WIPP PA

User's Manual

for

GENII-A, Version 2.10

Document Version 1.00

WPO # 27751

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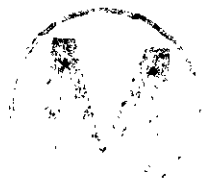

1.0 INTRODUCTION

1.1 Document Purpose

This document serves as a user's manual for GENII-A, as used in the 1996 WIPP PA calculation. As such, it describes the code's purpose and function, the user's interaction with the code, and the models and methods employed by the code. Examples of user-accessible input and output files are included for the user's convenience.

The GENII-A code, which runs on a DEC Alpha platform, duplicates a subset of the executables from the original GENII program (Radiation Shielding Information Center, 1995). Because a published conceptual representation and user's manuals for GENII already exist (Napier et al., 1988 [Volumes 1 and 2]), an important purpose of this user's manual (WPO # 27751) is to point the user to the discussions in Napier et al. pertinent to the 1996 WIPP PA calculation. It is recommended that the user have a copy of Napier et al., available from the Sandia WIPP Central Files, while reading this user's manual (WPO # 27751).

1.2 Software Identifier

Code Name:	GENII-A, a DEC Alpha-platform implementation of GENII, the second generation of the Hanford environmental dosimetry computer codes compiled in the Hanford Environmental Dosimetry System.
WIPP Prefix:	GI2
Version Number:	2.10, 1/16/96
Platforms:	FORTRAN 77 for OpenVMS AXP, version 6.1, on DEC Alpha

1.3 *Points of Contact*

1.3.1 Code Sponsor

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2.0 FUNCTIONAL REQUIREMENTS

The functional requirements for GENII-A are listed below:

R.1 GENII-A reads pathway and nuclide inventory input data.

R.2 GENII-A calculates doses for acute releases.

R.3 GENII-A calculates doses for chronic releases.

R.4 GENII-A calculates doses for air transport of radionuclides with or without meteorological input data.

R.5 GENII-A calculates doses for finite plume air immersion.

R.6 GENII-A calculates doses for infinite plume air immersion.

R.7 GENII-A calculates doses for external gound exposure.

R.8 GENII-A calculates doses for animal product ingestion with or without irrigation option.

R.9 GENII-A calculates doses for terrestrial food ingestion with or without irrigation option.

R.10 GENII-A calculates doses from dairy product ingestion with or without irrigation option.

R.11 GENII-A calculates doses from aquatic food ingestion.

R.12 GENII-A calculates doses from drinking water ingestion.

R.13 GENII-A calculates doses for far-field release.

R.14 GENII-A calculates doses for near-field release.

R.15 GENII-A calculates doses for lake or river surface water transport.

R.16 GENII-A calculates doses from external recreational exposure including boating, swimming, and external shoreline exposure.

R.17 GENII-A calculates doses from handling radioactive samples.

R.18 GENII-A calculates individual dose.

R.19 GENII-A calculates population dose using population distribution data.

R.20 GENII-A calculates doses from inhalation of airborne radionuclides.

3.0 REQUIRED USER TRAINING AND/OR BACKGROUND

In order to run the GENII-A code successfully, the user will need a basic knowledge of

- Open VMS
- Digital Command Language
- Sandia's CAMDAT database.

To understand the theoretical portions of this manual (and the theoretical portions of the user manual by Napier et al. [1988]) and understand and interpret the results of GENII-A, the user should have a working knowledge of

- scenario development
- biosphere transport of radionuclides
- some knowledge of radionuclide decay processes and
  - radionuclide/organ interactions
  - radiation interactions with organic matter

An undergraduate degree in science or engineering is also recommended. The user should also have some knowledge of the original GENII program and its user manuals (Napier et al., 1988; Radiation Shielding Information Center, 1995). (The original GENII program, because it can run on an IBM PC platform, is sometimes called PC-GENII.).

4.0 DESCRIPTION OF THE MODELS AND METHODS

4.1 Program Modules

While GENII is composed of seven linked computer codes and their associated data libraries, GENII-A makes use of only five of them, as Figure 1 shows. Note that the `ENVIN` module has been renamed `GENII`[1] and that `GENII` calls `ENV` and `DOSE`.

Aside from the above name and hierarchy changes, a minor modification was made to the GENII code allowing a combined dose calculation from a spherical radioactive source (hand-held by the driller) and the ground surface exposure dose from a nearby source of radionuclides spread over a

[1] This program module should not be confused with GENII, GENII-A's predecessor. To prevent confusion, this program module (and all program modules) are written in a Courier font: `GENII`.

specified surface area. This capability is an option and can be selected through appropriate input data.

The following should also be noted:

- Only static outputs from EXTDF and INTDF are used by GENII-A; in other words, the boxes labeled EXTDF and INTDF in Figure 1 represent static data files, not program modules that are exercised when GENII-A is run. (EXTDF and INTDF are described in Sections 3.5 and 3.6 of Volume 1 of Napier et al., 1988 and Sections 3.3 and 3.4 of Volume 2 of Napier et al., 1988.) These modules are discussed below.

- Some modification to input formatting was made along with the deletion of unused parameters and the addition of new parameters for the sample exposure option mentioned above.

- Another addition was the inclusion of the requirement to indicate the number of nuclides in the GENII-A input file.

4.1.1 GENII

The ENVIN portion of GENII

- controls the reading of the input control text (.INP) file prepared by PREGENII (see computational flow discussion in Section 6.0 and input control file discussion in Section 7.2)

- organizes the input for the environmental transport and exposure module, ENV

- prepares the data transfer files that are used as input by ENV

- outputs the run input parameters report (i.e., the output input echo file) (Section 9.3).

Details on ENVIN are provided in Volume 1 of Napier et al. (Section 3.2).

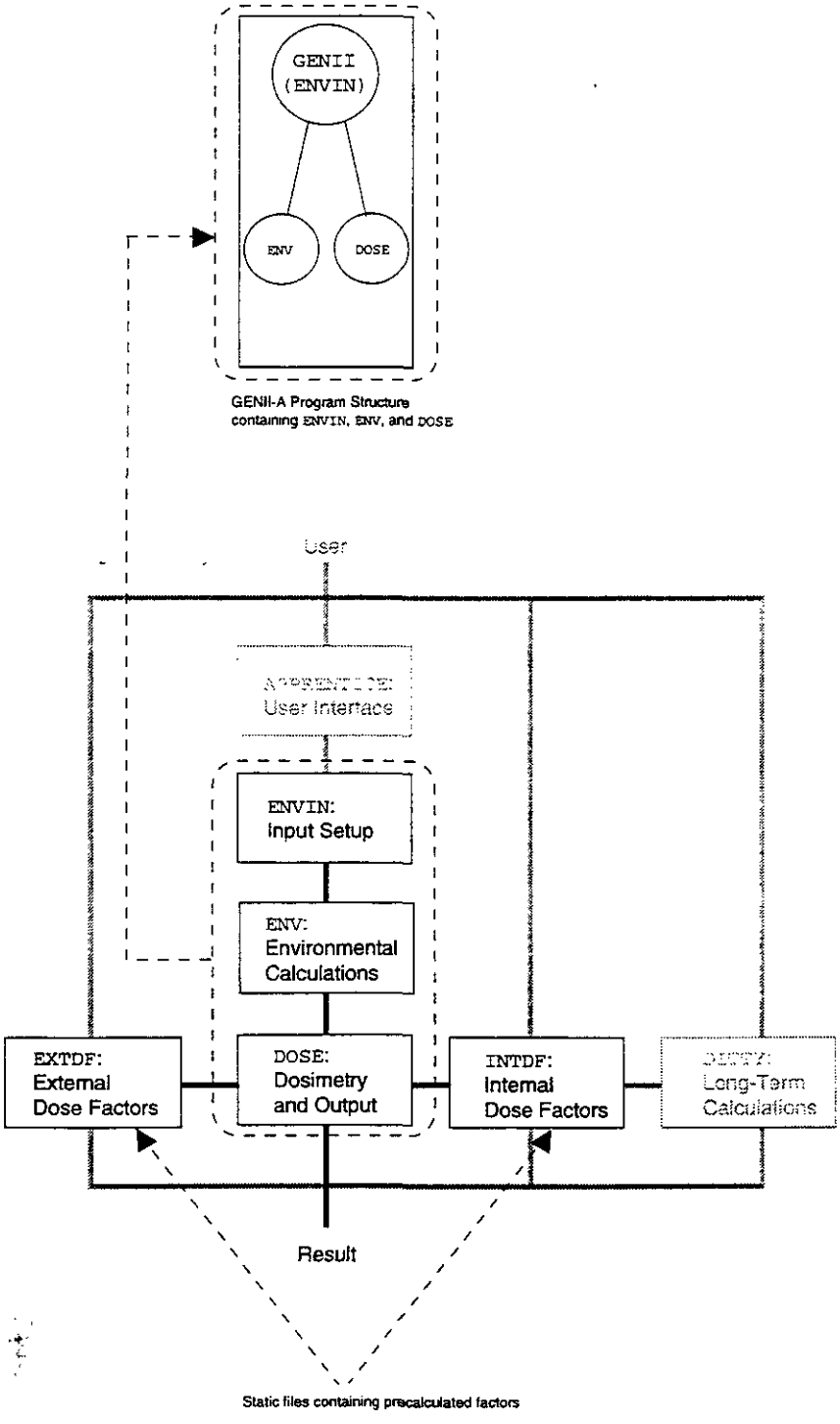


Figure 1. GENII-A implementation of GENII. (Faded portions of figure not used by GENII-A.)

4.1.2 ENV

ENV calculates environmental transfer, uptake, and human exposure to radionuclides that result from the chosen pathway for the defined source terms, as described in Volume 1 of Napier et al. (1988) (Section 3.3). The intermediate information that ENV calculates on annual media concentrations and intake rates are written to data transfer files that are input to DOSE.

4.1.3 DOSE

GENII-A uses DOSE to compute concentrations and intake through the following six principal exposure routes or pathways through the biosphere:

1. **Contaminated stockpond, water-stock cattle, man (rancher).** Contaminated brine from an exploratory drillhole leaks into an aquifer and its groundwater is pumped into a stockpond. Livestock drink exclusively from this pond and ranchers consume the livestock.

2. **Contaminated cuttings, man (driller).** Individuals operating the exploratory drill that penetrates the WIPP repository are, because of their proximity to drilling operations, exposed externally to (1) contaminated soil from the drilling mud pit and (2) drilling samples that they examine.[2]

3. **Contaminated stockpond, dust-air transport, man (farm family).** Contaminants from a dried stockpond (contaminated with radionuclides migrating through the groundwater, as explained in pathway 1) are suspended in an air plume that deposits the contamination onto a nearby farm. The contaminated crops and livestock from this farm are consumed by humans.

4. **Contaminated drilling-mud pit, dust-air transport, man (farm family).** Contaminants from a dried drilling-mud pit are suspended in an air plume that deposits the contamination onto a nearby farm. The contaminated crops and livestock from this farm are consumed by humans.

