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Code for Internal Dosimetry (CINDY) Part 2: User's Guide

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October 1990

Prepared for the U.S. Department of Energy
under Contract DE-AC06-76RLO 1830

Pacific Northwest Laboratory
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CODE FOR INTERNAL DOSIMETRY (CINDY)
PART 2: USER'S GUIDE

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Pacific Northwest Laboratory
Richland, Washington

EXECUTIVE SUMMARY

The CINDY (Code for Internal Dosimetry) Software Package has been developed by Pacific Northwest Laboratory to address the Department of Energy (DOE) Order 5480.11 by providing the capabilities to calculate organ dose equivalents and effective dose equivalents using the approach of International Commission on Radiological Protection (ICRP) 30. The code assists in the interpretation of bioassay data, evaluates committed and calendar-year doses from intake or bioassay measurement data, provides output consistent with revised DOE orders, is easy to use, and is generally applicable to DOE sites. Flexible biokinetics models are used to determine organ doses for annual, 50-year, calendar-year, or any other time-point dose necessary for chronic or acute intakes.

CINDY is an interactive program that prompts the user to describe the cases to be analyzed and calculates the necessary results for the type of analysis being performed. Four types of analyses may be specified:

- **Intake Assessment Mode** - estimate intake based on bioassay data using weighted or unweighted least-squares regression between measured and expected bioassay values calculated, based on reference man and other models,

- **Dose Assessment Mode: Specified Time Periods** - estimate organ dose equivalents and effective dose equivalents for specified time periods and committed effective dose equivalents for given intakes,

- **Dose Assessment Mode: Calendar Year Doses** - estimate organ and effective dose equivalents for the present calendar year and future annual increments, for given intakes,

- **Bioassay Projection Mode** - estimate organ burdens and urinary and fecal excretion rates from given intakes.

Evaluation of radiation doses and excretion rates involves numerical solution to the differential equations describing intake of activity (by inhalation, ingestion, absorption, or wounds), metabolism and translocation (involving various body organs and systems), and elimination from the body. The equations programmed in CINDY are those recommended by the ICRP and NCRP and other closely related or slightly modified versions of the same models. CINDY obtains precise solutions to these differential equations used to determine radionuclide amounts in model compartments over time. The heart of the CINDY package is the numerical solver used to evaluate the intake, metabolism, and excretion of radionuclides. Differential equations are solved using the LSODES package (from the ODEPACK collection developed at Lawrence Livermore National Laboratory).

Results of the analyses can be displayed on the screen in tabular or graphical form, tables can be printed, and data files and reports can be saved for later retrieval. All saved files (input and output) are marked by a unique identifier for the subject individual, allowing easy access to the necessary information for a given analysis.

This report is the second part of a three-part series documenting the CINDY computer code, and provides guidance on the use of CINDY. General features and conceptual models are presented in Part 1 (Conceptual Representation) and the technical details of the program are documented in Part 3 (Advanced User's Guide).

ACKNOWLEDGEMENTS

We wish to thank the personnel at the DOE sites who worked with us throughout the design and implementation phases of the CINDY development effort. These individuals provided valuable feedback that helped improve the interface between the user and CINDY. Their comments and suggestions on several prototypes of the software package alerted us to many bugs and provided information on hardware configuration problems. They worked under difficult conditions having very little documentation and a partially completed undebugged code. The individuals who provided feedback during the developmental phase are listed below.

We would also like to thank Prof. John Poston, chairman, Prof. Ken Scrable, Dr. Keith Eckerman, and Dr. Rick Brake for their participation in the PNL Final Internal Development Review. Their critical comments and suggestions helped us improve the software package, particularly the documentation.

The support and encouragment of Leo Faust and Darrell Fisher of PNL's DOE Applied Health Physics Program and Joel Rabovsky of DOE Office of Health are acknowledged and appreciated.

We would like to thank Edmond Hui for his review of the software implementation and Nadia Droppo for her assistance in executing and tabulating hundreds of test runs. We would also like to thank Jim Webber for editing documents and Marianna Cross for text processing of Part 1.

Although the contributions of these individuals are much appreciated, the authors take sole responsibility for the accuracy and quality of these documents.

The following are some of individuals who provided comments on the prototypes of the CINDY software program.

Dave Abbott
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Robert M. Ryan
Carl J. Schopfer
Bill Sharkey
Henry B. Spitz
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Al N. Tschaeche
Ira J. (Joe) Wells

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INTRODUCTION

The computer code CINDY (Code for Internal Dosimetry Software Package) addresses the Department of Energy (DOE) Order 5480.11 by providing the capabilities to calculate organ dose equivalents and effective dose equivalents using the International Commission on Radiological Protection (ICRP) 30 approach. Flexible biokinetic models are used to determine organ doses for annual, fifty-year, calendar-year, or any other time-point dose necessary for chronic or acute intakes. The doses are expressed as organ dose equivalents, effective dose equivalents or committed dose equivalents as appropriate to the specific calculation being performed.

The code is developed to assist in the interpretation of bioassay data, evaluate committed and calendar-year doses from intake or bioassay measurement data, provide output consistent with revised DOE orders, be easy to use, and be generally applicable to DOE sites.

Part 1 of the CINDY software documentation package describes the dosimetry concepts and design features implemented by CINDY. This part is the user's guide to operation of the code, and Part 3 is an advanced user's guide.

Material in this user's guide has been organized to allow the user to quickly find necessary information. Computer requirements and installation procedures are given in sections so named. A tutorial section is provided for the beginning user to get acquainted with the general operation and features of CINDY. An expanded reference section is provided that contains definitions of key words and phrases that appear in menus and lists in the CINDY screens. The user can quickly locate items in this reference list and read about the intended use or limitations related to the particular item. Another section lists error messages alphabetically, with information on the cause of the message and what should be done to correct the situation. A hierarchy diagram of the menu and screen sequences is also presented as a quick reference for the user to identify the location of each screen and option.

Five sample problems are included with the CINDY software package. It is suggested that soon after installation of the CINDY code and becoming familiar with its general operation, the user run all five sample problems and compare output reports to those provided in this user's guide. The numerical results should agree exactly with the values provided in the sample problem report listings contained in this report. If future updates to the CINDY program cause results from the sample problems to change, updated listings of sample problem output will be provided for comparison.

TARGET USER

The target user of the CINDY software package is an internal dosimetrist at a DOE facility. The user is assumed to be a knowledgeable health physicist familiar with operation of a bioassay program for radiation worker exposures. The user is responsible for the quality and accuracy of the input information, and for interpretation of the results provided by the output reports.

The purpose of the software is to provide a tool for the target user for assessing occupational internal exposure cases and designing bioassay monitoring programs. During the CINDY development period, several potential users at DOE facilities were identified and their help solicited during the design and implementation of CINDY to ensure that needs of the target user were being addressed.

Users will be distinguished in this document as novices, typical users, and power users, as described below:

- The **novice user** is assumed to be unfamiliar with CINDY, with computers in general, or with the process used by internal dosimetrists in evaluating exposures.

- The **typical user** views CINDY as a tool used to perform evaluations and is not particularly interested in maintaining large subject databases, extended capabilities of CINDY, or computer details.

- The **power user** utilizes CINDY to perform evaluations, but may also wish to organize and maintain large subject databases, maintain several site configurations, set up batch-process files, import and export data to/from CINDY input/output files, and be interested in the computer-details behind the CINDY shell.

SYSTEM REQUIREMENTS

CINDY will run on an IBM[(a)] PS/2 or fully-IBM-compatible computer configured with a IBM Video Graphics Adapter (VGA) monitor, an 80387[(b)] math co-processor, 640 kilobytes RAM, a minimum of five megabytes of on-line disk storage, and either a 5-1/4 in. or 3-1/2 in. high density floppy disk drive. The software assumes that a printer is attached to the computer. For printed graphic output either an HP[(c)] LaserJet or an Epson/IBM-compatible dot matrix printer is required.

Version 1.0 of CINDY operates successfully under DOS 3.3 (IBM 1987). All RAM, with the exception of that used by DOS and peripheral drivers, should be available for the CINDY software. DOS 4.0 (IBM 1988) may not leave enough available RAM for successful execution of CINDY. Version 1.0 of CINDY will not execute in expanded memory.

The CINDY software may also be installed on an IBM AT computer, configured with a VGA monitor, an 80287 math co-processor, 640 kilobytes RAM, a minimum of five megabytes of on-line disk storage, and either a 5-1/4 in. or 3-1/2 in. high density floppy disk drive. Although most portions of the code will be operational, dose calculations for radionuclides with explicit daughters are not possible.

The CINDY software may be installed on a computer without a VGA monitor but otherwise configured as described above. The software will be functional with the exception that graphic reports may not be displayed to the screen or printed.

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(b) 80286, 80386, 80287, and 80387 are trademarks of Intel, Inc.
(c) HP and LaserJet are trademarks of the Hewlett Packard Company. The LaserJet+ and LaserJet II printers are products of Hewlett Packard.

CINDY SOFTWARE DISTRIBUTION

Distribution of the CINDY software package, in accordance with DOE Order 1360.4A (10-7-87) is through the National Energy Software Center (NESC). Requests for CINDY may be made to:

Director
National Energy Software Center
Argonne National Laboratory
9700 South Cass Avenue
Argonne, Illinois 60439

NESC will provide users notice of updates to the CINDY software package when they become available.

A database is maintained of users who participated in the development of CINDY. PNL will provide the software and updates directly to those users in accordance with Paragraph 8d of DOE 1360.4A.

The CINDY software is distributed on two high density disks (either 3-1/2 in. or 5-1/4 in.), formatted under DOS 3.3 (IBM 1987) for the IBM personal computer and compatible.

SECURITY

Maintenance of the integrity and confidentiality of the software package and associated subject data files is the responsibility of the user. No special provisions for accessibility of the program or data files are included in the software package. No attempt has been made to install a security system into the software because of the inherent fallibility of available systems. However, the integrity of the executable portions of the software package is maintained through control of the source code by PNL.

As with any computer program there are limitations that must be recognized as to applicability and use of the various features provided. The user is responsible for the quality and accuracy of the input information, and for interpretation of the results provided by the output reports. The results generated by the CINDY code are not intended to be used without scrutiny.

CINDY WORKING ENVIRONMENT

The CINDY Software Package provides a working environment in which the internal dosimetrist may evaluate the intake and dose from radiation exposures to individuals in a manner consistent with DOE Order 5480.11.

The organization of the CINDY environment is depicted in Figure 1. The working environment, referred to as a site configuration, may contain many subjects, each subject may have several exposures (note: only one exposure may be defined in the current version of CINDY), and each intake may have several components. Understanding the nomenclature used in this figure will help to clarify much of CINDY's organization.

The working environment is defined by a **site configuration** file. The site configuration allows the user to customize the working environment for a particular site or facility. The site configuration defines default parameter

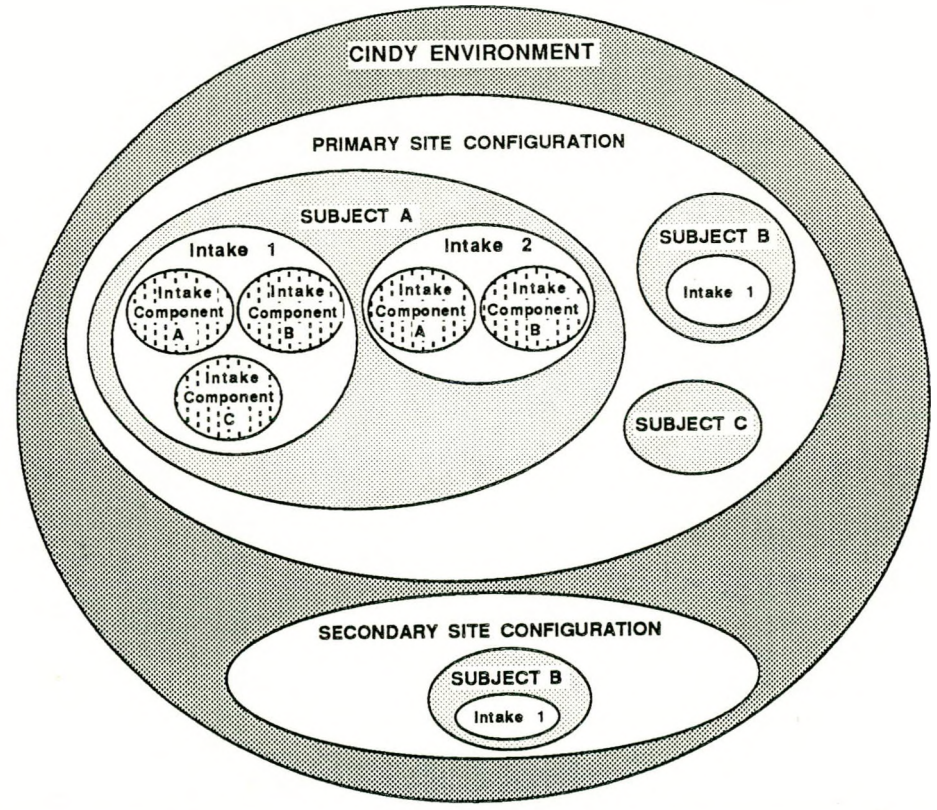


FIGURE 1. CINDY Working Environment

values and options, the list of radionuclides available for calculations, and the default metabolic data. The process of establishing the site configuration is sometimes referred to as **site set-up**. A user may define more than one site configuration. Site configurations are stored in files and may be retrieved at the command line (e.g., by executing **CINDY mysite** where **mysite** is the name given to the site configuration) or from a menu within CINDY.

Intake information in CINDY is organized by **subject** or worker to simplify reporting. Subject information includes biographic data (for report headings), exposure scenario information, and, optionally, specific metabolic data. Typically, there would be many subjects per site configuration.

For each subject there may be one or more **intake(s)** or exposure scenarios. (Currently only a single intake may be specified.) An intake may be either acute or chronic and can consist of a mixture of exposure modes (e.g., inhalation, ingestion, wound), radionuclides, and solubility classifications.

An intake is treated as a collection of **intake components**. Each intake component consists of a single exposure mode, a radionuclide or radionuclide chain, and a solubility classification. CINDY evaluates the intake components for the current subject based on the selected exposure modes and types, the radionuclides of concern, and intake composition or quantity.

Four modes of operation may be specified in CINDY:

- **Intake Assessment Mode** - estimate intake based on bioassay data using weighted or unweighted least-squares regression between measured and expected bioassay values calculated, based on reference man and other models,

- **Dose Assessment Mode: Specified Time Periods** - estimate organ dose equivalents and effective dose equivalents for specified time periods and committed effective dose equivalents for given intakes,

- **Dose Assessment Mode: Calendar Year Doses** - estimate organ and effective dose equivalents for the present calendar year and future annual increments, for given intakes,

- **Bioassay Projection Mode** - estimate organ burdens and urinary and fecal excretion rates from given intakes.

The relationship between these modes is shown schematically in Figure 2. For example, evaluation of an internal exposure case might involve 1) the assessment of intake based on bioassay measurements performed after the intake (Intake Assessment Mode), 2) the calculation of the calendar year effective dose equivalent values for the intake (Dose Assessment Mode: Calendar Year Doses), and 3) the projection of expected bioassay results for future samples (Bioassay Projection Mode).

The use of separate operating modes is intended to reduce the complexity and time of execution. By allowing the user to select operating modes, only the required analyses will be evaluated. This is an important consideration because each mode involves a unique set of model solution times; selecting

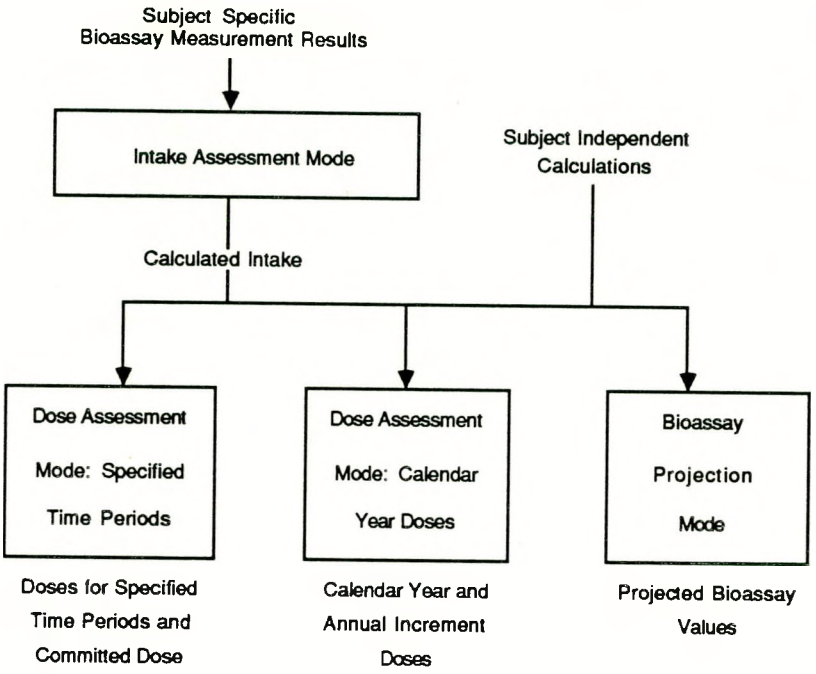


FIGURE 2. CINDY Operating Modes

operating modes will minimize the time taken by the code to perform calculations.

The user may choose one, some, or all intake components for a given evaluation. A **run** consists of an evaluation using a set of selected intake components. Each run is for a single operational mode. The user may change operating modes between runs. Because each intake component requires a separate execution of the differential equation solver, runs with multiple intake components take longer to execute than those with a single component.

For intake assessments and bioassay projections, results are summed over intake components by radionuclide. For dose assessments, results are summed over all intake components. The user may request reports detailing how much each intake component contributed to the total excretion, retention, and/or dose.

INPUT REQUIREMENTS

Input parameters are associated primarily with the subject, the intake, or the run. It is most beneficial for a user to become familiar with the distinction between subject-specific and run-specific parameters. Table 1 summarizes subject and run-specific parameters, as well as parameters for bioassay data points, intakes, and intake components. Subject- and intake-specific parameters are not likely to be changed during the course of an evaluation. Run-specific parameters are likely to change as the user performs an evaluation. Default values are included for all input parameters in CINDY except for bioassay data. The user may establish default values for all input parameters when establishing a site configuration.

TABLE 1. Subject-specific and Run-specific Parameters

Classification	Parameters
Subject-specific	Name
	ID
	Social Security Number (SSN)
	Date of birth
	Sex
	File name prefix
Bioassay-data-point-specific	Exclusion flag
	Bioassay type
	Bioassay radionuclide
	Sample end date
	Sample end time
	Excretion period
	Measured value
	Measurement uncertainty factor
	Unit numerator
	Unit denominator type (Units are..)
	Sample size
	Sample size units
	Comment
Intake-specific	Exposure rate
	Intake mode
	Begin date and time of intake
	End date of intake (chronic exposure only)
	Particle size
	Facility (location of intake)
	Employer at time of intake
Intake component-specific	Radionuclides of concern
	Intake estimate
Run-specific	Report times
	Dose reporting limit
	Detail report options
	Radiological working units options
	Error tolerances
	Radionuclide daughter handling
	Pu excretion model option
	Tritium model option

REPORTING OPTIONS

Reports from CINDY calculations may be either text or graphic. In addition, status reports are displayed during CINDY execution to show the current value of parameters and options of interest. Text, graphic, and status reports are discussed below. After becoming familiar with the reporting options, the user may tailor the selection of output to match the needs of the facility.

Text Reports

Text reports are provided to serve as concise summaries of analyses performed. Text reports from CINDY are written to a file buffer. After a calculation, results written to the file buffer may optionally be displayed on the screen, printed on the computer system default printer, and stored to a subject-specific file. Reports saved from previous calculations may also be displayed or printed.

The available reports for each operating mode are summarized in Table 2. Optional reports, as identified in Table 2, may be requested from a menu before performing the calculation. In addition to the reports identified in Table 2, a report giving input parameters for the run is always included.

Graphic Reports

Graphic reports allow the user to quickly see the time variations in bioassay quantities. Graph reports are available for intake assessments and bioassay projections. Graphs may optionally be displayed on the screen, printed on the computer system default printer, stored as a subject-specific graph data text file, and stored as a graphic screen image file. To print graphic reports, either an HP Laser Jet series or an Epson/IBM-compatible dot matrix printer is required. The subject-specific graph data text file may optionally be retrieved into stand-alone graphing packages able to import text files. The graphic screen image file may be imported into popular desktop publishing programs.

Status Reports

Status reports provide a frame of reference in the CINDY working environment by displaying pertinent parameter values. There are two pages to the status report: 1) subject page and 2) run parameters. The subject page contains biographical information, file names and status, and intake information. The parameters displayed on the run parameter page vary by operating mode. The subject page is displayed whenever a subject file is being created or has been retrieved. Run status pages overlay the subject report and are shown whenever the user sets run-specific parameters.

TABLE 2. Available Reports by Operating Mode

Operating Mode	Reports Available
Intake Assessment	Bioassay intake estimate summary.
	Estimated quantity (excretion rate or organ retention) by method for each bioassay data point.
	Expected/measurement ratios by method for each bioassay data point.
	Optional - Percent contribution by intake component for each bioassay data point.
Dose Assessment/Specified Periods	Effective dose equivalent summarization page for the exposure scenario for each specified time period.
	Committed dose equivalent to each organ or tissue for the specified time periods.
	Optional - Specific effective energies for each explicit radionuclide chain member.
	Optional - Number of nuclear transformations over the last specified time period in source organs or tissue per unit intake of activity (transformations/Bq) of radionuclide.
	Optional - Percent contribution by intake component.
Dose Assessment/Calendar Year Doses	Effective dose equivalent for the exposure scenario for each calendar year. Report may be terminated when a specified dose reporting limit is reached.
	Committed dose equivalent to each organ or tissue for each calendar year. Report may be terminated when a specified dose reporting limit is reached.
	Optional - Specific effective energies for each explicit radionuclide chain member.
	Optional - Percent contribution by intake component.
Bioassay Projection	Excretion rates and retention for each time point for urine, feces, total lung, total body, stomach, small intestine, upper large intestine, lower large intestine, lung, lymph, bone, and specified organs, as appropriate.

SUBJECT DATABASE

The database associated with the software package maintains information by subject (worker) of interest, for consistency with the DOE Order and with current practice at DOE facilities. Allowances are made in the database for storing data when more than one exposure or intake has occurred. (Note: multiple exposure evaluations are not supported in the current version; however, the database has been structured to store the necessary information.)

Information on each subject is easily retrieved and updated in CINDY. Once a subject has been established, the user may iteratively evaluate intake and/or dose for that individual by selectively changing parameter values and models. When desired, the user may easily save the current parameter values and the results of the calculations for the given subject.

The CINDY database is intended to be compatible with other databases in use at DOE facilities. A bioassay data import format has been established, (with suggestions from the field), to allow easy transport of data from other record-keeping databases. Files prepared in this format may be imported directly into the CINDY working environment. Additional information on importing bioassay data into CINDY is included in the **Importing Bioassay Data** section of this manual.

Subject data is stored in several files; each file has the user-specified subject file name prefix and a standard file name extension. Standard file name extensions are identified and described in Table 3. The list of files associated with each subject may be viewed, provided that the subject files have been retrieved, within the CINDY working environment.

TABLE 3. Standard File Name Extensions for the Subject Database

Extension	Category	Description
.BIO	Input	Bioassay data.
.CIN	Input	Subject-specific, intake-specific, and intake component-specific data (i.e., selected options, descriptive information, and parameter values).
.MOD	Input	Customized metabolic data. Subject metabolic data files are not generated unless the user makes changes to the metabolic data for a subject. Whenever a change is made to the metabolic data, a flag is set and the customized metabolic data is stored automatically. This file will then be retrieved each time the subject is selected.
.PCX	Report	Graphic screen image file of either an intake assessment or bioassay projection calculation.
.RDA	Report	Dose assessment text report for specified periods.
.RDC	Report	Dose assessment text report by calendar year.
.RIG	Report	Text file used by CINDY to create graphic report of an intake assessment. This file may optionally be retrieved into stand-alone graphing packages able to import text files.
.RIT	Report	Intake assessment text report.
.RPG	Report	Text file used by CINDY to create graphic report of a bioassay projection. This file may optionally be retrieved into stand-alone graphing packages able to import text files.
.RPT	Report	Bioassay projection text report.
.RST	Report	Subject text report. Includes subject-specific and run-specific information. Also included is bioassay data currently considered, normalized to current working units.

SITE CONFIGURATION DATABASE

A database of site configurations is maintained within the CINDY Software Package. All site configuration database files are stored in the **\CINDY** main directory. Options and capabilities associated with each site configuration are easily updated within the CINDY working environment.

Creating, modifying, selecting and using site configurations with be discussed in the Tutorial Section. Information is also available in the Reference section.

Site configuration data is stored in several files; each file has the user-specified site file name prefix and a standard file name extension. Standard file name extensions are identified and described in Table 4.

TABLE 4. Standard File Name Extensions for the Site Configuration Database

Extension	Description
.FIG	Primary site configuration file containing selected options and default parameter values.
.RMD	List of available radionuclides for the site configuration and radionuclide-specific parameter values.
.MOD	Model parameter values for the radionuclides included in the site configuration.
.SEE	Specific effective energies for the radionuclides included in the site configuration.

CINDY screen, menu, window, and user manual conventions are identified and discussed in this section.

Screen Conventions

There are three types of screen areas defined in CINDY:

- backdrop
- menus
- windows

The backdrop is the base area, encompassing the entire screen. This area is used for status reports and instructional messages. The highlighted numbers in Figure 3 indicate where the following information is located on the backdrop.

1) Current version number of the CINDY software package.

2) Current operating mode.

3) Current site configuration file name.

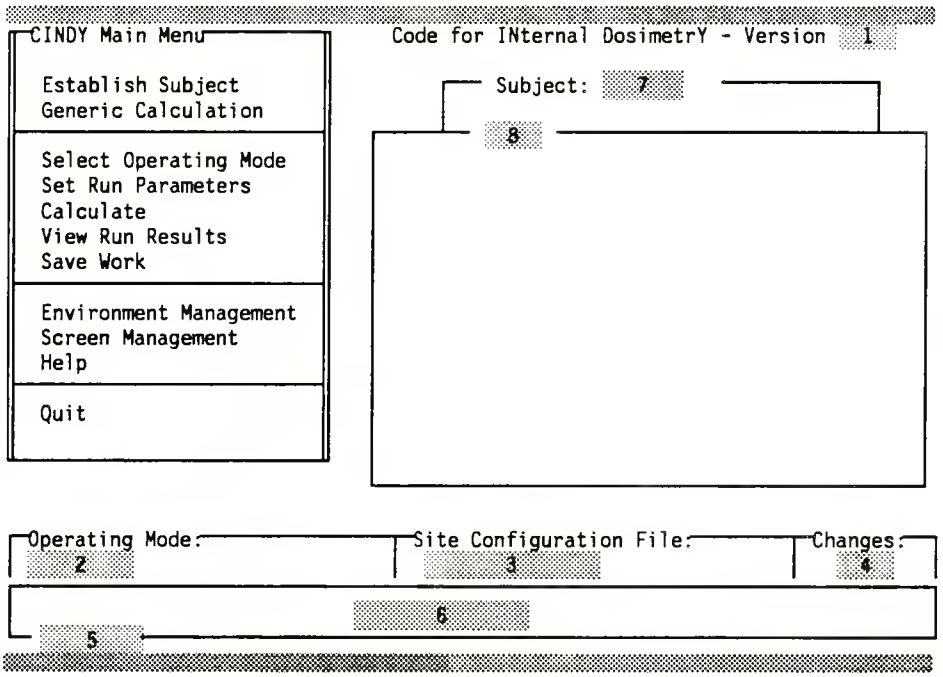


FIGURE 3. CINDY Backdrop Information

4) Number of changes made since last save of subject files. The number of changes is informational only. This is not a "smart" change status; for example, if you change a parameter value, and then change it back to the previous value, **Changes** reports two changes, not zero. Its purpose is to alert the user to inadvertent changes.

5) Current date and time. The date and time are displayed in the lower left hand corner of the backdrop. This date stamp will appear on any screens the user prints with the **PrintScreen** key. This information is updated whenever the instructional box is updated.

6) The message box located at the bottom of the screen contains context-sensitive help for the user. Messages tell how to move about within menus and windows and to input parameter information. Warning messages and informational messages concerning CINDY execution are also shown in the message box. The message box is not highlighted and does not compete with the menus and windows for the user's attention. The user should form the habit of checking the message box anytime he/she is unsure about how to proceed with CINDY; it is likely that needed information is displayed.

7) The subject status page contains pertinent information about the current subject. Information included is subject name, identification number, social security number, and birth date. The subject file name prefix, including path, is shown. A message indicates whether or not bioassay data was found for the current subject. A message is also displayed if a subject-specific metabolic data file is found. Summary information about intake is also displayed: intake index number, date and time of intake, exposure type and intake mode(s). Sometimes the run status box will overlay the subject status box. Information on the subject and run status pages is refreshed on return to the calling menu; consequently, some parameter value changes may not be immediately reflected on the subject status page.

8) The run status page overlays the subject status page whenever the **Set Run Parameters** menu has been opened. The run status screen page contains the current status of the run including operating mode, run title, and information pertinent to the current operating mode, such as whether or not radionuclide daughters are to be considered in the calculations. Also displayed is a list of intake components currently defined and those intake components currently selected, which are highlighted and marked with asterisks.

Menu Conventions

Menus are used throughout CINDY to control user selections. The main menu is always displayed; other menus may overlay the main menu. Whenever possible, menus are stacked so that the user may visualize the menu path taken to the most current menu. Menu items allow the user to logically move about within the CINDY environment and to select options. Several conventions control menu usage throughout CINDY:

- The **up** and **down** arrow keys move the cursor to the items in the menu.
- Pressing **Enter** selects a menu item.
- Selecting a menu item will cause one of the following actions:

  1) A window will open and control will be passed to the window.

  2) Another menu of control items will open and control will be passed to the new menu.

  3) Another menu of parameter options will open and control will be passed to the new menu. Selected items will be highlighted in the menu and an asterisk will proceed the item. When the menu bar overlies a selected item, the menu bar will be the reverse of the colors used for the highlight. When only one menu item may be selected from a menu, such as the **Select Operating Mode** menu, the cursor will initially be positioned on the currently selected item. An audible sound will also accompany option changes. These features will protect the user from inadvertently changing the selected option.

- When menus are larger than the box in which they are displayed, the **PageUp**, **PageDown**, **Home**, and **End** keys, as well as the arrow keys scroll menu items in the box.
- After a menu item has been selected, the cursor will move down to the next applicable menu item.
- The last entry on all menus (other than the main menu and parameter selection menus,) is labelled **Previous Menu** and will return the user to the menu directly underlying the current menu.
- Using the **Esc** key while the cursor is active in a menu is an alternate way to return to the menu directly underlying the current menu.

Window Conventions

Windows are used to control parameter input and selection, display results and files, or provide informational messages. Windows used to control parameter input and selection are referred to as **input windows**. Input windows may contain input fields (e.g., names, numbers), program options (e.g., **Inhalation, Ingestion**) as well as operational options (e.g., **Return to menu**). Several conventions are used within an input window:

- Default values are displayed for all input parameters and options.
- There are three edit modes available: 1) insert off, 2) insert on, and 3) blank field on first key stroke. The status of the edit mode is displayed in the lower right-hand corner of the screen while the cursor is in an input field. Default edit modes are stored for each site configuration.

- Use the arrow keys to move vertically from one field to the next. When within an input field, use Cntl-right arrow and Cntl-left arrow to move horizontally between fields.

- Use the right and left arrow keys to move within the field. Dates and times require leading zeros for single digits. Delimiters in the date and time routines (e.g., "/", ":") are automatically skipped over by the input routine.

- Special instructions are provided on a field-by-field basis in the instruction box at the bottom of the screen. If unsure of how to proceed in the program at any point, check to see if additional instructions have been provided.

- Press **Esc** as an alternate return to the previous menu or next input window.

User Manual Instruction Conventions

Conventions used for instructions in this user's manual are as follows:

- Commands to be typed at the keyboard are shown indented and in bold face.

- All command lines are terminated by pressing the **Enter** key.

- Commands are typed in capital letters, exactly as shown. Lower case commands indicate user-specific names; if unsure, type exactly as shown. However, any user-supplied valid names may be used.

- Menu options are in printed in boldface when discussed in the text. When operating the software, move the cursor to the appropriate menu item and press the **Enter** key.

- Actual screen text is printed in boldface when discussed in the text. The user should be able to locate the exact text on the appropriate CINDY screen.

Ensure that the host computer is minimally configured as stated in the **System Requirements** section of this volume.

The CINDY software must reside in a subdirectory named **CINDY** at the root directory level. CINDY may then be accessed from any subdirectory located on that disk drive. To install the CINDY software, move to the select hard disk, and either create a CINDY subdirectory or erase the old files in an existing CINDY subdirectory.

Preparing to Install CINDY for the First Time

Create a subdirectory for the CINDY software on the selected hard disk by typing:

MD \CINDY

and press **Enter**.

Establish a working subdirectory. To create a working subdirectory named **cindysam**, type the following:

MD \cindysam

and press **Enter**. Any user-selected subdirectory name may be substituted for **cindysam**.

Installing the CINDY Software from Two Distribution Disks

Move to a working sudirectory. For example, type:

CD \cindysam

and press **Enter**, to move to a working subdirectory named **cindysam**.

Place the CINDY Distribution Disk #1 in the source floppy disk drive.

To install on destination hard disk **c:** from source floppy disk drive **a:** with a working subdirectory named **\cindysam**, type:

a:INSTALL c: a: High \cindysam

and press **Enter**, where **c:**, **a:**, and **\cindysam** may be unique to your system.

Insert disks as requested. CINDY files will be established in the \CINDY subdirectory. The working subdirectory will be initialized (i.e., the file

named **CINDY.BAT** will be copied to the subdirectory) and the sample input files will be copied to the working subdirectory. You will be in the working subdirectory upon completion of the installation procedure.

Installing the CINDY Software from Three Distribution Disks

Move to a working sudirectory. For example, type:

CD \cindysam

and press **Enter**, to move to a working subdirectory named **cindysam**.

Place the CINDY Distribution Disk #1 in the source floppy disk drive.

To install on destination hard disk **c:** from source floppy disk drive **a:** with a working subdirectory named **\cindysam**, type:

a:INSTALL c: a: Low \cindysam

and press **Enter**, where **c:**, **a:**, and **\cindysam** may be unique to your system.

Insert disks as requested. CINDY files will be established in the \CINDY subdirectory. The working subdirectory will be initialized (i.e., the file named **CINDY.BAT** will be copied to the subdirectory) and the sample input files will be copied to the working subdirectory. You will be in the working subdirectory upon completion of the installation procedure.

Updating CINDY

If you are updating CINDY (i.e., you previously had CINDY installed on your computer and are installing a new version) and had created customized site configuration files under your previous version, *it is important to update the site configurations to the new version*.

Essentially, this is accomplished by retrieving and then saving each site configuration. *During the course of saving each site configuration, the program queries if you wish to regenerate all libraries. It is important that you answer yes to this question after installing updates to the CINDY software package.* Regeneration of the libraries ensures that your site configuration files reflect any changes made to the radionuclide organization and decay, the metabolic data, and the specific effective energy data.

Updating the site configurations with be discussed in Tutorial Three of the Tutorial Section. Information is also available under **Save Configuration** in the Reference section.

HOW TO RUN CINDY

Instructions for executing the CINDY software are included in this section. Novice users will find a detailed procedure under **The First Time**. Typical and power users may initiate CINDY runs three different ways: 1) by simply executing CINDY, 2) by executing CINDY with a customized site configuration specified in the command line, and 3) by using a customized **.BAT** execution file. Each of these procedures are discussed below.

The First Time

To execute CINDY do the following:

1) Create a working subdirectory. This subdirectory must be on the same hard disk where the CINDY subdirectory resides. For instance, type

   MD \CINDY\nnn

   and press **Enter** to create a working subdirectory named **nnn** below the CINDY subdirectory. The subdirectory does not need to reside below the CINDY subdirectory, as is illustrated in this example.

2) Move to the working subdirectory, and transfer a copy of the **CINDY** command file by typing:

   CD \CINDY\nnn

   and press **Enter**.

   COPY \CINDY\CINDY.BAT

   and press **Enter**.

3) Start CINDY by typing:

   CINDY

   and press **Enter**.

Simplest Method

The simplest way to execute CINDY is to move to a working subdirectory and then to start CINDY by typing:

CINDY

and press **Enter**.

With Command Line Customized Site Configuration File

If the user has created customized site configuration files, CINDY may be executed with the customized site configuration option and parameter values by typing:

CINDY nnn

where **nnn** is a valid site configuration name. **Nnn** must be located in the working subdirectory.

With Customized .BAT Execution File

The third way to initiate CINDY execution is to edit the **CINDY.BAT** file in the working subdirectory. The file named **CINDY.BAT** controls CINDY execution with the following commands:

\cindy\data8k
IF errorlevel GOTO stop
\cindy\cin *%1*
IF errorlevel GOTO stop
\cindy\undata
:stop

A copy of this file should be copied into each CINDY working subdirectory when the subdirectory is created. The file may then be customized, using a standard text-processing editor, by replacing **%1** with **nnn** where **nnn** is any valid site configuration file name in the working subdirectory.

TUTORIALS

The tutorials are included to aid the novice user in learning to use the CINDY software package. The tutorials present several typical evaluation scenarios, each demonstrating potential usages of the code. The tutorials are progressive in that the later tutorials presume a growing proficiency with the software. Very explicit instructions are provided with the first tutorial while instructions with the following tutorials provide more generalized instructions. Consequently, it is suggested that the user proceed sequentially through the tutorials. The scenarios associated with each tutorial are described briefly and major features to be presented are identified. Sample problems are used in the tutorials. The user is referred to the Sample Problem section, following the tutorials, for typical outputs. The final tutorial walks the user through customizing a site configuration.

Tutorial One

The purpose of the first tutorial is two-fold:

- to acquaint the first-time user of CINDY with the mechanics of executing CINDY
- to provide a walk-through of a simple typical evaluation.

The evaluation considered in this tutorial involves retrieving a previously-created subject file, adding a bioassay data point, performing an intake assessment, comparing the results of the assessment with a previous evaluation, and performing a calendar-year dose assessment.

Extensive help is provided with the mechanics of menu and window handling in this tutorial. Options and activities introduced in Tutorial One include retrieving a previously-created subject file, entering bioassay data, establishing radionuclides of concern and intake composition, using the intake component list, model viewing, calculating, viewing graphic results on screen, selecting a graphics printer, printing a graphics report, viewing a text report on screen, printing a text report, saving work, retrieving a previously-generated report, changing operating modes, and using the dose-reporting limit.

It is assumed that you have had no previous hands-on experience with CINDY when performing this tutorial; however, it is assumed that CINDY has been successfully installed on the host computer. It is further assumed that you are using the default site configuration.

The first scenario involves evaluation of an exposure to cobalt-60. It is assumed that you, the evaluator, have previously performed an evaluation of the exposure and that an additional whole body bioassay measurement has

been made. You wish to update the CINDY subject file and determine if any changes need to be made on the dose estimate.

1) Create a working subdirectory (as described in the **How to Run Cindy** section). Assuming that you wish to create a new working subdirectory named **tutorial**, the following sequence should be used:

   MD \CINDY\tutorial
   CD \CINDY\tutorial
   COPY \CINDY\CINDY.BAT

2) Move the sample problem input files to the working subdirectory by typing:

   COPY \CINDY\SAMPLE?.CIN
   COPY \CINDY\SAMPLE?.BIO

   and press **Enter**. Sample Problem One files will be used in this tutorial.

3) Start CINDY by typing:

   CINDY

   After an initialization message, the screen should appear as shown in Figure 4.

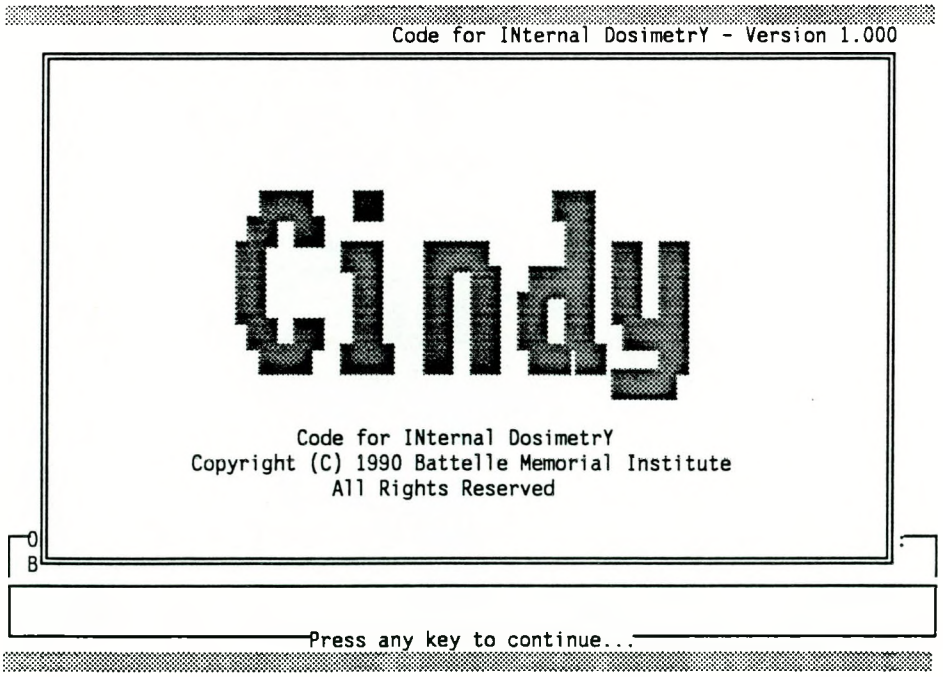


FIGURE 4. CINDY Tutorial Screen 1

4) Press **Enter** to clear the title screen and again after reading the introductory screen.

5) The main menu of CINDY will appear as shown in Figure 5.

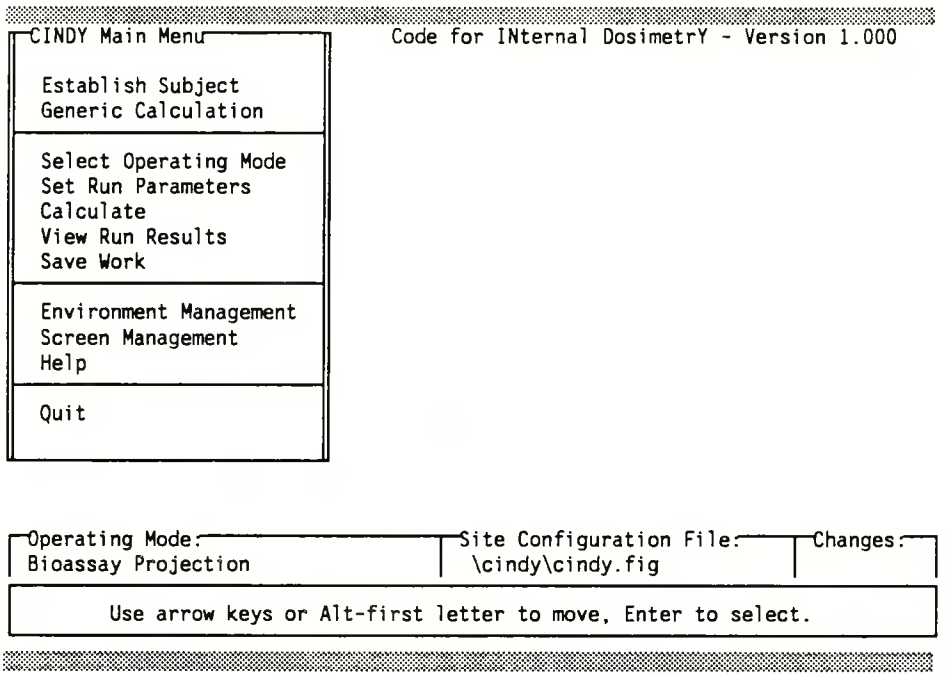


FIGURE 5. CINDY Tutorial Screen 2

This menu will always be displayed though occasionally it will be overlaid with other menus or a window. To select a menu, move the menu bar to the desired selection and press **Enter**. Menus will open when a main menu item is selected. Selecting an item from a menu will move you to either another level of menus (all menus are "stacked" on the screen) or to the appropriate input or report window.

Pressing **Esc** is an alternate way to return to the previous screen.

Retrieving a subject's file

6) The first step in performing an evaluation is to establish information about the subject. The CINDY database is organized around the subject (worker or individual). Consequently, when a subject is retrieved, all intake information and previously created reports are available to you. Select **Establish Subject** on the main menu.

For purposes of this tutorial, it is assumed that you have performed previous analyses on the subject of interest and saved the subject files. It is now necessary to retrieve the subject file. To do so, select **Retrieve Subject Files** from the menu. An alphabetized menu of the subject files will be displayed as shown in Figure 6. Each file name has an extension of **.CIN**, which is the standard file extension for the primary subject files. The DOS date and time stamp for each file is also displayed in the menu. Move the cursor to the item **sample1.cin** and press **Enter**.

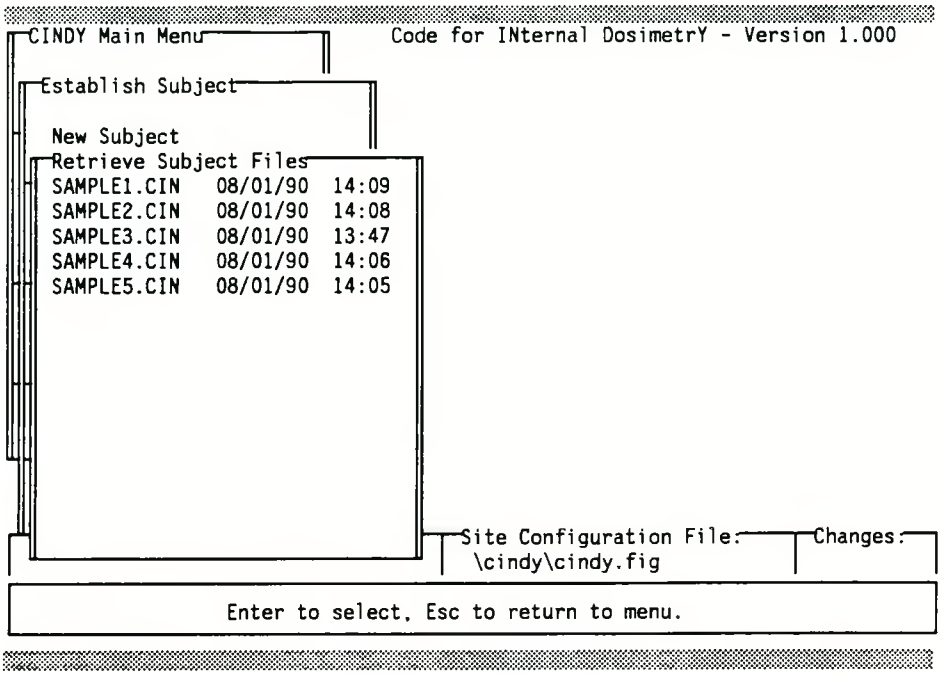


FIGURE 6. CINDY Tutorial Screen 3

Refer to the subject status page on the backdrop. Information on the status page should match the status page shown in Figure 7.

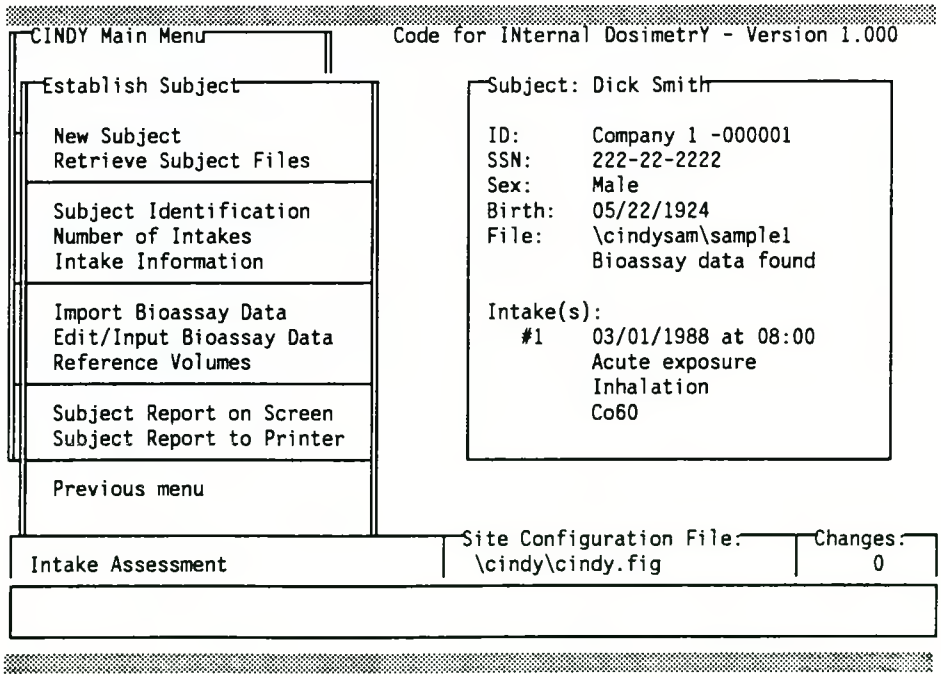


FIGURE 7. CINDY Tutorial Screen 4

7) To add the bioassay data point for the given subject, select **Edit/Input Bioassay Data** from the menu. A window will open listing bioassay data for the subject, as shown in Figure 8.

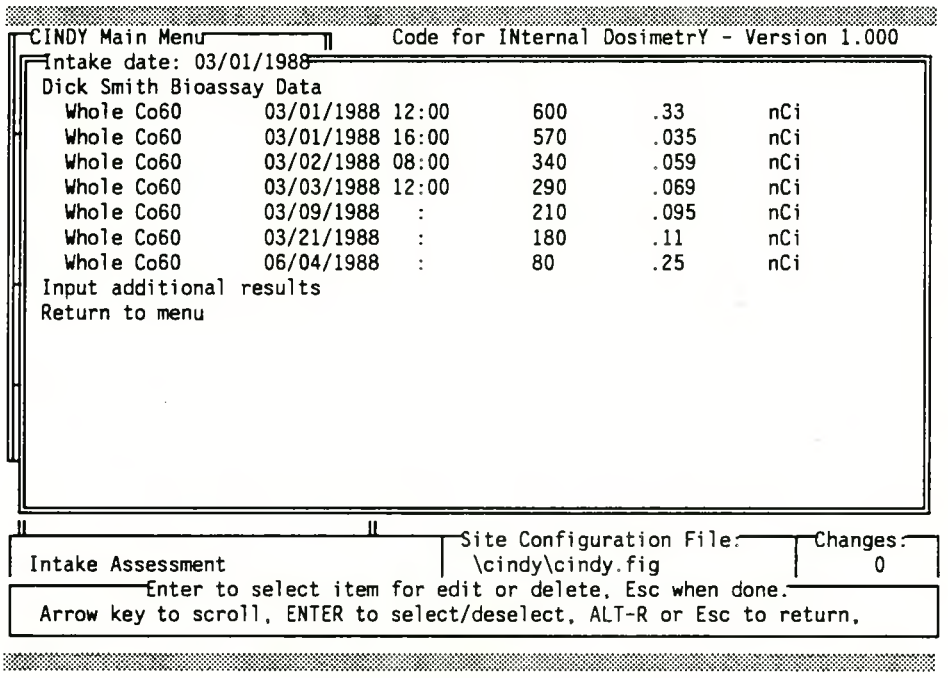


FIGURE 8. CINDY Tutorial Screen 5

Updating a subject's bioassay data

8) Move the menu bar to **Input Additional Results** and press **Enter**. Another window will overlay the current window to control input of additional bioassay data. Some of the fields will be pre-filled with data.

Assume the new bioassay measurement to be added is a whole body count of 20 nCi for Co-60 taken on June 6, 1989. Because of the pre-filled fields it is necessary to enter only the date and the measured value. To enter the date, move to the date field and edit. Note that the right and left arrow keys may be used to position the cursor within an edit field. Next, move to the field labelled **Measured value:** and enter **20**. Upon completion, the screen should appear as shown in Figure 9.

