CAP88-PC Version 3.0 User Guide

Draft Revision 1

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1. INTRODUCTION

1.1 Background

On October 31, 1989 the Environmental Protection Agency (EPA) issued final rules for radionuclide emissions to air under 40 CFR 61, National Emission Standards for Hazardous Air Pollutants (NESHAPS). Emission monitoring and compliance procedures for Department of Energy (DOE) facilities (40 CFR 61.93 (a)) require the use of CAP-88 or AIRDOS-PC computer models, or other approved procedures, to calculate effective dose equivalents to members of the public.

The CAP88 (which stands for Clean Air Act Assessment Package - 1988) computer model is a set of computer programs, databases and associated utility programs for estimation of dose and risk from radionuclide emissions to air. CAP88 is composed of modified versions of AIRDOS-EPA (Mo79) and DARTAB (ORNL5692). The original CAP88 model is written in FORTRAN77 and has been compiled and run on an IBM 3090 under OS/VS2, using the IBM FORTRAN compiler, at the EPA National Computer Center in Research Triangle Park, NC.

1.2 Purpose

The original CAP88-PC software package, version 1.0, allowed users to perform full-featured dose and risk assessments in a DOS environment for the purpose of demonstrating compliance with 40 CFR 61.93 (a). CAP88-PC provides the CAP-88 methodology for assessments of both collective populations and maximally-exposed individuals. The complete set of dose and risk factors used in CAP88 is provided. CAP88-PC differs from the dose assessment software AIRDOS-PC in that it estimates risk as well as dose, offers a wider selection of radionuclide and meteorological data, provides the capability for collective population assessments, and allows users greater freedom to alter values of environmental transport variables. CAP88-PC version 1.0 was approved for demonstrating compliance with 40 CFR 61.93 (a) in February 1992.

CAP88-PC version 2.0 provided a framework for developing inputs to perform full-featured dose and risk assessments in a Windows environment for the purpose of demonstrating compliance with 40 CFR 61.93 (a). Version 2.1 included some additional changes compared to the DOS version and the previous Windows version, 2.0. The changes included the addition of more decay chains, improvements in the Windows code error handling, and a modified nuclide data input form. Section 1.6 provides a summary of the changes incorporated into Version 2.1 relative to Version 2.0.

CAP88-PC Version 3.0 is a significant update to the version 2 system. Version 3 incorporates dose and risk factors from Federal Guidance Report 13 (FGR 13, EPA99) in place of the RADRISK data that was used in previous versions. The FGR 13 factors are based on the methods in Publication 72 of the International Commission on Radiological Protection (ICRP72). . In addition, the CAP88-PC database, the user interface, input files, and output files, were modified to accommodate the FGR 13

data formats and nomenclature. Section 1.7 describes the modifications incorporated into Version 3 relative to Version 2.1.

1.3 Model Summary

CAP-88 PC uses a modified Gaussian plume equation to estimate the average dispersion of radionuclides released from up to six emitting sources. The sources may be either elevated stacks, such as a smokestack, or uniform area sources, such as a pile of uranium mill tailings. Plume rise can be calculated assuming either a momentum or buoyant-driven plume. Assessments are done for a circular grid of distances and directions for a radius of up to 80 kilometers (50 miles) around the facility. The Gaussian plume model produces results that agree with experimental data as well as any model, is fairly easy to work with, and is consistent with the random nature of turbulence.

There are a few differences between CAP88-PC and earlier mainframe versions of AIRDOS, PREPAR and DARTAB. In particular, population assessments are easier to perform in CAP88-PC. When performing population assessments, population arrays must always be supplied to the program as a file, using the same format as the mainframe version of CAP88. Sample population files are supplied with CAP88-PC, which the user should modify to reflect their own population distributions. Population files for the mainframe version of CAP88 may be downloaded in ASCII format and used with CAP88-PC. When performing population dose assessments, CAP88-PC uses the distances in the population array to determine the sector midpoint distances where the code calculates concentrations. Note that CAP88-PC only uses circular grids. When an individual assessment is run, the sector midpoint distances are input by the user on the Run Option tab form. Direct user input of radionuclide concentrations is not an option in CAP88-PC.

CAP88-PC has the capability to vary equilibrium fractions; previously they were set to a constant of 0.7. The new method varies the equilibrium fractions depending on the distance from the source. Linear interpolation is used to determine the equilibrium fractions for distances that do not match the set distances given.

Agricultural arrays of milk cattle, beef cattle and agricultural crop area are generated automatically, requiring the user to supply only the State name or agricultural productivity values. When a population assessment is performed, the arrays are generated to match the distances used in the population arrays supplied to the code, and use State-specific or user-supplied agricultural productivity values. The state name (standard two letter abbreviation) must be provided on the Facility Data tab form. Users are given the option to override the default agricultural productivity values by entering the data directly on the Agricultural Data tab form. If Alaska, Hawaii, or Washington, D.C. is selected, agricultural productivity values are set to zero and must be provided by the user.

CAP88-PC is also modified to do either "Radon-only" or "Non-Radon" runs, to conform to the format of the 1988 Clean Air Act NESHAPS Rulemaking. "Radon-only" assessments, which only have Rn-222 in the source term, automatically include working level calculations; any other source term ignores working levels. Synopsis reports customized to both formats are automatically generated. Assessments for Radon-222 now automatically include Working Level calculations

when only a single source term of Rn-222 may be used in this option. Input of any additional radionuclides, even Rn-220, will cause CAP88-PC to omit working level calculations. Version 3 has not changed the "Radon Only" methodology relative to the previous versions 2.0 and 2.1.

The calculation of deposition velocity and the default scavenging coefficient is defined by current EPA policy. Deposition velocity is set to 3.5e-2 m/sec for Iodine, 1.8e-3 m/sec for Particulate, and 0.0 m/sec for Gas. The default scavenging coefficient is calculated as a function of annual precipitation, which is input on the Meteorological Data tab form. Version 3 has not modified these calculations.

Organs and weighting factors have been modified in Version 3 to follow the FGR 13 method. In accordance with the FGR 13 dose model, the code now calculates dose for 23 internal organs, rather than the 7 organs used in earlier versions. A '24^{th}' organ is also calculated, which is the total effective dose equivalent. The code now reports cancer risk for the 15 target cancer sites used in FGR 13. As was the case in version 2, changing the organs and weights will invalidate the results.