5. **Contaminated lake (drinking water, aquatic activities, fishing, irrigation).** Contaminated water from an exploratory drillhole leaks into an aquifer and its groundwater reaches a lake. Humans are contaminated by drinking water from the lake, fishing from the lake, aquatic activities in the lake, and by consuming crops irrigated by contaminated lake water.

[2] *It is to be noted that this option will not be exercised for the WIPP PA calculations since it was not included* in the test cases for the QA series. The exposure of the driller will be determined from two separate calculations, one involving exposure from a ground plane source (mud pit) and the second from handling the spherical source. In this way each contribution can be examined separately. These test cases have been included in the QA series.

6. **Contaminated well water (drinking water, irrigation).** Contaminated water from an exploratory drillhole leaks into an aquifer and its groundwater reaches a well. Humans are contaminated by drinking desalinated water from the well and consuming crops irrigated by contaminated well water.

The 1996 WIPP PA calculation is limited to the above six principal exposure routes.

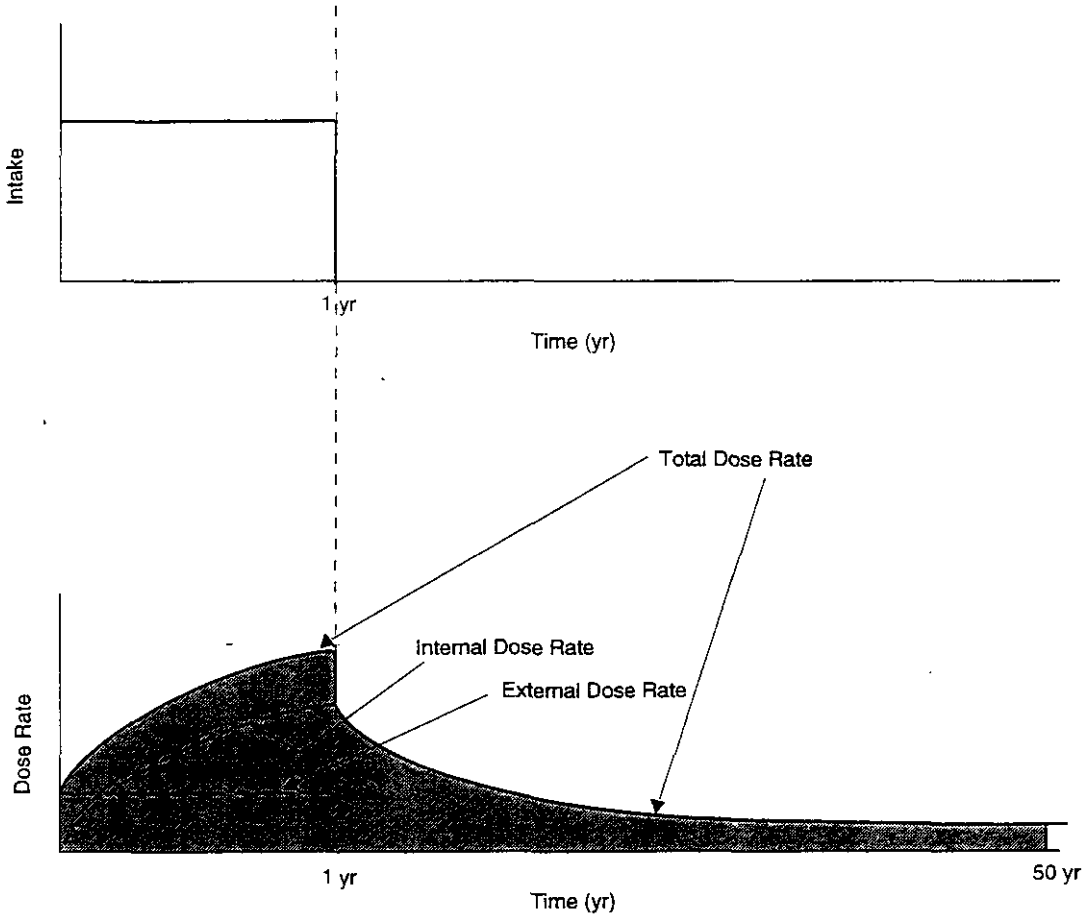
DOSE reads the annual intake and exposure rates defined by ENV and converts them to radiation dose. The calculation of external dose is done with precalculated factors from EXTDF, and the calculation of internal dose is done with precalculated factors from INTDF.

GENII-A uses DOSE to calculate the following for each radionuclide:

- inhalation effective dose equivalent
- ingestion effective dose equivalent
- external dose
- internal effective dose equivalent
- annual effective dose equivalent.

All values are reported in dose equivalent units of rem. A 50-year dose commitment is assumed. The effective dose equivalent (EDE) combines the 1-year external dose and the internal dose over a 50-year period with an assumed 1-year intake period, as shown in Figure 2, multiplied by appropriate weighting factors for nuclides and organs. The internal effective dose equivalent equals the sum of the ingestion and inhalation dose. Further details on DOSE are provided in Volume 1 of Napier et al., 1988 (Section 3.4).

Note that an additonal dose calculation capability has been added to GENII-A: the spherical source exposure calculation, which utilizes the external exposure algorithm provided in DOSE with the appropriate dose convergence factors. See Section 7.1.5 for details.



$$\text{Committed Dose} = \int_{0\,\text{yr}}^{50\,\text{yr}} (\text{Total Dose Rate})\, dt$$

Figure 2. Committed dose from 1-year internal and external exposure plus extended internal dose (from Figure 3.2 of Volume 1 of Napier et al., 1988)

4.2 Mathematical Representations

The mathematical models and algorithms used by GENII are discussed in detail in Chapter 4.0 of Volume 1 of Napier et al. (1988). To understand the theory upon which GENII-A is based, the reader should read the following portions of Chapter 4.0 of Napier et al.:

- Section 4.1, Internal Dosimetry
- Section 4.2, External Dosimetry
- Section 4.3, Atmospheric Dispersion
- Section 4.4, Air Submersion
- Section 4.5, Surface Water Transport Models
- Section 4.6, Soil Contamination Model
- The following subsections in Section 4.7, Terrestrial Exposure Pathways:
  - Subsection 4.7.1, Inhalation
  - Subsection 4.7.2, Drinking Water Ingestion
  - Subsection 4.7.4, Crop Ingestion — Chronic Exposures
  - Subsection 4.7.5, Animal Product Ingestion — Chronic Exposures
  - Subsection 4.7.7, External Exposure

4.3 Solution Techniques

The GENII package of computer codes is written in standard FORTRAN 77 using a Lahey compiler. Most routines are simple algebraic solutions, and no special logic is employed. One exception is the set of Bateman differential equations used by `DOSE` to calculate radioactive decay and generation of daughter products; the Bateman equations are solved in subroutine `CHAIN` using a chain decay solver. Another exception is `INTDF`, which is not run when GENII-A is exercised. (The same static output from `INTDF` is used for all GENII-A runs; see Section 4.1.)

5.0 CAPABILITIES AND LIMITATIONS OF THE SOFTWARE

5.1 Capabilities

GENII-A, as used for the 1996 WIPP PA calculation,

- calculates radiation doses for chronic releases
- evaluates the following exposure pathways—soil (surface source), air (semi-infinite cloud and finite cloud geometries), inhalation pathways, and ingestion pathways
- inputs measured concentrations of the source term in specified environmental media
- provides an interface for external calculation of atmospheric dispersion
- identifies target populations by distance and direction for individuals and populations.

5.2 *Limitations*

The following limitations and assumptions are discussed in the noted parts of Napier et al., 1988:

- The internal dosimetry model does not account for elimination of material leaving a target organ (Volume 1, Subsection 4.1.1).
- All iodine decay products (isotopes of the noble gas xenon) are assumed to be stable or to escape the body before decaying (Volume 1, Subsections 4.1.3 and 4.1.4).
- 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 (Volume 1, Subsection 4.1.6).
- All intakes of carbon-14 are assumed to be completely and instantaneously absorbed (Volume 1, Subsection 4.1.6).
- For chains with daughters with very short half-lives, the decay energy is assigned to the parent (Volume 1, Subsection 4.1.7).
- Simple atmospheric dispersion modeling is used (Volume 1, Section 4.3 and Subsection 4.3.7).
- The derivation of the atmospheric 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 (Volume 1, Subsection 4.3.7).
- The surface water models make the following limiting assumptions: constant flow depth; constant downstream or longshore velocity; straight river channel; constant lateral dispersion coefficient; continuous point discharge release of effluents; constant river width (Volume 1, Section 4.5).
- The quantity of activity from contaminated soil brought to the surface by animals is assumed to be uniformly distributed in the surface soil and available for entry into plant and animal product pathways in subsequent years (Volume 1, Section 4.6.3).

- There is no measurable decrease in the the Anspaugh resuspension factor (used for calculating inhalation exposure) after about 17 years (Volume 1, Subsection 4.7.1).

- Inadvertent ingestion of water during bathing is neglected (Volume 1, Subsection 4.7.2).

- Because interception of materials in irrigation water (i.e., the fraction of radionuclides deposited within a unit area that ends up on vegetation surfaces) is not well understood, a default value of 0.25 is used (Volume 1, Subsection 4.7.4).

- The concentrations of tritium or carbon-14 in environmental media (soil, plants, and animal products) are assumed to have the same specific activity as the contaminating medium (Volume 1, Subsection 4.7.9).

6.0 USER INTERACTIONS WITH THE SOFTWARE

GENII-A is run for each input control file generated by PREGENII corresponding to a *n*-vector sample space. As the computational flow diagram (Figure 3) shows, radionuclide concentration processed by PREGENII can originate from WIPP PA codes that simulate the direct route to the accessible environment (CUTTINGS code sequence), or from the WIPP PA codes that simulate the indirect route to the accessible environment (BRAGFLO, NUTS/PANEL, SECOFL, and SECOTP code sequences). (Pathways 2 and 4 listed in Subsection 4.1.3 use output from the CUTTINGS code sequence; pathways 1 and 3 listed in Subsection 4.1.3 use output from the BRAGFLO, NUTS/PANEL, SECOFL, and SECOTP code sequences.)

