E-08 1.2E-08 1.1E-08 1.0E-08 9.3E-09 8.7E-09 8.1E-09 7.5E-09 7.0E-09 6.5E-09
  6.0E-09 5.6E-09 5.2E-09 4.8E-09 4.5E-09 4.2E-09 3.9E-09 3.6E-09 3.4E-09 3.1E-09 2.9E-09 2.7E-09 2.5E-09 2.3E-09 2.2E-09
  2.0E-09 1.9E-09 1.7E-09 1.6E-09 1.5E-09
H 7.8E-08 7.8E-08 7.3E-08 6.8E-08 6.3E-08 5.9E-08 5.4E-08 5.1E-08 4.7E-08 4.4E-08 4.1E-08 3.8E-08 3.5E-08 3.3E-08 3.0E-08
  2.8E-08 2.6E-08 2.4E-08 2.3E-08 2.1E-08 2.0E-08 1.8E-08 1.7E-08 1.6E-08 1.5E-08 1.4E-08 1.3E-08 1.2E-08 1.1E-08 1.0E-08
  9.5E-09 8.8E-09 8.2E-09 7.6E-09 7.1E-09 6.6E-09 6.1E-09 5.7E-09 5.3E-09 4.9E-09 4.6E-09 4.2E-09 3.9E-09 3.7E-09 3.4E-09
  3.2E-09 3.0E-09 2.7E-09 2.6E-09 2.4E-09
! W 181   Class: D F1:   0.30000     12/11/87  10:33:06.6   Acute  Sv/Bq
 14  1  3  4  5  6  7  8 11 12 13 14 16 17 19
  1  1  1  1  1  2  2  1  1  1  1  2  1  2
G 4.2E-12
G 3.1E-11
G 7.7E-11
G 2.0E-10
G 5.1E-10
G 4.4E-11 3.2E-12
G 4.8E-11 2.1E-12
G 4.6E-12
G 5.5E-11
G 8.0E-12
G 2.0E-12
G 7.4E-11 6.7E-13
G 2.0E-11
```

DOSINC.DAT

5.1002

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9 6 7 1 8 4 0 1 6

G 6.6E-11 5.9E-13
2 2 2 2 2 3 3 2 2 2 2 2 2 2
H 5.4E-11 3.2E-13
H 1.2E-11 1.6E-13
H 1.7E-11 2.3E-13
H 3.6E-11 1.9E-13
H 8.2E-11 2.9E-13
H 6.7E-11 5.5E-12 5.3E-13
H 5.0E-11 3.6E-12 3.4E-13
H 3.0E-12 1.3E-13
H 1.2E-11 2.2E-13
H 6.8E-12 2.8E-13
H 3.7E-12 2.0E-13
H 1.2E-10 1.2E-12
H 3.2E-11 3.8E-13
H 1.1E-10 1.0E-12
! W 185 Class: D F1: 0.30000 12/11/87 10:42:15.5 Acute Sv/Bq
14 1 3 4 5 6 7 8 11 12 13 14 16 17 19
1 1 1 1 1 1 1 1 1 1 1 1 1 1
G 2.8E-12
G 1.5E-10
G 2.6E-10
G 1.5E-09
G 4.5E-09
G 1.5E-10
G 5.2E-11
G 2.7E-12
G 2.9E-12
G 2.7E-12
G 2.7E-12
G 4.0E-10
G 7.3E-11
G 3.4E-10
1 1 1 1 1 2 2 1 1 1 1 2 1 2
H 3.9E-10
H 2.5E-11
H 4.2E-11
H 2.4E-10
H 6.9E-10
H 2.6E-10 6.3E-12
H 9.0E-11 2.1E-12
H 4.7E-12
H 5.0E-12
H 4.7E-12
H 4.7E-12
H 7.0E-10 1.5E-12
H 1.3E-10
H 5.9E-10 1.3E-12
! W 187 Class: D F1: 0.30000 12/11/87 10:51:19.1 Acute Sv/Bq
14 1 3 4 5 6 7 8 11 12 13 14 16 17 19
1 1 1 1 1 1 1 1 1 1 1 1 1 1

91048 1798

5.1004

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DOSINC.DAT

```
G 1.3E-11
G 4.2E-10
G 7.7E-10
G 2.6E-09
G 4.6E-09
G 8.1E-11
G 6.0E-11
G 2.4E-11
G 2.0E-10
G 3.2E-11
G 8.0E-12
G 8.9E-11
G 4.5E-11
G 7.5E-11
  1  1  1  1  1  1  1  1  1  1  1  1  1  1
H 6.2E-10
H 7.9E-11
H 1.3E-10
H 4.1E-10
H 7.1E-10
H 1.1E-10
H 3.7E-11
H 1.5E-11
H 4.2E-11
H 2.0E-11
H 1.6E-11
H 9.7E-11
H 4.6E-11
H 8.7E-11
! RE187   Class: W F1:   0.80000     12/11/87  11:04:25.8   Acute  Sv/Bq
 13  1  3  4  5  6  7  8 11 12 13 14 22 17
  1  1  1  1  1  1  1  1  1  1  1  1  1
G 4.0E-13
G 2.2E-11
G 6.1E-13
G 2.4E-12
G 7.1E-12
G 2.0E-13
G 4.0E-13
G 4.0E-13
G 4.0E-13
G 4.0E-13
G 1.1E-11
G 2.2E-11
G 5.5E-13
  2  1  1  1  1  1  1  1  1  1  1  1  1
H 1.1E-10 9.4E-13
H 1.4E-11
H 3.5E-13
H 1.3E-12
H 3.7E-12
```

9 1 0 4 8 1 7 9 9

5.1005

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DOSINC.DAT

```
H 1.3E-13
H 2.7E-13
H 2.7E-13
H 2.7E-13
H 2.7E-13
H 6.9E-12
H 1.4E-11
H 3.6E-13
! IR192   Class: Y F1:   0.01000    07/12/88  14:23:32.2   Acute  Sv/Bq
 14  1  3  4  5  6  7  8 11 12 13 14 17 16 19
  1  1  1  1  1  1  1  1  1  1  1  1  1  1
G 6.7E-11
G 5.5E-10
G 1.6E-09
G 4.9E-09
G 1.3E-08
G 9.9E-11
G 2.5E-10
G 1.3E-10
G 1.0E-09
G 1.5E-10
G 3.9E-11
G 4.4E-10
G 4.9E-10
G 4.0E-10
  2  1  1  1  1  1  1  1  1  1  1  1  1  1
H 4.9E-08 1.1E-09
H 1.3E-09
H 8.9E-10
H 2.5E-09
H 6.1E-09
H 6.4E-10
H 8.7E-10
H 9.4E-11
H 5.8E-10
H 8.1E-10
H 6.0E-10
H 1.7E-09
H 9.5E-10
H 1.5E-09
! OS185   Class: D F1:   0.01000    07/12/88  14:30:36.9   Acute  Sv/Bq
 14  1  3  4  5  6  7  8 11 12 13 14 17 16 19
  1  1  1  1  1  1  1  1  1  1  1  2  1  1
G 5.3E-11
G 2.8E-10
G 8.6E-10
G 1.4E-09
G 2.8E-09
G 8.6E-11
G 2.1E-10
G 1.0E-10
```

```
G 8.4E-10
G 1.3E-10
G 2.8E-11
G 2.5E-10 3.3E-12
G 2.5E-10
G 2.0E-10
  2  2  2  2  2  2  2  2  2  2  2  2  2  2
H 1.7E-09 2.9E-11
H 1.9E-09 3.5E-11
H 1.9E-09 3.3E-11
H 2.1E-09 3.6E-11
H 1.9E-09 2.7E-11
H 1.3E-09 2.3E-11
H 1.6E-09 2.9E-11
H 1.4E-09 2.6E-11
H 1.3E-09 2.3E-11
H 1.4E-09 2.6E-11
H 1.2E-09 2.2E-11
H 8.1E-09 1.5E-10
H 6.8E-09 1.3E-10
H 5.7E-09 1.1E-10
! OS191   Class: D F1:   0.01000     07/12/88  14:37:58.8   Acute  Sv/Bq
 14  1  3  4  5  6  7  8 11 12 13 14 17 18 19
  1  1  1  1  1  1  1  1  1  1  1  1  1  1
G 5.2E-12
G 1.9E-10
G 4.9E-10
G 2.3E-09
G 6.6E-09
G 1.6E-11
G 4.8E-11
G 1.1E-11
G 1.2E-10
G 1.5E-11
G 3.5E-12
G 5.1E-11
G 6.0E-11
G 5.0E-11
  1  1  1  1  1  1  1  1  1  1  1  1  1  1
H 4.4E-10
H 1.6E-10
H 2.0E-10
H 4.7E-10
H 1.1E-09
H 1.4E-10
H 1.9E-10
H 1.8E-10
H 1.9E-10
H 1.7E-10
H 1.6E-10
H 1.9E-09
```

0081 84016

5.1006

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DOSINC.DAT

```
H 2.2E-09
H 1.8E-09
! HG203   Class: D F1:   1.00000     12/11/87  11:23:19.1   Acute  Sv/Bq
 13  1  3  4  5  6  7  8 11 12 13 14 21 16
  1  1  1  1  1  1  1  1  1  1  1  1  1
G 1.2E-09
G 1.3E-09
G 1.6E-09
G 1.5E-09
G 1.4E-09
G 9.7E-10
G 1.5E-09
G 1.1E-09
G 1.4E-09
G 1.3E-09
G 1.3E-09
G 1.2E-08
G 1.9E-08
  1  1  1  1  1  1  1  1  1  1  1  1  1
H 6.6E-10
H 7.8E-10
H 1.0E-09
H 9.8E-10
H 9.0E-10
H 6.1E-10
H 9.3E-10
H 7.3E-10
H 8.7E-10
H 8.0E-10
H 8.3E-10
H 7.3E-09
H 1.2E-08
! PU236   Class: Y F1:   0.00010     02/23/88  14:26:23.1   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1 27 17  9  1  1  1 20
G 8.6E-13
G 1.3E-09
G 3.5E-09
G 1.9E-08
G 5.9E-08
G 4.8E-08 3.7E-08 2.9E-08 2.2E-08 1.7E-08 1.3E-08 1.0E-08 8.0E-09 6.2E-09 4.8E-09 3.7E-09 2.8E-09 2.2E-09 1.7E-09 1.3E-09
  1.0E-09 7.9E-10 6.1E-10 4.7E-10 3.6E-10 2.8E-10 2.2E-10 1.7E-10 1.3E-10 1.0E-10 7.8E-11 6.0E-11
G 3.8E-09 2.9E-09 2.3E-09 1.8E-09 1.4E-09 1.1E-09 8.2E-10 6.3E-10 4.9E-10 3.8E-10 2.9E-10 2.3E-10 1.7E-10 1.3E-10 1.0E-10
  8.1E-11 6.2E-11
G 5.2E-10 4.0E-10 3.1E-10 2.4E-10 1.9E-10 1.5E-10 1.2E-10 9.0E-11 7.0E-11
G 4.4E-12
G 9.7E-13
G 8.5E-13
G 1.3E-08 9.8E-09 7.4E-09 5.6E-09 4.3E-09 3.2E-09 2.4E-09 1.8E-09 1.4E-09 1.1E-09 8.0E-10 6.1E-10 4.6E-10 3.5E-10 2.6E-10
  2.0E-10 1.5E-10 1.1E-10 8.7E-11 6.6E-11
 16  1  1  1  1 24 14  1  1  1  1 17
```

5.1007

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DOSINC.DAT

9 1 0 4 8 1 8 0 1

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H 6.4E-05 3.5E-05 1.9E-05 1.1E-05 6.5E-06 3.8E-06 2.3E-06 1.5E-06 9.2E-07 6.0E-07 4.0E-07 2.7E-07 1.8E-07 1.3E-07 9.3E-08
  6.8E-08
H 7.3E-10
H 1.8E-09
H 9.7E-09
H 2.9E-08
H 3.2E-06 4.9E-06 5.5E-06 5.5E-06 5.1E-06 4.5E-06 3.8E-06 3.1E-06 2.6E-06 2.1E-06 1.7E-06 1.3E-06 1.0E-06 8.1E-07 6.3E-07
  4.9E-07 3.9E-07 3.0E-07 2.3E-07 1.8E-07 1.4E-07 1.1E-07 8.4E-08 6.5E-08
H 2.5E-07 3.9E-07 4.4E-07 4.4E-07 4.0E-07 3.5E-07 3.0E-07 2.5E-07 2.0E-07 1.6E-07 1.3E-07 1.0E-07 8.2E-08 6.4E-08
H 3.5E-08
H 8.3E-11
H 8.8E-11
H 8.0E-11
H 8.6E-07 1.3E-06 1.5E-06 1.4E-06 1.3E-06 1.1E-06 9.5E-07 7.7E-07 6.2E-07 4.9E-07 3.9E-07 3.0E-07 2.3E-07 1.8E-07 1.4E-07
  1.1E-07 8.1E-08
I PU242   Class: Y F1:   0.00010    02/23/88  14:35:03.3   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1 50 50 50  1  1  1 50
G 7.3E-13
G 1.2E-09
G 2.8E-09
G 1.7E-08
G 5.1E-08
G 4.5E-08 4.5E-08 4.4E-08 4.3E-08 4.3E-08 4.2E-08 4.2E-08 4.1E-08 4.0E-08 4.0E-08 3.9E-08 3.9E-08 3.8E-08 3.8E-08 3.7E-08
  3.7E-08 3.6E-08 3.6E-08 3.5E-08 3.5E-08 3.4E-08 3.4E-08 3.3E-08 3.3E-08 3.2E-08 3.2E-08 3.2E-08 3.1E-08 3.1E-08 3.0E-08
  3.0E-08 2.9E-08 2.9E-08 2.9E-08 2.8E-08 2.8E-08 2.7E-08 2.7E-08 2.7E-08 2.6E-08 2.6E-08 2.6E-08 2.5E-08 2.5E-08 2.5E-08
  2.4E-08 2.4E-08 2.4E-08 2.3E-08 2.3E-08
G 3.7E-09 3.7E-09 3.6E-09 3.6E-09 3.5E-09 3.5E-09 3.4E-09 3.4E-09 3.3E-09 3.3E-09 3.2E-09 3.2E-09 3.2E-09 3.1E-09 3.1E-09
  3.0E-09 3.0E-09 2.9E-09 2.9E-09 2.9E-09 2.8E-09 2.8E-09 2.7E-09 2.7E-09 2.7E-09 2.6E-09 2.6E-09 2.6E-09 2.5E-09 2.5E-09
  2.5E-09 2.4E-09 2.4E-09 2.4E-09 2.3E-09 2.3E-09 2.3E-09 2.2E-09 2.2E-09 2.2E-09 2.1E-09 2.1E-09 2.1E-09 2.1E-09 2.0E-09
  2.0E-09 2.0E-09 1.9E-09 1.9E-09 1.9E-09
G 4.9E-10 4.9E-10 4.9E-10 4.8E-10 4.8E-10 4.8E-10 4.7E-10 4.7E-10 4.7E-10 4.6E-10 4.6E-10 4.6E-10 4.5E-10 4.5E-10 4.5E-10
  4.4E-10 4.4E-10 4.4E-10 4.4E-10 4.3E-10 4.3E-10 4.3E-10 4.2E-10 4.2E-10 4.2E-10 4.2E-10 4.1E-10 4.1E-10 4.1E-10 4.0E-10
  4.0E-10 4.0E-10 4.0E-10 3.9E-10 3.9E-10 3.9E-10 3.8E-10 3.8E-10 3.8E-10 3.8E-10 3.7E-10 3.7E-10 3.7E-10 3.7E-10 3.6E-10
  3.6E-10 3.6E-10 3.6E-10 3.5E-10 3.5E-10
G 3.9E-12
G 9.0E-13
G 7.1E-13
G 1.2E-08 1.2E-08 1.1E-08 1.1E-08 1.1E-08 1.0E-08 1.0E-08 9.6E-09 9.3E-09 9.0E-09 8.7E-09 8.4E-09 8.1E-09 7.8E-09 7.6E-09
  7.3E-09 7.1E-09 6.8E-09 6.6E-09 6.4E-09 6.1E-09 5.9E-09 5.7E-09 5.5E-09 5.4E-09 5.2E-09 5.0E-09 4.8E-09 4.7E-09 4.5E-09
  4.3E-09 4.2E-09 4.1E-09 3.9E-09 3.8E-09 3.7E-09 3.5E-09 3.4E-09 3.3E-09 3.2E-09 3.1E-09 3.0E-09 2.9E-09 2.8E-09 2.7E-09
  2.6E-09 2.5E-09 2.4E-09 2.3E-09 2.3E-09
 50  1  1  1  1 50 50 50  1  1  1 50
H 6.0E-05 4.1E-05 2.9E-05 2.1E-05 1.6E-05 1.2E-05 9.4E-06 7.4E-06 6.0E-06 5.0E-06 4.2E-06 3.6E-06 3.2E-06 2.9E-06 2.6E-06
  2.4E-06 2.3E-06 2.2E-06 2.1E-06 2.0E-06 2.0E-06 1.9E-06 1.9E-06 1.9E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06
  1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06
  1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06
H 6.5E-10
H 1.4E-09
H 8.2E-09
H 2.5E-08
```

9 1 0 4 8 1 8 0 2

5.1008

9/30/88

DOSINC.DAT

```
H 3.1E-06 5.9E-06 8.5E-06 1.1E-05 1.3E-05 1.4E-05 1.5E-05 1.6E-05 1.7E-05 1.7E-05 1.8E-05 1.8E-05 1.8E-05 1.8E-05 1.8E-05
  1.8E-05 1.8E-05 1.8E-05 1.7E-05 1.7E-05 1.7E-05 1.7E-05 1.7E-05 1.6E-05 1.6E-05 1.6E-05 1.6E-05 1.6E-05 1.5E-05 1.5E-05
  1.5E-05 1.5E-05 1.5E-05 1.4E-05 1.4E-05 1.4E-05 1.4E-05 1.4E-05 1.3E-05 1.3E-05 1.3E-05 1.3E-05 1.3E-05 1.2E-05 1.2E-05
  1.2E-05 1.2E-05 1.2E-05 1.2E-05 1.1E-05
H 2.5E-07 4.8E-07 7.0E-07 8.9E-07 1.0E-06 1.2E-06 1.3E-06 1.3E-06 1.4E-06 1.4E-06 1.5E-06 1.5E-06 1.5E-06 1.5E-06 1.5E-06
  1.5E-06 1.5E-06 1.4E-06 1.4E-06 1.4E-06 1.4E-06 1.4E-06 1.4E-06 1.4E-06 1.3E-06 1.3E-06 1.3E-06 1.3E-06 1.3E-06 1.3E-06
  1.2E-06 1.2E-06 1.2E-06 1.2E-06 1.2E-06 1.2E-06 1.1E-06 1.1E-06 1.1E-06 1.1E-06 1.1E-06 1.1E-06 1.0E-06 1.0E-06 1.0E-06
  1.0E-06 9.9E-07 9.8E-07 9.6E-07 9.5E-07
H 3.4E-08 6.4E-08 9.3E-08 1.2E-07 1.4E-07 1.6E-07 1.7E-07 1.8E-07 1.9E-07 2.0E-07 2.0E-07 2.0E-07 2.1E-07 2.1E-07 2.1E-07
  2.1E-07 2.1E-07 2.1E-07 2.1E-07 2.1E-07 2.1E-07 2.1E-07 2.0E-07 2.0E-07 2.0E-07 2.0E-07 2.0E-07 2.0E-07 2.0E-07 2.0E-07
  1.9E-07 1.9E-07 1.9E-07 1.9E-07 1.9E-07 1.9E-07 1.9E-07 1.9E-07 1.8E-07 1.8E-07 1.8E-07 1.8E-07 1.8E-07 1.8E-07 1.8E-07
  1.8E-07 1.7E-07 1.7E-07 1.7E-07 1.7E-07
H 7.3E-11
H 8.2E-11
H 7.3E-11
H 8.4E-07 1.6E-06 2.3E-06 2.8E-06 3.3E-06 3.6E-06 3.9E-06 4.1E-06 4.2E-06 4.2E-06 4.2E-06 4.2E-06 4.1E-06 4.1E-06 4.0E-06
  3.9E-06 3.8E-06 3.7E-06 3.6E-06 3.5E-06 3.4E-06 3.3E-06 3.2E-06 3.1E-06 3.0E-06 2.9E-06 2.8E-06 2.7E-06 2.6E-06 2.5E-06
  2.4E-06 2.3E-06 2.3E-06 2.2E-06 2.1E-06 2.0E-06 2.0E-06 1.9E-06 1.8E-06 1.8E-06 1.7E-06 1.7E-06 1.6E-06 1.5E-06 1.5E-06
  1.4E-06 1.4E-06 1.3E-06 1.3E-06 1.3E-06
! NP238   Class: W F1:   0.00100    02/23/88  14:55:57.0   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1 50  1  1  1  1  1  1
G 1.0E-11
G 4.3E-10
G 1.1E-09
G 4.2E-09
G 9.3E-09
G 8.8E-11 5.6E-11 5.6E-11 5.5E-11 5.4E-11 5.3E-11 5.2E-11 5.2E-11 5.1E-11 5.0E-11 4.9E-11 4.9E-11 4.8E-11 4.7E-11 4.7E-11
  4.6E-11 4.5E-11 4.5E-11 4.4E-11 4.3E-11 4.3E-11 4.2E-11 4.1E-11 4.1E-11 4.0E-11 4.0E-11 3.9E-11 3.8E-11 3.8E-11 3.7E-11
  3.7E-11 3.6E-11 3.6E-11 3.5E-11 3.5E-11 3.4E-11 3.4E-11 3.3E-11 3.3E-11 3.2E-11 3.2E-11 3.1E-11 3.1E-11 3.0E-11 3.0E-11
  3.0E-11 2.9E-11 2.9E-11 2.8E-11 2.8E-11
G 8.3E-11
G 3.2E-11
G 3.8E-10
G 4.8E-11
G 1.5E-12
G 4.6E-11
  2  1  1  1  1 50 50 50  1  1  1 50
H 3.3E-09 9.6E-12
H 1.7E-10
H 3.8E-10
H 1.4E-09
H 3.0E-09
H 6.4E-09 6.6E-09 6.5E-09 6.4E-09 6.3E-09 6.2E-09 6.1E-09 6.0E-09 5.9E-09 5.8E-09 5.7E-09 5.7E-09 5.6E-09 5.5E-09 5.4E-09
  5.3E-09 5.3E-09 5.2E-09 5.1E-09 5.0E-09 5.0E-09 4.9E-09 4.8E-09 4.7E-09 4.7E-09 4.6E-09 4.5E-09 4.5E-09 4.4E-09 4.3E-09
  4.3E-09 4.2E-09 4.1E-09 4.1E-09 4.0E-09 4.0E-09 3.9E-09 3.8E-09 3.8E-09 3.7E-09 3.7E-09 3.6E-09 3.6E-09 3.5E-09 3.5E-09
  3.4E-09 3.4E-09 3.3E-09 3.3E-09 3.2E-09
H 6.3E-10 5.3E-10 5.2E-10 5.1E-10 5.1E-10 5.0E-10 4.9E-10 4.8E-10 4.8E-10 4.7E-10 4.6E-10 4.6E-10 4.5E-10 4.4E-10 4.4E-10
  4.3E-10 4.2E-10 4.2E-10 4.1E-10 4.0E-10 4.0E-10 3.9E-10 3.9E-10 3.8E-10 3.8E-10 3.7E-10 3.6E-10 3.6E-10 3.5E-10 3.5E-10
  3.4E-10 3.4E-10 3.3E-10 3.3E-10 3.2E-10 3.2E-10 3.1E-10 3.1E-10 3.1E-10 3.0E-10 3.0E-10 2.9E-10 2.9E-10 2.8E-10 2.8E-10
  2.8E-10 2.7E-10 2.7E-10 2.6E-10 2.6E-10
```