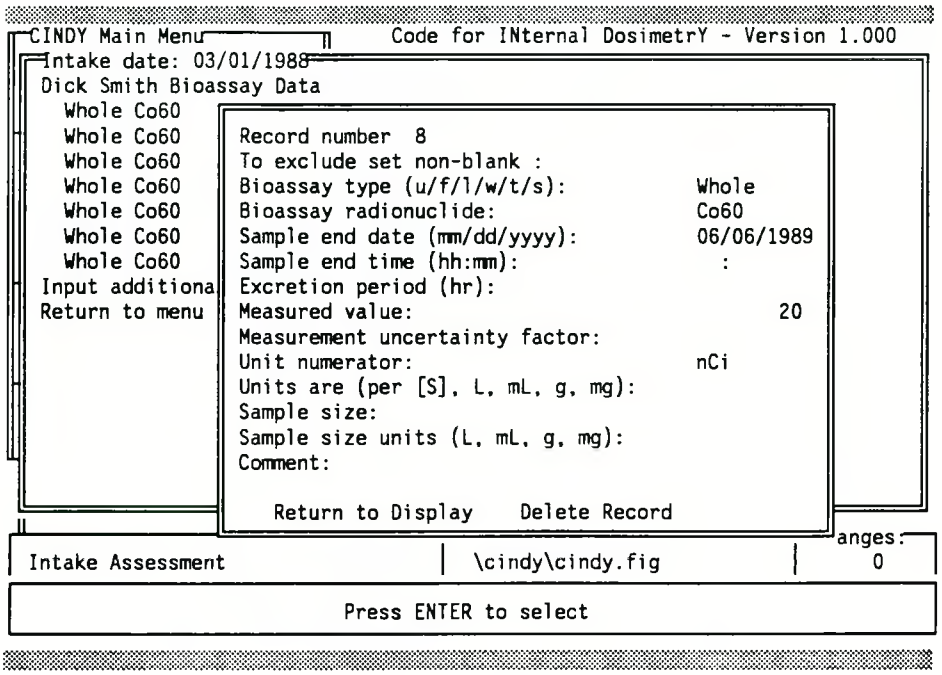


FIGURE 9. CINDY Tutorial Screen 6

9) Select **Return to Display** from the menu. The new bioassay data point should be shown on the bioassay data file window. Select **Return to Menu.** Select **Previous Menu** on the **Establish Subject** menu. Revision of the subject bioassay data has now been completed. *Note, however, that no changes have been made to the subject data base files. Files are updated only from the* ***Save Work*** *option on the main menu. After making substantive changes, you might wish to save the changes before proceeding with calculations. However, in this tutorial you will proceed directly to an evaluation.*

Performing an intake assessment

10) The first analysis to be performed is an intake assessment. Check that the operating mode is set to **Intake Assessment.** (The currently selected operating mode appears in the lower left corner of the screen.)

11) When returning to a calling menu, the menu bar usually moves automatically to the next menu item. Select **Set Run Parameters.** A menu will open, as shown in Figure 10.

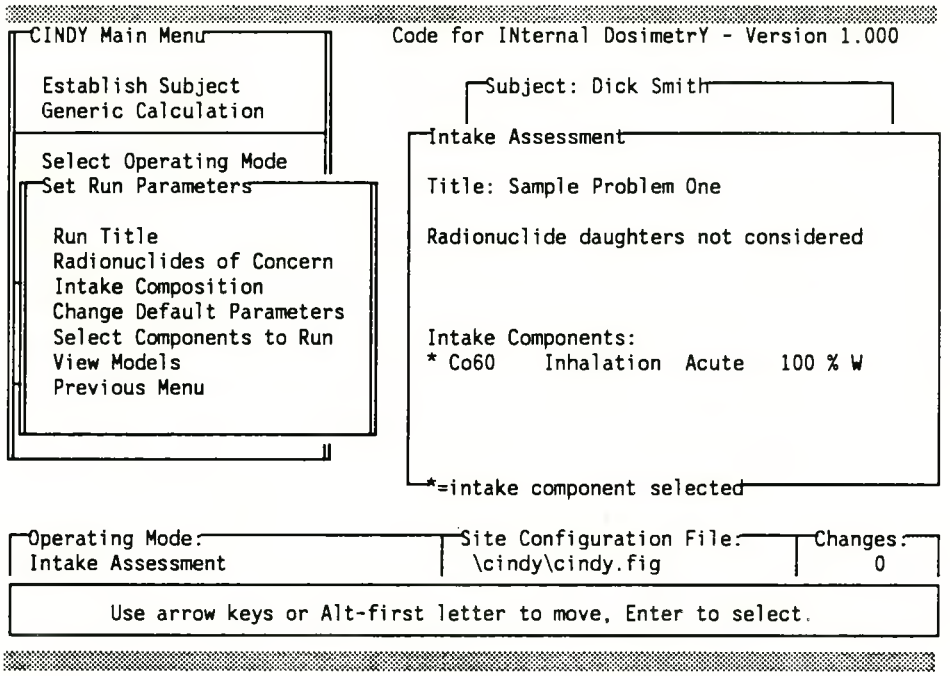


FIGURE 10. CINDY Tutorial Screen 7

Using the Set Run Parameters Menu

12) Change the run title by selecting **Run Title** from the menu and then editing the field displayed in the window that opens. For example, change the title to **1989 Intake Assessment Update.**

13) Select **Radionuclides of Concern** to review radionuclide options. A menu will be displayed, as shown in Figure 11. Radionuclides of concern for the current subject's exposure scenario are highlighted; in this tutorial, Co-60 is highlighted. The yes flag indicates that there is pertinent bioassay data for Co-60. The currently selected working units for Co-60 are **pCi**; all reports will present results in terms of pCi's. Return to the calling menu.

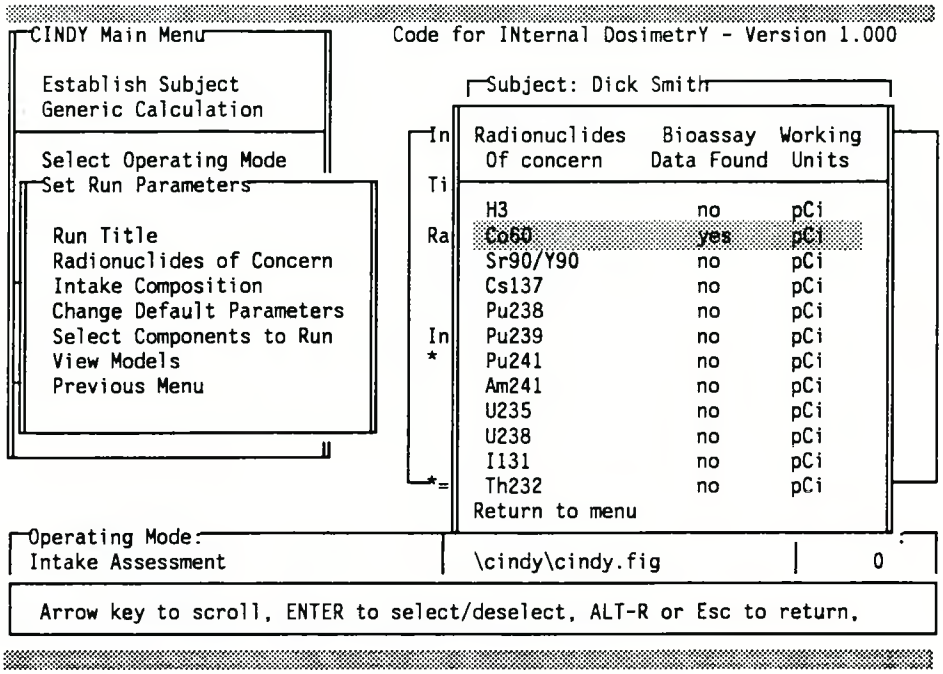


FIGURE 11. CINDY Tutorial Screen 8

14) Select **Intake Composition** on the **Set Run Parameters** menu. A window will open, as shown in Figure 12. Pertinent fields in this window are highlighted, based on previous subject-specific data provided. Because only one mode of exposure was specified, the fraction inhaled was preset to 1.0. On the previous analysis, the assumption was made that the material was all ICRP 30 Class W.

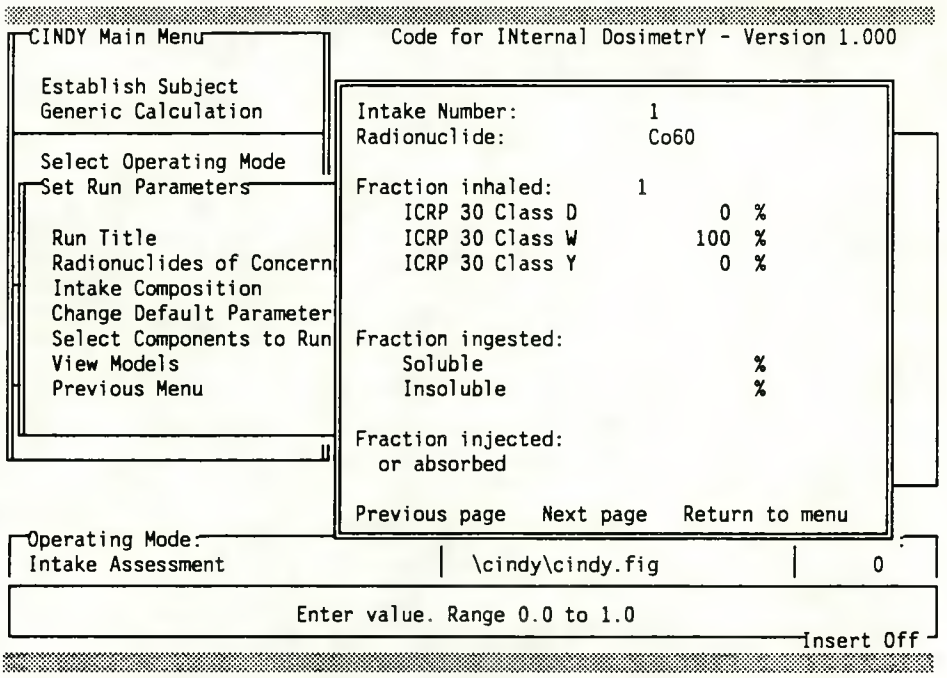


FIGURE 12. CINDY Tutorial Screen 9

15) If additional radionuclides were of concern for this exposure scenario, you would use **Next page** to display additional input pages. Because this scenario considers only Co-60, select **Return to menu.**

16) The cursor should now be positioned on **Change Default Parameters.** Let us assume that you are not currently interested in reviewing or changing default parameter values. The run status page indicates that you only have one intake component defined and that component is already selected. *CINDY generates a list of possible intake components based on user input. An asterisk preceding a component and a highlight indicates that a component has been selected. CINDY initially sets all intake components as selected; additional components added through scenario changes may need to be explicitly selected by the user.*

Reviewing model parameters

17) Select **View Models** to demonstrate how easy it is in CINDY to review model parameters used in the calculations. A window will open, providing a summary of the models selected for the calculation. The summary shows input to the transfer compartment from the lungs and gastrointestinal (GI) tract and output from the transfer compartment to the liver and "other" tissues. Press any key to continue.

18) After providing a summary of the models used in the calculations, CINDY displays a detail screen of each of the model components. The lung model screen should now be depicted, as shown in Figure 13.

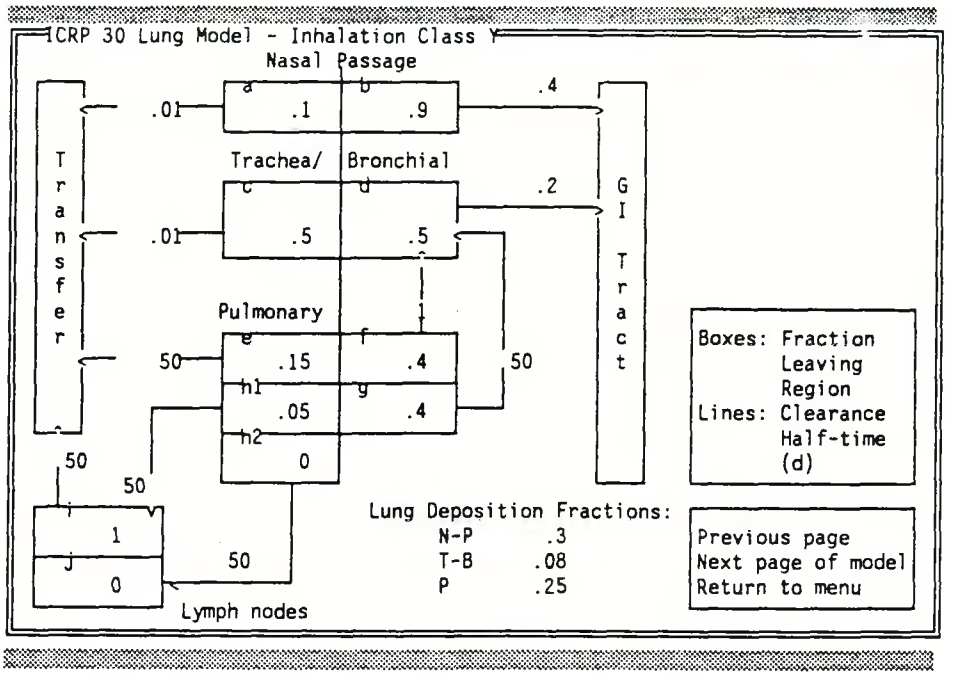


FIGURE 13. CINDY Tutorial Screen 10

Models are depicted as presented in ICRP Publication 30 whenever possible. Note that numbers inside compartment boxes indicate fraction initially deposited in that region and that numbers displayed on lines correspond to the clearance half-time in days.

The cursor is positioned on **Next page of model.** Press **Enter** to move to the next page of the model. Note that you may choose to by-pass the remainder of the model pages and return directly to the controlling menu by using the cursor to select **Return to menu.**

19) A window should now be displaying the GI tract model. The cursor is positioned on **Next page of model.** Press **Enter.** The systemic screen should now be displayed. Select **Next page of model.** The liver model should be displayed. Select **Next page of model** again to display the "other tissues" model. Press either **Next page of model** or **Return to menu.** Select **Previous Menu** on the **Set Run Parameters** menu.

Calculating and viewing results

20) Select **Calculate** on the main menu. A window will open to alert you that the calculation is in progress. It will take a few seconds for the calculation to be completed. At that time the program will "beep," the window will close, and the cursor will be positioned on **View Run Results.**

21) Select **View Run Results** on the main menu. A menu will open, as shown in Figure 14. The cursor will be positioned on **Graphic Display on Screen.** Press **Enter.**

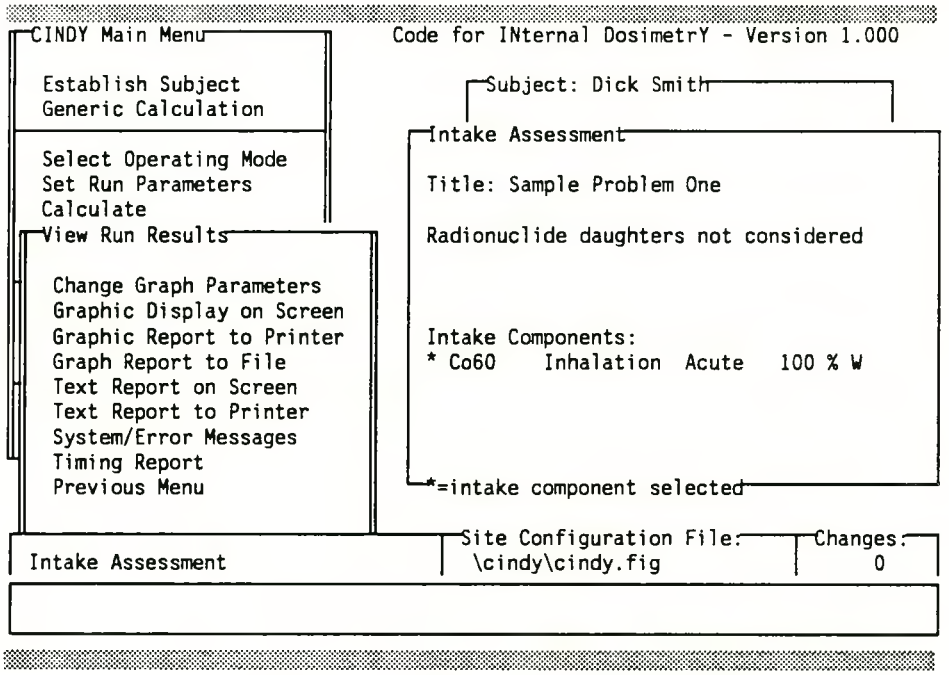


FIGURE 14. CINDY Tutorial Screen 11

22) The graphic display shown in Figure 15 should be displayed.

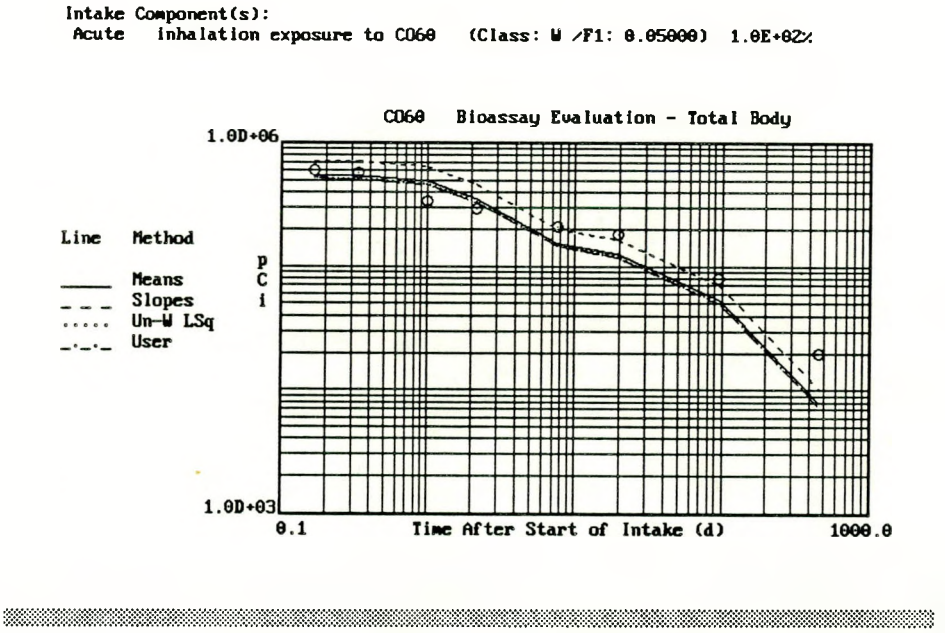


FIGURE 15. CINDY Tutorial Screen 12

23) *If an error message is displayed in the message box, write it down. Then, select **System/Error Messages** on the **View Run Results** menu.* Write down any additional messages displayed in the window.

24) Press any key to return to the calling menu. The cursor is now positioned on **Graphic Report to Printer**. Press **Enter**. The message **"Cannot print graph. Check settings."** will appear in the message box.

Setting graphics printer type

25) To protect against system hang-ups, the default site configuration assumes that no graphic printer is attached to the host computer. This default can easily be changed. Press any key to clear the message box. Select **Change Graph Parameters** on the **View Run Results** menu.

Select **Printer Type**. A menu of printer types will appear, as shown in Figure 16. Select the appropriate option for your host computer. Select **Previous Menu** on the **Change Graph Parameters** menu. Select **Graphic Report to Printer** again.

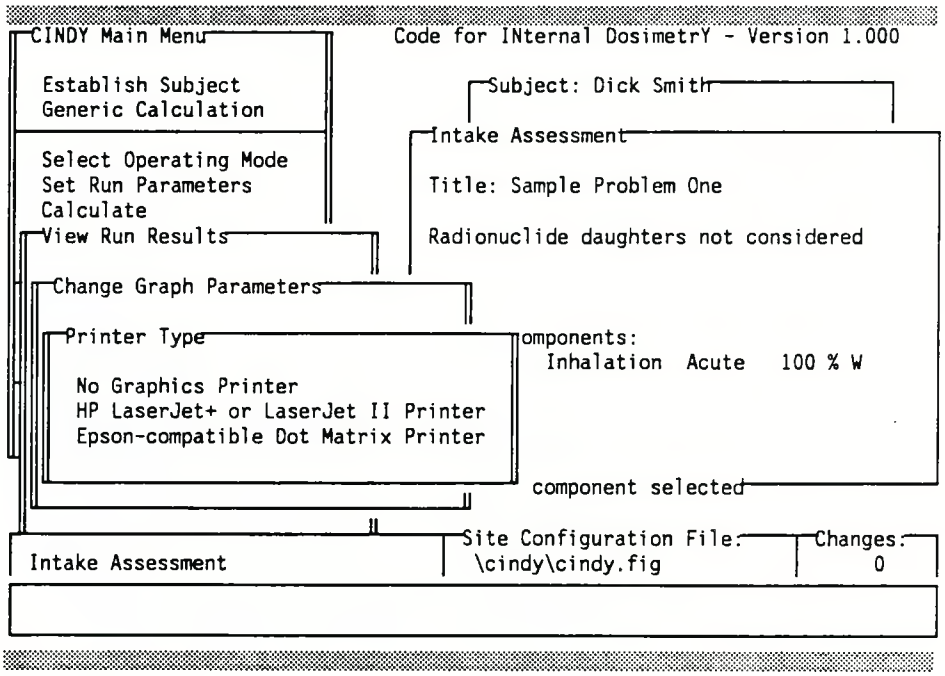


FIGURE 16. CINDY Tutorial Screen 13

26) The intake assessment graphic report allows you to visually determine the goodness of the model's fit to the bioassay data. The text report contains the intake estimate as well as additional numeric detail reports. Select **Text Report on Screen**. A window will open to display the text report, as shown in Figure 17. Use the **PageDown** key to scroll down a screen page into the report. Note that intake estimates are calculated by three methods: ratio of the means, average of the slopes, and unweighted least squares. A fourth intake estimate is calculated if you have provided weights in the bioassay data file.

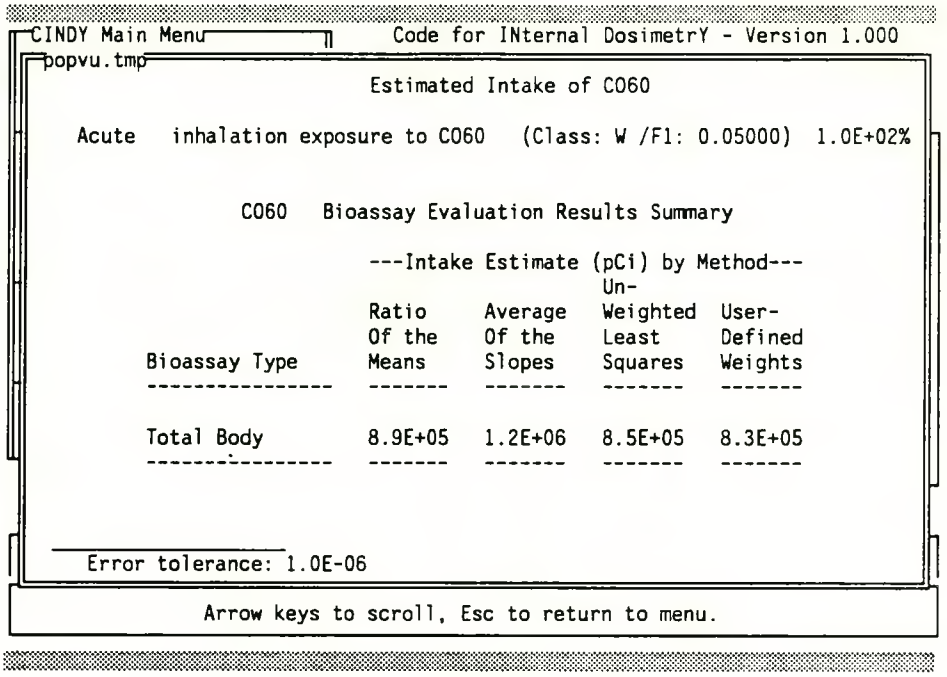


FIGURE 17. CINDY Tutorial Screen 15

27) Press **Esc** to return to the calling menu. Select **Text Report to Printer.** You may wish to compare this recently calculated intake estimate with a previously calculated intake. Note that you have not yet saved any of our current work; all files associated with subject **sample1** have not been updated. Consequently, you may compare the new output (just printed) to the previous results stored for **sample1.**

Retrieving a previously-generated subject's report

Select **Previous Menu** on the **View Run Results** menu. Select **Environment Management** on the **Main Menu.** Select **List Files: Current Subject.** Select the file named **sample1.rit.** (Refer to Table 3 for a list of the standard file name extensions and their meanings.) A window will open displaying the file.

Note that the intake estimate did not change by much with the addition of the new bioassay data point. Press **Esc** to return to menu. Select **Previous Menu** on the **Environment Management** menu.

Saving your work

28) The next action will be to change to a dose assessment operating mode. It is important to remember to *save work before changing operating modes*. This is necessary because the output file buffers used by the calculation programs will be reused with the next calculation. As noted above, no work has been saved in this session. Select **Save Work** on the main menu. A menu will open, supplying save options. *No saving of user parameters is done in CINDY except from this menu. This feature gives you complete control over which results are saved.* Select **Save All Work** from the **Save Work** menu.

29) A window will open requesting the file name prefix to use, as shown in Figure 18. The default selection is shown in the field, in this tutorial, **sample1.**

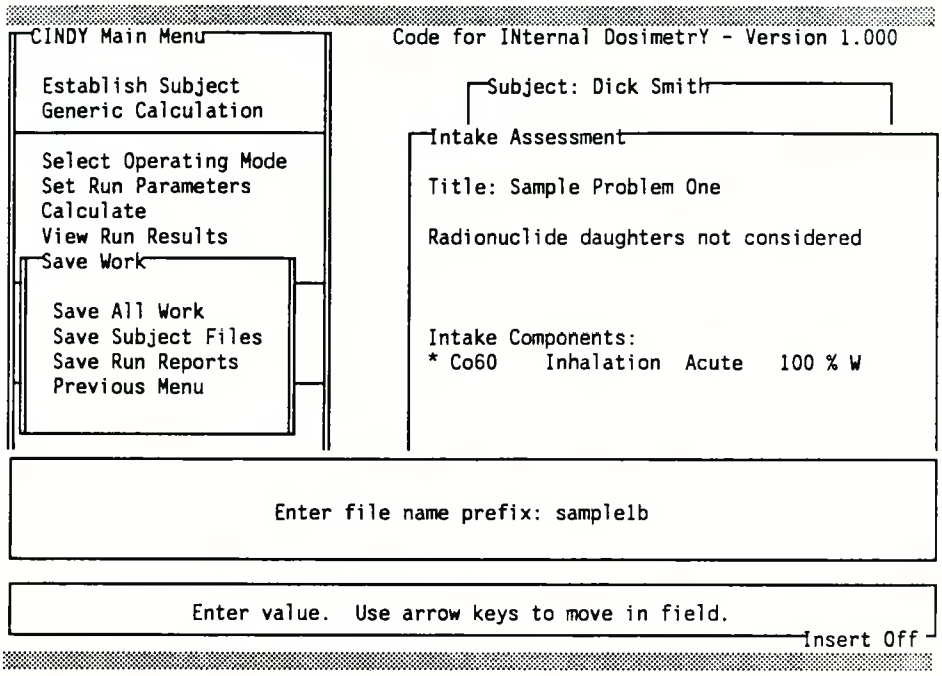


FIGURE 18. CINDY Tutorial Screen 14

Typically, if you added new bioassay data, the same file name would be used, overwriting the previously-saved files for the current subject. However, to preserve the integrity of the sample problems, you will provide a different file name for storing the files. Change the file name from **sample1** to **sample1b**, which effectively establishes a "new" subject. Select **Previous Menu.**

You have complete control over file name selection and conventions. Procedures should be established at each site to control file name usage.

30) Because there was no change in the intake estimate (for the ratio of the means method), it would not be necessary to recalculate dose at this point. However, it will be beneficial for the purposes of this tutorial to do so nonetheless. Let us assume that instead of selecting the ratio of the means method for arriving at the dose estimate, you choose to use the average of the means method, which in this scenario produced a higher estimate.

Move to **Select Operating Mode** on the **Main Menu** and press **Enter.** Select **Dose Assessment - Calendar-year.** Note the current parameter values on the calendar year dose status report.

Performing a calendar-year dose assessment

31) Select **Set Run Parameters** on the main menu. Select **Intake Estimate.** A window will open, as shown in Figure 19. Note that this window is similar to the intake composition window (see Figure 12).

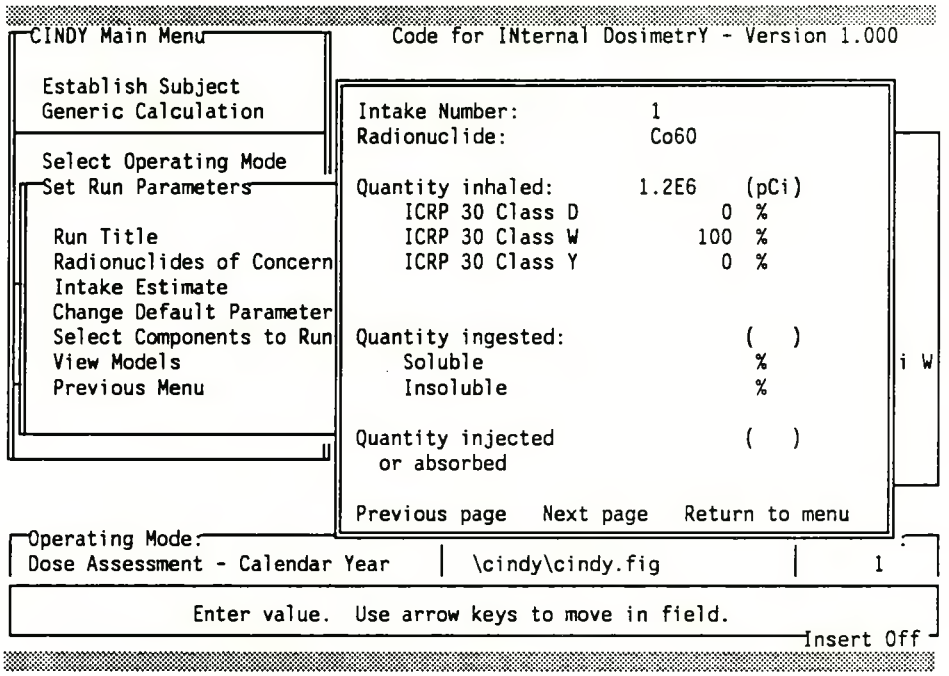


FIGURE 19. CINDY Tutorial Screen 16

CINDY does not make any presumptions as to what intake estimate you may wish to use. Consequently, you must type in the value. Enter the average of the slopes intake estimate of 1.2×10^6 nCi.

Use any format you wish for entering the number. You may wish to try to enter an invalid number. CINDY has extensive numeric input checking features. Return to the calling menu. The inhalation class W fraction should be set to **100%** to match the intake assessment calculation. Return to the main menu and select **Calculate.**

32) Select **View Run Results.** Select **Text Report on Screen.** A window will open to display the text report as shown in Figure 20. Use the cursor keys to scroll through the report.

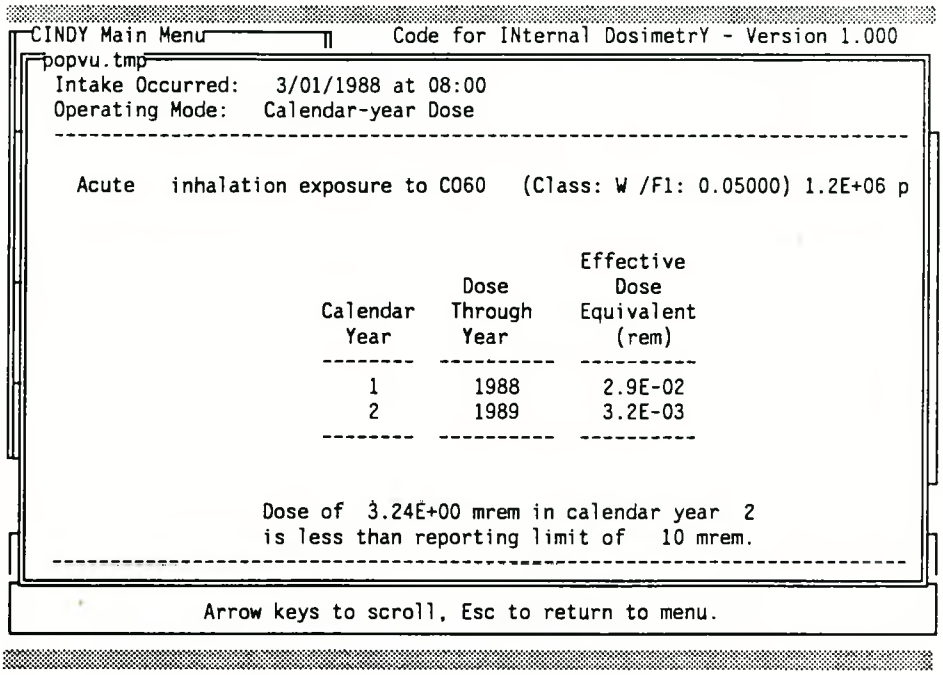


FIGURE 20. CINDY Tutorial Screen 17

Using the dose-reporting limit option

33) Note that the dose is below the reporting limit set at 10 mrem for this scenario. You may change the reporting limit or indicate that no reporting limit is to be used. To see the effect of this parameter on the report, return to the main menu and select **Set Run Parameters**. Select **Change Default Parameters**. Next, select **Dose Reporting Limit** and respond **no** to the question **Do you wish to set a dose reporting limit?** Alternately you may wish to respond **yes** and then set a smaller limit. Return to the main menu and select **Calculate**. Use **View Results** to compare the reports.

    The report now gives doses in each calendar year. When the dose reporting limit option is used, doses are reported for each year until the dose becomes less than the limit.

34) Save the dose calculation results if you wish. Note that whenever you save the subject files, all option values are saved as well. For example, if you save all work at this time, the next time you retrieve **sample1b,** the operating mode will be calendar year dose assessment and the dose reporting limit will be set as in step 32.

35) You have now successfully completed the first tutorial. All that is now necessary is to select **Quit** on the main menu. A window will open asking if you really wish to quit. The default is **no**. This question protects you from inadvertently exiting CINDY.

Tutorial Two

The purpose of Tutorial Two is to acquaint you with basic features of CINDY not included in the first tutorial. Features introduced in this tutorial include generic calculations, the bioassay projection operating mode, the wound intake mode, graphic presentation parameters, and most of the environment and screen management features.

The second tutorial walks you through a generic wound calculation. It is assumed that you have completed Tutorial One and that the default site configuration is in use.

1) Execute CINDY.

Setting up a generic calculation

2) Select **Generic Calculation** on the main menu. A menu will open as shown in Figure 21.

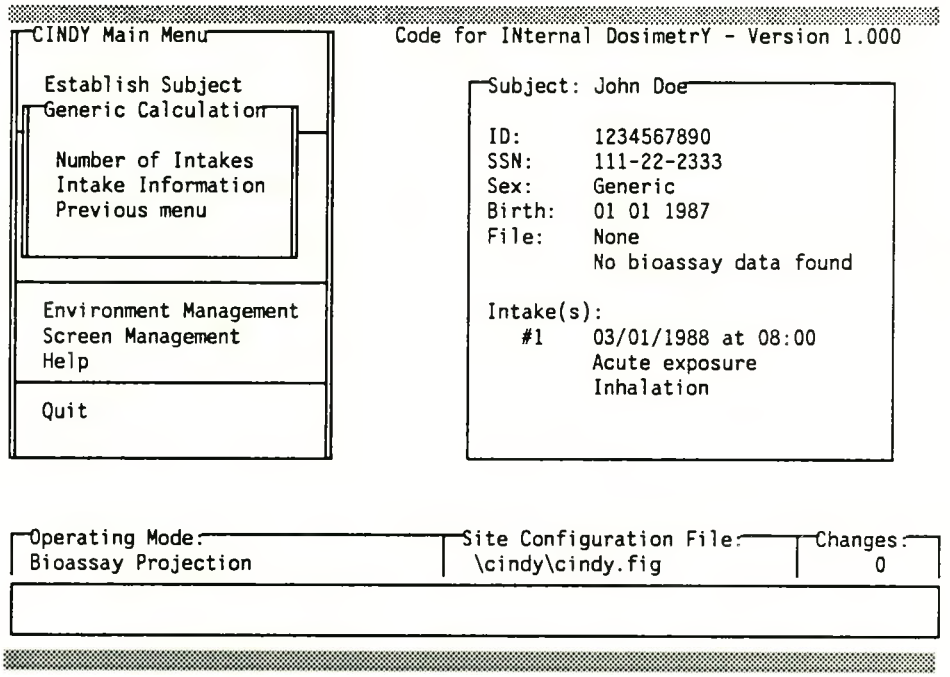


FIGURE 21. CINDY Tutorial Screen 18

3) Select **Intake Information.** A window will open, as shown in Figure 22.

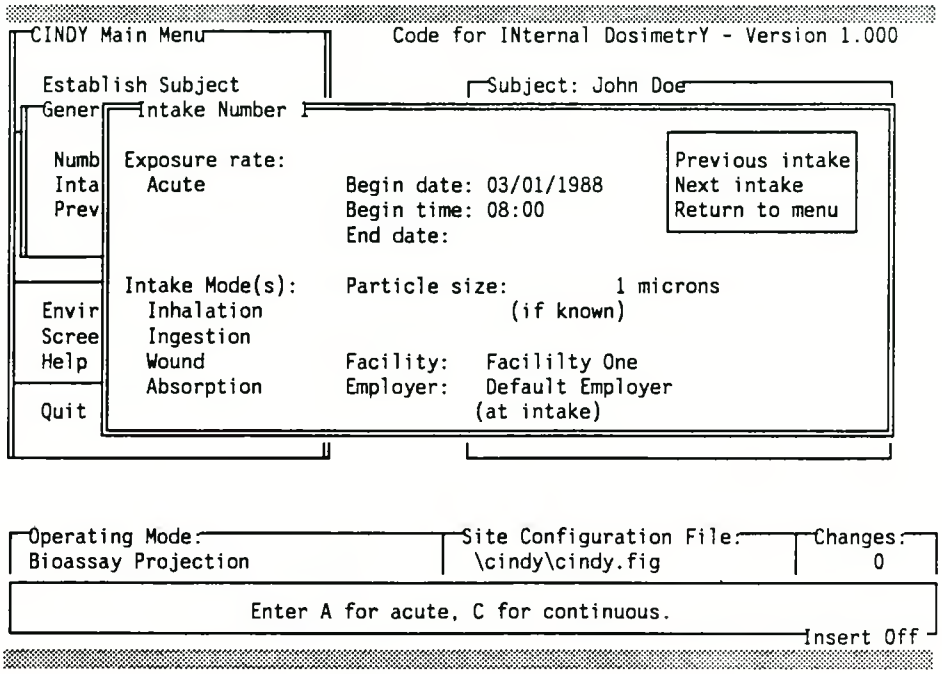


FIGURE 22. CINDY Tutorial Screen 19

4) *Note that default values are displayed in fields as defined in the site configuration. Some of this information is subject-specific, included primarily for report headings and consequently of no importance for generic calculations. With generic calculations, date and time are important only for the intake assessment mode where it is used in conjunction with bioassay measurement dates and times to determine output times.*

   For this tutorial you need only set the exposure rate to **Acute** and the intake mode to **Wound**. Note that the default intake mode of **Inhalation** should be deselected. Enter these values, referring to the message box for additional instructions. Return to the main menu.

5) Move to **Select Operating Mode** and select **Bioassay Projection.**

6) Select **Set Run Parameters**. Select **Run Title** and then input a title of your choice. Run titles appear in the heading of all reports.

7) Select **Radionuclides of Concern** and then **Am241**. Return to the calling menu.

Entering wound parameter values

8) Select **Intake Estimate** and enter **1000** pCi for the quantity injected or absorbed. Select **Next page** or **Return to menu**. A window will open for entering direct intake parameters. Because direct intakes may be from wounds, skin absorption, or injections, CINDY does not contain default values for any parameters for the direct intake model. For complexity, let us assume that the contamination is not all equally mobile; you assume that half of the material will enter the transfer compartment with a clearance half-time of 1 day, 20% with a 14-day clearance half-time, and 30% with a 300-day clearance half-time. Upon completion, the screen should appear as shown in Figure 23.

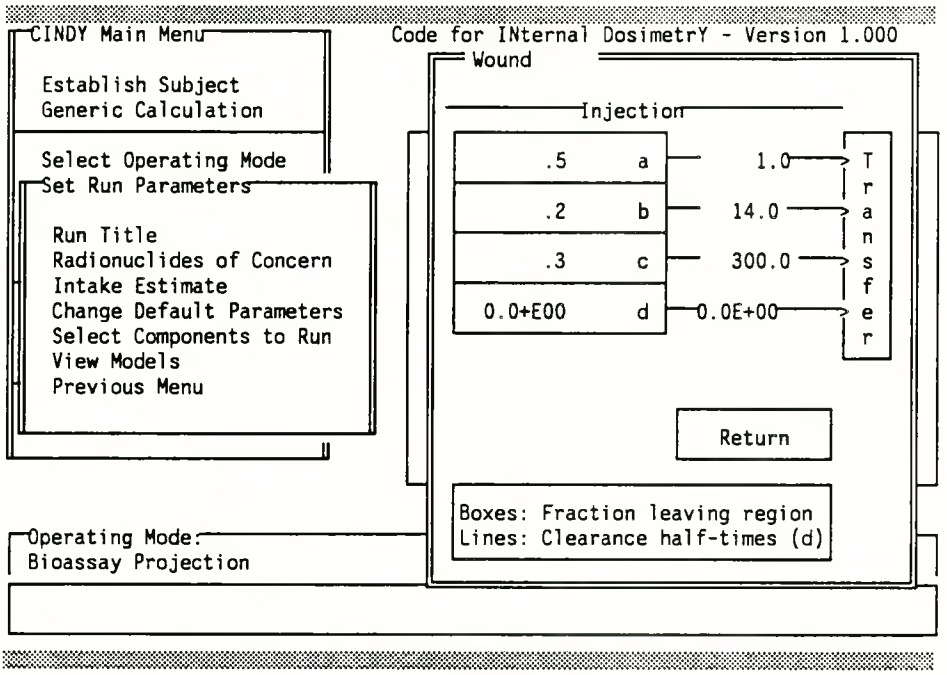


FIGURE 23. CINDY Tutorial Screen 20

9) Select **View Models.** The model summary screen should appear as shown in Figure 24.

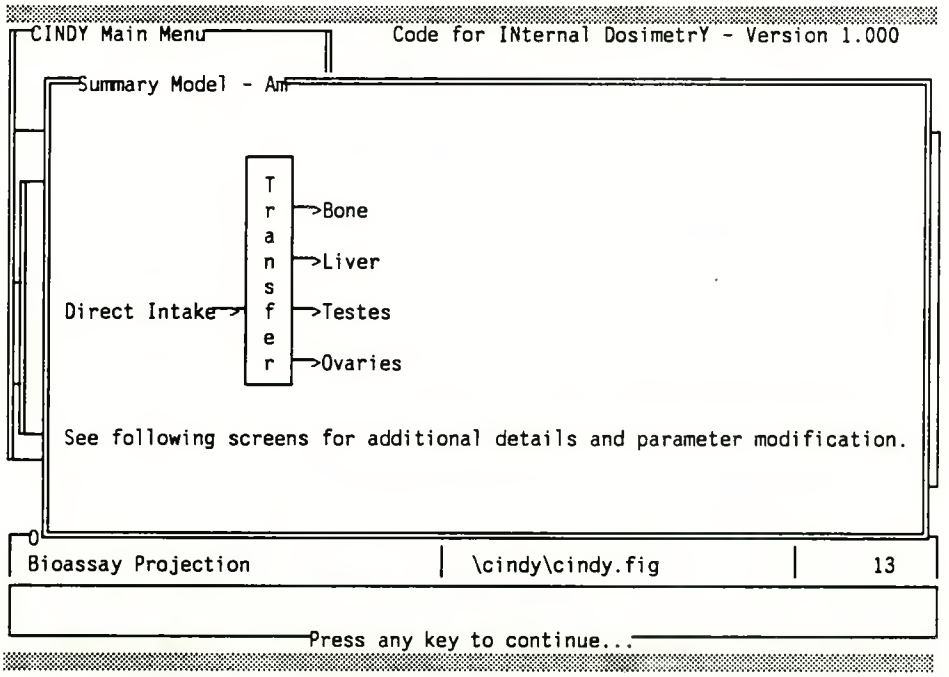


FIGURE 24. CINDY Tutorial Screen 21

Press any key to continue. The injection model will be displayed next, followed by the transfer compartment and organ models.

10) Return to the main menu and select **Calculate**. Select **View Run Results**, then **Graphic Display on Screen**. View the screens and return to the calling menu.

Changing graph parameter values

11) For purposes of this scenario, let us assume that you are dissatisfied with the log/log scale presentation of the data. Select **Change Graph Parameters** on the **View Run Results** menu. Select **Graph Type (Linear/Log)**. A menu will open as shown in Figure 25. Select the graph type of your choice.

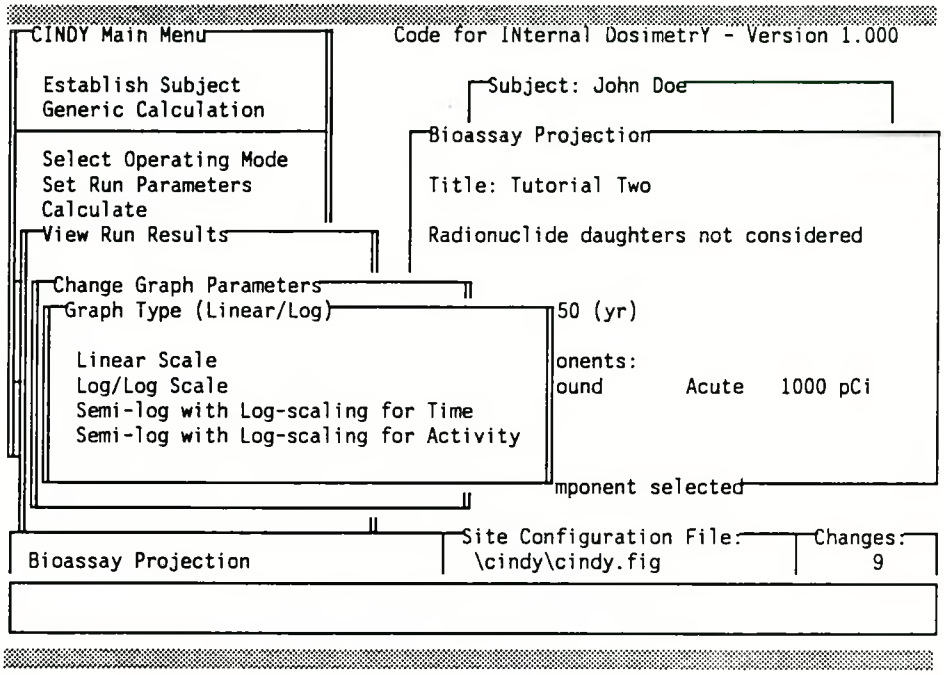


FIGURE 25. CINDY Tutorial Screen 22

12) Select **Previous Menu** on the **Change Graph Parameters**, then **Graphic Display on Screen** to view the results on the changed graph type.

13) Return to the **Change Graph Parameters** menu. Change the maximum number of cycles on an axis and graph size to become acquainted with the range of graph presentation possibilities. Return to the main menu.

Using the Environment Management menu

14) Select **Environment Management**. The menu shown in Figure 26 should appear. Select **Subject Directory**. A menu will open listing all subject files stored in the current subdirectory.

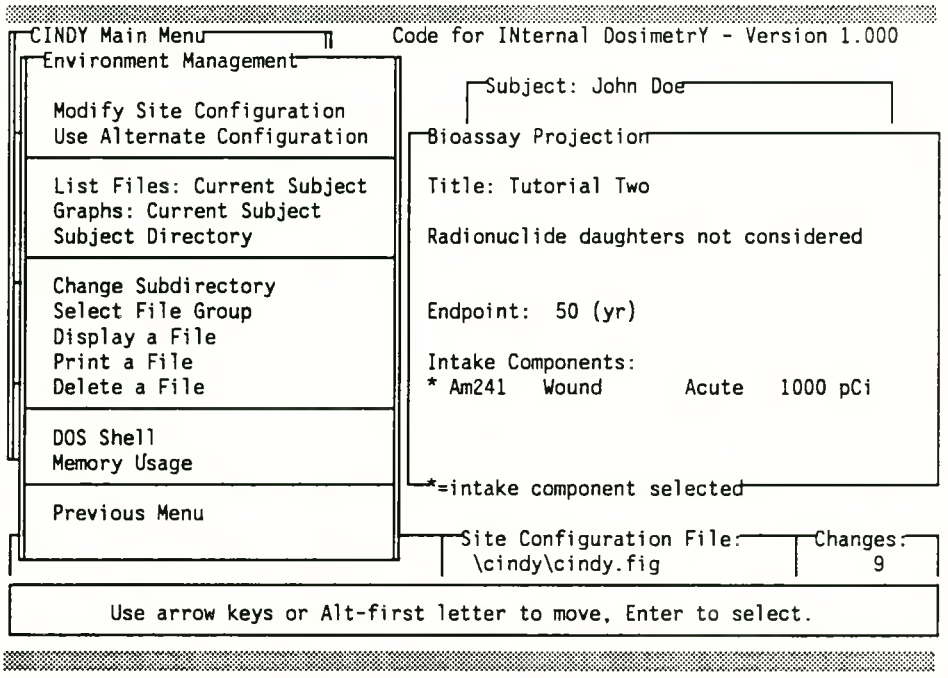


FIGURE 26. CINDY Tutorial Screen 23

15) Move to the third box on the menu. Note that you can change subdirectories while within CINDY. You are cautioned that all subject files should be saved prior to changing the subdirectory. This feature allows you to organize CINDY subject files into a variety of subdirectories.

16) Move to **Select File Group** and press **Enter**. A window will open requesting that you **Enter file group specification:** and the field contents set to ***.***. This parameter controls the files that will be displayed for the menu items, **Display a File**, **Print a File**, and **Delete a File**. If you enter ***.cin**, and then select **Display a File**, the same list of files should appear as shown in the previous step.

17) Move to **DOS Shell** and press **Enter**. A message will appear reminding you to type **EXIT** at the DOS prompt to return to CINDY. Press any key and you should be at the DOS prompt. Type **EXIT**.

Checking memory

18) Select **Memory Usage**. A window opens displaying the output of the public domain software PCMAP[(a)]. The last line indicates the number of bytes of free space. This is the amount of memory CINDY has available to run the calculation and auxiliary programs. If there is insufficient memory, the message **Program too big to fit into memory** would appear in the **System/Error Messages** window on the **View Run Results** menu. Return to the main menu.

19) Select **Screen Management**. A menu will appear as shown in Figure 27.

(a) PCMAP is copyrighted by Ziff-Davis Publishing Corp. 1987.

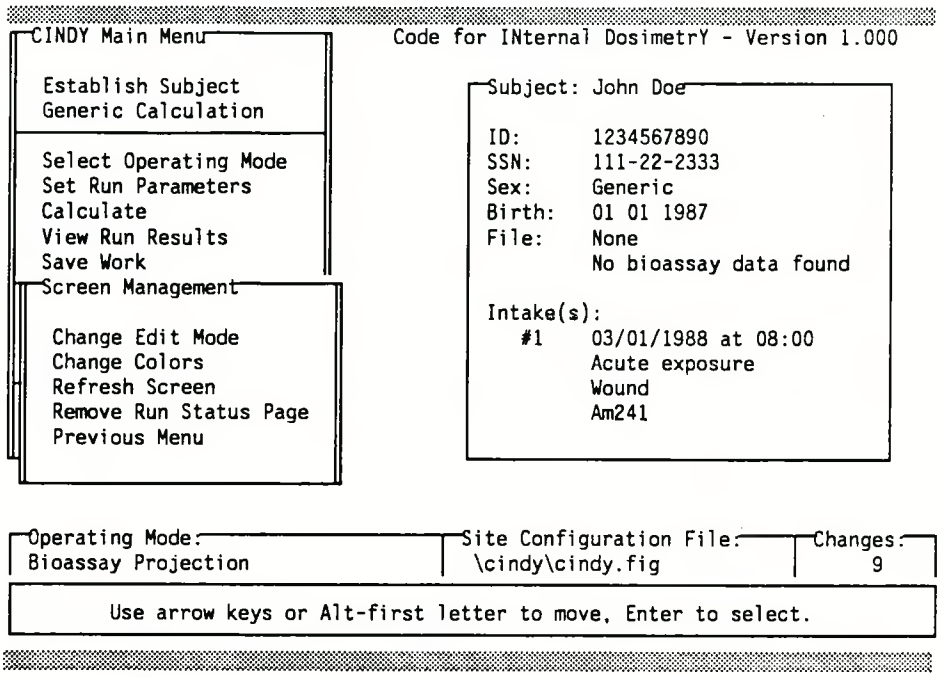


FIGURE 27. CINDY Tutorial Screen 24

Changing text-editing options

Select **Change Edit Mode.** Note that there are three edit modes from which to choose:

- insert off (typeover)
- insert on
- blank field.

In the blank field edit mode, the default value is displayed in the input field and then erased on the first keystroke. Select an edit mode of your choice. This new edit mode will be in effect for the duration of the CINDY session. In Tutorial Four you will learn how to change the edit mode in the site configuration.

20) Select **Change Colors.** A window will open as shown in Figure 28 with the exception that the colors are not displayed in the figure.