6.1 Interactive Execution

The user can execute GENII-A interactively by typing the following two lines (each followed by a carriage return) at the VMS "$" prompt:

```
DEFINE GI2_DFL$DEF WP$TESTROOT:[GI2.DAT]
RUN WP$PRODROOT:[GI.EXE]GENII-A.EXE
```

A banner scrolls down the screen and then the following information describing the file definitions is printed on the screen:

```
*******************************************************************************

GENII-A expects the following files:
   1) Input Text File
   2) Input Filenames File
   3) Output dose file
   4) Output input echo file
   5) Output Diagnostics/Debug File (optional)

*******************************************************************************
```

THIS SAMPLE COMPUTATIONAL FLOW DIAGRAM *IS NOT NECESSARILY* THE FLOW USED IN THE 1996 WIPP PA CALCULATION. IT IS *INCLUDED SOLELY FOR ILLUSTRATIVE PURPOSES.*

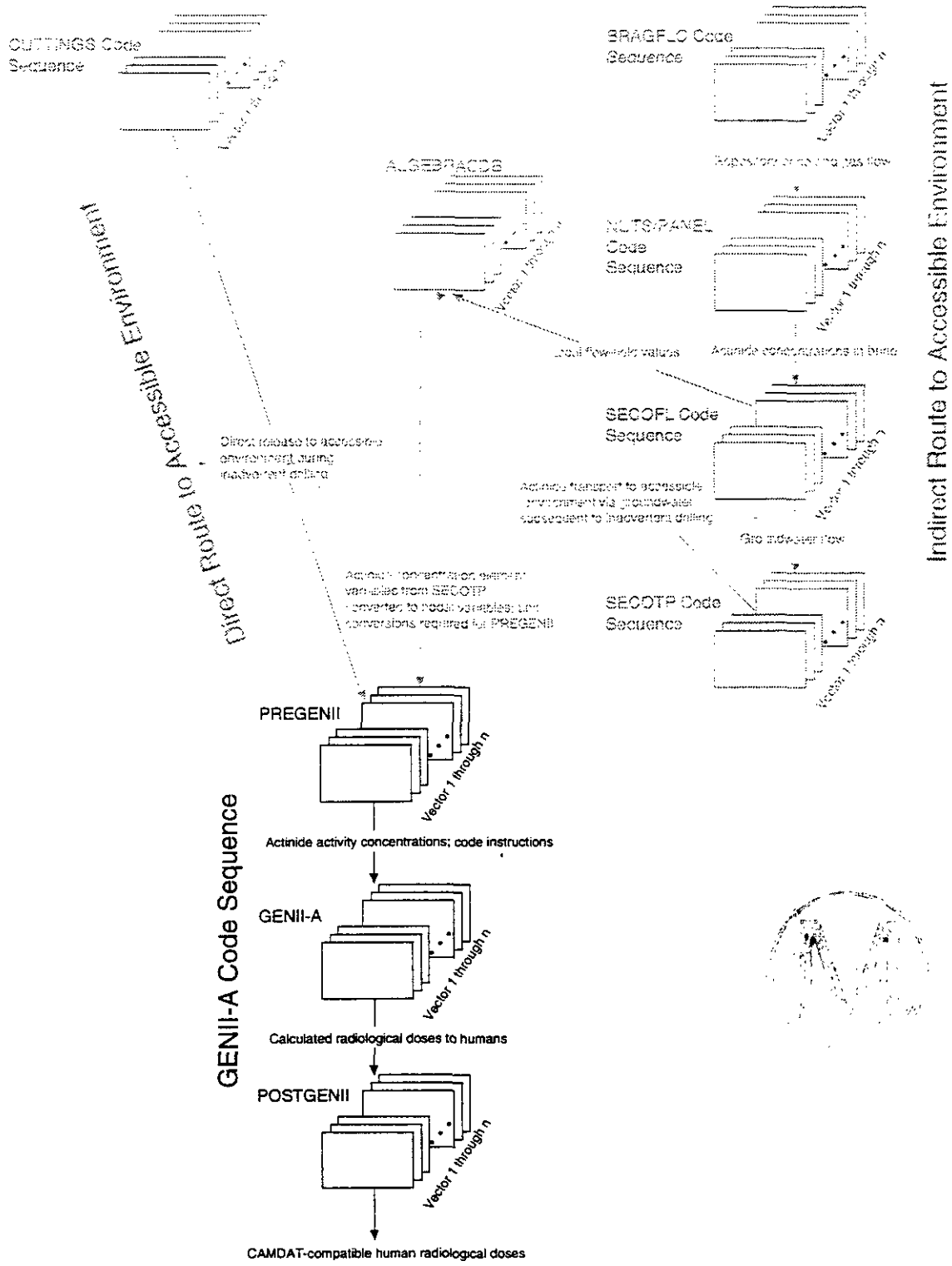


Figure 3. Sample computational flow diagram for GENII-A.

Subsequent questions in the procedure file request names for the above five files, described briefly below:

1. ***Input text* (.INP) file.** *This is the ASCII input control file output by PREGENII* (Figure 3) to run GENII-A for the sampled vector. See Section 7.1 for more information on this file.

2. **Input filenames (.DAT) file.** This file contains the names of the data files, input files, output files, and buffers required to run GENII-A. See Section 7.2 for more information on this file.

3. **Output dose (.OUT) file.** This file contains the results of the GENII-A calculation for the sampled vector; it is read by POSTGENII (see Figure 3). See Section 9.1 for more information on this file.

4. **Output input echo (.OUT) file.** This file, referred to in Napier et al. (1988) as the run input parameters report, contains a listing of parameters input to GENII-A for the sampled vector. See Section 9.2 for more information on this file.

5. **Output diagnostics/debug (.OUT) file.** This output file contains information about the GENII-A run for the sampled vector. It is an optional file, but it must be specified if the user wants to take advantage of error reporting. See Section 9.3 for more information on this file.

6.2 Execution via Command File

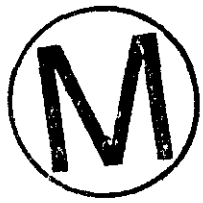
Alternatively, the user may use a command file to execute GENII-A. A sample command file (SAMPLE.COM) follows:

```
! ----
! MODULE:          SAMPLE.COM
! PURPOSE:         RUN A CASE THROUGH GENII-A USING A COM FILE
! DATE:            22-DEC-1995
! AUTHOR:          USER NAME
! ----
  SET NOON
  START_DIR = F$ENVIRONMENT("DEFAULT")
  EXE_SRC :== $WP$PRODROOT:[GI.EXE]GENII-A.EXE
  DEFINE  GI2_DFL$DEF WP$TESTROOT:[GI2.DAT]
  DEFINE  GI2_FND$INP GI2_DFL$DEF:GI2_FILENAME.DAT
  SET DEFAULT WP$TESTROOT:[GI2.TEST]
! ----
  DEFINE  GI2_TRN$INP GI2_TEST1_TRN.INP
  DEFINE  GI2_TRN$OUT GI2_TEST1_TRN.OUT
  DEFINE  GI2_ECO$OUT GI2_TEST1_ECO.OUT
  DEFINE  GI2_DBG$OUT GI2_TEST1_DBG.OUT
  EXE_SRC GI2_TRN$INP GI2_FND$INP GI2_TRN$OUT GI2_ECO$OUT GI2_DBG$OUT
! ----
  SET DEFAULT 'START_DIR
```

```
EXIT
```

Note that the the above command file specifies the names of Files 1 through 5 as `GI2_TEST1_TRN.INP`, `GI2_FILENAME.DAT`, `GI2_TEST1_TRN.OUT`, `GI2_TEST1_ECO.OUT`, and `GI2_TEST1_DBG.OUT`, respectively. (For user's convenience, these filenames appear in bold type in the above sample command file.) Once the command file is written and stored, the user simply types an "@" followed by the name of the command file, which in this case would be:

```
@SAMPLE.COM
```



7.0 DESCRIPTION OF INPUT FILES

7.1 ASCII Input Control (.INP) File

The GENII-A ASCII input control file (File 1 introduced in Section 6.1) contains the input specifications required to exercise GENII-A. This input file is referred to as GENII.IN by Napier et al. (1988) and is described line by line in Volume 2 (Section 3.2) of that publication.

A higher-level description of the GENII-A ASCII input control file, as used for the 1996 WIPP PA calculation, follows. In addition, a sample input control file, along with a detailed line-by-line description of the sample file, is provided in Appendix A.

By examining the sample input control file in Appendix A, one can see that the GENII-A input control file consists of seven major fields:

- options
- inventory
- time
- far-field scenarios
- near-field scenarios
- transport
- exposure.

A description of these fields follows. The sample input control file provided in Appendix A can be used as a guide while reading this description. This sample input control file is not necessarily indicative of one which will be used for the 1996 WIPP PA calculation.

7.1.1 Options

7.1.1.1 General

GENII-A allows for either near- or far-field scenarios. Far-field scenarios are for processes involving release of radioactive material into a wide environment. Near-field scenarios focus on possible doses to an individual at a particular location. For the 1996 WIPP PA calculation, the contaminated cuttings, man (driller) exposure pathway (described in Subsection 4.1.3 of this user's manual) is near-field; the remaining five pathways (also described in Subsection 4.1.3) are far-field.

GENII-A can be commanded to calculate either individual doses (for representative members of a critical group) or population doses (collective doses to regional populations or subpopulations). For the 1996 WIPP PA calculation, individual doses are calculated for all pathways.

For the 1996 WIPP PA calculation, GENII-A is limited to chronic releases; acute releases are not modeled.

"Maximum Individual data set used" indicates a conservative approach to selection of individual dose calculation parameters used for inhalation, ingestion, and external exposure. These conservative parameters are in line with the "critical group" requirement.

7.1.1.2 Transport

For the 1996 WIPP PA calculation, only one of the four transport options is ever invoked: the air transport option, which is used for the two dust-air transport pathways. As Figure 3 shows, groundwater transport for the stockpond pathway is handled by the SECO family of WIPP PA codes, and transport up the borehole to the drilling site is handled by the CUTTINGS family of WIPP PA codes. Sources from these calculations are deposited at the location of the scenario as basic concentrations.

7.1.1.3 Report

For all pathways considered for the 1996 WIPP PA calculation, the following report options are used:

- Dose is reported as committed dose equivalent (CDE), the committed dose from one year of exposure over a 50-year period (see Figure 2), appropriately weighted for each organ.
- Dose is reported for each radionuclide.
- Dose is reported by exposure pathway.
- The debug report is not printed on the screen.

7.1.1.4 Exposure Pathway

The following exposure pathways are exercised for the 1996 WIPP PA calculation:

- finite plume, external
- infinite plume, external
- ground, external
- inhalation uptake
- terrestrial foods ingestion
- animal product ingestion
- sample exposure.

7.1.2 Inventory

The inventory field specifies the input activity units, surface soil units, and the number of nuclides in the source term.

The inventory field also requires specification of the source term as a release term, basic concentration, or derived concentration. Release terms are sources to air or water or concentrations in buried wastes. The WIPP dust-air transport pathways specify an air release term. Basic concentrations can be entered when the transport steps are calculated outside of GENII-A. Basic concentrations are used for the WIPP groundwater and drilling cuttings pathways.

7.1.3 Time

Values provided to the time field allow specification of length of exposure, period for which dose commitment is calculated, length of time during which release occurs, and the time of air or irrigation water deposition prior to the intake period. For the 1996 WIPP PA calculation, the intake and release times are typically assumed to be one year, the dose calculation covers a 50-year period, and no air or irrigation water deposition is assumed to occur before the intake period.

7.1.4 Far-Field Scenarios

For the 1996 WIPP PA calculation, the dust-air pathways are considered far-field scenarios. Only individual doses are calculated.