1.4 Validation

The CAP88-PC programs represent one of the best available validated codes for the purpose of making comprehensive dose and risk assessments. The Gaussian plume model used in CAP88-PC to estimate dispersion of radionuclides in air is one of the most commonly used models in Government guidebooks. It produces results that agree with experimental data as well as any model, is fairly easy to work with, and is consistent with the random nature of turbulence. Version 3 has not modified the basic Gaussian plume algorithm used by the AIRDOS module of CAP88-PC, and comparison cases between version 2 and 3 have shown no significant changes in the dispersion calculations.

The Office of Radiation and Indoor Air has made comparisons between the predictions of annual-average ground-level concentration to actual environmental measurements, and found very good agreement. In the paper "Comparison of AIRDOS-EPA Prediction of Ground-Level Airborne Radionuclide Concentrations to Measured Values" (Be86), environmental monitoring data at five Department of Energy (DOE) sites were compared to AIRDOS-EPA predictions. EPA concluded that as often as not, AIRDOS-EPA predictions are within a factor of 2 of actual concentrations.

1.5 Limitations

Like all models, there are some limitations in the CAP88-PC system.

While up to six stack or area sources can be modeled, all the sources are modeled as if located at the same point; that is, stacks cannot be located in different areas of a facility. The same plume rise mechanism (buoyant or momentum) is used for each source. Also, area sources are treated as uniform. Variation in radionuclide concentrations due to complex terrain cannot be modeled.

Errors arising from these assumptions will have a negligible effect for assessments where the distance to exposed individuals is large compared to the stack height, area or facility size.

Dose and risk estimates from CAP88-PC are applicable only to low-level chronic exposures, since the health effects and dosimetric data are based on low-level chronic intakes. CAP88-PC cannot be used for either short-term or high-level radionuclide intakes.

1.6 Summary of Version 2.1 Changes from Version 2.0

Version 2.1.of CAP88-PC is an incremental change from Version 2.0, meaning that no significant modifications were introduced to the algorithms for calculating transport, uptake, dose, and risk. The changes have primarily been improvements to the Visual Basic code which performs the user interface and data collection functions. Some small changes were made to the FORTRAN calculation routines in order to accommodate variable input for humidity and to permit greater numbers of nuclides in a dataset. Additionally, the database files that are part of CAP88-PC's data management system have been updated to be more widely compatible with various versions of Windows. Some important modifications to the CAP88-PC code in Version 2.1 include:

- More extensive input field checking for valid values
- An error handling routine has been added to provide a text file output of errors encountered by the code. Most errors are now written to a file named 'YYYYMMDDErrorlog.txt', where the date code refers to the date when the error occurred. This file will be located in the CAP88-PC install directory
- Many updates to the directory structure, which provide more installation flexibility and better default initialization in the selection boxes for custom wind and population files.
- Added an absolute humidity entry on the Met Data tab for site specific calculation of tritium concentration in vegetables.
- Added a user selectable distance and sector (JLOC and ILOC) option for the individual assessment case. Setting these to non-zero values will cause the code to provide results for the distance and sector indicated.
- Increased the number of radionuclides allowed in a run to 120 from 36
- Incorporated the Year 2000 patch needed by Version 2.0
- Eliminated all third party functions and software packages that were in the Version 2.0 Visual Basic code
- Eliminated the dialog box that asked the user if they wanted to use MS-DOS mode
- Updated and shortened the initial splash screen
- The toolbar is now located at the top of the window in accordance with Windows standard practice
- The data environment (the accompanying database) has been updated to Microsoft Access for greater compatibility with Windows
- The 'Open From File' option is provided to allow the user to open input datasets that have not yet been included in the drop-down file list of available cases
- The default directory locations for the wind and population library are now the default install directories for these files.
- The radionuclide entry method has been changed. Rather than enter data directly into the Nuclide Data tab, the user now selects either 'Add Nuclide', 'Edit Nuclide' or 'Delete Nuclide' from the buttons on the form. When 'Add Nuclide' or 'Edit Nuclide' are selected, a new data entry form containing all selectable data for the nuclide is presented.
- A new 'Save and Close' button is available on the Nuclide Data tab of the input data form.

The user interface for Version 2.1 was built in Visual Basic 6.0, and the install package was made using InstallShield 7.2. The installer technology has been updated and tested with all Windows versions from 95(b) to XP. It will now check for some necessary Windows components, such as DCOM and Windows Scripting, and will install these if needed. This has eliminated the requirement for a separate installation of the DCOM98 module.

1.7 Summary of Version 3 Changes from Version 2.1

Version 3 of CAP88-PC is a significant update to the previous version 2.1. Version 3 incorporates all the Version 2.1 updates listed in Section 1.6, along with the following additional modifications:

- Expansion of the nuclide database to 825 nuclides, including all FGR 13 decay chains
- Incorporation of the new FGR 13 dose and risk factors
- Elimination of the calculation of Genetic Effects
- Dose factors are now a function of radionuclide chemical form, wherever that is included in the FGR 13 database
- Organ dose equivalent is now calculated for 23 internal organs
- Cancer mortality risk is calculated for 15 cancer sites
- The radionuclide inhalation absorption 'Class' terminology has been replaced by the new 'Type' nomenclature. The new types are F (fast), M (medium), and S (slow), and are analogous to the older classes D (day), W (week), and Y (year).
- All particulate sizes are 1.0 micron per the FGR 13 model data, except gases and vapor forms which are 0.
- Default values for all radionuclide inputs are included; these defaults correspond to the recommended values from FGR 13 wherever a recommendation was available.
- The radionuclide transfer factors for all elements in the CAP88-PC database have been updated to the values from the National Council on Radiation Protection and Measurement (NCRP) report number 123 (NCRP123).
- The nuclide input form has been modified to allow selection of the nuclide absorption type and the nuclide chemical form wherever dose factors based on multiple values of these are included in the database
- The code now contains additional data for:
    - Age dependent dose factors
    - Dose factors for additional pathways such as drinking water ingestion and external exposure from multiple depths of soil contamination.
    - Dose factors for external exposure to infinite clouds
    - Cancer morbidity risk factors in addition to mortality risk factors