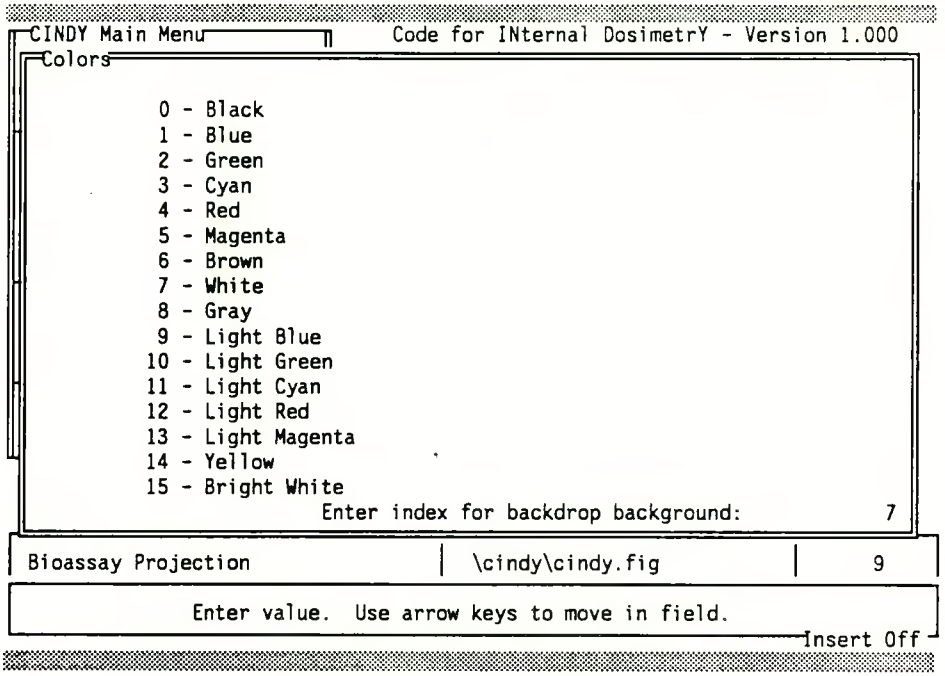


FIGURE 28. CINDY Tutorial Screen 25

Changing screen colors

This is your opportunity to customize CINDY. After cycling through the series of color questions, you are asked if you wish to make additional changes. If you answer, **yes**, the cycle of questions will be repeated; if **no**, the window will close and the cursor will be positioned on **Refresh Screen** on the **Screen Management** menu.

Press **Enter**; a message will notify you that the screen will be refreshed on return to the main menu. Return to the main menu. The screen should now be displayed in the new colors. Note that these colors will be in effect for the duration of the CINDY session. In Tutorial Four you will also find out how to change the colors in the site configuration.

21) You have now successfully completed Tutorial Two. Exit CINDY.

Tutorial Three

The purpose of the third tutorial is to discuss features of interest to typical and power users of CINDY. Features discussed include options available for entering bioassay data, normalization of bioassay data to working units, changing model options, intake component definition and selection, and error tolerances.

Sample Problem Two, which considers an acute inhalation exposure to Pu-239, will be used for this tutorial. A comparison will be made between the Jones, Durbin, and ICRP-30 plutonium excretion models.

It is assumed that you have completed the previous tutorials; consequently, some proficiency in menu handling will be assumed in this tutorial. It is also assumed that you are using the default site configuration.

1) Execute CINDY and retrieve the subject file **sample2**.

2) View the bioassay data by selecting **Edit/Input Bioassay Data** on the **Establish Subject** menu. Move the cursor to any record of interest. Press **Enter** to select the record. A window opens with the record moved into fields for editing. Note that the record information is more meaningful when displayed with the descriptive text. When **Return to Display** is selected, the data values are checked for consistency between the sample size, excretion period, and reference volume for the sex of the subject. If there is greater than a 40% inconsistency, you are warned and asked if a correction should be made to the sample time period. The test and correction are described in Part 1, Section 3.1.1.2.

Viewing the subject report

Sample Problem Two demonstrates the many options you have for entering bioassay data. The input options are listed below:

- Total sample activity analysis

  a) Sampling period and volume unknown
  b) Sampling period known, volume unknown
  c) Sampling volume known and period unknown

- Activity concentration analysis

  a) Sample volume and period unknown
  b) Sample period known and volume unknown
  c) Sample volume known and period unknown
  d) Sample period and volume known

Sections 3.1.1.1 and 3.1.1.2 of Volume 1 discuss the options available. CINDY will normalize all measurements to the working units for each radionuclide.

To view the normalized values, return to the **Establish Subject** menu and select either **Subject Report on Screen** or **Subject Report to Printer**. Figure 29 shows a portion of the report. Note that measured values and measurement uncertainty factor are shown in units as entered and normalized to the selected working units.

Bioassay Data Currently Considered

Measurement Date	Time Post Intake (d)	Bioassay Units: Measured Value	Sample Size	Sample Period	Normalized Value	Working Units Normalized Value
Pu239/Urine						
01/01/1980	0.4	2.3D+01 pCi/s		8 hr	7.0E+01 pCi/d	7.0E+01 pCi/d
01/02/1980	1.0	8.0D+01 pCi/s		12 hr	1.6E+02 pCi/d	1.6E+02 pCi/d
01/03/1980	1.7	2.0D+01 pCi/s		7 hr	7.4E+01 pCi/d	7.4E+01 pCi/d
01/13/1980	12	1.0D+01 pCi/s		24 hr	1.0E+01 pCi/d	1.0E+01 pCi/d
02/13/1980	43	7.0D+00 pCi/s		(24 hr)	7.0E+00 pCi/d	7.0E+00 pCi/d
08/13/1980	225	5.0D+00 pCi/s		(24 hr)	5.0E+00 pCi/d	5.0E+00 pCi/d
08/13/1981	590	4.0D+00 pCi/s		(24 hr)	4.0E+00 pCi/d	4.0E+00 pCi/d
Pu239/Feces						
08/13/1980	225	6.0D+00 pCi/s		(24 hr)	6.0E+00 pCi/d	6.0E+00 pCi/d
09/15/1981	623	2.5D-02 pCi/g	120 g	24 hr	3.0E+00 pCi/d	3.0E+00 pCi/d
09/15/1982	988	1.5D-02 pCi/g	100 g		1.6E+00*pCi/d	1.6E+00 pCi/d
09/15/1983	1353	1.0D-02 pCi/g		(24 hr)	1.1E+00*pCi/d	1.1E+00 pCi/d

Measurement Date	Time Post Intake (d)	Measurement Uncertainty Factor	Working Units Normalized Value
Pu239/Urine			
01/01/1980	0.4	1.1E+00 pCi/d	1.1E+00 pCi/d
01/02/1980	1.0	2.1E+01 pCi/d	2.1E+01 pCi/d
01/03/1980	1.7	1.8E+01 pCi/d	1.8E+01 pCi/d
01/13/1980	12	2.6E+00 pCi/d	2.6E+00 pCi/d
02/13/1980	43	0.0E+00 pCi/d	0.0E+00 pCi/d
08/13/1980	225	0.0E+00 pCi/d	0.0E+00 pCi/d
08/13/1981	590	0.0E+00 pCi/d	0.0E+00 pCi/d
Pu239/Feces			
08/13/1980	225	6.0E-01 pCi/d	6.0E-01 pCi/d
09/15/1981	623	0.0E+00 pCi/d	0.0E+00 pCi/d
09/15/1982	988	0.0E+00 pCi/d	0.0E+00 pCi/d
09/15/1983	1353	0.0E+00 pCi/d	0.0E+00 pCi/d

Note: Assumed excretion periods shown in parentheses.
* Normalized using reference volume or mass.

FIGURE 29. CINDY Tutorial Report 1

Changing radiological units

3) Assume that you do not wish to work in units of pCi for plutonium. Select **Set Run Parameters** on the main menu, then **Change Default Parameters**, and **Select Radiological Units**. A menu will open displaying

the radionuclides of interest and the current working radiological unit for each. Select **Pu239**. A menu will open, as shown in Figure 30.

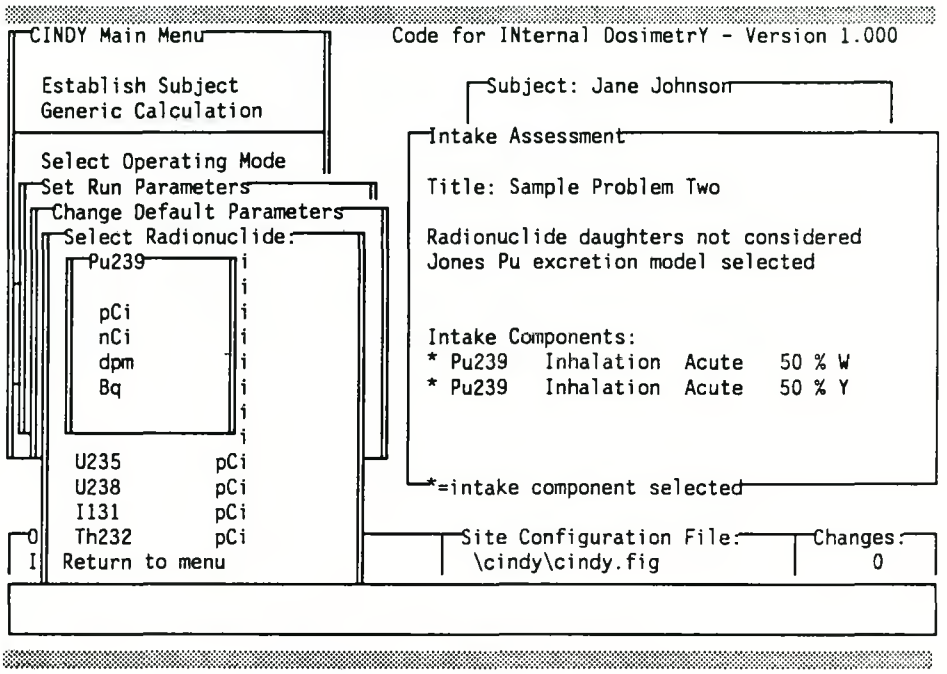


FIGURE 30. CINDY Tutorial Screen 26

Select your desired working units and then return to the main menu. Return to the **Establish Subject** menu and redisplay the subject report. The bioassay measurements will be displayed in the recently selected working units. Return to the main menu.

Working with multiple intake components

4) Select the **Intake Assessment** operating mode. Note that there are two intake components; the plutonium is assumed to be a mixture of 50% inhalation Class W and 50% Class Y. Also note that the Jones plutonium excretion model is currently selected.

Select **View Models**. A menu will open, displaying each intake component. Select a component for viewing. The summary screen will be displayed, followed by the lung model screen and the GI model screen. The next screen displays the Jones plutonium excretion model, as shown in Figure 31. Page through the remaining model screens and return to the **Set Run Parameters** menu.

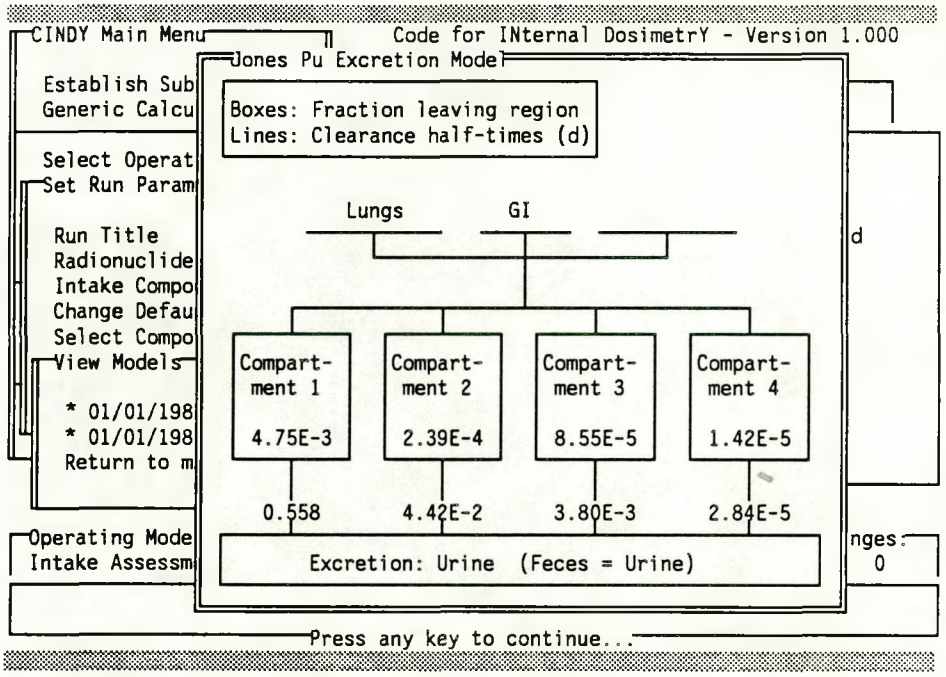


FIGURE 31. CINDY Tutorial Screen 27

Changing model options

5) Assume that you wish to compare the intake estimate for this scenario for the three available plutonium excretion models. Select **Change Default Parameters**, then **Pu Excretion Model**. A window will open, as shown in Figure 32. Select the Durbin excretion model.

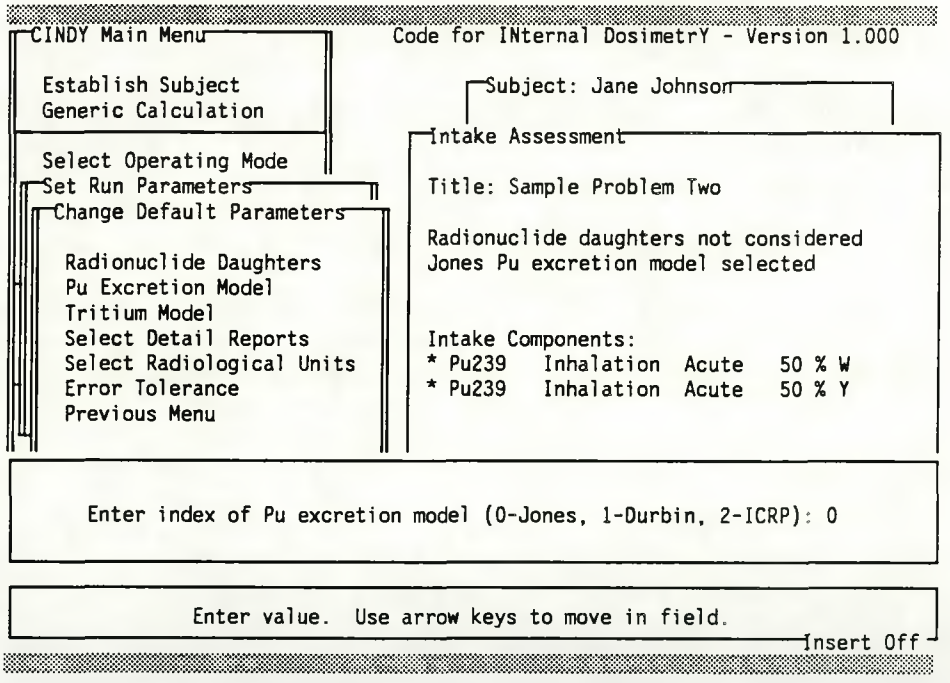


FIGURE 32. CINDY Tutorial Screen 28

6) Return to the main menu and select **Calculate**. Upon completion, select **View Run Results** to compare the results. Print the reports and compare to the results in the Sample Problem Section of this manual.

7) Now select the ICRP excretion model and recalculate. Print the results and compare with the reports using the Jones and Durbin plutonium excretion models.

8) Select the bioassay projection operating mode. Select the **Set Run Parameters** menu. Explore the capabilities available through this menu. For instance, add radionuclides of concern, change physical and chemical composition of the radionuclides, or change other default parameter values.

Selecting an intake component for consideration

9) Another feature available through the **Set Run Parameters** menu is the capability to interactively select any, some, or all of the defined intake components for consideration in any given run. Note that an asterisk before an intake component indicates that it is selected for consideration, as can be seen in the run status report.

10) Before leaving this menu, let us will briefly discuss the error tolerance parameter. Select **Set Run Parameters**, then **Change Default Parameters**, and then **Error Tolerance**. A window will open, as shown in Figure 33.

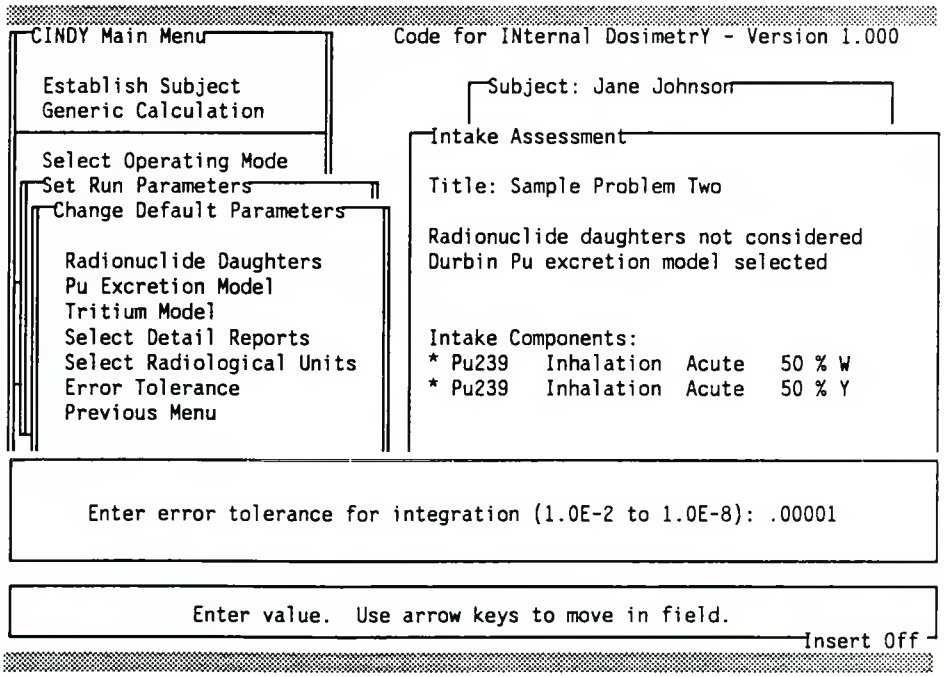


FIGURE 33. CINDY Tutorial Screen 29

Setting the error tolerance

This parameter is used by the LSODES differential equation solver to determine accuracy of the results. LSODES uses this parameter to determine the error control performed by the solver. The tighter the error control, the longer it takes the solver to arrive at a solution. (Because speed of execution is a critically important component of the CINDY environment, and because the effect of the error tolerance is highly scenario-specific, this parameter has been brought out to the user input level. The alternative would have been to keep the error tolerance extremely tight for all situations and accept slow executions for all scenarios.)

It is up to you to decide whether to set the error tolerance conservatively tight (1.0×10^{-8}) for all scenarios or to check error tolerance on a scenario basis. The error tolerance default value may be set in the site configuration. The default error tolerance value is 1.0×10^{-6} which is believed to give sufficiently precise results for all analyses. However, tests have indicated that a value of 1.0×10^{-4} may be sufficient for the dose assessment modes. You are encouraged to try less restrictive values if execution speeds are long.

The following guidance is provided to you to check error tolerance on a scenario basis. For a given scenario it is relatively easy for you to determine "how good is good enough" when it comes to accuracy of results. The following heuristic is provided:

a) Perform a calculation.

b) Determine result of interest.

c) Lower the error tolerance parameter by an order of magnitude.

d) Recalculate the result and compare the result with previous calculation.

e) If the results agree, the first error tolerance was adequate.

f) If the results differ, repeat steps c and d until the result of interest is in agreement with the previous calculation.

The error tolerance parameter should then be set as small as the adequate value for very similar scenarios. The degree of precision used is at the discretion of the user.

The bioassay projection mode provides a good example of the error tolerance parameter effect on the result of interest. Use your current scenario for this example, changing the bioassay projection endpoint to 50 years. Calculate and print the report from this base case.

Then, raise the error tolerance twice from the base case, by an order of magnitude each time, and then lower the error tolerance twice (from the initial setting) as described above, printing the report each time. Now

Viewing the timing report

compare the effect of the error tolerance against whether you are interested in results after days, weeks, months, a few years, or 50 years.

To quantify the effect of error tolerance on speed of execution, select **Timing Report** on the **View Run Results** menu. The timing report is a log of each calculation for the current CINDY session. The file is not saved when CINDY is exited. To determine the execution time for each calculation, subtract the time on the line labelled **Setup** from the time on the line labelled **Done.** Additional information is provided about each calculation including the error tolerance used and the amount of work done by the solver. An example timing report is displayed in Figure 34.

11) You have now successfully completed Tutorial Three. Exit CINDY.

```
CINDY Main Menu          Code for INternal Dosimetry - Version 1.000
\cindy\timing.out
 ------------------------------------------------------------------------
 Error tolerances (relative and absolute):    1.0E-04   1.0E-04

    Setup      08/31/90    10:19:56.2
    AM241      08/31/90    10:20:00.2
    Done int   08/31/90    10:20:17.7

 Number of steps taken by the LSODES solver:          109
 Number of F (DIFEQ2) evaulations:                    143
 Number of Jacobian evaluations:                        2
 Length of RWORK actually required:                  1414
 Length of IWORK actually required:                    30
 Number of non-zero elements in Jacobian matrix:      102

    Post       08/31/90    10:20:19.8
    Done       08/31/90    10:20:25.0

 Bioassay Projection

 Acute   wound      exposure to AM241                        1.0E+03 pCi

              Arrow keys to scroll, Esc to return to menu.
```

FIGURE 34. CINDY Tutorial Screen 30

Tutorial Four

The final tutorial addresses the topic of the site configuration database. The use of site configurations is discussed and a walk-through of generating a customized site configuration is provided.

Site configurations allow you to establish parameter and option defaults and the list of available radionuclides that may then be accessed on entry to CINDY. There is no limit on the number of site configurations that may be defined in the CINDY environment. If you are unsure of what a site configuration is, it may be useful to review the discussion on site configurations in the **CINDY Environment** section at this time.

Site configurations are referred to by their eight-character file name prefix. The standard file name extension for site configuration files is **.fig.** The

default site configuration file name is **cindy.fig**. The default site configuration is referred to as the **cindy** site configuration.

You may either:

- Edit an existing site configuration (i.e., replace the existing file by overwriting the existing file with the new file under the existing file name)
- Establish a new configuration (i.e., write a new file).

If you add radionuclides to the list of available radionuclides, CINDY will only allow you to save the site configuration under a new file name.

It is assumed that you have completed the previous tutorials and are familiar with CINDY's menu selection and parameter input techniques. In this tutorial, you will establish a new site configuration.

Modifying a site configuration

1) Execute CINDY and select **Environment Management** on the main menu.

2) Select **Modify Site Configuration**. A menu will open as shown in Figure 35. You will move through each item on this menu in the process of creating the new site configuration. To have access to all parameters that may be specified in a site configuration from this menu.

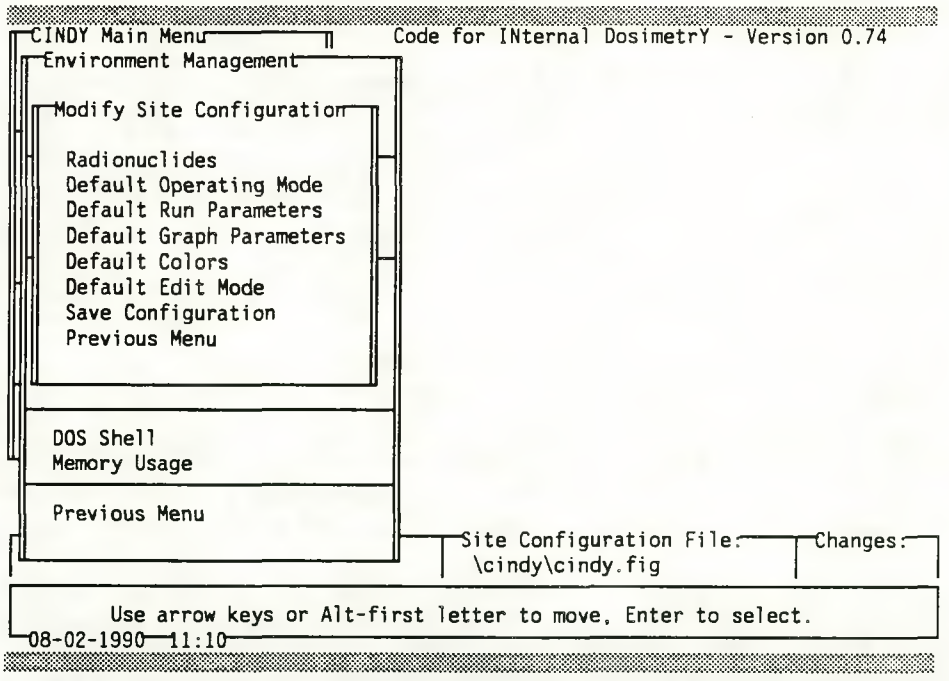


FIGURE 35. CINDY Tutorial Screen 31

3) Select **Radionuclides**. A menu will open as shown in Figure 36.

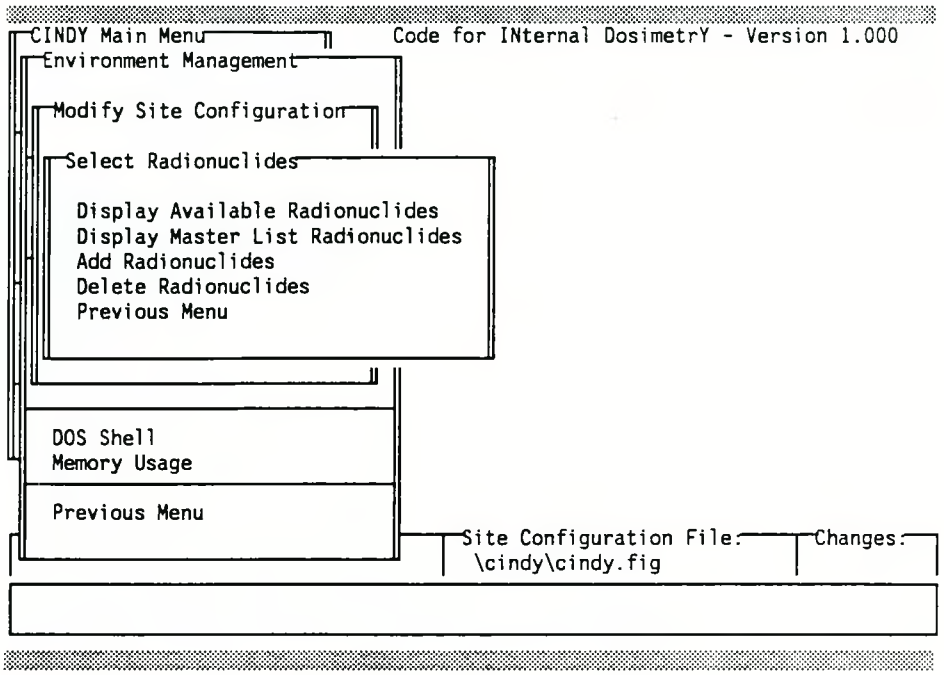


FIGURE 36. CINDY Tutorial Screen 32

The first two items on this menu allow you to display both the currently available list and the master list of radionuclides that can be included in a site configuration without making any changes to the available list.

Changing the list of available radionuclides

Select **Display Available Radionuclides.** A window will open as shown in Figure 37. Press **Esc** to return to the menu and select **Display Master Radionuclide List.** Another window will open containing the master radionuclide list for CINDY. Note that the cursor keys allow movement and scrolling within the window. Press **Esc** to return to the main menu.

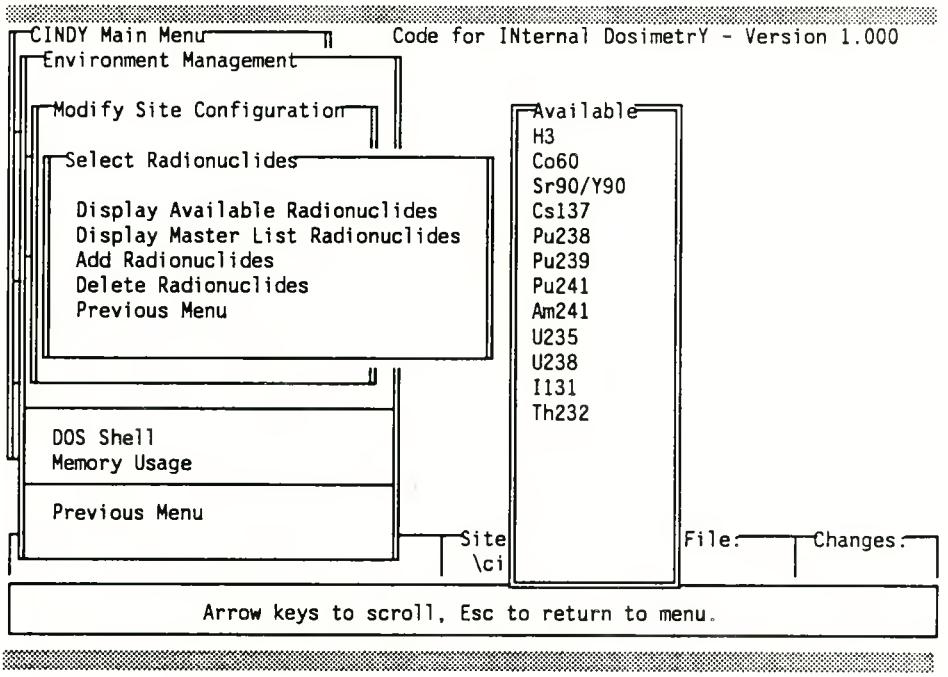


FIGURE 37. CINDY Tutorial Screen 33

4) Select **Add Radionuclides.** A menu will open that contains all radionuclides in the master list. Note that currently available radionuclides are displayed in bold face, and that the menu bar is displayed in reverse bold face when the menu bar overlies a selected item.

   Move the cursor to a radionuclide that you wish to add to the site configuration and press **Enter.** The radionuclide should now be bolded, indicating that it is to be included in the list. *You may select as many radionuclides as you wish while in this menu. However, the more radionuclides selected, the larger the size of the CINDY program and consequently the smaller the amount of memory available for executing the calculation programs.* Press **Esc** to return to the **Select Radionuclides** menu. Select **Display Available Radionuclides** to verify that the additional radionuclides were added to the list.

5) Select **Delete Radionuclides.** A menu will open, shown in Figure 38, containing the currently available radionuclides.

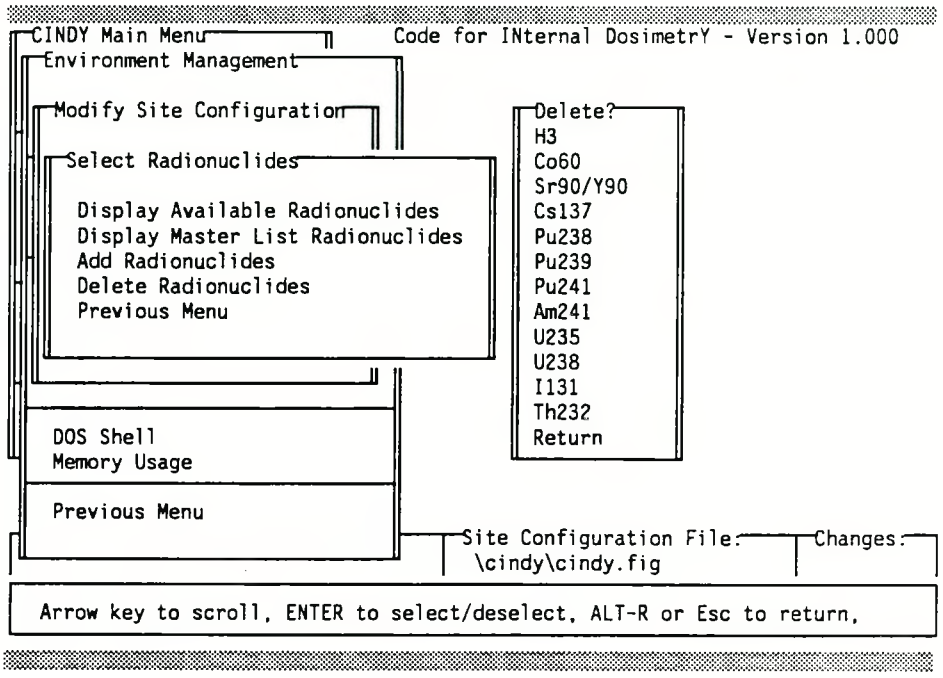


FIGURE 38. CINDY Tutorial Screen 34

Move the highlight bar to overlay any radionuclides that you wish to delete from the list and the press **Enter**. The radionuclide will be immediately removed from the list. Move cursor to the **Return** item and press **Enter** to return to the **Select Radionuclides** menu.

Radionuclide libraries are ordered as shown on the available list. You may wish to move frequently used radionuclides to the top of the list. This can be accomplished by deleting radionuclides from the top of the list and then adding those radionuclides to the list.

6) Press **Esc** or **Previous Menu** to return to the calling menu. If radionuclides were added to the available list, the **Select Units** menu will be displayed and active at this time. This is to ensure that you do not forget to set the default working radiological units for the added radionuclides.

Setting the default operating mode

7) Select **Default Operating Mode** on the **Modify Site Configuration** menu. A menu will open, displaying the operating modes. The highlight bar will overlay the currently selected operating mode. Select the operating mode to be active on entry into CINDY.

Setting default run parameters

8) Select **Default Run Parameters**. A window will open as shown in Figure 39. You may set default values for all run parameters for all the operating modes from this menu. It is suggested that you step through each item on this menu sequentially to review and or modify parameter values.

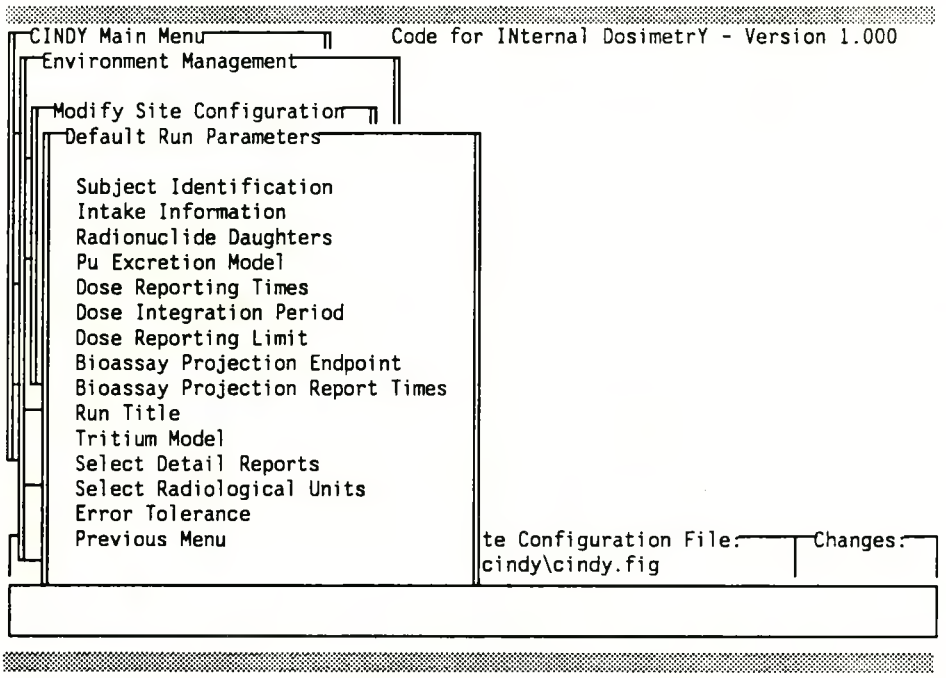


FIGURE 39. CINDY Tutorial Screen 35

9) Select **Subject Identification.** A window will open allowing you to preset subject data as shown in Figure 40.

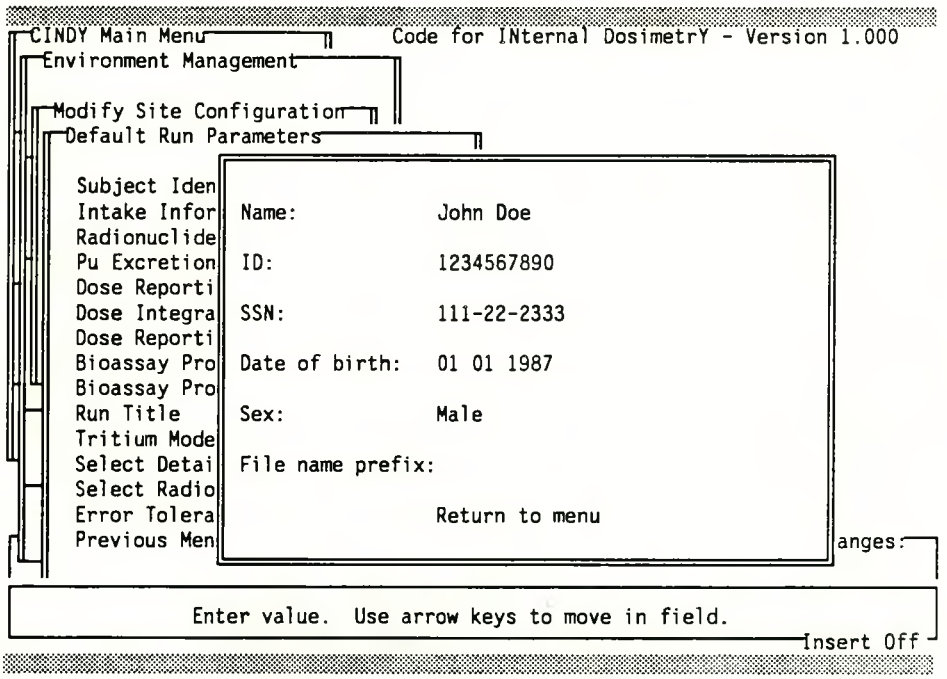


FIGURE 40. CINDY Tutorial Screen 36

Most of the information in this window is highly subject-specific. Consequently, it is not particularly useful to preset the fields. However, it does allow you to blank the name, identification (ID), and file name prefix fields. Note that the social security number (SSN), date of birth, and sex fields may not be blanked. The SSN and date may be preset with digits to indicate not set (e.g., all 9's in the SSN field). Note that a valid date must be entered in the date field. Sex must be preset to either male or female. Return to the calling menu.

10) Select **Intake Information**. The intake information window will open, as shown in Figure 41, allowing you to preset each field.

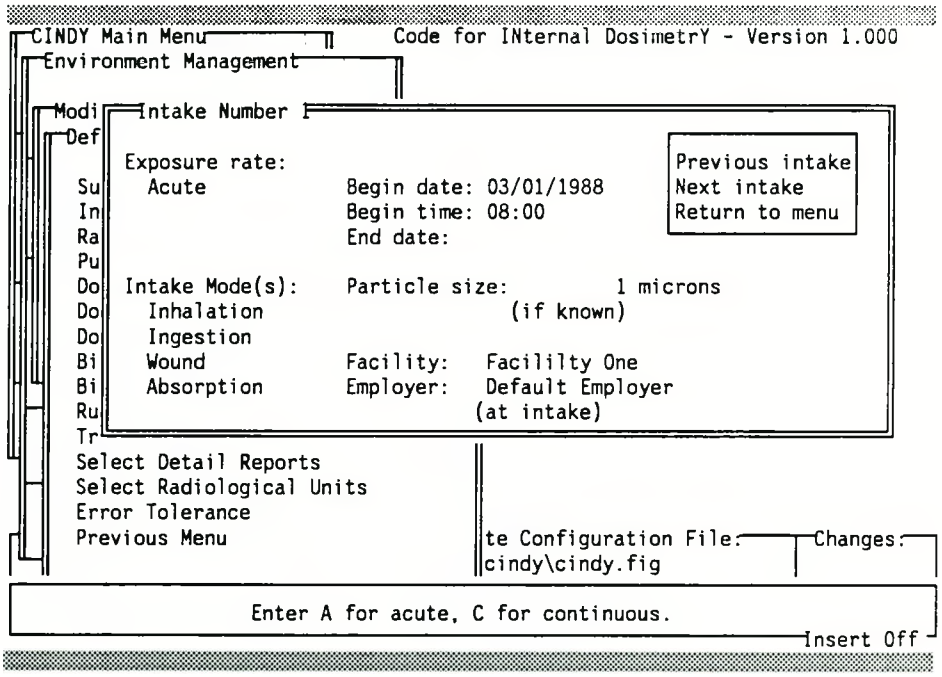


FIGURE 41. CINDY Tutorial Screen 37

Setting default intake information

The exposure rate must be preset to either acute or chronic. You may preset any, all, or none of the intake modes. A valid date must be specified. To preset the exposure end date, the exposure rate must be set to **Continuous**. The particle size, facility, and employer fields may be preset or blanked. When calculations are performed, a zero particle size will default to 1.0 micron. Return to the menu.

Setting default radionuclide daughter handling

11) Select **Radionuclide Daughters**. A window will open asking, "**Consider radionuclide daughters for intake/projections (Y/N)?**" Radionuclide daughters are always considered for dose calculations. You have the option of whether or not to consider daughters during intake assessments and bioassay projections. Considering daughters during intake assessments and bioassay projections will require more execution time for radionuclides with explicit daughters. Return to the menu.

Setting default report options

12) Select each remaining item on the menu and modify values as desired. The **Select Detail Reports** menu is shown in Figure 42.

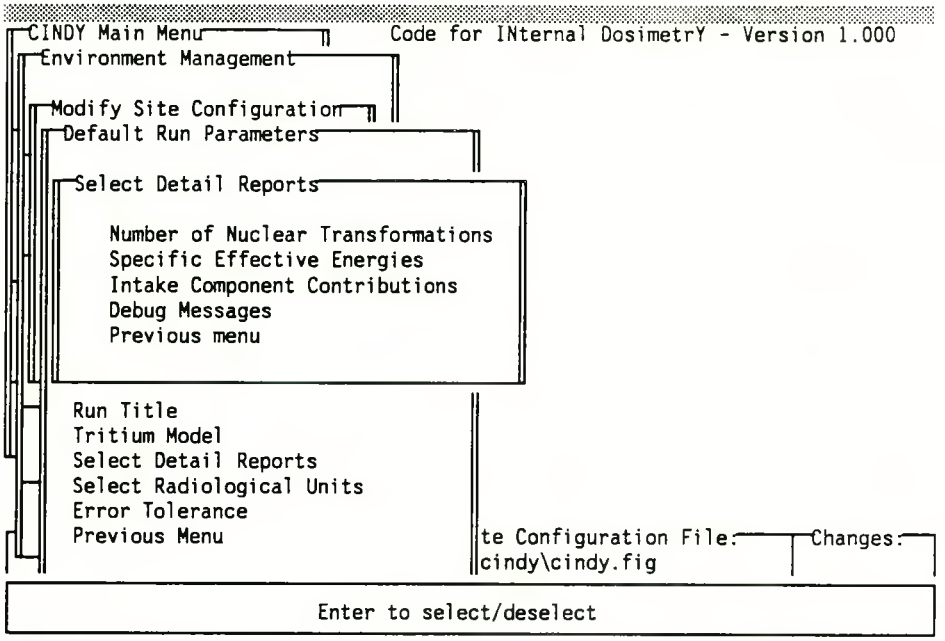


FIGURE 42. CINDY Tutorial Screen

If you regularly wish to see any of the detail reports, preselect the reports on this menu. The **Intake Component Contribution** report is displayed only for runs containing more than one intake component.

Uranium unit selection

13) Select **Previous Menu**. If there are any uranium radionuclides in your available list of radionuclides, select one of them at this time. The screen will appear similar to the screen displayed in Figure 43. Note that for uranium radionuclides, you also have the option of working in mass units.

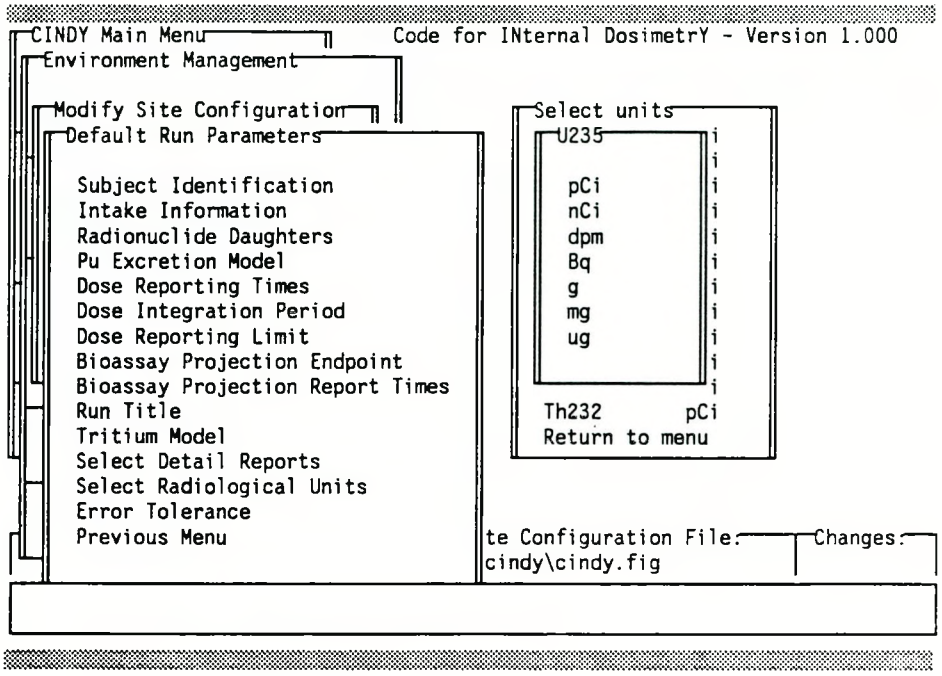


FIGURE 43. CINDY Tutorial Screen 39

Set working units for any added radionuclides at this time. Select **Previous Menu.**

Select **Default Graph Parameters**. Move through each menu item, selecting default conditions. Select **Previous Menu.**

14) Select **Default Colors** and then set colors as desired.

15) Select **Default Edit Mode** and select desired mode.

16) Select **Save Configuration.**

If radiological units were not set for all radionuclides in the available list, a message is now displayed to that effect and the appropriate menu is opened and active.

Saving a customized site configuration

A message will announce that the site configuration must be saved under a new name (because radionuclides were added to the list). A window will open requesting the file name prefix. Enter a unique file name. The file name will be tested for validity before the program continues.

The program now asks if you wish to regenerate all libraries. Usually, you may answer **no** to this question. When you do not regenerate all libraries, data in the current site configuration libraries are used whenever possible. Consequently, the site configuration files are rebuilt much more quickly than when all parameter values must be located in the master libraries. However, it is important that you answer yes to this question after installing any future updates to the CINDY software package so that your site configuration files reflect any changes made to

the radionuclide organization and decay, the metabolic data, and the specific effective energy data.

A window opens to inform you that the site radionuclide file is being written. Then the message **"To complete new site configuration, return to main menu"** will appear. Press any key to continue. Select **Previous Menu**. Another window will open informing you to allow 2-3 minutes for each radionuclide added to the available radionuclide list.

When complete, the window will close. Check the site configuration file box on the backdrop. The new site configuration file name should appear.

Selecting an alternate site configuration from within CINDY

17) Select **Environment Management** and then **Use Alternate Configuration**. A menu opens listing the available configurations. There should be two entries on this menu: **cindy.fig** and the configuration just established. This menu is one of three ways to select a site configuration. Another way is to execute CINDY by typing:

CINDY nnn

where **nnn** is a valid site configuration name. The third method is to edit the **CINDY.BAT** file in the working subdirectory to contain the CINDY execution command shown above.

A subject may be evaluated under a site configuration other than the site configuration under which it was created as long as the site configuration's list of available radionuclides contains all the radionuclides of concern for the subject. When a subject file is retrieved, CINDY checks all radionuclides of concern against the list of available radionuclides. CINDY stores the name of the site configuration file under which the subject was created. Then, if the current site configuration is not appropriate, a message is displayed to use that alternate site configuration and then retrieve the subject file.

18) You have now completed the final tutorial.

SAMPLE PROBLEMS

Five sample problems are included with the CINDY Software Package to illustrate features and capabilities of the code and to provide a basis for installation check-out on the host computer. A full set of the input and report files for the sample problems are included with the CINDY distribution package. File names for the sample problems follow the convention of a file name prefix of **SAMPLE?** where **?** is the number of the sample problem. Typical reports are presented in this section. Table 5 provides a summary of the options and features used in the sample problems. All subject names and data used in the sample problems are fictitious and are not based on actual measurements.

TABLE 5. Sample Problem Options and Features

Sample Problem Number	Operational Mode	Exposure Type	Intake Mode	Options and Features
1	Intake Assessment Dose Assessment: Calendar-year	Acute	Inhalation	Co-60, male, evaluation of whole body bioassay data, user-entered measurement uncertainty factors, calendar-year dose cut-off
2	Intake Assessment Bioassay Projection	Acute	Inhalation	Pu-239, female, evaluation of excreta bioassay data, user-entered measurement uncertainty factors, multiple components, 10-yr integration period, Jones excretion model
3	Dose Assessment: Specified Period	Contin-uous	Ingestion	U-235, female, setting report times, unit intake
4	Intake Assessment, Bioassay Projection Dose Assessment: Specified Period	Acute	Inhalation	H-3, male, tritium model, evaluation of tritium urine excretion, evaluation of single data point, 1-yr dose
5	Intake Assessment Bioassay Projection	Acute	Wound	Am-241, female, evaluation of whole body and excreta bioassay data, direct intake model, evaluation of single data point for each of three bioassay data types

Sample Problem One

Sample Problem One involves an acute inhalation exposure to Co-60. Whole body count data is available for the hypothetical male subject for a period of about 3 months following the exposure. The purpose of the analysis is to estimate the amount of Co-60 inhaled and to use this estimate to provide a calendar year dose assessment.

Sample Problem One may be retrieved into CINDY by selecting the subject file named **SAMPLE1.CIN**. Exhibit 1 shows the subject report for Sample Problem One that is displayed or printed when the user selects a subject report option on the **Establish Subject** menu. The subject report file is stored in the file named SAMPLE1.RST. Note that the bioassay data measurements and measurement uncertainty factor have been normalized to the selected working units for Co-60 (pCi).

To perform the intake assessment of Sample Problem One, select the Intake Assessment operating mode and the select **Calculate** on the CINDY main menu. Compare the results of the calculation (using the **Graphic Report to Printer** and **Text Report to Printer** options on the **View Run Results** menu) to the reports displayed in Exhibits 2-3. Exhibit 2 depicts the printed graphic intake assessment report, constructed from data stored in the file named **SAMPLE1.RIG**. Exhibit 3 contains the complete text intake assessment report.

Results of the intake assessment indicate that the total activity inhaled was 1×10^6 pCi. The intake estimates for the four methods all give approximately the same value. Additional tables are printed in the intake assessment report to document the analysis and provide a permanent record of the models and parameter values used to generate the results. The final table printed in the report gives the metabolic transfer and retention data for cobalt. Note that the values given for **Compartmental Fraction** for the **Transfer** compartment (0.5) is the fraction of the material entering the transfer compartment that is excreted directly.

To perform the dose assessment, change the operating mode to **Dose Assessment - Calendar Year**. Then, under **Set Run Parameters** and **Intake Estimates**, enter the calculated intake estimate from the intake assessment calculation (1×10^6 pCi). (A value should already be available). Select **Calculate**. Compare the results of the calculation to the text report shown in Exhibit 1 and stored in the file named **SAMPLE1.RDC**. Note that a reporting limit cut-off (10 mrem) is in effect for this report. The report gives results for years in which the dose is above the dose limit (10 mrem) plus the first year the dose is below the limit. To perform the calculation for all years, the dose limit cut-off option must be de-selected.

EXHIBIT 1. Sample Problem One Subject Report

```
                    CINDY - Code for INternal DosimetrY
                        (Version 1.000  16-Sep-90)
                      Report Date: 09-19-1990 at 12:49

Run Title:              Sample Problem One
Subject:                Dick Smith                          Sex: Male
ID No.:                 Company 1 -000001                   SSN: 222-22-2222
Intake occurred:        03/01/1988 at 08:00
Operating Mode:         Intake Assessment
------------------------------------------------------------------------------

Birth Date:             05/22/1924
Intake occurred at:     Facililty One
Employer at intake:     Default Employer

File:                   \cindysam\sample1
                        Radionuclide daughters not considered

Intake Components:
                        * 03/01/1988 Co60    Inhalation  Acute   100 % W
Bioassay Data Title:    Sample Problem 1 Bioassay Data


                          Bioassay Data Currently Considered
             Time
             Post  ---------------Bioassay Units----------------   Working Units
Measurement Intake    Measured    Sample  Sample     Normalized      Normalized
   Date      (d)      Value       Size    Period       Value          Value
---------- ------- -------------- ------- ------- --------------  --------------

Co60/Whole
----------
03/01/1988     0.2 6.0D+02 nCi                                     6.0E+05 pCi
03/01/1988     0.3 5.7D+02 nCi                                     5.7E+05 pCi
03/02/1988     1.0 3.4D+02 nCi                                     3.4E+05 pCi
03/03/1988     2.2 2.9D+02 nCi                                     2.9E+05 pCi
03/09/1988     7.7 2.1D+02 nCi                                     2.1E+05 pCi
03/21/1988    20   1.8D+02 nCi                                     1.8E+05 pCi
06/04/1988    95   8.0D+01 nCi                                     8.0E+04 pCi


             Time
             Post    Measurement    Working Units
Measurement Intake   Uncertainty     Normalized
   Date      (d)       Factor          Value
---------- ------- ---------------  -------------

Co60/Whole
----------
03/01/1988     0.2  3.3E-01 nCi     3.3E+02 pCi
03/01/1988     0.3  3.5E-02 nCi     3.5E+01 pCi
03/02/1988     1.0  5.9E-02 nCi     5.9E+01 pCi
03/03/1988     2.2  6.9E-02 nCi     6.9E+01 pCi
03/09/1988     7.7  9.5E-02 nCi     9.5E+01 pCi
03/21/1988    20    1.1E-01 nCi     1.1E+02 pCi
06/04/1988    95    2.5E-01 nCi     2.5E+02 pCi
------------------------------------------------------------------------------
```

EXHIBIT 2. Sample Problem One Graphic Intake Assessment Report

```
                    CINDY - Code for INternal DosimetrY
                        (Version 1.000  16-Sep-90)
                      Report Date: 09-19-1990 at 13:02

Run Title:            Sample Problem One
Subject:              Dick Smith                          Sex: Male
ID No.:               Company 1 -000001                   SSN: 222-22-2222
Intake occurred:      03/01/1988 at 08:00
Operating Mode:       Intake Assessment
```

```
Birth Date:           05/22/1924
Intake occurred at:   Facililty One
Employer at intake:   Default Employer

File:                 \cindysam\sample1
                      Radionuclide daughters not considered
Error tolerance:      .000001
```

```
Intake Component(s):
 Acute   Inhalation exposure to CO60   (Class: W /F1: 0.05000)  1.0E+02
```

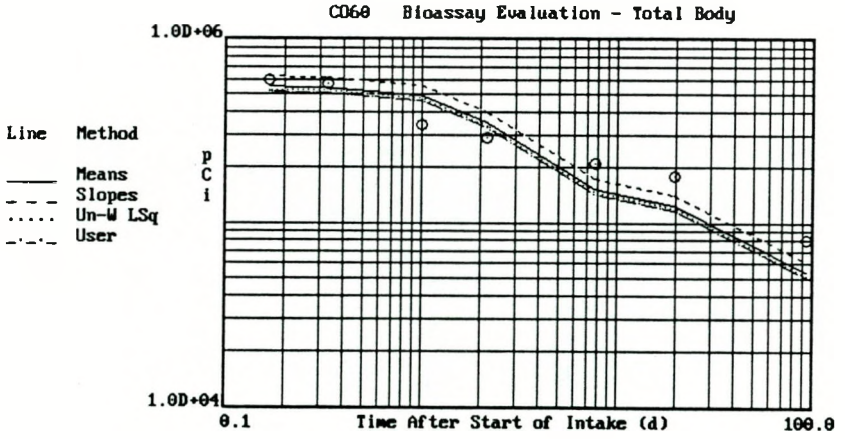


EXHIBIT 3. Sample Problem One Text Intake Assessment Report

```
------------------------------------------------------------------------------
                    CINDY - Code for INternal DosimetrY
                         (Version 1.000 16-Sep-90)
                       Report Date: 09/20/90 at 07:36

Run title:         Sample Problem One
Subject:           Dick Smith                                Sex:  Male
ID No.:            Company 1 -000001                         SSN:  222-22-2222
Intake Occurred:    3/01/1988 at 08:00
Operating Mode:    Intake Assessment
------------------------------------------------------------------------------

                            Estimated Intake of C060

  Acute   inhalation exposure to C060   (Class: W /F1: 0.05000)  1.0E+02%

                C060   Bioassay Evaluation Results Summary

                              ---Intake Estimate (pCi) by Method---
                                                  Un-
                              Ratio     Average   Weighted  User-
                              Of the    Of the    Least     Defined
        Bioassay Type         Means     Slopes    Squares   Weights
        ----------------      -------   -------   -------   -------

        Total Body            8.8E+05   1.0E+06   8.5E+05   8.3E+05
        ----------------      -------   -------   -------   -------


    Error tolerance: 1.0E-06
```

EXHIBIT 3. (Contd.)