DOSINC.DAT

5.1009

9/30/88

3 0 8 1 8 4 0 1 6

```
H 6.2E-11 4.3E-11 4.2E-11 4.1E-11 4.1E-11 4.0E-11 4.0E-11 3.9E-11 3.8E-11 3.8E-11 3.7E-11 3.7E-11 3.6E-11 3.6E-11 3.5E-11
  3.5E-11 3.4E-11 3.4E-11 3.3E-11 3.3E-11 3.2E-11 3.2E-11 3.1E-11 3.1E-11 3.0E-11 3.0E-11 2.9E-11 2.9E-11 2.9E-11 2.8E-11
  2.8E-11 2.7E-11 2.7E-11 2.7E-11 2.6E-11 2.6E-11 2.5E-11 2.5E-11 2.5E-11 2.4E-11 2.4E-11 2.4E-11 2.3E-11 2.3E-11 2.3E-11
  2.2E-11 2.2E-11 2.2E-11 2.1E-11 2.1E-11
H 1.3E-10
H 4.1E-11
H 2.4E-11
H 4.5E-10 3.5E-10 3.4E-10 3.3E-10 3.2E-10 3.2E-10 3.1E-10 3.0E-10 2.9E-10 2.9E-10 2.8E-10 2.7E-10 2.7E-10 2.6E-10 2.5E-10
  2.5E-10 2.4E-10 2.3E-10 2.3E-10 2.2E-10 2.2E-10 2.1E-10 2.1E-10 2.1E-10 2.0E-10 2.0E-10 1.9E-10 1.9E-10 1.8E-10 1.8E-10 1.7E-10
  1.7E-10 1.7E-10 1.6E-10 1.6E-10 1.5E-10 1.5E-10 1.5E-10 1.4E-10 1.4E-10 1.4E-10 1.3E-10 1.3E-10 1.3E-10 1.2E-10 1.2E-10
  1.2E-10 1.1E-10 1.1E-10 1.1E-10 1.1E-10
! U 232   Class: Y F1:   0.00200     02/26/88  17:19:06.2   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 16
  1  1  1  1  1 50 50  1  1  1  1 31
G 8.3E-11
G 1.3E-09
G 3.3E-09
G 1.8E-08
G 5.6E-08
G 7.2E-09 8.5E-09 1.1E-08 1.2E-08 1.2E-08 1.2E-08 1.2E-08 1.1E-08 1.1E-08 1.0E-08 9.9E-09 9.4E-09 8.8E-09 8.3E-09 7.9E-09
  7.4E-09 7.0E-09 6.6E-09 6.2E-09 5.8E-09 5.5E-09 5.1E-09 4.8E-09 4.6E-09 4.3E-09 4.0E-09 3.8E-09 3.6E-09 3.3E-09 3.2E-09
  3.0E-09 2.8E-09 2.6E-09 2.5E-09 2.3E-09 2.2E-09 2.1E-09 1.9E-09 1.8E-09 1.7E-09 1.6E-09 1.5E-09 1.4E-09 1.3E-09 1.3E-09
  1.2E-09 1.1E-09 1.0E-09 9.8E-10 9.2E-10
G 5.2E-10 5.5E-10 6.8E-10 7.5E-10 7.7E-10 7.7E-10 7.5E-10 7.3E-10 6.9E-10 6.6E-10 6.3E-10 5.9E-10 5.6E-10 5.3E-10 5.0E-10
  4.7E-10 4.4E-10 4.1E-10 3.9E-10 3.6E-10 3.4E-10 3.2E-10 3.0E-10 2.9E-10 2.7E-10 2.5E-10 2.4E-10 2.2E-10 2.1E-10 2.0E-10
  1.9E-10 1.7E-10 1.6E-10 1.5E-10 1.4E-10 1.4E-10 1.3E-10 1.2E-10 1.1E-10 1.1E-10 1.0E-10 9.4E-11 8.9E-11 8.3E-11 7.8E-11
  7.4E-11 6.9E-11 6.5E-11 6.1E-11 5.8E-11
G 8.2E-11
G 8.6E-11
G 8.1E-11
G 8.2E-11
G 1.4E-08 4.9E-09 5.4E-09 5.3E-09 4.8E-09 4.3E-09 3.8E-09 3.2E-09 2.7E-09 2.3E-09 2.0E-09 1.7E-09 1.4E-09 1.2E-09 9.8E-10
  8.2E-10 6.8E-10 5.7E-10 4.8E-10 4.0E-10 3.3E-10 2.8E-10 2.3E-10 2.0E-10 1.6E-10 1.4E-10 1.1E-10 9.5E-11 8.0E-11 6.7E-11
  5.6E-11
 50  1  1  1  1 26  1  1  1  1  1 16
H 1.2E-04 1.6E-04 1.4E-04 1.2E-04 9.9E-05 7.9E-05 6.3E-05 5.1E-05 4.2E-05 3.5E-05 2.9E-05 2.5E-05 2.2E-05 2.0E-05 1.8E-05
  1.6E-05 1.5E-05 1.4E-05 1.4E-05 1.3E-05 1.2E-05 1.2E-05 1.2E-05 1.1E-05 1.1E-05 1.1E-05 1.1E-05 1.1E-05 1.1E-05 1.0E-05
  1.0E-05 1.0E-05 1.0E-05 9.9E-06 9.8E-06 9.7E-06 9.6E-06 9.5E-06 9.4E-06 9.3E-06 9.2E-06 9.1E-06 9.0E-06 8.9E-06 8.8E-06
  8.7E-06 8.6E-06 8.5E-06 8.4E-06 8.3E-06
H 2.1E-09
H 2.5E-09
H 1.0E-08
H 3.0E-08
H 3.7E-08 0.0E+00 1.4E-07 1.8E-07 2.2E-07 2.5E-07 2.6E-07 2.7E-07 2.7E-07 2.7E-07 2.7E-07 2.6E-07 2.5E-07 2.4E-07 2.3E-07
  2.2E-07 2.1E-07 2.0E-07 1.9E-07 1.8E-07 1.7E-07 1.6E-07 1.5E-07 1.4E-07 1.3E-07 1.2E-07
H 3.4E-09
H 6.4E-10
H 7.1E-10
H 1.2E-09
H 1.1E-09
H 9.9E-08 1.5E-07 1.9E-07 2.1E-07 2.2E-07 2.1E-07 1.9E-07 1.8E-07 1.6E-07 1.4E-07
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DOSINC.DAT

5.1010

9/30/88

4081 8401 6

DOSINC.DAT

5.1011

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! TH232   Class: Y F1:   0.00020 '   02/26/88  19:09:56.4   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  4  4  4  4  4 50 50  4  4  4  4 13
G 1.9E-10 1.7E-10 1.5E-10 1.4E-10
G 1.1E-09 1.7E-10 1.5E-10 1.4E-10
G 2.5E-09 1.7E-10 1.5E-10 1.4E-10
G 1.4E-08 1.7E-10 1.5E-10 1.4E-10
G 4.2E-08 1.7E-10 1.5E-10 1.4E-10
G 1.2E-07 1.5E-07 1.9E-07 2.4E-07 2.9E-07 3.3E-07 3.8E-07 4.1E-07 4.4E-07 4.6E-07 4.8E-07 5.0E-07 5.1E-07 5.1E-07 5.2E-07
  5.2E-07 5.2E-07 5.1E-07 5.1E-07 5.0E-07 4.9E-07 4.9E-07 4.8E-07 4.7E-07 4.6E-07 4.5E-07 4.4E-07 4.2E-07 4.1E-07 4.0E-07
  3.9E-07 3.8E-07 3.7E-07 3.6E-07 3.5E-07 3.4E-07 3.3E-07 3.2E-07 3.1E-07 3.0E-07 2.9E-07 2.9E-07 2.8E-07 2.7E-07 2.6E-07
  2.5E-07 2.5E-07 2.4E-07 2.3E-07 2.2E-07
G 1.0E-08 1.2E-08 1.5E-08 1.9E-08 2.3E-08 2.7E-08 3.0E-08 3.3E-08 3.5E-08 3.7E-08 3.9E-08 4.0E-08 4.1E-08 4.1E-08 4.2E-08
  4.2E-08 4.2E-08 4.1E-08 4.1E-08 4.0E-08 4.0E-08 3.9E-08 3.8E-08 3.8E-08 3.7E-08 3.6E-08 3.5E-08 3.4E-08 3.3E-08 3.2E-08
  3.2E-08 3.1E-08 3.0E-08 2.9E-08 2.8E-08 2.7E-08 2.7E-08 2.6E-08 2.5E-08 2.4E-08 2.4E-08 2.3E-08 2.2E-08 2.2E-08 2.1E-08
  2.0E-08 2.0E-08 1.9E-08 1.9E-08 1.8E-08
G 1.9E-10 1.7E-10 1.5E-10 1.4E-10
G 2.0E-10 1.7E-10 1.5E-10 1.4E-10
G 1.9E-10 1.7E-10 1.5E-10 1.4E-10
G 1.9E-10 1.7E-10 1.5E-10 1.4E-10
G 1.6E-09 1.4E-09 1.3E-09 1.2E-09 1.0E-09 8.5E-10 6.9E-10 5.4E-10 4.2E-10 3.2E-10 2.4E-10 1.8E-10 1.3E-10
 50  1  1  1  1 50 50  1  1  1  1 21
H 5.1E-05 4.4E-05 4.2E-05 4.0E-05 3.7E-05 3.3E-05 3.0E-05 2.7E-05 2.4E-05 2.2E-05 2.0E-05 1.8E-05 1.7E-05 1.6E-05 1.5E-05
  1.4E-05 1.4E-05 1.4E-05 1.3E-05 1.3E-05 1.3E-05 1.3E-05 1.3E-05 1.3E-05 1.3E-05 1.3E-05 1.3E-05 1.3E-05 1.3E-05 1.3E-05
  1.3E-05 1.3E-05 1.3E-05 1.3E-05 1.3E-05 1.3E-05 1.3E-05 1.3E-05 1.3E-05 1.3E-05 1.3E-05 1.3E-05 1.3E-05 1.3E-05 1.3E-05
  1.3E-05 1.3E-05 1.3E-05 1.3E-05 1.3E-05
H 7.7E-09
H 8.2E-09
H 1.4E-08
H 2.8E-08
H 4.3E-06 1.0E-05 1.9E-05 3.1E-05 4.4E-05 5.9E-05 7.3E-05 8.6E-05 9.8E-05 1.1E-04 1.2E-04 1.2E-04 1.3E-04 1.3E-04 1.3E-04
  1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.3E-04 1.3E-04 1.3E-04 1.3E-04 1.2E-04 1.2E-04 1.2E-04 1.2E-04 1.1E-04 1.1E-04
  1.1E-04 1.0E-04 1.0E-04 9.9E-05 9.6E-05 9.3E-05 9.1E-05 8.8E-05 8.5E-05 8.3E-05 8.0E-05 7.8E-05 7.6E-05 7.3E-05 7.1E-05
  6.9E-05 6.7E-05 6.5E-05 6.3E-05 6.1E-05
H 3.5E-07 8.2E-07 1.5E-06 2.5E-06 3.6E-06 4.8E-06 5.9E-06 6.9E-06 7.9E-06 8.7E-06 9.4E-06 9.9E-06 1.0E-05 1.1E-05 1.1E-05
  1.1E-05 1.1E-05 1.1E-05 1.1E-05 1.1E-05 1.1E-05 1.1E-05 1.0E-05 1.0E-05 1.0E-05 9.8E-06 9.6E-06 9.3E-06 9.1E-06 8.9E-06
  8.6E-06 8.4E-06 8.2E-06 8.0E-06 7.7E-06 7.5E-06 7.3E-06 7.1E-06 6.9E-06 6.7E-06 6.5E-06 6.3E-06 6.1E-06 5.9E-06 5.7E-06
  5.5E-06 5.4E-06 5.2E-06 5.1E-06 4.9E-06
H 7.1E-09
H 7.1E-09
H 7.2E-09
H 7.2E-09
H 5.8E-08 1.1E-07 1.9E-07 2.6E-07 3.2E-07 3.6E-07 3.9E-07 3.9E-07 3.7E-07 3.4E-07 3.1E-07 2.8E-07 2.4E-07 2.0E-07 1.7E-07
  1.4E-07 1.2E-07 9.8E-08 8.0E-08 6.5E-08 5.2E-08
! RA228   Class: W F1:   0.20000    02/26/88  20:33:33.1   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  1  1  1  1  1 50 32  1  1  1  1
G 1.4E-10
G 2.8E-10
G 1.1E-09
G 5.8E-09
```

9/30/88

508-840-6

```
G 2.1E-08
G 2.5E-07 5.0E-07 5.6E-07 5.5E-07 5.1E-07 4.5E-07 3.9E-07 3.3E-07 2.8E-07 2.4E-07 2.0E-07 1.7E-07 1.4E-07 1.2E-07 1.0E-07
  8.5E-08 7.2E-08 6.0E-08 5.1E-08 4.3E-08 3.6E-08 3.1E-08 2.6E-08 2.2E-08 1.9E-08 1.6E-08 1.4E-08 1.2E-08 9.8E-09 8.3E-09
  7.1E-09 6.0E-09 5.1E-09 4.4E-09 3.7E-09 3.2E-09 2.7E-09 2.3E-09 2.0E-09 1.7E-09 1.4E-09 1.2E-09 1.1E-09 9.0E-10 7.7E-10
  6.6E-10 5.7E-10 4.9E-10 4.2E-10 3.6E-10
G 2.7E-08 5.7E-08 6.5E-08 6.3E-08 5.6E-08 4.8E-08 4.0E-08 3.3E-08 2.7E-08 2.2E-08 1.8E-08 1.5E-08 1.2E-08 9.7E-09 7.9E-09
  6.4E-09 5.2E-09 4.3E-09 3.5E-09 2.9E-09 2.4E-09 1.9E-09 1.6E-09 1.3E-09 1.1E-09 8.9E-10 7.3E-10 6.0E-10 5.0E-10 4.1E-10
  3.4E-10 2.8E-10
G 1.7E-10
G 8.1E-10
G 2.2E-10
G 1.1E-10
  2  1  1  1  1 32 10  1  1  1  1
H 6.4E-06 2.9E-07
H 1.8E-09
H 1.6E-09
H 4.7E-09
H 1.3E-08
H 2.6E-07 5.4E-07 6.1E-07 5.9E-07 5.4E-07 4.8E-07 4.2E-07 3.6E-07 3.0E-07 2.6E-07 2.2E-07 1.8E-07 1.5E-07 1.3E-07 1.1E-07
  9.1E-08 7.7E-08 6.5E-08 5.5E-08 4.6E-08 3.9E-08 3.3E-08 2.8E-08 2.4E-08 2.0E-08 1.7E-08 1.4E-08 1.2E-08 1.0E-08 8.9E-09
  7.6E-09 6.5E-09
H 2.9E-08 6.2E-08 7.0E-08 6.8E-08 6.1E-08 5.2E-08 4.3E-08 3.6E-08 2.9E-08 2.4E-08 1.9E-08 1.6E-08 1.3E-08 1.0E-08 8.5E-09
  6.9E-09
H 5.5E-10
H 9.9E-10
H 1.3E-09
H 1.1E-09
! AC228   Class: Y F1:   0.00100     02/26/88  21:48:41.8   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1 17 10  4  1  1  1 13
G 7.4E-12
G 6.1E-10
G 1.1E-09
G 2.4E-09
G 1.9E-09
G 9.2E-10 6.4E-10 4.4E-10 3.1E-10 2.1E-10 1.5E-10 1.0E-10 7.0E-11 4.8E-11 3.3E-11 2.3E-11 1.6E-11 1.1E-11 7.6E-12 5.2E-12
  3.6E-12 2.5E-12
G 1.1E-10 5.2E-11 3.6E-11 2.5E-11 1.7E-11 1.2E-11 8.2E-12 5.6E-12 3.9E-12 2.7E-12
G 2.1E-11 7.0E-12 4.8E-12 3.4E-12
G 1.5E-10
G 2.3E-11
G 9.7E-13
G 2.8E-10 1.7E-10 1.2E-10 8.1E-11 5.5E-11 3.8E-11 2.6E-11 1.8E-11 1.2E-11 8.3E-12 5.7E-12 3.9E-12 2.6E-12
 12  1  1  1  1 17  9  1  1  1  1 13
H 1.2E-07 5.9E-08 2.9E-08 1.5E-08 7.7E-09 4.1E-09 2.2E-09 1.2E-09 6.8E-10 3.9E-10 2.3E-10 1.4E-10
H 1.1E-10
H 1.9E-10
H 4.1E-10
H 3.4E-10
H 6.5E-09 8.6E-09 8.7E-09 7.7E-09 6.3E-09 4.9E-09 3.7E-09 2.8E-09 2.0E-09 1.4E-09 1.0E-09 7.3E-10 5.1E-10 3.6E-10 2.5E-10
  1.7E-10 1.2E-10
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DOSINC.DAT

5.1012

9/30/88

910481809

DOSINC.DAT

5.1013

9/30/88

7081 8401 6

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H 5.4E-10 7.0E-10 7.0E-10 6.2E-10 5.1E-10 4.0E-10 3.0E-10 2.2E-10 1.6E-10
H 7.3E-11
H 2.5E-11
H 1.1E-11
H 6.5E-12
H 1.8E-09 2.3E-09 2.3E-09 2.0E-09 1.7E-09 1.3E-09 9.8E-10 7.2E-10 5.2E-10 3.7E-10 2.6E-10 1.8E-10 1.3E-10
! TH228   Class: Y F1:   0.00020     02/26/88  22:30:31.3   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1 18 12  1  1  1  1  4
G 1.2E-09
G 2.5E-09
G 5.0E-09
G 3.0E-08
G 1.3E-07
G 7.7E-07 5.3E-07 3.6E-07 2.4E-07 1.6E-07 1.1E-07 7.3E-08 5.0E-08 3.3E-08 2.3E-08 1.5E-08 1.0E-08 6.9E-09 4.7E-09 3.1E-09
  2.1E-09 1.4E-09 9.6E-10
G 6.3E-08 4.3E-08 2.9E-08 1.9E-08 1.3E-08 8.8E-09 5.9E-09 4.0E-09 2.7E-09 1.8E-09 1.2E-09 8.2E-10
G 1.2E-09
G 1.5E-09
G 1.2E-09
G 1.2E-09
G 1.0E-08 5.1E-09 2.5E-09 1.2E-09
 12  1  1  1  1 17 10  1  1  1  1  3
H 3.3E-04 1.6E-04 8.1E-05 4.1E-05 2.1E-05 1.1E-05 6.0E-06 3.3E-06 1.9E-06 1.1E-06 6.3E-07 3.8E-07
H 4.8E-08
H 4.6E-08
H 6.5E-08
H 1.3E-07
H 2.6E-05 3.5E-05 3.5E-05 3.0E-05 2.5E-05 1.9E-05 1.4E-05 1.0E-05 7.4E-06 5.2E-06 3.6E-06 2.5E-06 1.7E-06 1.2E-06 8.2E-07
  5.6E-07 3.8E-07
H 2.1E-06 2.8E-06 2.8E-06 2.5E-06 2.0E-06 1.5E-06 1.2E-06 8.4E-07 6.0E-07 4.2E-07
H 4.3E-08
H 4.4E-08
H 4.6E-08
H 4.5E-08
H 3.6E-07 4.0E-07 3.5E-07
! RA224   Class: W F1:   0.20000     02/26/88  23:06:51.4   Acute  Sv/Bq
 11  1  3  4  5  6  7  8 11 12 13 14
  1  1  1  1  1  1  1  1  1  1  1
G 8.7E-09
G 1.3E-08
G 1.8E-08
G 6.9E-08
G 1.9E-07
G 3.2E-07
G 2.7E-08
G 8.7E-09
G 9.5E-09
G 8.6E-09
G 8.6E-09
  1  1  1  1  1  1  1  1  1  1  1
```

```
H 6.2E-08
H 8.4E-09
H 1.1E-08
H 3.0E-08
H 7.2E-08
H 2.3E-07
H 1.9E-08
H 6.4E-09
H 6.8E-09
H 6.4E-09
H 6.4E-09
! PB212   Class: D F1:   0.20000     02/26/88  23:30:02.0   Acute  Sv/Bq
 13  1  3  4  5  6  7  8 11 12 13 14 17 16
   1  1  1  1  1  1  1  1  1  1  1  1  1
G 1.6E-09
G 2.9E-09
G 5.8E-09
G 1.7E-08
G 2.0E-08
G 1.8E-07
G 1.7E-08
G 1.7E-09
G 2.0E-09
G 1.7E-09
G 1.6E-09
G 2.5E-08
G 1.3E-08
   1  1  1  1  1  1  1  1  1  1  1  1  1
H 1.8E-07
H 3.6E-09
H 4.0E-09
H 5.5E-09
H 6.0E-09
H 3.9E-07
H 3.5E-08
H 3.4E-09
H 3.4E-09
H 3.4E-09
H 3.4E-09
H 5.2E-08
H 2.8E-08
! BI212   Class: W F1:   0.05000     02/26/88  23:43:11.6   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 16
   1  1  1  1  1  1  1  1  1  1  1  1
G 1.1E-11
G 1.6E-09
G 1.1E-09
G 7.1E-10
G 1.4E-10
G 3.9E-11
G 1.6E-11
```

DOSINC.DAT

5.1014

9/30/88

91048 1808

```
G 8.8E-12
G 2.9E-11
G 1.3E-11
G 7.7E-12
G 1.2E-09
  1  1  1  1  1  1  1  1  1  1  1  1
H 3.8E-08
H 1.1E-10
H 9.4E-11
H 8.0E-11
H 6.0E-11
H 2.4E-10
H 6.7E-11
H 4.9E-11
H 5.0E-11
H 5.0E-11
H 5.0E-11
H 7.8E-09
! PU236   Class: Y F1:   0.00010     02/26/88  23:48:37.2   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1 27 17  9  1  1  1 20
G 8.6E-13
G 1.3E-09
G 3.5E-09
G 1.9E-08
G 5.9E-08
G 4.8E-08 3.7E-08 2.9E-08 2.2E-08 1.7E-08 1.3E-08 1.0E-08 8.0E-09 6.2E-09 4.8E-09 3.7E-09 2.8E-09 2.2E-09 1.7E-09 1.3E-09
  1.0E-09 7.9E-10 6.1E-10 4.7E-10 3.6E-10 2.8E-10 2.2E-10 1.7E-10 1.3E-10 1.0E-10 7.8E-11 6.0E-11
G 3.8E-09 2.9E-09 2.3E-09 1.8E-09 1.4E-09 1.1E-09 8.2E-10 6.3E-10 4.9E-10 3.8E-10 2.9E-10 2.3E-10 1.7E-10 1.3E-10 1.0E-10
  8.1E-11 6.2E-11
G 5.2E-10 4.0E-10 3.1E-10 2.4E-10 1.9E-10 1.5E-10 1.2E-10 9.0E-11 7.0E-11
G 4.4E-12
G 9.7E-13
G 8.5E-13
G 1.3E-08 9.8E-09 7.4E-09 5.6E-09 4.3E-09 3.2E-09 2.4E-09 1.8E-09 1.4E-09 1.1E-09 8.0E-10 6.1E-10 4.6E-10 3.5E-10 2.6E-10
  2.0E-10 1.5E-10 1.1E-10 8.7E-11 6.6E-11
 16  1  1  1  1 24 14  1  1  1  1 17
H 6.4E-05 3.5E-05 2.0E-05 1.1E-05 6.5E-06 3.9E-06 2.3E-06 1.5E-06 9.3E-07 6.0E-07 4.0E-07 2.7E-07 1.9E-07 1.3E-07 9.3E-08
  6.8E-08
H 7.3E-10
H 1.8E-09
H 9.7E-09
H 2.9E-08
H 3.2E-06 4.9E-06 5.5E-06 5.5E-06 5.1E-06 4.5E-06 3.8E-06 3.2E-06 2.6E-06 2.1E-06 1.7E-06 1.3E-06 1.0E-06 8.1E-07 6.4E-07
  5.0E-07 3.9E-07 3.0E-07 2.3E-07 1.8E-07 1.4E-07 1.1E-07 8.4E-08 6.5E-08
H 2.6E-07 3.9E-07 4.4E-07 4.4E-07 4.0E-07 3.5E-07 3.0E-07 2.5E-07 2.0E-07 1.6E-07 1.3E-07 1.0E-07 8.2E-08 6.4E-08
H 3.5E-08
H 8.3E-11
H 8.9E-11
H 8.0E-11
H 8.7E-07 1.3E-06 1.5E-06 1.4E-06 1.3E-06 1.1E-06 9.5E-07 7.8E-07 6.3E-07 5.0E-07 3.9E-07 3.0E-07 2.4E-07 1.8E-07 1.4E-07
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DOSINC.DAT

5.1015

9/30/88

9 0 8 1 8 4 0 1 6

DOSINC.DAT