7.1.5 Near-Field Scenarios

For the 1996 WIPP PA calculation, values can be provided for the following parameters in the near-field scenarios input field:

- "Manual redistribution: deep soil/surface soil dilution factor." A value is specified for the drilling cuttings pathway because drilling a borehole involves physical disruption that mixes deeply buried waste.

- "Source area for external dose modification factor." The value corresponding to this parameter is the area of the contaminated surface; a value is required for the dust-air transport pathways.

- "Source area for close examination dose factor." The GENII-A code has the capability to calculate exposure from a spherical hand-held source and a ground plane. The user has the option to implement either or both of these capabilities:

  - In order to implement the spherical source exposure option, the following input parameters are needed: The "Source area for close examination dose factor" should be set equal to 1250 square meters, and the soil overburden depth should be set to 0.15 meters in the "External Exposure" input field in order to flag within the code the appropriate area modification factor and dose calculation factor, respectively. Additionally, a value must be set for the "Examined soil contamination duration" (hours).

  - The input for the ground plane exposure consists of the area over which the radionuclides are spread in addition to the exposure time to the ground plane area and the distance from that source.

  The exposure times may not necessarily be equal for the two sources (spherical source and ground plane). When the selection is made to calculate exposure from a ground plane together with that from the spherical source, the program combines the two exposures into one and outputs the result as the external dose. If only one pathway is selected (spherical or ground plane), then the external exposure for that pathway will appear as the external dose. When the combined calculation is made, the basic concentration is input in the "Deep Soil" column under "Basic Concentrations."

7.1.6 Transport

7.1.6.1 Air Transport

The 1996 WIPP PA calculation requires that the plume model be calculated by PREGENII, meaning that the "0=Calculate PM" model is selected. When the pathway is dust-air, PREGENII can provide either

- a grid of precalculated χ/Q values and a matching grid of population that GENII-A cross-multiplies to create a population-weighted χ/Q

- joint frequency distribution in place of the χ/Q grid.

7.1.6.2 Surface Water Transport

Surface water transport is not a pathway used for the 1996 WIPP PA calculation.

7.1.7 Exposure

7.1.7.1 External Exposure

For the 1996 WIPP PA calculation, PREGENII can provide values for the following parameters:

- Plume exposure time — length of exposure per year to chronic atmospheric plumes. Plume exposure time is specified for the dust-air pathway. If the pathway is not dust-air, any value assigned to this parameter is neglected.

- Examined soil contamination duration — length of time the driller inspects the contaminated sample. A value is provided for this parameter for the drilling pathway. This parameter specifies the exposure time to the examined sample.

- Soil overburden depth — This parameter is used as a flag when set to 0.15 m to obtain the dose conversion factor for sample exposure. Other values can be used for scenarios not including sample exposure.

7.1.7.2 Inhalation

In the WIPP PA dust-air pathways, PREGENII must provide the following:

- the number of hours of exposure to contamination per year

- the type of resuspension model (none, mass loading, or Anspaugh)

The mass loading and Anspaugh models are explained in Volume 1 of Napier et al., 1988 (Subsection 4.7.1).

7.1.7.3 Ingestion Population

PREGENII specifies one of two options dealing with plant and animal food production:

- Option 1, use same χ/Q value distribution as used for the population (Section 7.1.6.1), essentially assuming the source of food and the people are co-located (used for the dust-air pathways)

- Option 2, assume that the food is produced uniformly throughout an 80-km grid (used for the stockpond pathway)

7.1.7.4 Aquatic Foods/Drinking Water Ingestion

While aquatic foods are not considered for the 1996 WIPP PA calculation, drinking water ingestion may be. If it is exercised, the source would be ground water (Option 1), it would have to be treated, and holdup/transit and consumption parameters would be specified.

7.1.7.5 Terrestrial Food Ingestion

PREGENII provides values for terrestrial food ingestion parameters here. See page 3.25 of Volume 2 of Napier et al. (1988) for details.

7.1.7.6 Animal Production/Consumption

PREGENII provides values for animal production and consumption parameters here. See pages 3.25 and 3.26 of Volume 2 of Napier et al. (1988) for details.

7.2 Input Filenames File

A sample input filenames file is provided in Appendix B. The input filenames file contains the names of the external data, input, and output files and their corresponding unique logical unit numbers (left column of Appendix B). Further information on this file is provided in Volume 2 of Napier et al. (1988) on pages 2.34 through 2.36.

8.0 ERROR MESSAGES

GENII-A generates an alphabetical list of error messages that are written to the diagnostics/debug file (Section 9.3). There are five error types:

1. **Warnings.** These messages are informational only; no action is necessary.

2. **Scenarios errors.** These errors often occur when there is a problem with an input file. The code 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. The user should carefully check and correct any inconsistencies in the input file.

3. **Program errors.** The sponsor should be notified if a program error message is displayed.

4. **Scenario/file errors.** These errors indicate a problem with auxiliary input files.Users should refer to Sections 2.2.1 through 2.2.12 of Napier et al. (1988), Volume 2 for assistance in determining the cause of scenario/file errors.

5. **Program/file errors.** The sponsor should be notified if a program/file error message is displayed. Program/file errors usually indicate that the user, in attempting to expand the application of GENII-A for research purposes, has made incorrect changes to data files

used by the code. The user should check file format and usage as presented in Section 2.3 of Napier et al. (1988), Volume 2.

Error outputting by GENII is thoroughly documented in Appendix B of Napier et al. (1988), Volume 2. Especially useful is the alphabetical list of messages contained in Table B.1 in Appendix B of Napier et al. (1988), Volume 2. The user should follow the specific guidance provided in that table when recovering from errors.

9.0 DESCRIPTION OF OUTPUT FILES

9.1 Output Dose File

The output dose file contains the actual dose calculation results. The sample output dose file provided in Appendix C, a representative GENII-A output dose file, consists of

- the effective dose equivalent summary calculation, from which individual organ doses may be obtained, and a summary table of the dominant organ, dominant exposure pathway[3], and dominant radionuclide (see listing in Appendix C titled Page C.4)
- the dose assembly matrix (defined in Figure 3.6 of Volume 1 of Napier et al., 1988), from which the annual dose, effective dose equivalent, cumulative dose, and maximum annual dose may be obtained (see listing in Appendix C titled Page C.5)
- the dose contribution by exposure pathway (see listing in Appendix C titled Page C.6)
- the dose contribution by radionuclide (see listing in Appendix C titled Page C.7 through Page C.10)
- the dose contribution by radionuclide as a function of ingestion, inhalation, and external exposure (see listing in Appendix C titled Page C.11 and Page C.12)

9.2 Output Input Echo File

The output input echo file (see Appendix D for a sample listing) is the quality assurance output portion. The input values and scenario description flags are repeated to allow checking of the calculation assumptions.

9.3 Output Diagnostics/Debug File

The output diagnostics/debug file (see Appendix E for a sample listing) contains the file assignments and any error messages generated during the run.

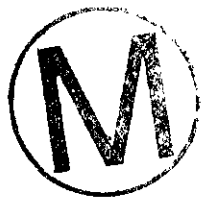
---

[3] Here "exposure pathway" refers to mechanisms within the the five exposure pathways described in Section 4.1.2.

10.0 REFERENCES

Napier, B.A., R.A. Peloquin, D.L. Strenge, and J.V. Ramsdell. 1988. *GENII - The Hanford Environmental Radiation Dosimetry Software System, Volume 1: Conceptual Representation and Volume 2: Users' Manual.* PNL-6584, Richland, Washington: Pacific Northwest Laboratory.

Radiation Shielding Information Center. 1995. *GENII 1.485 Environmental Radiation Dosimetry Software System, March 1995.* Oak Ridge, Tennessee: Oak Ridge National Laboratory.



11.0 APPENDICES

Note

The sample files and displays provided in Appendices A through E are examples *only*. They *are not necessarily* the files used for the 1996 WIPP PA regulatory calculation.

Appendix A: Annotated Sample GENII-A Input Control (.INP) File

A.1 Line-by-Line Annotation

An example of the GENII-A file is presented in Section A.2. A line-by-line description of the parameters and options that are defined in GENII-A, along with the code variable names, is provided below.

Line 1: File identifier line for the GENII-A file. See B. Napier et al. Vol. 2 page 3.7 for more detail.

Line 2: Title line for the specific input case. (Name of the specific input file copied into GENII-A.)

Line 3: Creation date.

Line 4: OPTIONS header line.

Line 5: Near-field or far-field scenario option flag. See B. Napier et al. Vol. 2 pp. 3.7 to 3.9 for more detail.

Line 6: Population or individual dose calculation flag, POPDOS. See B. Napier et al. Vol. 2 pg. 3.9 for more detail.

Line 7: Acute or chronic release flag, ACUTE. See B. Napier et al. Vol. 2 pg. 3.9 for more detail.

Line 8: This line contains a reminder of the type of individual exposure parameters used for inhalation, ingestion, and external exposure. See B. Napier et al. Vol. 2 pg. 3.9 for more detail.

Lines 9 to 10: Header line for transport pathway options.

Line 11: Atmospheric transport flag, AIR. See B. Napier et al. Vol 2. pg. 3.10 for more detail.

Line 12: Surface water transport flag, SWAT.

Line 13: Biotic transport flag (only activated for near-field scenarios with subsurface contamination), BIOT. Inoperative in GENII-A version.

Line 14: Waste form degradation flag (only activated for near field scenarios with buried wastes), BURWAS. Inoperative in GENII-A version.

Line 15 to 16: Report Options header.

Line 17:	Flag for type of dose calculation, OUTEDE. See B. Napier et al. Vol 2. pg. 3.10 for more detail.
Line 18:	Flag to provide report of exposure by radionuclide, OUTRAD.
Line 19:	Flag to provide report of exposure pathway, OUTPTH.
Line 20:	Flag to provide debugging output, DEBUG. See B. Napier et al. Vol 2. pg. 3.11 for more detail.
Lines 21 to 22:	Header line for exposure pathway options.
Line 23:	Flag to activate finite plume external exposure pathway, FINITE. See B. Napier et. al Vol. 2 pg. 3.11 for more detail.
Line 24:	Infinite plume external exposure flag, AIREXT.
Line 25:	Soil exposure external exposure flag, GROUND.
Line 26:	Aquatic recreation (swimming, boating, shoreline) exposure flag, RECRE.
Line 27:	Inhalation exposure flag, INHAL.
Line 28:	Drinking water ingestion exposure flag, DRINK.
Line 29:	Aquatic foods ingestion exposure flag, AQFOOD.
Line 30:	Terrestrial foods (crops) ingestion exposure flag, TFOOD.
Line 31:	Animal product (meat, milk, eggs) ingestion exposure flag, ANFOOD.
Line 32:	Inadvertent soil ingestion model exposure flag, SLING.
Lines 33 to 35:	Inventory editing header.
Line 36:	Selection of radionuclide inventory activity units, IUNIT. See B. Napier et al. Vol. 2 pg. 3.12 for more detail.
Line 37:	Selection of surface soil inventory units- the source may be entered in terms of area, volume, or mass, SOLUNT.
Line 38:	Number of nuclides in source term.
Lines 39 to 46:	Inventory editing headers. See B. Napier et al. Vol. 2 pg. 3.12 for more detail.