CINDY - Code for INternal DosimetrY
(Version 1.000 16-Sep-90)
Report Date: 09/20/90 at 07:36

Run title: Sample Problem One
Subject: Dick Smith Sex: Male
ID No.: Company 1 -000001 SSN: 222-22-2222
Intake Occurred: 3/01/1988 at 08:00
Operating Mode: Intake Assessment

Estimated Intake of C060

Acute inhalation exposure to C060 (Class: W /F1: 0.05000) 1.0E+02%

Measurement Date	Time Post Intake (d)	Observed Quantity	Estimated Quantity by Method: Ratio Of the Means	Average Of the Slopes	Un-Weighted Least Squares	User-Defined Weights
Total Body		(pCi)	(pCi)	(pCi)	(pCi)	(pCi)
03/01/1988	0.2	6.0E+05	5.5E+05	6.3E+05	5.3E+05	5.2E+05
03/02/1988	0.3	5.7E+05	5.4E+05	6.2E+05	5.2E+05	5.1E+05
03/02/1988	1.0	3.4E+05	4.9E+05	5.6E+05	4.7E+05	4.6E+05
03/03/1988	2.2	2.9E+05	3.5E+05	4.0E+05	3.4E+05	3.3E+05
03/09/1988	7.7	2.1E+05	1.5E+05	1.7E+05	1.5E+05	1.4E+05
03/21/1988	19.7	1.8E+05	1.2E+05	1.4E+05	1.2E+05	1.2E+05
06/04/1988	94.7	8.0E+04	5.4E+04	6.1E+04	5.2E+04	5.1E+04

Measurement Date	Time Post Intake (d)	Measurement/Expected Ratios: Ratio Of the Means	Average Of the Slopes	Un-Weighted Least Squares	User-Defined Weights
Total Body					
03/01/1988	0.2	1.09	0.96	1.13	1.16
03/02/1988	0.3	1.05	0.92	1.09	1.12
03/02/1988	1.0	0.69	0.61	0.72	0.73
03/03/1988	2.2	0.83	0.73	0.86	0.88
03/09/1988	7.7	1.37	1.20	1.42	1.46
03/21/1988	19.7	1.45	1.28	1.51	1.54
06/04/1988	94.7	1.49	1.31	1.54	1.58

EXHIBIT 3. (Contd.)

```
                    CINDY - Code for INternal DosimetrY
                         (Version 1.000 16-Sep-90)
                       Report Date: 09/20/90 at 07:36

Run title:          Sample Problem One
Subject:            Dick Smith                                  Sex:  Male
ID No.:             Company 1 -000001                           SSN:  222-22-2222
Intake Occurred:     3/01/1988 at 08:00
Operating Mode:     Intake Assessment
```

---------- Lung Model ----------

Particle size: 1.00
Lung deposition fractions -
Nasal-pharynx region: 0.30
Tracheo-bronchial region: 0.08
Pulmonary region: 0.25

Name	Compartment	Class D: Compartmental Fraction	Class D: Removal Half-time (d)	Class W: Compartmental Fraction	Class W: Removal Half-time (d)	Class Y: Compartmental Fraction	Class Y: Removal Half-time (d)
Lung	a	0.500	0.01	0.100	0.01	0.010	0.01
Lung	b	0.500	0.01	0.900	0.40	0.990	0.40
Lung	c	0.950	0.01	0.500	0.01	0.010	0.01
Lung	d	0.050	0.20	0.500	0.20	0.990	0.20
Lung	e	0.800	0.50	0.150	50.00	0.050	500.00
Lung	f	0.000	0.00	0.400	1.00	0.400	1.00
Lung	g	0.000	0.00	0.400	50.00	0.400	500.00
Lung	h1	0.200	0.50	0.050	50.00	0.135	500.00
Lung	h2	0.000	0.50	0.000	50.00	0.015	500.00
Lung	i	1.000	0.50	1.000	50.00	0.900	1000.00

---------- Gastrointestinal Tract Model ----------

Compartment	Mean Residence Time (d)
Stomach	1.0
Small Intestine	4.0
UL Intestine	13.0
LL Intestine	24.0

EXHIBIT 3. (Contd.)

CINDY - Code for INternal DosimetrY
(Version 1.000 16-Sep-90)
Report Date: 09/20/90 at 07:36

Run title: Sample Problem One
Subject: Dick Smith Sex: Male
ID No.: Company 1 -000001 SSN: 222-22-2222
Intake Occurred: 3/01/1988 at 08:00
Operating Mode: Intake Assessment

----------Intake Component 1----------

Acute inhalation exposure to CO60 (Class: W /F1: 0.05000) 1.0E+02%

ICRP Systemic Model

Name	Compartment	Compartmental Fraction	Removal Half-time (d)	Urine Fraction	Feces Fraction
Transfer		0.50000	0.50	0.70000	0.30000
Liver	1	0.03000	6.00E+00	0.70000	0.30000
Liver	2	0.01000	6.00E+01	0.70000	0.30000
Liver	3	0.01000	8.00E+02	0.70000	0.30000
Other	1	0.27000	6.00E+00	0.70000	0.30000
Other	2	0.09000	6.00E+01	0.70000	0.30000
Other	3	0.09000	8.00E+02	0.70000	0.30000

Input prepared by: _____ Date: _____

Input checked by: _____ Date: _____

EXHIBIT 4. Sample Problem One Calendar-Year Dose Assessment Report

```
------------------------------------------------------------------------------
                    CINDY - Code for INternal DosimetrY
                         (Version 1.000 16-Sep-90)
                       Report Date: 09/20/90 at 07:40

Run title:        Sample Problem One
Subject:          Dick Smith                                Sex:  Male
ID No.:           Company 1 -000001                         SSN:  222-22-2222
Intake Occurred:   3/01/1988 at 08:00
Operating Mode:   Calendar-year Dose
------------------------------------------------------------------------------

  Acute   inhalation exposure to C060   (Class: W /F1: 0.05000) 8.8E+05 pCi

                                          Effective
                                  Dose       Dose
                          Calendar Through Equivalent
                            Year    Year     (rem)
                          -------- ------- ----------
                             1      1988     2.1E-02
                             2      1989     2.4E-03
                          -------- ------- ----------

                  Dose of  2.38E+00 mrem in calendar year  2
                  is less than reporting limit of   10 mrem.

------------------------------------------------------------------------------
                    CINDY - Code for INternal DosimetrY
                         (Version 1.000 16-Sep-90)
                       Report Date: 09/20/90 at 07:40

Run title:        Sample Problem One
Subject:          Dick Smith                                Sex:  Male
ID No.:           Company 1 -000001                         SSN:  222-22-2222
Intake Occurred:   3/01/1988 at 08:00
Operating Mode:   Calendar-year Dose
------------------------------------------------------------------------------

  Acute   inhalation exposure to C060   (Class: W /F1: 0.05000) 8.8E+05 pCi

       Calendar Year Dose Equivalent in Target Organs or Tissue (rem)

  Year     Lung     Stomach  S Int.   UL Int.  LL Int.  Bone Sur R Marrow

    1    1.1E-01  1.2E-02  9.3E-03  1.3E-02  2.1E-02  6.9E-03  8.7E-03
    2    3.6E-03  2.0E-03  2.4E-03  2.3E-03  2.3E-03  1.8E-03  2.0E-03

  Year     Testes   Ovaries  Muscle   Thyroid  Liver    Other

    1    3.6E-03  7.7E-03  8.4E-03  7.4E-03  1.7E-02  1.0E-02
    2    2.0E-03  2.0E-03  1.9E-03  1.8E-03  4.8E-03  2.0E-03
```

Sample Problem Two

Sample Problem Two involves an acute inhalation exposure to Pu-239 by a female subject. The material inhaled is assumed to be 50% Class W and 50% Class Y. Urine and feces measurement data are available and are to be used to estimate the inhalation intake. The intake estimate is then used in a bioassay projection analysis.

Sample Problem Two may be retrieved into CINDY by selecting the subject file named **SAMPLE2.CIN**. Exhibit 5 shows the subject report for Sample Problem Two that is displayed or printed when the user selects a subject report option on the **Establish Subject** menu. The subject report file is stored in the file named SAMPLE2.RST.

To perform the intake assessment for Sample Problem Two, be sure **Intake Assessment** has been selected and that both intake components are selected for the analysis (under **Set Run Parameters, Select Components to Run**). Then, select **Calculate** on the CINDY main menu. Compare the results of the calculation (using the **Graphic Report to Printer** and **Text Report to Printer** options on the **View Run Results** menu) to the reports displayed in Exhibits 6-8. Exhibits 6 and 7 depict the printed graphic intake assessment report for urine and feces, respectively. The graphic reports are constructed from data stored in the file named **SAMPLE2.RIG**. Exhibit 8 contains part of the text intake assessment report for Sample Problem Two. The complete report is stored in the file named **SAMPLE2.RIT**.

To perform the bioassay projection analysis, enter the estimated intake (set to 4.2×10^4 pCi in the Sample Problem Two file), change the operating mode to **Bioassay Projection**, and calculate. Compare the results of the calculation to the graphic reports shown in Exhibits 9 and 10 of urine and feces, respectively, and to the partial text report shown in Exhibit 11. The graphic reports are constructed from data stored in the file named **SAMPLE2.RPG**. The text report is stored in the file named **SAMPLE2.RPT**.

EXHIBIT 5. Sample Problem Two Subject Report

```
------------------------------------------------------------------------------
                    CINDY - Code for INternal DosimetrY
                        (Version 1.000  16-Sep-90)
                      Report Date: 09-19-1990 at 15:95

Run Title:              Sample Problem Two
Subject:                Jane Johnson                        Sex: Female
ID No.:                 Company 1 - 000002                  SSN: 434-34-3434
Intake occurred:        01/01/1980 at 08:00
Operating Mode:         Intake Assessment
------------------------------------------------------------------------------

Birth Date:             12/04/1952
Intake occurred at:     Facililty One
Employer at intake:     Default Employer

File:                   \cindysam\sample2
                        Radionuclide daughters not considered
                        Jones Pu excretion model selected

Intake Components:
                        * 01/01/1980 Pu239   Inhalation  Acute   50 % W
                        * 01/01/1980 Pu239   Inhalation  Acute   50 % Y

Bioassay Data Title:    Sample bioassay data file for John Doe (SSN: 111-22-3333)
                        09-11-89 RAP


                        Bioassay Data Currently Considered
             Time
             Post  ---------------Bioassay Units----------------   Working Units
Measurement Intake     Measured    Sample  Sample     Normalized      Normalized
   Date      (d)       Value       Size    Period       Value          Value
---------- ------- -------------- ------- ------- --------------  --------------

Pu239/Urine
----------
01/01/1980     0.4 2.3D+01 pCi/s             8 hr  7.0E+01 pCi/d   7.0E+01 pCi/d
01/02/1980     1.0 8.0D+01 pCi/s            12 hr  1.6E+02 pCi/d   1.6E+02 pCi/d
01/03/1980     1.7 2.0D+01 pCi/s             7 hr  7.4E+01 pCi/d   7.4E+01 pCi/d
01/13/1980      12   1.0D+01 pCi/s            24 hr  1.0E+01 pCi/d   1.0E+01 pCi/d
02/13/1980      43   7.0D+00 pCi/s          (24 hr) 7.0E+00 pCi/d   7.0E+00 pCi/d
08/13/1980     225   5.0D+00 pCi/s          (24 hr) 5.0E+00 pCi/d   5.0E+00 pCi/d
08/13/1981     590   4.0D+00 pCi/s          (24 hr) 4.0E+00 pCi/d   4.0E+00 pCi/d

Pu239/Feces
----------
08/13/1980     225   6.0D+00 pCi/s          (24 hr) 6.0E+00 pCi/d   6.0E+00 pCi/d
09/15/1981     623   2.5D-02 pCi/g   120 g   24 hr  3.0E+00 pCi/d   3.0E+00 pCi/d
09/15/1982     988   1.5D-02 pCi/g   100 g          1.6E+00*pCi/d   1.6E+00 pCi/d
09/15/1983    1353   1.0D-02 pCi/g          (24 hr) 1.1E+00*pCi/d   1.1E+00 pCi/d
```

EXHIBIT 5. (Contd.)

Measurement Date	Time Post Intake (d)	Measurement Uncertainty Factor	Working Units Normalized Value
Pu239/Urine			
01/01/1980	0.4	1.1E+00 pCi/d	1.1E+00 pCi/d
01/02/1980	1.0	2.1E+01 pCi/d	2.1E+01 pCi/d
01/03/1980	1.7	1.8E+01 pCi/d	1.8E+01 pCi/d
01/13/1980	12	2.6E+00 pCi/d	2.6E+00 pCi/d
02/13/1980	43	0.0E+00 pCi/d	0.0E+00 pCi/d
08/13/1980	225	0.0E+00 pCi/d	0.0E+00 pCi/d
08/13/1981	590	0.0E+00 pCi/d	0.0E+00 pCi/d
Pu239/Feces			
08/13/1980	225	6.0E-01 pCi/d	6.0E-01 pCi/d
09/15/1981	623	0.0E+00 pCi/d	0.0E+00 pCi/d
09/15/1982	988	0.0E+00 pCi/d	0.0E+00 pCi/d
09/15/1983	1353	0.0E+00 pCi/d	0.0E+00 pCi/d

Note: Assumed excretion periods shown in parentheses.
* Normalized using reference volume or mass.

EXHIBIT 6. Sample Problem Two Intake Assessment Graphic Report (Urine)

```
                    CINDY - Code for INternal DosimetrY
                        (Version 1.000  16-Sep-90)
                      Report Date: 09-19-1990 at 16:07

Run Title:            Sample Problem Two
Subject:              Jane Johnson                    Sex: Female
ID No.:               Company 1 - 000002              SSN: 434-34-3434
Intake occurred:      01/01/1980 at 08:00
Operating Mode:       Intake Assessment
```

```
Birth Date:           12/04/1952
Intake occurred at:   Facililty One
Employer at intake:   Default Employer

File:                 \cindysam\sample2
                      Radionuclide daughters not considered
                      Jones Pu excretion model selected
Error tolerance:      .000001
```

```
Intake Component(s):
 Acute   inhalation exposure to PU239  (Class: W /F1: 0.00010)  5.0E+01%
 Acute   inhalation exposure to PU239  (Class: Y /F1: 0.00001)  5.0E+01%
```

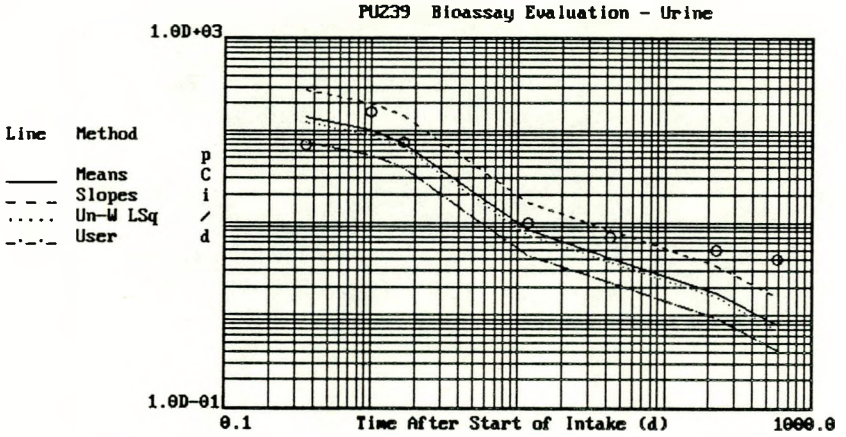


EXHIBIT 7. Sample Problem Two Intake Assessment Graphic Report (Feces)

```
                    CINDY - Code for INternal DosimetrY
                        (Version 1.000  16-Sep-90)
                      Report Date: 09-19-1990 at 16:07

Run Title:            Sample Problem Two
Subject:              Jane Johnson                    Sex: Female
ID No.:               Company 1 - 000002              SSN: 434-34-3434
Intake occurred:      01/01/1980 at 08:00
Operating Mode:       Intake Assessment
```

```
Birth Date:           12/04/1952
Intake occurred at:   Facililty One
Employer at intake:   Default Employer

File:                 \cindysam\sample2
                      Radionuclide daughters not considered
                      Jones Pu excretion model selected
Error tolerance:      .000001
```

Intake Component(s):
Acute inhalation exposure to PU239 (Class: W /F1: 0.00010) 5.0E+01%
Acute inhalation exposure to PU239 (Class: Y /F1: 0.00001) 5.0E+01%

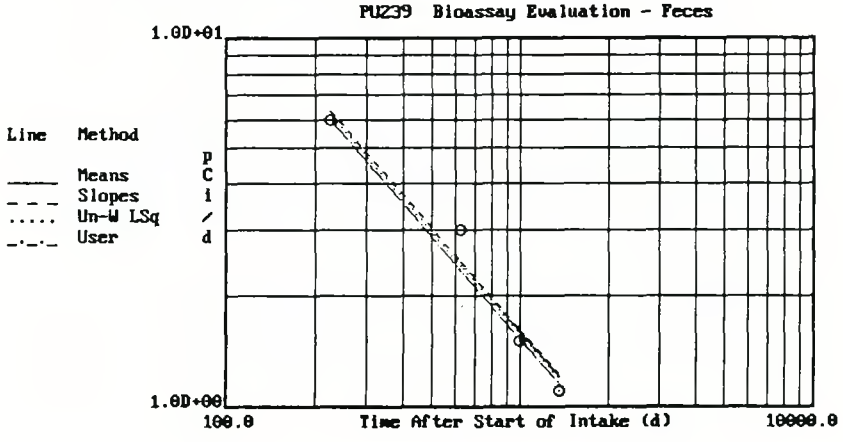


EXHIBIT 8. Sample Problem Two Intake Assessment Text Report

```
------------------------------------------------------------------------------
                    CINDY - Code for INternal DosimetrY
                        (Version 1.000  16-Sep-90)
                      Report Date: 09-19-1990 at 16:06

Run title:         Sample Problem Two
Subject:           Jane Johnson                              Sex:    Female
ID No.:            Company 1 - 000002                        SSN:    434-34-3434
Intake Occurred:    1/01/1980 at 08:00
Operating Mode:    Intake Assessment
------------------------------------------------------------------------------


                          Estimated Intake of PU239

Intake Components:
 1-Acute   inhalation exposure to PU239  (Class: W /F1: 0.00010)  5.0E+01%
 2-Acute   inhalation exposure to PU239  (Class: Y /F1: 0.00001)  5.0E+01%


                PU239  Bioassay Evaluation Results Summary

                          ---Intake Estimate (pCi) by Method---
                                                  Un-
                          Ratio      Average    Weighted  User-
                          Of the     Of the     Least     Defined
Bioassay Type             Means      Slopes     Squares   Weights
----------------          -------    -------    -------   -------

Urine                     3.2E+04    6.3E+04    2.9E+04   1.7E+04
Feces                     4.7E+04    4.7E+04    4.5E+04   4.4E+04
----------------          -------    -------    -------   -------


Weighted Average          4.2E+04    5.1E+04    4.2E+04   1.7E+04

_____________
  Error tolerance: 1.0E-06
  Jones Pu excretion model, ICRP retention model used.
```

EXHIBIT 8. (Contd.)

CINDY - Code for INternal DosimetrY
(Version 1.000 16-Sep-90)
Report Date: 09-19-1990 at 16:06

Run title: Sample Problem Two
Subject: Jane Johnson Sex: Female
ID No.: Company 1 - 000002 SSN: 434-34-3434
Intake Occurred: 1/01/1980 at 08:00
Operating Mode: Intake Assessment

Estimated Intake of PU239

Intake Components:
1-Acute inhalation exposure to PU239 (Class: W /F1: 0.00010) 5.0E+01%
2-Acute inhalation exposure to PU239 (Class: Y /F1: 0.00001) 5.0E+01%

Measurement Date	Time Post Intake (d)	Observed Quantity	Estimated Quantity by Method: Ratio Of the Means	Average Of the Slopes	Un-Weighted Least Squares	User-Defined Weights
Urine		(pCi/d)	(pCi/d)	(pCi/d)	(pCi/d)	(pCi/d)
01/02/1980	0.4	7.0E+01	1.4E+02	2.8E+02	1.3E+02	7.5E+01
01/02/1980	1.0	1.6E+02	1.0E+02	2.0E+02	9.0E+01	5.4E+01
01/03/1980	1.7	7.4E+01	7.3E+01	1.4E+02	6.5E+01	3.9E+01
01/13/1980	11.7	1.0E+01	8.3E+00	1.6E+01	7.4E+00	4.4E+00
02/13/1980	42.7	7.0E+00	4.2E+00	8.3E+00	3.7E+00	2.3E+00
08/13/1980	224.7	5.0E+00	1.7E+00	3.5E+00	1.6E+00	9.4E-01
08/13/1981	589.7	4.0E+00	8.0E-01	1.6E+00	7.1E-01	4.3E-01
Feces		(pCi/d)	(pCi/d)	(pCi/d)	(pCi/d)	(pCi/d)
08/13/1980	224.7	6.0E+00	6.4E+00	6.5E+00	6.2E+00	6.0E+00
09/15/1981	622.7	3.0E+00	2.5E+00	2.5E+00	2.4E+00	2.3E+00
09/15/1982	987.7	1.6E+00	1.6E+00	1.7E+00	1.6E+00	1.5E+00
09/15/1983	1352.7	1.1E+00	1.2E+00	1.2E+00	1.2E+00	1.1E+00

Error tolerance: 1.0E-06
Jones Pu excretion model, ICRP retention model used.

EXHIBIT 8. (Contd.)

CINDY - Code for INternal DosimetrY
(Version 1.000 16-Sep-90)
Report Date: 09-19-1990 at 12:49

Run title:	Sample Problem Two		
Subject:	Jane Johnson	Sex:	Female
ID No.:	Company 1 - 000002	SSN:	434-34-3434
Intake Occurred:	1/01/1980 at 08:00		
Operating Mode:	Intake Assessment		

Estimated Intake of PU239

Intake Components:
1-Acute inhalation exposure to PU239 (Class: W /F1: 0.00010) 5.0E+01%
2-Acute inhalation exposure to PU239 (Class: Y /F1: 0.00001) 5.0E+01%

Measurement Date	Time Post Intake (d)	Measurement/Expected Ratios: Ratio Of the Means	Average Of the Slopes	Un-Weighted Least Squares	User-Defined Weights
Urine					
01/02/1980	0.4	0.50	0.25	0.56	0.93
01/02/1980	1.0	1.58	0.80	1.77	2.94
01/03/1980	1.7	1.01	0.51	1.14	1.89
01/13/1980	11.7	1.21	0.61	1.36	2.26
02/13/1980	42.7	1.67	0.84	1.87	3.11
08/13/1980	224.7	2.86	1.45	3.21	5.33
08/13/1981	589.7	4.99	2.53	5.61	9.31
Feces					
08/13/1980	224.7	0.94	0.92	0.96	1.00
09/15/1981	622.7	1.21	1.19	1.24	1.29
09/15/1982	987.7	1.01	1.00	1.04	1.08
09/15/1983	1352.7	0.90	0.89	0.93	0.96

Error tolerance: 1.0E-06
Jones Pu excretion model, ICRP retention model used.

EXHIBIT 8. (Contd.)

```
CINDY - Code for INternal DosimetrY
(Version 1.000  16-Sep-90)
Report Date: 09-19-1990 at 16:06

Run title:        Sample Problem Two
Subject:          Jane Johnson                          Sex:   Female
ID No.:           Company 1 - 000002                    SSN:   434-34-3434
Intake Occurred:   1/01/1980 at 08:00
Operating Mode:   Intake Assessment
```

Estimated Intake of PU239

Intake Components:

1-Acute	inhalation exposure to PU239	(Class: W /F1: 0.00010)	5.0E+01%
2-Acute	inhalation exposure to PU239	(Class: Y /F1: 0.00001)	5.0E+01%

Percent Contribution by Intake Component

Time (d)	Component 1	Component 2
Urine		
0.4	52	48
1.0	52	48
1.7	52	48
11.7	52	48
42.7	53	47
224.7	53	47
589.7	52	48
Feces		
224.7	44	56
622.7	24	76
987.7	25	75
1352.7	30	70

EXHIBIT 9. Sample Problem Two Bioassay Projection Graphic Report for Urine

```
                    CINDY - Code for INternal DosimetrY
                        (Version 1.000  16-Sep-90)
                      Report Date: 09-19-1990 at 16:12

Run Title:            Sample Problem Two
Subject:              Jane Johnson                    Sex: Female
ID No.:               Company 1 - 000002              SSN: 434-34-3434
Intake occurred:      01/01/1980 at 08:00
Operating Mode:       Bioassay Projection
```

```
Birth Date:           12/04/1952
Intake occurred at:   Facililty One
Employer at intake:   Default Employer

File:                 \cindysam\sample2
                      Radionuclide daughters not considered
                      Jones Pu excretion model selected
Error tolerance:      .000001
```

```
Intake Component(s):
 Acute   inhalation exposure to PU239  (Class: W /F1: 0.00010) 2.1E+04 pCi
 Acute   inhalation exposure to PU239  (Class: Y /F1: 0.00001) 2.1E+04 pCi
```

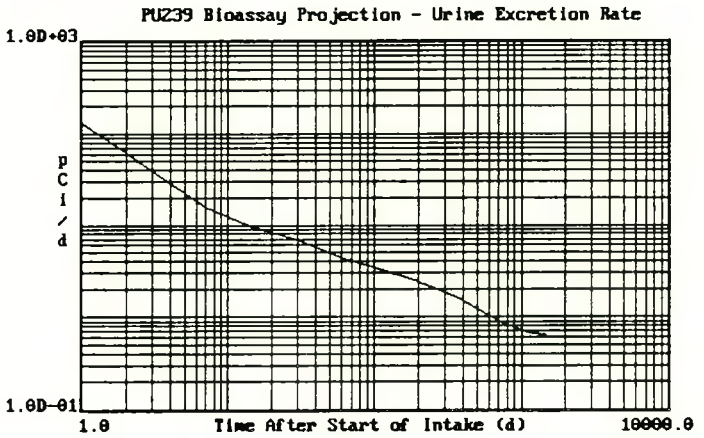


EXHIBIT 10. Sample Problem Two Bioassay Projection Graphic Report for Feces

```
------------------------------------------------------------------------------
                    CINDY - Code for INternal DosimetrY
                        (Version 1.000  16-Sep-90)
                      Report Date: 09-19-1990 at 16:12

Run Title:            Sample Problem Two
Subject:              Jane Johnson                      Sex: Female
ID No.:               Company 1 - 000002                SSN: 434-34-3434
Intake occurred:      01/01/1980 at 08:00
Operating Mode:       Bioassay Projection
------------------------------------------------------------------------------

Birth Date:           12/04/1952
Intake occurred at:   Facililty One
Employer at intake:   Default Employer

File:                 \cindysam\sample2
                      Radionuclide daughters not considered
                      Jones Pu excretion model selected
Error tolerance:      .000001

Intake Component(s):
 Acute   inhalation exposure to PUZ39  (Class: W /F1: 0.00010) 2.1E+04 pCi
 Acute   inhalation exposure to PUZ39  (Class: Y /F1: 0.00001) 2.1E+04 pCi
```

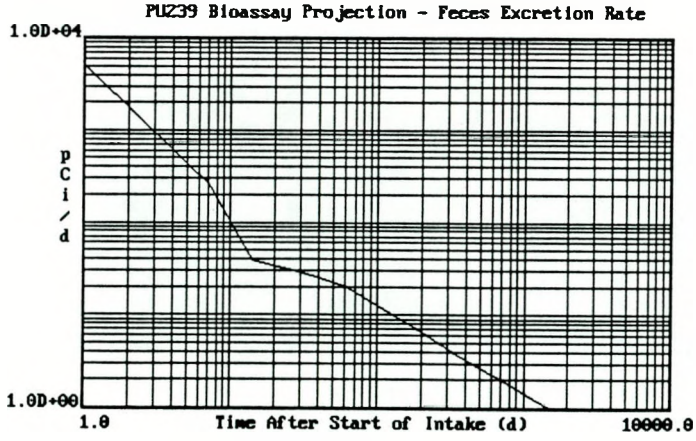


EXHIBIT 11. Sample Problem Two Bioassay Projection Text Report

```
                    CINDY - Code for INternal DosimetrY
                        (Version 1.000  16-Sep-90)
                      Report Date: 09-19-1990 at 16:11

Run title:          Sample Problem Two
Subject:            Jane Johnson                                Sex:   Female
ID No.:             Company 1 - 000002                          SSN:   434-34-3434
Intake Occurred:     1/01/1980 at 08:00
Operating Mode:     Bioassay Projection
```

Intake Components:

1-Acute	inhalation exposure to PU239	(Class: W /F1: 0.00010)	2.1E+04	pCi
2-Acute	inhalation exposure to PU239	(Class: Y /F1: 0.00001)	2.1E+04	pCi

PU239 Bioassay Projection - Excretion Rates and Retention*

Time	Urine	Feces	Total Lung	Total Body
(d)	(pCi/d)	(pCi/d)	(pCi)	(pCi)
1.0	1.3E+02	5.1E+03	8.9E+03	2.4E+04
7.0	1.6E+01	2.6E+02	6.1E+03	7.8E+03
14.0	1.0E+01	3.9E+01	5.7E+03	7.3E+03
30.0	6.8E+00	2.9E+01	5.2E+03	6.9E+03
60.0	4.4E+00	2.0E+01	4.4E+03	6.3E+03
180.0	2.6E+00	7.4E+00	2.9E+03	5.2E+03
365.0	1.6E+00	3.6E+00	2.2E+03	4.6E+03
730.0	8.8E-01	1.9E+00	1.5E+03	4.0E+03
1095.0	6.9E-01	1.3E+00	1.1E+03	3.6E+03
1460.0	6.4E-01	1.0E+00	8.1E+02	3.4E+03

Time	Stomach	S. Int.	UL Int.	LL Int.
(d)	(pCi)	(pCi)	(pCi)	(pCi)
1.0	2.5E+02	1.3E+03	5.4E+03	4.9E+03
7.0	2.4E+00	1.0E+01	4.5E+01	2.5E+02
14.0	1.1E+00	4.5E+00	1.5E+01	2.9E+01
30.0	9.2E-01	3.7E+00	1.2E+01	2.3E+01
60.0	6.4E-01	2.6E+00	8.4E+00	1.6E+01
180.0	2.0E-01	7.8E-01	2.5E+00	4.7E+00
365.0	8.1E-02	3.2E-01	1.1E+00	1.9E+00
730.0	4.4E-02	1.8E-01	5.7E-01	1.1E+00
1095.0	2.7E-02	1.1E-01	3.5E-01	6.4E-01
1460.0	1.6E-02	6.4E-02	2.1E-01	3.9E-01

```
Error tolerance: 1.0E-06
Jones Pu excretion model, ICRP retention model used.
```

EXHIBIT 11. (Contd.)

CINDY - Code for INternal DosimetrY
(Version 1.000 16-Sep-90)
Report Date: 09-19-1990 at 16:11

Run title:	Sample Problem Two		
Subject:	Jane Johnson	Sex:	Female
ID No.:	Company 1 - 000002	SSN:	434-34-3434
Intake Occurred:	1/01/1980 at 08:00		
Operating Mode:	Bioassay Projection		

Intake Components:

1-Acute inhalation exposure to PU239 (Class: W /F1: 0.00010) 2.1E+04 pCi
2-Acute inhalation exposure to PU239 (Class: Y /F1: 0.00001) 2.1E+04 pCi

PU239 Bioassay Projection - Excretion Rates and Retention*

Time (d)	Lung (pCi)	Lymph (pCi)	N-P Reg. (pCi)	Bone (pCi)
1.0	8.9E+03	4.7E+00	2.1E+03	6.6E+02
7.0	6.0E+03	3.1E+01	7.6E-02	7.3E+02
14.0	5.7E+03	5.7E+01	2.0E-04	7.6E+02
30.0	5.1E+03	1.0E+02	4.9E-04	8.3E+02
60.0	4.3E+03	1.6E+02	2.2E-05	9.3E+02
180.0	2.7E+03	2.2E+02	1.6E-06	1.1E+03
365.0	1.9E+03	2.9E+02	2.9E-07	1.2E+03
730.0	1.1E+03	3.9E+02	1.6E-06	1.3E+03
1095.0	6.9E+02	4.1E+02	3.4E-09	1.3E+03
1460.0	4.2E+02	4.0E+02	7.2E-10	1.3E+03

Time (d)	Liver (pCi)	Ovaries (pCi)
1.0	6.6E+02	1.2E+02
7.0	7.3E+02	4.3E+00
14.0	7.6E+02	1.7E-01
30.0	8.3E+02	7.5E-02
60.0	9.3E+02	5.6E-02
180.0	1.1E+03	1.8E-02
365.0	1.2E+03	5.0E-03
730.0	1.2E+03	3.2E-03
1095.0	1.2E+03	2.8E-03
1460.0	1.2E+03	2.4E-03

Error tolerance: 1.0E-06
Jones Pu excretion model, ICRP retention model used.

Sample Problem Three

Sample Problem Three involves continuous ingestion exposure over a 7-month period within calendar year 1989 by a female worker. No bioassay data is available; however, an intake estimate of 1 pCi/d of U-235 has been made. The material is assumed to be in soluble form.

Sample Problem Three may be retrieved into CINDY by selecting the subject file named **SAMPLE3.CIN**. To perform the dose assessment for Sample Problem Three, select **Calculate** on the CINDY main menu. Compare the results of the calculation for the first and last report times requested to the partial report displayed in Figure 55. The specified period dose assessment report for Sample Problem Three is stored in the file named **SAMPLE3.RDA.**

EXHIBIT 12. Sample Problem Three Dose Assessment Report

CINDY - Code for INternal DosimetrY
(Version 1.000 16-Sep-90)
Report Date: 09-19-1990 at 16:19

Run title: Sample Problem Three
Subject: Jane Johnson Sex: Female
ID No.: 55555 SSN: 818-23-4532
Intake Occurred: 2/20/1989 at 00:00 to 09/29/1989
Operating Mode: Dose at Specified Times

Chronic ingestion exposure to U 235 (Class: /F1: 0.05000) 1.0E+00 pCi/d

Dose Integration Period: 29.9 Day(s)

Organ	Dose Equivalent (rem)	Weighting Factors	Weighted Organ Dose Equivalent (rem)
Ovaries	1.4E-07	2.5E-01	3.5E-08
Breast	1.2E-07	1.5E-01	1.8E-08
R Marrow	2.3E-07	1.2E-01	2.8E-08
Lung	1.2E-07	1.2E-01	1.4E-08
Thyroid	1.2E-07	3.0E-02	3.5E-09
Bone Sur	1.8E-06	3.0E-02	5.5E-08
Kidneys	1.6E-05	6.0E-02	9.9E-07
LL Int.	5.4E-06	6.0E-02	3.3E-07
UL Int.	1.8E-06	6.0E-02	1.1E-07
Other	4.4E-07	6.0E-02	2.7E-08
S Int.	4.3E-07	6.0E-02	2.6E-08
Effective Dose Equivalent			1.6E-06

Error tolerance: 1.0E-06

EXHIBIT 12. (Contd.)

CINDY - Code for INternal DosimetrY
(Version 1.000 16-Sep-90)
Report Date: 09/19/90 at 16:19

Run title: Sample Problem Three
Subject: Jane Johnson Sex: Female
ID No.: 55555 SSN: 818-23-4532
Intake Occurred: 2/20/1989 at 00:00 to 09/29/1989
Operating Mode: Dose at Specified Times

Chronic ingestion exposure to U 235 (Class: /F1: 0.05000) 1.0E+00 pCi/d

Dose Integration Period: 50.0 Year(s)

Organ	Dose Equivalent (rem)	Weighting Factors	Weighted Organ Dose Equivalent (rem)
Ovaries	2.3E-06	2.5E-01	5.8E-07
Breast	2.2E-06	1.5E-01	3.2E-07
R Marrow	5.7E-05	1.2E-01	6.9E-06
Lung	2.1E-06	1.2E-01	2.6E-07
Thyroid	2.1E-06	3.0E-02	6.4E-08
Bone Sur	8.9E-04	3.0E-02	2.7E-05
Kidneys	3.7E-04	6.0E-02	2.2E-05
Other	1.3E-04	6.0E-02	7.5E-06
LL Int.	4.6E-05	6.0E-02	2.7E-06
UL Int.	1.6E-05	6.0E-02	9.4E-07
S Int.	4.5E-06	6.0E-02	2.7E-07
Effective Dose Equivalent			6.9E-05

Error tolerance: 1.0E-06

EXHIBIT 12. (Contd.)

CINDY - Code for INternal DosimetrY
(Version 1.000 16-Sep-90)
Report Date: 09/19/90 at 16:19

Run title: Sample Problem Three
Subject: Jane Johnson Sex: Female
ID No.: 55555 SSN: 818-23-4532
Intake Occurred: 2/20/1989 at 00:00 to 09/29/1989
Operating Mode: Dose at Specified Times

Chronic ingestion exposure to U 235 (Class: /Fl: 0.05000) 1.0E+00 pCi/d
Dose Equivalent in Target Organs or Tissue (rem)

Year	Lung	Stomach	S Int.	UL Int.	LL Int.	Bone Sur	R Marrow
0.08	1.2E-07	2.4E-07	4.3E-07	1.8E-06	5.4E-06	1.8E-06	2.3E-07
0.16	2.6E-07	5.0E-07	8.7E-07	3.7E-06	1.1E-05	5.7E-06	6.1E-07
0.25	4.3E-07	8.1E-07	1.4E-06	5.8E-06	1.7E-05	1.1E-05	1.1E-06
0.33	5.8E-07	1.1E-06	1.8E-06	7.6E-06	2.3E-05	1.7E-05	1.6E-06
0.41	7.3E-07	1.4E-06	2.3E-06	9.5E-06	2.9E-05	2.3E-05	2.2E-06
0.50	9.0E-07	1.7E-06	2.8E-06	1.2E-05	3.5E-05	3.1E-05	2.8E-06
0.57	1.0E-06	1.9E-06	3.2E-06	1.3E-05	4.0E-05	3.8E-05	3.4E-06
0.61	1.1E-06	2.0E-06	3.4E-06	1.4E-05	4.2E-05	4.1E-05	3.7E-06
1.00	1.3E-06	2.2E-06	3.7E-06	1.5E-05	4.5E-05	6.5E-05	5.3E-06
10.00	1.9E-06	2.9E-06	4.3E-06	1.6E-05	4.5E-05	3.9E-04	2.6E-05
20.00	2.1E-06	3.0E-06	4.5E-06	1.6E-05	4.6E-05	6.2E-04	4.1E-05
30.00	2.1E-06	3.1E-06	4.5E-06	1.6E-05	4.6E-05	7.6E-04	4.9E-05
40.00	2.1E-06	3.1E-06	4.5E-06	1.6E-05	4.6E-05	8.4E-04	5.4E-05
50.00	2.1E-06	3.1E-06	4.5E-06	1.6E-05	4.6E-05	8.9E-04	5.7E-05

Year	Testes	Ovaries	Muscle	Thyroid	Kidneys	Other
0.08	1.2E-07	1.4E-07	1.2E-07	1.2E-07	1.6E-05	4.4E-07
0.16	2.6E-07	3.1E-07	2.6E-07	2.6E-07	3.9E-05	1.2E-06
0.25	4.3E-07	5.0E-07	4.3E-07	4.2E-07	6.5E-05	2.3E-06
0.33	5.8E-07	6.8E-07	5.9E-07	5.8E-07	8.9E-05	3.3E-06
0.41	7.4E-07	8.5E-07	7.4E-07	7.3E-07	1.1E-04	4.4E-06
0.50	9.1E-07	1.1E-06	9.2E-07	9.0E-07	1.4E-04	5.8E-06
0.57	1.0E-06	1.2E-06	1.1E-06	1.0E-06	1.6E-04	6.9E-06
0.61	1.1E-06	1.3E-06	1.1E-06	1.1E-06	1.7E-04	7.5E-06
1.00	1.3E-06	1.4E-06	1.3E-06	1.2E-06	2.0E-04	1.1E-05
10.00	1.9E-06	2.1E-06	1.9E-06	1.9E-06	3.3E-04	5.7E-05
20.00	2.1E-06	2.3E-06	2.1E-06	2.1E-06	3.7E-04	8.9E-05
30.00	2.1E-06	2.3E-06	2.1E-06	2.1E-06	3.7E-04	1.1E-04
40.00	2.1E-06	2.3E-06	2.2E-06	2.1E-06	3.7E-04	1.2E-04
50.00	2.1E-06	2.3E-06	2.2E-06	2.1E-06	3.7E-04	1.3E-04

Sample Problem Four

Sample Problem Four involves an acute inhalation exposure to tritium by a male subject. One urine sample is available, taken 14 days after the suspected exposure. The tritium is assumed to be in the form of water vapor in the workplace air.

Sample Problem Four may be retrieved into CINDY by selecting the subject file named **SAMPLE4.CIN**. Exhibit 13 shows the subject report for Sample Problem Four that is displayed or printed when the user selects a **Subject Report** option on the **Establish Subject** menu. The subject report file is stored in the file named **SAMPLE4.RST**.

To perform the intake assessment for Sample Problem Four, select **Calculate** on the CINDY main menu. Compare the results of the calculation to the report displayed in Exhibit 14. The intake assessment text report is stored in the file named **SAMPLE4.RIT**.

The calculated intake of HTO is reported in the intake assessment report as 3.6×10^4 nCi. To use this value in the bioassay projection, first change the operating mode to **Bioassay Projection**. Then, under **Set Run Parameters** and **Intake Estimate**, enter the intake value. Calculate the bioassay projection and compare the results of the calculation to the partial text report shown in Exhibit 15. Now change the operating mode to **Dose Assessment - Specified Period** and calculate. Compare the results of the calculation with the report shown in Exhibit 16. The bioassay projection and specified period dose assessment reports are stored in the files named **SAMPLE4.RPT** and **SAMPLE4.RDA**, respectively.

EXHIBIT 13. Sample Problem Four Subject Text Report

```
                    CINDY - Code for INternal DosimetrY
                        (Version 1.000  16-Sep-90)
                      Report Date: 09-19-1990 at 17:04

Run Title:              Sample Problem Four
Subject:                Tom Jones                          Sex: Male
ID No.:  FFF-254546                                        SSN: 767-67-7766
Intake occurred:        02/24/1990 at 14 00
Operating Mode:         Bioassay Projection
-------------------------------------------------------------------------------

Birth Date:             08/10/1948
Intake occurred at:     Facililty One
Employer at intake:     Default Employer

File:                   \cindy\cindysam\sample4
                        Radionuclide daughters not considered

Intake Components:
                        * 02/24/1990 H3      Inhalation  Acute   34000 nCi


                          Bioassay Data Currently Considered
              Time
              Post      ---------------Bioassay Units----------------   Working Units
Measurement Intake    Measured    Sample  Sample     Normalized       Normalized
   Date      (d)       Value       Size   Period       Value            Value
---------- ------- -------------- ------- ------- --------------  --------------

H3/Urine
----------
03/11/1990    15   1.0D+01 pCi/mL          0 hr  1.0E+01 pCi/ml  1.0E-02 nCi/ml

_____________
  Note: Assumed excretion periods shown in parentheses.
```

EXHIBIT 14. Sample Problem Four Intake Assessment Text Report

```
------------------------------------------------------------------------------
                    CINDY - Code for INternal DosimetrY
                       (Version 1.000  16-Sep-90)
                     Report Date: 09-19-1990 at 17:06

Run title:         Sample Problem Four
Subject:           Tom Jones                                  Sex:   Male
ID No.:            FFF-254546                                 SSN:     767-67-7766
Intake Occurred:    2/24/1990 at 14 00
Operating Mode:    Intake Assessment
------------------------------------------------------------------------------

                          Estimated Intake of H 3

  Acute   inhalation exposure to H 3                    Water:    1.0E+02%

               H 3    Bioassay Evaluation Results Summary

                          ---Intake Estimate (nCi) by Method---
                                                 Un-
                          Ratio      Average     Weighted  User-
                          Of the     Of the      Least     Defined
       Bioassay Type      Means      Slopes      Squares   Weights
       ----------------   -------    -------     -------   -------

       Urine              3.6E+04    3.6E+04     3.6E+04   0.0E+00
       ----------------   -------    -------     -------   -------


  Error tolerance: 1.0E-06
  HTO inhalation activity increased by 50% to account for transpiration.
  Weighted average not determined when there is only one datapoint for one of
    the bioassay types.
```

EXHIBIT 14. (Contd.)

CINDY - Code for INternal DosimetrY
(Version 1.000 16-Sep-90)
Report Date: 09-19-1990 at 17:06

Run title: Sample Problem Four
Subject: Tom Jones Sex: Male
ID No.: FFF-254546 SSN: 767-67-7766
Intake Occurred: 2/24/1990 at 14 00
Operating Mode: Intake Assessment

Estimated Intake of H 3

Acute inhalation exposure to H 3 Water: 1.0E+02%

Measurement Date	Time Post Intake (d)	Observed Quantity	Estimated Quantity by Method: Ratio Of the Means	Average Of the Slopes	Un-Weighted Least Squares	User-Defined Weights
Urine		(nCi/ml)	(nCi/ml)	(nCi/ml)	(nCi/ml)	(nCi/ml)
03/11/1990	14.9	1.0E-02	1.0E-02	1.0E-02	1.0E-02	0.0E+00

Measurement Date	Time Post Intake (d)	Measurement/Expected Ratios: Ratio Of the Means	Average Of the Slopes	Un-Weighted Least Squares	User-Defined Weights
Urine					
03/11/1990	14.9	1.00	1.00	1.00	0.00

Intake Component 1

Acute inhalation exposure to H 3 Water: 1.0E+02%

ICRP Tritium Model

Lung to air removal rate constant (d-1):	7680.0
Lung to blood removal rate constant (d-1):	1.30E+01
Blood to lungs removal rate constant (d-1):	6.00E+01
Blood to body water removal rate constant (d-1):	1.85E+00
Body water removal rate constant (d-1):	6.93E-02
Excretion fraction to urine:	0.47
Excretion fraction to feces:	0.00

Input prepared by: _____ Date: _____

Input checked by: _____ Date: _____

EXHIBIT 15. Sample Problem Four Bioassay Projection Graphic Report for Urine

```
                    CINDY - Code for INternal DosimetrY
                        (Version 1.000  16-Sep-90)
                      Report Date: 09-19-1990 at 17:10

Run Title:            Sample Problem Four
Subject:              Tom Jones                          Sex: Male
ID No.:  FFF-254546                                      SSN: 767-67-7766
Intake occurred:      02/24/1990 at 14 00
Operating Mode:       Bioassay Projection
```

```
Birth Date:           08/10/1948
Intake occurred at:   Facililty One
Employer at intake:   Default Employer

File:                 \cindy\cindysam\sample4
                      Radionuclide daughters not considered
Error tolerance:      .000001
```

Intake Component(s):
Acute inhalation exposure to H 3 **Water: 3.6E+04 nCi**

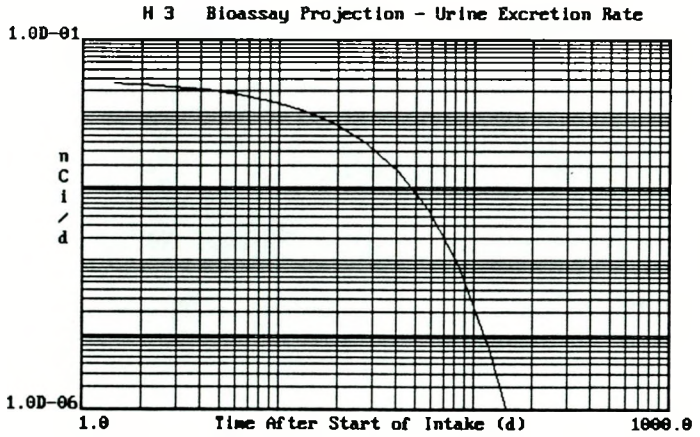


EXHIBIT 16. Sample Problem Four Specified Period Dose Assessment Report

CINDY - Code for INternal DosimetrY
(Version 1.000 16-Sep-90)
Report Date: 09/20/90 at 07:43

Run title: Sample Problem Four
Subject: Tom Jones Sex: Male
ID No.: FFF-254546 SSN: 767-67-7766
Intake Occurred: 2/24/1990 at 14 00
Operating Mode: Dose at Specified Times

Acute inhalation exposure to H 3 Water: 3.6E+04 nCi

Dose Integration Period: 365.0 Day(s)

Organ	Dose Equivalent (rem)	Weighting Factors	Weighted Organ Dose Equivalent (rem)
Testes	2.4E-03	2.5E-01	6.0E-04
Breast	2.4E-03	1.5E-01	3.6E-04
R Marrow	2.4E-03	1.2E-01	2.9E-04
Lung	2.4E-03	1.2E-01	2.9E-04
Thyroid	2.4E-03	3.0E-02	7.2E-05
Bone Sur	2.4E-03	3.0E-02	7.2E-05
Stomach	2.4E-03	6.0E-02	1.4E-04
S Int.	2.4E-03	6.0E-02	1.4E-04
UL Int.	2.4E-03	6.0E-02	1.4E-04
LL Int.	2.4E-03	6.0E-02	1.4E-04
Other	2.4E-03	6.0E-02	1.4E-04
Effective Dose Equivalent			2.4E-03

Error tolerance: 1.0E-06

Sample Problem Five

Sample Problem Five illustrates use of the CINDY direct intake model to evaluate a wound. A female worker is assumed to be contaminated with Am-241 and one data point each of urine, feces, and whole body measurements are available. Additional measurements for Am-241 at the wound site indicate that the activity is leaving the site according to a multiple exponential function, which can be approximated as 50% at a half time of 1 day, 20% at a half-time of 14 days, and 30% at a half-time of 300 days. The subject report for Sample Problem Five is shown in Exhibit 17.

When Sample Problem Five is run in the intake assessment mode, the report shown in Exhibit 18 is created. This report indicates that the amount of activity initially deposited at the wound site was about 5.8×10^3 pCi, based on the total body bioassay measurement. Note that zero values are reported for the weighted average over the three bioassay types. No values could be estimated (other than a straight arithmetic average) because only one data point was available for each of the bioassay types. The method used for evaluation of the weighted average requires at least two data points for evaluation of the statistical weighting parameter. Also note that the estimated intakes are equal for the three intake estimate methods. This also results from there being only one data point per bioassay type.

To perform the bioassay projection analysis, change the operating mode to **Bioassay Projection** and enter **5800 pCi** as the intake of Am-241 (the value should already be entered). Perform the bioassay projection analysis and compare the results with those shown in Exhibits 19 and 20. Note that the total body activity shown in the tables and graph do not include the activity in the wound site.