```
 1.1E-07 8.2E-08
! PU237   Class: Y F1:    0.00010      02/26/88   23:56:29.3   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1  1  1  1  1  1  1  1
G 7.7E-13
G 3.8E-11
G 1.2E-10
G 3.9E-10
G 1.0E-09
G 9.0E-12
G 2.4E-11
G 4.4E-12
G 7.2E-11
G 7.0E-12
G 3.8E-14
G 5.7E-12
  2  1  1  1  1  1  1  1  1  1  1  1
H 3.4E-09 9.2E-12
H 6.0E-11
H 6.1E-11
H 1.9E-10
H 4.8E-10
H 1.3E-10
H 7.1E-11
H 3.5E-12
H 3.5E-11
H 3.8E-11
H 2.1E-11
H 9.8E-11
! AM242M  Class: W F1:    0.00100      02/27/88   00:07:02.9   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1 50 50 50  1  1  1 50
G 7.5E-13
G 6.9E-11
G 2.6E-10
G 2.4E-09
G 9.7E-09
G 2.3E-07 4.2E-07 4.5E-07 4.5E-07 4.5E-07 4.4E-07 4.4E-07 4.3E-07 4.3E-07 4.2E-07 4.2E-07 4.1E-07 4.1E-07 4.0E-07 4.0E-07
  3.9E-07 3.9E-07 3.8E-07 3.8E-07 3.8E-07 3.7E-07 3.7E-07 3.6E-07 3.6E-07 3.5E-07 3.5E-07 3.4E-07 3.4E-07 3.4E-07 3.3E-07
  3.3E-07 3.2E-07 3.2E-07 3.1E-07 3.1E-07 3.1E-07 3.0E-07 3.0E-07 2.9E-07 2.9E-07 2.9E-07 2.8E-07 2.8E-07 2.7E-07 2.7E-07
  2.7E-07 2.6E-07 2.6E-07 2.6E-07 2.5E-07
G 1.9E-08 3.4E-08 3.7E-08 3.7E-08 3.7E-08 3.6E-08 3.6E-08 3.6E-08 3.5E-08 3.5E-08 3.4E-08 3.4E-08 3.3E-08 3.3E-08 3.3E-08
  3.2E-08 3.2E-08 3.1E-08 3.1E-08 3.1E-08 3.0E-08 3.0E-08 3.0E-08 2.9E-08 2.9E-08 2.8E-08 2.8E-08 2.8E-08 2.7E-08 2.7E-08
  2.7E-08 2.6E-08 2.6E-08 2.6E-08 2.5E-08 2.5E-08 2.5E-08 2.4E-08 2.4E-08 2.4E-08 2.3E-08 2.3E-08 2.3E-08 2.2E-08 2.2E-08
  2.2E-08 2.2E-08 2.1E-08 2.1E-08 2.1E-08
G 2.5E-09 4.6E-09 5.0E-09 5.0E-09 5.0E-09 5.0E-09 5.0E-09 5.0E-09 5.0E-09 4.9E-09 4.9E-09 4.9E-09 4.9E-09 4.8E-09 4.8E-09
  4.8E-09 4.8E-09 4.7E-09 4.7E-09 4.7E-09 4.7E-09 4.6E-09 4.6E-09 4.6E-09 4.5E-09 4.5E-09 4.5E-09 4.5E-09 4.4E-09 4.4E-09
  4.4E-09 4.4E-09 4.3E-09 4.3E-09 4.3E-09 4.3E-09 4.2E-09 4.2E-09 4.2E-09 4.1E-09 4.1E-09 4.1E-09 4.1E-09 4.0E-09 4.0E-09
  4.0E-09 4.0E-09 3.9E-09 3.9E-09 3.9E-09
G 2.9E-11
G 2.1E-12
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5.1016

9/30/88

0181 84016

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G 1.6E-13
G 6.3E-08 1.1E-07 1.2E-07 1.2E-07 1.1E-07 1.1E-07 1.1E-07 1.0E-07 9.9E-08 9.6E-08 9.3E-08 9.0E-08 8.7E-08 8.4E-08 8.1E-08
  7.9E-08 7.6E-08 7.4E-08 7.1E-08 6.9E-08 6.7E-08 6.4E-08 6.2E-08 6.0E-08 5.8E-08 5.6E-08 5.4E-08 5.3E-08 5.1E-08 4.9E-08
  4.8E-08 4.6E-08 4.4E-08 4.3E-08 4.2E-08 4.0E-08 3.9E-08 3.8E-08 3.6E-08 3.5E-08 3.4E-08 3.3E-08 3.2E-08 3.1E-08 2.9E-08
  2.8E-08 2.8E-08 2.7E-08 2.6E-08 2.5E-08
  2  1  1  1  1 50 50 50  1  1  1 50
H 3.7E-06 1.1E-07
H 2.6E-10
H 4.4E-10
H 2.1E-09
H 6.7E-09
H 2.6E-05 4.8E-05 5.2E-05 5.3E-05 5.2E-05 5.2E-05 5.1E-05 5.1E-05 5.0E-05 4.9E-05 4.9E-05 4.8E-05 4.8E-05 4.7E-05 4.7E-05
  4.6E-05 4.5E-05 4.5E-05 4.4E-05 4.4E-05 4.3E-05 4.3E-05 4.2E-05 4.2E-05 4.1E-05 4.1E-05 4.0E-05 4.0E-05 3.9E-05 3.9E-05
  3.8E-05 3.8E-05 3.7E-05 3.7E-05 3.6E-05 3.6E-05 3.5E-05 3.5E-05 3.4E-05 3.4E-05 3.3E-05 3.3E-05 3.2E-05 3.2E-05 3.2E-05
  3.1E-05 3.1E-05 3.0E-05 3.0E-05 2.9E-05
H 2.1E-06 4.0E-06 4.3E-06 4.3E-06 4.3E-06 4.2E-06 4.2E-06 4.1E-06 4.1E-06 4.0E-06 4.0E-06 3.9E-06 3.9E-06 3.9E-06 3.8E-06
  3.8E-06 3.7E-06 3.7E-06 3.6E-06 3.6E-06 3.5E-06 3.5E-06 3.4E-06 3.4E-06 3.4E-06 3.3E-06 3.3E-06 3.2E-06 3.2E-06 3.1E-06
  3.1E-06 3.1E-06 3.0E-06 3.0E-06 2.9E-06 2.9E-06 2.9E-06 2.8E-06 2.8E-06 2.8E-06 2.7E-06 2.7E-06 2.6E-06 2.6E-06 2.6E-06
  2.5E-06 2.5E-06 2.5E-06 2.4E-06 2.4E-06
H 2.8E-07 5.3E-07 5.8E-07 5.9E-07 5.9E-07 5.8E-07 5.8E-07 5.8E-07 5.8E-07 5.7E-07 5.7E-07 5.7E-07 5.7E-07 5.6E-07 5.6E-07
  5.6E-07 5.5E-07 5.5E-07 5.5E-07 5.4E-07 5.4E-07 5.4E-07 5.4E-07 5.3E-07 5.3E-07 5.3E-07 5.2E-07 5.2E-07 5.2E-07 5.1E-07
  5.1E-07 5.1E-07 5.0E-07 5.0E-07 5.0E-07 5.0E-07 4.9E-07 4.9E-07 4.9E-07 4.8E-07 4.8E-07 4.8E-07 4.7E-07 4.7E-07 4.7E-07
  4.6E-07 4.6E-07 4.6E-07 4.5E-07 4.5E-07
H 1.3E-10
H 1.6E-10
H 1.2E-10
H 7.0E-06 1.3E-05 1.4E-05 1.4E-05 1.3E-05 1.3E-05 1.2E-05 1.2E-05 1.2E-05 1.1E-05 1.1E-05 1.0E-05 1.0E-05 9.8E-06 9.5E-06
  9.2E-06 8.9E-06 8.6E-06 8.3E-06 8.0E-06 7.8E-06 7.5E-06 7.3E-06 7.0E-06 6.8E-06 6.6E-06 6.4E-06 6.2E-06 5.9E-06 5.7E-06
  5.6E-06 5.4E-06 5.2E-06 5.0E-06 4.9E-06 4.7E-06 4.5E-06 4.4E-06 4.2E-06 4.1E-06 4.0E-06 3.8E-06 3.7E-06 3.6E-06 3.4E-06
  3.3E-06 3.2E-06 3.1E-06 3.0E-06 2.9E-06
! AM242   Class: W F1:   0.00100     02/27/88  01:12:00.5   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1 50  3  1  1  1  1  4
G 1.6E-13
G 2.1E-10
G 4.5E-10
G 1.7E-09
G 2.6E-09
G 9.8E-10 2.1E-10 5.1E-11 1.7E-11 1.0E-11 8.5E-12 8.0E-12 7.7E-12 7.6E-12 7.4E-12 7.3E-12 7.1E-12 7.0E-12 6.8E-12 6.7E-12
  6.5E-12 6.4E-12 6.3E-12 6.1E-12 6.0E-12 5.9E-12 5.8E-12 5.6E-12 5.5E-12 5.4E-12 5.3E-12 5.2E-12 5.1E-12 5.0E-12 4.9E-12
  4.8E-12 4.7E-12 4.6E-12 4.5E-12 4.4E-12 4.3E-12 4.2E-12 4.1E-12 4.0E-12 4.0E-12 3.9E-12 3.8E-12 3.7E-12 3.7E-12 3.6E-12
  3.5E-12 3.4E-12 3.4E-12 3.3E-12 3.2E-12
G 8.3E-11 1.7E-11 4.2E-12
G 1.1E-11
G 1.0E-11
G 9.6E-13
G 2.6E-14
G 2.7E-10 5.7E-11 1.3E-11 4.4E-12
  1  1  1  1  1 50  4  2  1  1  1 25
H 4.7E-08
H 5.0E-11
```

5.1017

9/30/88

DOSINC.DAT

DOSINC.DAT

5.1018

9/30/88

```
H 1.1E-10
H 4.0E-10
H 6.5E-10
H 9.8E-08 2.5E-08 6.6E-09 2.0E-09 1.2E-09 9.8E-10 9.3E-10 9.0E-10 8.8E-10 8.6E-10 8.4E-10 8.2E-10 8.1E-10 7.9E-10 7.7E-10
  7.6E-10 7.4E-10 7.2E-10 7.1E-10 6.9E-10 6.8E-10 6.6E-10 6.5E-10 6.3E-10 6.2E-10 6.1E-10 5.9E-10 5.8E-10 5.7E-10 5.6E-10
  5.4E-10 5.3E-10 5.2E-10 5.1E-10 5.0E-10 4.9E-10 4.8E-10 4.7E-10 4.6E-10 4.5E-10 4.4E-10 4.3E-10 4.2E-10 4.1E-10 4.0E-10
  3.9E-10 3.8E-10 3.8E-10 3.7E-10 3.6E-10
H 8.0E-09 2.0E-09 4.9E-10 1.6E-10
H 1.1E-09 2.7E-10
H 4.7E-12
H 2.9E-12
H 2.5E-12
H 2.7E-08 6.6E-09 1.6E-09 5.1E-10 2.9E-10 2.4E-10 2.2E-10 2.1E-10 2.0E-10 1.9E-10 1.8E-10 1.8E-10 1.7E-10 1.6E-10 1.5E-10
  1.5E-10 1.4E-10 1.4E-10 1.3E-10 1.2E-10 1.2E-10 1.1E-10 1.1E-10 1.1E-10 1.0E-10
! CM242   Class: W F1:   0.00100    02/27/88  01:53:55.9   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1 50  4  2  1  1  1 22
G 9.0E-12
G 1.5E-09
G 3.5E-09
G 2.0E-08
G 6.3E-08
G 2.9E-07 6.2E-08 1.5E-08 5.1E-09 3.0E-09 2.5E-09 2.3E-09 2.3E-09 2.2E-09 2.2E-09 2.1E-09 2.1E-09 2.0E-09 2.0E-09 2.0E-09
  1.9E-09 1.9E-09 1.8E-09 1.8E-09 1.8E-09 1.7E-09 1.7E-09 1.6E-09 1.6E-09 1.6E-09 1.5E-09 1.5E-09 1.5E-09 1.4E-09 1.4E-09
  1.4E-09 1.3E-09 1.3E-09 1.3E-09 1.3E-09 1.2E-09 1.2E-09 1.2E-09 1.2E-09 1.1E-09 1.1E-09 1.1E-09 1.1E-09 1.0E-09 1.0E-09
  1.0E-09 9.7E-10 9.5E-10 9.3E-10 9.1E-10
G 2.4E-08 5.1E-09 1.2E-09 4.1E-10
G 3.2E-09 6.9E-10
G 1.2E-11
G 9.1E-12
G 9.0E-12
G 7.9E-08 1.7E-08 3.9E-09 1.3E-09 7.3E-10 6.0E-10 5.5E-10 5.3E-10 5.0E-10 4.8E-10 4.6E-10 4.4E-10 4.2E-10 4.1E-10 3.9E-10
  3.7E-10 3.6E-10 3.4E-10 3.3E-10 3.1E-10 3.0E-10 2.9E-10
  1  1  1  1  1 50  4  2  1  1  1 25
H 1.4E-05
H 1.6E-09
H 2.5E-09
H 1.0E-08
H 3.0E-08
H 2.9E-05 7.3E-06 1.8E-06 5.9E-07 3.5E-07 2.9E-07 2.7E-07 2.7E-07 2.6E-07 2.5E-07 2.5E-07 2.4E-07 2.4E-07 2.3E-07 2.3E-07
  2.2E-07 2.2E-07 2.1E-07 2.1E-07 2.0E-07 2.0E-07 2.0E-07 1.9E-07 1.9E-07 1.8E-07 1.8E-07 1.8E-07 1.7E-07 1.7E-07 1.6E-07
  1.6E-07 1.6E-07 1.5E-07 1.5E-07 1.5E-07 1.4E-07 1.4E-07 1.4E-07 1.4E-07 1.3E-07 1.3E-07 1.3E-07 1.2E-07 1.2E-07 1.2E-07
  1.2E-07 1.1E-07 1.1E-07 1.1E-07 1.1E-07
H 2.4E-06 5.9E-07 1.4E-07 4.8E-08
H 3.1E-07 8.0E-08
H 9.4E-10
H 9.4E-10
H 9.4E-10
H 7.9E-06 1.9E-06 4.6E-07 1.5E-07 8.6E-08 7.0E-08 6.5E-08 6.1E-08 5.9E-08 5.6E-08 5.4E-08 5.2E-08 5.0E-08 4.7E-08 4.5E-08
  4.4E-08 4.2E-08 4.0E-08 3.8E-08 3.7E-08 3.5E-08 3.4E-08 3.2E-08 3.1E-08 3.0E-08
! PU242   Class: Y F1:   0.00010    02/27/88  02:27:57.3   Acute  Sv/Bq
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DOSINC.DAT