Lines 47 to 54: Inventories of radionuclides may be entered here for release or basic concentrations. See B. Napier et al. Vol. 2 pg. 3.12 for more detail.

Lines 55 to 60: Derived concentration editing header. Inventories of derived concentrations of radionuclides may be entered following this header. See B. Napier et al. Vol. 2 pgs. 3.12 and 3.13 for more detail (not listed in sample listing shown in Section A.2).

Lines 61 to 63: Time editing header. See B. Napier et al. Vol. 2 pg. 3.13 for more detail.

Line 64: Length of time over which the intake occurs (time from "Intake Begins" to "Intake Ends." See B. Napier et al. Vol. 2 pg. 3.13 for more detail.

Line 65: Dose commitment.

Line 66: Length of time over which release occurs during exposure (time from " Intake Begins" to "Release Stops"), RELEND. If the AEDE ONLY options has been selected for the reports, only one year will be used.

Line 67: Length of time prior to time "Intake Begins" that inventory atmospheric release was initiated (the early portion of the "Release Period"), BEFAIR, yr.

Line 68: Length of time prior to time "Intake Begins" that inventory surface water release and irrigation were initiated (the early portion of the "Release Period") , BEFIRR, yr.

Line 69 to 71: Far-field scenario parameter editing header.

Line 72: To calculate population doses, you will be asked to input consumption/ exposure parameters for an average individual in the population. See B. Napier et al. Vol. 2 pg. 3.14 for more detail. In this sample file, the number "1" corresponds to the case where the number of people will be read from POP.IN.

Line 73: If only the total population is being used, enter it on this line, POPIN, persons. In this sample file, the number "2" on Line 72 corresponds to this selected option.

Lines 74 to 77: Near-field scenario editing header. B. Napier et al. Vol. 2 pg. 3.14 for more detail.

Line 78: The length of time prior to the time "Intake Begins" that the inventory "Disposal" was initiated, BEFORE, yr.

Line 79: 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. Inoperative in GENII-A version.

Line 80: A two-compartment model of plant roots is allowed. Root fractions are used in regular plant concentration model. The upper soil fraction is entered on this line, RF1. See B. Napier et al. Vol. 2 pg. 3.15 for more detail.

Line 81: The deep soil root fraction is entered on this line, RF2.

Line 82: For scenarios involving physical disruption that mixes deeply buried waste with surface soil, a "Manual Redistribution" factor is available, MANULR. See B. Napier et al. Vol. 2 pg. 3.15 for more detail.

Line 83: 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.

Line 84: The flag used to initiate the spherical sample calculation is set to 1250.

Line 85: Transport editing header.

Line 86: Air transport editing header.

Lines 87 to 90: A number of options are available to determine air concentration from releases. The option is selected by specifiying a parameter XOQOPT on line 88 of this field. See B. Napier et. al. Vol.2 pgs. 3.15 to 3.18 for more detail.

Line 91: Input chi/Q or population-weighted chi/Q, if used, goes on this line, XOQI, sec /m^3 or person-sec/m^3.

Line 92: Sector index for the location of the Maximum Individual, MIDIR. See B. Napier et al. Vol. 2 pg. 3.18 for more detail.

Line 93: Distance of Maximum Individual from the release point, meters, MIDIST. See B. Napier et al. Vol. 2 pg. 3.18 for more detail.

Line 94: Stack height or effective stack height, SHITE, m.

Line 95: Flag for use of joint frequency data, as defined by XOQOPT, JFIN.

Lines 96 to 97: Surface Water Transport editing header. See Napier et al. Vol. 2 pg. 3.19 for more detail.

Line 98: Indicator for which mixing ratiio model to use. MIXFLG. See Napier et al. Vol. 2 pg. 3.19 for more detail.

Line 99: Input mixing ratio MIXFLG=0, MIXR.

Line 100: 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 101: Transit time to irrigation withdrawal location, SWTT, h.

Line 103: Exposure editing header.

Line 104: External exposure editing header.

Line 105: Header for the exposure time for plume.

Line 106: Length of external exposure (per year) to chronic atmospheric plumes, HRPLUM, h.

Line 107: Length of external exposure per year to soil contamination, HRGRD, h.

Line 108: Length of external exposure to spherical sample (hours).

Line 109: Depth of soil over source. This parameter is also used when spherical sample calculation is implemented, in which case 0.15 m is specified.

Line 110: Length of time spent per year swimming in contaminated water, HRSWIM, h.

Line 111: Length of time spent by individuals (per year) boating, HRBOAT, h.

Line 112: Length of time spent by individuals exposed in shoreline activities, HRSHOR, h.

Line 113: Index for type of shoreline at the exposure location, SHRTYP. See B. Napier et al. Vol.2, pg. 3.22 for more detail.

Line 114: Travel time of water from the release point to the recreational exposure point, RECTT, h.

Line 115: For the acute air submersion model, the fraction ot total plume travel time that the individual spends in the plume, FRCLOD.

Lines 116 to 117: Irrigation header.

Line 118: Irrigation flag, RESIRR (T or F).

Lines 119 to 120: Irrigation source selection, IRRSR (1=groundwater, 2=surface water).

Line 121: Irrigation application rate, RIRR (in/yr).

Line 122: Irrigation time in months/year, IRTIMR.

Line 123: Inhalation editing header. See B. Napier et al. Vol.2, pg. 3.22 for more detail.

Line 124: Hours per year an individual spends exposed to contaminated air from either chronic plumes or from resuspension. HRINH, h.

Line 125: Flag for activating resuspension models, IRES. See B. Napier et al. Vol.2, pg. 3.22 for more detail.

Line 126: 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.

Lines 127 to 128: Ingestion Population editing header. See B. Napier et al. Vol.2, pp. 3.22 to 3.23 for more detail.

Line 129: Option selection for food production, FOQOPT. (Called "Atmospheric production" option because air transport of particulates is involved through the chi/Q factor.)

Line 130: If FOQOPT =0 , then the food-weighted chi/Q is entered on this line, FOQ, $kg\text{-}sec/m^3$.

Lines 131 to 133: Editing information.

Line 134: The number of people ingesting the aquatic food harvest, AQUPOP, persons, if different than the total population. See B. Napier et al. Vol.2, pg. 3.23 for more detail.

Line 135: The number of people drinking water from the contaminated source, DWPOP, persons, if different than the total population. See B. Napier et al. Vol.2, pg. 3.24 for more detail.

Line 136: An option is available to consider the total population of foods in the assessment area. The flag for this option is on this line, EXPORT. See B. Napier et al. Vol.2, pg. 3.24 for more detail.

Lines 137 to 139: Aquatic Food/Drinking Water editing header.

Line 140: Flag for consideration of freshwater or marine bioaccumulation factors for the aquatic food pathways, ISALT.

Lines 141 to 142: Drinking Water editing header.

Line 143: Because GENII-A allows simultnaeous consideration of several sources of contamination (surface water and ground water), you need to indicate which source is to be used for drinking, DWSRC. See Napier et al. Vol.2, pp. 3.24 and 3.25 for more detail.

Line 144: Flag to indicate whether drinking water is treated through a water treatment facility, DWTRET.

Line 145: Holdup /transit time for drinking water before use (decay), HOLDDW; days.

Line 146: Drinking water consumption rate, DWUSAG; liters/year.

Lines 147 to 155: For each of the aquatic food types you select with the flag in the first column (AQF), several parameters must be entered. See B. Napier et al. Vol.2, pg. 3.24 for more detail.

Lines 156 to 161: Terrestrial food ingestion editing header.

Line 162 to 165: Input of terrestrial food parameters. See B. Napier et al. Vol.2, pg. 3.25 for more detail.

Line 166 to 173: Animal production consumption editing header.

Line 174 to 180: 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. See B. Napier et al. Vol.2, pp. 3.25 to 3.26 for more detail.