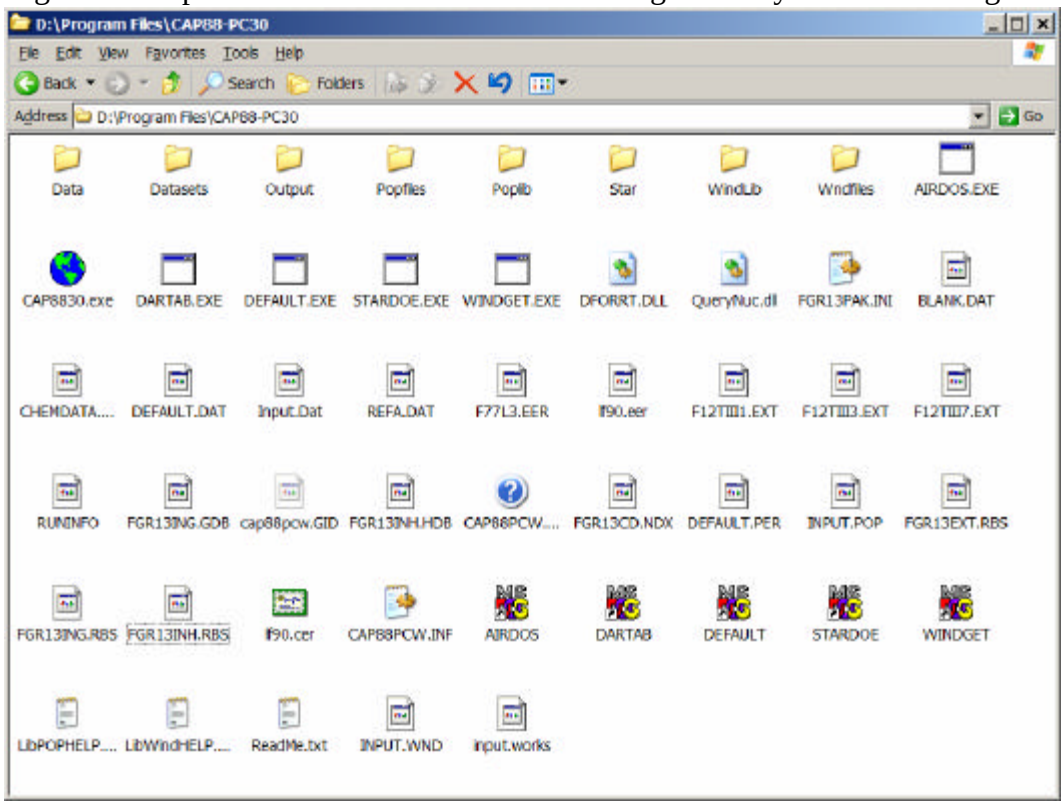
Although much of this information is now included in the CAP88-PC model, Version 3 of the code still reports data in the same formats and nomenclature as were used in the previous versions. This has been done to retain conformance of the model to the applicable regulation, 40 CFR Part 61 Subpart H. Accordingly, the dose factors used in version 3 for reporting dose to the maximum exposed individual and the populations are the values in FGR 13 for adults. The risk values reported by Version 3 are those for mortality, not morbidity. It is important to note that, because of the extensive data modifications, Version 3 does not allow the use of case input files created under earlier versions to be used as input for Version 3. Previous POP and WIND files are still useable.

2. GETTING STARTED

2.1. Installation of Version 3.0

The CAP88-PC Windows version 3.0 can be downloaded from the following EPA web site: http://www.epa.gov/radiation/assessment/CAP88/index.html

Follow steps 1-4 in section 2.2.1 if you have an existing installation of an earlier beta version of CAP88-PC version 3.0. If you do not have an existing installation of CAP88-PC version 3.0 then begin with step 5. CAP88-PC creates the following directory structure during a default installation:



2.2 Installation Notes:

- CAP88-PC Version 3.0 will not install properly under Windows 95a, Linux, or Unix.
- If you are running Windows NT, 2000, or XP, we strongly recommend that you be logged on with administrative privileges to properly install CAP88-PC Version 3.0.
- We recommend that you disable all virus scanners prior to installation.
- The new installation program eliminates the need for a separate installation of DCOM98. Installation of DCOM98 and the Windows Scripting engine are included in the installation package. Installation of these Windows components may require rebooting the system during the installation process.
- The procedure in Section 2.2.1 assumes you have an existing installation of an earlier beta version of CAP88-PC Version 3.0. If you do not have any existing installations begin at step 5.

- Steps 5 and 6 assume you are installing the software after downloading the CAP88-PC Version 3.0 ZIP archive. If you are installing from a CD then you may skip steps 5 and 6.

2.2.1 Installation Procedure

1. Save any user created input or output files that are in the 'Datasets' and 'Outputs' subdirectories of the previous install. Do not save the CAP88$ files as these are included in the install package.
2. Save any user generated wind or population files that are in the 'Popfiles' or 'Wndfiles' subdirectories of the previous install.
3. Uninstall any previous beta versions of CAP88-PC version 3.0.
4. Delete the directory structure from the previous install.
5. Create a temporary directory and download the .ZIP archive or self-extracting .EXE archive to the temporary directory.
6. Extract the files in the archive to the temporary directory. (Note - we recommend using a temporary directory as a location for the setup files rather than the directory where you intend to install CAP88-PC Version 3.0 to facilitate removal or archiving of the setup package following installation)
7. Run the SETUP.EXE program contained in the install package or on the CD. We recommend using the default installation directory for CAP88-PC Version 3.0. The install package will create the installation directory, and will also create a set of subdirectories underneath the installation directory. Please see section 2.1 of this document for a description of the directory structure created by the CAP88-PC Version 3.0 installation routine (this structure is not changed from Version 2.1, other than the top level name).
8. As part of the installation, SETUP will install the Windows Scripting System and, for users running a WIN9x operating system, may install DCOM98 if it is not detected as already installed on your system.
9. Accept the Windows Scripting installation and the DCOM installation if they are requested by SETUP. If these are installed and you are running Windows 95b, 98, or ME, you may need to reboot during the CAP88-PC installation.
10. Copy any saved input files from step 1 into the new 'Datasets' subdirectory if you wish them to be readily available in the new version.
11. Copy any saved output files to the new 'Outputs' subdirectory if desired.
12. Copy any .WND or .POP saved during step 2 into the 'Windlib' or 'Poplib' subdirectories of the new CAP88-PC directory.
13. If you are running Windows 95b, 98, or ME, we recommend rebooting after the installation is completed. This may not be necessary under Windows 2000 or Windows XP.
14. Restart any virus scanner software that was disabled during installation of CAP88-PC.

We recommend placing your previously saved wind and population files into the library subdirectories rather than the 'Wndfiles' or 'Popfiles' subdirectories, because the code will treat these initially as new files. The default open locations in CAP88-PC Version 3.0 for new wind or population files are the 'Windlib' and 'Poplib' subdirectories, not the 'Wndfiles' or "Popfiles' subdirectories, so this will make the files more readily accessible the first time you use them in the new installation. The code will subsequently save these files in the 'Wndfiles' and 'Popfiles' subdirectories after you select them for a run and perform a save of the case.