EXHIBIT 17. Sample Problem Five Subject Report

```
------------------------------------------------------------------------------
                    CINDY - Code for INternal DosimetrY
                        (Version 1.000  16-Sep-90)
                      Report Date: 09-19-1990 at 16:45

Run Title:            Sample Problem Five
Subject:              Mary Brown                          Sex: Female
ID No.:               23465                               SSN: 545-45-4545
Intake occurred:      01/20/1973 at 12:00
Operating Mode:       Intake Assessment
------------------------------------------------------------------------------

Birth Date:           10/08/1952
Intake occurred at:   Facililty One
Employer at intake:   Default Employer

File:                 \cindysam\sample5
                      Radionuclide daughters considered

Intake Components:
                      * 01/20/1973 Am241   Wound       Acute   100 %
Bioassay Data Title:  Sample bioassay data file for John Doe (SSN: 111-22-3333)
                      09-11-89 RAP


                        Bioassay Data Currently Considered
             Time
             Post  ---------------Bioassay Units----------------   Working Units
Measurement Intake    Measured    Sample  Sample     Normalized      Normalized
   Date      (d)       Value      Size   Period       Value           Value
---------- ------- ------------- ------- ------- --------------  --------------

Am241/Urine
----------
01/21/1973     1.2 2.0D+01 pCi/s           14 hr  3.4E+01 pCi/d   3.4E+01 pCi/d

Am241/Feces
----------
09/15/1973   238   3.0D-03 pCi/g           24 hr  3.3E-01*pCi/d   3.3E-01 pCi/d

Am241/Whole
----------
08/12/1973   204   5.3D+00 nCi                                     5.3E+03 pCi

_____________
  Note: Assumed excretion periods shown in parentheses.
* Normalized using reference volume or mass.
```

EXHIBIT 18. Sample Problem Five Intake Assessment Text Report

```
------------------------------------------------------------------------------
                    CINDY - Code for INternal DosimetrY
                        (Version 1.000  16-Sep-90)
                      Report Date: 09-19-1990 at 16:46

Run title:         Sample Problem Five
Subject:           Mary Brown                                Sex:   Female
ID No.:            23465                                     SSN:   545-45-4545
Intake Occurred:    1/20/1973 at 12:00
Operating Mode:    Intake Assessment
------------------------------------------------------------------------------

                          Estimated Intake of AM241

  Acute    wound       exposure to AM241                              1.0E+02%

                AM241  Bioassay Evaluation Results Summary

                                ---Intake Estimate (pCi) by Method---
                                                      Un-
                                Ratio      Average    Weighted  User-
                                Of the     Of the     Least     Defined
        Bioassay Type           Means      Slopes     Squares   Weights
        ----------------        -------    -------    -------   -------

        Urine                   3.5E+03    3.5E+03    3.5E+03   0.0E+00
        Feces                   7.5E+03    7.5E+03    7.5E+03   0.0E+00
        Total Body              5.8E+03    5.8E+03    5.8E+03   0.0E+00
        ----------------        -------    -------    -------   -------

        Weighted Average        0.0E+00    0.0E+00    0.0E+00   0.0E+00

    Error tolerance: 1.0E-06
    Weighted average not determined when there is only one datapoint for one of
      the bioassay types.
```

EXHIBIT 18. (Contd.)

CINDY - Code for INternal DosimetrY
(Version 1.000 16-Sep-90)
Report Date: 09-19-1990 at 16:46

Run title: Sample Problem Five
Subject: Mary Brown Sex: Female
ID No.: 23465 SSN: 545-45-4545
Intake Occurred: 1/20/1973 at 12:00
Operating Mode: Intake Assessment

Estimated Intake of AM241

Acute wound exposure to AM241 1.0E+02%

Measurement Date	Time Post Intake (d)	Observed Quantity	Estimated Quantity by Method: Ratio Of the Means	Average Of the Slopes	Un-Weighted Least Squares	User-Defined Weights
Urine		(pCi/d)	(pCi/d)	(pCi/d)	(pCi/d)	(pCi/d)
01/22/1973	1.2	3.4E+01	3.4E+01	3.4E+01	3.4E+01	0.0E+00
Feces		(pCi/d)	(pCi/d)	(pCi/d)	(pCi/d)	(pCi/d)
09/15/1973	237.5	3.3E-01	3.3E-01	3.3E-01	3.3E-01	0.0E+00
Total Body		(pCi)	(pCi)	(pCi)	(pCi)	(pCi)
08/12/1973	204.0	5.3E+03	5.3E+03	5.3E+03	5.3E+03	0.0E+00

Measurement Date	Time Post Intake (d)	Measurement/Expected Ratios: Ratio Of the Means	Average Of the Slopes	Un-Weighted Least Squares	User-Defined Weights
Urine					
01/22/1973	1.2	1.00	1.00	1.00	0.00
Feces					
09/15/1973	237.5	1.00	1.00	1.00	0.00
Total Body					
08/12/1973	204.0	1.00	1.00	1.00	0.00

EXHIBIT 19. Sample Problem Five Bioassay Projection Text Report

CINDY - Code for INternal DosimetrY
(Version 1.000 16-Sep-90)
Report Date: 09/19/90 at 16:48

Run title: Sample Problem Five
Subject: Mary Brown Sex: Female
ID No.: 23465 SSN: 545-45-4545
Intake Occurred: 1/20/1973 at 12:00
Operating Mode: Bioassay Projection

Acute wound exposure to AM241 5.8E+03 pCi

AM241 Bioassay Projection - Excretion Rates and Retention

Time	Urine	Feces	Total Lung	Total Body
(d)	(pCi/d)	(pCi/d)	(pCi)	(pCi)
0.1	2.4E+01	2.4E+01	0.0E+00	5.6E+03
1.0	6.2E+01	6.2E+01	0.0E+00	5.3E+03
2.0	3.7E+01	3.7E+01	0.0E+00	5.4E+03
14.0	1.9E+00	1.9E+00	0.0E+00	5.4E+03
28.0	9.0E-01	9.0E-01	0.0E+00	5.4E+03
50.0	4.3E-01	4.3E-01	0.0E+00	5.4E+03
100.0	2.9E-01	2.9E-01	0.0E+00	5.3E+03
300.0	2.4E-01	2.4E-01	0.0E+00	5.2E+03
900.0	1.8E-01	1.8E-01	0.0E+00	5.0E+03
1800.0	1.5E-01	1.5E-01	0.0E+00	4.6E+03

Time	Direct	Direct	Direct	Direct
(d)	(pCi)	(pCi)	(pCi)	(pCi)
0.1	2.7E+03	1.2E+03	1.7E+03	0.0E+00
1.0	1.5E+03	1.1E+03	1.7E+03	0.0E+00
2.0	7.3E+02	1.0E+03	1.7E+03	0.0E+00
14.0	1.9E-01	4.4E+02	1.7E+03	0.0E+00
28.0	6.5E-04	1.7E+02	1.6E+03	0.0E+00
50.0	5.3E-04	3.6E+01	1.5E+03	0.0E+00
100.0	8.6E-06	1.1E+00	1.4E+03	0.0E+00
300.0	1.1E-05	2.2E-03	8.7E+02	0.0E+00
900.0	2.2E-09	1.9E-07	2.2E+02	0.0E+00
1800.0	1.6E-07	1.3E-05	2.7E+01	0.0E+00

Error tolerance: 1.0E-06

EXHIBIT 19. (Contd.)

```
------------------------------------------------------------------------------

                    CINDY - Code for INternal DosimetrY
                         (Version 1.000 16-Sep-90)
                       Report Date: 09/19/90 at 16:48

Run title:         Sample Problem Five
Subject:           Mary Brown                                Sex:  Female
ID No.:            23465                                     SSN:  545-45-4545
Intake Occurred:    1/20/1973 at 12:00
Operating Mode:    Bioassay Projection
------------------------------------------------------------------------------

  Acute    wound      exposure to AM241                              5.8E+03 pCi

        AM241 Bioassay Projection - Excretion Rates and Retention

                  Time     Bone      Liver     Ovaries
                  (d)      (pCi)     (pCi)     (pCi)

                   0.1     2.4E+01   1.6E+01   3.1E-02
                   1.0     5.2E+02   5.0E+02   1.9E-01
                   2.0     9.5E+02   9.4E+02   2.7E-01
                  14.0     1.6E+03   1.6E+03   4.0E-01
                  28.0     1.8E+03   1.8E+03   4.4E-01
                  50.0     1.9E+03   1.9E+03   4.6E-01
                 100.0     2.0E+03   2.0E+03   4.8E-01
                 300.0     2.2E+03   2.2E+03   5.4E-01
                 900.0     2.4E+03   2.3E+03   6.0E-01
                1800.0     2.4E+03   2.2E+03   6.1E-01

    Error tolerance: 1.0E-06
```

EXHIBIT 20. Sample Problem Five Bioassay Projection Graph Report for Urine

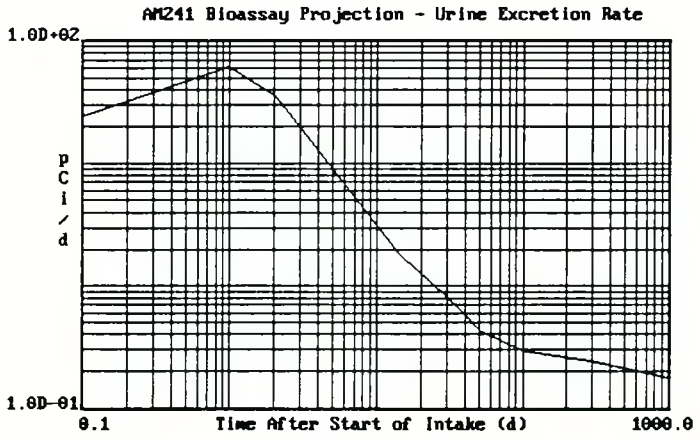
```
                    CINDY - Code for INternal DosimetrY
                        (Version 1.000  16-Sep-90)
                      Report Date: 09-19-1990 at 16:48

Run Title:            Sample Problem Five
Subject:              Mary Brown                        Sex: Female
ID No.:               23465                             SSN: 545-45-4545
Intake occurred:      01/20/1973 at 12:00
Operating Mode:       Intake Assessment
```

```
Birth Date:           10/08/1952
Intake occurred at:   Facililty One
Employer at intake:   Default Employer

File:                 \cindysam\sample5
                      Radionuclide daughters considered
Error tolerance:      .000001
```

```
Intake Component(s):
 Acute   wound      exposure to AM241                    5.8E+03 pCi
```



The menu structure used in CINDY allows the user to move freely within the CINDY working environment. The hierarchy of the menus is displayed in Exhibits 21-23. Exhibit 21 provides an overview of the menus as viewed from the CINDY main menu. Exhibit 22 provides the hierarchy of the menus called from the **Set Run Parameters** menu. Exhibit 23 shows the menus that are accessed from the **Environment Manangement** menu. The menus shown in Exhibits 21 and 22 are accessed during normal processing. The menus shown in Exhibits are used primarily during site configuration.

EXHIBIT 21. CINDY Main Menu Structure

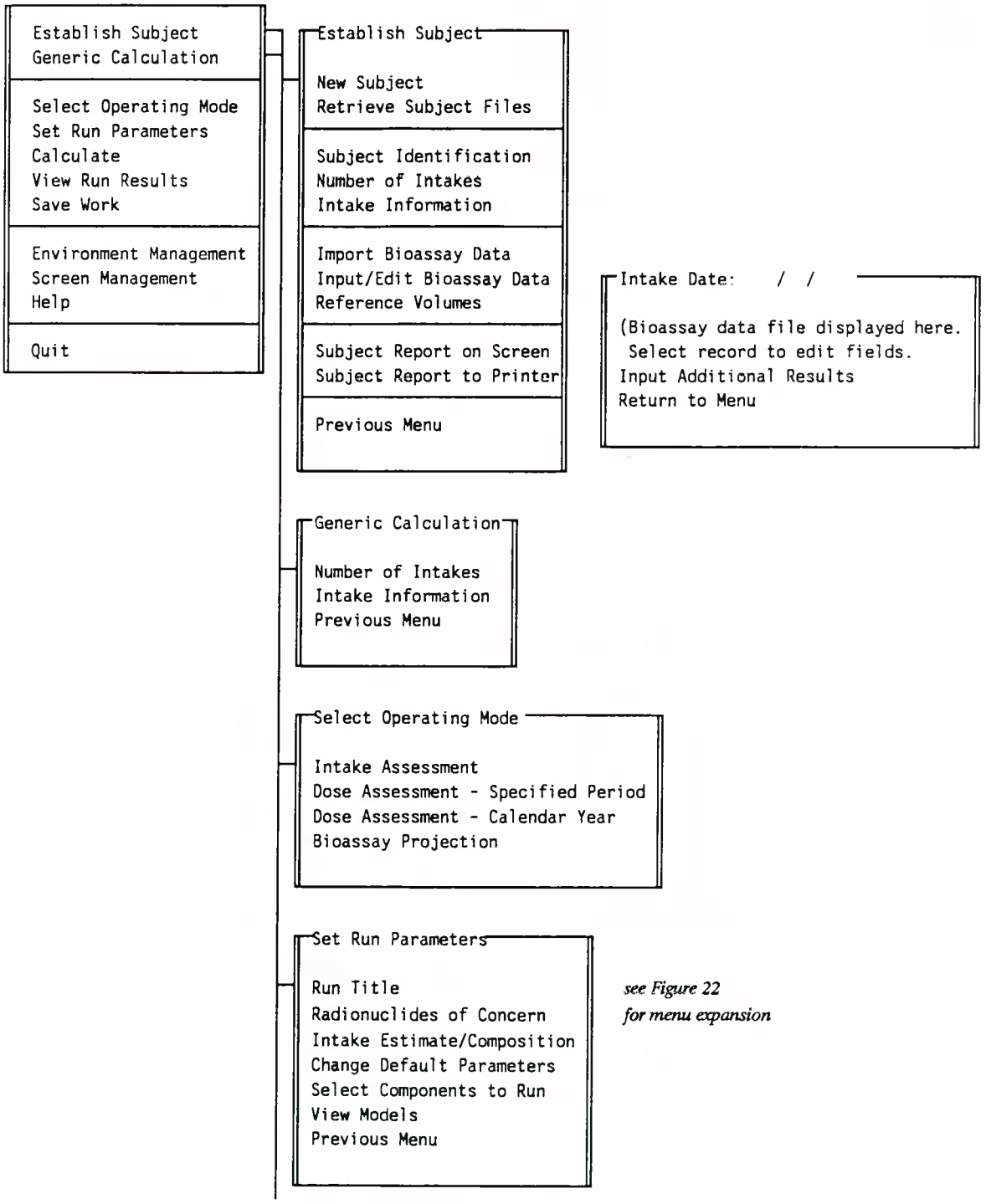


EXHIBIT 21. (Contd.)

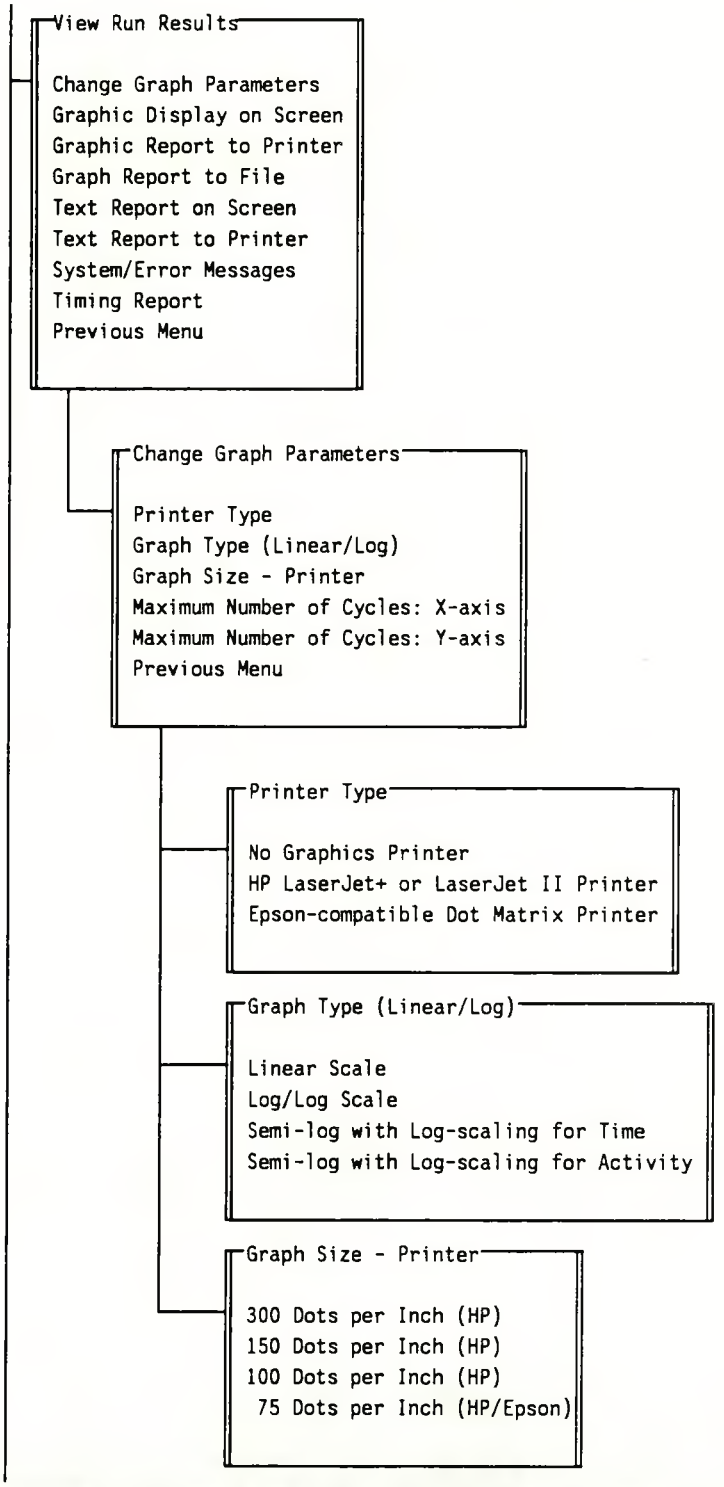
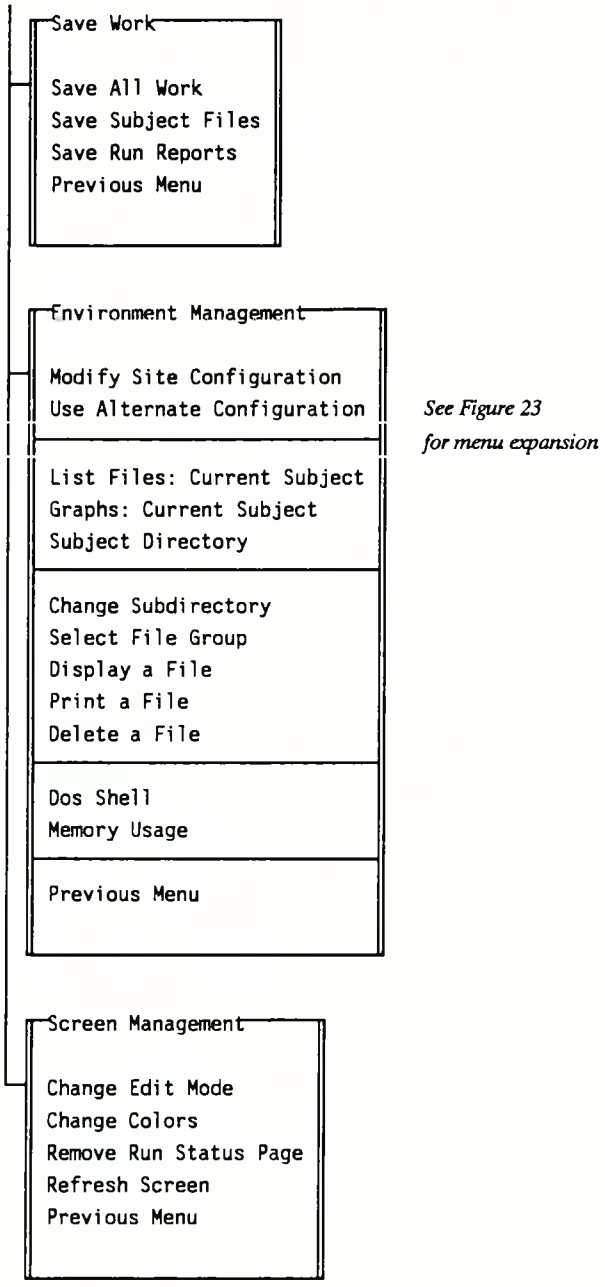


EXHIBIT 21. (Contd.)



See Figure 23 for menu expansion

EXHIBIT 22. CINDY Set Run Parameters Menu Structure

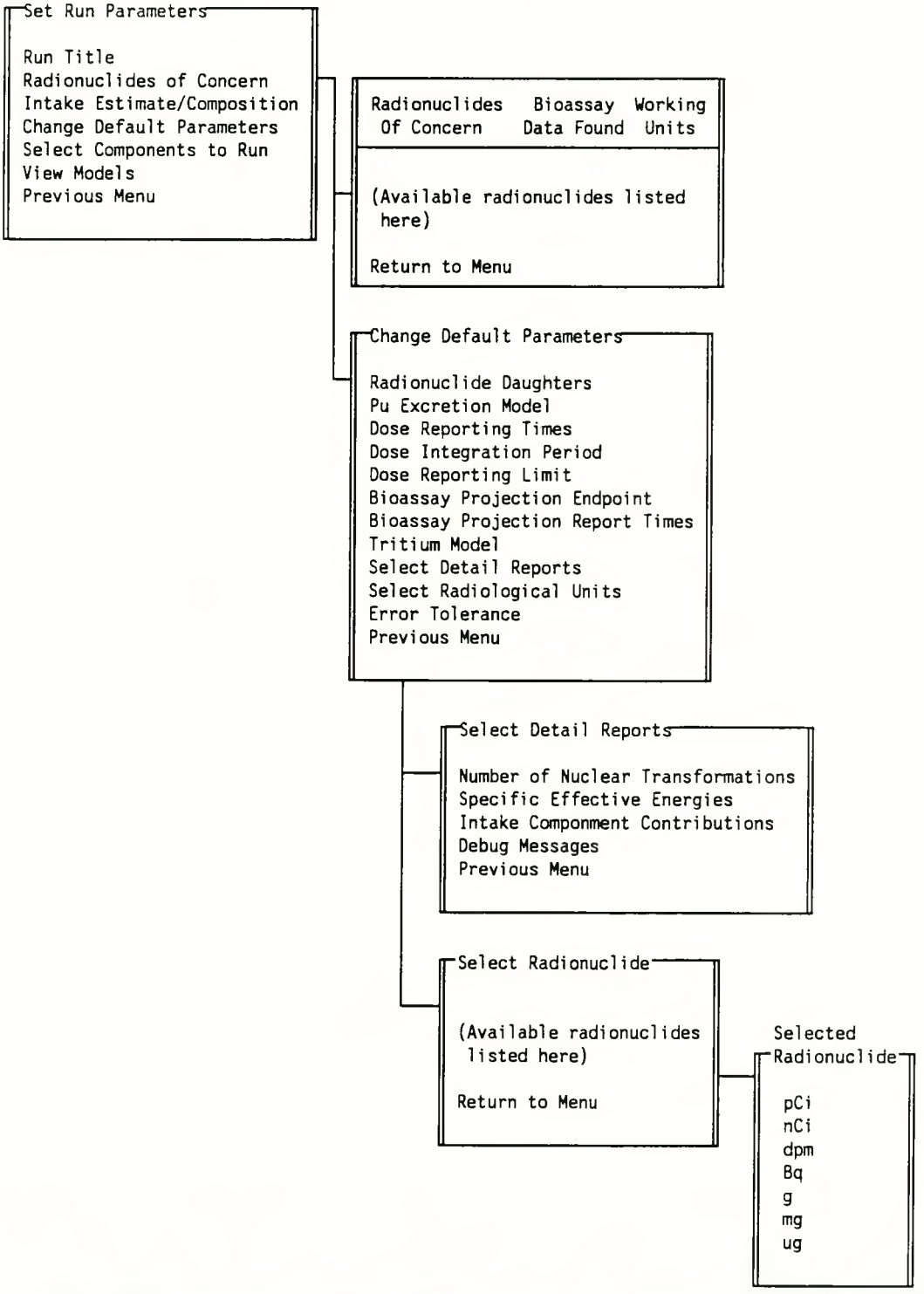


EXHIBIT 23. CINDY Environment Management Menu Structure

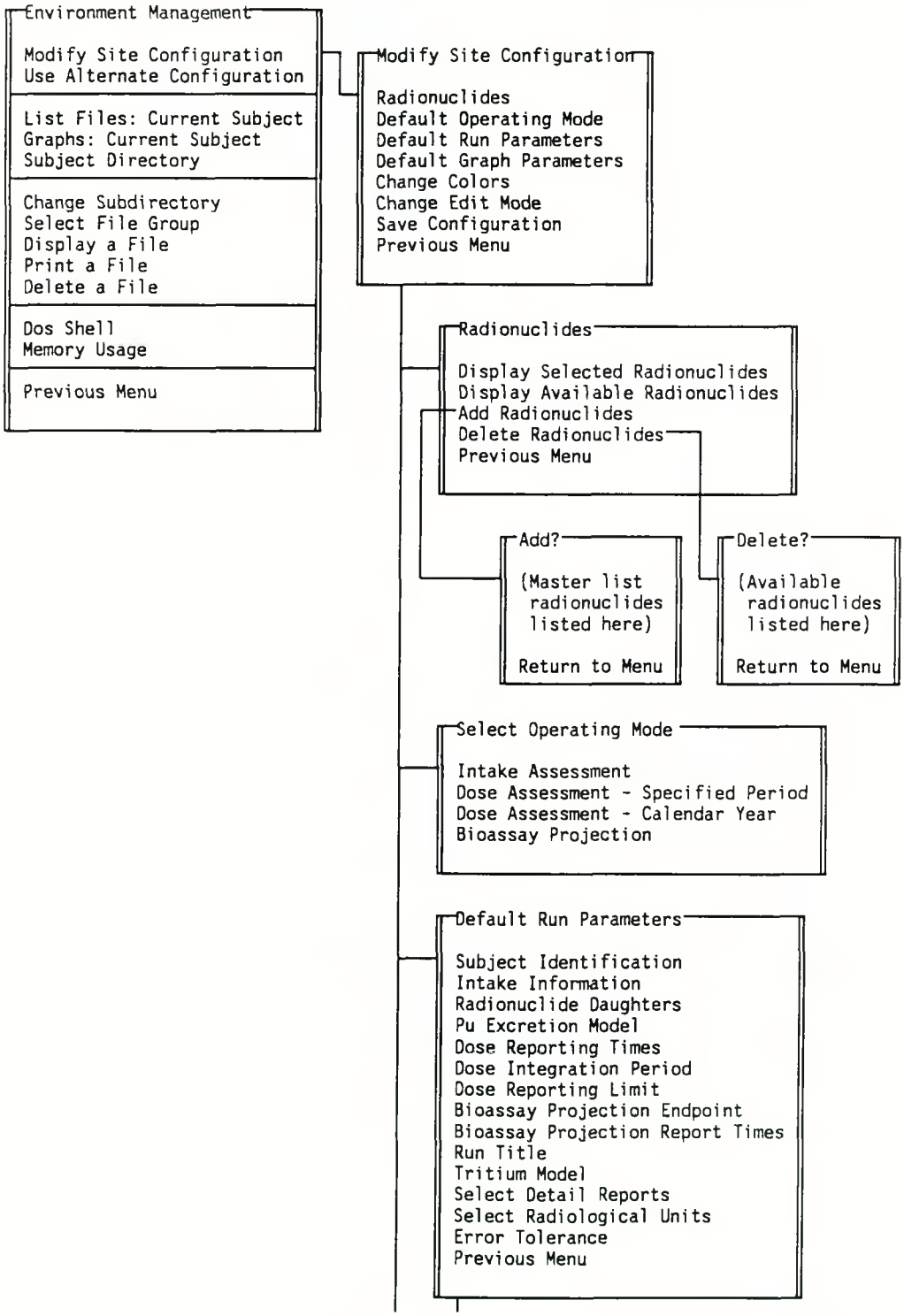
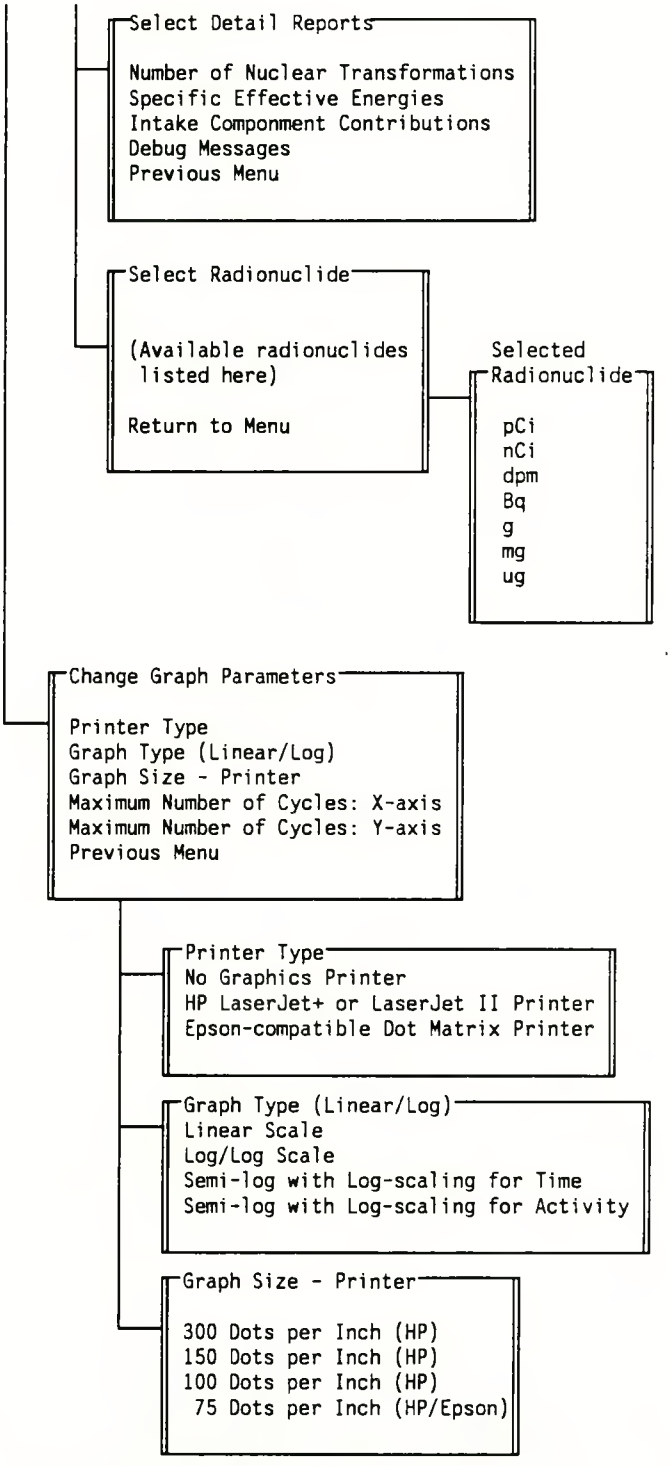


EXHIBIT 23. (Contd.)



This expanded reference section contains definitions of key words and phrases that appear in menus and lists in the CINDY screens. The key words and phrases are listed alphabetically. The user can quickly locate items in this reference section and read about the intended use or limitations related to the particular item. Menus and windows that open when key words or phrases are selected are shown in figures immediately following the key word or phase.

100 Dots per Inch (HP)

Select this printed graph size option to print a "postage stamp" graph. The screen image will measure 2.25" wide by 1.5 " high. This option is functional with an HP LaserJet+ or HP LaserJet II printer.

150 Dots per Inch (HP)

Select this printed graph size option to print a 4.5" wide by 3" high screen image. This graph size matches the print size of compressed fonts. This option is functional only with an HP LaserJet+ or HP LaserJet II printer.

300 Dots per Inch (HP)

Select this printed graph size option to print a 6.5" wide by 5" high screen image. This graph size matches the print size of most standard fonts. This option is functional only with an HP LaserJet+ or HP LaserJet II printer.

75 Dots per Inch (HP/Epson)

Select this printed graph size option to print an 8.5" wide by 6" high screen image. This graph size requires a default landscape orientation on the printer. This is the only size of printed graph available for Epson/IBM printers. The heading information will be printed on a separate page when this option is selected. See **Graph Size - Printer** in this section for more information.

Absorption

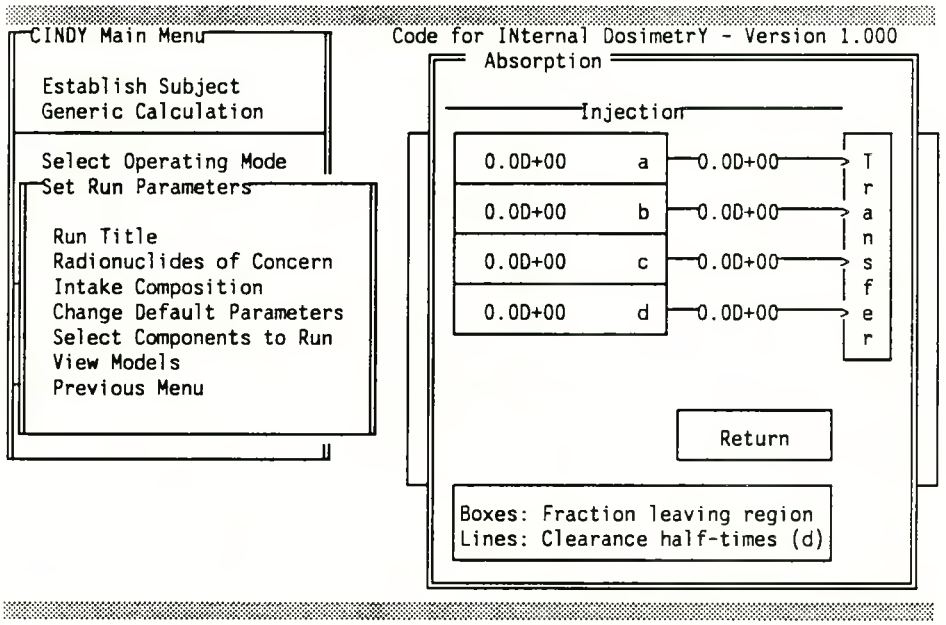


FIGURE 44. Absorption - Direct Intake Window

When the user has specified either wound or absorption intake mode(s), after the **Intake Composition** or **Intake Estimate** window has been displayed, a window opens for entering the direct intake parameters as shown in Figure 44. CINDY does not contain default values for any parameters for the direct intake model. However, the user may modify the site configuration to include site-specific direct intake parameters.

Add Radionuclides

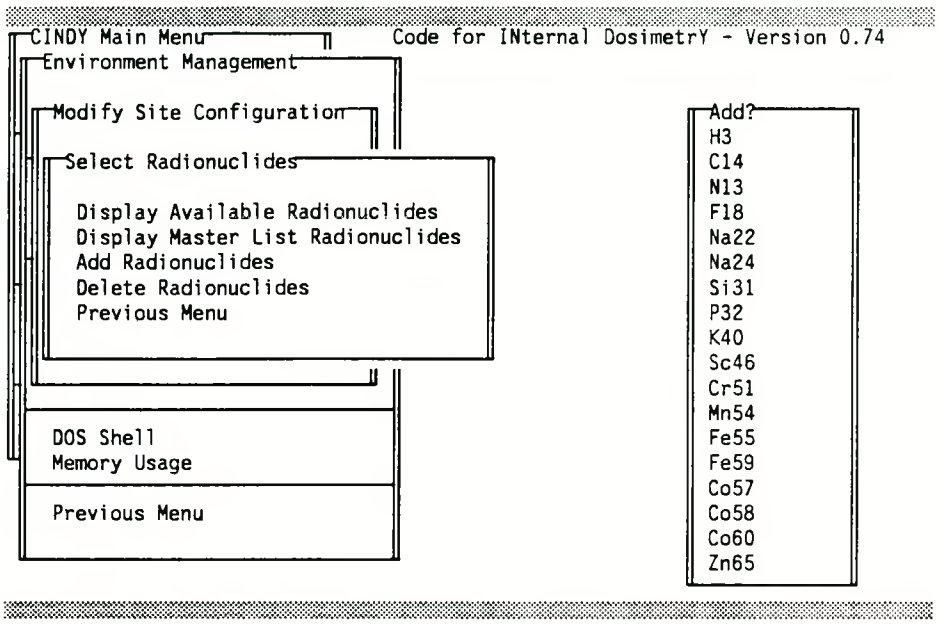


FIGURE 45. Add Radionuclides to Site Configuration Window

Use this menu to add radionuclides to a site configuration. A menu will open that contains all radionuclides in the master list, as shown in Figure 45. Currently available radionuclides are displayed in bold face. The menu bar is displayed in reverse bold face when the menu bar overlies a selected item. Use cursor, **PageUp**, **Delete**, **PageDown**, **Home**, and **End** keys to move about within the window. Press **Enter** to select a radionuclide. The radionuclide should then be displayed in bold face, indicating that it is to be included in the list. CINDY provides a warning if the user attempts to select a previously selected radionuclide. Pressing **Esc** returns the user to the menu.

You may select as many radionuclides as you wish while in this menu. However, the more radionuclides selected, the larger the size of the CINDY program. Consequently, the smaller the amount of memory available for executing the calculation programs. If the error "Program too large to fit into memory" is encountered under **View Run Results**, Sysytem/Error Messages when attempting to perform a calculation, try deleting infrequently used radionuclides from the site configuration.

If radionuclides are added to the available list, the **Select Units** menu will be displayed and active on return to the calling menu. This is to ensure that the user does not forget to set the default working radiological units for the added radionuclides.

Begin Time

Enter the starting time of the current intake. Use the 24-hour clock. **Begin time** is used in the intake assessment mode, along with the **Begin date,** to establish a basis for computing the time post intake associated with each bioassay data point. **Begin time** is used in the calendar-year dose assessment mode, along with the **Begin date** and **End date** to establish report times. This intake-specific parameter is input in the **Intake Information** window.

Begin Date

Enter the starting date of the current intake. **Begin date** is used in the intake assessment mode, along with the **Begin time,** to establish a basis for computing the time post intake associated with each bioassay data point. **Begin date** is used in chronic exposures, along with **Begin time** and **End date,** to determine the length of exposure. **Begin date** is used in the calendar year dose assessment mode to establish report times. This intake-specific parameter is input in the **Intake Information** window.

Bioassay Projection

This operating mode selection allows the user to estimate organ burdens and urinary and fecal excretion rates from given intakes. This option appears on the **Select Operating Mode** menu.

Bioassay Projection Endpoint

This run-specific parameter is input from the **Change Default Parameters** menu. A window opens and the following command is given:

Enter bioasssay projection endpoint (yr):

This parameter is used when bioasssay projection report times are not specified. Sixteen equally-spaced points (on a log-scale) are automatically generated based on this endpoint.

Bioassay Projection Report Times

This run-specific parameter is input from the **Change Default Parameters** menu item **Report Times.** A window opens and the following question is asked:

Do you wish to specify bioassay projection report times (Y/N) ?

If you respond, **yes**, you are then asked to:

Enter number of report times:

There is a limit of 69 report times. You are asked to enter the report times as follows:

Enter report time 1 in days:

Times may be specified as integers or with decimal fractions. To review the values, first complete entry of all times, then re-enter the **Report Times** option and scroll through the values using the **Enter** or down arrow keys.

Bioassay Radionuclide

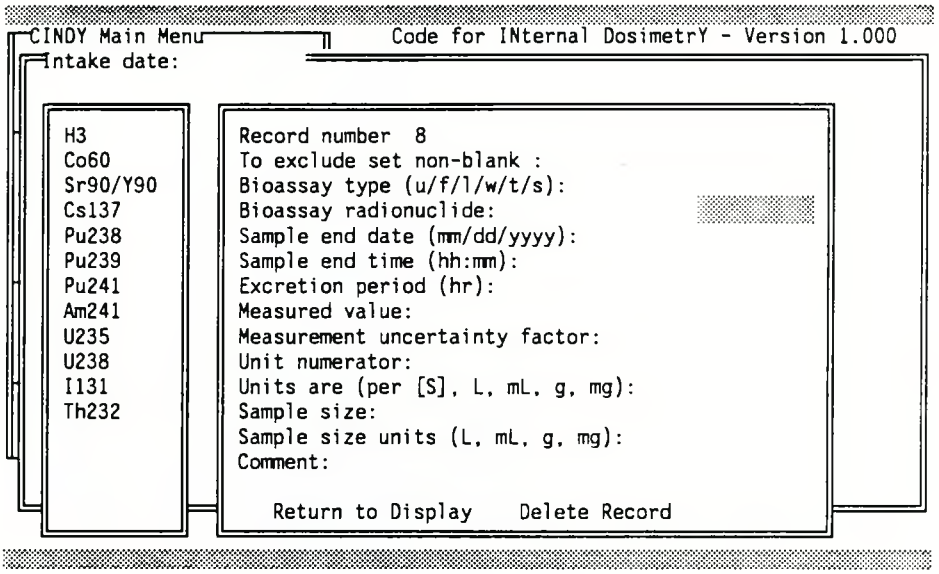


FIGURE 46. Bioassay Radionuclide Field

This bioassay-data-point-specific input parameter is input in the **Edit/Input Bioassay Data** window. Specify the bioassay radionuclide name as specified in the CINDY master radionuclide list. When the cursor bar lands on this parameter, a window opens listing the available radionuclides, as shown in Figure 46. The window closes when the user moves to the next field. This parameter is used only in the intake assessment operating mode.

Bioassay Type

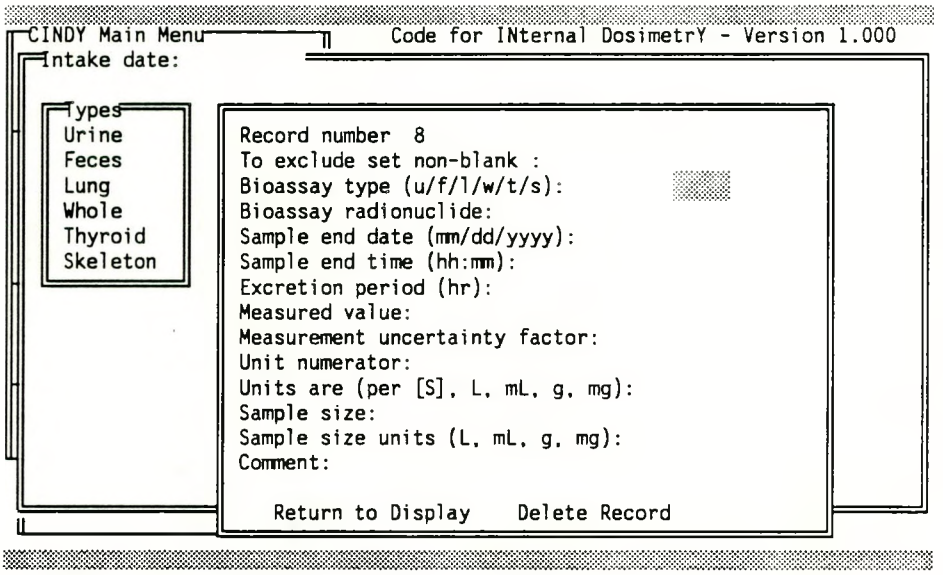


FIGURE 47. Bioassay Type Field in the Edit/Input Bioassay Data Record

This bioassay-data-point-specific input parameter is input in the **Edit/Input Bioassay Data** window. When the cursor bar lands on this parameter a window opens listing the valid bioassay data types as shown in Figure 47. The window closes when the user moves to the field. This parameter is only used in the intake assessment operating mode.

Only the first character of this field is processed; the remainder are included for readability. Entries may be either upper or lower case. Valid entries, and the bioassay types to which they correspond, are as follows:

U - Urine
F - Feces
L - Lung
W - Whole body
T - Thyroid
S - Skeleton

Calculate

After establishing the subject, selecting the desired operating mode, and setting run parameters, the user should be ready for CINDY to perform the calculations. When this item is selected, the program checks to see if essential input parameters have been specified. If so, a window will open to alert the user that the calculation is in progress. It will take a few seconds for the calculation to be completed. At that time the program will "beep", the window will close, and the cursor will be positioned on **View Run Results**.

It is important to remember to *save work before changing operating modes*. This is necessary because the output file buffers used by the calculation programs will be reused with the next calculation.

When this item is selected, separate programs are called to perform the integration and the post-processing (e.g., intake assessment, dose assessment). The length of time required to evaluate a run varies greatly, from several seconds to many minutes, based on a variety of factors including hardware, run complexity, error tolerances and file sizes.

Change Colors

The user has complete control over selection of colors used in screen displays. Three types of screen areas are defined: 1) screen (full screen area, (i.e., background), 2) menus, and 3) windows. For each of these areas the user may specify: 1) background color, 2) text color, and 3) highlight color.

For each of the screen areas, the user is shown a color block in the currently selected color and given the opportunity to select alternate colors. If an alternate color is selected, the color block is re-displayed with the newly selected colors. After cycling through the series of color questions, the user is asked if additional changes are to be made. If the answer is **yes**, the cycle of questions will be repeated; if **no**, the window will close and the cursor will be positioned on **Refresh Screen** on the **Screen Management** menu.

Press **Enter** to return to the calling menu; a message will notify you that the screen will be refreshed on return to the main menu. Return to the main menu. The screen should now be displayed in the newly-selected colors. Note that these colors will be in effect for the duration of the CINDY session. The user is cautioned not to select the same color for the background and text within any of the screen areas, because doing so will make the text invisible.

See **Default Colors** for additional information.

Change Default Parameters

Use this menu to change run-specific parameter values used in the current operating mode. For a list of all run-specific parameter values that may be changed, refer to **Run Default Parameters** in this section.

Change Edit Mode

There are three edit modes available in CINDY:

1) **insert off** (i.e., type over),
2) **insert on** (i.e., text inserted at cursor position), and
3) **blank field** (i.e, default is displayed in field but field is blanked on first keystroke).

The edit modes are in effect during data entry or edit of all input parameter fields. The selected status is displayed in the lower right-hand corner of the screen whenever the user is in an input field.

See **Default Edit Mode** to make permanent changes.

Change Graph Parameters

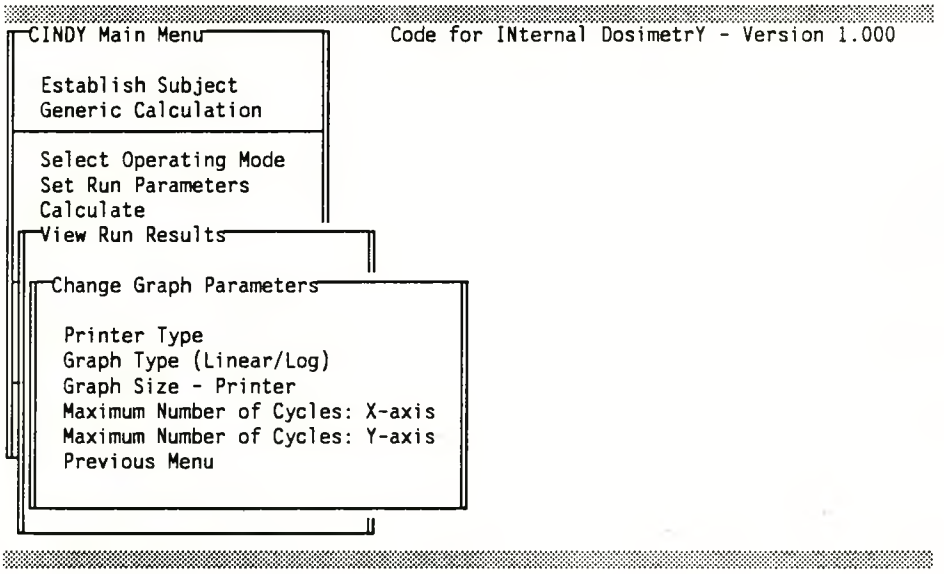


FIGURE 48. Change Graph Parameters Menu

The user has control over several parameters that affect graphic presentations, as shown in Figure 48. Select this menu to set printer type, set graph scale type (i.e., linear, log, semi-log), size of the printed graph, and maximum number of cycles on each axis.

Change Subdirectory

This feature allows the user to organize CINDY subject files into several subdirectories while remaining in the CINDY working environment. The

user is cautioned that *all subject files should be saved prior to changing subdirectories* or subject files may not be saved in the proper subdirectory.

CINDY Main Menu

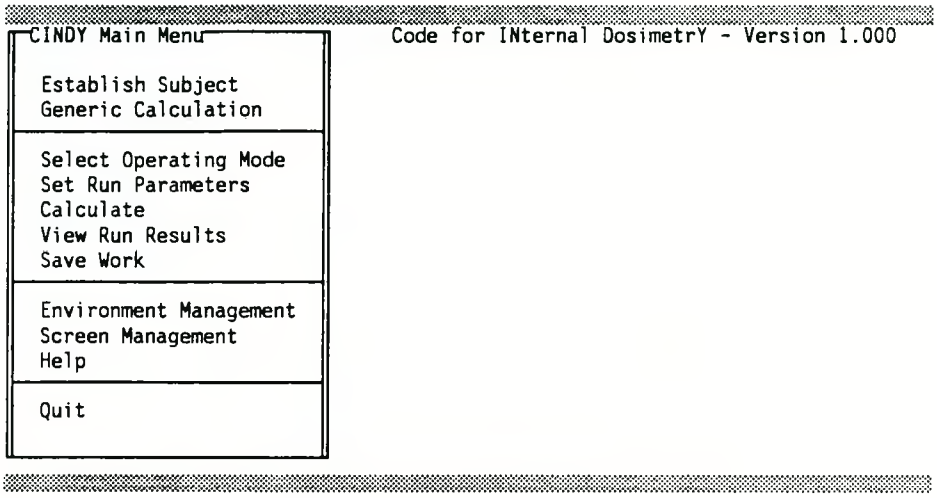


FIGURE 49. CINDY Main Menu

The CINDY main menu is divided into four sections: subject handling, the work environment, miscellaneous items, and program termination. The menu is shown in Figure 49. This menu will always be displayed though occasionally it will be overlaid with other menus or windows. To select a menu item, move the menu bar to the desired selection and press **Enter**. Selecting an item from a menu will move the user to either another level of menus (all menus are "stacked" on the screen) or to the appropriate input or report window. Pressing **Esc** is an alternate way to return to the previous screen.

Comment

This bioassay-data-point-specific parameter is input in the **Edit/Input Bioassay Data** window. Comments associated with each data point may be entered, such as why data was excluded from calculations, or the type of normalization done on the data. This field is included in the bioassay-data file for user-information only.

Date of Birth

This subject-specific parameter is entered in the **Subject Identification** window. This field is not processed by CINDY; it is included for report purposes.

Debug Messages

This option is of limited use to most users. Select this detail report option for additional information about the calculations. Some reports will be included in the run report files, others may be viewed, after a calculation, by selecting **System/Error Messages** in the **View Run Results.**

Default Colors

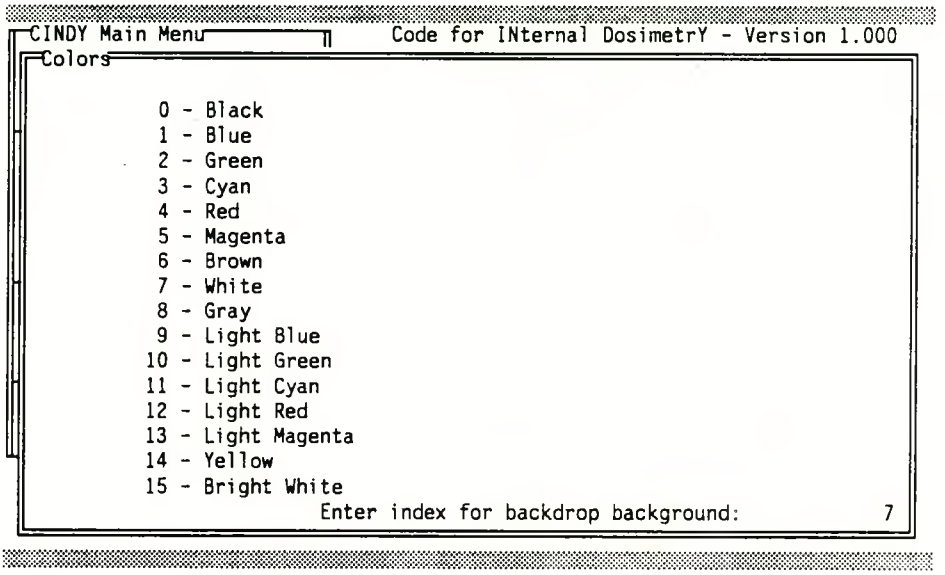


FIGURE 50. Default Colors Window

The user has complete control over selection of colors used in screen displays. Three types of screen areas are defined:

1) **backdrop** (full screen area),
2) **menus**, and
3) **windows.**

For each of these areas the user may specify:

1) **background color**,
2) **text color**, and
3) **highlight color.**

When the user selected **Default Colors** a window opens as shown in Figure 50. For each of the screen areas, the user is shown a color block in the currently selected color and given the opportunity to select alternate colors. If an alternate color is selected, the color block is re-displayed with the newly selected colors. After cycling through the series of color questions, the user is asked if additional changes are to made to the colors. If the answer is yes,

the cycle of questions will be repeated; if **no**, the window will close and the cursor will be positioned on **Refresh Screen** on the **Screen Management** menu.