A.2 Sample Listing

```
====GENII  Input  file=========10   -Oct  95==================SECTION  2=====
                      test file sample3 genii alpha
                          Created on 12 Oct-95
OPTIONS=========================DEFAULT============
F     Near-field scenario?
T     Population dose?
T     Acute release?
      Maximum Individual data set used
                                    Complete
TRANSPORT  OPTIONS============Section
 T                        Air Transport
 F              Surface Water Transport
 F       Biotic Transport (near-field)
 F       Waste Form Degradation (near)

REPORT  OPTIONS======================
 T          Report AEDE only
 T          Report by radionuclide
 T          Report by pathway
 F          Debug Report
                                 Complete
EXPOSURE  PATHWAY  OPTIONS=====  Section
 F           Finite plume, external
 T           Infinite plume, external
 T                 Ground, external
 F             Recreation, external
 T                Inhalation uptake
 F          Drinking water ingestion
 F           Aquatic foods ingestion
 T     Terrestrial foods ingestion
 T        Animal product ingestion
 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)2
 8    Number of nuclides in source term

        --------|----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
       nuclide |/yr       /yr     /m3    |/L        /unit     /m3      /L       /L      |
        --------|------- ------- -------|------- ------- ------- ---------------
       SM153     2.8E-04
       EU154     6.8E-06
       EU155     7.0E-06
       EU156     7.8E-04
       CO60      1.2E-06
       CR51      2.9E-06
       FE59      2.5E-06
       FE55      3.0E-05
--------|----Derived  Concentrations-----|
       Use when|    measured values are known    |
        Release |Terres.  Animal   Drink    Aquatic|
        Radio-  |Plant    Product  Water    Food    |
        nuclide |/kg      /kg      /l       /kg     |
         --------|------- ------- ------- -------|
```

```
61
62 TIME  ##########################################
63
64     1. Intake ends after (yr)
65    50. Dose calc. ends after (yr)
66     1. Release ends after (yr)
67     0  No. of years of air deposition prior to the intake period
68     0  No. of years of irrigation water deposition prior to the intake period
69
70 FAR-FIELD  SCENARIOS  (IF POPULATION DOSE)  ########################################
71
72 2             Definition option: 1-Use population grid in filePOP.IN
73 1                                2-Use total entered on this line
74
75 NEAR-FIELD  SCENARIOS  ############################################################
76
77               Prior to the beginning of the intake period: (yr)
78 0               When was the inventory disposed?  (Package degradation starts)
79 0               When was LOIC?  (Biotic transport starts)
80 0.0000       Fraction of roots in upper soil (top 15 cm)
81 0.0000       Fraction of roots in deep soil
82 0.0           Manual redistribution: deep soil/surface soil dilution factor
83 0.0           Source area for external dose modification factor (m2)
84 0.0           Source area for close examination dose factor (m2)
85 TRANSPORT  ##############################,#######################################
86                ====AIR TRANSPORT=======================,================SECTION 1=====
87                      0-Calculate PM
88 1            Option: 1-Use chi/Q or PM value
89                      2-Select MI dist & dir
90                      3-Specify MI dist & dir
91 6.8E-03     Chi/Q or PM value
92 0            MI sector index (1=S)
93 .000E+00    MI distance from release point (m)
94  1.0         Release height (m)
95 F            Use jf data, (T/F) else chi/Q grid
96
97                ====SURFACE WATER TRANSPORT============================SECTION 2=====
98  0            Mixing ratio model: 0-use value, 1-river, 2-lake
99  0            Mixing ratio, dimensionless
100  0.00        Average river flow rate for: MIXFLG=0 (m3/s) MIXFLG=1,2 (m/s)
101  0.0         Transit time to irrigation withdrawl location (hr)
102              If mixing ratio model > 0:
103 EXPOSURE##############################################################################
104               ====EXTERNAL EXPOSURE================================SECTION 5=====
105              Exposure time (hours):
106   0.         Plume (hr)
107  2920.0      Surrounding soil contamination duration (hr)
108  0.0         Examined soil contamination duration (hr)
109  0.0         Soil overburden depth (m)
110  0.0         Swimming (hr)
111  0.0         Boating (hr)
112  0.0         Shoreline activities (hr)
113  0.0            Shoreline type: (1-river, 2-lake, 3-ocean, 4-tidal basin
114  0.0            Transit time for release to reach aquatic recreation (hr)
115  1.0         Average fraction of time submersed in acute cloud (hr/person hr)
116
117              Residential irrigation;
118 T          Consider: (T/F)
119 0          Source: 1-ground water
120                    2-surface water
121 0.0       Application rate (in/yr)
122 0.0       Duration (mo/yr)
123                ====INHALATION=======================================SECTION 6=====
```

```
2920.0        Hours of exposure to contamination per year
  0.0          0-No resus-  1-Use Mass Loading          2-Use Anspaugh model
  0.0          pension      Mass loading factor (g/m^3)   Top soil available (cm)

               ====INGESTION POPULATION============================SECTION 7=====
 1             Atmospheric production option
.000E+00       0-Use food-weighted chi/Q, (kg-sec/m^3), enter value on this line
               1-Use population-weighted chi/Q
               2-Use uniform production
               3-Use chi/Q and production gridss (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)
                  DRINKING WATER (Humans)
               -------------------
2          SOURCE (see above)
T          TREATMENT? T/F
1.0        HOLDUP/TRANSIT(da)
730.0      CONSUMPTION (L/yr)

              USE        TRAN-  PROD-     -CONSUMPTION-
              ?   FOOD   SIT    UCTION    HOLDUP   RATE
              T/F TYPE   hr     kg/yr     da       kg/yr
              --- ------ -----  -------   ------   -----
              F   FISH    0.0   1.5E+04    1.00    40.0
              F   MOLLUS  1.0   0.0E+00    0.00     0.0
              F   CRUSTA  1.0   0.0E+00    0.00     0.0
              F   PLANTS  1.0   0.0E+00    0.00     0.0
====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+0     14.0      15.0
              T   ROOT V 90.00  0  0.0      0.0     4.0     0.0E+0     14.0     140.0
              T   FRUIT  90.00  0  0.00     0.0     2.0     0.0E+00    14.0      64.0
              T   GRAIN  90.00  0  0.0      0.0     0.8     0.0E+0    180.0      72.0

               ====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      70.0  34.0   0.00     0.0     0.0  90.00  0   0.0    0.0   0.80  0.0
T    POULTRY   8.5   34.0   0.00     0.0     0.0  90.00  0   0.0    0.0   0.80  0.0
T    MILK     230.0   4.0   0.00     0.0     0.0  45.00  0   0.0    0.0   2.00  0.0
T    EGG       20.0  18.0   0.00     0.0     0.0  90.00  0   0.0    0.0   0.80  0.0
                                              ------------FRESH FORAGE-----------
     BEEF                                    0.00 45.00  2   0.0    0.0   2.00 100.0
     MILK                                    0.00 30.00  2   0.0    0.0   1.50   0.0

#################################################################################
```

Appendix B: Input Filenames File

```
FILENAME.DAT;18
 2        HOME$ROOT:[GENII.FILES]RMDLIB.DAT
 3        HOME$ROOT:[GENII.FILES]METADATA.DAT
 4        HOME$ROOT:[GENII.FILES]RMDBYELE.DAT
 8        HOME$ROOT:[GENII.FILES]FTRANS.DAT
 9        HOME$ROOT:[GENII.FILES]BIOACI.DAT
10        HOME$ROOT:[GENII.FILES]GRDF.DAT
11        HOME$ROOT:[GENII.FILES]ENV.IN
12        HOME$ROOT:[GENII.FILES]DOSSUM.DAT
13        HOME$ROOT:[GENII.FILES]ENV.OUT
14        HOME$ROOT:[GENII.FILES]DOSE.OUT
15        HOME$ROOT:[GENII.FILES]INTDF.OUT
16        HOME$ROOT:[GENII.FILES]CDEINC.OUT
17        HOME$ROOT:[GENII.FILES]DITTY.OUT
18        HOME$ROOT:[GENII.FILES]INTDF.IN
19        HOME$ROOT:[GENII.FILES]DITTYQA.OUT
20        HOME$ROOT:[GENII.FILES]CDE.OUT
21        HOME$ROOT:[GENII.FILES]MEDIA.OUT
22        HOME$ROOT:[GENII.FILES]DEFAULT.IN
23        HOME$ROOT:[GENII.FILES]JOINTFRE.IN
24        HOME$ROOT:[GENII.FILES]CHIQ.IN
25        HOME$ROOT:[GENII.FILES]PLUMDRF.DAT
26        HOME$ROOT:[GENII.FILES]ENERGY.DAT
27        HOME$ROOT:[GENII.FILES]POP.IN
28        HOME$ROOT:[GENII.FILES]GENII2.OUT
30        HOME$ROOT:[GENII.FILES]DSFCT30.DAT
31        HOME$ROOT:[GENII.FILES]WATREL.IN
32        HOME$ROOT:[GENII.FILES]AIRREL.IN
33        HOME$ROOT:[GENII.FILES]DITTY.IN
34        HOME$ROOT:[GENII.FILES]ISOLIB.DAT
35        HOME$ROOT:[GENII.FILES]EXTDF.IN
36        HOME$ROOT:[GENII.FILES]EXTDF.OUT
37        HOME$ROOT:[GENII.FILES]DOSINC.OUT
38        HOME$ROOT:[GENII.FILES]GAMEN.DAT
39        HOME$ROOT:[GENII.FILES]DOSEQA.OUT
40        HOME$ROOT:[GENII.FILES]DOSINC.DAT
41        HOME$ROOT:[GENII.FILES]SEE.IN
42        HOME$ROOT:[GENII.FILES]FOODPROD.IN
44        HOME$ROOT:[GENII.FILES]SEERPT.OUT
45        HOME$ROOT:[GENII.FILES]SEE1.DAT
46        HOME$ROOT:[GENII.FILES]SEE2.DAT
47        HOME$ROOT:[GENII.FILES]SEE3.DAT
48        HOME$ROOT:[GENII.FILES]WORK.BUF
49        HOME$ROOT:[GENII.FILES]WORK2.BUF
50        HOME$ROOT:[GENII.FILES]WORK3.BUF
[End of file]
```

Appendix C: Sample Output Dose File

```
                    GENII-A Dose Calculation Program
                      (Version 2.10 15-Dec-95)

Case title:       Demonstration of CAMCON PREGENII/GENII interface

Executed on:  01/19/96 at 12:22:33                              Page C.  4
```

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	1.2E-01	2.5E-01	3.0E-02
Breast	1.1E-01	1.5E-01	1.6E-02
R Marrow	2.8E-01	1.2E-01	3.4E-02
Lung	2.0E-01	1.2E-01	2.4E-02
Thyroid	2.0E+02	3.0E-02	6.1E+00
Bone Sur	2.3E+00	3.0E-02	6.8E-02
Liver	3.7E-01	6.0E-02	2.2E-02
LL Int.	9.9E-02	6.0E-02	5.9E-03
Stomach	9.7E-02	6.0E-02	5.8E-03
UL Int.	9.3E-02	6.0E-02	5.6E-03
S Int.	9.0E-02	6.0E-02	5.4E-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
Total Inhalation EDE:	1.6E-01
Total Ingestion EDE:	6.1E+00

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                    GENII-A Dose Calculation Program
                      (Version 2.10 15-Dec-95)

Case title:       Demonstration of CAMCON PREGENII/GENII interface

Executed on:  01/19/96 at 12:22:33                              Page C.  5
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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 Dose Equivalent
		+	+			
1	5.5E+00	+ 6.0E-01	+ 6.8E-02	+ ...	= 6.3E+00	
	||	||	||			
Internal Annual Dose	5.5E+00	+ 6.0E-01	+ 6.8E-02	+ ...	= 6.3E+00	Cumulative Internal 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 + 6.8E-02 + ...  =  6.3E+00  Dose