2.3. Running Version 3.0

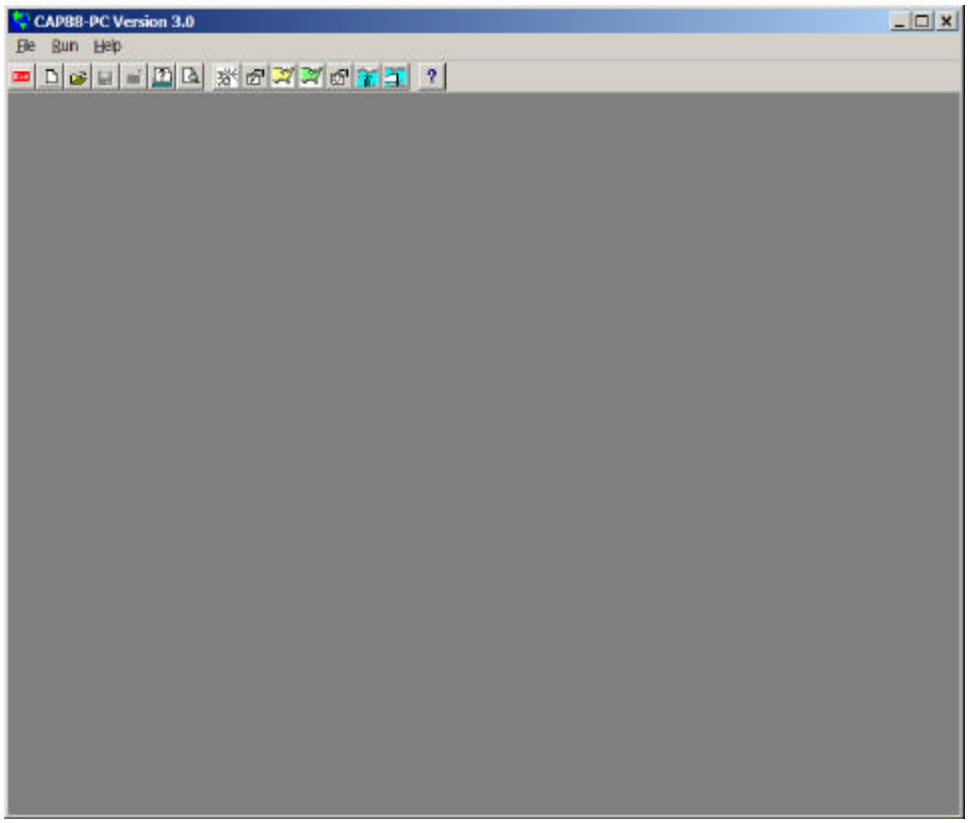
The installation package of CAP88-PC Version 3.0 ships with three pre-existing input files, named CAP88$.dat, NUKETEST.dat, and MODTEST.dat, along with their associated output files for those input datasets. The input file CAP88$.dat, along with its backup file CAP88$.bak, reside in the 'Datasets' subdirectory of the installation directory. Output files are still written into the 'Output' subdirectory in the same formats as under Version 2.0 and Version 2.1.

2.3.1 Initial Post-Installation Running of Version 3.0

When running Version 3.0 for the first time, no input datasets are included in the dropdown file selection list. In this instance, when selecting <File>, <Open Dataset>, the user will receive a message box stating "Nothing to Open!". The user has a choice to create a new dataset, or open an existing input dataset from a file. If the user selects to open an existing file, a listing of the available files that reside in the 'Datasets' subdirectory is provided in the directory navigation window. The user may select one of these, or may navigate to another directory and select an input file from there. Once the dataset is created either by manual entry or by opening an existing file, perform a save of the dataset. This dataset will then be included in the drop-down file list for opening and for executing the case.