5.1019

9/30/88

3-1-8-1-4-8-0-1-6

```
12  1  3  4  5  6  7  8 11 12 13 14 17
 1  1  1  1  1 50 50 50  1  1  1 50
G 7.3E-13
G 1.2E-09
G 2.8E-09
G 1.7E-08
G 5.1E-08
G 4.5E-08 4.5E-08 4.4E-08 4.3E-08 4.3E-08 4.2E-08 4.2E-08 4.1E-08 4.0E-08 4.0E-08 3.9E-08 3.9E-08 3.8E-08 3.8E-08 3.7E-08
  3.7E-08 3.6E-08 3.6E-08 3.5E-08 3.5E-08 3.4E-08 3.4E-08 3.3E-08 3.3E-08 3.2E-08 3.2E-08 3.2E-08 3.1E-08 3.1E-08 3.0E-08
  3.0E-08 2.9E-08 2.9E-08 2.9E-08 2.8E-08 2.8E-08 2.7E-08 2.7E-08 2.7E-08 2.6E-08 2.6E-08 2.6E-08 2.5E-08 2.5E-08 2.5E-08
  2.4E-08 2.4E-08 2.4E-08 2.3E-08 2.3E-08
G 3.7E-09 3.7E-09 3.6E-09 3.6E-09 3.5E-09 3.5E-09 3.4E-09 3.4E-09 3.3E-09 3.3E-09 3.2E-09 3.2E-09 3.2E-09 3.1E-09 3.1E-09
  3.0E-09 3.0E-09 2.9E-09 2.9E-09 2.9E-09 2.8E-09 2.8E-09 2.7E-09 2.7E-09 2.7E-09 2.6E-09 2.6E-09 2.6E-09 2.5E-09 2.5E-09
  2.5E-09 2.4E-09 2.4E-09 2.4E-09 2.3E-09 2.3E-09 2.3E-09 2.2E-09 2.2E-09 2.2E-09 2.1E-09 2.1E-09 2.1E-09 2.1E-09 2.0E-09
  2.0E-09 2.0E-09 1.9E-09 1.9E-09 1.9E-09
G 4.9E-10 4.9E-10 4.9E-10 4.8E-10 4.8E-10 4.8E-10 4.7E-10 4.7E-10 4.7E-10 4.6E-10 4.6E-10 4.6E-10 4.5E-10 4.5E-10 4.5E-10
  4.4E-10 4.4E-10 4.4E-10 4.4E-10 4.3E-10 4.3E-10 4.3E-10 4.2E-10 4.2E-10 4.2E-10 4.2E-10 4.1E-10 4.1E-10 4.1E-10 4.0E-10
  4.0E-10 4.0E-10 4.0E-10 3.9E-10 3.9E-10 3.9E-10 3.8E-10 3.8E-10 3.8E-10 3.8E-10 3.7E-10 3.7E-10 3.7E-10 3.7E-10 3.6E-10
  3.6E-10 3.6E-10 3.6E-10 3.5E-10 3.5E-10
G 3.9E-12
G 9.0E-13
G 7.1E-13
G 1.2E-08 1.2E-08 1.1E-08 1.1E-08 1.1E-08 1.0E-08 1.0E-08 9.6E-09 9.3E-09 9.0E-09 8.7E-09 8.4E-09 8.1E-09 7.8E-09 7.6E-09
  7.3E-09 7.1E-09 6.8E-09 6.6E-09 6.4E-09 6.1E-09 5.9E-09 5.7E-09 5.5E-09 5.4E-09 5.2E-09 5.0E-09 4.8E-09 4.7E-09 4.5E-09
  4.3E-09 4.2E-09 4.1E-09 3.9E-09 3.8E-09 3.7E-09 3.5E-09 3.4E-09 3.3E-09 3.2E-09 3.1E-09 3.0E-09 2.9E-09 2.8E-09 2.7E-09
  2.6E-09 2.5E-09 2.4E-09 2.3E-09 2.3E-09
 50  1  1  1  1 50 50 50  1  1  1 50
H 6.0E-05 4.2E-05 3.0E-05 2.2E-05 1.6E-05 1.2E-05 9.4E-06 7.5E-06 6.0E-06 5.0E-06 4.2E-06 3.7E-06 3.2E-06 2.9E-06 2.6E-06
  2.4E-06 2.3E-06 2.2E-06 2.1E-06 2.0E-06 2.0E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06
  1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06
  1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06
H 6.5E-10
H 1.4E-09
H 8.3E-09
H 2.5E-08
H 3.1E-06 5.9E-06 8.5E-06 1.1E-05 1.3E-05 1.4E-05 1.5E-05 1.6E-05 1.7E-05 1.7E-05 1.8E-05 1.8E-05 1.8E-05 1.8E-05 1.8E-05
  1.8E-05 1.8E-05 1.8E-05 1.7E-05 1.7E-05 1.7E-05 1.7E-05 1.7E-05 1.6E-05 1.6E-05 1.6E-05 1.6E-05 1.6E-05 1.5E-05 1.5E-05
  1.5E-05 1.5E-05 1.5E-05 1.4E-05 1.4E-05 1.4E-05 1.4E-05 1.4E-05 1.3E-05 1.3E-05 1.3E-05 1.3E-05 1.3E-05 1.3E-05 1.2E-05
  1.2E-05 1.2E-05 1.2E-05 1.2E-05 1.2E-05
H 2.5E-07 4.9E-07 7.0E-07 8.9E-07 1.0E-06 1.2E-06 1.3E-06 1.3E-06 1.4E-06 1.4E-06 1.5E-06 1.5E-06 1.5E-06 1.5E-06 1.5E-06
  1.5E-06 1.5E-06 1.5E-06 1.4E-06 1.4E-06 1.4E-06 1.4E-06 1.4E-06 1.4E-06 1.3E-06 1.3E-06 1.3E-06 1.3E-06 1.3E-06 1.3E-06
  1.2E-06 1.2E-06 1.2E-06 1.2E-06 1.2E-06 1.2E-06 1.1E-06 1.1E-06 1.1E-06 1.1E-06 1.1E-06 1.1E-06 1.0E-06 1.0E-06 1.0E-06
  1.0E-06 9.9E-07 9.8E-07 9.7E-07 9.5E-07
H 3.4E-08 6.5E-08 9.4E-08 1.2E-07 1.4E-07 1.6E-07 1.7E-07 1.8E-07 1.9E-07 2.0E-07 2.0E-07 2.1E-07 2.1E-07 2.1E-07 2.1E-07
  2.1E-07 2.1E-07 2.1E-07 2.1E-07 2.1E-07 2.1E-07 2.1E-07 2.1E-07 2.0E-07 2.0E-07 2.0E-07 2.0E-07 2.0E-07 2.0E-07 2.0E-07
  2.0E-07 1.9E-07 1.9E-07 1.9E-07 1.9E-07 1.9E-07 1.9E-07 1.9E-07 1.9E-07 1.8E-07 1.8E-07 1.8E-07 1.8E-07 1.8E-07 1.8E-07
  1.8E-07 1.8E-07 1.7E-07 1.7E-07 1.7E-07
H 7.3E-11
H 8.2E-11
H 7.4E-11
H 8.4E-07 1.6E-06 2.3E-06 2.8E-06 3.3E-06 3.7E-06 3.9E-06 4.1E-06 4.2E-06 4.2E-06 4.2E-06 4.2E-06 4.1E-06 4.1E-06 4.0E-06
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 3.9E-06 3.8E-06 3.7E-06 3.6E-06 3.5E-06 3.4E-06 3.3E-06 3.2E-06 3.1E-06 3.0E-06 2.9E-06 2.8E-06 2.7E-06 2.6E-06 2.5E-06
 2.4E-06 2.3E-06 2.3E-06 2.2E-06 2.1E-06 2.0E-06 2.0E-06 1.9E-06 1.8E-06 1.8E-06 1.7E-06 1.7E-06 1.6E-06 1.5E-06 1.5E-06
 1.4E-06 1.4E-06 1.3E-06 1.3E-06 1.3E-06
! NP238   Class: W F1:   0.00100    02/27/88  02:48:28.1   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1 50  1  1  1  1  1  1
G 1.0E-11
G 4.3E-10
G 1.1E-09
G 4.2E-09
G 9.3E-09
G 8.8E-11 5.6E-11 5.6E-11 5.5E-11 5.4E-11 5.3E-11 5.2E-11 5.2E-11 5.1E-11 5.0E-11 4.9E-11 4.9E-11 4.8E-11 4.7E-11 4.7E-11
  4.6E-11 4.5E-11 4.5E-11 4.4E-11 4.3E-11 4.3E-11 4.2E-11 4.1E-11 4.1E-11 4.0E-11 4.0E-11 3.9E-11 3.8E-11 3.8E-11 3.7E-11
  3.7E-11 3.6E-11 3.6E-11 3.5E-11 3.5E-11 3.4E-11 3.4E-11 3.3E-11 3.3E-11 3.2E-11 3.2E-11 3.1E-11 3.1E-11 3.0E-11 3.0E-11
  3.0E-11 2.9E-11 2.9E-11 2.8E-11 2.8E-11
G 8.3E-11
G 3.2E-11
G 3.8E-10
G 4.8E-11
G 1.5E-12
G 4.6E-11
  2  1  1  1  1 50 50 50  1  1  1 50
H 3.3E-09 9.6E-12
H 1.7E-10
H 3.8E-10
H 1.4E-09
H 3.0E-09
H 6.4E-09 6.6E-09 6.5E-09 6.4E-09 6.3E-09 6.2E-09 6.1E-09 6.0E-09 5.9E-09 5.8E-09 5.8E-09 5.7E-09 5.6E-09 5.5E-09 5.4E-09
  5.3E-09 5.3E-09 5.2E-09 5.1E-09 5.0E-09 5.0E-09 4.9E-09 4.8E-09 4.7E-09 4.7E-09 4.6E-09 4.5E-09 4.5E-09 4.4E-09 4.3E-09
  4.3E-09 4.2E-09 4.2E-09 4.1E-09 4.0E-09 4.0E-09 3.9E-09 3.9E-09 3.8E-09 3.7E-09 3.7E-09 3.6E-09 3.6E-09 3.5E-09 3.5E-09
  3.4E-09 3.4E-09 3.3E-09 3.3E-09 3.2E-09
H 6.3E-10 5.3E-10 5.2E-10 5.1E-10 5.1E-10 5.0E-10 4.9E-10 4.8E-10 4.8E-10 4.7E-10 4.6E-10 4.6E-10 4.5E-10 4.4E-10 4.4E-10
  4.3E-10 4.2E-10 4.2E-10 4.1E-10 4.1E-10 4.0E-10 3.9E-10 3.9E-10 3.8E-10 3.8E-10 3.7E-10 3.7E-10 3.6E-10 3.5E-10 3.5E-10
  3.4E-10 3.4E-10 3.3E-10 3.3E-10 3.2E-10 3.2E-10 3.1E-10 3.1E-10 3.1E-10 3.0E-10 3.0E-10 2.9E-10 2.9E-10 2.8E-10 2.8E-10
  2.8E-10 2.7E-10 2.7E-10 2.6E-10 2.6E-10
H 6.2E-11 4.3E-11 4.2E-11 4.1E-11 4.1E-11 4.0E-11 4.0E-11 3.9E-11 3.9E-11 3.8E-11 3.7E-11 3.7E-11 3.6E-11 3.6E-11 3.5E-11
  3.5E-11 3.4E-11 3.4E-11 3.3E-11 3.3E-11 3.2E-11 3.2E-11 3.1E-11 3.1E-11 3.0E-11 3.0E-11 2.9E-11 2.9E-11 2.9E-11 2.8E-11
  2.8E-11 2.7E-11 2.7E-11 2.7E-11 2.6E-11 2.6E-11 2.5E-11 2.5E-11 2.5E-11 2.4E-11 2.4E-11 2.4E-11 2.3E-11 2.3E-11 2.3E-11
  2.2E-11 2.2E-11 2.2E-11 2.1E-11 2.1E-11
H 1.3E-10
H 4.1E-11
H 2.4E-11
H 4.5E-10 3.5E-10 3.4E-10 3.3E-10 3.2E-10 3.2E-10 3.1E-10 3.0E-10 2.9E-10 2.9E-10 2.8E-10 2.7E-10 2.7E-10 2.6E-10 2.5E-10
  2.5E-10 2.4E-10 2.4E-10 2.3E-10 2.2E-10 2.2E-10 2.1E-10 2.1E-10 2.0E-10 2.0E-10 1.9E-10 1.9E-10 1.8E-10 1.8E-10 1.7E-10
  1.7E-10 1.7E-10 1.6E-10 1.6E-10 1.5E-10 1.5E-10 1.5E-10 1.4E-10 1.4E-10 1.4E-10 1.3E-10 1.3E-10 1.3E-10 1.2E-10 1.2E-10
  1.2E-10 1.1E-10 1.1E-10 1.1E-10 1.1E-10
! CM244   Class: W F1:   0.00100    02/27/88  03:03:59.6   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1 50 50 50  1  1  1 50
G 8.6E-12
G 1.3E-09
```

```
G 3.5E-09
G 1.9E-08
G 5.9E-08
G 5.3E-07 5.1E-07 4.8E-07 4.6E-07 4.3E-07 4.1E-07 3.9E-07 3.7E-07 3.5E-07 3.3E-07 3.2E-07 3.0E-07 2.9E-07 2.7E-07 2.6E-07
  2.4E-07 2.3E-07 2.2E-07 2.1E-07 2.0E-07 1.9E-07 1.8E-07 1.7E-07 1.6E-07 1.5E-07 1.5E-07 1.4E-07 1.3E-07 1.2E-07 1.2E-07
  1.1E-07 1.1E-07 1.0E-07 9.6E-08 9.1E-08 8.6E-08 8.2E-08 7.8E-08 7.4E-08 7.0E-08 6.7E-08 6.3E-08 6.0E-08 5.7E-08 5.4E-08
  5.2E-08 4.9E-08 4.6E-08 4.4E-08 4.2E-08
G 4.3E-08 4.1E-08 3.9E-08 3.7E-08 3.5E-08 3.3E-08 3.2E-08 3.0E-08 2.9E-08 2.7E-08 2.6E-08 2.4E-08 2.3E-08 2.2E-08 2.1E-08
  2.0E-08 1.9E-08 1.8E-08 1.7E-08 1.6E-08 1.5E-08 1.5E-08 1.4E-08 1.3E-08 1.2E-08 1.2E-08 1.1E-08 1.1E-08 1.0E-08 9.6E-09
  9.1E-09 8.6E-09 8.2E-09 7.8E-09 7.4E-09 7.0E-09 6.7E-09 6.3E-09 6.0E-09 5.7E-09 5.4E-09 5.1E-09 4.9E-09 4.6E-09 4.4E-09
  4.2E-09 4.0E-09 3.8E-09 3.6E-09 3.4E-09
G 5.9E-09 5.6E-09 5.4E-09 5.1E-09 4.9E-09 4.7E-09 4.5E-09 4.3E-09 4.1E-09 3.9E-09 3.7E-09 3.6E-09 3.4E-09 3.3E-09 3.1E-09
  3.0E-09 2.9E-09 2.7E-09 2.6E-09 2.5E-09 2.4E-09 2.3E-09 2.2E-09 2.1E-09 2.0E-09 1.9E-09 1.8E-09 1.7E-09 1.7E-09 1.6E-09
  1.5E-09 1.5E-09 1.4E-09 1.3E-09 1.3E-09 1.2E-09 1.2E-09 1.1E-09 1.1E-09 1.0E-09 9.7E-10 9.3E-10 8.9E-10 8.5E-10 8.1E-10
  7.8E-10 7.4E-10 7.1E-10 6.8E-10 6.5E-10
G 1.2E-11
G 8.6E-12
G 8.5E-12
G 1.4E-07 1.3E-07 1.2E-07 1.1E-07 1.1E-07 9.9E-08 9.2E-08 8.6E-08 8.0E-08 7.4E-08 6.9E-08 6.4E-08 6.0E-08 5.5E-08 5.1E-08
  4.8E-08 4.5E-08 4.1E-08 3.8E-08 3.6E-08 3.3E-08 3.1E-08 2.9E-08 2.7E-08 2.5E-08 2.3E-08 2.2E-08 2.0E-08 1.9E-08 1.7E-08
  1.6E-08 1.5E-08 1.4E-08 1.3E-08 1.2E-08 1.1E-08 1.0E-08 9.7E-09 9.0E-09 8.4E-09 7.8E-09 7.2E-09 6.7E-09 6.3E-09 5.8E-09
  5.4E-09 5.0E-09 4.7E-09 4.4E-09 4.1E-09
  2  1  1  1  1 50 50 50  1  1  1 50
H 1.8E-05 1.5E-07
H 1.6E-09
H 2.7E-09
H 1.0E-08
H 3.0E-08
H 5.6E-05 5.9E-05 5.6E-05 5.3E-05 5.0E-05 4.8E-05 4.5E-05 4.3E-05 4.1E-05 3.9E-05 3.7E-05 3.5E-05 3.3E-05 3.2E-05 3.0E-05
  2.8E-05 2.7E-05 2.6E-05 2.4E-05 2.3E-05 2.2E-05 2.1E-05 2.0E-05 1.9E-05 1.8E-05 1.7E-05 1.6E-05 1.5E-05 1.4E-05 1.4E-05
  1.3E-05 1.2E-05 1.2E-05 1.1E-05 1.1E-05 1.0E-05 9.6E-06 9.1E-06 8.6E-06 8.2E-06 7.8E-06 7.4E-06 7.0E-06 6.7E-06 6.3E-06
  6.0E-06 5.7E-06 5.4E-06 5.1E-06 4.9E-06
H 4.5E-06 4.8E-06 4.5E-06 4.3E-06 4.1E-06 3.9E-06 3.7E-06 3.5E-06 3.3E-06 3.2E-06 3.0E-06 2.8E-06 2.7E-06 2.6E-06 2.4E-06
  2.3E-06 2.2E-06 2.1E-06 2.0E-06 1.9E-06 1.8E-06 1.7E-06 1.6E-06 1.5E-06 1.4E-06 1.4E-06 1.3E-06 1.2E-06 1.2E-06 1.1E-06
  1.1E-06 1.0E-06 9.6E-07 9.1E-07 8.6E-07 8.2E-07 7.8E-07 7.4E-07 7.0E-07 6.6E-07 6.3E-07 6.0E-07 5.7E-07 5.4E-07 5.1E-07
  4.9E-07 4.6E-07 4.4E-07 4.2E-07 4.0E-07
H 6.2E-07 6.5E-07 6.3E-07 6.0E-07 5.7E-07 5.5E-07 5.2E-07 5.0E-07 4.8E-07 4.6E-07 4.4E-07 4.2E-07 4.0E-07 3.8E-07 3.6E-07
  3.5E-07 3.3E-07 3.2E-07 3.0E-07 2.9E-07 2.8E-07 2.7E-07 2.5E-07 2.4E-07 2.3E-07 2.2E-07 2.1E-07 2.0E-07 1.9E-07 1.9E-07
  1.8E-07 1.7E-07 1.6E-07 1.6E-07 1.5E-07 1.4E-07 1.4E-07 1.3E-07 1.2E-07 1.2E-07 1.1E-07 1.1E-07 1.0E-07 9.9E-08 9.5E-08
  9.1E-08 8.7E-08 8.3E-08 7.9E-08 7.6E-08
H 1.0E-09
H 1.0E-09
H 9.9E-10
H 1.5E-05 1.5E-05 1.4E-05 1.3E-05 1.2E-05 1.2E-05 1.1E-05 1.0E-05 9.3E-06 8.6E-06 8.0E-06 7.5E-06 7.0E-06 6.5E-06 6.0E-06
  5.6E-06 5.2E-06 4.8E-06 4.5E-06 4.2E-06 3.9E-06 3.6E-06 3.4E-06 3.1E-06 2.9E-06 2.7E-06 2.5E-06 2.3E-06 2.2E-06 2.0E-06
  1.9E-06 1.7E-06 1.6E-06 1.5E-06 1.4E-06 1.3E-06 1.2E-06 1.1E-06 1.1E-06 9.8E-07 9.1E-07 8.5E-07 7.9E-07 7.3E-07 6.8E-07
  6.3E-07 5.9E-07 5.5E-07 5.1E-07 4.7E-07
! PU244   Class: Y F1:   0.00010     02/27/88  03:36:04.8   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1 50 50 50  1  1  1 50
G 7.8E-12
```

DOSINC.DAT

```
G 1.3E-09
G 3.6E-09
G 2.4E-08
G 8.4E-08
G 4.5E-08 4.5E-08 4.4E-08 4.3E-08 4.3E-08 4.2E-08 4.2E-08 4.1E-08 4.1E-08 4.0E-08 3.9E-08 3.9E-08 3.8E-08 3.8E-08 3.7E-08
  3.7E-08 3.6E-08 3.6E-08 3.5E-08 3.5E-08 3.4E-08 3.4E-08 3.3E-08 3.3E-08 3.3E-08 3.2E-08 3.2E-08 3.1E-08 3.1E-08 3.0E-08
  3.0E-08 3.0E-08 2.9E-08 2.9E-08 2.8E-08 2.8E-08 2.8E-08 2.7E-08 2.7E-08 2.6E-08 2.6E-08 2.6E-08 2.5E-08 2.5E-08 2.5E-08
  2.4E-08 2.4E-08 2.4E-08 2.3E-08 2.3E-08
G 3.7E-09 3.6E-09 3.5E-09 3.5E-09 3.5E-09 3.4E-09 3.4E-09 3.3E-09 3.3E-09 3.2E-09 3.2E-09 3.1E-09 3.1E-09 3.1E-09 3.0E-09
  3.0E-09 2.9E-09 2.9E-09 2.8E-09 2.8E-09 2.8E-09 2.7E-09 2.7E-09 2.7E-09 2.6E-09 2.6E-09 2.6E-09 2.5E-09 2.5E-09 2.4E-09
  2.4E-09 2.4E-09 2.3E-09 2.3E-09 2.3E-09 2.3E-09 2.2E-09 2.2E-09 2.2E-09 2.1E-09 2.1E-09 2.1E-09 2.0E-09 2.0E-09 2.0E-09
  2.0E-09 1.9E-09 1.9E-09 1.9E-09 1.9E-09
G 5.7E-10 4.9E-10 4.9E-10 4.9E-10 4.8E-10 4.8E-10 4.8E-10 4.8E-10 4.7E-10 4.7E-10 4.7E-10 4.6E-10 4.6E-10 4.6E-10 4.5E-10
  4.5E-10 4.5E-10 4.4E-10 4.4E-10 4.4E-10 4.3E-10 4.3E-10 4.3E-10 4.3E-10 4.2E-10 4.2E-10 4.2E-10 4.1E-10 4.1E-10 4.1E-10
  4.1E-10 4.0E-10 4.0E-10 4.0E-10 4.0E-10 3.9E-10 3.9E-10 3.9E-10 3.8E-10 3.8E-10 3.8E-10 3.8E-10 3.7E-10 3.7E-10 3.7E-10
  3.7E-10 3.6E-10 3.6E-10 3.6E-10 3.6E-10
G 4.6E-10
G 5.2E-11
G 1.8E-12
G 1.2E-08 1.2E-08 1.1E-08 1.1E-08 1.1E-08 1.0E-08 9.9E-09 9.6E-09 9.2E-09 8.9E-09 8.6E-09 8.3E-09 8.0E-09 7.8E-09 7.5E-09
  7.3E-09 7.0E-09 6.8E-09 6.5E-09 6.3E-09 6.1E-09 5.9E-09 5.7E-09 5.5E-09 5.3E-09 5.1E-09 5.0E-09 4.8E-09 4.6E-09 4.5E-09
  4.3E-09 4.2E-09 4.0E-09 3.9E-09 3.8E-09 3.6E-09 3.5E-09 3.4E-09 3.3E-09 3.2E-09 3.1E-09 3.0E-09 2.9E-09 2.8E-09 2.7E-09
  2.6E-09 2.5E-09 2.4E-09 2.3E-09 2.2E-09
 50  1  1  1  1 50 50 50  1  1  1 50
H 5.9E-05 4.1E-05 2.9E-05 2.1E-05 1.6E-05 1.2E-05 9.2E-06 7.3E-06 5.9E-06 4.9E-06 4.1E-06 3.6E-06 3.2E-06 2.8E-06 2.6E-06
  2.4E-06 2.2E-06 2.1E-06 2.0E-06 2.0E-06 1.9E-06 1.9E-06 1.9E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06
  1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06
  1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06
H 3.0E-09
H 2.7E-09
H 1.4E-08
H 4.4E-08
H 3.1E-06 5.9E-06 8.5E-06 1.1E-05 1.3E-05 1.4E-05 1.5E-05 1.6E-05 1.7E-05 1.7E-05 1.8E-05 1.8E-05 1.8E-05 1.8E-05 1.8E-05
  1.8E-05 1.8E-05 1.8E-05 1.8E-05 1.7E-05 1.7E-05 1.7E-05 1.7E-05 1.7E-05 1.6E-05 1.6E-05 1.6E-05 1.6E-05 1.6E-05 1.5E-05
  1.5E-05 1.5E-05 1.5E-05 1.4E-05 1.4E-05 1.4E-05 1.4E-05 1.4E-05 1.4E-05 1.3E-05 1.3E-05 1.3E-05 1.3E-05 1.3E-05 1.2E-05
  1.2E-05 1.2E-05 1.2E-05 1.2E-05 1.2E-05
H 2.5E-07 4.8E-07 6.9E-07 8.7E-07 1.0E-06 1.1E-06 1.2E-06 1.3E-06 1.4E-06 1.4E-06 1.4E-06 1.4E-06 1.5E-06 1.5E-06 1.5E-06
  1.4E-06 1.4E-06 1.4E-06 1.4E-06 1.4E-06 1.4E-06 1.4E-06 1.3E-06 1.3E-06 1.3E-06 1.3E-06 1.3E-06 1.3E-06 1.2E-06 1.2E-06
  1.2E-06 1.2E-06 1.2E-06 1.2E-06 1.2E-06 1.1E-06 1.1E-06 1.1E-06 1.1E-06 1.1E-06 1.1E-06 1.0E-06 1.0E-06 1.0E-06 1.0E-06
  9.9E-07 9.8E-07 9.6E-07 9.5E-07 9.4E-07
H 3.4E-08 6.5E-08 9.5E-08 1.2E-07 1.4E-07 1.6E-07 1.7E-07 1.8E-07 1.9E-07 2.0E-07 2.0E-07 2.1E-07 2.1E-07 2.1E-07 2.1E-07
  2.1E-07 2.1E-07 2.1E-07 2.1E-07 2.1E-07 2.1E-07 2.1E-07 2.1E-07 2.1E-07 2.1E-07 2.0E-07 2.0E-07 2.0E-07 2.0E-07 2.0E-07
  2.0E-07 2.0E-07 2.0E-07 1.9E-07 1.9E-07 1.9E-07 1.9E-07 1.9E-07 1.9E-07 1.9E-07 1.9E-07 1.8E-07 1.8E-07 1.8E-07 1.8E-07
  1.8E-07 1.8E-07 1.8E-07 1.8E-07 1.7E-07
H 5.0E-10
H 1.6E-09
H 1.2E-09
H 8.3E-07 1.6E-06 2.3E-06 2.8E-06 3.3E-06 3.6E-06 3.9E-06 4.0E-06 4.1E-06 4.2E-06 4.2E-06 4.2E-06 4.1E-06 4.0E-06 4.0E-06
  3.9E-06 3.8E-06 3.7E-06 3.6E-06 3.5E-06 3.4E-06 3.3E-06 3.2E-06 3.1E-06 3.0E-06 2.9E-06 2.8E-06 2.7E-06 2.6E-06 2.5E-06
  2.4E-06 2.3E-06 2.3E-06 2.2E-06 2.1E-06 2.0E-06 2.0E-06 1.9E-06 1.8E-06 1.8E-06 1.7E-06 1.7E-06 1.6E-06 1.5E-06 1.5E-06
  1.4E-06 1.4E-06 1.3E-06 1.3E-06 1.3E-06
```