                                                          Maximum
                                              5.6E+00     Annual
                                                          Dose Occurred
                                                          In Year  1
```

GENII-A Dose Calculation Program
(Version 2.10 15-Dec-95)

Case title: *Demonstration of CAMCON PREGENII/GENII interface*

Executed on: 01/19/96 at 12:22:33 Page C. 6

Release period: 1.0
Uptake/exposure period: 1.0
Dose commitment period: 50.0
Dose units: Person rem

Committed Dose Equivalent by Exposure Pathway

Pathway	Lung	Stomach	S Int.	UL Int.	LL Int.	Bone Su	R Marro	Testes
Inhale	1.1E-01	4.9E-03	5.0E-03	5.7E-03	6.6E-03	2.1E+00	1.7E-01	3.3E-02
Leaf Veg	2.2E-03	2.5E-03	2.1E-03	2.5E-03	3.5E-03	1.4E-02	3.6E-03	2.2E-03
Oth. Veg	1.4E-02	1.4E-02	1.4E-02	1.4E-02	1.6E-02	3.6E-02	1.9E-02	1.4E-02
Fruit	6.0E-03	6.2E-03	5.9E-03	6.2E-03	6.8E-03	1.4E-02	7.9E-03	5.9E-03
Cereals	2.1E-02	2.2E-02	2.1E-02	2.2E-02	2.2E-02	3.7E-02	2.7E-02	2.1E-02
Meat	1.4E-02	1.4E-02	1.4E-02	1.4E-02	1.5E-02	1.7E-02	1.7E-02	1.4E-02
Poultry	1.4E-03	1.4E-03	1.4E-03	1.4E-03	1.4E-03	1.7E-03	1.7E-03	1.4E-03
Cow Milk	2.6E-02	2.9E-02	2.5E-02	2.5E-02	2.5E-02	3.1E-02	3.2E-02	2.4E-02
Eggs	2.6E-03	2.7E-03	2.6E-03	2.6E-03	2.6E-03	3.2E-03	3.3E-03	2.6E-03
Total	2.0E-01	9.7E-02	9.0E-02	9.3E-02	9.9E-02	2.3E+00	2.8E-01	1.2E-01

Pathway	Ovaries	Muscle	Thyroid	Kidneys	Liver	Spleen
Inhale	3.3E-02	4.9E-03	1.1E+00	1.5E-02	3.6E-01	1.0E-08
Leaf Veg	2.2E-03	3.0E-03	1.2E+01	2.0E-06	2.0E-03	6.5E-10
Oth. Veg	1.4E-02	1.5E-02	2.4E+01	3.4E-06	3.4E-03	1.1E-09
Fruit	6.0E-03	6.5E-03	7.6E+00	1.1E-06	1.1E-03	3.6E-10
Cereals	2.1E-02	2.2E-02	1.2E+01	1.8E-06	1.9E-03	2.2E-11
Meat	1.4E-02	1.5E-02	1.1E+01	1.7E-07	4.8E-06	7.3E-15
Poultry	1.4E-03	1.4E-03	4.5E-03	3.1E-08	4.2E-09	4.9E-17
Cow Milk	2.5E-02	3.5E-02	1.3E+02	1.0E-06	4.2E-07	3.1E-13
Eggs	2.6E-03	2.7E-03	1.2E+00	6.1E-08	5.0E-07	6.9E-16
Total	1.2E-01	1.1E-01	2.0E+02	1.5E-02	3.7E-01	1.2E-08

External Dose by Exposure Pathway

Pathway	
Plume	3.3E-02
Sur Soil	1.3E-04
Total	3.3E-02

GENII-A Dose Calculation Program
(Version 2.10 15-Dec-95)

Case title: *Demonstration of CAMCON PREGENII/GENII interface*

Executed on: 01/19/96 at 12:22:33 Page C. 7

Release period: 1.0
Uptake/exposure period: 1.0
Dose commitment period: 50.0
Dose units: Person rem

Committed Dose Equivalent by Radionuclide

Radionuclide	Lung	Stomach	S Int.	UL Int.	LL Int.	Bone Su	R Marro	Testes
H 3	1.8E-02	1.8E-02	1.8E-02	1.8E-02	1.8E-02	2.2E-02	2.3E-02	1.8E-02
C 14	5.8E-02	5.8E-02	5.8E-02	5.8E-02	5.8E-02	7.2E-02	7.3E-02	5.8E-02
KR 85	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SR 90	8.5E-07	9.1E-07	1.4E-06	8.0E-06	3.3E-05	8.8E-04	3.9E-04	4.9E-07

Y 90	1.1E-07	1.9E-06	4.4E-06	2.2E-05	5.4E-05	8.5E-10	8.3E-10	2.8E-11
NB 95	1.3E-07	1.6E-08	2.6E-08	5.1E-08	1.1E-07	1.4E-08	1.1E-08	2.4E-09
RU 103	5.1E-06	3.0E-07	5.2E-07	1.5E-06	3.9E-06	1.2E-07	1.8E-07	7.5E-08
RH 103M	2.2E-09	1.2E-08	8.0E-09	4.6E-09	7.8E-10	4.8E-10	5.7E-11	2.5E-11
RU 106	3.3E-02	3.9E-04	6.6E-04	2.8E-03	8.2E-03	2.2E-04	2.4E-04	1.9E-04
SB 125	3.7E-05	2.7E-06	5.0E-06	1.4E-05	3.8E-05	5.6E-06	2.1E-06	6.5E-07
TE 125M	7.9E-08	3.0E-07	6.3E-07	2.8E-06	7.8E-06	2.2E-05	2.0E-06	6.5E-08
I 129	1.4E-02	1.9E-02	1.2E-02	1.2E-02	1.2E-02	1.5E-02	1.6E-02	1.1E-02
I 131	1.0E-06	2.5E-06	3.6E-07	3.6E-07	3.4E-07	1.4E-06	7.4E-07	3.0E-07
XE 131M	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CS 134	4.3E-06	4.8E-06	5.6E-06	5.2E-06	5.6E-06	4.2E-06	4.8E-06	5.2E-06
CS 137	1.4E-05	1.5E-05	1.5E-05	1.5E-05	1.5E-05	1.4E-05	1.4E-05	1.5E-05
PM 147	1.2E-04	5.1E-07	1.3E-06	7.4E-06	2.3E-05	3.4E-05	2.7E-06	1.9E-10
SM 147	2.8E-17	5.9E-18	1.5E-17	8.5E-17	2.7E-16	1.1E-14	8.9E-16	1.3E-20
PB 212	5.2E-02	9.6E-04	1.1E-03	1.5E-03	1.6E-03	1.1E-01	9.3E-03	9.1E-04
BI 212	8.8E-03	9.3E-05	7.8E-05	6.5E-05	4.8E-05	6.5E-04	7.3E-05	4.3E-05
PU 238	8.7E-04	2.5E-07	5.6E-07	3.1E-06	9.1E-06	9.4E-02	7.6E-03	1.3E-03
U 234	9.5E-04	4.9E-08	6.9E-08	2.3E-07	6.2E-07	1.6E-05	1.0E-06	3.6E-08
U 238	8.5E-04	4.5E-08	6.3E-08	2.1E-07	5.9E-07	1.4E-05	9.5E-07	3.1E-08
TH 234	8.1E-10	8.0E-09	2.0E-08	1.2E-07	3.4E-07	1.7E-10	1.5E-10	1.9E-11
PA 234	2.0E-13	1.0E-11	1.9E-11	4.1E-11	3.3E-11	3.6E-13	1.1E-12	3.2E-13
PU 241	3.6E-05	2.6E-07	4.2E-07	1.7E-06	4.3E-06	2.1E-01	1.6E-02	3.1E-03
U 237	8.7E-12	9.3E-12	2.5E-10	1.1E-09	3.0E-09	1.2E-11	1.9E-11	4.0E-12
AM 241	2.9E-03	1.2E-06	2.2E-06	1.1E-05	3.2E-05	3.6E-01	2.8E-02	5.0E-03
PU 237	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NP 237	3.2E-13	7.8E-14	1.8E-13	9.9E-13	2.9E-12	1.8E-09	1.5E-10	1.3E-11
PA 233	1.4E-16	1.1E-14	2.9E-14	1.3E-13	3.7E-13	4.0E-15	2.6E-15	7.7E-16
PU 239	1.1E-02	3.1E-06	7.0E-06	3.7E-05	1.1E-04	1.4E+00	1.1E-01	1.9E-02
U 235	3.1E-05	2.1E-09	2.5E-09	8.1E-09	2.4E-08	5.1E-07	3.3E-08	1.2E-09
TH 231	7.2E-12	7.0E-11	1.7E-10	7.0E-10	1.3E-09	1.0E-11	2.8E-12	2.1E-13
PA 231	1.2E-15	3.2E-15	7.7E-15	4.2E-14	1.3E-13	1.8E-10	1.4E-11	1.9E-16
AC 227	2.8E-18	2.5E-18	3.5E-18	1.8E-17	9.0E-17	7.9E-13	6.3E-14	9.3E-15
TH 227	1.1E-18	1.4E-17	3.5E-17	2.1E-16	7.8E-16	5.9E-16	4.8E-17	1.2E-18
FR 223	3.7E-19	4.0E-19	3.7E-19	3.7E-19	3.7E-19	4.0E-18	5.0E-19	3.7E-19

GENII-A Dose Calculation Program
(Version 2.10 15-Dec-95)

Case title: Demonstration of CAMCON PREGENII/GENII interface

Executed on: 01/19/96 at 12:22:33 Page C. 8

Release period: 1.0
Uptake/exposure period: 1.0
Dose commitment period: 50.0
Dose units: Person rem

Committed Dose Equivalent by Radionuclide

Radionuclide	Ovaries	Muscle	Thyroid	Kidneys	Liver	Spleen
H 3	1.8E-02	1.8E-02	1.8E-02	0.0E+00	0.0E+00	0.0E+00
C 14	5.8E-02	5.9E-02	5.8E-02	0.0E+00	0.0E+00	0.0E+00
KR 85	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SR 90	4.9E-07	4.9E-07	4.9E-07	0.0E+00	0.0E+00	0.0E+00
Y 90	3.1E-11	2.8E-11	2.8E-11	0.0E+00	8.2E-10	0.0E+00
NB 95	2.3E-08	8.7E-09	6.0E-09	8.3E-09	0.0E+00	1.2E-08
RU 103	3.4E-07	1.5E-07	1.1E-07	0.0E+00	0.0E+00	0.0E+00
RH 103M	4.3E-11	2.8E-11	2.5E-11	0.0E+00	0.0E+00	0.0E+00
RU 106	2.0E-04	1.9E-04	1.9E-04	0.0E+00	0.0E+00	0.0E+00
SB 125	3.5E-06	1.2E-06	7.6E-07	0.0E+00	2.7E-06	0.0E+00
TE 125M	2.2E-07	7.6E-08	6.5E-08	0.0E+00	0.0E+00	0.0E+00
I 129	1.2E-02	2.7E-02	2.0E+02	0.0E+00	0.0E+00	0.0E+00
I 131	3.3E-07	1.0E-06	3.7E-03	0.0E+00	0.0E+00	0.0E+00
XE 131M	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CS 134	4.2E-06	4.2E-06	4.2E-06	0.0E+00	0.0E+00	0.0E+00
CS 137	1.4E-05	1.4E-05	1.4E-05	0.0E+00	0.0E+00	0.0E+00
PM 147	2.3E-10	2.4E-10	2.0E-10	0.0E+00	8.9E-06	0.0E+00
SM 147	1.3E-20	1.3E-20	1.3E-20	0.0E+00	3.1E-15	0.0E+00
PB 212	9.1E-04	9.1E-04	9.1E-04	7.5E-03	1.4E-02	0.0E+00
BI 212	4.3E-05	4.3E-05	4.3E-05	7.0E-03	0.0E+00	0.0E+00
PU 238	1.3E-03	4.9E-08	4.8E-08	0.0E+00	1.7E-02	0.0E+00
U 234	3.6E-08	3.6E-08	3.6E-08	6.4E-06	0.0E+00	0.0E+00
U 238	3.2E-08	3.3E-08	3.3E-08	5.8E-06	0.0E+00	0.0E+00
TH 234	2.3E-10	2.7E-11	2.4E-12	0.0E+00	3.3E-11	0.0E+00
PA 234	4.5E-12	6.7E-13	2.5E-14	1.1E-12	8.0E-13	0.0E+00
PU 241	3.1E-03	2.0E-07	8.4E-08	0.0E+00	3.2E-02	0.0E+00
U 237	6.3E-11	6.0E-12	9.3E-14	1.0E-11	0.0E+00	0.0E+00
AM 241	4.9E-03	4.9E-07	2.8E-07	0.0E+00	6.4E-02	0.0E+00
PU 237	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NP 237	1.3E-11	1.3E-14	9.7E-15	0.0E+00	7.9E-11	0.0E+00
PA 233	9.2E-15	9.9E-16	1.8E-17	1.2E-15	8.8E-16	0.0E+00
PU 239	1.9E-02	6.0E-07	5.9E-07	0.0E+00	2.4E-01	0.0E+00
U 235	1.3E-09	1.6E-09	1.4E-09	2.1E-07	0.0E+00	0.0E+00
TH 231	7.7E-12	5.4E-13	2.2E-14	0.0E+00	4.3E-13	0.0E+00
PA 231	4.0E-16	3.0E-16	2.5E-16	1.7E-14	1.1E-14	0.0E+00
AC 227	9.5E-15	1.8E-18	9.7E-19	0.0E+00	1.8E-13	0.0E+00
TH 227	2.5E-18	1.2E-18	1.0E-18	0.0E+00	9.3E-18	0.0E+00

FR 223	3.9E-19	3.7E-19	3.7E-19	0.0E+00	0.0E+00	0.0E+00

GENII-A Dose Calculation Program
(Version 2.10 15-Dec-95)

Case title: Demonstration of CAMCON PREGENII/GENII interface

Executed on: 01/19/96 at 12:22:33 Page C. 9

Release period: 1.0
Uptake/exposure period: 1.0
Dose commitment period: 50.0
Dose units: Person rem

Committed Dose Equivalent by Radionuclide

Radionuclide	Lung	Stomach	S Int.	UL Int.	LL Int.	Bone Su	R Marro	Testes
RA 223	9.0E-17	1.4E-16	1.9E-16	6.9E-16	1.9E-15	8.2E-15	5.7E-16	9.0E-17
Total	2.0E-01	9.7E-02	9.0E-02	9.3E-02	9.9E-02	2.3E+00	2.8E-01	1.2E-01

GENII-A Dose Calculation Program
(Version 2.10 15-Dec-95)

Case title: Demonstration of CAMCON PREGENII/GENII interface

Executed on: 01/19/96 at 12:22:33 Page C. 10

Release period: 1.0
Uptake/exposure period: 1.0
Dose commitment period: 50.0
Dose units: Person rem

Committed Dose Equivalent by Radionuclide

Radionuclide	Ovaries	Muscle	Thyroid	Kidneys	Liver	Spleen
RA 223	9.0E-17	9.0E-17	8.2E-17	0.0E+00	0.0E+00	0.0E+00
Total	1.2E-01	1.1E-01	2.0E+02	1.5E-02	3.7E-01	1.2E-08

GENII-A Dose Calculation Program
(Version 2.10 15-Dec-95)

Case title: Demonstration of CAMCON PREGENII/GENII interface

Executed on: 01/19/96 at 12:22:33 Page C. 11

Release period: 1.0
Uptake/exposure period: 1.0
Dose commitment period: 50.0
Dose units: Person rem

Radionuclide	Inhalation Effective Dose Equivalent	Ingestion Effective Dose Equivalent	External Dose	Internal Effective Dose Equivalent	Annual Effective Dose Equivalent
H 3	2.7E-03	1.5E-02	0.0E+00	1.8E-02	1.8E-02
C 14	8.9E-04	5.6E-02	0.0E+00	5.7E-02	5.7E-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	4.9E-06	1.5E-08	4.9E-06	4.9E-06
NB 95	2.4E-08	1.4E-08	1.6E-08	3.8E-08	5.4E-08
RU 103	7.7E-07	3.5E-07	2.3E-07	1.1E-06	1.4E-06
RH 103M	4.0E-10	1.4E-09	1.0E-10	1.8E-09	1.9E-09
RU 106	4.0E-03	7.2E-04	4.4E-05	4.8E-03	4.8E-03
SB 125	5.5E-06	4.3E-06	5.3E-06	9.7E-06	1.5E-05
TE 125M	1.1E-09	1.7E-06	4.8E-09	1.7E-06	1.7E-06
I 129	3.3E-02	6.1E+00	7.6E-05	6.1E+00	6.1E+00
I 131	2.6E-06	1.1E-04	3.1E-07	1.1E-04	1.1E-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	5.1E-07	1.3E-05	3.0E-07	1.4E-05	1.4E-05
PM 147	1.7E-05	1.8E-06	9.4E-11	1.9E-05	1.9E-05
SM 147	7.5E-17	5.7E-16	0.0E+00	6.5E-16	6.5E-16
PB 212	1.2E-02	4.7E-09	5.9E-06	1.2E-02	1.2E-02
BI 212	1.5E-03	1.1E-10	5.1E-05	1.5E-03	1.6E-03
PU 238	5.1E-03	1.2E-04	1.8E-11	5.2E-03	5.2E-03
U 234	1.1E-04	8.0E-07	2.2E-12	1.2E-04	1.2E-04
U 238	1.0E-04	7.3E-07	1.2E-12	1.0E-04	1.0E-04
TH 234	1.2E-10	2.9E-08	4.6E-10	3.0E-08	3.0E-08

PA 234	9.3E-16	7.7E-12	7.0E-11	7.7E-12	7.8E-11
PU 241	1.1E-02	2.5E-04	1.4E-15	1.1E-02	1.1E-02
U 237	1.6E-12	2.9E-10	3.2E-14	2.9E-10	2.9E-10
AM 241	1.9E-02	4.5E-04	6.3E-09	1.9E-02	1.9E-02
PU 237	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NP 237	3.3E-12	7.8E-11	8.8E-20	8.1E-11	8.1E-11
PA 233	1.2E-19	3.5E-14	3.7E-14	3.5E-14	7.2E-14
PU 239	7.4E-02	1.8E-03	2.7E-10	7.6E-02	7.6E-02
U 235	3.7E-06	2.7E-08	6.7E-11	3.7E-06	3.7E-06
TH 231	2.2E-12	1.3E-10	4.0E-12	1.3E-10	1.4E-10
PA 231	1.8E-14	7.1E-12	2.7E-16	7.2E-12	7.2E-12
AC 227	0.0E+00	4.5E-14	7.7E-21	4.5E-14	4.5E-14
TH 227	0.0E+00	8.7E-17	6.7E-18	8.7E-17	9.4E-17

GENII-A Dose Calculation Program
(Version 2.10 15-Dec-95)

Case title: Demonstration of CAMCON PREGENII/GENII interface

Executed on: 01/19/96 at 12:22:33 Page C. 12

Release period: 1.0
Uptake/exposure period: 1.0
Dose commitment period: 50.0
Dose units: Person rem

Radionuclide	Inhalation Effective Dose Equivalent	Ingestion Effective Dose Equivalent	External Dose	Internal Effective Dose Equivalent	Annual Effective Dose Equivalent
FR 223	0.0E+00	4.8E-19	4.0E-20	4.8E-19	5.2E-19
RA 223	0.0E+00	5.4E-16	1.8E-17	5.4E-16	5.6E-16

Appendix D: Sample Output Input Echo File