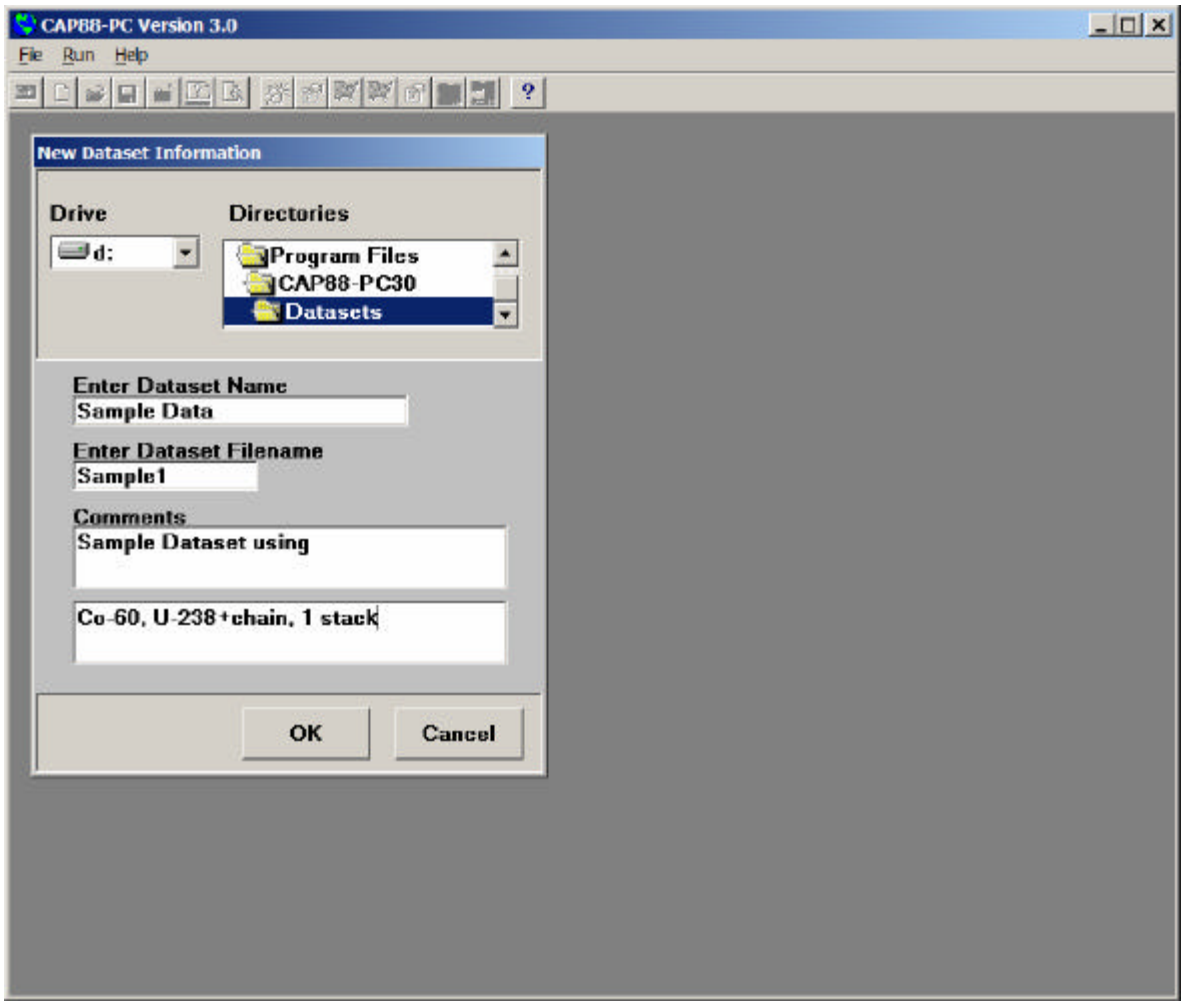
2.3.2 Building an Example Data Set

1. Start the code by double-clicking on the desktop icon or by using the icons installed on the <Start>, <Programs>, <Cap88pc30> location on the Windows start menu. After the initial splash screen, you will be at the following screen:

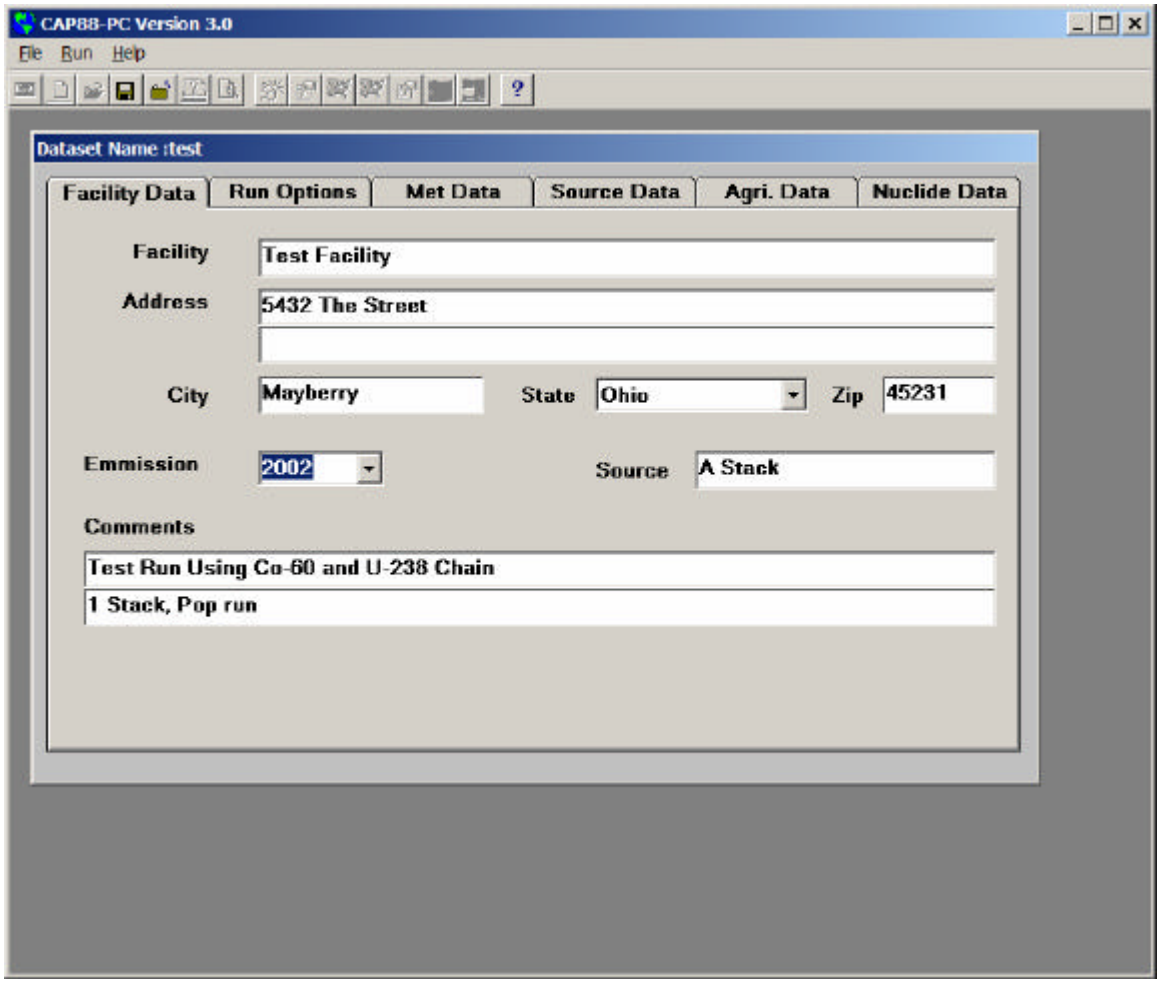


Note that in many cases the input screens have not changed from those in Version 2.1, so these screens are still applicable to these examples.