5.1022

9/30/88

9 1 8 1 8 4 0 1 6

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! U 240   Class: Y F1:   0.00200    02/27/88  03:58:03.4   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 16
  1  1  1  1  1 50  1  1  1  1  1  1
G 3.9E-12
G 9.5E-10
G 2.1E-09
G 7.2E-09
G 1.0E-08
G 1.2E-11 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 1.0E-11 1.1E-11 1.2E-11 1.2E-11 1.3E-11 1.4E-11 1.4E-11
  1.5E-11 1.6E-11 1.6E-11 1.7E-11 1.7E-11 1.8E-11 1.8E-11 1.9E-11 1.9E-11 1.9E-11 2.0E-11 2.0E-11 2.1E-11 2.1E-11 2.1E-11
  2.1E-11 2.2E-11 2.2E-11 2.2E-11 2.2E-11 2.3E-11 2.3E-11 2.3E-11 2.3E-11 2.3E-11 2.4E-11 2.4E-11 2.4E-11 2.4E-11 2.4E-11
  2.4E-11 2.4E-11 2.5E-11 2.5E-11 2.5E-11
G 2.7E-11
G 9.9E-12
G 1.3E-10
G 1.6E-11
G 5.9E-13
G 2.8E-11
  6  1  1  1  1  1  1  1  1  1  1  1
H 2.3E-09 1.0E-11 7.2E-12 5.3E-12 3.9E-12 3.0E-12
H 2.5E-10
H 5.3E-10
H 1.9E-09
H 2.6E-09
H 9.8E-12
H 1.2E-11
H 2.9E-12
H 3.4E-11
H 8.8E-12
H 4.0E-12
H 2.0E-11
! CM245   Class: W F1:   0.00100    02/27/88  04:11:15.0   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1 50 50 50  1  1  1 50
G 1.2E-11
G 1.4E-09
G 3.3E-09
G 2.0E-08
G 5.8E-08
G 5.0E-07 4.9E-07 4.8E-07 4.8E-07 4.7E-07 4.6E-07 4.6E-07 4.5E-07 4.5E-07 4.4E-07 4.3E-07 4.3E-07 4.2E-07 4.2E-07 4.1E-07
  4.1E-07 4.0E-07 4.0E-07 3.9E-07 3.9E-07 3.8E-07 3.8E-07 3.7E-07 3.7E-07 3.6E-07 3.6E-07 3.5E-07 3.5E-07 3.4E-07 3.4E-07
  3.3E-07 3.3E-07 3.3E-07 3.2E-07 3.2E-07 3.1E-07 3.1E-07 3.1E-07 3.0E-07 3.0E-07 3.0E-07 2.9E-07 2.9E-07 2.8E-07 2.8E-07
  2.8E-07 2.7E-07 2.7E-07 2.7E-07 2.6E-07
G 4.1E-08 4.0E-08 4.0E-08 3.9E-08 3.8E-08 3.8E-08 3.7E-08 3.7E-08 3.6E-08 3.6E-08 3.6E-08 3.5E-08 3.5E-08 3.4E-08 3.4E-08
  3.3E-08 3.3E-08 3.2E-08 3.2E-08 3.2E-08 3.1E-08 3.1E-08 3.0E-08 3.0E-08 3.0E-08 2.9E-08 2.9E-08 2.8E-08 2.8E-08 2.8E-08
  2.7E-08 2.7E-08 2.7E-08 2.6E-08 2.6E-08 2.6E-08 2.5E-08 2.5E-08 2.5E-08 2.4E-08 2.4E-08 2.4E-08 2.4E-08 2.3E-08 2.3E-08
  2.3E-08 2.2E-08 2.2E-08 2.2E-08 2.2E-08
G 5.5E-09 5.4E-09 5.4E-09 5.4E-09 5.3E-09 5.3E-09 5.2E-09 5.2E-09 5.2E-09 5.1E-09 5.1E-09 5.1E-09 5.1E-09 5.0E-09 5.0E-09
  5.0E-09 4.9E-09 4.9E-09 4.9E-09 4.8E-09 4.8E-09 4.8E-09 4.8E-09 4.7E-09 4.7E-09 4.7E-09 4.6E-09 4.6E-09 4.6E-09 4.6E-09
  4.5E-09 4.5E-09 4.5E-09 4.5E-09 4.4E-09 4.4E-09 4.4E-09 4.4E-09 4.3E-09 4.3E-09 4.3E-09 4.3E-09 4.2E-09 4.2E-09 4.2E-09
  4.2E-09 4.1E-09 4.1E-09 4.1E-09 4.1E-09
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G 1.4E-10
G 2.3E-11
G 8.7E-12
G 1.4E-07 1.3E-07 1.3E-07 1.2E-07 1.2E-07 1.1E-07 1.1E-07 1.1E-07 1.0E-07 1.0E-07 9.7E-08 9.3E-08 9.0E-08 8.7E-08 8.4E-08
  8.2E-08 7.9E-08 7.6E-08 7.4E-08 7.1E-08 6.9E-08 6.7E-08 6.4E-08 6.2E-08 6.0E-08 5.8E-08 5.6E-08 5.4E-08 5.3E-08 5.1E-08
  4.9E-08 4.8E-08 4.6E-08 4.5E-08 4.3E-08 4.2E-08 4.0E-08 3.9E-08 3.8E-08 3.6E-08 3.5E-08 3.4E-08 3.3E-08 3.2E-08 3.1E-08
  3.0E-08 2.9E-08 2.8E-08 2.7E-08 2.6E-08
  2  1  1  1  1 50 50 50  1  1  1 50
H 1.7E-05 1.5E-07
H 1.9E-09
H 2.7E-09
H 1.1E-08
H 2.9E-08
H 5.2E-05 5.7E-05 5.6E-05 5.6E-05 5.5E-05 5.4E-05 5.3E-05 5.3E-05 5.2E-05 5.1E-05 5.1E-05 5.0E-05 4.9E-05 4.9E-05 4.8E-05
  4.7E-05 4.7E-05 4.6E-05 4.6E-05 4.5E-05 4.4E-05 4.4E-05 4.3E-05 4.3E-05 4.2E-05 4.2E-05 4.1E-05 4.1E-05 4.0E-05 4.0E-05
  3.9E-05 3.9E-05 3.8E-05 3.8E-05 3.7E-05 3.7E-05 3.6E-05 3.6E-05 3.5E-05 3.5E-05 3.4E-05 3.4E-05 3.4E-05 3.3E-05 3.3E-05
  3.2E-05 3.2E-05 3.1E-05 3.1E-05 3.1E-05
H 4.3E-06 4.7E-06 4.6E-06 4.5E-06 4.5E-06 4.4E-06 4.4E-06 4.3E-06 4.2E-06 4.2E-06 4.1E-06 4.1E-06 4.0E-06 4.0E-06 3.9E-06
  3.9E-06 3.8E-06 3.8E-06 3.7E-06 3.7E-06 3.6E-06 3.6E-06 3.5E-06 3.5E-06 3.4E-06 3.4E-06 3.4E-06 3.3E-06 3.3E-06 3.2E-06
  3.2E-06 3.1E-06 3.1E-06 3.1E-06 3.0E-06 3.0E-06 3.0E-06 2.9E-06 2.9E-06 2.8E-06 2.8E-06 2.8E-06 2.7E-06 2.7E-06 2.7E-06
  2.6E-06 2.6E-06 2.6E-06 2.5E-06 2.5E-06
H 5.7E-07 6.3E-07 6.3E-07 6.2E-07 6.2E-07 6.2E-07 6.1E-07 6.1E-07 6.0E-07 6.0E-07 6.0E-07 5.9E-07 5.9E-07 5.8E-07 5.8E-07
  5.8E-07 5.7E-07 5.7E-07 5.7E-07 5.6E-07 5.6E-07 5.6E-07 5.5E-07 5.5E-07 5.5E-07 5.4E-07 5.4E-07 5.4E-07 5.3E-07 5.3E-07
  5.3E-07 5.2E-07 5.2E-07 5.2E-07 5.2E-07 5.1E-07 5.1E-07 5.1E-07 5.0E-07 5.0E-07 5.0E-07 5.0E-07 4.9E-07 4.9E-07 4.9E-07
  4.8E-07 4.8E-07 4.8E-07 4.8E-07 4.7E-07
H 1.1E-09
H 1.2E-09
H 1.1E-09
H 1.4E-05 1.5E-05 1.5E-05 1.4E-05 1.4E-05 1.3E-05 1.3E-05 1.3E-05 1.2E-05 1.2E-05 1.1E-05 1.1E-05 1.1E-05 1.0E-05 9.9E-06
  9.5E-06 9.2E-06 8.9E-06 8.6E-06 8.3E-06 8.0E-06 7.8E-06 7.5E-06 7.3E-06 7.0E-06 6.8E-06 6.6E-06 6.4E-06 6.1E-06 5.9E-06
  5.7E-06 5.6E-06 5.4E-06 5.2E-06 5.0E-06 4.9E-06 4.7E-06 4.5E-06 4.4E-06 4.3E-06 4.1E-06 4.0E-06 3.8E-06 3.7E-06 3.6E-06
  3.5E-06 3.4E-06 3.3E-06 3.1E-06 3.0E-06
! CM246   Class: W F1:   0.00100    02/27/88  04:35:22.0   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1 50 50 50 .1 .1  1 50
G 9.3E-12
G 1.3E-09
G 3.3E-09
G 1.8E-08
G 5.7E-08
G 5.2E-07 5.1E-07 5.1E-07 5.0E-07 4.9E-07 4.8E-07 4.8E-07 4.7E-07 4.6E-07 4.6E-07 4.5E-07 4.5E-07 4.4E-07 4.3E-07 4.3E-07
  4.2E-07 4.2E-07 4.1E-07 4.0E-07 4.0E-07 3.9E-07 3.9E-07 3.8E-07 3.8E-07 3.7E-07 3.7E-07 3.6E-07 3.6E-07 3.5E-07 3.5E-07
  3.4E-07 3.4E-07 3.3E-07 3.3E-07 3.2E-07 3.2E-07 3.1E-07 3.1E-07 3.1E-07 3.0E-07 3.0E-07 2.9E-07 2.9E-07 2.8E-07 2.8E-07
  2.8E-07 2.7E-07 2.7E-07 2.7E-07 2.6E-07
G 4.1E-08 4.0E-08 4.0E-08 3.9E-08 3.8E-08 3.8E-08 3.7E-08 3.7E-08 3.6E-08 3.6E-08 3.5E-08 3.5E-08 3.4E-08 3.4E-08 3.3E-08
  3.3E-08 3.2E-08 3.2E-08 3.2E-08 3.1E-08 3.1E-08 3.0E-08 3.0E-08 2.9E-08 2.9E-08 2.9E-08 2.8E-08 2.8E-08 2.7E-08 2.7E-08
  2.7E-08 2.6E-08 2.6E-08 2.6E-08 2.5E-08 2.5E-08 2.5E-08 2.4E-08 2.4E-08 2.4E-08 2.3E-08 2.3E-08 2.3E-08 2.2E-08 2.2E-08
  2.2E-08 2.1E-08 2.1E-08 2.1E-08 2.0E-08
G 5.7E-09 5.6E-09 5.6E-09 5.5E-09 5.5E-09 5.4E-09 5.4E-09 5.4E-09 5.3E-09 5.3E-09 5.3E-09 5.2E-09 5.2E-09 5.1E-09 5.1E-09
  5.1E-09 5.0E-09 5.0E-09 5.0E-09 4.9E-09 4.9E-09 4.9E-09 4.8E-09 4.8E-09 4.8E-09 4.7E-09 4.7E-09 4.7E-09 4.6E-09 4.6E-09
  4.6E-09 4.5E-09 4.5E-09 4.5E-09 4.4E-09 4.4E-09 4.4E-09 4.3E-09 4.3E-09 4.3E-09 4.3E-09 4.2E-09 4.2E-09 4.2E-09 4.1E-09
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  4.1E-09 4.1E-09 4.0E-09 4.0E-09 4.0E-09
G 6.0E-11
G 1.5E-11
G 8.3E-12
G 1.4E-07 1.3E-07 1.3E-07 1.2E-07 1.2E-07 1.1E-07 1.1E-07 1.1E-07 1.0E-07 1.0E-07 9.6E-08 9.3E-08 9.0E-08 8.7E-08 8.4E-08
  8.1E-08 7.8E-08 7.5E-08 7.3E-08 7.0E-08 6.8E-08 6.6E-08 6.3E-08 6.1E-08 5.9E-08 5.7E-08 5.5E-08 5.3E-08 5.1E-08 5.0E-08
  4.8E-08 4.6E-08 4.5E-08 4.3E-08 4.2E-08 4.0E-08 3.9E-08 3.8E-08 3.6E-08 3.5E-08 3.4E-08 3.3E-08 3.2E-08 3.1E-08 2.9E-08
  2.8E-08 2.8E-08 2.7E-08 2.6E-08 2.5E-08
  2  1  1  1  1 50 50 50  1  1  1 50
H 1.7E-05 1.5E-07
H 1.7E-09
H 2.6E-09
H 9.8E-09
H 2.9E-08
H 5.4E-05 6.0E-05 5.9E-05 5.8E-05 5.7E-05 5.6E-05 5.6E-05 5.5E-05 5.4E-05 5.3E-05 5.3E-05 5.2E-05 5.1E-05 5.0E-05 5.0E-05
  4.9E-05 4.8E-05 4.8E-05 4.7E-05 4.6E-05 4.6E-05 4.5E-05 4.4E-05 4.4E-05 4.3E-05 4.3E-05 4.2E-05 4.1E-05 4.1E-05 4.0E-05
  4.0E-05 3.9E-05 3.9E-05 3.8E-05 3.8E-05 3.7E-05 3.7E-05 3.6E-05 3.6E-05 3.5E-05 3.5E-05 3.4E-05 3.4E-05 3.3E-05 3.3E-05
  3.2E-05 3.2E-05 3.1E-05 3.1E-05 3.0E-05
H 4.3E-06 4.7E-06 4.6E-06 4.5E-06 4.5E-06 4.4E-06 4.4E-06 4.3E-06 4.2E-06 4.2E-06 4.1E-06 4.1E-06 4.0E-06 3.9E-06 3.9E-06
  3.8E-06 3.8E-06 3.7E-06 3.7E-06 3.6E-06 3.6E-06 3.5E-06 3.5E-06 3.4E-06 3.4E-06 3.3E-06 3.3E-06 3.2E-06 3.2E-06 3.2E-06
  3.1E-06 3.1E-06 3.0E-06 3.0E-06 2.9E-06 2.9E-06 2.9E-06 2.8E-06 2.8E-06 2.7E-06 2.7E-06 2.7E-06 2.6E-06 2.6E-06 2.6E-06
  2.5E-06 2.5E-06 2.5E-06 2.4E-06 2.4E-06
H 5.9E-07 6.5E-07 6.5E-07 6.4E-07 6.4E-07 6.3E-07 6.3E-07 6.3E-07 6.2E-07 6.2E-07 6.1E-07 6.1E-07 6.0E-07 6.0E-07 5.9E-07
  5.9E-07 5.9E-07 5.8E-07 5.8E-07 5.7E-07 5.7E-07 5.7E-07 5.6E-07 5.6E-07 5.5E-07 5.5E-07 5.5E-07 5.4E-07 5.4E-07 5.4E-07
  5.3E-07 5.3E-07 5.2E-07 5.2E-07 5.2E-07 5.1E-07 5.1E-07 5.1E-07 5.0E-07 5.0E-07 4.9E-07 4.9E-07 4.9E-07 4.8E-07 4.8E-07
  4.8E-07 4.7E-07 4.7E-07 4.7E-07 4.6E-07
H 1.0E-09
H 1.1E-09
H 9.9E-10
H 1.4E-05 1.5E-05 1.5E-05 1.4E-05 1.4E-05 1.3E-05 1.3E-05 1.2E-05 1.2E-05 1.2E-05 1.1E-05 1.1E-05 1.0E-05 1.0E-05 9.8E-06
  9.4E-06 9.1E-06 8.8E-06 8.5E-06 8.2E-06 7.9E-06 7.7E-06 7.4E-06 7.2E-06 6.9E-06 6.7E-06 6.4E-06 6.2E-06 6.0E-06 5.8E-06
  5.6E-06 5.4E-06 5.2E-06 5.0E-06 4.9E-06 4.7E-06 4.5E-06 4.4E-06 4.2E-06 4.1E-06 4.0E-06 3.8E-06 3.7E-06 3.6E-06 3.4E-06
  3.3E-06 3.2E-06 3.1E-06 3.0E-06 2.9E-06
! CM247   Class: W F1:   0.00100    02/27/88  04:46:06.1   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1 50 50 50  1  1  1 50
G 2.2E-11
G 1.3E-09
G 3.5E-09
G 2.0E-08
G 6.1E-08
G 4.7E-07 4.7E-07 4.6E-07 4.6E-07 4.5E-07 4.4E-07 4.4E-07 4.3E-07 4.3E-07 4.2E-07 4.1E-07 4.1E-07 4.0E-07 4.0E-07 3.9E-07
  3.9E-07 3.8E-07 3.8E-07 3.7E-07 3.7E-07 3.6E-07 3.6E-07 3.5E-07 3.5E-07 3.4E-07 3.4E-07 3.3E-07 3.3E-07 3.2E-07 3.2E-07
  3.1E-07 3.1E-07 3.1E-07 3.0E-07 3.0E-07 2.9E-07 2.9E-07 2.9E-07 2.8E-07 2.8E-07 2.7E-07 2.7E-07 2.7E-07 2.6E-07 2.6E-07
  2.6E-07 2.5E-07 2.5E-07 2.5E-07 2.4E-07
G 3.7E-08 3.7E-08 3.6E-08 3.6E-08 3.5E-08 3.5E-08 3.4E-08 3.4E-08 3.3E-08 3.3E-08 3.3E-08 3.2E-08 3.2E-08 3.1E-08 3.1E-08
  3.0E-08 3.0E-08 3.0E-08 2.9E-08 2.9E-08 2.8E-08 2.8E-08 2.8E-08 2.7E-08 2.7E-08 2.6E-08 2.6E-08 2.6E-08 2.5E-08 2.5E-08
  2.5E-08 2.4E-08 2.4E-08 2.4E-08 2.3E-08 2.3E-08 2.3E-08 2.2E-08 2.2E-08 2.2E-08 2.2E-08 2.1E-08 2.1E-08 2.1E-08 2.0E-08
  2.0E-08 2.0E-08 2.0E-08 1.9E-08 1.9E-08
G 5.2E-09 5.1E-09 5.1E-09 5.0E-09 5.0E-09 5.0E-09 4.9E-09 4.9E-09 4.9E-09 4.8E-09 4.8E-09 4.8E-09 4.7E-09 4.7E-09 4.7E-09
  4.6E-09 4.6E-09 4.6E-09 4.5E-09 4.5E-09 4.5E-09 4.4E-09 4.4E-09 4.4E-09 4.3E-09 4.3E-09 4.3E-09 4.3E-09 4.2E-09 4.2E-09
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 4.2E-09 4.1E-09 4.1E-09 4.1E-09 4.1E-09 4.0E-09 4.0E-09 4.0E-09 4.0E-09 3.9E-09 3.9E-09 3.9E-09 3.8E-09 3.8E-09 3.8E-09
 3.8E-09 3.7E-09 3.7E-09 3.7E-09 3.7E-09
G 4.4E-10
G 5.8E-11
G 1.1E-11
G 1.3E-07 1.2E-07 1.2E-07 1.1E-07 1.1E-07 1.1E-07 1.0E-07 9.8E-08 9.5E-08 9.2E-08 8.9E-08 8.6E-08 8.3E-08 8.0E-08 7.7E-08
 7.5E-08 7.2E-08 7.0E-08 6.7E-08 6.5E-08 6.3E-08 6.1E-08 5.9E-08 5.7E-08 5.5E-08 5.3E-08 5.1E-08 4.9E-08 4.8E-08 4.6E-08
 4.4E-08 4.3E-08 4.2E-08 4.0E-08 3.9E-08 3.7E-08 3.6E-08 3.5E-08 3.4E-08 3.3E-08 3.1E-08 3.0E-08 2.9E-08 2.8E-08 2.7E-08
 2.6E-08 2.6E-08 2.5E-08 2.4E-08 2.3E-08
 2  1  1  1  1 50 50 50  1  1  1 50
H 1.5E-05 1.4E-07
H 2.6E-09
H 3.4E-09
H 1.2E-08
H 3.1E-08
H 5.0E-05 5.5E-05 5.4E-05 5.3E-05 5.2E-05 5.2E-05 5.1E-05 5.0E-05 5.0E-05 4.9E-05 4.8E-05 4.8E-05 4.7E-05 4.6E-05 4.6E-05
 4.5E-05 4.4E-05 4.4E-05 4.3E-05 4.3E-05 4.2E-05 4.1E-05 4.1E-05 4.0E-05 4.0E-05 3.9E-05 3.9E-05 3.8E-05 3.8E-05 3.7E-05
 3.7E-05 3.6E-05 3.6E-05 3.5E-05 3.5E-05 3.4E-05 3.4E-05 3.3E-05 3.3E-05 3.2E-05 3.2E-05 3.1E-05 3.1E-05 3.1E-05 3.0E-05
 3.0E-05 2.9E-05 2.9E-05 2.9E-05 2.8E-05
H 3.9E-06 4.3E-06 4.2E-06 4.2E-06 4.1E-06 4.1E-06 4.0E-06 4.0E-06 3.9E-06 3.8E-06 3.8E-06 3.7E-06 3.7E-06 3.6E-06 3.6E-06
 3.5E-06 3.5E-06 3.4E-06 3.4E-06 3.4E-06 3.3E-06 3.3E-06 3.2E-06 3.2E-06 3.1E-06 3.1E-06 3.0E-06 3.0E-06 3.0E-06 2.9E-06
 2.9E-06 2.8E-06 2.8E-06 2.8E-06 2.7E-06 2.7E-06 2.7E-06 2.6E-06 2.6E-06 2.5E-06 2.5E-06 2.5E-06 2.4E-06 2.4E-06 2.4E-06
 2.3E-06 2.3E-06 2.3E-06 2.2E-06 2.2E-06
H 5.4E-07 5.9E-07 5.9E-07 5.8E-07 5.8E-07 5.8E-07 5.7E-07 5.7E-07 5.6E-07 5.6E-07 5.6E-07 5.5E-07 5.5E-07 5.5E-07 5.4E-07
 5.4E-07 5.3E-07 5.3E-07 5.3E-07 5.2E-07 5.2E-07 5.2E-07 5.1E-07 5.1E-07 5.1E-07 5.0E-07 5.0E-07 5.0E-07 4.9E-07 4.9E-07
 4.9E-07 4.8E-07 4.8E-07 4.8E-07 4.7E-07 4.7E-07 4.7E-07 4.6E-07 4.6E-07 4.6E-07 4.5E-07 4.5E-07 4.5E-07 4.4E-07 4.4E-07
 4.4E-07 4.4E-07 4.3E-07 4.3E-07 4.3E-07
H 1.4E-09
H 1.7E-09
H 1.4E-09
H 1.3E-05 1.4E-05 1.4E-05 1.3E-05 1.3E-05 1.2E-05 1.2E-05 1.1E-05 1.1E-05 1.1E-05 1.0E-05 1.0E-05 9.7E-06 9.3E-06 9.0E-06
 8.7E-06 8.4E-06 8.1E-06 7.9E-06 7.6E-06 7.3E-06 7.1E-06 6.8E-06 6.6E-06 6.4E-06 6.2E-06 6.0E-06 5.8E-06 5.6E-06 5.4E-06
 5.2E-06 5.0E-06 4.8E-06 4.7E-06 4.5E-06 4.4E-06 4.2E-06 4.1E-06 3.9E-06 3.8E-06 3.7E-06 3.6E-06 3.4E-06 3.3E-06 3.2E-06
 3.1E-06 3.0E-06 2.9E-06 2.8E-06 2.7E-06
! CM243   Class: W F1:   0.00100    02/27/88  06:04:47.9   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1 50 50 50  1  1  1 50
G 1.4E-11
G 1.5E-09
G 3.8E-09
G 2.2E-08
G 6.6E-08
G 5.3E-07 5.2E-07 5.0E-07 4.8E-07 4.6E-07 4.4E-07 4.3E-07 4.1E-07 3.9E-07 3.8E-07 3.7E-07 3.5E-07 3.4E-07 3.3E-07 3.1E-07
 3.0E-07 2.9E-07 2.8E-07 2.7E-07 2.6E-07 2.5E-07 2.4E-07 2.3E-07 2.2E-07 2.1E-07 2.1E-07 2.0E-07 1.9E-07 1.8E-07 1.8E-07
 1.7E-07 1.6E-07 1.6E-07 1.5E-07 1.5E-07 1.4E-07 1.4E-07 1.3E-07 1.3E-07 1.2E-07 1.2E-07 1.1E-07 1.1E-07 1.0E-07 1.0E-07
 9.6E-08 9.3E-08 8.9E-08 8.6E-08 8.3E-08
G 4.4E-08 4.2E-08 4.0E-08 3.9E-08 3.7E-08 3.6E-08 3.5E-08 3.3E-08 3.2E-08 3.1E-08 3.0E-08 2.9E-08 2.8E-08 2.7E-08 2.6E-08
 2.5E-08 2.4E-08 2.3E-08 2.2E-08 2.1E-08 2.0E-08 2.0E-08 1.9E-08 1.8E-08 1.7E-08 1.7E-08 1.6E-08 1.6E-08 1.5E-08 1.4E-08
 1.4E-08 1.3E-08 1.3E-08 1.2E-08 1.2E-08 1.1E-08 1.1E-08 1.1E-08 1.0E-08 9.8E-09 9.5E-09 9.1E-09 8.8E-09 8.4E-09 8.1E-09
 7.8E-09 7.5E-09 7.3E-09 7.0E-09 6.7E-09
G 5.9E-09 5.7E-09 5.6E-09 5.4E-09 5.2E-09 5.1E-09 4.9E-09 4.8E-09 4.6E-09 4.5E-09 4.3E-09 4.2E-09 4.1E-09 3.9E-09 3.8E-09
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   3.7E-09 3.6E-09 3.5E-09 3.4E-09 3.3E-09 3.2E-09 3.1E-09 3.0E-09 2.9E-09 2.8E-09 2.7E-09 2.6E-09 2.5E-09 2.5E-09 2.4E-09
   2.3E-09 2.3E-09 2.2E-09 2.1E-09 2.0E-09 2.0E-09 1.9E-09 1.9E-09 1.8E-09 1.8E-09 1.7E-09 1.6E-09 1.6E-09 1.5E-09 1.5E-09
   1.5E-09 1.4E-09 1.4E-09 1.3E-09 1.3E-09
 G 1.9E-10
 G 2.9E-11
 G 9.7E-12
 G 1.5E-07 1.4E-07 1.3E-07 1.2E-07 1.2E-07 1.1E-07 1.0E-07 9.7E-08 9.1E-08 8.6E-08 8.1E-08 7.6E-08 7.2E-08 6.8E-08 6.4E-08
   6.0E-08 5.7E-08 5.4E-08 5.0E-08 4.8E-08 4.5E-08 4.2E-08 4.0E-08 3.8E-08 3.5E-08 3.3E-08 3.1E-08 3.0E-08 2.8E-08 2.6E-08
   2.5E-08 2.3E-08 2.2E-08 2.1E-08 2.0E-08 1.9E-08 1.7E-08 1.6E-08 1.6E-08 1.5E-08 1.4E-08 1.3E-08 1.2E-08 1.2E-08 1.1E-08
   1.0E-08 9.7E-09 9.1E-09 8.6E-09 8.1E-09
   2  1  1  1  1 50 50 50  1  1  1 50
 H 1.8E-05 1.6E-07
 H 2.1E-09
 H 3.1E-09
 H 1.2E-08
 H 3.3E-08
 H 5.6E-05 6.0E-05 5.8E-05 5.6E-05 5.4E-05 5.2E-05 5.0E-05 4.8E-05 4.6E-05 4.4E-05 4.3E-05 4.1E-05 3.9E-05 3.8E-05 3.7E-05
   3.5E-05 3.4E-05 3.3E-05 3.1E-05 3.0E-05 2.9E-05 2.8E-05 2.7E-05 2.6E-05 2.5E-05 2.4E-05 2.3E-05 2.2E-05 2.1E-05 2.1E-05
   2.0E-05 1.9E-05 1.8E-05 1.8E-05 1.7E-05 1.6E-05 1.6E-05 1.5E-05 1.5E-05 1.4E-05 1.4E-05 1.3E-05 1.3E-05 1.2E-05 1.2E-05
   1.1E-05 1.1E-05 1.0E-05 1.0E-05 9.6E-06
 H 4.6E-06 4.9E-06 4.7E-06 4.5E-06 4.4E-06 4.2E-06 4.0E-06 3.9E-06 3.7E-06 3.6E-06 3.5E-06 3.3E-06 3.2E-06 3.1E-06 3.0E-06
   2.9E-06 2.8E-06 2.7E-06 2.6E-06 2.5E-06 2.4E-06 2.3E-06 2.2E-06 2.1E-06 2.0E-06 2.0E-06 1.9E-06 1.8E-06 1.7E-06 1.7E-06
   1.6E-06 1.6E-06 1.5E-06 1.4E-06 1.4E-06 1.3E-06 1.3E-06 1.2E-06 1.2E-06 1.1E-06 1.1E-06 1.1E-06 1.0E-06 9.8E-07 9.5E-07
   9.1E-07 8.8E-07 8.4E-07 8.1E-07 7.8E-07
 H 6.2E-07 6.7E-07 6.5E-07 6.3E-07 6.1E-07 5.9E-07 5.7E-07 5.5E-07 5.4E-07 5.2E-07 5.0E-07 4.9E-07 4.7E-07 4.6E-07 4.5E-07
   4.3E-07 4.2E-07 4.1E-07 3.9E-07 3.8E-07 3.7E-07 3.6E-07 3.5E-07 3.4E-07 3.3E-07 3.2E-07 3.1E-07 3.0E-07 2.9E-07 2.8E-07
   2.7E-07 2.6E-07 2.5E-07 2.5E-07 2.4E-07 2.3E-07 2.2E-07 2.2E-07 2.1E-07 2.0E-07 2.0E-07 1.9E-07 1.9E-07 1.8E-07 1.7E-07
   1.7E-07 1.6E-07 1.6E-07 1.5E-07 1.5E-07
 H 1.2E-09
 H 1.3E-09
 H 1.2E-09
 H 1.5E-05 1.6E-05 1.5E-05 1.4E-05 1.3E-05 1.3E-05 1.2E-05 1.1E-05 1.1E-05 1.0E-05 9.4E-06 8.9E-06 8.4E-06 7.9E-06 7.5E-06
   7.0E-06 6.6E-06 6.2E-06 5.9E-06 5.6E-06 5.2E-06 4.9E-06 4.7E-06 4.4E-06 4.1E-06 3.9E-06 3.7E-06 3.5E-06 3.3E-06 3.1E-06
   2.9E-06 2.7E-06 2.6E-06 2.4E-06 2.3E-06 2.2E-06 2.0E-06 1.9E-06 1.8E-06 1.7E-06 1.6E-06 1.5E-06 1.4E-06 1.4E-06 1.3E-06
   1.2E-06 1.1E-06 1.1E-06 1.0E-06 9.5E-07
 ! PU243   Class: Y F1:   0.00010    02/27/88  06:51:22.4   Acute  Sv/Bq
  12  1  3  4  5  6  7  8 11 12 13 14 17
   1  1  1  1  1  1  1  1  1  1  1  1
 G 1.5E-13
 G 1.8E-10
 G 2.8E-10
 G 5.8E-10
 G 3.9E-10
 G 5.6E-13
 G 1.8E-12
 G 1.5E-13
 G 4.5E-12
 G 5.8E-13
 G 5.7E-15
 G 6.7E-13
 16  1  1  1  1 50  1  1  1  1  1 31
```