Default Edit Mode

There are three edit modes available in CINDY:

1) **insert off** (i.e., type over),
2) **insert on** (i.e., text inserted at cursor position), and
3) **blank field** (i.e, default is displayed in field but field is blanked on first keystroke).

The edit modes are in effect during data entry in any field. The edit mode will be saved in the site configuration file. The selected status is displayed in the lower right-hand corner of the screen whenever the user is in an input field.

See **Change Edit Mode** for making temporary changes to the edit mode.

Default Graph Parameters

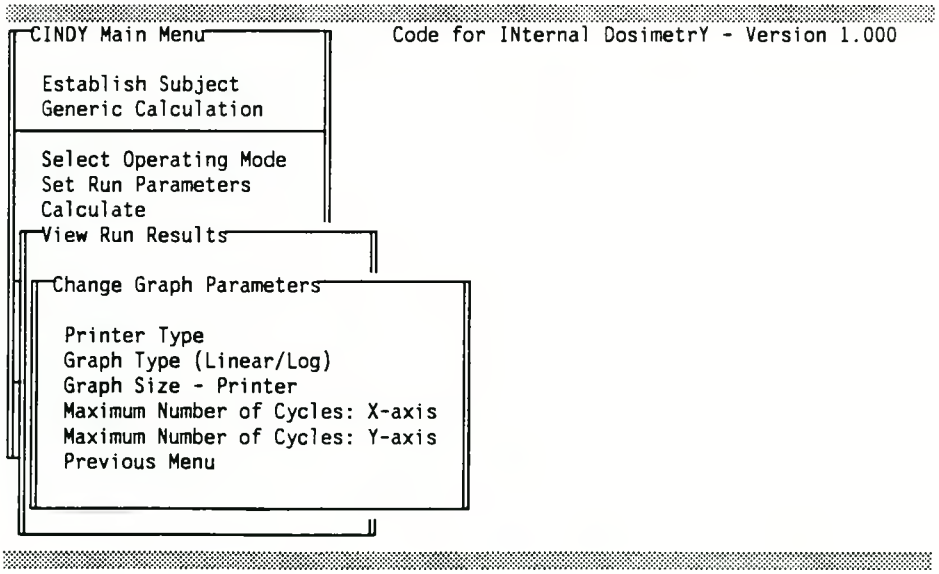


FIGURE 51. Default Graph Parameters Menu

Use this menu, shown in Figure 51, to establish default graph and graphic printer parameter values. The user may specify the type of graphic printer in use, any combination of linear/logarithmic scaling, and the maximum number of cycles to display on logarithmic axes.

Default Operating Mode

There are four operational modes in CINDY:

1) Intake Assessment,
2) Dose Assessment - Specified Period,
3) Dose Assessment - Calendar-year, and
4) Bioassay Projection.

Use this option to select the default operating mode on start-up for the site configuration.

Default Run Parameters

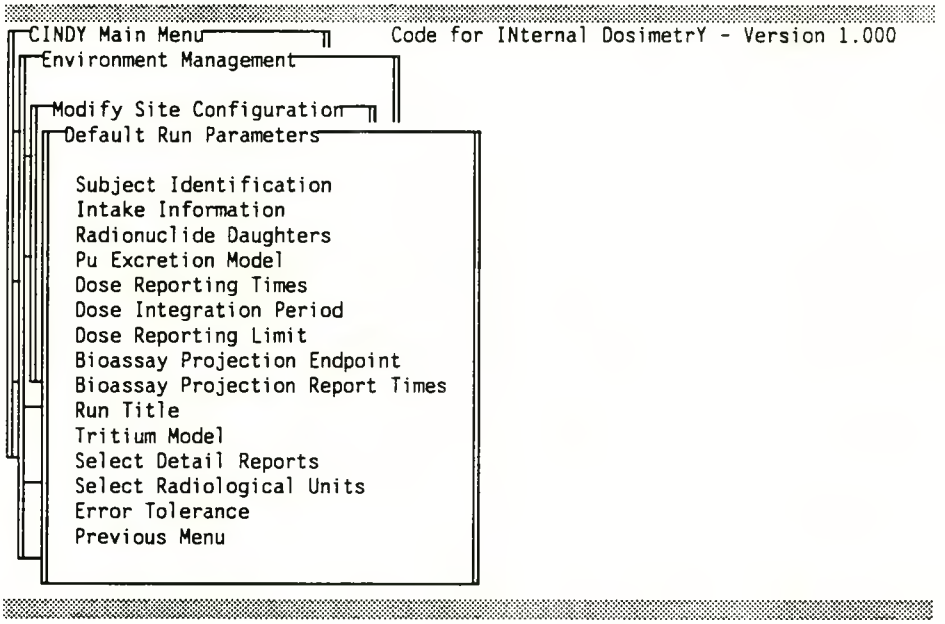


FIGURE 52. Default Run Parameters Menu

Use this menu, shown in Figure 52, to establish default run parameter values for all four operational modes for the site configuration. For additional information on each of the menu items, refer to the entry listing in this section.

Delete a File

The user may delete any file stored on the default disk drive with this item. When selected, a list of files matching the specification identified under **Select File Group** is displayed. Move the menu bar to the file of interest and press **Enter** to select the file for deletion. The user is asked to confirm the deletion.

Delete Radionuclides

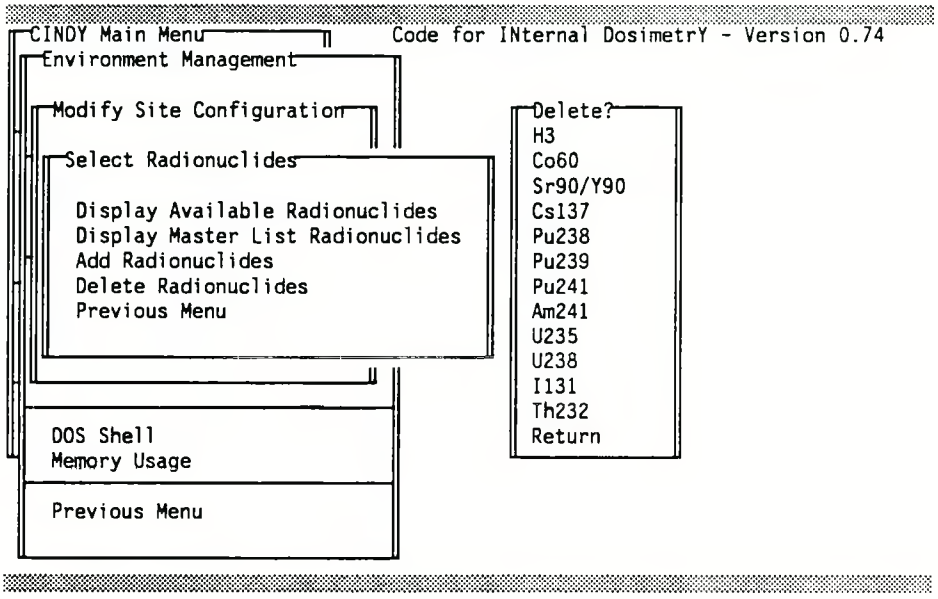


FIGURE 53. Delete Radionuclides Menu

Select this item to delete radionuclides from the site configuration. A menu is displayed with all currently selected radionuclides as shown in Figure 53. Use cursor, **PageUp**, **PageDown**, **Home**, and **End** keys to move about within the window. Move the menu bar to overlay any radionuclides that you wish to delete from the list and then press **Enter**. Deleted radionuclides are immediately removed from the list. Press **Esc** to return to the menu.

Radionuclide libraries are ordered as shown on the available list. You may wish to move frequently used radionuclides to the top of the list. This can be accomplished by deleting infrequently used radionuclides from the top of the list and then adding those radionuclides to the list.

The greater the number of radionuclides included in a site configuration, the larger the size of the programs in the CINDY Software Package. If the error "Program too large to fit into memory" is encountered when attempting to perform a calculation, try deleting infrequently used radionuclides from the site configuration. Alternately, remove other resident software packages from memory.

Display a File

The user may display any file stored on the default disk drive with this item. When selected, a list of files matching the specification identified under **Select File Group** is displayed. Move the menu bar to the file of interest and press **Enter** to display the file on the screen.

Any file may be viewed with this option, even non-text files. Note that subject graph files (file name extensions of **.RIG** and **.RPG**) are not displayed

as graphs with this option, but rather as the text files used as input to the CINDY graph routines.

Display Available Radionuclides

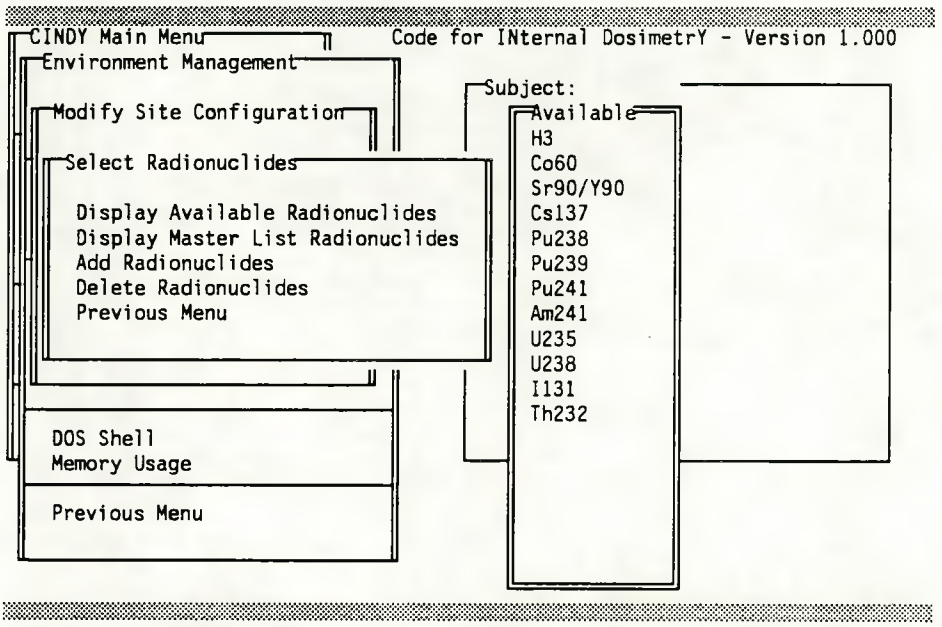


FIGURE 54. Display Available Radionuclides Window

When this item is selected, a window is opened listing the radionuclides included in the current site configuration, as shown in Figure 54. Use cursor, **PageUp**, **PageDown**, **Home**, and **End** keys to move about within the window. Press **Esc** to return to the menu. This window is informational only.

Display Master List Radionuclides

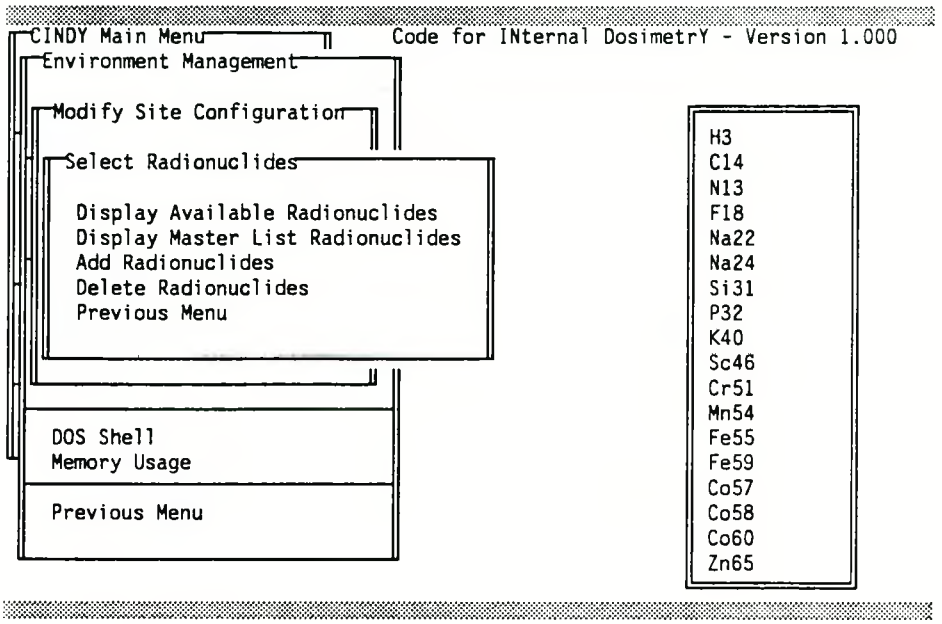


FIGURE 55. Display Master List Radionuclides Window

When this item is selected, a window is opened listing all radionuclides included in the CINDY master radionuclide library, as shown in Figure 55. Use cursor, **PageUp, PageDown, Home,** and **End** keys to move about within the window. Press **Esc** to return to the menu. This window is informational only.

DOS Shell

This option under the **Environment Managemennt** menu allows the user to shell out to DOS, and then return to CINDY. The program saves and restores the active drive and subdirectory to protect against error.

A message will appear reminding you to type **EXIT** at the DOS prompt to return to CINDY. Press any key and you should be at the DOS prompt. Type **EXIT** to return to CINDY.

Dose Assessment - Calendar Year

Select this operating mode to estimate organ and effective dose equivalents for the present calendar year and future annual increments, for given intakes. See **Select Operating Mode** for more information.

Dose Assessment - Specified Period

Select this operating mode to estimate organ and effective dose equivalents for any specified dose period or periods, for given intakes. See **Select Operating Mode** for more information.

Dose Integration Period

This run-specific input parameter is used in the calendar-year dose assessment mode to determine the time period for the dose integration period. When selected on the **Change Default Parameters** or **Default Run Parameters** menu, a window opens and the following request is made:

Enter dose integration period (yr):

The dose integration period may be entered as an integer or decimal number.

Dose Reporting Limit

This run-specific input parameter is used in the calendar-year dose assessment mode to determine how many years worth of dose results to include in the report. When selected on the **Change Default Parameters** or **Run Default Parameters** menu, a window will open and the following question will be asked:

Do you wish to set a dose reporting limit (Y/N) ?

If the user responses **yes**, the following request is then made:

Enter dose reporting limit (mrem):

When the dose reporting limit option is used, doses are reported for each year until the dose becomes less than the limit. When the dose reporting limit option is not used, the doses are reported for all years.

Dose Reporting Times

This run-specific input parameter is used in the specified period dose assessment mode to establish dose reporting times. Tables of organ and effective dose equivalents will be prepared for each requested dose period. When selected on the **Change Default Parameters** or **Run Default Parameters** menu, a window will open and the following question will be asked:

Do you wish to specify dose reporting times (Y/N) ?

If you respond, **yes**, you are then asked to:

Enter number of report times:

There is a limit of 69 report times. You are asked to enter the report times as follows:

Enter report time 1 in days:

Enter values one at a time and press **Enter** after typing each value.

Edit/Input Bioassay Data

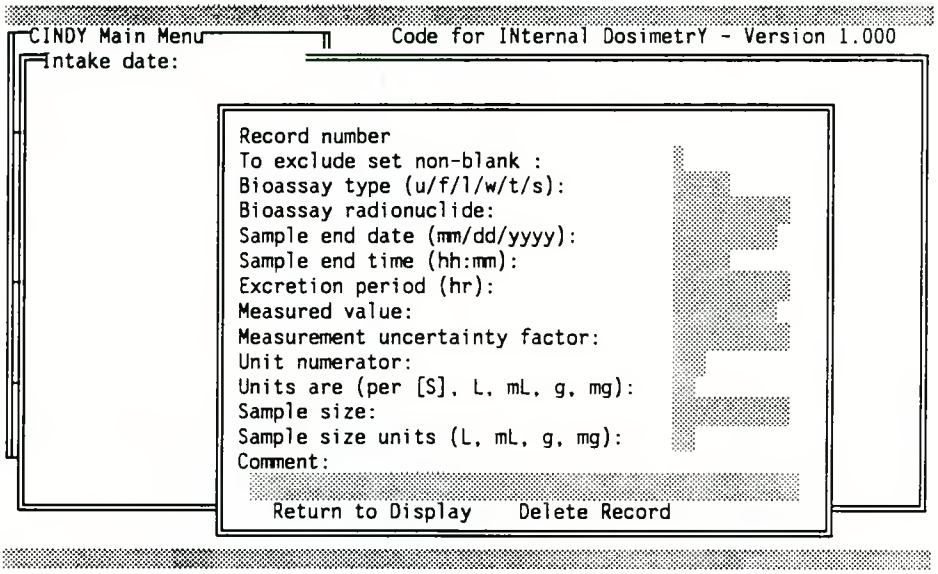


FIGURE 56. Edit/Input Bioassay Data Window

All manipulation of bioassay data within CINDY is controlled from this menu item. When a file is retrieved, CINDY checks to see if there is a file with the selected prefix and an extension of **.BIO**. If so, the file is read and evaluated. Valid records that follow the date of intake are highlighted. All other records are ignored.

The records are displayed in the bioassay data file window that opens when this menu item is selected. Each data record comprises one line of the file and the window. Use the arrow, **PageUp,** and **PageDown** keys to move around within the window. Note that the file may be larger than the window. (Up to 200 bioassay data records may be included in each subject's bioassay data file.)

The file window presentation of the bioassay data is most useful when there are many bioassay data records; the presentation may appear quite cryptic with only a few records to view. To view or edit a record, move the menu bar to the selected record and press **Enter**. Another window will overlay the bioassay data file window in which the selected record is displayed, as shown in Figure 56. The fields in the record may be edited in this window only.

To input bioassay data, move the menu bar to **Input Additional Results** and press **Enter**. Some of the fields will be prefilled with data from the last record in the file in order to minimize keystrokes.

Up to ten additional records may be entered in any input session. When ten additional records have been entered, CINDY prompts you to save and then retrieve the file. After the files have been saved and retrieved, you may then enter up to ten additional records. You may add records by successive inputs and saves until the maximum of 200 records is reached. It is assumed that large quantities of bioassay data will be prepared externally and imported into CINDY. For more information see **"Maximum new records added. Save file, then retrieve"** in the **User Warnings and Error Messages** section.

Additional information is available in this section for each field in the bioassay data file. Information is stored under the field descriptors shown below. All information in this section is arranged alphabetically.

Note that no changes are made to the subject data base files from this menu. Files are updated only from the **Save Work** option on the main menu. After making substantive changes or entries, the user might wish to save the changes before proceeding.

Employer

This subject-specific parameter is entered in the **Subject Identification** window. This field is not processed by CINDY; it is included for report purposes.

End Date

This intake-specific parameter is input in the **Intake Information** window. The end date pertains to chronic exposures only. The end date is used, along with **Begin date** and **Begin time**, to establish a basis for computing the time period of exposure.

Environment Management

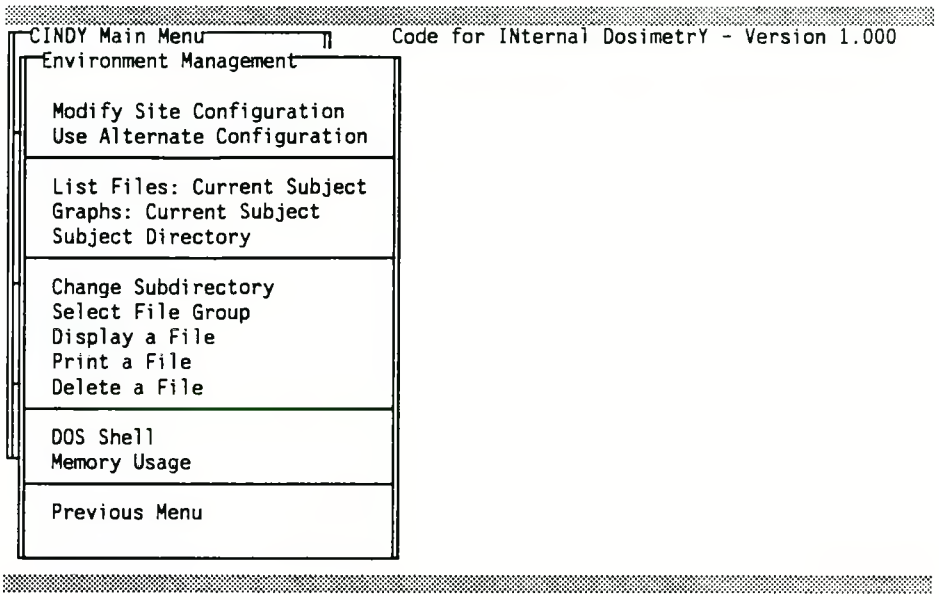


FIGURE 57. Environment Management Menu

The **Environment Management** menu allows the user to manipulate site configuration files and to perform a variety of file-related tasks without exiting CINDY. The menu, shown in Figure 57, is divided into four groups: site configuration actions, subject directory and file listings, DOS file handling, and miscellaneous. Refer to each menu item in this section for additional information.

Epson-compatible Dot Matrix Printer

Select this menu item on the **Printer Type** menu of the **Change Graph Parameters** menu when an Epson/IBM compatible dot matrix printer is the default printer of the host computer. This parameter is used only to control printing of screen-image graphic reports. This parameter selection may be saved in the site configuration.

Error Tolerance

This parameter is used by the LSODES differential equation solver to determine accuracy of the results. LSODES uses this parameter to determine the error control performed by the solver. The tighter the error control, the longer it takes the solver to arrive at a solution. Because speed of execution is a critically important component of the CINDY environment, and because the effect of the error tolerance is highly scenario-specific, this parameter has been brought out to the user input level. The alternative would have been to keep the error tolerance extremely tight for all situations and accept slow executions for all scenarios.

The default error tolerance value is 1.0×10^{-6} which is believed to give sufficiently precise results for all analyses. However, tests have indicated that a value of 1.0×10^{-4} may be sufficient for the dose assessment modes. You are encouraged to try less restrictive values if execution speeds are long.

It is up to the user to decide whether to set the error tolerance conservatively tight (1.0×10^{-8}) for all scenarios or to check error tolerance on a scenario basis. The error tolerance default value may be set in the site configuration. The code has been designed for use by knowledgeable health physicists familiar with operation of a bioassay program for radiation worker exposures. The user is responsible for the quality and accuracy of the input information, and for interpretation of the results provided by the output reports. The results generated by the CINDY code are not intended to be used without scrutiny.

The following guidance is provided for the user who chooses to check the error tolerance setting for a specific scenario. It is relatively easy for the user to determine "how good is good enough" when it comes to accuracy of results. The following heuristic is provided:

a) Perform a calculation.

b) Determine result of interest.

c) Lower the error tolerance parameter by an order of magnitude.

d) Recalculate result and compare result with previous calculation.

e) If results are in agreement, the first error tolerance was adequate.

f) If results differ, repeat steps c and d until the result of interest is in agreement with the previous calculation.

The error tolerance parameter should then be set to the adequate value for very similar scenarios. The degree of precision used is at the discretion of the user. Valid error tolerances for integration are in the range of 1.0×10^{-2} to 1.0×10^{-8}.

Establish Subject

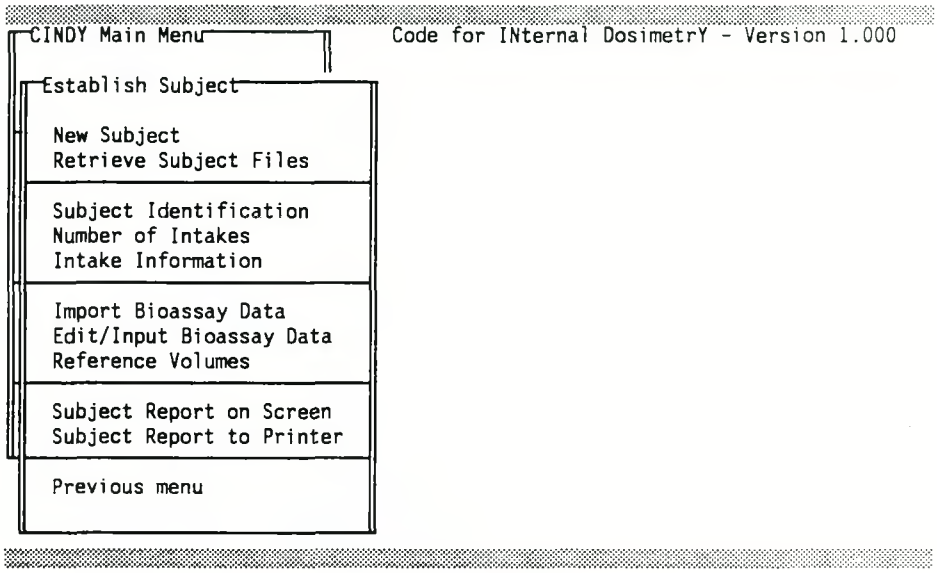


FIGURE 58. Establish Subject Menu

The **Establish Subject** menu is shown in Figure 58. All subject-related activities are handled from this menu item: creating a new subject file or retrieving an existing subject file; inputing subject identification and intake information such as type and date of exposure; identifying radionuclides of concern; importing, inputing, viewing and editing bioassay data; and showing reports on screen or in print. One subject file should be established for each worker; the file can contain all data related to the individual.

Exclusion Flag

This input parameter, which is specific to particular bioassay data points, is input in the **Edit/Input Bioassay Data** window. Any non-blank entry placed in this field excludes the record from all CINDY calculations. This field allows the user to interactively disregard questionable bioassay data points. This parameter is used only in the intake assessment operating mode. This field is available for user-definition.

Excretion Period

This input parameter, specific to bioassay data points, is input in the **Edit/Input Bioassay Data** window. The time period (hours) is the excretion period that the sample was collected over. This parameter is used only in the intake assessment operating mode.

Exposure Rate

This intake-specific input parameter is input in the **Intake Information** window. There are two valid exposure rates: acute and continuous. Only the first character of this parameter is checked, after converting the character to upper case.

Facility

This intake-specific parameter is input in the **Intake Information** window. This parameter is included in the subject report for information only.

File Name Prefix

The file name prefix for the subject file may be entered either in the **Subject Identification** window or when saving files in the **Save Work** menu. All subject files will bear this file name prefix and file name extensions as identified in Table 3.

Generic Calculation

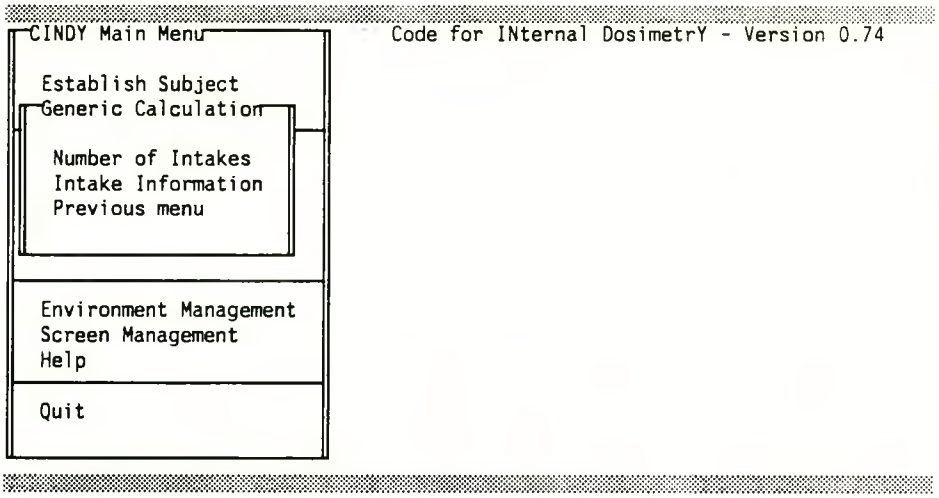


FIGURE 59. Generic Calculation Menu

The generic calculation option allows calculations to be performed independent of a subject. For example, dose factors could be calculated per unit intake for comparison with values reported in other compilations. The generic calculation menu is shown in Figure 59.

Note that default values are displayed in fields as defined in the site configuration. Some of this information is subject-specific, included

primarily for report headings and consequently of no importance for generic calculations. With generic calculations, date and time are important only for the intake assessment mode where it is used in conjunction with bioassay measurement dates and times to determine output times.

Graph Size - Printer

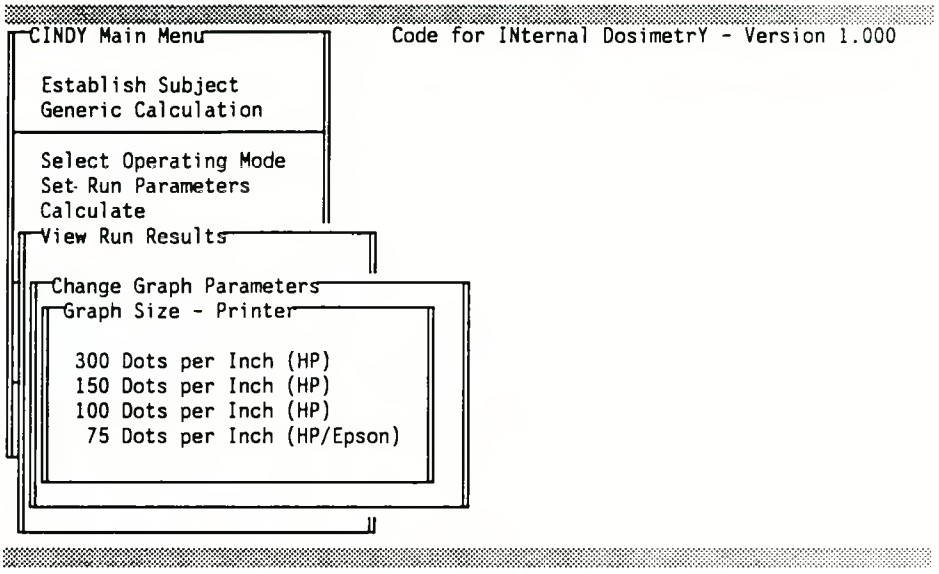


FIGURE 60. Graph Size - Printer Menu

This menu controls the size of graphs printed with the **Graphic Report to Printer** option on the **View Run Results** menu. The graph size - printer menu is shown in Figure 60. The menu bar will be positioned on the currently selected option when this menu opens.

These options require an HP LaserJet+ or LaserJet II printer. With an Epson/IBM graphics printer, the only valid option is 75 dots per inch; this option is automatically selected when the Epson/IBM graphic printer is selected.

A heading is printed with all graphs, using the printer's default font.

Graph Type (Linear/Log)

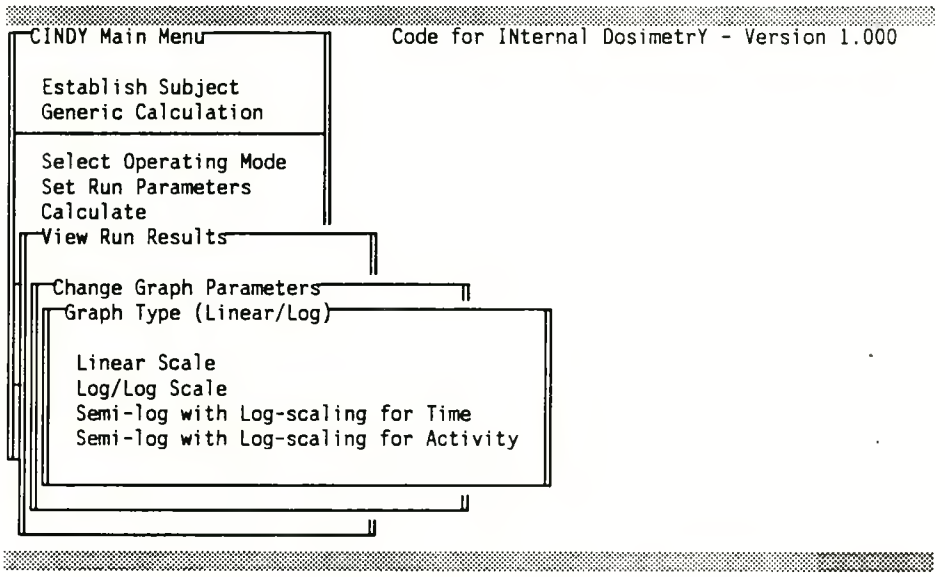


FIGURE 61. Graph Type Menu

The graph type menu is shown in Figure 61. The user may select any of the graph types shown in the menu. The menu bar will be positioned on the currently selected option when this menu opens.

Graphic Display on Screen

Select this option for a graphic display of intake assessments and bioassay projections. There are no graphic reports for dose calculations. The user must have either an IBM Enhanced Graphics Adapter (EGA) or IBM Video Graphics Adapter (VGA) to display graphics.

The intake assessment graphic report allows the user to visually determine the goodness of the model fit to the bioassay data. Intake estimates are calculated by three methods: ratio of the means, average of the slopes, and unweighted least squares. A fourth intake estimate is calculated if the user has provided weights in the bioassay data file.

The bioassay projection graphic reports are presented sequentially by bioassay type. Press any key to display the next graph. Upon completion, the user is returned to the calling menu.

Graphic Report to File

Graphic report screen images may be saved in a Microsoft Paintbrush[(a)] format (.PCX) for importing into popular desktop publishing programs. The PCX file format compresses screen images to an average of 40% of their original size. The user must have either an IBM Enhanced Graphics Adapter (EGA) or IBM Video Graphics Adapter (VGA) to save graphic report screen images.

Graphic Report to Printer

Select this option for a printed graphics report of intake assessments and bioassay projections. There are no graphic reports for dose calculations.

The user must have either an IBM Enhanced Graphics Adapter (EGA) or IBM Video Graphics Adapter (VGA), and either a HP[(b)] LaserJet+, HP LaserJet II, or Epson/IBM-compatible dot matrix printer to print graphics.

When selected, graphs will be constructed on the screen and then sent to the printer. All graphs in the current run will be printed. Subject information is included in a heading on printed graphic reports. Example graphic reports are shown in the sample problem section.

Graphs: Current Subject

Select this option from the **Environment Management** menu to display previously calculated intake assessments and bioassay projections for the current subject. When this option is selected, a menu will open containing available graph files. A file name extension of **.rig** indicates an intake assessment graphic report. A file name extension of **.rpg** indicates a bioassay projection graphic report.

Help

Select this option on the main menu to page through additional information on running CINDY. All information available through the **Help** menu item is contained in this volume.

(a) Microsoft Paintbrush is a registered trademark of Microsoft Corporation.
(b) HP and LaserJet are trademarks of the Hewlett Packard Company. The LaserJet+ and LaserJet II printers are products of Hewlett Packard.

HP LaserJet+ or LaserJet II Printer

Select this menu item on the **Printer Type** menu of the **Change Graph Parameters** menu when an HP LaserJet+ or LaserJet II printer is the default printer of the host computer. This parameter is used only to control printing of screen-image graphic reports. This parameter selection may be saved in the site configuration.

ID

This subject-specific intake parameter (ID for identification) is entered in the **Subject Identification** window. This field is included in report headings for information only.

Import Bioassay Data

The CINDY subject database is intended to be compatible with other databases in use at DOE facilities. A bioassay data import format has been established to allow easy transport of data from other record-keeping databases. Files prepared in this format may be imported directly into the CINDY working environment.

The ASCII-formatted file is composed of fixed-size, blank-delimited fields. The file consists of a title record (not processed by CINDY but included for quality-assurance and readability) followed by a variable number of records.

See the section **Importing Bioassay Data** in this report for additional information on this file.

Intake Assessment

Select this operational mode to estimate intakes based on bioassay data using regression formulas between measured and estimated excretion rates. This mode requires bioassay data to be provided. Four regression formulas are used:

1) ratio of means,
2) average of the slopes,
3) unweighted least squares, and
4) user-defined weights.

The fourth method is only evaluated if values are given for **Measurement Uncertainty** in the bioassay data records. The inverse of these values are used as weights in the weighted regression analysis to estimate intake.

Intake Component Contributions

Select this report option from the **Select Detail Reports** menu when more than one intake component has been specified. This option is in affect for all four operational modes. This parameter may be saved with site configuration files.

Intake Composition

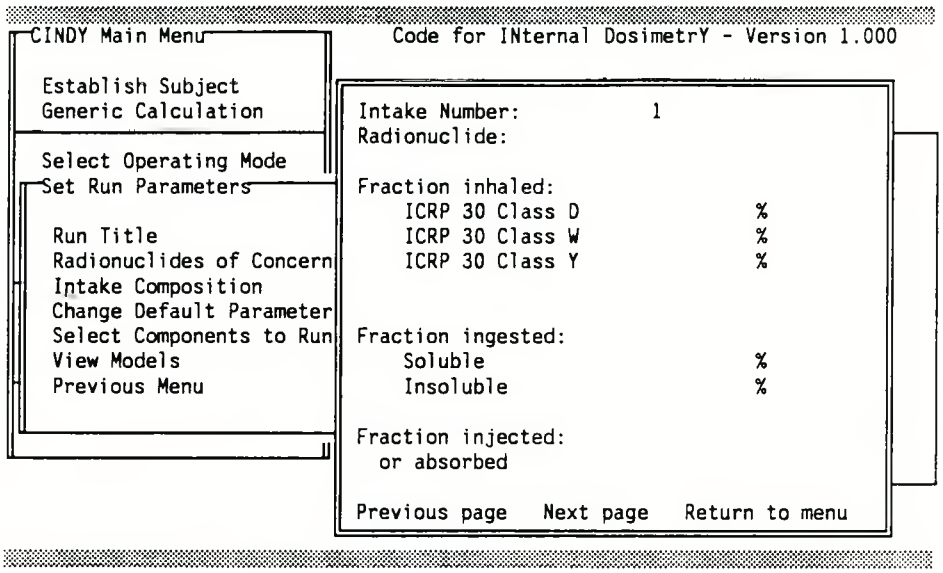


FIGURE 62. Intake Composition Window

The intake composition window is shown in Figure 62. A window is displayed for each radionuclide of concern. Pertinent fields in this window are highlighted, based on previous subject-specific intake information provided. The user may enter data into any highlighted fields. If only one mode of exposure is specified, the fraction taken in is preset to 1.0.

Pages are ordered by radionuclide position in the **Radionuclides of Concern** menu. If more than one radionuclide of concern was indicated for this exposure scenario, the user would use **Next page** to display additional radionuclide input pages. **Previous page** returns the user to previously displayed radionuclide input pages.

If either wound or absorption intake modes are specified, a window will open for entering direct intake parameters when the user returns to the calling menu. Because direct intakes may be from wounds, skin absorption, or injections, CINDY does not contain default values for any parameters for the direct intake model. See **Wound** and **Absorption** in this section for additional information.

*The Intake Estimate window will not open if no **Radionuclides of Concern** have been identified or if no intake modes were identified (under **Establish Subject, Intake Information**).*

Intake Estimate

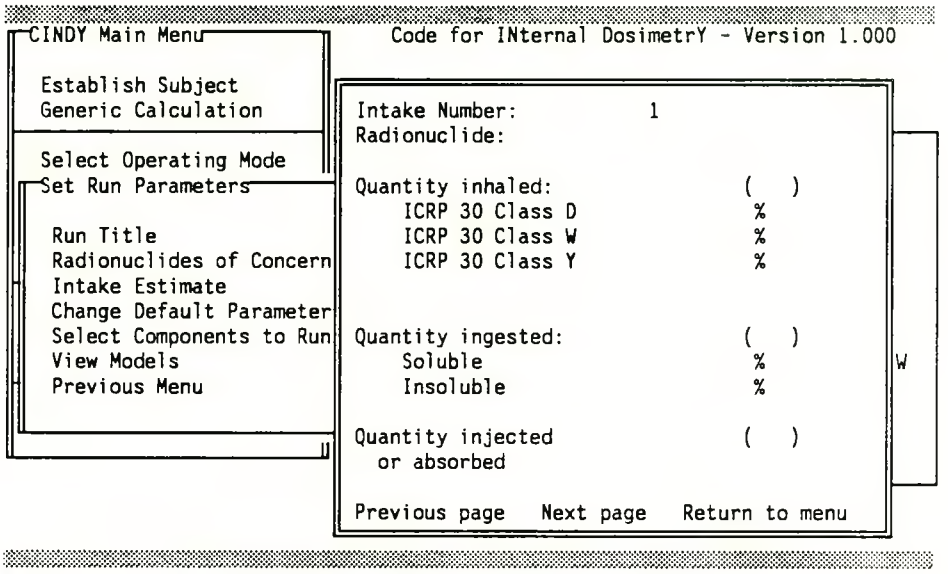


FIGURE 63. Intake Estimate Window

Select this item to enter the intake quantity. A window is displayed for each **Radionuclide of Concern**. Note that the window, shown in Figure 63, is similar to the **Intake Composition** window. Pertinent fields in this window are highlighted, based on previous subject-specific intake information provided. The user may enter data into any highlighted fields.

Pages are ordered by radionuclide position in the **Radionuclides of Concern** menu. If more than one radionuclide of concern was indicated for this exposure scenario, the user would use **Next page** to display additional radionuclide input pages. **Previous page** returns the user to previously displayed radionuclide input pages.

If either wound or absorption intake modes are specified, a window will open for entering direct intake parameters when the user returns to the calling menu. Because direct intakes may be from wounds, skin absorption, or injections, CINDY does not contain default values for any parameters for the direct intake model. See **Wound** and **Absorption** in this section for additional information.

*The Intake Estimate window will not open if no **Radionuclides of Concern** have been identified or if no intake modes were identified (under **Establish Subject, Intake Information**).*

Intake Information

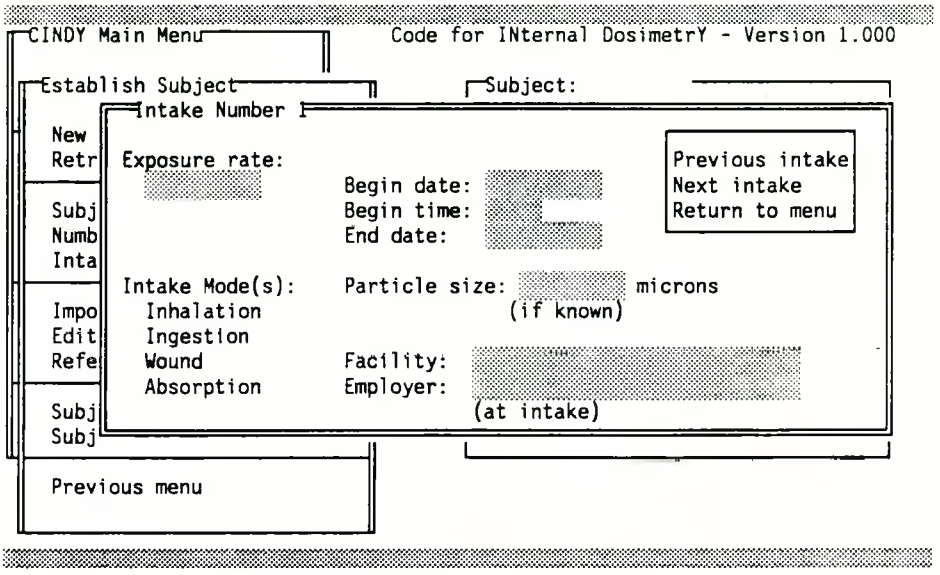


FIGURE 64. Intake Information Window

Intake information in CINDY is organized by **subject** or worker to simplify reporting. For each subject there may be one or more **intake**(s) or exposure scenarios. CINDY currently handles only a single intake. An intake may be either acute or chronic and can consist of a mixture of exposure modes (e.g., inhalation, ingestion, wound), radionuclides, and solubility classifications. CINDY treats an intake as a collection of **intake components**. Each intake component consists of a single exposure mode, a radionuclide or radionuclide chain, and a solubility classification. CINDY determines the intake components for the current subject based on the selected exposure modes and types, the radionuclides of concern, and intake composition or quantity. A **run** consists of the selected intake components for the current calculation.

Information about the intake, with the exception of radionuclide identification, may be entered or edited when the **Intake Information** window, shown in Figure 64, is open. Use this window to indicate the mode(s) of exposure, the date(s) and time of the exposure, and particle size (if inhalation), and whether the exposure is acute or chronic . Other information may be entered, such as facility and employer at time of this intake.

When performing generic calculations, date and time are important only for the intake assessment mode when it is used in conjunction with bioassay measurement dates and times to determine output times.

Intake Mode(s)

There are four possible intake modes available in CINDY:

1) **inhalation,**
2) **ingestion,**
3) **wound,** and
4) **absorption.**

Wound and absorption intakes use the direct intake model. Any evaluation may consist of a mixture of the four possible intake modes. The inhalation intake may be specified as Classes D, W, or Y, or any mixture of the three classes. Ingestion intake may be classified as soluble or insoluble, or a mixture of the two.

The intake modes are specified in the **Intake Information** window. To select or deselect an intake mode, move the menu bar to the appropriate intake mode and press **Enter**. Selected modes are highlighted. The bell sounds whenever an intake mode is selected or deselected to protect against inadvertent changes.

Intake modes must be specified before intake composition or intake estimates can be input.

Linear Scale

Select this option on the **Graph Type** menu to display graphs with linear scales on both axes. Refer to **Graph Type** in this section for additional options.

List Files: Current Subject

A list of all database files for the current subject, both input and report, will be displayed when this item is selected. **Esc** returns the user to the menu, pressing return will display the highlighted file.

Log/Log Scale

Select this option on the **Graph Type** menu to display graphs with log scales on both axes. Refer to **Graph Type** in this section for additional options.

Main Menu

(See **CINDY Main Menu**).

Maximum Number of Cycles: Y-axis

Select this option on the **Change Graph Parameters** or **Default Graph Parameters** menus to set the maximum number of cycles to be displayed on the y-axis (radiological activity). This parameter affects data presentation by ignoring data points outside the selected range.

Maximum Number of Cycles: X-axis

Select this option on the **Change Graph Parameters** or **Default Graph Parameters** menus to set the maximum number of cycles to be displayed on the x-axis (time). This parameter affects data presentation by ignoring data points outside the selected range.

Measured Value

This input parameter, specific to particular bioassay data points, is input in the **Edit/Input Bioassay Data** window. Measured value is at indicated time. Units are specified below. See **Edit/Input Bioassay Data** in this section.

Measurement Uncertainty

This input parameter, which is specific to particular bioassay data points, is input in the **Edit/Input Bioassay Data** window. Measurement uncertainty is included in the file for use in evaluating the estimate of intake for the "user-defined weights" method. See **Intake Assessment** and **Edit/Input Bioassay Data** in this section.

Memory Usage

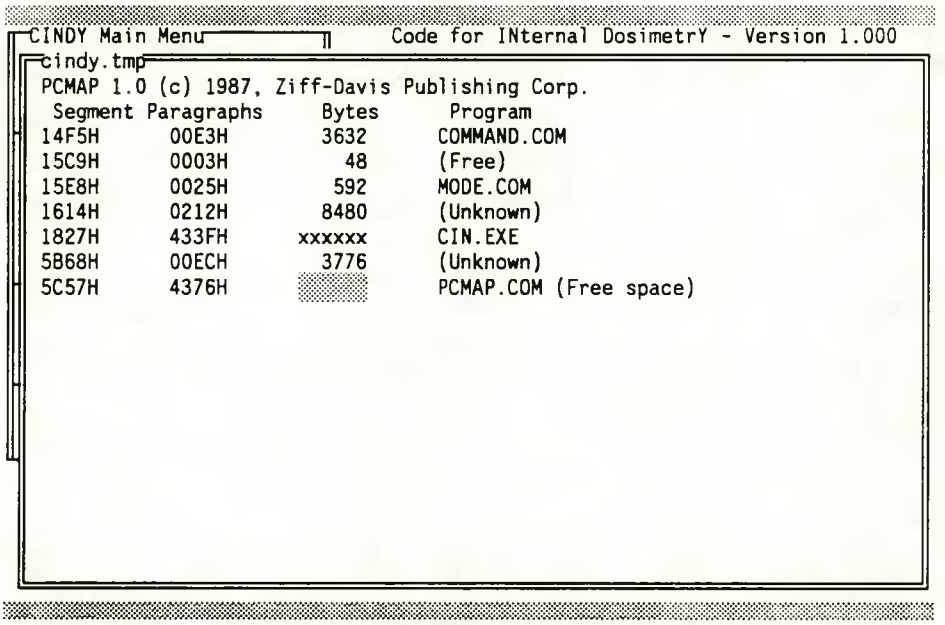


FIGURE 65. Memory Usage Window

Use this feature to check amount of available memory while CINDY is executing. A window opens displaying the output of the public domain software PCMAP as shown in Figure 65. The number of bytes used by each program currently in memory is displayed. Memory resident programs should all be noted on this screen, although some may be listed as **(Unknown).** Note that the size of the program named **CIN.EXE** varies by CINDY version as well as by site configuration and subject file. The **Unknown** block listed directly before **CIN.EXE** (8480 bytes) is a data area reserved by CINDY for communication with auxiliary programs. The last line, labelled **PCMAP.COM (Free space),** indicates the number of bytes of free space. This is the amount of memory CINDY has available to run the calculation and auxiliary programs. If there is insufficient memory, the message **Program too big to fit into memory** would appear in the **System/Error Messages** window on the **View Run Results** menu.

The size of the auxiliary and calculation programs vary somewhat by CINDY version. The number of bytes necessary to execute these programs is roughly comparable to the size in bytes of the executable files. The largest program will most likely be the file named **INTGRAT.EXE** in the **CINDY** subdirectory (about 300 kilobytes). Check the size of the **INTGRAT.EXE** and compare to the amount of free space shown on the last line in the window. If there is insufficient free space to execute the program **INTGRAT.EXE**, remove memory resident programs until sufficient memory is available.

Modify Site Configuration

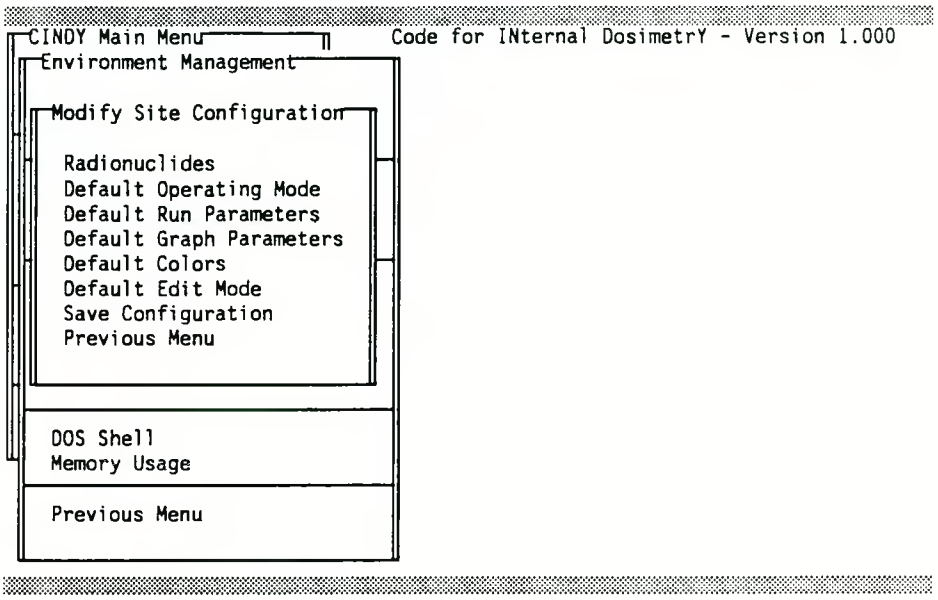


FIGURE 66. Modify Site Configuration

Use this menu, shown in Figure 66, to create, edit, or save a site configuration. This item may also be used to view current site configuration parameter values.

The site configuration allows the user to customize the working environment for a particular site or facility. The site configuration defines default parameter values and options, the list of radionuclides available for calculations, and the default metabolic data. The process of establishing the site configuration is sometimes referred to as **site set-up**. A user may define more than one site configuration.

Site configurations are stored in files and may be retrieved at the command line (e.g., by executing **CINDY mysite** where **mysite** is the name given to the site configuration) or from the **Use Alternate Configuration** menu (on the **Environment Management** menu) within CINDY.

Name

This subject-specific input parameter is entered in the **Subject Identification** window. This field is included in report headings and on the subject status screen report.

New Subject

Select this option to establish a new subject. When selected, all parameter values are reset to the site configuration defaults. *No data on the new subject is written until the user selects **Save All Work** or **Save Subject Files** on the **Save Work** menu.*

No Graphics Printer

Select this menu item on the **Printer Type** menu of the **Change Graph Parameters** menu when the default printer of the host computer cannot support either HP LaserJet or Epson/IBM dot matrix graphics. This parameter is used only to protect against system hang-up following inadvertent selection of the **Graphic Report to Printer** when a supported graphics printer is not available. This parameter selection may be saved in the site configuration.

Number of Intakes

Currently, only a single may be evaluated in CINDY. This parameter has been included in this menu to allow for future development. However, each intake may consist of multiple modes of exposure, radionuclides, and solubility classifications, all occurring over the same intake period.

Number of Nuclear Transformations

The user may select this report option from the **Select Detail Reports** menu. This option is active only for dose assessment operational modes. The number of nuclear transformations at the last report time is reported.

Particle Size

This intake-specific input parameter is entered in the **Intake Information** window. The user may specify the particle size of the inhaled material. Lung deposition fractions are calculated based on this parameter. (See **Intake Information** in this section.)

Previous Menu

Select this menu item to return to the calling menu (i.e., the menu immediately underlying the current menu). Pressing **Esc** is an alternate way to return to the previous menu.

Print a File

The user may print any file stored on the default disk drive with this item. When selected, a list of files matching the specification identified under **Select File Group** is displayed. Move the menu bar to the file of interest and press **Enter** to print the file. (See **Environment Management** in this section.)