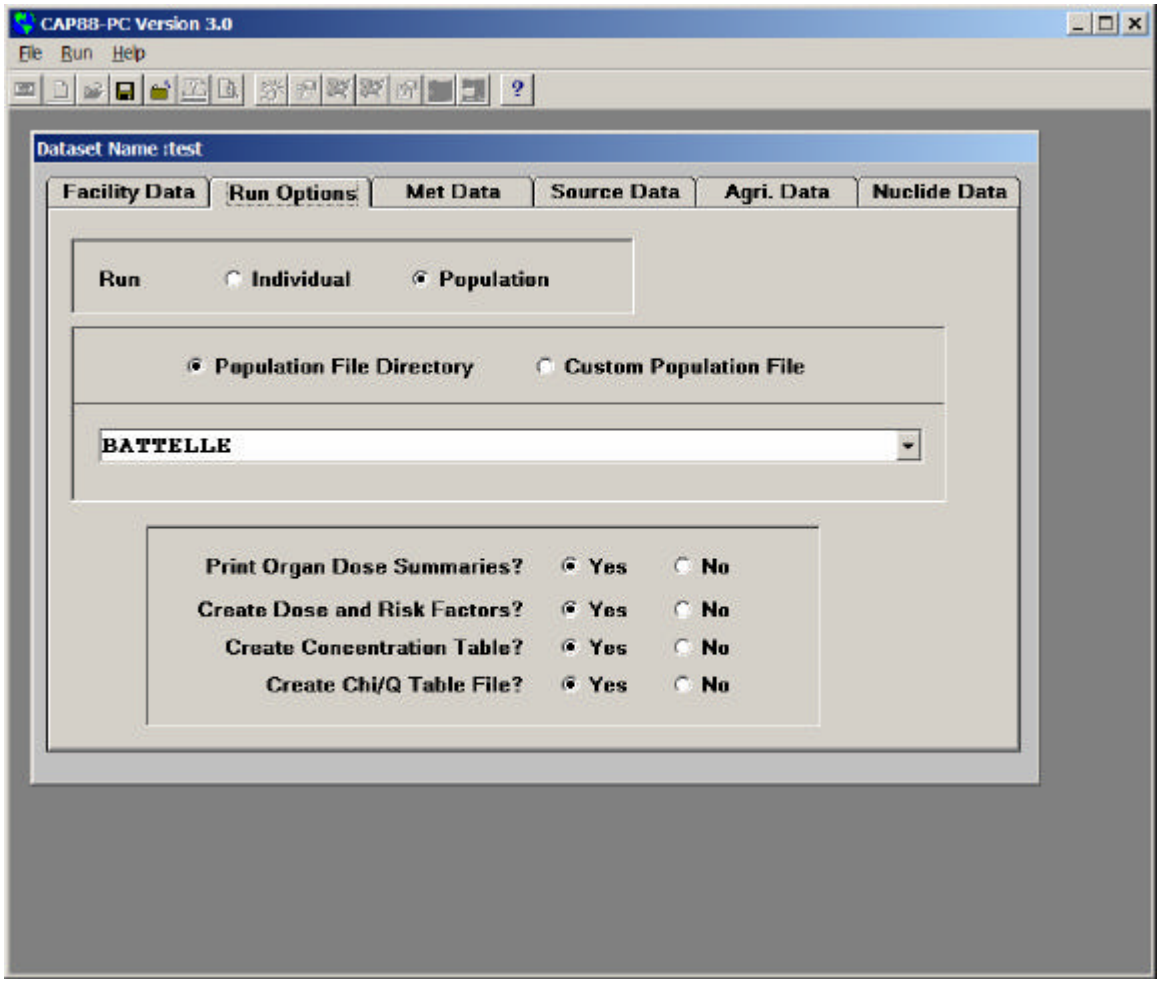
2. Select <File> from the menu bar, then <New Dataset> to begin creating a new CAP88-PC case. Enter the information for Dataset Name, Dataset Filename, and the two comment fields, and then click <OK>. Dataset Name must less than or equal to sixteen (**16**) characters, and Dataset Filename less than or equal to eight **(8)** characters. The comment fields are now optional; entries in each field must be less than fifty **(50)** characters.



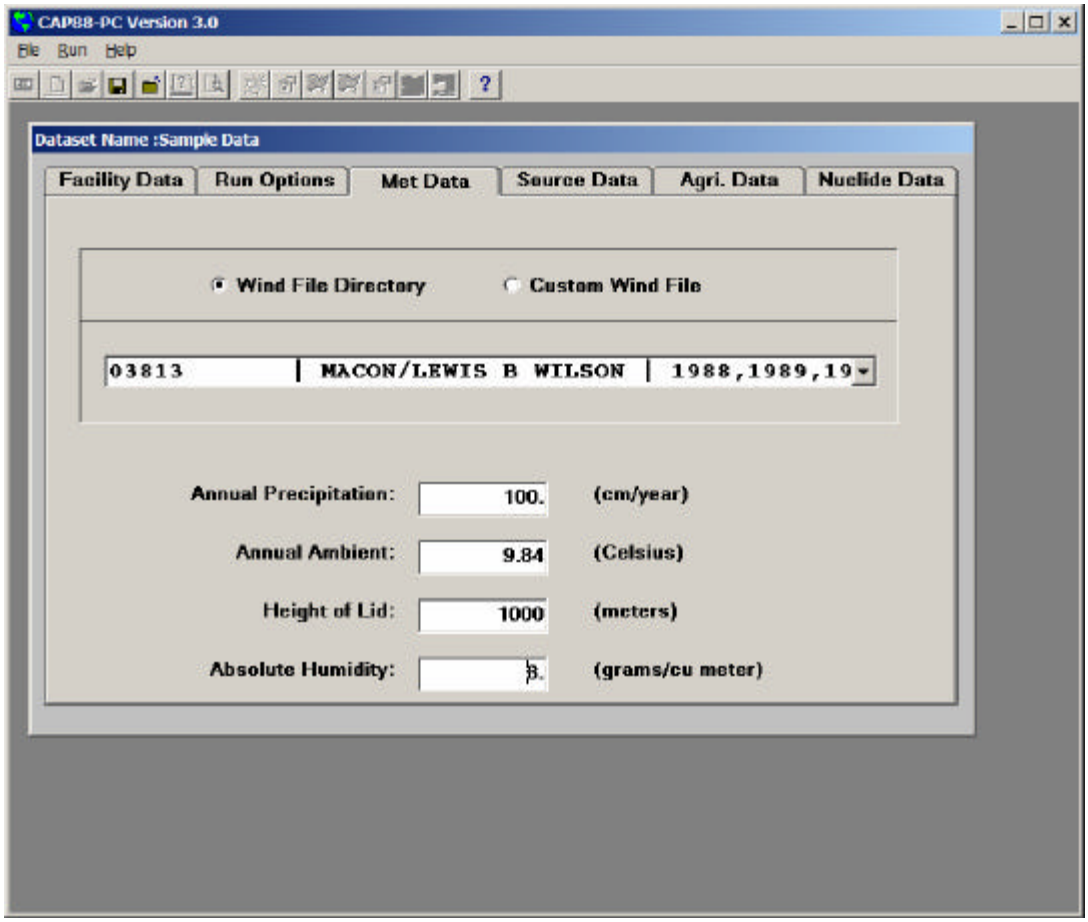
3. The next screen is the initial tab of the main form used to provide dataset information to CAP88-PC. The form consists of six tabs; each tab provides fields of related data. The user fills in these fields to build the dataset for the case being analyzed. This particular tab, shown here, is used to provide descriptive information regarding the facility being modeled. Providing the sample case data to this <Facility Data> tab results in the following screen.