```
H 1.9E-10 3.3E-12 2.3E-12 1.7E-12 1.3E-12 9.6E-13 7.5E-13 6.0E-13 4.8E-13 4.0E-13 3.4E-13 2.9E-13 2.6E-13 2.3E-13 2.1E-13
  1.9E-13
H 2.5E-11
H 4.0E-11
H 8.2E-11
H 5.5E-11
H 1.7E-12 4.6E-13 6.7E-13 8.5E-13 1.0E-12 1.1E-12 1.2E-12 1.3E-12 1.3E-12 1.4E-12 1.4E-12 1.4E-12 1.4E-12 1.4E-12 1.4E-12
  1.4E-12 1.4E-12 1.4E-12 1.4E-12 1.4E-12 1.3E-12 1.3E-12 1.3E-12 1.3E-12 1.3E-12 1.3E-12 1.2E-12 1.2E-12 1.2E-12 1.2E-12
  1.2E-12 1.2E-12 1.1E-12 1.1E-12 1.1E-12 1.1E-12 1.1E-12 1.1E-12 1.1E-12 1.0E-12 1.0E-12 1.0E-12 1.0E-12 9.8E-13 9.7E-13
  9.6E-13 9.4E-13 9.3E-13 9.2E-13 9.1E-13
H 6.3E-13
H 5.6E-14
H 6.6E-13
H 2.5E-13
H 1.1E-13
H 7.2E-13 0.0E+00 0.0E+00 2.2E-13 2.6E-13 2.9E-13 3.0E-13 3.2E-13 3.3E-13 3.3E-13 3.3E-13 3.3E-13 3.2E-13 3.2E-13 3.1E-13
  3.0E-13 3.0E-13 2.9E-13 2.8E-13 2.7E-13 2.6E-13 2.6E-13 2.5E-13 2.4E-13 2.3E-13 2.2E-13 2.2E-13 2.1E-13 2.0E-13 2.0E-13
  1.9E-13
! AM243   Class: W F1:   0.00100     02/27/88  07:16:36.1   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1 50 50 50  1  1  1 50
G 1.6E-11
G 1.3E-09
G 3.4E-09
G 1.9E-08
G 6.0E-08
G 5.0E-07 4.9E-07 4.8E-07 4.8E-07 4.7E-07 4.6E-07 4.6E-07 4.5E-07 4.5E-07 4.4E-07 4.3E-07 4.3E-07 4.2E-07 4.2E-07 4.1E-07
  4.0E-07 4.0E-07 3.9E-07 3.9E-07 3.8E-07 3.8E-07 3.7E-07 3.7E-07 3.6E-07 3.6E-07 3.5E-07 3.5E-07 3.4E-07 3.4E-07 3.3E-07
  3.3E-07 3.2E-07 3.2E-07 3.1E-07 3.1E-07 3.1E-07 3.0E-07 3.0E-07 2.9E-07 2.9E-07 2.9E-07 2.8E-07 2.8E-07 2.7E-07 2.7E-07
  2.7E-07 2.6E-07 2.6E-07 2.6E-07 2.5E-07
G 4.0E-08 3.9E-08 3.9E-08 3.8E-08 3.7E-08 3.7E-08 3.6E-08 3.6E-08 3.5E-08 3.5E-08 3.4E-08 3.4E-08 3.4E-08 3.3E-08 3.3E-08
  3.2E-08 3.2E-08 3.1E-08 3.1E-08 3.0E-08 3.0E-08 3.0E-08 2.9E-08 2.9E-08 2.8E-08 2.8E-08 2.8E-08 2.7E-08 2.7E-08 2.6E-08
  2.6E-08 2.6E-08 2.5E-08 2.5E-08 2.5E-08 2.4E-08 2.4E-08 2.4E-08 2.3E-08 2.3E-08 2.3E-08 2.2E-08 2.2E-08 2.2E-08 2.1E-08
  2.1E-08 2.1E-08 2.1E-08 2.0E-08 2.0E-08
G 5.5E-09 5.4E-09 5.4E-09 5.4E-09 5.3E-09 5.3E-09 5.3E-09 5.2E-09 5.2E-09 5.1E-09 5.1E-09 5.1E-09 5.0E-09 5.0E-09 5.0E-09
  4.9E-09 4.9E-09 4.9E-09 4.8E-09 4.8E-09 4.8E-09 4.7E-09 4.7E-09 4.7E-09 4.6E-09 4.6E-09 4.6E-09 4.5E-09 4.5E-09 4.5E-09
  4.4E-09 4.4E-09 4.4E-09 4.4E-09 4.3E-09 4.3E-09 4.3E-09 4.2E-09 4.2E-09 4.2E-09 4.1E-09 4.1E-09 4.1E-09 4.1E-09 4.0E-09
  4.0E-09 4.0E-09 3.9E-09 3.9E-09 3.9E-09
G 1.8E-10
G 2.7E-11
G 9.5E-12
G 1.3E-07 1.3E-07 1.3E-07 1.2E-07 1.2E-07 1.1E-07 1.1E-07 1.1E-07 1.0E-07 9.8E-08 9.5E-08 9.2E-08 8.9E-08 8.6E-08 8.3E-08
  8.0E-08 7.7E-08 7.5E-08 7.2E-08 7.0E-08 6.7E-08 6.5E-08 6.3E-08 6.1E-08 5.8E-08 5.6E-08 5.5E-08 5.3E-08 5.1E-08 4.9E-08
  4.7E-08 4.6E-08 4.4E-08 4.3E-08 4.1E-08 4.0E-08 3.9E-08 3.7E-08 3.6E-08 3.5E-08 3.4E-08 3.2E-08 3.1E-08 3.0E-08 2.9E-08
  2.8E-08 2.7E-08 2.6E-08 2.5E-08 2.5E-08
  2  1  1  1  1 50 50 50  1  1  1 50
H 1.7E-05 1.5E-07
H 2.3E-09
H 3.1E-09
H 1.1E-08
H 3.2E-08
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9 1 0 4 8 1 8 2 2

5.1028

9/30/88

DOSINC.DAT

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H 5.2E-05 5.7E-05 5.6E-05 5.6E-05 5.5E-05 5.4E-05 5.3E-05 5.3E-05 5.2E-05 5.1E-05 5.0E-05 5.0E-05 4.9E-05 4.8E-05 4.8E-05
  4.7E-05 4.6E-05 4.6E-05 4.5E-05 4.5E-05 4.4E-05 4.3E-05 4.3E-05 4.2E-05 4.2E-05 4.1E-05 4.0E-05 4.0E-05 3.9E-05 3.9E-05
  3.8E-05 3.8E-05 3.7E-05 3.7E-05 3.6E-05 3.6E-05 3.5E-05 3.5E-05 3.4E-05 3.4E-05 3.3E-05 3.3E-05 3.2E-05 3.2E-05 3.1E-05
  3.1E-05 3.1E-05 3.0E-05 3.0E-05 2.9E-05
H 4.2E-06 4.5E-06 4.5E-06 4.4E-06 4.4E-06 4.3E-06 4.2E-06 4.2E-06 4.1E-06 4.1E-06 4.0E-06 4.0E-06 3.9E-06 3.9E-06 3.8E-06
  3.7E-06 3.7E-06 3.6E-06 3.6E-06 3.5E-06 3.5E-06 3.4E-06 3.4E-06 3.4E-06 3.3E-06 3.3E-06 3.2E-06 3.2E-06 3.1E-06 3.1E-06
  3.0E-06 3.0E-06 3.0E-06 2.9E-06 2.9E-06 2.8E-06 2.8E-06 2.8E-06 2.7E-06 2.7E-06 2.6E-06 2.6E-06 2.6E-06 2.5E-06 2.5E-06
  2.5E-06 2.4E-06 2.4E-06 2.4E-06 2.3E-06
H 5.8E-07 6.3E-07 6.3E-07 6.2E-07 6.2E-07 6.2E-07 6.1E-07 6.1E-07 6.0E-07 6.0E-07 5.9E-07 5.9E-07 5.9E-07 5.8E-07 5.8E-07
  5.7E-07 5.7E-07 5.7E-07 5.6E-07 5.6E-07 5.5E-07 5.5E-07 5.5E-07 5.4E-07 5.4E-07 5.4E-07 5.3E-07 5.3E-07 5.2E-07 5.2E-07
  5.2E-07 5.1E-07 5.1E-07 5.1E-07 5.0E-07 5.0E-07 5.0E-07 4.9E-07 4.9E-07 4.9E-07 4.8E-07 4.8E-07 4.8E-07 4.7E-07 4.7E-07
  4.7E-07 4.6E-07 4.6E-07 4.6E-07 4.5E-07
H 1.2E-09
H 1.5E-09
H 1.2E-09
H 1.4E-05 1.5E-05 1.5E-05 1.4E-05 1.4E-05 1.3E-05 1.3E-05 1.2E-05 1.2E-05 1.1E-05 1.1E-05 1.1E-05 1.0E-05 1.0E-05 9.7E-06
  9.3E-06 9.0E-06 8.7E-06 8.4E-06 8.1E-06 7.8E-06 7.6E-06 7.3E-06 7.1E-06 6.8E-06 6.6E-06 6.4E-06 6.2E-06 5.9E-06 5.7E-06
  5.5E-06 5.4E-06 5.2E-06 5.0E-06 4.8E-06 4.7E-06 4.5E-06 4.3E-06 4.2E-06 4.1E-06 3.9E-06 3.8E-06 3.7E-06 3.5E-06 3.4E-06
  3.3E-06 3.2E-06 3.1E-06 3.0E-06 2.9E-06
! NP239   Class: W F1:   0.00100    02/27/88  07:39:30.5   Acute  Sv/Bq
 12  1  3  4  5  6  7  8 11 12 13 14 17
  1  1  1  1  1  1  1  1  1  1  1  1
G 2.5E-12
G 3.5E-10
G 8.8E-10
G 3.9E-09
G 8.8E-09
G 2.9E-11
G 4.7E-11
G 1.1E-11
G 1.7E-10
G 1.7E-11
G 2.1E-13
G 1.5E-11
  1  1  1  1  1 50  1  1  1  1  1  1
H 2.3E-09
H 1.2E-10
H 2.9E-10
H 1.3E-09
H 2.9E-09
H 1.1E-09 2.6E-11 2.5E-11 2.5E-11 2.5E-11 2.5E-11 2.5E-11 2.5E-11 2.5E-11 2.4E-11 2.4E-11 2.4E-11 2.4E-11 2.4E-11 2.4E-11
  2.3E-11 2.3E-11 2.3E-11 2.3E-11 2.3E-11 2.3E-11 2.2E-11 2.2E-11 2.2E-11 2.2E-11 2.2E-11 2.2E-11 2.1E-11 2.1E-11 2.1E-11
  2.1E-11 2.1E-11 2.1E-11 2.1E-11 2.0E-11 2.0E-11 2.0E-11 2.0E-11 2.0E-11 2.0E-11 2.0E-11 1.9E-11 1.9E-11 1.9E-11 1.9E-11
  1.9E-11 1.9E-11 1.9E-11 1.9E-11 1.8E-11
H 1.4E-10
H 1.5E-11
H 5.8E-11
H 1.6E-11
H 7.5E-12
H 9.6E-11
! CM248   Class: W F1:   0.00100    02/27/88  07:52:56.8   Acute  Sv/Bq
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9 1 0 4 8 1 8 2 3