Printer Type

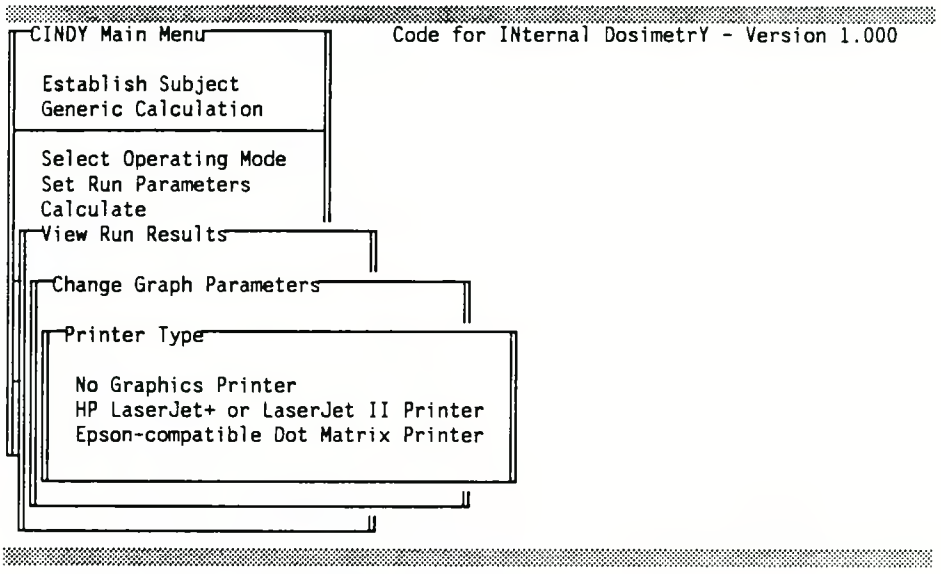


FIGURE 67. Printer Type Menu

This menu, shown in Figure 67, controls printing of graphic screen images within CINDY. Select the appropriate option for your host computer. The default site configuration assumes that no graphic printer is attached to the host computer to protect against system hang-ups. See **Change Graph Parameters** in this section.

Pu Excretion Model

The user may select from three available plutonium excretion models, as discussed in Part 1. When this item is selected on the **Change Run Parameters** or **Run Default Parameters** menus, a window opens and the following request is displayed:

Enter index of Pu excretion model (0-Jones, 1-Durbin, 2-ICRP):

This parameter is active in the intake assessment and bioassay projection operational modes.

Quit

A window will open asking if you really wish to quit. The default is no. This question protects the user from inadvertently exiting CINDY.

Radionuclides

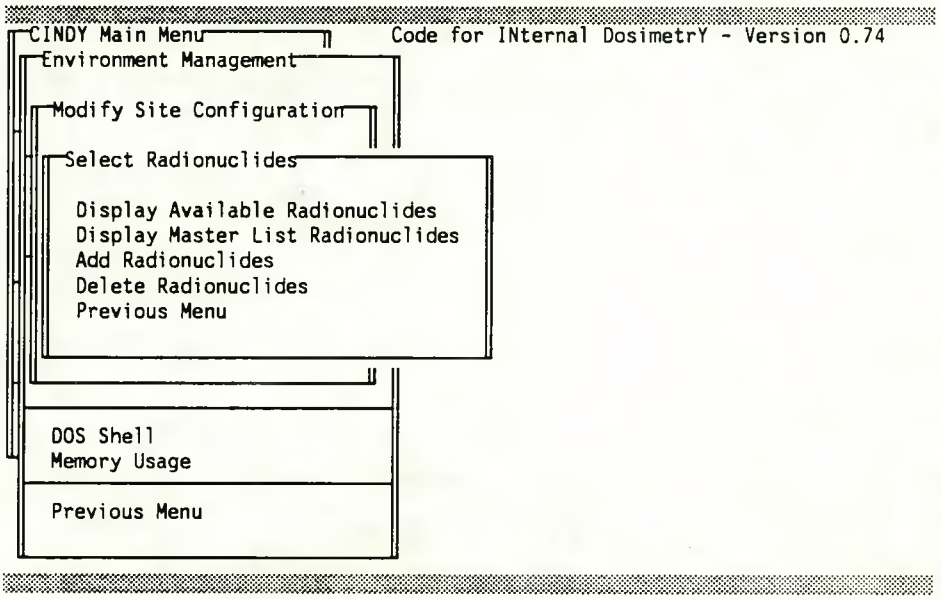


FIGURE 68. Radionuclides Menu

Select this item on the **Modify Site Configuration** menu to make changes to the list of available radionuclides. A menu opens as shown in Figure 68. *If changes are made to the list of available radionuclides, the site configuration must be saved under a new name. CINDY will check for changes to the list of available radionuclides and not allow the user to save site configuration under the current name if changes have been made.*

The greater the number of radionuclides included in a site configuration, the larger the size of the programs in the CINDY Software Package. If the error "Program too large to fit into memory" is encountered when attempting to perform a calculation, try deleting infrequently used radionuclides from the site configuration.

There is a relationship between position of radionuclide in the site-configuration list and program execution speed. The closer to the beginning of the list, the less time needed to search for library values.

Radionuclide Daughters

When this menu item on the **Change Default Parameters** or **Run Default Parameters** menu is selected, a window will open and the following question will be displayed:

Consider radionuclide daughters for intake/projections (Y/N)?

Radionuclide daughters are always considered for dose calculations. The user has the option of whether or not to consider daughters during intake assessments and bioassay projections. Considering daughters during intake assessments and bioassay projections will require more execution time for radionuclides with explicit daughters.

Radionuclides of Concern

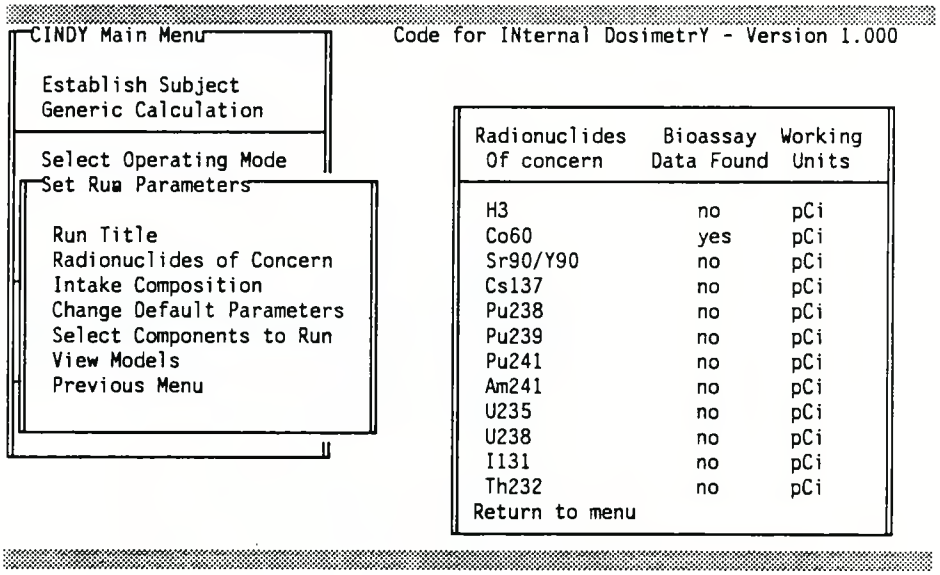


FIGURE 69. Radionuclide of Concern Menu

Use this menu to identify radionuclides of concern for the current subject. Selecting this menu item opens a window listing all available radionuclides in the current site configuration, as shown in Figure 69. Selected radionuclides of concern are highlighted and a **yes/no** flag indicates whether bioassay data was found that was pertinent to the current intake. When the bioassay data is entered or read, CINDY evaluates the data and sets the radionuclide of concern flags automatically. Press **Enter** to select or deselect any radionuclide. Bioassay data is used only in the intake assessment mode. The user may select any number of radionuclides of concern.

The working units for each radionuclide are displayed for information only on this screen. To change the working units, return to the **Set Run Parameters** menu, select **Change Default Parameters** and **Select Radiological Units.**

Reference Volumes

Select this menu item on the **Establish Subject** and **Modify Site Configuration** menus to specify reference excretion volumes/masses for the current subject or site configuration, respectively. When this item is selected, a window opens and the following requests for information are made. The default reference volumes/masses are also displayed.

Enter reference volume for urine - male (mL): 1400
Enter reference volume for urine - female (mL): 1000
Enter reference mass for feces - male (g): 135
Enter reference mass for feces - female (g): 110

Refresh Screen

Select this option on the **Screen Management** menu after changing colors or if the screen was inadvertently disturbed by untrapped error messages. Report untrapped error messages to the code developers.

Remove Run Status Page

At times the user may wish to remove the run status page to view information contained on the subject status page. Select this item on the **Screen Management** menu to remove the run status page.

Retrieve Subject Files

Subject information that was saved during a previous CINDY execution may be retrieved using this menu item. When selected, an alphabetized directory of all subject files in the current subdirectory will pop up. Each file name has an extension of **.CIN** which is the standard file extension for the primary subject files. The DOS date and time stamp for each file is also displayed in the menu.

Use the arrow, **PageUp** and **PageDown** keys to display all files within the menu. Move the menu bar to the selected file and press **Enter**. If you wish to select a file from another subdirectory, move to the **Environment Management** item on the main menu, select the **Change Subdirectory** item, enter the name of the alternate subdirectory, and then return to this menu item.

Return to Menu

Select this menu item to close the current window and return to the calling menu. Pressing **Esc** is an alternate way to return to the calling menu.

Run Title

This run-specific input parameter may be entered when this menu item is selected on the **Set Run Parameters** or **Run Default Parameters** menus. When selected, a window opens and the user is asked to enter a run title. The run title is included in the heading of all reports as well as on the run status page. Optionally, this space may be used for notes the user wishes documented with the current run.

Sample End Date

This input parameter is entered in the **Edit/Input Bioassay Data** window. Sample end date reflects the end of the collection period in the following format: mm/dd/yyyy. See **Edit/Input Bioassay Data** in this section.

Sample End Time

This input parameter is entered in the **Edit/Input Bioassay Data** window. Sample time in 24-hour format reflects the end of the collection period in the following format: hh:mm. See **Edit/Input Bioassay Data** in this section.

Sample Size

This input parameter is entered in the **Edit/Input Bioassay Data** window. Enter sample size in terms of volume (urine) or mass (fecal). See **Edit/Input Bioassay Data** in this section.

Sample Size Units

This input parameter is entered in the **Edit/Input Bioassay Data** window. In the present version, allowable units are:

L
ml
g
mg

See **Edit/Input Bioassay Data** in this section.

Save All Work

Select this item on the **Save Work** menu to save the current subject parameters and the reports from the most recent calculation. A window will open requesting the file name prefix to use. The default selection is shown in the field. Refer to the discussion under **Save Subject Files** and **Save Report Files** for additional information on each type of database file.

Save Configuration

When this menu item is selected on the **Modify Site Configuration** menu, CINDY checks if any changes have been made to the list of available radionuclides.

If changes have been made, a message will announce that the site configuration must be saved under a new name. A window will open requesting a file name prefix. Enter a unique file name. The file name will be tested for validity before the program continues.

The program next asks if the user wishes to regenerate all libraries. Usually, you may answer **no** to this question. When you do not regenerate all libraries, data in the current site configuration libraries are used whenever possible, and, consequently, the site configuration files are rebuilt much more quickly than when all parameter values must be located in the master libraries. *However, it is important that you answer **yes** to this question after installing future updates to the CINDY software package so that your site configuration files reflect any changes made to the radionuclide organization and decay, the metabolic data, and the specific effective energy data.*

A window opens to inform the user that the site radionuclide file is being written. Then the message **"To complete new site configuration, return to main menu"** will appear. Press any key to continue. Select **Previous Menu.** Another window will open informing the user to allow 2-3 minutes for each radionuclide added to the available radionuclide list.

When complete, the window will close. Check the site configuration file box on the backdrop. The new site configuration file name should appear.

Save Work

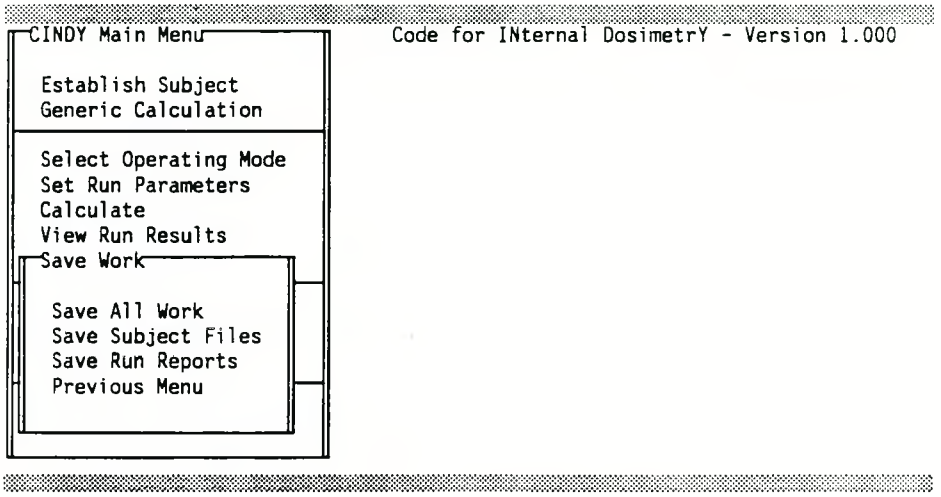


FIGURE 70. Save Work Menu

You may save all subject input and report files from this menu, shown in Figure 70. All subject files are saved with a user-specified file name prefix. CINDY appends reserved file name extensions to store various input and report files. Refer to the **Subject Database Files** section for more information on the file name extension used in CINDY.

Information must be explicitly saved in CINDY. This feature is based on the assumption that the user may iterate through several runs (e.g., getting a good fit on an intake assessment) before being satisfied with results. Subject data is stored in several files; each file has the user-specified subject file name prefix and a standard file name extension. Standard file name extensions are identified and described in Table 1. The list of files associated with each subject may be viewed, provided that the subject files have been retrieved, from the **Environment Management** menu, **List Files: Current Subject** item.

Save Run Reports

The most current report files will also be saved for the current operating mode when this menu item is selected. Report files may be saved for each of the four operating modes. These files are stored with the subject file name prefix and extensions, as identified in Table 1. Information in each report file may vary based on the selected output options active when the calculations were performed. A window will open requesting the file name prefix to use. The default selection is shown in the field.

Save Subject Files

All subject-specific and run-specific parameters will be saved, including the current operating mode. The primary subject input file has a file extension of **.CIN**; the bioassay data file for this subject has a file extension of **.BIO**. Both the input and bioassay data files are written in ASCII format.

If any metabolic parameters have been changed for the subject, a subject-specific metabolic data file is also saved with a file name extension of **.MOD**. A message is printed on reports when a subject-specific metabolic data file is present to alert the user that metabolic data may differ from the standard metabolic data library. If a subject-specific metabolic data file exists and the user wishes to return to using standard metabolic data, from the **Environment Management** menu, select **Delete a File**, and select **nnnn.MOD**, where **nnnn** is the subject-specific file name prefix.

If a calculation has been performed, the most current calculational input file is saved with a file extension of **.IN**. The calculational input file is written as an annotated ASCII-formatted file. Use of the calculational input file is transparent to the novice and typical users; however, the power user may set up batch process files using the calculational input files, as discussed in the Advanced Users Manual.

When **Save Subject File** is selected, a window will open requesting the file name prefix to use. The default selection is shown in the field. Whenever you save the subject files, all currently selected options are saved.

Screen Management

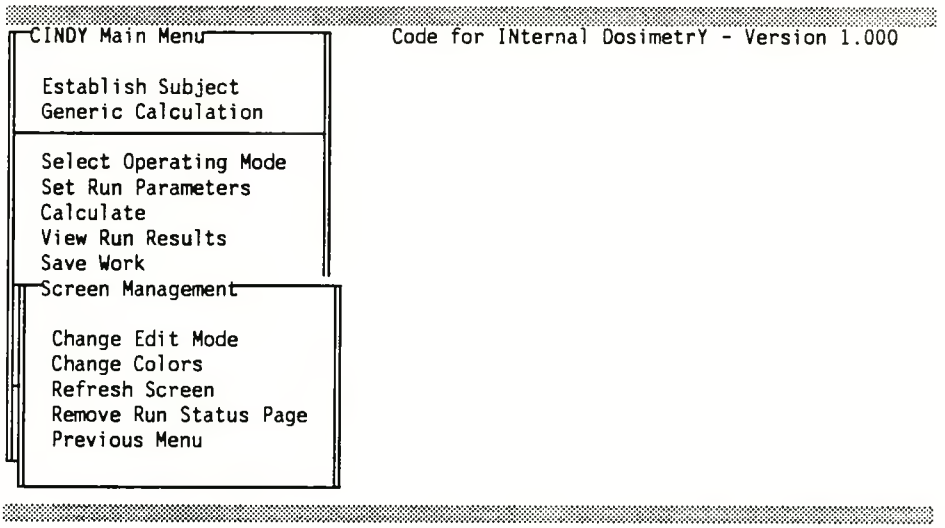


FIGURE 71. Screen Management Menu

The **Screen Management** menu, shown in Figure 71, allows the user to select alternate colors, change the edit mode, remove the run status page from the screen, and refresh the screen. Refer to each menu item in this section for more information.

Select Components to Run

Use this menu item to select/deselect intake components for the current run. The user may select any or all of the defined intake components for consideration in any given run. An asterisk before an intake component indicates that it is selected for consideration. Selected components are also highlighted.

CINDY generates a list of possible intake components based on user input. CINDY initially sets all intake components as selected; additional components added through scenario changes may need to be explicitly selected by the user.

Select Detail Reports

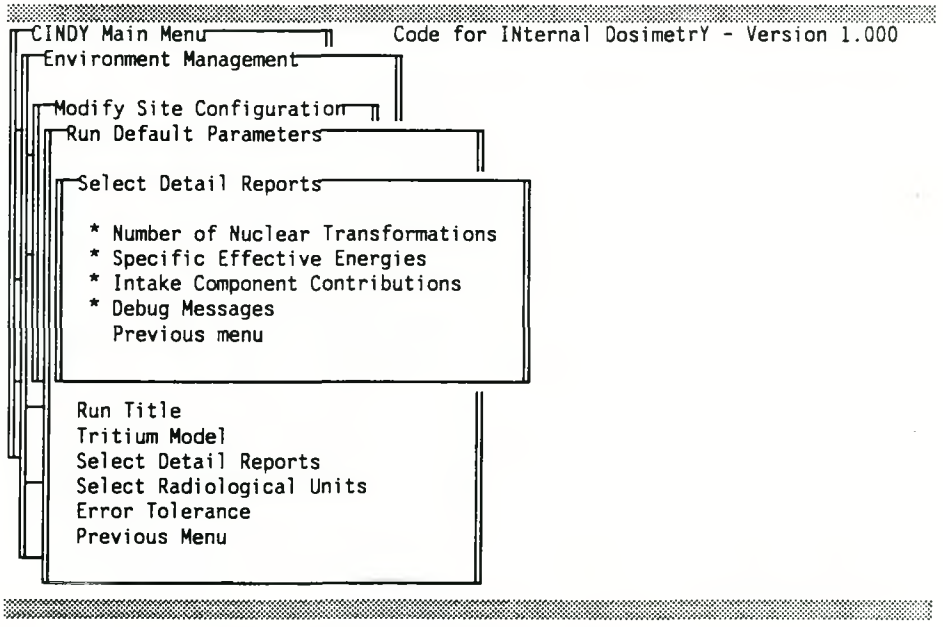


FIGURE 72. Select Detail Reports Menu

Use this menu, shown in Figure 72, to select/deselect additional reports. Refer to each menu item in this section for additional information.

Select File Group

This option on the **Environment Management** menu controls the files available for the menu items, **Display a File, Print a File**, and **Delete a File.**

The default value is a wild card, designated by ***.***, and indicating all files in the current subdirectory). A wild card is a place holder that permits substitiution of individual characters in file names under limited conditions. The wild card substitution for individual characters is the question mark (?). The wild card substitution for contiguous blocks of characters is the asterisk (*).

A window will open requesting:

Enter file group specification:

For example, if you enter ***.cin**, and then select **Display a File**, a menu should open listing all files in the current subdirectory with a file name extension of **.cin.**

Select Operating Mode

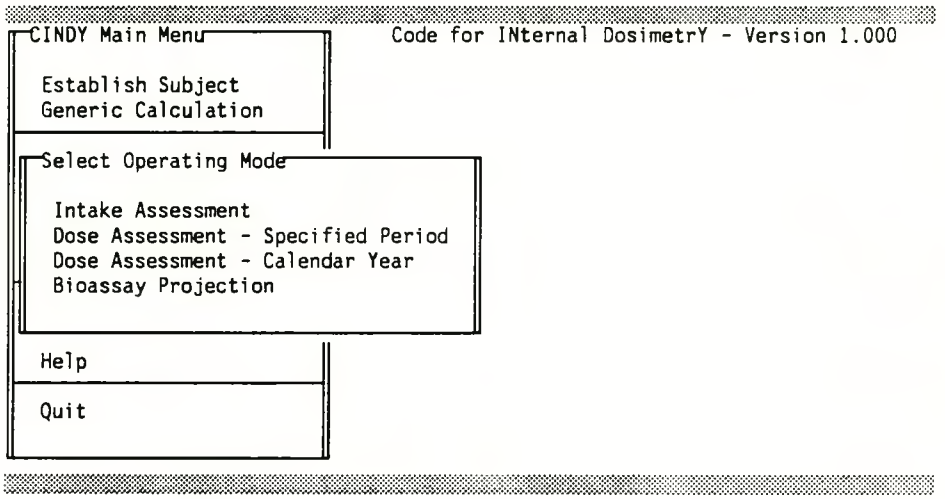


FIGURE 73. Select Operating Mode Menu

Four operating modes are available in CINDY. Only one mode may be active at any given time. The operating mode controls the selection of options and input of parameter for all run parameters. Select the operating mode from this menu, shown in Figure 73. Available operating modes are:

1) **Intake Assessment Mode** - estimate intake based on bioassay data using weighted or unweighted least-squares regression between measured and expected bioassay values calculated, based on Reference Man and other models

2) **Dose Assessment Mode: Specified Time Periods** - estimate organ dose equivalents and effective dose equivalents for specified time periods and committed effective dose equivalents for given intakes

3) **Dose Assessment Mode: Calendar Year Doses** - estimate organ and effective dose equivalents for the present calendar year and future annual increments, for given intakes

4) **Bioassay Projection Mode** - estimate organ burdens and urinary and fecal excretion rates from given intakes.

It is important to remember to save work before changing operating modes. This is necessary because the output file buffers used by the calculation programs will be reused with the next calculation.

Select Radiological Units

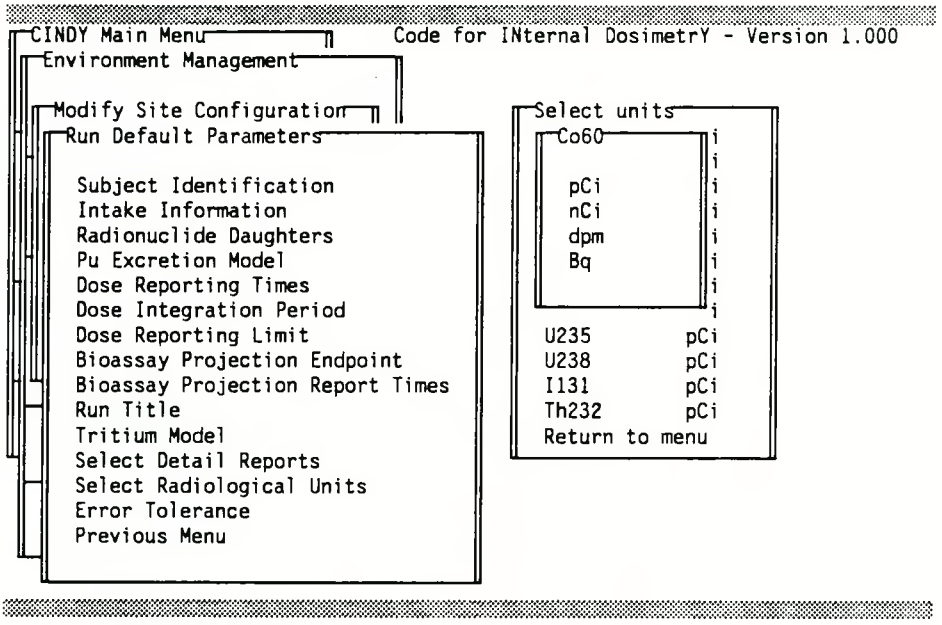


FIGURE 74. Select Radiological Units Menu

Use this menu, shown in Figure 74, to select radiological working units under the **Change Default Parameters** or **Run Default Parameters** menus. The user may specify different working units for each radionuclide in the available list. In the intake assessment mode, all bioassay data will be normalized to the selected working units. Intake assessment and bioassay projection results will be presented in the working units; dose assessments will be in corresponding dose units.

Select Radionuclides

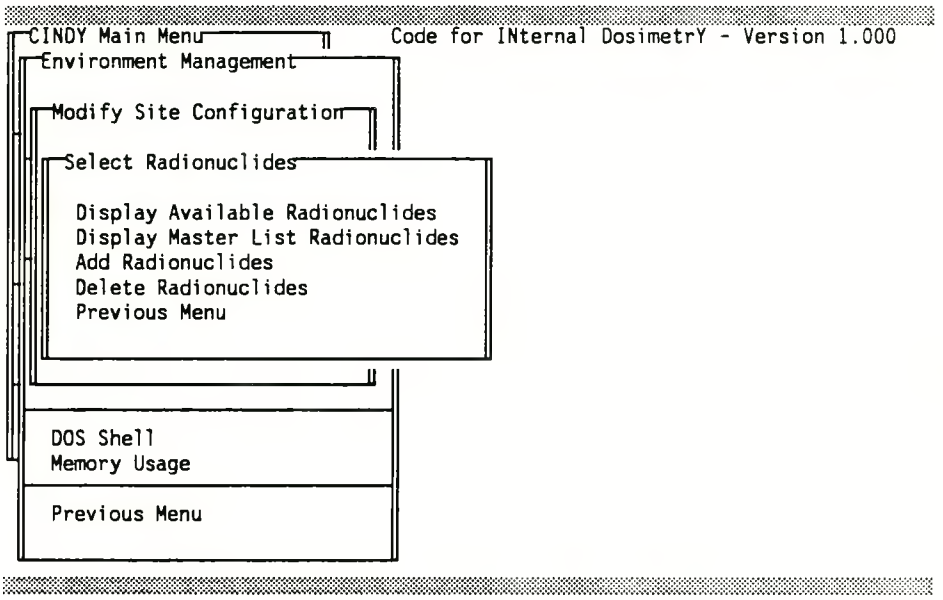


FIGURE 75. Select Radionuclides Menu

Use this menu, shown in Figure 75, to establish the list of available radionuclides for the site configuration. *The changes made to the list of available radionuclides are not saved until the user selects* ***Save Configuration*** *on the* ***Modify Site Configuration*** *menu.*

It is suggested that most frequently used radionuclides be placed at the beginning of the list to increase execution speed. The number of radionuclides included in the site configuration determines the size of some of the CINDY programs during execution. Consequently, it is suggested that radionuclides of no concern be eliminated from the list.

Semi-Log with Log-scaling for Time

Select this option on the **Graph Type** menu to display graphs with a logarithmic scale on the time axis and a linear scale on the radiological activity axis. Refer to **Graph Type** in this section for additional options.

Semi-Log with Log-scaling for Activity

Select this option on the **Graph Type** menu to display graphs with a logarithmic scale on the radiological activity axis and a linear scale on the time axis. Refer to **Graph Type** in this section for additional options.

Set Run Parameters

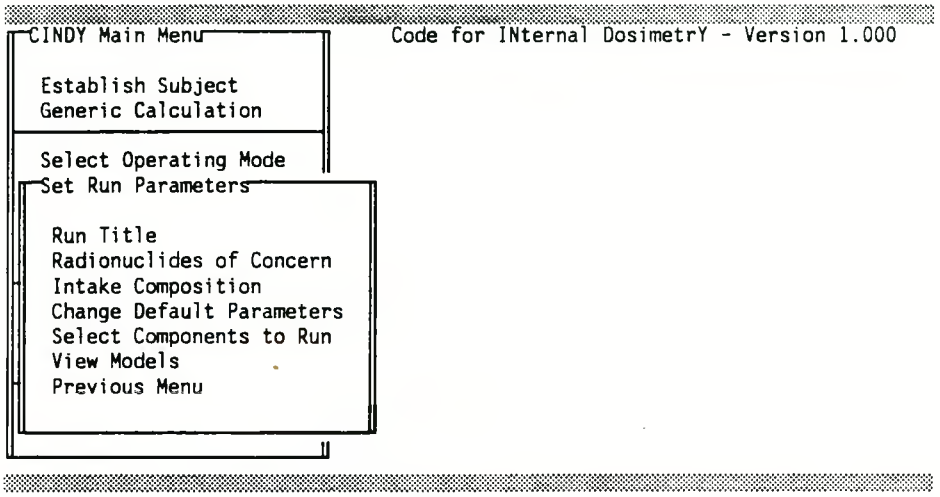


FIGURE 76. Set Run Parameters Menu

To prepare for an evaluation, the user must estimate the intake composition or quantity (depending on selected operating mode), select cases to be included in the current run, and (optionally) review and/or modify run-specific parameter values and view models included in the run. All of the above activities are accessed through the **Set Run Parameters** menu, shown in Figure 76.

Sex

This subject-specific parameter is input in the **Subject Identification** window. This information is used to establish reference excretion volumes and to select either ovaries or testes committed effective dose equivalent when calculating the effective dose equivalent. Two options are available: **M** for male, and **F** for female. When **Generic Calculation** has been selected, sex is set to **G** for generic.

Specific Effective Energies

The user may select this report option from the **Select Detail Reports** menu. This option is active only for dose assessment operational modes. The specific effective energies for each explicit radionuclide chain member is reported.

SSN

This field allows the user to store social security numbers. This subject-specific parameter is input in the **Subject Identification** window. This field is included in report headings for information only.

Subject Directory

A list of all subjects found in the current subdirectory (identified by the eight-character file name prefix) are displayed when this item is selected on the **Environment Management** menu.

Subject Identification

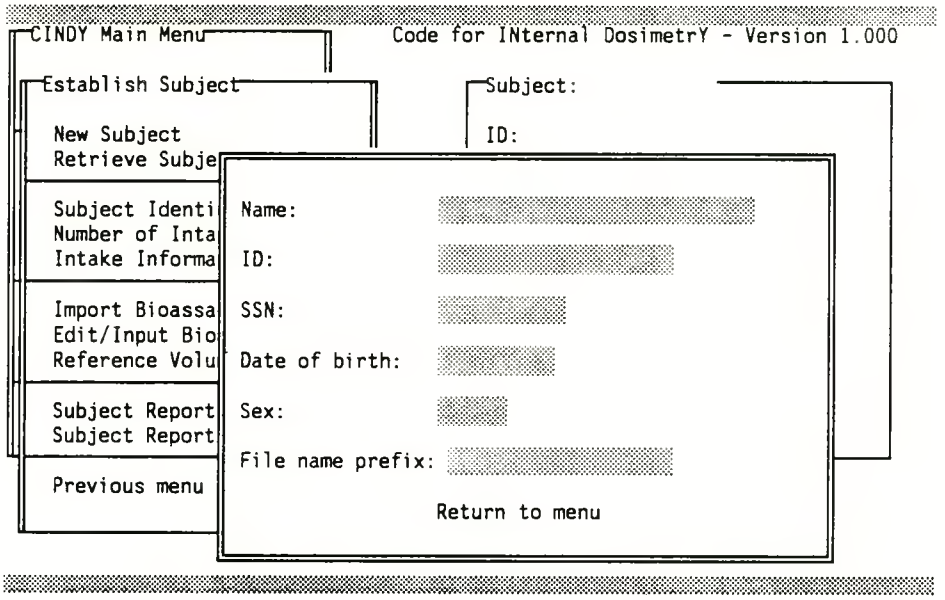


FIGURE 77. Subject Identification Window

The user may store information about each subject in the subject database. When the user selects **Subject Identification**, a window is opened, as shown in Figure 77. The window contains fields for name, identification number, social security number (SSN), date of birth, sex, and file name prefix. The user may enter or edit these fields at this time.

Most of the information in this window is highly subject-specific. Consequently, it is not particularly useful to preset the fields. However, it does allow the user to blank the name, identification (ID), and file name prefix fields. Note that the social security number (SSN), date of birth, and sex fields may not be blanked. The SSN and date may be preset with digits to indicate **not set**, (e.g., all 9's in the SSN field). Note that a valid date must be entered in the date field. Sex must be preset to either male or female.

This information, with the exception of sex which may be used to establish reference excretion volume/mass, is not processed, but included in report headings. More information on these input parameters is included in the **Input Parameters** section.

Subject Report to Printer

This report contains subject-specific information and a list of all bioassay measurements currently available. Bioassay measurements are shown in input units and are also normalized and shown in run-specific units. Both the date and the time post intake are included. Select this option on the **Establish Subject** menu for a printed report.

Subject Report on Screen

This report contains subject-specific information and tabulations of all bioassay measurements and associated measurement uncertainty factors currently available. Bioassay measurements are shown in input units and normalized to run-specific units. Both the date and the time post intake are included. Select this option on the **Establish Subject** menu for a screen report.

System/Error Messages

Select this item to view system and error messages primarily from the CINDY calculational programs. If you have performed a calculation and CINDY does not allow you to view the results, select this item. For instance, if there was not enough available memory for loading the calculational programs, the DOS message "Program too large to fit in memory" might be displayed. Refer to the **User Warnings and Error Messages** section of this manual for additional information.

Text Report on Screen

The text report generated during the most-recent calculation may be previewed on screen by selecting this item on the **View Run Results** menu.

Text Report to Printer

Select this menu item on the **View Run Results** menu to print text reports generated during the most recent calculation.

There are four operational modes in CINDY. Only one mode may be active at a time. The user may switch between the various modes while evaluating a given subject. For instance, a typical evaluation might involve making several iterations of the Intake Assessment mode to establish intake and then

switching to a dose assessment mode for dose estimates. The selection of input parameters and reports vary by operational mode.

Timing Report

The timing report contains information on the length of time required for calculations and the amount of work performed by the LSODES differential equation solver. The report is appended for each run in the current CINDY session. The report is not saved. This item may be selected on the **View Run Results** menu.

The timing report is a log of each calculation for the current CINDY session. The file is not saved when CINDY is exited. To determine the execution time for each calculation, subtract the time on the line labelled **Setup** from the time on the line labelled **Done**. Additional information is provided about each calculation, including the error tolerance used and the amount of work done by the solver.

Error tolerances control the accuracy of the results from the differential equation solver used in CINDY. There is a relationship between the accuracy of the result and the time required to generate a result. The tighter the error tolerances, the longer the time required to obtain a result. The error tolerance parameter has been brought out to the input level to allow the user some control in the accuracy versus execution speed trade-off. This parameter is accessed through the **Set Run Parameters** and **Change Default Parameters** menus.

Tritium Model

The user can select from two tritium models, the ICRP tritium model and the Dunford and Johnson model. When this item is selected on the **Change Default Parameters** or **Run Default Parameters** menu, a window opens and the following run-specific question is asked:

Enter index of tritium model (0-ICRP, 1-Dunford and Johnson):

Note that the Dunford and Johnson elemental-tritium lung model is always used with the ICRP retention and excretion models when elemental tritium is specified.

Unit Numerator

This parameter is input in the **Edit/Input Bioassay Data** window. **Unit numerator** indicates the activity units used in the numerator for the **measured value** and **measurement uncertainty** terms. When this item is

selected, a widow opens displaying the available units. In the present version the allowable entries are:

pCi
nCi
dpm
Bq
g
mg
ug

Note that the entry for micrograms is **ug**. Units are converted to uppercase by the program before validity testing.

Units Are...

This parameter is input in the **Edit/Input Bioassay Data** window. This parameter indicates if the denominator for the result and uncertainty terms are "per volume" or "per sample". Allowable entries are:

L
ml
g
mg
S - for "per sample"

Input is converted to upper case by the program before validity testing.

Use Alternate Configuration

The user may interactively select a different site configuration while executing CINDY. If a subject file is open, a warning message is displayed. When this menu item is selected, a menu will open listing available configurations. To select a configuration, move the menu bar to the desired configuration and press **Enter**. Note: colors may not be completely revised until returning to the main menu.

This menu provides one of three ways to select a site configuration. Another way is to execute CINDY by typing:

CINDY nnn

where **nnn** is a valid site configuration name. The third method is to edit the **CINDY.BAT** file in the working subdirectory to contain the CINDY execution command shown above.

A word about incompatibilities between site configuration and subject definitions. A subject may be evaluated under a site configuration other than the site configuration under which it was created as long as the site configuration's list of available radionuclides contains all the radionuclides of concern for the subject. When a subject file is retrieved, CINDY checks all

radionuclides of concern against the list of available radionuclides. CINDY stores the name of the site configuration file under which the subject was created. Then, if the current site configuration is not appropriate, a message is displayed to use that alternate site configuration and then retrieve the subject file.

View Models

The user may select **View Models** on the **Set Run Parameters** menu to display and/or edit model parameters. When this menu item is selected, a run-specific menu of intake components is presented. Select the intake component of interest by moving the menu bar to the selected item and pressing **Enter**. A series of model pages follows. When only one intake component has been defined, the first page of models is displayed immediately upon selection of **View Models**.

Models are depicted as presented in ICRP Publication 30 whenever possible. Note that numbers inside compartment boxes indicate fraction deposited in or leaving that region and that numbers displayed on lines correspond to the clearance half-time in days.

The cursor is positioned on **Next page of model**. Press **Enter** to move to the next page of the model. Note that the user may choose to by-pass the remainder of the model pages and return directly to the controlling menu by using the cursor to select **Return to menu**.

The first page to be displayed is a summary of the model centered around the transfer compartment, as shown in Figure 78. Inputs to the transfer compartment are shown entering the transfer compartment from the left, systemic compartments leaving to the right.

If there was a intake via a wound or absorption, the summary screen would be followed by the direct intake screen, presented as shown in Figure 79. If there was an inhalation intake, the lung model would be presented as shown in Figure 80 with appropriate values. The gastrointestinal tract model is presented as shown in Figure 81. Transfer compartment excretion parameters are presented in the window shown in Figure 82. Parameters for each systemic component would be presented as shown in Figure 83. Figure 84 displays the presentation of the tritium model. Figure 85 is the representation of the Dunford/Johnson extension to the tritium model. The alkaline earth model is presented as shown in Figure 86 with appropriate inputs added. The Jones plutonium excretion model is presented as shown in Figure 87 with appropriate inputs added. The Durbin plutonium excretion model is presented as shown in Figure 88. The carbon model is presented as shown in Figure 89. The iodine model is presented as shown in Figure 90.