```
------------------------------------------------------------------------
                      GENII-A Dose Calculation Program
                        (Version 2.10 15-Dec-95)

 Case title:       Demonstration of CAMCON PREGENII/GENII interface

 Executed on:  01/19/96 at 12:22:33                              Page     1
 ------------------------------------------------------------------------

          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


========== FILENAMES AND TITLES OF FILES/LIBRARIES USED ======================

 Input file name:       sample1  is name of GENI
 GENII Default Parameter Values (28-Mar-90 RAP)
 Radionuclide Master Library - Long Times  (23-July-93 PDR)
 PNL Food Transfer Factor Library (by Z, with Fr&Os 7/19/93 PDR)
 External Dose Factors for GENII-Sphere source modification BAN 5/19/
 Worst-Case Solubilities, Yearly Dose Increments (23-Jul-93 PDR)
 EXTGAM - Gamma Energies by Group for Finite Plume (13-May-90 RAP)
 200 Area Population (Sommer, Rau, and Robinson, PNL-4010)
 200 AREA - 89 M - Pasquill A - F (1983 - 1987 Average)

================================================================================

          -------- ----Release Terms------
          Release           Surface Buried
          Radio-   Air      Water   Source
          nuclide   Ci/yr    Ci/yr   Ci/m3
          -------- ------- ------- -------
          H 3      7.0E+01 0.0E+00 0.0E+00
          C 14     1.0E+00 0.0E+00 0.0E+00
          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   Stack height (m)
0.0E+00   Stack flow (m3/s)
0.0E+00   Stack radius (m)
0.0E+00   Effluent temperaure (degrees C)

========== 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 inhalation exposure 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	S *	--IRRIGATION-- 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

========== ANIMAL FOOD INGESTION ==========

FOOD TYPE	---HUMAN---- CONSUMPTION RATE kg/yr	HOLDUP d	TOTAL PROD-UCTION kg/yr	DRINK WATER CONTAM FRACT.	DIET FRAC-TION	GROW TIME d	-IRRIGATION-- S *	RATE in/yr	TIME mo/yr	YIELD kg/m3	STOR-AGE d
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: _____

Appendix E: Sample Diagnostics/Debug File

```
GENII-A C-2.10 PROD PA96 01/16/96                              01/19/96 12:22:33

 GGGGG   EEEEEEE  N     NN    IIII     IIII            AAAAA
GG   GG  EE       NN    NN     II       II            AA   AA
GG       EE       NNN   NN     II       II            AA   AA
GG       EEEEE    NN N  NN     II       II    -------  AAAAAAA
GG  GGG  EE       NN  NNN     II       II            AA   AA
GG   GG  EE       NN   NN     II       II            AA   AA
 GGGGG   EEEEEEE  NN    N     IIII     IIII           AA   AA

          A program for generating doses, GENII

                GENII-A Version C-2.10
                   Revised 12-15-95
              Written by Bruce Napier et al
                 Sponsored by Leo Rahal

              Run on 01/19/96 at 12:22:33
            Run on ALPHA AXP BEATLE OpenVMS V6.1
         Using GENII-A_PA96 PROD PA96 built 01/16/96

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Prepared for
Sandia National Laboratories
Albuquerque, New Mexico 87185-5800
for the United States Department of Energy
under Contract DE-AC04-76DP00789

*****************************************************************

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                          ----------

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*****************************************************************

*************************************************************************

FILE ASSIGNMENTS:
-----------------
Input Text File:
   WP$TESTROOT:[GI2.TEST]GI2_TEST1_TRN.INP;1
      Written on 11/21/95 14:15:12
Input Filenames File:
   WP$TESTROOT:[GI2.DAT]GI2_FILENAME.DAT;1
      Written on 10/19/95 14:42:19
Output dose file:
   WP$TESTROOT:[GI2.TEST]GI2_TEST1_TRN.OUT
Output input echo file:
   WP$TESTROOT:[GI2.TEST]GI2_TEST1_ECO.OUT
Output Diagnostics/Debug File:
   WP$TESTROOT:[GI2.TEST]GI2_TEST1_DBG.OUT
CHECK:  stack release not set, stack height set to 89.0
REDSET:  Internal dose factors not found for XE131M
```

Appendix F: Review Forms

This appendix contains review forms for the GENII-A User's Manual.

NOTE: Copies of the User's Manual Reviewer's Forms are available in the Sandia WIPP Central Files.