5.1029

9/30/88

DOSINC.DAT

DOSINC.DAT

5.1030

9/30/88

9 1 0 4 8 1 8 2 4

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12  1  3  4  5  6  7  8 11 12 13 14 17
 1  1  1  1  1 50 50 50  1  1  1 50
G 4.9E-10
G 1.1E-08
G 3.2E-08
G 9.6E-08
G 2.8E-07
G 1.9E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.7E-06 1.7E-06 1.7E-06 1.7E-06 1.6E-06 1.6E-06 1.6E-06 1.6E-06 1.5E-06 1.5E-06
  1.5E-06 1.5E-06 1.5E-06 1.4E-06 1.4E-06 1.4E-06 1.4E-06 1.4E-06 1.3E-06 1.3E-06 1.3E-06 1.3E-06 1.3E-06 1.3E-06 1.2E-06
  1.2E-06 1.2E-06 1.2E-06 1.2E-06 1.2E-06 1.1E-06 1.1E-06 1.1E-06 1.1E-06 1.1E-06 1.1E-06 1.0E-06 1.0E-06 1.0E-06 1.0E-06
  9.9E-07 9.8E-07 9.7E-07 9.5E-07 9.4E-07
G 1.5E-07 1.5E-07 1.4E-07 1.4E-07 1.4E-07 1.4E-07 1.4E-07 1.3E-07 1.3E-07 1.3E-07 1.3E-07 1.3E-07 1.2E-07 1.2E-07 1.2E-07
  1.2E-07 1.2E-07 1.2E-07 1.1E-07 1.1E-07 1.1E-07 1.1E-07 1.1E-07 1.1E-07 1.1E-07 1.0E-07 1.0E-07 1.0E-07 1.0E-07 9.8E-08
  9.7E-08 9.6E-08 9.4E-08 9.3E-08 9.2E-08 9.1E-08 8.9E-08 8.8E-08 8.7E-08 8.6E-08 8.4E-08 8.3E-08 8.2E-08 8.1E-08 8.0E-08
  7.9E-08 7.8E-08 7.7E-08 7.6E-08 7.5E-08
G 2.4E-08 1.9E-08 1.9E-08 1.9E-08 1.9E-08 1.9E-08 1.9E-08 1.9E-08 1.8E-08 1.8E-08 1.8E-08 1.8E-08 1.8E-08 1.8E-08 1.8E-08
  1.8E-08 1.7E-08 1.7E-08 1.7E-08 1.7E-08 1.7E-08 1.7E-08 1.7E-08 1.7E-08 1.7E-08 1.6E-08 1.6E-08 1.6E-08 1.6E-08 1.6E-08
  1.6E-08 1.6E-08 1.6E-08 1.6E-08 1.5E-08 1.5E-08 1.5E-08 1.5E-08 1.5E-08 1.5E-08 1.5E-08 1.5E-08 1.5E-08 1.4E-08 1.4E-08
  1.4E-08 1.4E-08 1.4E-08 1.4E-08 1.4E-08
G 1.8E-08
G 2.5E-09
G 1.6E-10
G 4.9E-07 4.8E-07 4.6E-07 4.4E-07 4.3E-07 4.1E-07 4.0E-07 3.9E-07 3.7E-07 3.6E-07 3.5E-07 3.4E-07 3.2E-07 3.1E-07 3.0E-07
  2.9E-07 2.8E-07 2.7E-07 2.6E-07 2.5E-07 2.5E-07 2.4E-07 2.3E-07 2.2E-07 2.1E-07 2.1E-07 2.0E-07 1.9E-07 1.9E-07 1.8E-07
  1.7E-07 1.7E-07 1.6E-07 1.6E-07 1.5E-07 1.5E-07 1.4E-07 1.4E-07 1.3E-07 1.3E-07 1.2E-07 1.2E-07 1.1E-07 1.1E-07 1.1E-07
  1.0E-07 1.0E-07 9.7E-08 9.3E-08 9.0E-08
  2  1  1  1  1 50 50 50  1  1  1 50
H 6.2E-05 5.6E-07
H 5.7E-08
H 4.7E-08
H 8.5E-08
H 1.5E-07
H 1.9E-04 2.1E-04 2.1E-04 2.1E-04 2.0E-04 2.0E-04 2.0E-04 2.0E-04 1.9E-04 1.9E-04 1.9E-04 1.9E-04 1.8E-04 1.8E-04 1.8E-04
  1.8E-04 1.7E-04 1.7E-04 1.7E-04 1.7E-04 1.6E-04 1.6E-04 1.6E-04 1.6E-04 1.5E-04 1.5E-04 1.5E-04 1.5E-04 1.5E-04 1.4E-04
  1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.3E-04 1.3E-04 1.3E-04 1.3E-04 1.3E-04 1.3E-04 1.2E-04 1.2E-04 1.2E-04 1.2E-04 1.2E-04
  1.2E-04 1.1E-04 1.1E-04 1.1E-04 1.1E-04
H 1.5E-05 1.7E-05 1.7E-05 1.6E-05 1.6E-05 1.6E-05 1.6E-05 1.6E-05 1.5E-05 1.5E-05 1.5E-05 1.5E-05 1.5E-05 1.4E-05 1.4E-05
  1.4E-05 1.4E-05 1.4E-05 1.3E-05 1.3E-05 1.3E-05 1.3E-05 1.3E-05 1.2E-05 1.2E-05 1.2E-05 1.2E-05 1.2E-05 1.2E-05 1.1E-05
  1.1E-05 1.1E-05 1.1E-05 1.1E-05 1.1E-05 1.1E-05 1.0E-05 1.0E-05 1.0E-05 1.0E-05 9.8E-06 9.7E-06 9.6E-06 9.4E-06 9.3E-06
  9.2E-06 9.1E-06 8.9E-06 8.8E-06 8.7E-06
H 2.1E-06 2.3E-06 2.2E-06 2.2E-06 2.2E-06 2.2E-06 2.2E-06 2.2E-06 2.2E-06 2.1E-06 2.1E-06 2.1E-06 2.1E-06 2.1E-06 2.1E-06
  2.0E-06 2.0E-06 2.0E-06 2.0E-06 2.0E-06 2.0E-06 2.0E-06 2.0E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06 1.9E-06
  1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.8E-06 1.7E-06 1.7E-06 1.7E-06 1.7E-06 1.7E-06 1.7E-06 1.7E-06
  1.7E-06 1.7E-06 1.6E-06 1.6E-06 1.6E-06
H 2.5E-08
H 4.7E-08
H 2.2E-08
H 5.2E-05 5.5E-05 5.4E-05 5.2E-05 5.0E-05 4.8E-05 4.7E-05 4.5E-05 4.4E-05 4.2E-05 4.1E-05 3.9E-05 3.8E-05 3.7E-05 3.5E-05
  3.4E-05 3.3E-05 3.2E-05 3.1E-05 3.0E-05 2.9E-05 2.8E-05 2.7E-05 2.6E-05 2.5E-05 2.4E-05 2.3E-05 2.3E-05 2.2E-05 2.1E-05
  2.0E-05 2.0E-05 1.9E-05 1.8E-05 1.8E-05 1.7E-05 1.6E-05 1.6E-05 1.5E-05 1.5E-05 1.4E-05 1.4E-05 1.3E-05 1.3E-05 1.3E-05
  1.2E-05 1.2E-05 1.1E-05 1.1E-05 1.1E-05
```

Gamma Energies by Group (EXTGAM) 7-28-87 DLS

H 3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
BE10	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
C 14	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
N 13	0.00000	0.00000	1.02001	0.00000	0.00000	0.00000
F 18	0.00000	0.00000	0.98858	0.00000	0.00000	0.00000
NA22	0.00000	0.00000	0.91878	1.27374	0.00000	0.00000
NA24	0.00000	0.00000	0.00000	1.36849	0.00000	2.75275
P 32	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
P 33	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
S 35	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
CL36	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
K 40	0.00003	0.00000	0.00000	0.15587	0.00000	0.00000
AR39	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
AR41	0.00000	0.00000	0.00000	1.28273	0.00087	0.00000
CA41	0.00041	0.00000	0.00000	0.00000	0.00000	0.00000
CA45	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
SC46	0.00000	0.00000	0.88911	1.12035	0.00000	0.00000
CR51	0.00112	0.03146	0.00000	0.00000	0.00000	0.00000
MN54	0.00138	0.00000	0.83463	0.00000	0.00000	0.00000
MN56	0.00000	0.00000	0.83718	0.00220	0.49231	0.35995
FE55	0.00166	0.00000	0.00000	0.00000	0.00000	0.00000
FE59	0.00745	0.00087	0.00000	1.18014	0.00000	0.00000
CO57	0.12386	0.00000	0.00126	0.00000	0.00000	0.00000
CO58	0.00170	0.00000	0.96508	0.00000	0.00899	0.00000
CO60	0.00000	0.00000	0.00011	2.50570	0.00000	0.00000
NI59	0.00237	0.00000	0.00000	0.00000	0.00000	0.00000
NI63	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
NI65	0.00000	0.01687	0.00370	0.51364	0.01439	0.00000
CU64	0.00125	0.00000	0.18263	0.00659	0.00000	0.00000
ZN65	0.00316	0.00000	0.01449	0.56612	0.00000	0.00000
ZN69M	0.00018	0.41621	0.00000	0.00000	0.00000	0.00000
ZN69	0.00000	0.00001	0.00000	0.00000	0.00000	0.00000
AS76	0.00000	0.00000	0.30271	0.09922	0.00591	0.02217
SE75	0.34231	0.05010	0.00000	0.00000	0.00000	0.00000
SE79	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
BR82	0.00804	0.00000	1.71753	0.90539	0.01424	0.00000
BR83	0.00000	0.00000	0.00745	0.00000	0.00000	0.00000
KR83M	0.00257	0.00000	0.00000	0.00000	0.00000	0.00000
BR84	0.00071	0.00327	0.45220	0.14089	0.35633	0.83404
KR85M	0.11498	0.04265	0.00012	0.00000	0.00000	0.00000
KR85	0.00000	0.00000	0.00223	0.00000	0.00000	0.00000
KR87	0.00002	0.19928	0.08334	0.02757	0.05791	0.42498
RB87	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
KR88	0.05870	0.01545	0.13950	0.11115	0.22300	1.40675
RB88	0.00000	0.00000	0.12606	0.01658	0.39675	0.09705
KR89	0.05026	0.08839	0.37700	0.28430	0.33461	0.69989
RB89	0.00542	0.00000	0.15425	1.13866	0.07170	0.69822

SR89	0.00000	0.00000	0.00014	0.00000	0.00000	0.00000
RB86	0.00000	0.00000	0.00000	0.09452	0.00000	0.00000
SR85	0.00803	0.00000	0.51036	0.00000	0.00000	0.00000
SR90	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Y 90	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
SR91	0.00459	0.00054	0.31013	0.36407	0.00736	0.00000
Y 91M	0.00045	0.00000	0.53014	0.00000	0.00000	0.00000
Y 91	0.00000	0.00000	0.00000	0.00361	0.00000	0.00000
SR92	0.00717	0.01562	0.03786	1.27841	0.00000	0.00000
Y 92	0.00000	0.01286	0.15965	0.06996	0.00915	0.00000
Y 93	0.01830	0.00000	0.02261	0.01409	0.02695	0.00714
MO93	0.01069	0.00000	0.00000	0.00000	0.00000	0.00000
ZR93	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
NB93M	0.00195	0.00000	0.00000	0.00000	0.00000	0.00000
ZR95	0.00000	0.00000	0.73495	0.00000	0.00000	0.00000
NB95M	0.06628	0.00000	0.00002	0.00000	0.00000	0.00000
NB95	0.00002	0.00011	0.76432	0.00000	0.00000	0.00000
ZR97	0.00458	0.01049	0.06068	0.07473	0.03010	0.00000
NB97M	0.00022	0.00000	0.72820	0.00000	0.00000	0.00000
NB97	0.00002	0.00071	0.64925	0.01305	0.00178	0.00000
NB94	0.00002	0.00000	1.57373	0.00000	0.00000	0.00000
MO99	0.01756	0.00502	0.13237	0.00000	0.00000	0.00000
TC99M	0.12656	0.00000	0.00000	0.00000	0.00000	0.00000
TC99	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
TC101	0.00928	0.27179	0.06165	0.00000	0.00000	0.00000
RU103	0.00112	0.44393	0.03879	0.00000	0.00000	0.00000
PD103	0.01440	0.00011	0.00000	0.00000	0.00000	0.00000
RH103M	0.00172	0.00000	0.00000	0.00000	0.00000	0.00000
RU105	0.05761	0.17903	0.57612	0.00650	0.00000	0.00000
RH105	0.00073	0.07692	0.00000	0.00000	0.00000	0.00000
RU106	0.00000	0.00000	0.17437	0.03051	0.00245	0.00000
PD107	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
PD109	0.01125	0.00000	0.00069	0.00000	0.00000	0.00000
AG110M	0.00026	0.01667	2.13423	0.39763	0.21503	0.00000
AG111	0.00315	0.02285	0.00037	0.00000	0.00000	0.00000
CD109	0.01491	0.00000	0.00000	0.00000	0.00000	0.00000
CD113M	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
CD115M	0.00000	0.00093	0.01333	0.00764	0.00000	0.00000
CD115	0.00856	0.04191	0.15388	0.00000	0.00000	0.00000
IN115M	0.00834	0.15733	0.00000	0.00000	0.00000	0.00000
IN111	0.40503	0.00000	0.00000	0.00000	0.00000	0.00000
IN114M	0.03982	0.00000	0.08549	0.00247	0.00000	0.00000
SN117M	0.15751	0.00000	0.00000	0.00000	0.00000	0.00000
SN119M	0.01140	0.00000	0.00000	0.00000	0.00000	0.00000
SN121M	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
SN121	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
SN123	0.00000	0.00000	0.00036	0.00653	0.00000	0.00000
I 125	0.04154	0.00000	0.00000	0.00000	0.00000	0.00000

SN125	0.00000	0.01113	0.08264	0.16128	0.00264	0.04542
SB125	0.02861	0.18259	0.22136	0.00000	0.00000	0.00000
TE125M	0.03503	0.00000	0.00000	0.00000	0.00000	0.00000
SN126	0.05658	0.00000	0.00000	0.00000	0.00000	0.00000
SB126M	0.00042	0.35528	1.18777	0.02913	0.00000	0.00000
SB126	0.02662	0.34950	2.32194	0.05508	0.00000	0.00000
SB124	0.00010	0.00143	0.77122	0.13805	0.83837	0.11972
SB127	0.03091	0.15835	0.46409	0.00854	0.00000	0.00000
TE127M	0.01115	0.00000	0.00007	0.00000	0.00000	0.00000
TE127	0.00022	0.00461	0.00000	0.00000	0.00000	0.00000
TE123M	0.14797	0.00000	0.00000	0.00000	0.00000	0.00000
TE129M	0.00810	0.00000	0.03134	0.00000	0.00000	0.00000
TE129	0.00787	0.03900	0.00390	0.00688	0.00000	0.00000
I 129	0.02464	0.00000	0.00000	0.00000	0.00000	0.00000
TE131M	0.07549	0.06372	0.85844	0.32604	0.04601	0.05658
TE131	0.10725	0.11211	0.12197	0.07737	0.00173	0.00000
I 131	0.02124	0.29740	0.06250	0.00000	0.00000	0.00000
XE131M	0.02010	0.00000	0.00000	0.00000	0.00000	0.00000
TE132	0.23070	0.00000	0.00000	0.00000	0.00000	0.00000
I 132	0.00710	0.01370	1.89129	0.31364	0.02796	0.03761
TE133M	0.10345	0.09246	1.64030	0.08973	0.16213	0.13001
TE133	0.00065	0.35257	0.16865	0.28513	0.10738	0.01416
I 133	0.00141	0.00271	0.54457	0.05798	0.00000	0.00000
XE133M	0.04145	0.00000	0.00000	0.00000	0.00000	0.00000
XE133	0.04529	0.00000	0.00000	0.00000	0.00000	0.00000
TE134	0.18445	0.15441	0.53035	0.00462	0.00000	0.00000
I 134	0.01398	0.06838	1.86253	0.39138	0.27176	0.01729
CS134M	0.02721	0.00000	0.00000	0.00000	0.00000	0.00000
CS134	0.00035	0.00694	1.47489	0.07291	0.00000	0.00000
I 130	0.00046	0.14385	1.83805	0.15632	0.00000	0.00000
I 135	0.01473	0.02267	0.12977	0.93328	0.42008	0.05455
XE135M	0.00418	0.00000	0.42650	0.00000	0.00000	0.00000
XE135	0.22665	0.00225	0.01904	0.00000	0.00000	0.00000
CS135	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
XE137	0.00045	0.14038	0.00723	0.02363	0.01086	0.00516
CS137	0.00231	0.00000	0.56320	0.00000	0.00000	0.00000
XE138	0.10170	0.12420	0.03183	0.06156	0.34422	0.46233
CS138	0.00796	0.16570	0.11454	1.45862	0.04027	0.57390
CS139	0.00000	0.00060	0.01557	0.11743	0.09828	0.07431
BA139	0.02994	0.00000	0.00000	0.00532	0.00000	0.00000
BA140	0.01701	0.03693	0.13702	0.00000	0.00000	0.00000
LA140	0.00409	0.30205	0.37080	0.00503	1.52450	0.10980
CS136	0.09978	0.16693	0.82360	1.07774	0.00000	0.00000
BA141	0.16577	0.21519	0.20276	0.20700	0.07879	0.02127
LA141	0.00000	0.00000	0.00000	0.03549	0.00720	0.00000
CE141	0.07685	0.00000	0.00000	0.00000	0.00000	0.00000
BA142	0.09524	0.06134	0.23787	0.51066	0.00000	0.00000
LA142	0.00043	0.00372	0.45633	0.22278	0.38435	1.65135

GAMEN.DAT

CE143	0.15892	0.02352	0.08690	0.00403	0.00000	0.00000
PR143	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
CE144	0.01927	0.00000	0.00000	0.00000	0.00000	0.00000
PR144M	0.01185	0.00000	0.00000	0.00000	0.00000	0.00000
PR144	0.00000	0.00000	0.01031	0.00469	0.00000	0.01692
ND147	0.04707	0.01636	0.07731	0.00000	0.00000	0.00000
PM147	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
SM147	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
PM148M	0.04495	0.11520	1.62553	0.20563	0.00000	0.00000
PM148	0.00007	0.00000	0.24504	0.32920	0.00000	0.00000
PM149	0.00896	0.00000	0.00267	0.00000	0.00000	0.00000
PM151	0.09890	0.14200	0.09536	0.00000	0.00000	0.00000
SM151	0.00001	0.00000	0.00000	0.00000	0.00000	0.00000
SM153	0.06042	0.00117	0.00000	0.00000	0.00000	0.00000
EU152	0.08543	0.12011	0.31693	0.62590	0.00393	0.00000
EU154	0.07828	0.00412	0.46221	0.66277	0.04586	0.00000
EU155	0.06058	0.00000	0.00000	0.00000	0.00000	0.00000
EU156	0.01587	0.00254	0.24981	0.55343	0.17001	0.35364
GD153	0.11049	0.00000	0.00000	0.00000	0.00000	0.00000
TB160	0.12069	0.00868	0.59490	0.35739	0.00000	0.00000
HO166M	0.25855	0.08869	1.21835	0.03137	0.00000	0.00000
W 181	0.04035	0.00000	0.00000	0.00000	0.00000	0.00000
W 185	0.00003	0.00000	0.00000	0.00000	0.00000	0.00000
W 187	0.04032	0.11198	0.32391	0.00000	0.00000	0.00000
RE187	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
OS185	0.05025	0.00000	0.65658	0.00000	0.00000	0.00000
OS191	0.07427	0.00000	0.00000	0.00000	0.00000	0.00000
IR192	0.10384	0.60181	0.11270	0.00000	0.00000	0.00000
HG203	0.22871	0.00000	0.00000	0.00000	0.00000	0.00000
TH230	0.00141	0.00000	0.00000	0.00000	0.00000	0.00000
RA226	0.00673	0.00002	0.00000	0.00000	0.00000	0.00000
RN222	0.09857	0.14232	0.40388	0.46074	0.47373	0.18035
PB210	0.00451	0.00000	0.00000	0.00000	0.00000	0.00000
BI210	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
PO210	0.00000	0.00000	0.00001	0.00000	0.00000	0.00000
U 232	0.00178	0.00000	0.00000	0.00000	0.00000	0.00000
TH232	0.00120	0.00000	0.00000	0.00000	0.00000	0.00000
RA228	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
AC228	0.04017	0.08358	0.62712	0.04824	0.12781	0.00000
TH228	0.00307	0.00000	0.00000	0.00000	0.00000	0.00000
RA224	0.00993	0.00008	0.00054	0.00000	0.00000	0.00000
PB212	0.13789	0.01022	0.00000	0.00000	0.00000	0.00000
BI212	0.01221	0.00236	0.37205	0.01203	0.05859	0.93758
U 234	0.00148	0.00000	0.00000	0.00000	0.00000	0.00000
U 236	0.00137	0.00000	0.00000	0.00000	0.00000	0.00000
U 235	0.15251	0.00000	0.00000	0.00000	0.00000	0.00000
TH231	0.02355	0.00000	0.00000	0.00000	0.00000	0.00000
PA231	0.01784	0.01933	0.00000	0.00000	0.00000	0.00000

GAMEN.DAT

AC227	0.00027	0.00000	0.00000	0.00000	0.00000	0.00000
TH227	0.08702	0.02260	0.00000	0.00000	0.00000	0.00000
FR223	0.04329	0.00793	0.00302	0.00000	0.00000	0.00000
RA223	0.13683	0.12143	0.03514	0.00000	0.00000	0.00000
U 237	0.13957	0.00447	0.00000	0.00000	0.00000	0.00000
NP237	0.03297	0.00000	0.00000	0.00000	0.00000	0.00000
PA233	0.04772	0.16986	0.00000	0.00000	0.00000	0.00000
U 233	0.00072	0.00000	0.00000	0.00000	0.00000	0.00000
TH229	0.09477	0.00000	0.00000	0.00000	0.00000	0.00000
RA225	0.01440	0.00000	0.00000	0.00000	0.00000	0.00000
AC225	0.05383	0.13421	0.00483	0.00527	0.03374	0.00000
U 238	0.00121	0.00000	0.00000	0.00000	0.00000	0.00000
TH234	0.00954	0.00000	0.00504	0.00588	0.00000	0.00000
PA234	0.18261	0.04548	1.42175	0.19064	0.12554	0.00000
PU236	0.00182	0.00000	0.00000	0.00000	0.00000	0.00000
PU237	0.05363	0.00000	0.00000	0.00000	0.00000	0.00000
AM242M	0.00470	0.00000	0.00000	0.00000	0.00000	0.00000
AM242	0.01778	0.00000	0.00000	0.00000	0.00000	0.00000
CM242	0.00167	0.00000	0.00000	0.00000	0.00000	0.00000
PU242	0.00127	0.00000	0.00000	0.00000	0.00000	0.00000
NP238	0.00600	0.00000	0.28516	0.26293	0.00000	0.00000
PU238	0.00160	0.00000	0.00000	0.00000	0.00000	0.00000
CM244	0.00149	0.00000	0.00000	0.00000	0.00000	0.00000
PU244	0.00109	0.00000	0.00000	0.00000	0.00000	0.00000
U 240	0.01831	0.00339	0.26342	0.04079	0.01450	0.00000
PU240	0.00153	0.00000	0.00000	0.00000	0.00000	0.00000
CM245	0.07692	0.00000	0.00000	0.00000	0.00000	0.00000
PU241	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
AM241	0.02810	0.00000	0.00000	0.00000	0.00000	0.00000
CM246	0.00133	0.00000	0.00000	0.00000	0.00000	0.00000
CM247	0.02186	0.29550	0.00000	0.00000	0.00000	0.00000
CM243	0.13261	0.00000	0.00000	0.00000	0.00000	0.00000
PU243	0.02228	0.00257	0.00000	0.00000	0.00000	0.00000
AM243	0.05833	0.00000	0.00000	0.00000	0.00000	0.00000
NP239	0.16029	0.01182	0.00000	0.00000	0.00000	0.00000
PU239	0.00065	0.00000	0.00000	0.00000	0.00000	0.00000
CM248	0.00105	0.00000	0.00000	0.00000	0.00000	0.00000
CF252	0.00111	0.00000	0.00000	0.00000	0.00000	0.00000

```
 1
 1
143
  29  34
          BLAD CON
          S CONT
          SI+CONT
          ULI CONT
          LLI CONT
           KIDNEYS
           LIVER
          SAL GLND
           TB REG
           LUNG       (P REG)
  RESP    LYM NODE
          BREAST
           OVARIES
          PANCREAS
          COR BONE
          TRA BONE    (TRA BONE)
          R MARROW
          Y MARROW
           SKIN
           SPLEEN TESTES
           THYROID
           T BODY
            CLOUD
          ADRENALS
           BRAIN
          S WALL
          ULI WALL
          LLI WALL
              BLADDER WALL
GI TRACT      S WALL
              SI+CONT
              ULI WALL
              LLI WALL
              KIDNEYS
              LIVER
              LUNGS
              SAL GLND
              TB REG
              P REG
  RESP        LYM NODE
              BREAST
              OVARIES
              PANCREAS
SKELETON        BONE
```


91048 1830

SEE.IN

COR BONE
CAN BONE
RED MARROW
Y MARROW
T MARROW
COR E CL
CAN E CL
T E CL
SKIN
SPLEEN
TESTES
THYMUS
THYROID
UTERUS
TOTAL BODY
ADRENALS
BONE SURFACE
BRAIN

BONE

H
HE
LI
BE
B
C
N
O
F
NE
NA
MG
AL
SI
P
S
CL
AR
K
CA
SC
TI
V
CR
MN
FE
CO
NI
CU
ZN

SEE.IN

GA
GE
AS
SE
BR
KR
RB
SR
Y
ZR
NB
MO
TC
RU
RH
PD
AG
CD
IN
SN
SB
TE
I
XE
CS
BA
LA
CE
PR
ND
PM
SM
EU
GD
TB
DY
HO
ER
TM
YB
LU
HF
TA
W
RE
OS
IR
PT

SEE IN

AU
HG
TL
PB
BI
PO
AT
RN
FR
RA
AC
TH
PA
U
NP
PU
AM
CM
BK
CF
ES
FM
MD
NO
LR

PARAMS.DAT

```
GENII Input Parameters     29-Aug-88     RAP

1 1 1
1
1
0 70
Intake ends after ____ years:

2 1 1
50
50
0 70
Dose calculations end after ____ years:

3 1 1
1
1
0 70
Release ends after ____ years:

4 2 1
0
0
0 1000
There were ____ years of air deposition
prior to the beginning of the intake period:

5 2 1
0
0
0 1000
There were ____ years of irrigation deposition
prior to the beginning of the intake period:

6 2 1
0
0
0 1000
The inventory was disposed ____ years
prior to the beginning of the intake period:

7 2 1
0
0
0 1000
Loss of institutional control occured
____ years prior to the intake period:
```

```
8 2 2
1.0
1.0
0.0  1.0
Fraction of roots in surface soil,
(top 15 cm layer):

9 1 2
0.0
0.0
0.0  1.0
Fraction of roots in deep soil:

10 2 2
0.0
0.0
0.0  1.0
Manual redistribution; deep soil/surface
soil dilution factor:

11 1 2
0.0
0.0
0.0  1.0
Chi/Q value (sec/m3):

12 1 2
0.0
0.0
0.0  1.0
E/Q value (sec/m3):

13 2 2
0.0
0.0
0.0  10.0
Population-weighted Chi/Q value
(person sec/m3):

14 2 1
1
1
1  16
Maximum individual is located in
sector index (1 = South):

15 2 2
1000.0
```

PARAMS.DAT

```
1000.0
100.0  100000.0
Maximum individual is located
____ meters from release point:

16 2 0
T
Do you wish to calculate chi/Q grid
from joint frequency data (Y/N) ?

17  1  0
F
Is this an elevated release (Y/N) ?

18  1  0
T
Effective stack height (Y/N) ?