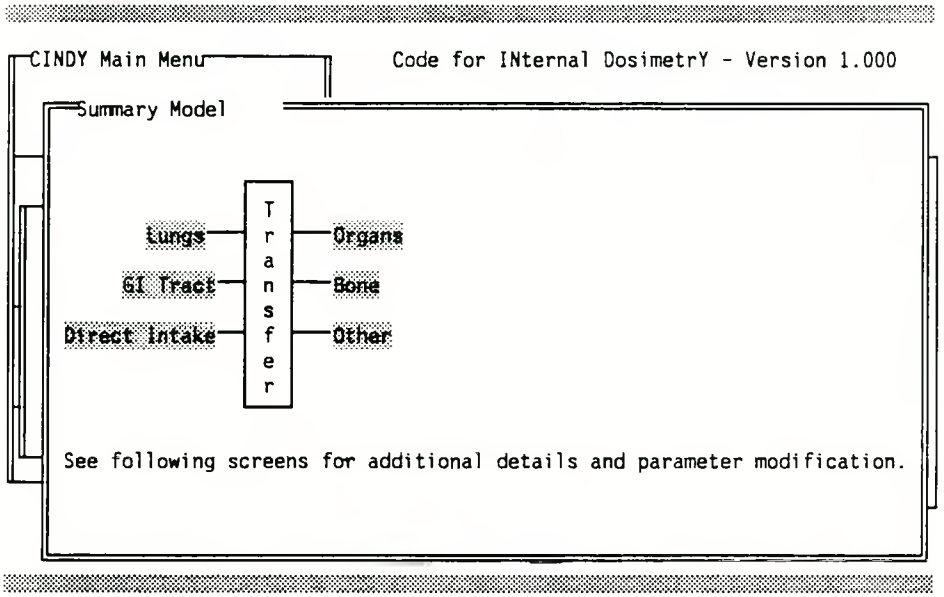


FIGURE 78. Summary Model Window

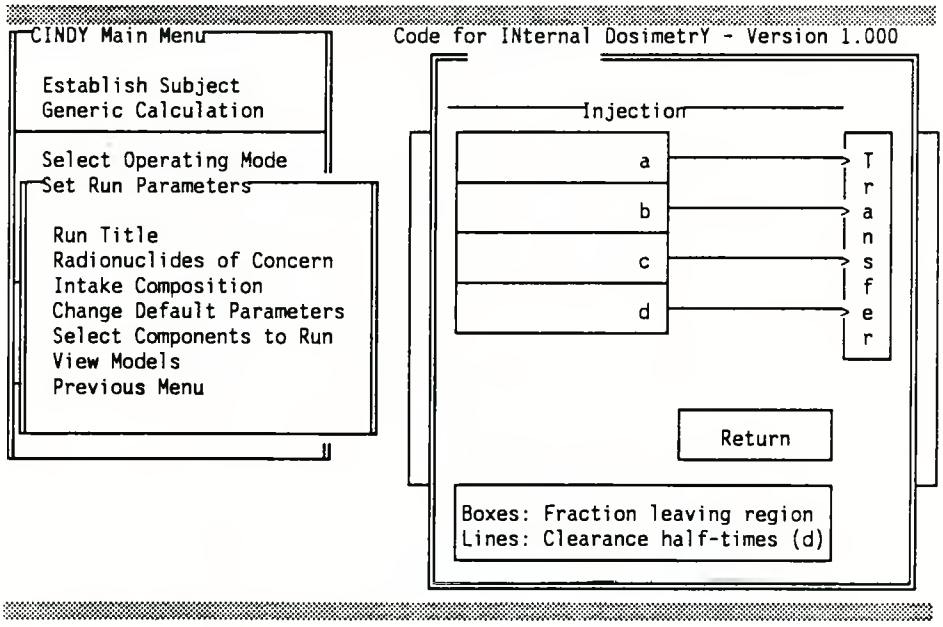


FIGURE 79. Direct Intake Window

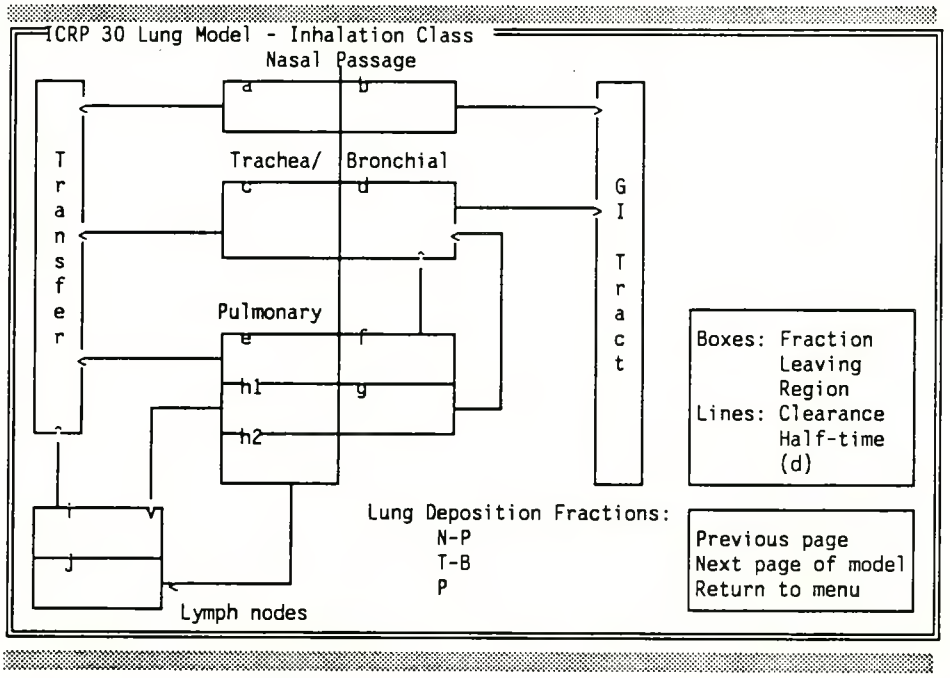


FIGURE 80. Lung Model Window

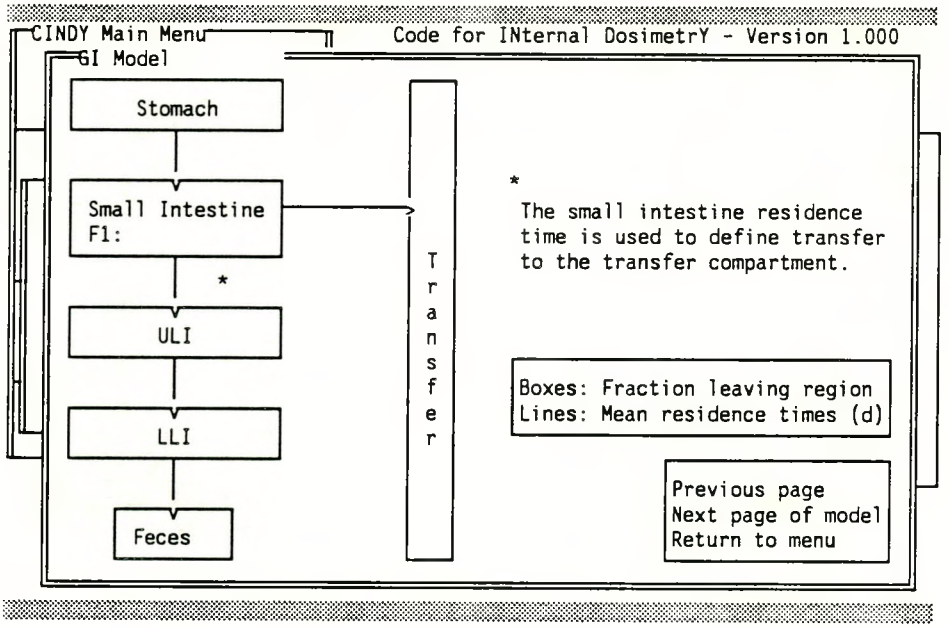


FIGURE 81. GI Tract Model Model

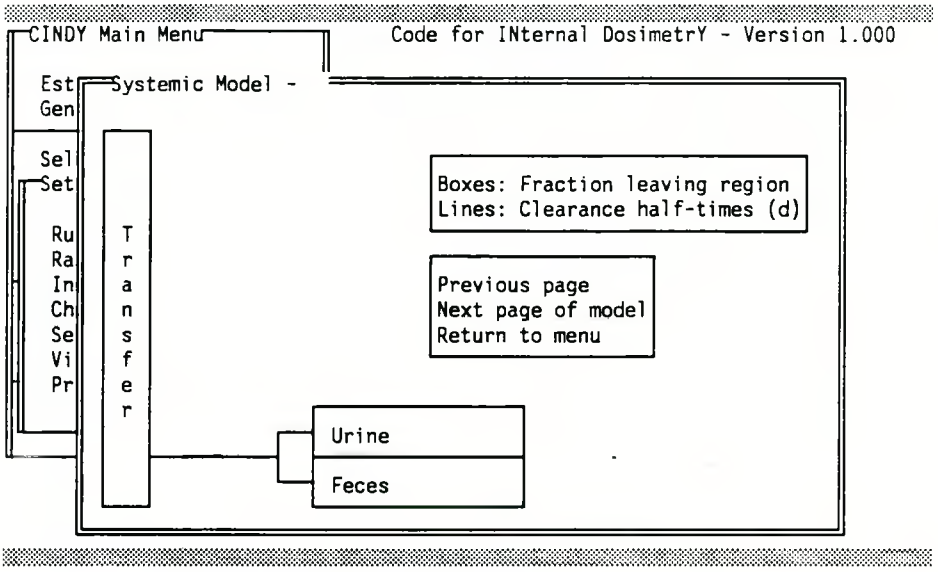


FIGURE 82. Transfer Compartment Model Window

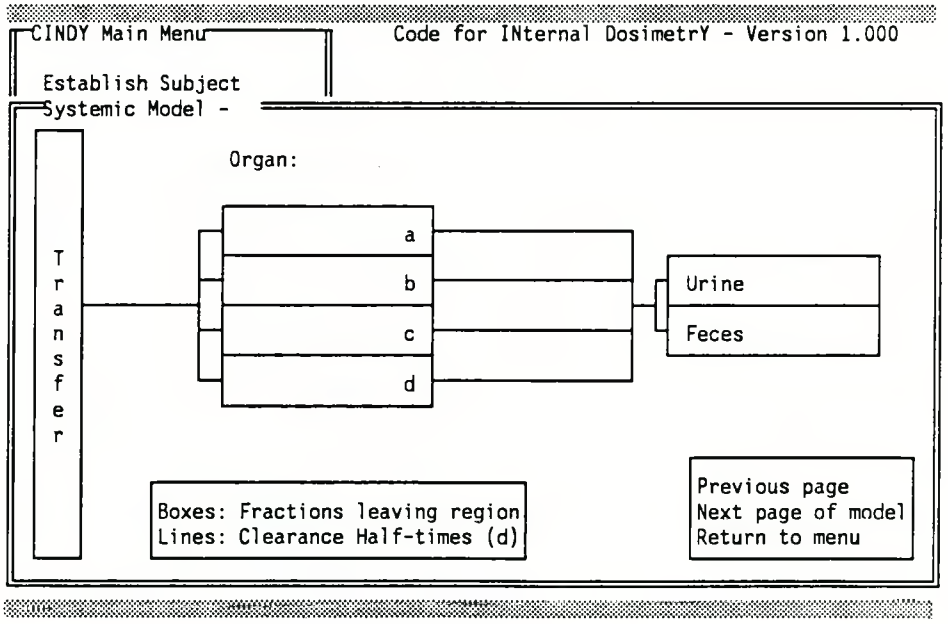


FIGURE 83. System Model Window

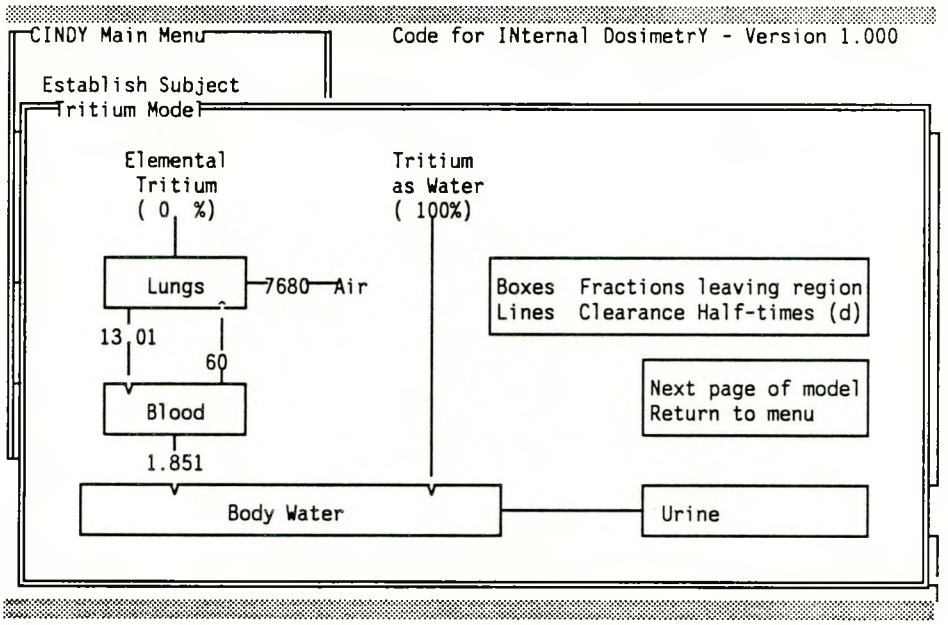


FIGURE 84. Tritium Model Window

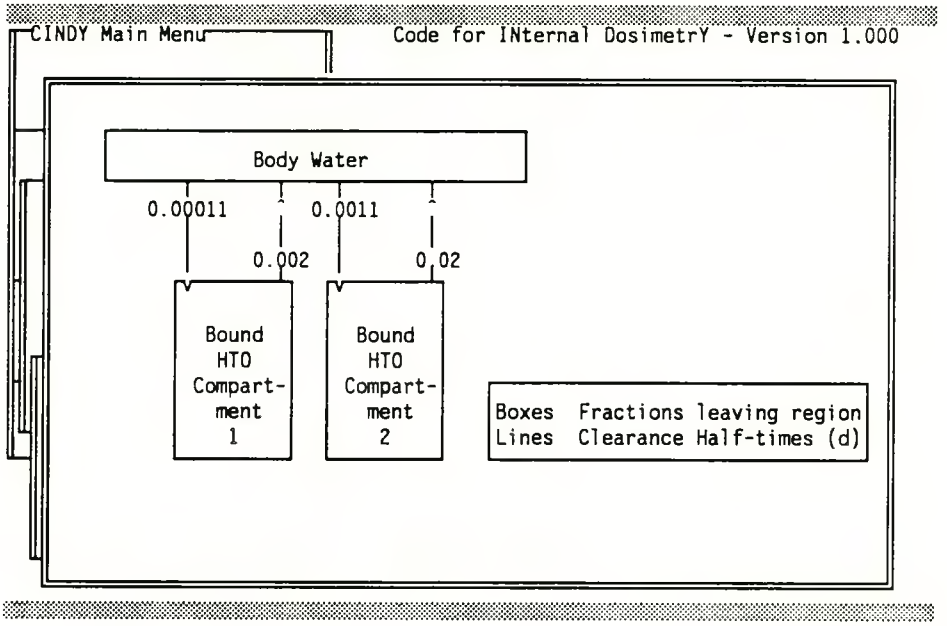


FIGURE 85. Dunford/Johnson Tritium Model Window

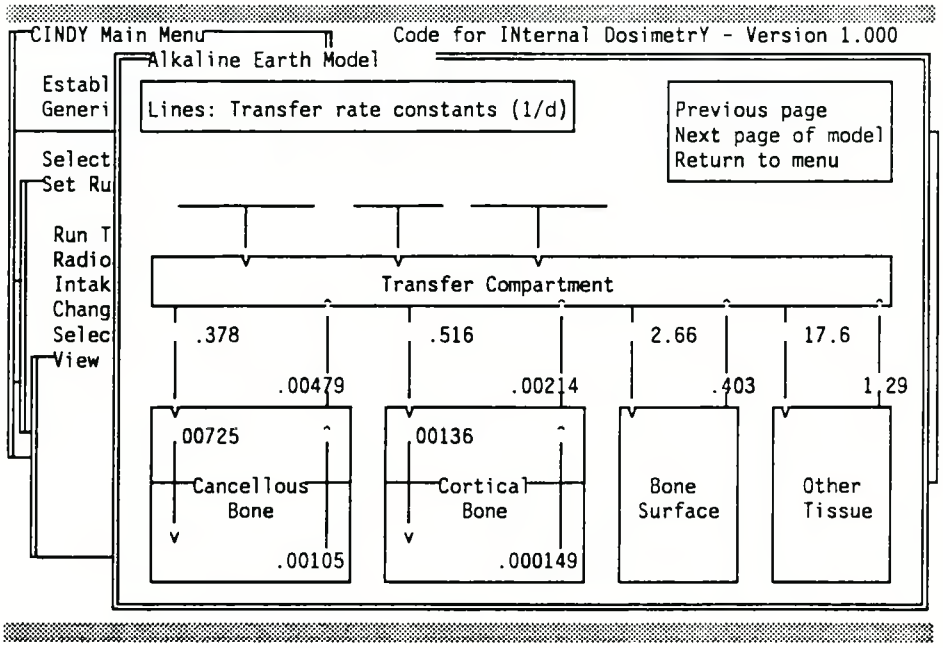


FIGURE 86. Alkaline Earth Model Window

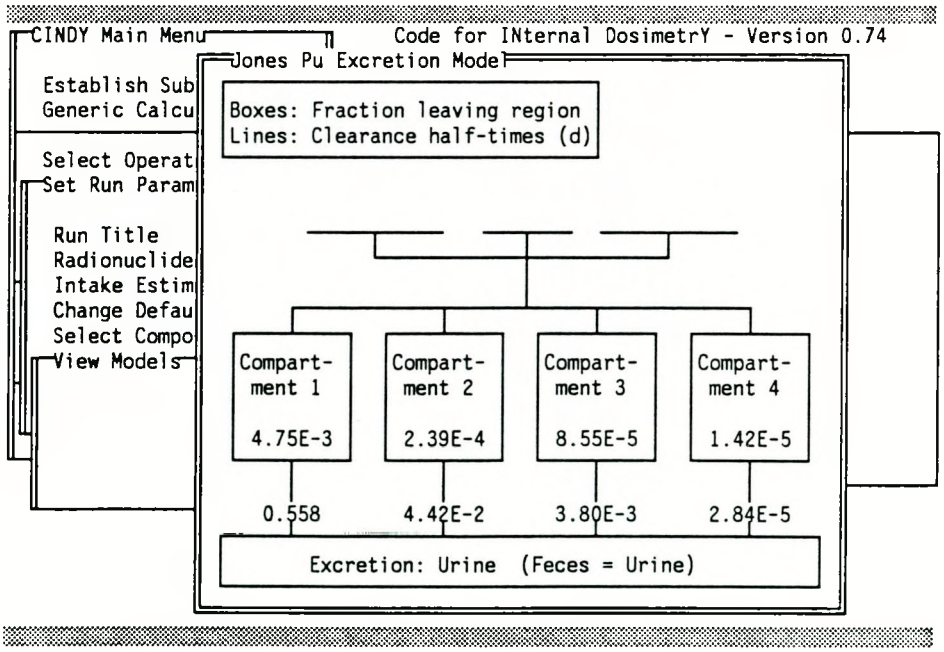


FIGURE 87. Jones Plutonium Excretion Model Window

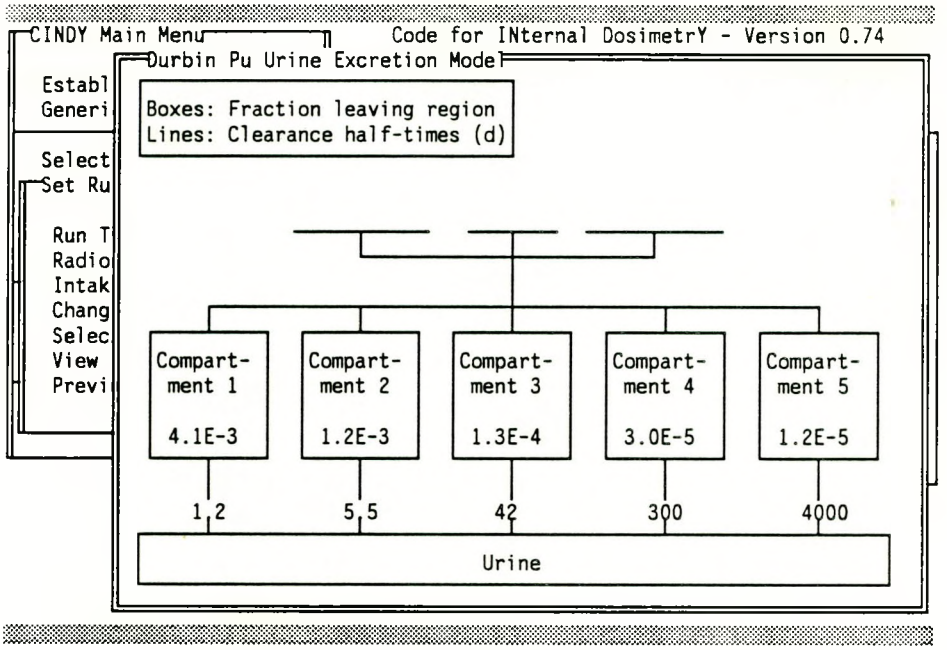


FIGURE 88. Durbin Pu Urine Excretion Model Winodw

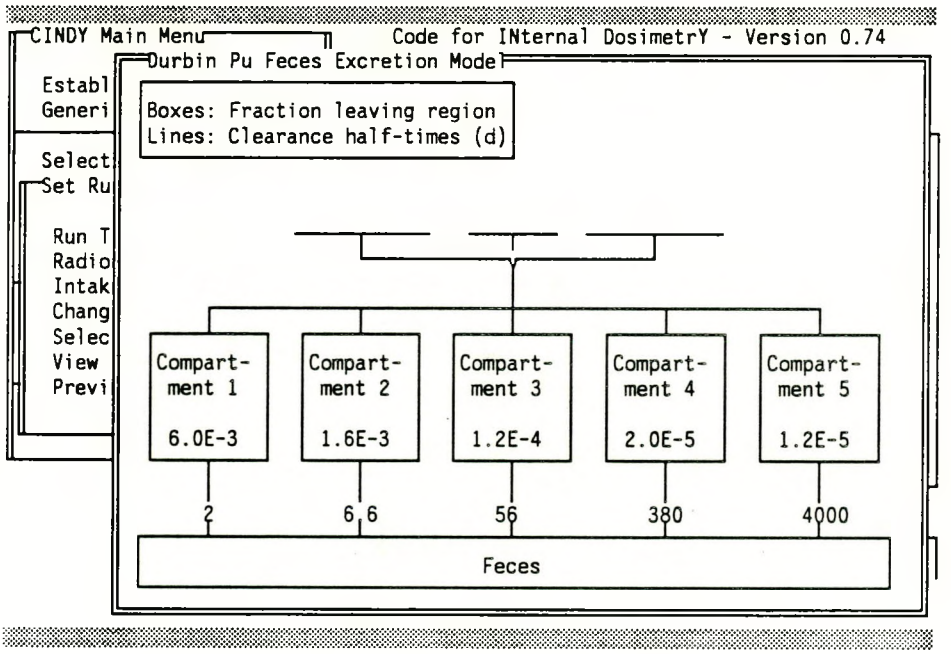


FIGURE 89. Durbin Pu Feces Excretion Model Winodw

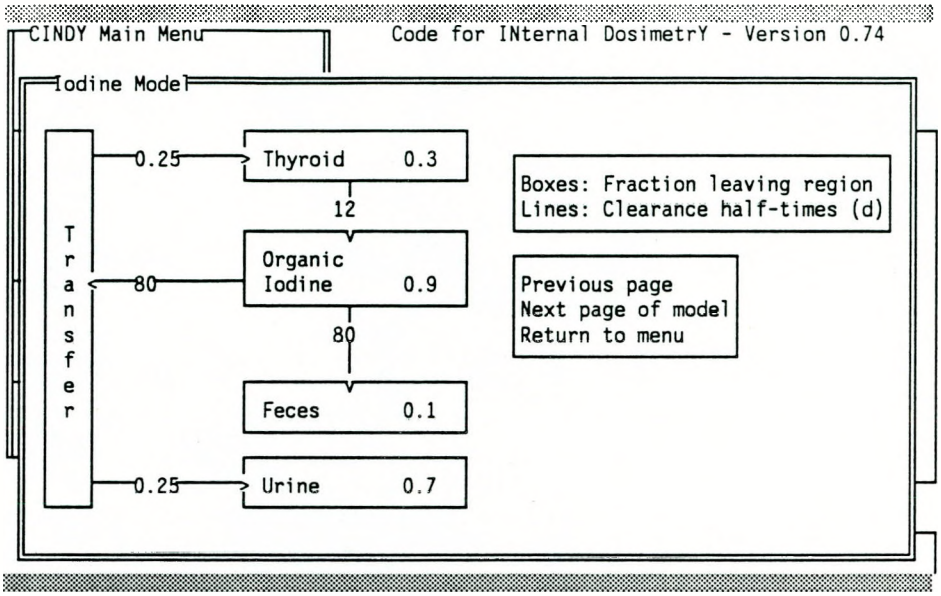


FIGURE 90. Iodine Model Window

View Run Results

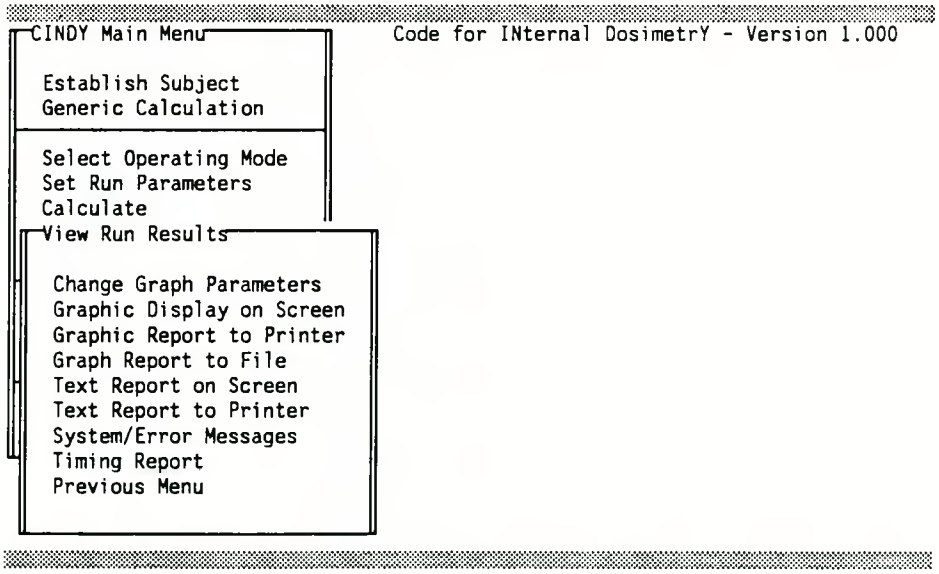


FIGURE 91. View Run Results Menu

After performing a calculation, results may be viewed in a variety of ways by selecting options from this menu, shown in Figure 91. Refer to the appropriate menu item in the Reference Section of this manual for additional information.

To view previously calculated and saved runs, retrieve a subject, and then, on the **Environment Management** menu, use **Graphs: Current Subject, List Files: Current Subject, Display a File**, and **Print a File** as appropriate.

Wound

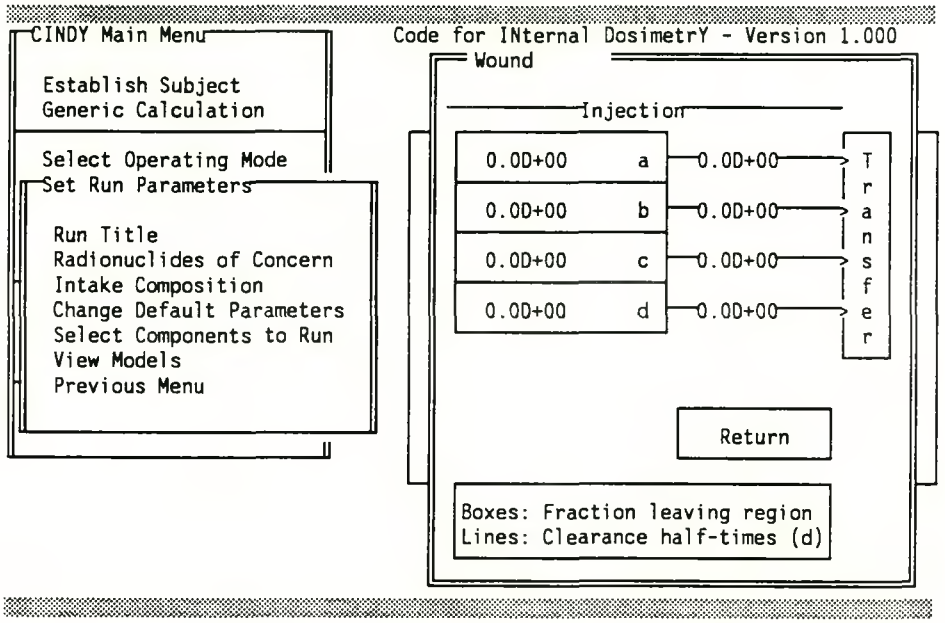


FIGURE 92. Wound - Direct intake Window

When the user has specified either wound or absorption intake mode(s), after the **Intake Composition** or **Intake Estimate** window has been displayed, a window opens for entering the direct intake parameters, as shown in Figure 92. CINDY does not contain default values for any parameters for the direct intake model. However, the user may modify the site configuration to include site-specific direct intake parameters.

The following file/record format may be used to import bioassay data into CINDY. Data could either be downloaded from a database or prepared manually. Not all data will be used in CINDY calculations but are included to assist the user in evaluation of the data.

File Format

The ASCII-formatted file is composed of fixed-size, blank-delimited fields. The file consists of a title record (not processed by CINDY but included for quality-assurance and readability) followed by a variable number of records in the format described below.

Record Format

The record format for the bioassay data import file is shown in Table 6.

TABLE 6. Import Bioassay Data Record Format

Field No.	Start Col.	Field Length	Type	Field Description
1	1	1	Character	EXCLUSION FLAG. Any non-blank entry placed in this field excludes the record from all CINDY calculations except printing.
2	3	5	Character	BIOASSAY TYPE. Only the first character of this field is processed; the remainder are included for readability. Entries may be either upper or lower case. Valid entries, and the bioassay types to which they correspond, are as follows: U - urine F - feces L - lung W - whole body T - thyroid S - skeleton
3	9	6	Character	BIOASSAY RADIONUCLIDE name as specified in the CINDY master radionuclide list.

TABLE 6. (Contd.)

Field No.	Start Col.	Field Length	Type	Field Description
4	16	10	Date	SAMPLE DATE reflects the end of the collection period in the following format: mm/dd/yyyy.
5	27	5	Time	SAMPLE TIME in 24-hour format reflects the end of the collection period in the following format: hh:mm.
6	33	5	Numeric	EXCRETION PERIOD. The time period (hours) of excretion that the collected sample represents.
7	39	9	Numeric	MEASURED VALUE at indicated time. Units specified below.
8	49	9	Numeric	MEASUREMENT UNCERTAINTY. Result uncertainty included in the file to assist user in evaluating the goodness of fit. This parameter is used in the calculational portions of the code to evaluate intake for the user-defined weights method. The measurement uncertainty parameter is the inverse of the weighting factor.
9	59	3	Character	NUMERATOR TYPE FOR RESULT AND UNCERTAINTY TERM. In the present version the allowable entries are: pCi nCi dpm Bq Units will be converted to uppercase by the program before validity testing.

TABLE 6. (Contd.)

Field No.	Start Col.	Field Length	Type	Field Description
10	63	1	Character	DENOMINATOR FOR RESULT AND UNCERTAINTY TERM. Responses will be either "per volume" or "per sample." Allowable entries are: L ml g mg S - for "per sample"
11	65	4	Numeric	SAMPLE SIZE in terms of volume (urine) or mass (fecal).
12	70	2	Character	SAMPLE SIZE UNITS. In the present version, allowable units are: L ml g mg Units will be converted to upper case by the program before validity testing.
13	73	40	Character	COMMENTS associated with the record, such as why data was excluded from calculations and type of normalization done on the data.

USER WARNINGS AND ERROR MESSAGES

This section contains information on user warnings and error messages that may be encountered in the CINDY working environment. Suggested user responses to the messages are also provided. The messages are divided into three groups: 1) user warnings and error messages provided by CINDY, 2) error messages provided by the differential equation solver LSODES, and 3) FORTRAN errors that may be returned by the FORTRAN calculational programs.

Table 7 contains an alphabetized list of messages provided in the CINDY working environment, additional information about each message, and suggested action for the user should the error occur.

The error messages that may be returned by the LSODES differential equation solver are listed in Table 8. If any of these errors occur, forward a description of the circumstances leading to these error messages to the code developers. Be sure to include an explicit description of the hardware and system configuration.

The FORTRAN calculational programs may return an error index. Table 9 describes the FORTRAN error indices. A situation where this type of error may occur is when the user is attempting to perform a calculation including explicit daughters (usually a dose calculation) on an 80286-based computer. See **Systems Requirements**. In this situation the error message is: **F77L.eer, error #6 in PRJS**. Another likely situation is when there is insufficient RAM to execute the FORTRAN program (Error indices 1 and 81). Refer to **Memory Usage** in the **Reference** section of this document for more information on this error. It may be necessary to unload memory-resident programs from the host computer for successful operation of the CINDY Software Package. Please forward a description of all other FORTRAN error messages to the code developers.

TABLE 7. User Warnings and Error Messages

Access denied	This general file handling error occurs when CINDY was not able to read or write a file because of restrictive attributes. Contact the code developers if this error occurs. Do a screen print to document the error. The message is generated by MESSAG2.BAS.
Bioassay type not found: *nnn*. Record follows.	This warning message is displayed when the user is interactively entering or editing bioassay data and CINDY does not recognize the input bioassay type (*nnn* is the unrecognized bioassay type). The bioassay data record in question is displayed after the user acknowledges this message. The message is generated by BIOHAN.BAS. Edit record or disregard if not interested in evaluating this bioassay data point within the CINDY working environment.
Cannot calculate explicit daughter dose without 80386/7	This warning message is displayed when CINDY prepares to calculate a dose assessment and an 80387 math co-processor is not detected. The host computer may not be compatible with CINDY. Refer to the **Systems Requirement** section in this manual for more information. The message is generated by RITIN.BAS.
Cannot print graph. Check settings.	This informational message is displayed when CINDY attempts to display a graph and the current options indicate that no graphics printer is available (the default setting on the CINDY default site configuration). If a graphics printer is available on the host computer, select **Change Graph Parameters** on the **View Run Results** menu, then **Printer Type**, followed by the appropriate selection. The message is generated by POPVU.BAS
Chronic end not set	This warning message is displayed when CINDY prepares to evaluate a chronic exposure scenario and the chronic exposure end date has not been set. Return to the **Intake Information** window on the **Establish Subject** menu and specify the chronic end date. The message is generated by TIMCAL.BAS.
Configuration must be saved under new name	This message informs the users that additions and/or deletions have been made to the changes have been made to the list of available radionuclides and consequently the site configuration must be saved

TABLE 7. (Contd.)

	under a new name. After the user acknowledges this message, a window will open requesting a new file name. The message is generated by POPINS.BAS.
Error in methan	Do a screen print to document the error message. After exiting CINDY, copy all current site configuration files to disk (i.e., **copy \cindy*nnn*.* a:**, where *nnn* is the site configuration file name). Send these items, along with any other pertinent information and a Software Change Packet (included in the CINDY transfer package) to the developers. This message is generated by METHAN.BAS.
Error in times2n2	An error occurred while CINDY attempted to convert an input time from a character to a number representation. Contact the software developers. This message is generated by UTILITY.BAS.
Error: no calculation	This message informs the user that errors (previously displayed) occurred during preparation for a calculation; consequently, the calculation will not be performed. This message is generated by PART2.BAS.
Error writing .rmd: *nnn*	Where *nnn* is the name of the questionable radionuclide. Contact the software developers if this error occurs. Do a screen print to document the error message. Send these items, along with any other pertinent information and a Software Change Packet (included in the CINDY transfer package) to the developers. This message is generated by POPINS.BAS.
Exponent out of range.	This warning message is displayed after an invalid exponent for the input number is determined to be outside the valid range. Edit the number. This message is generated by INCHAR.BAS.
Feces mass unit not recognized. Record follows.	This warning message is displayed when the user is interactively entering or editing bioassay data and CINDY does not recognize the input feces mass unit. The bioassay data record in question is displayed after the user acknowledges this message. This message is generated by BIOHAN.BAS. Edit record or disregard if not interested in evaluating this bioassay data point within the CINDY working environment.

TABLE 7. (Contd.)

File error: *nnn*	Where *nnn* is a file error index. This general file handling error occurs when CINDY was processing a file. Contact the code developers if this error occurs. Do a screen print to document the error. This message is generated by MESSAG2.BAS.
File error while printing	This general file handling error occurs when CINDY encounters a file error while attempting to print. Contact the code developers if this error occurs. Do a screen print to document the error. This message is generated by MESSAG2.BAS.
File not deleted	This warning is displayed to alert the user that CINDY was not able to delete a file as requested from the **Delete a File** item on the **Environment Management** menu. This message is generated by POPMAN.BAS.
File not found	This general file handling error occurs when CINDY was not able to find a requested file. Contact the code developers if this error occurs. Do a screen print to document the error. This message is generated by MESSAG2.BAS.
File not found. Check system/error messages	This warning message is displayed when the user is attempting to view run results and the output file buffers were not created. The user is instructed to select **System/Error Messages** on the **View Run Results** menu for additional information about the aborted execution. Most output from secondary programs in the CINDY working environment is diverted into a file that is then displayed when **System/Error Messages** is selected. Refer to Table 8, FORTRAN Errors, in this section for additional information. This message is generated by POPVU.BAS.
File not found: *nnn*	This message is displayed when CINDY was not able to find the requested subject files. Notify the code developers if this error occurs. This message is generated by POPSUB.BAS.
File not saved. No valid file name.	This message alerts the user that the subject files were not saved as requested because no valid file name had been entered. Reselect the save option and edit the selected file name. This message is generated by POPSAV.BAS.

TABLE 7. (Contd.)

Graphs not available for dose assessments	This informational message reminds the user that graphic reports are not available for dose assessments. This message is generated by POPVU.BAS.
Iget out of range: *nnn*	Contact the software developers if this error occurs. Do a screen print to document the error message. After exiting CINDY, copy all current site configuration files to disk (i.e., **copy \cindy*nnn*.* a:**, where *nnn* is the site configuration file name). Send these items, along with any other pertinent information and a Software Change Packet (included in the CINDY transfer package) to the developers. This message is generated by METHAN.BAS.
ILIN out of range: *nnn*	Contact the software developers if this fatal error errors. Do a screen print to document the error message. After exiting CINDY, copy all subject files to disk (i.e., **copy *nnn*.* a:**, where *nnn* is the subject file name in the working subdirectory). Send these items, along with any other pertinent information and a Software Change Packet (included in the CINDY transfer package) to the developers. This message is generated by BIOHAN.BAS.
Intake fraction greater than 1.0	When the user is inputing either intake composition or intake quantity, CINDY checks to ensure that the sum of the intake mode fractions (inhalation, ingestion, and wound/absorption) is not greater than 1.0. This informational message is displayed to protect the user against inadvertent error. This message is generated by INTAKE2.BAS.
Invalid case in inchar: *nnn*	Contact the code developers if this error occurs. This message is generated by INCHAR.BAS.
Invalid date: *nnn*	This warning message is displayed after an invalid date is entered. Edit the date. This message is generated by INCHAR.BAS.
Invalid drive	This general file handling error occurs when CINDY was not able to read or write a file because an invalid disk drive specification was supplied. Contact the code developers if this error occurs. Do a screen print to document the error. This message is generated by MESSAG2.BAS.

TABLE 7. (Contd.)

Invalid file	This general file handling error occurs when CINDY encounters a corrupted file while attempting to perform a file operation. Contact the code developers if this error occurs. Do a screen print to document the error. This message is generated by MESSAG2.BAS.
Invalid handle	This general file handling error occurs when CINDY was not able to read or write a file because an invalid file handle was assigned. Contact the code developers if this error occurs. Do a screen print to document the error. This message is generated by MESSAG2.BAS.
Invalid index.	This warning message is displayed after an invalid option (index) is entered. Valid option indices are displayed on the screen. Enter a valid option. This message is generated by POPDEF.BAS.
Invalid number, reenter.	This warning message is displayed after an invalid number is entered. Edit the number. This message is generated by INCHAR.BAS.
Invalid option	This warning message is displayed when the user enters an invalid color index when selecting screen colors. Enter a valid index. This message is generated by COLORS.BAS.
Invalid rad units. Record follows.	This warning message is displayed when the user is interactively entering or editing bioassay data and CINDY does not recognize the input radiological units. The bioassay data record in question is displayed after the user acknowledges this message. Edit record or disregard if not interested in evaluating this bioassay data point within the CINDY working environment. This message is generated by BIOHAN.BAS.
Invalid screen page option: *nnn*	Contact the code developers if this error occurs. Do a screen print to document the value of *nnn*. This message is generated by SCRFILE.BAS.

TABLE 7. (Contd.)

Invalid time: *nnn*	This warning message is displayed after an invalid time is entered. Edit the time. This message is generated by INCHAR.BAS.
Maximum new records added. Save file, then retrieve.	The user may enter up to 10 additional bioassay data records during any edit session. When the maximum number of new records has been entered, this message instructs the user to save the current work and then input additional records. Return to the main menu and select **Save Work** and then **Save Subject Files** or **Save All Work**. Proceed to the **Establish Subject** menu and retrieve the subject file. Return to inputing bioassay data records. This message is generated by BIOHAN.BAS.
Maximum report times exceeded.	Only 70 time periods may be considered per run. Excludes bioassay data points. This message is generated by TIMCAL.BAS.
Misc	This error occurs when the CINDY general file error handling routine is called and the error index flag is not specified within the routine. Contact the code developers if this error occurs. Do a screen print to document the error. This message is generated by MESSAG2.BAS.
***nnn* not found**	Contact the code developers if this error occurs. Do a screen print to document the value of *nnn*. This message is generated by FILHAN.BAS.
No files found	This informational message is displayed when CINDY is attempting to construct a menu of file names that match a wild card specification. Check the wild card specification under **Select File Group**. This message is generated by DIRWMENU.BAS.
No handle available	This general file handling error occurs when CINDY was not able to assign a file handle to perform the requested input/output operation. Check the **Buffers** and **Files** statements in the host computer's CONFIG.SYS file. Refer to the **Installing the Software** section of this manual. This message is generated by MESSAG2.BAS.

TABLE 7. (Contd.)

No intake components	This message informs the user that the requested activity cannot be performed because no intake components are selected/defined. CINDY determines intake components based on intake mode, radionuclides of concern, and intake composition/estimate. Verify that these parameters have been set. If necessary, select appropriate intake components. This message is generated by SELCAS.BAS, CINDY.BAS, and POPCAS.BAS.
No math co-processor. Unable to do calculations.	This warning message is displayed during initialization of the CINDY working environment when no math co-processor is found. The host computer may be incompatible with CINDY. Refer to the **System Requirements** section of this manual. This message generated by INIT.BAS.
No measured value. Record follows.	This warning message is displayed when the user is interactively entering or editing bioassay data and no measured value was entered. The bioassay data record in question is displayed after the user acknowledges this message. Edit record or disregard if appropriate. This message generated by BIOHAN.BAS.
No messages	This message informs the user that no messages have been generated when the user selects **System/Error Messages**. This message is generated by POPVU.BAS.
No output file buffers, check error messages.	This message alerts the user that no output file buffers have been generated when the user selects either **Save All Work** or **Save Run Reports** on the **Save Work** menu. No action is necessary if the user did not perform a calculation. If the user did perform a calculation, select **System/Error Messages** under **View Run Results** to determine what error terminated the calculation. This message is generated by POPSAV.BAS.
No report	This warning message is displayed when the user requests run reports and no run reports have been generated. Select **System/Error Messages** on the **View Run Results** menu for additional information. This message is generated by POPVU.BAS.

TABLE 7. (Contd.)

No such subdirectory	This general file handling error occurs when CINDY attempts to access a non-existent subdirectory. Contact the code developers if this error occurs. Do a screen print to document the error. Check the current subdirectory under **Change Subdirectory** in the **Environment Management** menu. This message is generated by MESSAG2.BAS.
Nonexistent drive	This general file handling error indicates that CINDY was not able to recognize the requested disk drive. Contact the code developers if this error occurs. Do a screen print to document the error. This message is generated by MESSAG2.BAS.
Nonexistent subdirectory Error: +STR$(errs)	This general file handling error indicates that CINDY was not able to find the requested subdirectory. Contact the code developers if this error occurs. Do a screen print to document the error. This message is generated by MESSAG2.BAS.
Nsclin = 0 on page *nnn*	Contact the code developers if this error occurs. Do a screen print to document the value of *nnn*. This message is generated by SCRFILE.BAS.
Number outside acceptable range.	This warning message is displayed after a number has been entered that is outside the acceptable range. The acceptable range is displayed on the screen. Edit the number. This message is generated by INCHAR.BAS.
Only one intake may be considered at this time.	This message informs the user that only one intake may be considered in the current version of CINDY. This message is generated by POPSUB.BAS when the user selects **Number of Intakes** on the **Establish Subject** menu.
Only 3 bioassay types per run allowed	This message informs the user that only three bioassay types may be considered in any given run. Define bioassay data for fewer bioassay types. This message is by RITIN.BAS.
Outside range.	This warning message is displayed after a number has been entered that is outside the acceptable range. The acceptable range is displayed on the screen. Edit the number. This message is generated by POPGRA.BAS and POPDEF.BAS.

TABLE 7. (Contd.)

Page number out of range *nnn* ipag	Contact the code developers if this error occurs. Do a screen print to document the value of *nnn*. This message is generated by SCRFILE.BAS.
Path not found	This general file handling error occurs when CINDY was not able to find the subdirectory specified as the path of a requested file. Check the path specified for the file. Contact the code developers if this error occurs. Do a screen print to document the error. This message is generated by MESSAG2.BAS.
Printer error	This general file handling error occurs when CINDY is attempting to print. CINDY prints to the host's computer default primary printer. Check if printer is out of paper or if printer is jammed. Test host computer printer configuration. This message is generated by MESSAG2.BAS.
Radionuclide already selected	This message is displayed to inform the user that an attempt was made to add a radionuclide to the list of available radionuclides. This message is generated by POPRAD2.BAS.
Radionuclide Master File not found	Contact the code developers if this error occurs. This message is generated by POPINS.BAS.
Radionuclide not found in master list: *nnn*. Record follows.	Where *nnn* is the unrecognized radionuclide. This warning message is displayed when the user is interactively entering or editing bioassay data and CINDY does not recognize the input radionuclide. The bioassay data record in question is displayed after the user acknowledges this message. Check the designation of the radionuclide against the available radionuclide list, edit record, or disregard if not interested in evaluating this bioassay data point within the CINDY working environment. This message is generated by BIOHAN.BAS.
Return to main menu to complete selection.	When the user is creating a new site configuration and generating new library files, this message is displayed to prompt the user to return immediately to the main menu to complete the site configuration process. This message is generated by POPMAN.BAS.

TABLE 7. (Contd.)

Sample date before intake. Record follows.	This message is displayed when the user is interactively entering or editing bioassay data and CINDY determines that the current intake data is after the sample date. CINDY will disregard this record, but warns the user to protect against inadvertent error. The bioassay data record in question is displayed after the user acknowledges this message. Edit record or disregard if appropriate. This message is generated by BIOHAN.BAS.
Saving subject model file	This informational message is displayed when a subject model file is being saved. This message is to protect the user from inadvertently saving subject-specific model parameters. If the user does not wish to retain the modified model parameters, select **Environment Management** on the main menu, select **Select File Group**, and enter ***nnn.**** (where *nnn* is the subject file name prefix); and then select **Delete a File**, and select ***nnn*.mod**. This message is generated by POPSAV.BAS.
Screen will be refreshed on return to main menu	This informational message informs the user that the requested screen change will be completed when the user returns to the main menu. This message is generated by SCREENS.BAS.
Select *nnn*, then retrieve this subject.	Where *nnn* is a site configuration file name. This message is displayed when the user attempts to retrieve a subject file with radionuclides of concern not supported in the current site configuration. CINDY will not continue with the subject retrieval. This message is provided to inform the user that the subject file in question was created under the *nnn* site configuration. Select this site configuration from the **Use Alternate Configuration** menu on the **Environment Management** menu. This message is generated by FILHAN.BAS.
Set graph defaults	This message is displayed when the user requests a display of graphs for the current subject and a check indicates that vital graphic parameters have not been set. Select **Default Graph Parameters** and review all graphic parameter values. This message is generated by POPMAN.BAS.

TABLE 7. (Contd.)

Set default radiological units next.	This message reminds the user to select default radiological units for each radionuclide added to the list of available radionuclides for the modified site configuration. This message is generated by POPINS.BAS.
Set chronic exposure end point	This warning message is displayed to alert the user that a chronic exposure scenario has been specified and that the chronic exposure end date has not been set. Enter the chronic end date. This message is generated by INTAKE1.BAS.
Snapshot already in memory	Contact the code developers if this error occurs. This message is generated by UTILITY.BAS.
Subdirectory changed to: *nnn*	Where *nnn* is the now-current subdirectory. This informational message informs the user that the requested subdirectory change was completed satisfactorily. This message is generated by POPMAN.BAS.
Total greater than 100%	When the user is inputing either intake composition or intake quantity, CINDY checks to ensure that the sum of the inhalation class percentages (inhalation intake mode) or the solubility class percentages (ingestion intake mode) is not greater than 100%. This informational message is displayed to protect the user against inadvertent error. This message is generated by INTAKE2.BAS.
Unable to read/write all information	This general file handling error occurs when CINDY was not able to read or write a memory buffer to/from disk. Contact the code developers if this error occurs. Do a screen print to document the error. This message is generated by MESSAG2.BAS.
Unknown video mode	This warning message is displayed during initialization of the CINDY working environment when the video mode is not recognized. The host computer may be incompatible with CINDY. Refer to the **System Requirements** section of this manual. This message is generated by INIT.BAS.

TABLE 7. (Contd.)

Urine volume unit not recognized. Record follows.	Where *nnn* is the unrecognized urine volume unit. This warning message is displayed when the user is interactively entering or editing bioassay data and CINDY does not recognize the input urine volume unit. The bioassay data record in question is displayed after the user acknowledges this message. Edit record or disregard if not interested in evaluating this bioassay data point within the CINDY working environment. This message is generated by BIOHAN.BAS.
Video board not specified: *nnn*	Where *nnn* is the index of the video board. This informational message is displayed when CINDY attempts to display a graph and finds the video board incompatible. After the user acknowledges this message, CINDY does not attempt to display the graph and continues operation. The supported video board is VGA (index of 3). Refer to the **System Requirements** section of this manual. An index of 0 indicates a monochrome video board; an index of 1, a CGA video board; and an index of 2, an EGA video board. This message is generated by SETGRAF.BAS.
Volume in following record is suspect. Record follows.	This informational/warning message is displayed when the user is interactively entering or editing bioassay data and CINDY suspects the daily volume. CINDY compares the daily volume to the reference volume for the sex of the worker and the sample type. This message indicates that the daily volume estimated from the input is not within 40% of the reference volume. The record in question is displayed after the user acknowledges this message. The user is then asked, **"Do you wish CINDY to correct period of exposure?"** the user has three the options: • Change the input data • Have CINDY correct the data • Add a comment to the data file about the data value. If CINDY is requested to correct the data, then the period of exposure will be modified by ratio of the volumes. This message is generated by BIOHAN.BAS.

TABLE 7. (Contd.)

When you wish to return to CINDY, type EXIT	This informational message is displayed when the user selects **DOS Shell** on the **Environment Management** menu. It is the users responsibility to return to CINDY by typing **Exit** at the DOS prompt. Before exiting to DOS, CINDY saves the current screen image, current drive, and current subdirectory. When the user returns to CINDY, the CINDY screen image is restored, and the current drive and subdirectory are checked. If the user changed the default drive and/or subdirectory, CINDY returns the default drive and subdirectory to the locations active when the Shell occurred. These actions protect the user against inadvertent error. This message is generated by POPMAN.BAS.

TABLE 8. LSODES Error Messages

LS2: Error return from LSODES2, ISTATE = -1	This error indicates that an excessive amount of work was done on this call to the solver.
LS2: Error return from LSODES2, ISTATE = -2	This error indicates that an too much accuracy was requested for the precision of the machine being used.
LS2: Error return from LSODES2, ISTATE = -3	This error indicates that illegal input was detected before taking any integration steps.
LS2: Error return from LSODES2, ISTATE = -4	This error indicates that there were repeated error tests failures on one attempted step.
LS2: Error return from LSODES2, ISTATE = -5	This error indicates that there were repeated convergence tests failures on one attempted step.
LS2: Error return from LSODES2, ISTATE = -6	This error indicates that the parameter **ewt(i)** become zero for **i** during the integration. Pure relative error control was requested on a variable which has now vanished.

TABLE 9. FORTRAN Error Messages

1	Insufficient RAM to Continue Execution
2	Program Stack Exhausted
3	NDP Divide by Zero
4	NDP Arithmetic Overflow
5	NDP Arithmetic Underflow
6	NDP Error - Invalid Number, Integer Overflow, or 0/0
7	Integer Divide Error
8	Integer*2 Overflow
9	Chain File Error
10	System Error During Chain
11	SUBROUTINE Subprogram Invoked as a FUNCTION
12	FUNCTION Subprogram Invoked as a SUBROUTINE
13	Subprogram Argument Count Differs from Caller
14	Subprogram Alternate Return Count Differs from Caller
15	Substring Bounds are Poorly Defined
16	Array Subscript Exceeds Allocated Area
19	DO Increment is Zero
20	Adjustable Array Dimension is Not Positive
22	SQRT Argument Negative
25	Invalid Argument Value for LOG
26	Invalid Argument Value for LOG10
28	Invalid Exponentiation
29	Invalid Argument Value for SIN Function
30	Invalid Argument Value for COS Function
31	Invalid Argument Value for TAN Function
35	Invalid Argument Value for ASIN Function
36	Invalid Argument Value for ACOS Function
38	Invalid Argument Value for ATAN2 Function
40	COMPLEX Divide by Zero
42	Runtime System Error in Subroutine "SYSTEM"
43	Insufficient RAM for "COMMAND.COM" in Subroutine "SYSTEM"
44	"COMMAND.COM" is Not Available in Subroutine "SYSTEM"
81	Insufficient RAM to Continue Execution
82	Program Stack Exhausted
83	NDP Divide by Zero
84	NDP Arithmetic Overflow
85	NDP Arithmetic Underflow
86	NDP Error - Invalid Number, Integer Overflow, or 0/0
87	Integer Divide Error
88	Integer*2 Overflow
91	FORMAT Repeat Count Less Than 1 or Greater Than 32767
92	Invalid Direct File Record Number
93	Data Transfer Beyond End of Record
94	Data Transfer Beyond End of File
95	System I/O Error
96	Invalid Close Parameters

TABLE 9. (Contd.)

97 Invalid Record Length Specification
98 Invalid ACCESS= Specification
99 Invalid FORM= Specification
100 Invalid STATUS= Specification
101 Invalid BLANK= Specification
102 Unable to Create File
103 Invalid Parameter Change on Open File
104 Invalid I/O Operation on a non-Disk Device
105 Invalid Syntax in FORMAT
106 FORMAT Specification Incompatible with Data Type
107 Too Many Conversion Digits Requested in FORMAT
108 Invalid CARRIAGECONTROL= Specification
109 Invalid FORMAT Field Width
110 Invalid Logical Input
111 Invalid Character Input
112 Invalid List-Directed Input
113 Invalid Numeric Input
114 Output Field Width Exceeded
115 Invalid Unit Number
116 Initiating I/O While Doing I/O
117 Direct I/O on a Sequential File
118 Sequential I/O on a Direct File
119 Unit Already Connected
120 Invalid Hollerith Constant in FORMAT
121 File is in an Inconsistent State
122 Unable to Position File
123 Unable to Close File
124 Unable to Read File
125 Unable to Write File
126 Invalid Repeated Input
127 List-Directed I/O Not Allowed
128 Nesting too Deep in FORMAT
129 Conversion Specification Missing in FORMAT
130 Invalid Scale Factor in FORMAT
131 Unable to Delete File
132 File Already in Use
133 Formatted I/O on a Formatted File
134 Unformatted I/O on a Formatted File
135 Invalid File Format for Open Specification
136 File is Already in the Directory
137 Cannot Open File
138 Invalid File Name
139 No file Connected to Unit
140 Invalid Open Parameters

TABLE 9. (Contd.)

141 Too Many Digits if Precision Requested for Data Type
142 No file Handles Left
143 Number in FORMAT is Negative or Too Large
144 Invalid Value for T or X in FORMAT
145 Path Not Found
146 Invalid NAMELIST Input Format
147 Array Subscript Exceeds Allocated Area
148 Wrong Number of Array Dimensions
149 Variable Name Not Found
150 File Specified STATUS="NEW" Already Exists
151 File Specified STATUS="OLD" Does Not Exist
152 RECL Specifier Differs from Record Length of File
153 Filename Length Exceeds 51 Characters
154 Record Length > 32767
155 Invalid ACTION= Specification
156 Invalid DELIM= Specification
157 Invalid PAD= Specification
158 Invalid POSITION= Specification

RESERVED FILES

The CINDY directory is used to store files of the CINDY Software Package. The files identified in Table 10 are to be considered reserved for use by CINDY.

TABLE 10. CINDY Reserved Files

File Name	Description
cin.exe	CINDY environment shell executable
cindy.bat	Execution control master file
cindy.dat	CIN program text and constants
cindy.fig	Default site configuration
cindy.mod	Default model parameter library
cindy.rmd	Default available radionuclide library
cindy.see	Default specific effective energy library
cindyscr.dat	Window text and control parameter library
colors.exe	Color selection control executable
data8k.com	Reserve memory area executable
dep.exe	Lung deposition fraction executable
doses.exe	Dose assessment post-processor executable
files.dat	FORTRAN codes file name text file
helps.dat	Help screen text library
int.buf	Calculation programs' communication file buffer
int.in	Calculation programs' input file buffer
int.gra	Caclulation programs' graph file buffer
int.out	Calculation programs' output file buffer
intake.exe	Intake assessment post-processor executable
intgrat.exe	Numerical integration executable
makelib.exe	Site-specific metabolic and specific effective energy library generator
makemet.exe	Model parameter library generator
metadata.dat	Master metabolic data library
new.met	Site configuration library generation file buffer for metabolic data (ASCII format)
new.mod	Site configuration library generation file buffer for metabolic data (compressed format)
new.rmd	Site configuration library generation file buffer for the radionuclides
new.see	Site configuration library generation file buffer for specific effective energies
part2.exe	View models and calculation preparation executable
pcmap.com	Memory map display executable

TABLE 10. (Contd.)

File Name	Description
photofil.exe	Save screen image executable
popgra.exe	View/edit graph display parameters executable
popvu.exe	Control results viewing executable
post.out	Calculation post-processor output file
prject.exe	Bioassay projection post-processor
rmdlib.dat	Master radionuclide library
sample1.bio	Sample Problem 1 subject bioassay data file
sample1.cin	Sample Problem 1 subject file
sample1.rdc	Sample Problem 1 calendar-year dose assessment graphic report
sample1.rig	Sample Problem 1 intake assessment graphic parameters report
sample1.rit	Sample Problem 1 intake assessment text report
sample1.rpg	Sample Problem 1 bioassay projection graphic parameters report
sample1.rst	Sample Problem 1 subject report
sample2.bio	Sample Problem 2 subject bioassay data file
sample2.cin	Sample Problem 2 subject file
sample2.rig	Sample Problem 2 intake assessment graphic parameters report
sample2.rit	Sample Problem 2 intake assessment text report
sample2.rpg	Sample Problem 2 bioassay projection graphic parameter report
sample2.rpt	Sample Problem 2 bioassay projection text report
sample2.rst	Sample Problem 2 subject report
sample3.cin	Sample Problem 3 subject file
sample3.rda	Sample Problem 3 specified period dose assessment report
sample3.rdc	Sample Problem 3 calendar-year dose assessment report
sample3.rpg	Sample Problem 3 bioassay projection report
sample3.rpt	Sample Problem 3 bioassay projection text report
sample3.rst	Sample Problem 3 subject report
sample4.bio	Sample Problem 4 subject bioassay data file
sample4.cin	Sample Problem 4 subject file
sample4.rda	Sample Problem 4 specified period dose assessment report
sample4.rig	Sample Problem 4 intake assessment graphic parameter report

TABLE 10. (Contd.)

File Name	Description
sample4.rit	Sample Problem 4 intake assessment text report
sample4.rpg	Sample Problem 4 bioassay projection graphic parameter report
sample4.rpt	Sample Problem 4 bioassay projection text report
sample4.rst	Sample Problem 4 subject report
sample5.bio	Sample Problem 5 subject bioassay data file
sample5.cin	Sample Problem 5 subject file
sample5.rig	Sample Problem 5 intake assessment graphic parameter report
sample5.rit	Sample Problem 5 intake assessment text report
sample5.rpg	Sample Problem 5 bioassay projection graphic parameter report
sample5.rpt	Sample Problem 5 bioassay projection text report
sample5.rst	Sample Problem 5 subject report
see.dat	Specific effective energy file buffer
see1.dat	Specific effective energy master library, part 1
see2.dat	Specific effective energy master library, part 2
see3.dat	Specific effective energy master library, part 3
subject.bio	Subject bioassay data file buffer
subject.buf	Subject file buffer
subject.gra	Subject graph report heading file buffer
subject.mod	Subject model buffer
subject.rpt	Subject report file buffer
timing.out	Timing report file buffer
undata.com	Unreserve memory area executable

GLOSSARY

ASCII	An acronym for American Standard Code for Information Interchange. ASCII is one of the standard formats for representing characters so that files can be shared between programs. It is a seven-bit code that defines 128 standard characters. Characters include control characters, letters, numbers, and symbols. A text file is in ASCII format.
Backdrop	The base area on the video display, encompassing the entire screen. This area is used is CINDY for status reports and instructional messages.
Byte	The amount of space needed to store a single character (number, letter, or code). A byte generally represents eight binary digits (bits). For example, if a character requires one byte of storage space, that one byte is translated to eight bits when processed in the computer. 1024 bytes equals one kilobyte (Kb).
Character String	A sequence of letters, numbers, and symbols. Character strings are normally enclosed in quotation marks or other delimiters.
Column	A number that is used to indicate the starting horizontal position on either the video monitor, the printer, or a field within a record. Column values increase from the left, with the smallest value being zero.
Cursor	The visible marker used to indicate the current position on the video monitor.
Database	A generalized, common, integrated collection of data which fulfills the data requirements of all applications which access it, and which is structured to model the natural data relationships which exist in an enterprise.
Default	A preprogrammed option that may be accepted or changed in the current working session.
Directory	A catalogue of files on a disk.
DOS	The Disk Operating System is software that directs the flow of data between disk drives and the computer. Without an operating system, a computer can do nothing.

Drive	Indicates the disk-drive identifier (For example, A, B, or C). When used as part of a file name, the disk-drive identifier must be followed by a colon (for example, A:).
Enter	A synonym for the **Enter** or **Return** key.
Esc	A synonym for escape key. The escape key generates the ASCII code (27). The escape key is used in CINDY to abort the current command execution.
Expanded Memory	Lotus Intel Microsoft specification for addressing more than 640 Kb of memory. To access expanded memory, the computer must be configured with especial memory and/or driver.
Extension	Up to 3 characters added to the end of a file name (preceded by a period) to identify the type of file. CINDY assigns file name extensions.
Field	A field may contain an identified item of information in a record of a database file. It corresponds to a column in a paper database of rows and columns. See **Record**).
Field Type	The field type indicates the kind of data that may be stored within a field. Field types used in CINDY are character, numeric, date, time, and social security number.
Field Width	The number of character spaces assigned to a field.
File	File refers to a disk file. File may also refer to a database file consisting of records and fields.
File Management	A generic term for the functions of creation, insertion, deletion, and modification of files.
File Name	The name of a disk file. A file name may consist of up to eight character. It must begin with a letter and may not contain embedded blank spaces. The file name may contain an **extension** and may be preceded by a **pathname**.
Input Window	(See **Window**.)
Intake	For each subject there may be one or more **intake(s)** or exposure scenarios. (Currently only a single intake may be specified). An intake may be either acute or chronic and can consist of a mixture of exposure modes (e.g., inhalation, ingestion, wound), radionuclides, and solubility classifications.

Intake Component	An **intake** is treated as a collection of intake components. Each intake component consists of a single exposure mode, a radionuclide or radionuclide chain, and a solubility classification.
Integer	A number with no fractional part: a whole number.
Kilobyte	See **byte**. 1024 bytes equals one kilobyte (Kb).
Megabyte (M)	1024 kilobytes (1,048,576 bytes) of information or storage space.
Memory	A computer's temporary data storage area. (See **RAM** and **ROM**.)
Menu Bar	The cursor within a menu, indicated by a reverse-video display of the current menu item.
Menu	A list of options. Menus are used throughout CINDY to control user selections. The main menu is always displayed; other menus may overlay the main menu. Whenever possible, menus are stacked so that the user may visualize the menu path taken to the most current menu. Menu items allow the user to logically move about within the CINDY environment and to select options.
Menu-driven	A process that allows the user to select a course of action based on one or more user-selectable options.
Monitor	The video display device.
Numeric fields	Contains number that may be directly used in mathematical calculations.
Output	The transfer of information from a computer program to an outside device; for example data sent to a printer, a video monitor, or a disk file.
Pathname	A full pathname includes the drive, root, and any subdirectory names. Each name is separated by a backslash (\).
Program	An ordered series of software instructions designed to have the computer perform a specific sequence of actions.
Public domain software	Free or minimal cost software available from such sources as government agencies, certain periodicals, and computer user groups.

RAM	**Random Access Memory** is the working space or temporary storage area for the current program. RAM is erased when the power is turned off.
Record	A group of adjacent data items in a computer system, manipulated as a unit. A complete horizontal row in a database file or a rectangular table of rows and columns.
ROM	**Read Only Memory** contains information the computer uses to run the system. ROM is permanent and is not erased when the power is turned off.
Run	A run consists of the selected intake components for the current calculation. Each run is for a single operational mode. Each intake component requires a separate execution of the differential equation solver.
Structure	The definition of the database fields.
Target User	The end user to whom the software package is addressed.
Toggle	Refers to those situations where the same command causes switching between two stable states. The state achieved is dependent upon the state that existed when the command was issued. For example, pressing **Enter** on a selected (highlighted) option will cause the field to be deselected.
TSR	**Terminate and Stay Resident program.**
VGA	IBM Video Graphics Adapter monitor and controller card.
Site Configuration	The CINDY working environment is defined by a **site configuration** file. The site configuration allows the user to customize the working environment for a particular site or facility. The site configuration defines default parameter values and options, the list of radionuclides available for calculations, and the default metabolic data. The process of establishing the site configuration is sometimes referred to as **site set-up.**
Software Package	Computer programs, procedures, associated data and documentation pertaining to specified application, usually referred to by a common name. For example, the CINDY Software Package is a collection of computer programs, data files, and documentation that is usually referred to as **CINDY.**
Subject	Intake information in CINDY is organized by **subject** or worker to simplify reporting. Subject information

	includes biographic data (for report headings), exposure scenario information, and, optionally, specific metabolic data. Typically, there would be many subjects per site configuration.
Wild Card	A place holder that permits substitution for individual characters in file names under limited conditions. The wild card substitution for individual characters is the question mark (?). The wild card substitution for contiguous blocks of characters is the asterisk (*).
Window	Windows are used to control parameter input and selection, display results and files, or provide informational messages. Windows used to control parameter input and selection are referred to as **input windows**. Input windows may contain input fields (e.g., names, numbers), program options (e.g., **Inhalation**, **Ingestion**) as well as operational options (e.g., **Return to menu**).

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