19  1  2
100.0
100.0
0.0  1000.0
Stack height (m):

20  1  2
1.0
1.0
0.0  5000.0
Stack flow (m3/s):

21  1  2
5.0
5.0
0.001  30.0
Stack radius (m):

22  1  2
100.0
100.0
0.0  300.0
Effluent temperature (degrees Celsius):

23  1  2
1.0
1.0
0.0  1.0
Surface water mixing ratio:
```

<u>PARAMS.DAT</u>

```
24  1  2
3.0E+3
3.0E+3
0.0  1.0E+6
Average river flow rate (m3/s):

25  1  2
100.0
100.0
0.0  1.0E+2
Average water flow rate (m/s):

26  2  2
0.0
0.0
0.0  1.0E+3
Transit time to irrigation withdrawal
location (hr):

27  2  2
0.0
0.0
0.0  1.0E+4
Rate of effluent discharge to receiving
water body (m3/s):

28  2  2
0.0
0.0
0.0  1.0E+4
Longshore distance from release point
to usage location (m):

29  1  2
0.0
0.0
0.0  1.0E+4
Offshore distance to water intake (m):

30  1  2
0.0
0.0
0.0  1.0E+3
Average water depth in surface water body (m):

31  1  2
0.0
0.0
```

PARAMS.DAT

```
0.0  1.0E+3
Average river width (m):

32  2  2
0.0
0.0
0.0  1.0E+2
Depth of effluent discharge point to
surface water (m):

33  1  2
0.0
0.0
0.0  1.0E+3
Waste form / package half life (yr):

34  1  2
0.0
0.0
0.0  1.0E+2
Waste / contaminated soil thickness (m):

35  1  2
0.0
0.0
0.0  1.0E+3
Depth of soil overburden (m):

36  2  0
T
Do you wish to consider biotic transport
during inventory decay/buildup period (Y/N):

37  2  0
T
Do you wish to consider biotic transport
during intake period (Y/N):

38  2  1
1
1
1  3
Pre-intake site condition (1- Arid non-agricultural,
2- Humid non-agricultural, 3- agricultural):

39  1  2
1.0
1.0
```

<u>PARAMS.DAT</u>

```
1.0  5.0E+6
Total population:

40  1  2
1.0
1.0
1.0E-12  10.0
Population-weighted E/Q value:

41 1 1
1
1
1  3
Surface soil source units (1-m2, 2-m3, 3-kg):

42  1  2
8766.0
8766.0
0.0  8766.0
Individual annual exposure time to plume (hr):

43  1  2
0.0
0.0
0.0  1.0
Unused

44  2  2
4380.0
2920.0
0.0  8766.0
Individual annual exposure time to soil
contamination (hr):

45  2  2
100.0
10.0
0.0  1000.0
Individual annual exposure time while
swimming (hr):

46  2  2
100.0
5.0
0.0  8766.0
Individual annual exposure time while
boating (hr):
```

47 2 2
500.0
17.0
0.0 1000.0
Individual annual exposure time from
shoreline actvities (hr):

48 2 1
1
1
1 4
Shoreline type (1-river, 2-lake, 3-ocean,
4-tidal basin):

49 2 2
8.0
13.0
0.0 1000.0
Transit time for release to reach aquatic
recreation area (hr):

50 2 0
T
External Ground Exposure: Is irrigation
with contaminated water considered?

51 2 1
1
1
1 2
External Ground Exposure: irrigation water
source (1-ground water, 2-surface water):

52 2 2
40.0
40.0
0.0 100.0
External Ground Exposure: irrigation water
application rate (in/irrigation season):

53 2 2
6
6
0 12
External Ground Exposure: duration of
irrigation (mo/yr):

54 1 2

PARAMS.DAT

```
1.0
1.0
0.0   1.0
Fraction of plume passage time spent in plume:

55  1  2
8766.0
8766.0
0.0  8766.0
Individual annual inhalation exposure (hr):

56  2  1
0
0
0  2
Resuspension  (0-not considered, 1-use Mass
Loading model, 2-use Anspaugh model):

57 1  2
1.0E-4
1.0E-4
1.0E-9   1.0E-2
Mass loading factor (g/m3):

58  1  2
1.0
1.0
0.0  15.0
Top soil available for resuspension (cm):

59  2  1
0
0
0  5.0E+6
Population ingesting aquatic foods,
0 defaults to total population (person):

60  2  2
0
0
0  5.0E+6
Population ingesting drinking water,
0 defaults to total population (person):

61  2  0
F
Do you wish to consider dose from contaminated
food exported out of the region?
```

PARAMS.DAT

```
62  2  1
1
1
1  2
Drinking water source (1-ground water,
2-surface water):

63  1  0
T
Is drinking water treated?

64  1  2
1.0
1.0
0.0   10.0
Holdup/transit time of drinking water (da):

65  2  2
730.0
440.0
0.0   1.0E+3
Per capita drinking water consumption rate
(L/yr):

66  2  0
F
Are aquatic foods harvested from salt water
(default is fresh water)?

67  2  0
F
Do you wish to consider uncontaminated food
imported into the region?

68  2  2
0.0
0.0
0.0  1000.0
Fish - Transit time for release to reach
harvest area (hr):

69  1  2
15000.0
15000.0
0.0  1.0E+6
Fish - Total production (kg/yr):
```

PARAMS.DAT

```
70  2  2
1.0
1.0
0.0  1.0E+3
Fish - Holdup between harvest and
consumption (da):

71  1  2
40.0
6.9
0.0  1.0E+2
Fish - Per capita consumption rate (kg/yr):

72  2  2
0.0
0.0
0.0  1000.0
Mollusc - Transit time for release to reach
harvest area (hr):

73  1  2
0.0
0.0
0.0  1.0E+6
Mollusc - Total production (kg/yr):

74  2  2
0.0
0.0
0.0  1.0E+3
Mollusc - Holdup between harvest and
consumption (da):

75  1  2
6.9
0.0
0.0 1.0E+2
Mollusc - Per capita consumption rate (kg/yr):

76  2  2
0.0
0.0
0.0  1000.0
Crustacea - Transit time for release to reach
harvest area (hr):

77  1  2
0.0
```

```
0.0
0.0  1.0E+6
Crustacea - Total production (kg/yr):

78  2  2
0.0
0.0
0.0  1.0E+3
Crustacea - Holdup between harvest and
consumption (da):

79  1  2
6.9
0.0
0.0 1.0E+2
Crustacea - Per capita consumption rate (kg/yr):

80  2  2
0.0
0.0
0.0  1000.0
Aquatic plants - Transit time for release to reach
harvest area (hr):

81  1  2
0.0
0.0
0.0  1.0E+6
Aquatic plants - Total production (kg/yr):

82  2  2
0.0
0.0
0.0  1.0E+3
Aquatic plants - Holdup between harvest and
consumption (da):

83  1  2
6.9
0.0
0.0 1.0E+2
Aquatic plants - Per capita consumption rate (kg/yr):

84  1  2
90.0
90.0
1.0  365.0
Leafy vegetables - Growing time (da):
```

85 2 1
2
2
0 2
Leafy vegetables - Irrigation source
(0-none, 1-ground water, 2-surface water):

86 2 2
35.0
35.0
0.0 100.0
Leafy vegetables - Irrigation rate
(in/irrigation season):

87 1 2
6.0
6.0
0.0 12.0
Leafy Vegetables - Irrigation duration (mo/yr):

88 1 2
1.5
1.5
0.0 10.0
Leafy vegetables - Yield (kg/m2):

89 1 2
0.0
0.0
0.0 1.0E+8
Leafy Vegetables - Total production (kg/yr):

90 2 2
1.0
14.0
0.0 365.0
Leafy Vegetables - Holdup between harvest and
consumption (da):

91 2 2
30.0
15.0
0.0 200.0
Leafy Vegetables - Per capita consumption
rate (kg/yr):

92 1 2

```
90.0
90.0
1.0  365.0
Other vegetables - Growing time (da):

93  2  1
2
2
0  2
Other vegetables - Irrigation source
(0-none, 1-ground water, 2-surface water):

94  2  2
40.0
40.0
0.0  100.0
Other vegetables - Irrigation rate
(in/irrigation season):

95  1  2
6.0
6.0
0.0  12.0
Other Vegetables - Irrigation duration (mo/yr):

96  1  2
4.0
4.0
0.0   10.0
Other vegetables - Yield (kg/m2):

97  1  2
0.0
0.0
0.0  1.0E+8
Other Vegetables - Total production (kg/yr):

98  2  2
5.0
14.0
0.0  365.0
Other Vegetables - Holdup between harvest and
consumption (da):

99  2  2
220.0
140.0
0.0 300.0
```

```
Other Vegetables - Per capita consumption
rate (kg/yr):

100  1  2
90.0
90.0
1.0  365.0
Fruit - Growing time (da):

101  2  1
2
2
0  2
Fruit - Irrigation source
(0-none, 1-ground water, 2-surface water):

102  2  2
35.0
35.0
0.0  100.0
Fruit - Irrigation rate (in/irrigation
season):

103  1  2
6.0
6.0
0.0  12.0
Fruit - Irrigation duration (mo/yr):

104  1  2
2.0
2.0
0.0   10.0
Fruit - Yield (kg/m2):

105  1  2
0.0
0.0
0.0  1.0E+8
Fruit - Total production (kg/yr):

106  2  2
5.0
14.0
0.0  365.0
Fruit - Holdup between harvest and
consumption (da):
```

PARAMS.DAT

```
107  1  2
330.0
64.0
0.0 500.0
Fruit - Per capita consumption rate (kg/yr):

108  1  2
90.0
90.0
1.0  365.0
Cereals - Growing time (da):

109  2  1
0
0
0  2
Cereals - Irrigation source
(0-none, 1-ground water, 2-surface water):

110  2  2
0.0
0.0
0.0  100.0
Cereals - Irrigation rate (in/irrigation
season):

111  1  2
0.0
0.0
0.0  12.0
Cereals - Irrigation duration (mo/yr):

112  1  2
0.8
0.8
0.0   10.0
Cereals - Yield (kg/m2):

113  1  2
0.0
0.0
0.0  1.0E+8
Cereals - Total production (kg/yr):

114  2  2
180.0
180.0
0.0  365.0
```

Cereals - Holdup between harvest and
consumption (da):

115 2 2
80.0
72.0
0.0 300.0
Cereal and bread - Per capita consumption
rate (kg/yr):

116 2 2
15.0
34.0
0.0 365.0
Meat (beef and pork) - Holdup between
harvest and consumption (da):

117 2 2
80.0
70.0
0.0 200.0
Meat (beef and pork) - Per capita
consumption rate (kg/yr):

118 2 2
0.0
0.0
0.0 1.0E+8
Meat (beef and pork) - Total production
(kg/yr):

119 2 2
1.0
1.0
0.0 1.0
Meat - Fraction of animal drinking water
that is contaminated:

120 2 2
0.25
0.25
0.0 1.0
Meat - Fraction of animal diet consisting of
contaminated grain:

121 1 2
90.0
90.0

PARAMS.DAT

```
1.0  365.0
Meat - Grain growing time (da):

122  2  1
0
0
0  2
Meat - Grain irrigation source (0-none,
1-ground water, 2-surface water):

123  2  2
35.0
35.0
0.0  100.0
Meat - Grain irrigation rate (in/irrigation
season):

124  1  2
6.0
6.0
0.0  12.0
Meat - Grain irrigation duration (mo/yr):

125  1  2
0.8
0.8
0.0   10.0
Meat - Grain yield (kg/m2):

126  1  2
180.0
180.0
0.0   365.0
Meat - Storage time for grain (da):

127  2  2
0.75
0.75
0.0  1.0
Meat - Fraction of animal diet consisting of
contaminated hay:

128  1  2
45.0
45.0
1.0  365.0
Meat - Hay growing time (da):
```

PARAMS.DAT

```
129  2  1
2
2
0  2
Meat - Hay irrigation source (0-none,
1-ground water, 2-surface water):

130  2  2
47.0
47.0
0.0  100.0
Meat - Hay irrigation rate (in/irrigation
season):

131  1  2
6.0
6.0
0.0  12.0
Meat - Hay irrigation duration (mo/yr):

132  1  2
2.0
2.0
0.0   10.0
Meat - Hay yield (kg/m2):

133  1  2
100.0
100.0
0.0   365.0
Meat - Storage time for hay (da):

134  2  2
1.0
34.0
0.0  365.0
Poultry- Holdup between harvest and
consumption (da):

135  1  2
18.0
8.5
0.0 50.0
Poultry - Per capita consumption rate (kg/yr):

136  1  2
0.0
0.0
```

PARAMS.DAT

```
0.0  1.0E+6
Poultry - Total production (kg/yr):

137  2  2
1.0
1.0
0.0  1.0
Poultry - Fraction of drinking water that is
contaminated:

138  2  2
1.0
1.0
0.0  1.0
Poultry - Fraction of animal diet consisting of
contaminated grain:

139  1  2
90.0
90.0
1.0  365.0
Poultry - Grain growing time (da):

140  2  1
0
0
0  2
Poultry - Grain irrigation source (0-none,
1-ground water, 2-surface water):

141  2  2
0.0
0.0
0.0  100.0
Poultry - Grain irrigation rate (in/irrigation
season):

142  1  2
0.0
0.0
0.0  12.0
Poultry - Grain irrigation duration (mo/yr):

143  1  2
0.8
0.8
0.0   10.0
Poultry - Grain yield (kg/m2):
```

PARAMS.DAT

```
144   1   2
180.0
180.0
0.0    365.0
Poultry - Storage time for grain (da):

145   2   2
1.0
4.0
0.0   365.0
Milk- Holdup between harvest and
consumption (da):

146   1   2
270.0
230.0
0.0 1000.0
Milk - Per capita consumption rate (kg/yr):

147   1   2
0.0
0.0
0.0   1.0E+8
Milk - Total production (kg/yr):

148   2   2
1.0
1.0
0.0   1.0
Milk cow - Fraction of drinking water that is
contaminated:

149   2   2
0.25
0.25
0.0   1.0
Milk cow - Fraction of animal diet consisting
of contaminated hay:

150   1   2
45.0
45.0
1.0   365.0
Milk cow - Hay growing time (da):

151   2   1
2
```

```
2
0  2
Milk cow - Hay irrigation source (0-none,
1-ground water, 2-surface water):

152  2  2
47.0
47.0
0.0  200.0
Milk cow - Hay irrigation rate (in/irrigation
season):

153  1  2
6.0
6.0
0.0  12.0
Milk cow - Hay irrigation duration (mo/yr):

154  1  2
2.0
2.0
0.0   10.0
Milk cow - Hay yield (kg/m2):

155  1  2
100.0
100.0
0.0   365.0
Milk cow - Storage time for hay (da):

156  2  2
0.75
0.75
0.0  1.0
Milk cow - Fraction of animal diet consisting
of contaminated fresh forage:

157  1  2
30.0
30.0
1.0  365.0
Milk cow - Fresh forage growing time (da):

158  2  1
2
2
0  2
Milk cow - Fresh forage irrigation source
```

(0-none, 1-ground water, 2-surface water):

159 2 2
47.0
47.0
0.0 100.0
Milk cow - Fresh forage irrigation rate
(in/irrigation season):

160 2 2
6.0
6.0
0.0 12.0
Milk cow - Fresh forage irrigation duration
(mo/yr):

161 1 2
1.5
1.5
0.0 10.0
Milk cow - Fresh forage yield (kg/m2):

162 1 2
0.0
0.0
0.0 365.0
Milk cow - Storage time for fresh forage (da):

163 2 2
1.0
18.0
0.0 365.0
Eggs - Holdup between harvest and
consumption (da):

164 1 2
30.0
20.0
0.0 100.0
Eggs - Per capita consumption rate (kg/yr):

165 1 2
0.0
0.0
0.0 1.0E+8
Eggs - Total production (kg/yr):

166 2 2

PARAMS.DAT

```
1.0
1.0
0.0  1.0
Laying hen - Fraction of drinking water that is
contaminated:

167  2  2
1.0
1.0
0.0  1.0
Laying hen - Fraction of animal diet consisting of
contaminated grain:

168  1  2
90.0
90.0
1.0  365.0
Laying hen - Grain growing time (da):

169  2  1
0
0
0  2
Laying hen - Grain irrigation source (0-none,
1-ground water, 2-surface water):

170  2  2
0.0
0.0
0.0  100.0
Laying hen - Grain irrigation rate
(in/irrigation season):

171  2  2
0.0
0.0
0.0  12.0
Laying hen - Grain irrigation duration
(mo/yr):

172  1  2
0.8
0.8
0.0   10.0
Laying hen - Grain yield (kg/m2):

173  1  2
180.0
```

```
180.0
0.0   365.0
Laying hen - Storage time for grain (da):

174   1  1
1
1
1 2
POPOPT

175  1  1
1
1
0  3
XOQOPT

176  1  1
1
1
0  3
FOQOPT

177 1  2
0.0
0.0
1.0E-12   1.0
Food-weighted Chi/Q value (sec/m3):

178 1  1
1
1
0  3
MIXFLG

179 1  0
F
Is source area less than 1250 m2 (Y/N)?

180  2  2
1250.0
1250.0
0.0  1250.0
Source area for external dose modification
factor (m2):

181 1  1
0
0
```

PARAMS.DAT

```
0  3
IRELES

182 1 2
100.0
100.0
0.0  5000.0
Building cross-sectional area (m):

183 1 2
10.0
10.0
0.0  100.0
Building height (m):

184 1 0
F
Use building wake model (Y/N):

185 1 1
1
1
1  16
Which down-wind sector (1 = South):
```

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```
######################## Program GENII Input File ###########  8 Jul 88 ####
Title:

OPTIONS======================= Default ===================================
    Near-field scenario?       (Far-field)   NEAR-FIELD: narrowly-focused
    Population dose?          (Individual)               release, single site
    Acute release?              (Chronic)    FAR-FIELD:  wide-scale release,
                          data set used                  multiple sites
                                Complete                                Complete
TRANSPORT OPTIONS============ Section   EXPOSURE PATHWAY OPTIONS===== Section
   Air Transport                  1        Finite plume, external        5
   Surface Water Transport        2        Infinite plume, external      5
   Biotic Transport (near-field) 3,4       Ground, external              5
   Waste Form Degradation (near) 3,4       Recreation, external          5
                                           Inhalation uptake             5,6
REPORT OPTIONS======================       Drinking water ingestion      7,8
   Report AEDE only                        Aquatic foods ingestion       7,8
   Report by radionuclide                  Terrestrial foods ingestion   7,9
   Report by exposure pathway              Animal product ingestion      7,10
   Debug report on screen                  Inadvertent soil ingestion

INVENTORY ##############################################################

     Inventory input activity units: (1-pCi  2-uCi  3-mCi  4-Ci  5-Bq)
     Surface soil source units (1- m2  2- m3  3- kg)
     Equilibrium question goes here

     --------|----Release Terms------|----------Basic Concentrations---------|
     Use when|  transport selected   |  near-field scenario, optionally      |
     --------|-----------------------|---------------------------------------|
     Release |       Surface Buried  |        Surface Deep    Ground  Surface|
     Radio-  |Air    Water   Waste   |Air     Soil    Soil    Water   Water  |
     nuclide |/yr    /yr     /m3     |/L      /unit   /m3     /L      /L     |
     --------|------- ------- -------|------- ------- ------- ------- -------|

     --------|----Derived Concentrations-----|
     Use when|  measured values are known    |
     --------|-------------------------------|
     Release |Terres. Animal  Drink   Aquatic|
     Radio-  |Plant   Product Water   Food   |
     nuclide |/kg     /kg     /L      /kg    |
     --------|------- ------- ------- -------|

TIME ###################################################################

     Intake ends after (yr)
     Dose calc. ends after (yr)
     Release ends after (yr)
```

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No. of years of air deposition prior to the intake period
No. of years of irrigation water deposition prior to the intake period

FAR-FIELD SCENARIOS (IF POPULATION DOSE) ####################################

Definition option: 1-Use population grid in file POP.IN
2-Use total entered on this line

NEAR-FIELD SCENARIOS ###

Prior to the beginning of the intake period: (yr)
When was the inventory disposed? (Package degradation starts)
When was LOIC? (Biotic transport starts)
Fraction of roots in upper soil (top 15 cm)
Fraction of roots in deep soil
Manual redistribution: deep soil/surface soil dilution factor
Source area for external dose modification factor (m2)

TRANSPORT ##

====AIR TRANSPORT====================================SECTION 1=====

Option: 0-Calculate PM	Release type (0-3)
1-Use chi/Q or PM value	Stack release (T/F)
2-Select MI dist & dir	Stack height (m)
3-Specify MI dist & dir	Stack flow (m3/sec)
Chi/Q or PM value	Stack radius (m)
MI sector index (1=S)	Effluent temp. (C)
MI distance from release point (m)	Building x-section (m2)
Use jf data, (T/F) else chi/Q grid	Building height (m)

====SURFACE WATER TRANSPORT=========================SECTION 2=====
Mixing ratio model: 0-use value, 1-river, 2-lake
Mixing ratio, dimensionless
Average river flow rate for: MIXFLG=0 (m3/s), MIXFLG=1,2 (m/s),
Transit time to irrigation withdrawl location (hr)
If mixing ratio model > 0:
Rate of effluent discharge to receiving water body (m3/s)
Longshore distance from release point to usage location (m)
Offshore distance to the water intake (m)
Average water depth in surface water body (m)
Average river width (m), MIXFLG=1 only
Depth of effluent discharge point to surface water (m), lake only

====WASTE FORM AVAILABILITY=========================SECTION 3=====
Waste form/package half life, (yr)
Waste thickness, (m)
Depth of soil overburden, m

====BIOTIC TRANSPORT OF BURIED SOURCE===============SECTION 4=====
Consider during inventory decay/buildup period (T/F)?

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```
     Consider during intake period (T/F)?      | 1-Arid non agricultural
     Pre-Intake site condition.............    | 2-Humid non agricultural
                                               | 3-Agricultural

EXPOSURE ###################################################################

     ====EXTERNAL EXPOSURE================================SECTION 5=====
     Exposure time:                  |    Residential irrigation:
       Plume (hr)                    |           Consider: (T/F)
       Soil contamination (hr)       |           Source: 1-ground water
       Swimming (hr)                 |                   2-surface water
       Boating (hr)                  |           Application rate (in/yr)
       Shoreline activities (hr)     |           Duration (mo/yr)
     Shoreline type: (1-river, 2-lake, 3-ocean, 4-tidal basin)
     Transit time for release to reach aquatic recreation (hr)
     Average fraction of time submersed in acute cloud (hr/person hr)

     ====INHALATION=======================================SECTION 6=====
     Hours of exposure to contamination per year
     0-No resus-  1-Use Mass Loading            2-Use Anspaugh model
       pension      Mass loading factor (g/m3)    Top soil available (cm)

     ====INGESTION POPULATION=============================SECTION 7=====
     Atmospheric production definition (select option):
       0-Use food-weighted chi/Q, (food-sec/m3), enter value on this line
       1-Use population-weighted chi/Q
       2-Use uniform production
       3-Use chi/Q and production grids (PRODUCTION will be overridden)
     Population ingesting aquatic foods, 0 defaults to total (person)
     Population ingesting drinking water, 0 defaults to total (person)
     Consider dose from food exported out of region (default=F)

     Note below: S* or Source: 0-none, 1-ground water, 2-surface water
                               3-Derived concentration entered above
     ==== AQUATIC FOODS / DRINKING WATER INGESTION=========SECTION 8====

     Salt water? (default is fresh)

     USE        TRAN-  PROD-    -CONSUMPTION-  |
     ?   FOOD   SIT    UCTION   HOLDUP  RATE   |
     T/F TYPE   hr     kg/yr    da      kg/yr  |      DRINKING WATER
     --- ------ -----  -------  ------  -----  |-------------------------
         FISH                                  |    Source (see above)
         MOLLUS                                |    Treatment? T/F
         CRUSTA                                |    Holdup/transit(da)
         PLANTS                                |    Consumption (L/yr)

     ====TERRESTRIAL FOOD INGESTION=======================SECTION 9=====
```

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```
                USE         GROW    --IRRIGATION--          PROD-    --CONSUMPTION--
                ?   FOOD    TIME    S RATE   TIME    YIELD  UCTION   HOLDUP  RATE
                T/F TYPE    da      * in/yr  mo/yr   kg/m2  kg/yr    da      kg/yr
                --- ------ -----    - -----  -----   -----  -------  ------  ------
                    LEAF V
                    ROOT V
                    FRUIT
                    GRAIN

                ====ANIMAL PRODUCTION CONSUMPTION===================SECTION 10====

                ---HUMAN---- TOTAL  DRINK   -------------STORED FEED-------------
USE             CONSUMPTION  PROD-  WATER   DIET  GROW -IRRIGATION--        STOR-
?   FOOD        RATE  HOLDUP UCTION CONTAM  FRAC- TIME S RATE  TIME   YIELD AGE
T/F TYPE        kg/yr  da    kg/yr  FRACT.  TION  da   * in/yr mo/yr  kg/m3 da
--- ------      ------ ----- ------ ------- ----  ---- - ----- -----  ----- -----
    BEEF
    POULTR
    MILK
    EGG
                                            -------------FRESH FORAGE------------
    BEEF
    MILK

#####################################################################################
```

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