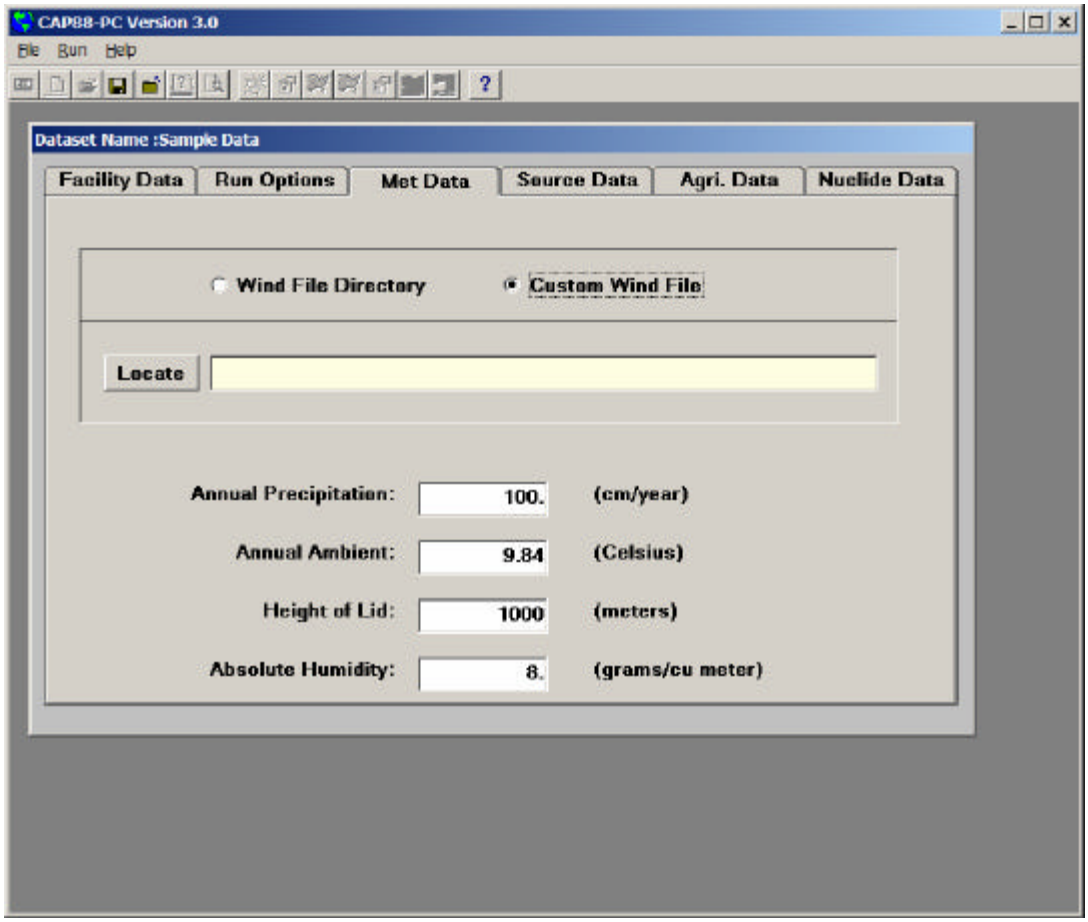
4. Select the <Run Options> tab, which will display the fields for selecting the type of run for this dataset (population or individual), for selecting the population file, and for selecting the type of output files for the run. For this sample dataset, select the data as shown in the figure below. Note that when the radio button for Population File Directory is selected, the file selection control is a drop down list of the population files that have been extracted into CAP88-PC's data environment. If the Custom Population File button is selected, then the file selection control allows selecting a population file by navigating to any file location. The initial default directory for the Custom Population File selection is the POPLIB subdirectory of the CAP88-PC Version 3.0 installation directory.



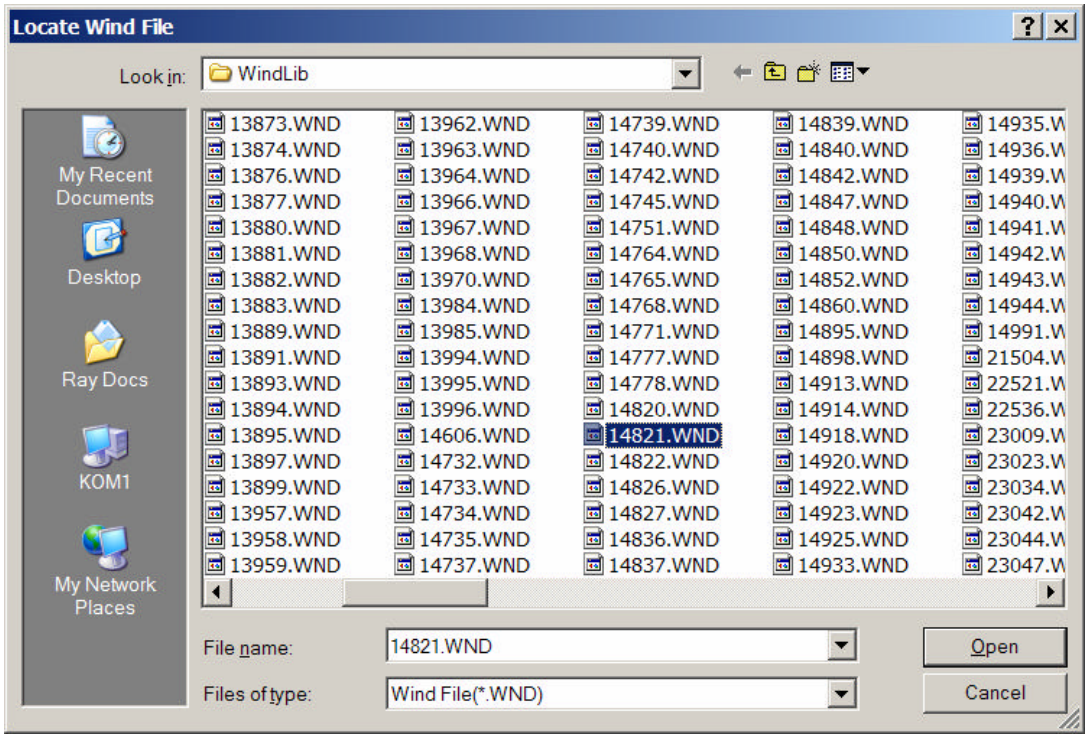
5. Select the <Met Data> tab to display the fields for describing the meteorological data required by CAP88-PC Version 3.0. One change to this tab from version 2.0 is the addition of the Absolute Humidity field, which has a default value of 8 grams water per cubic meter of air. The tab should initially appear similar to the following figure:



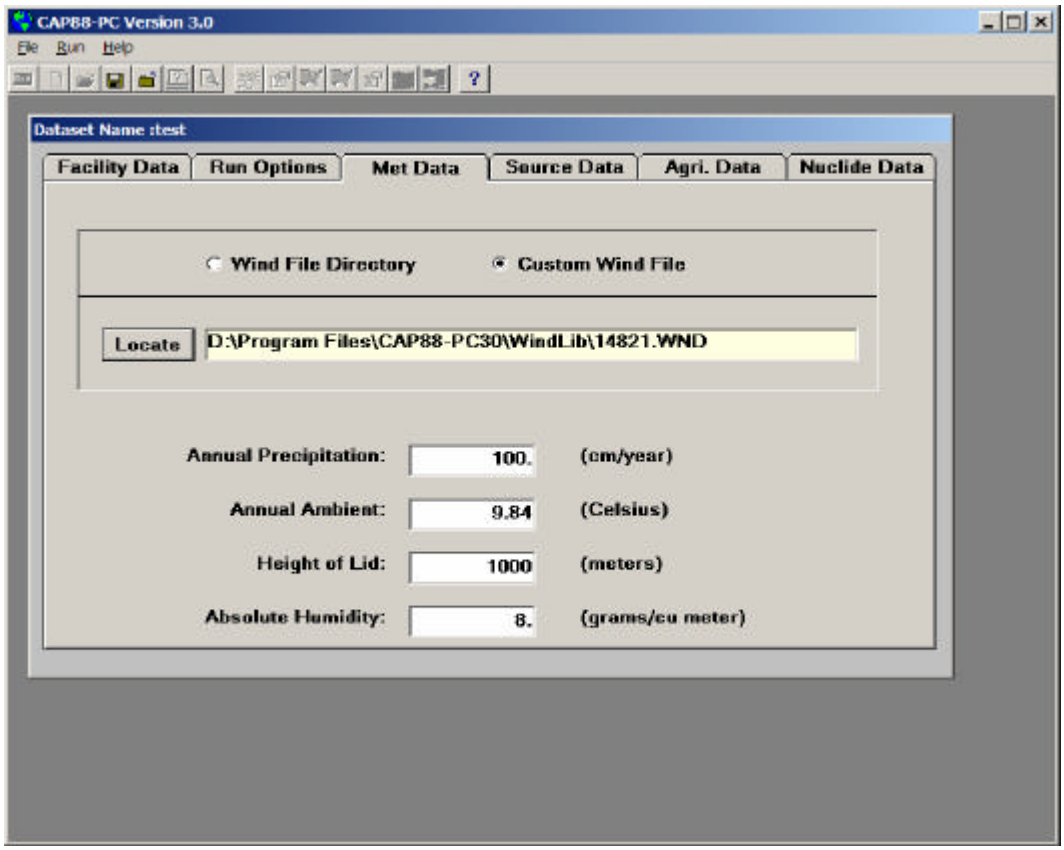
For this sample dataset, do not use the Wind File Directory button, since no wind file applicable to Columbus Ohio has been extracted into the CAP88-PC data environment. Select the Custom Wind File button to change the file selection control to one that will permit selecting a wind file from a separate directory. The tab should now display as follows:



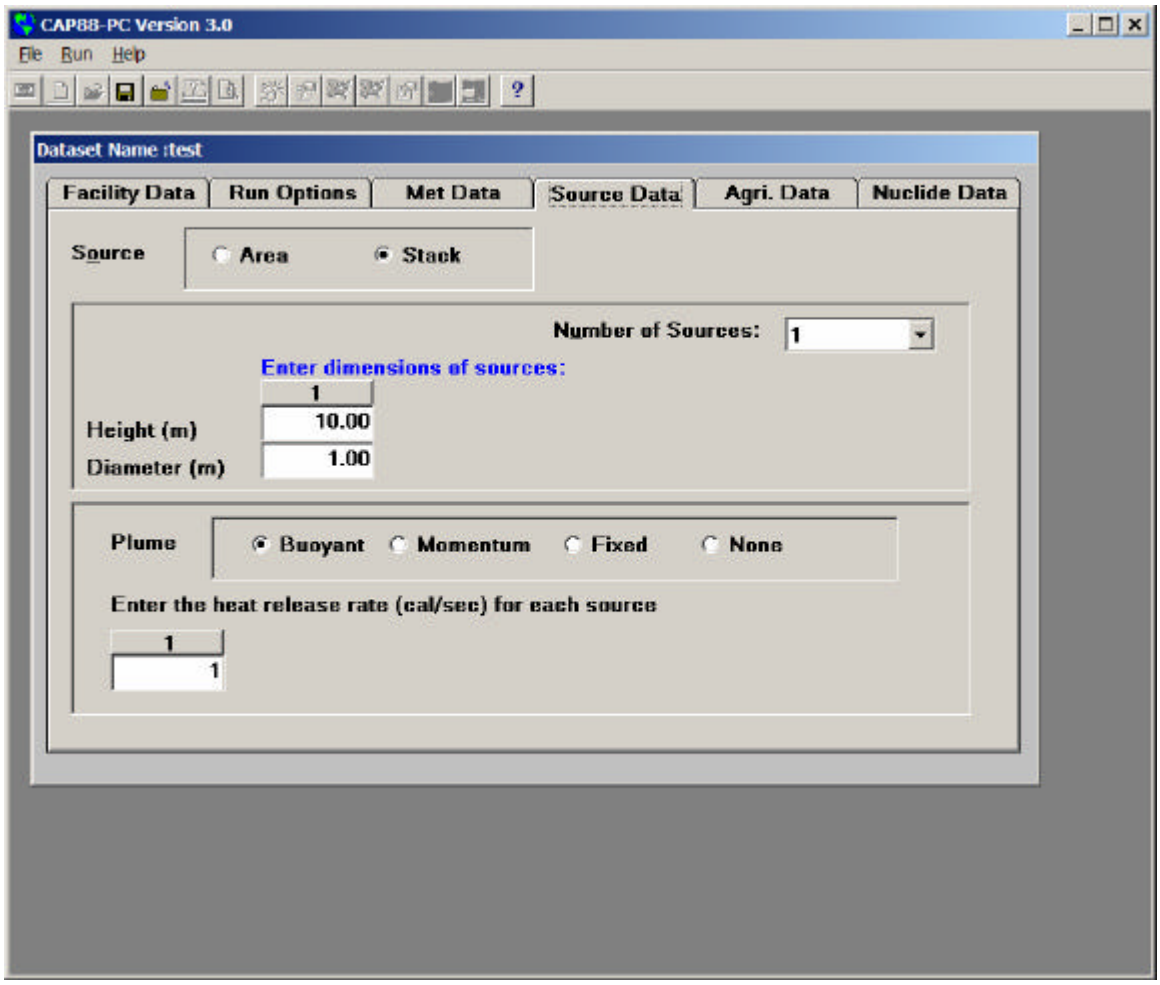
Click the <Locate> button to display a list of wind files stored in the Windlib subdirectory of the CAP88-PC Version 3.0 installation directory. Select the file named 14821.wnd, and the following sub-screen should result:



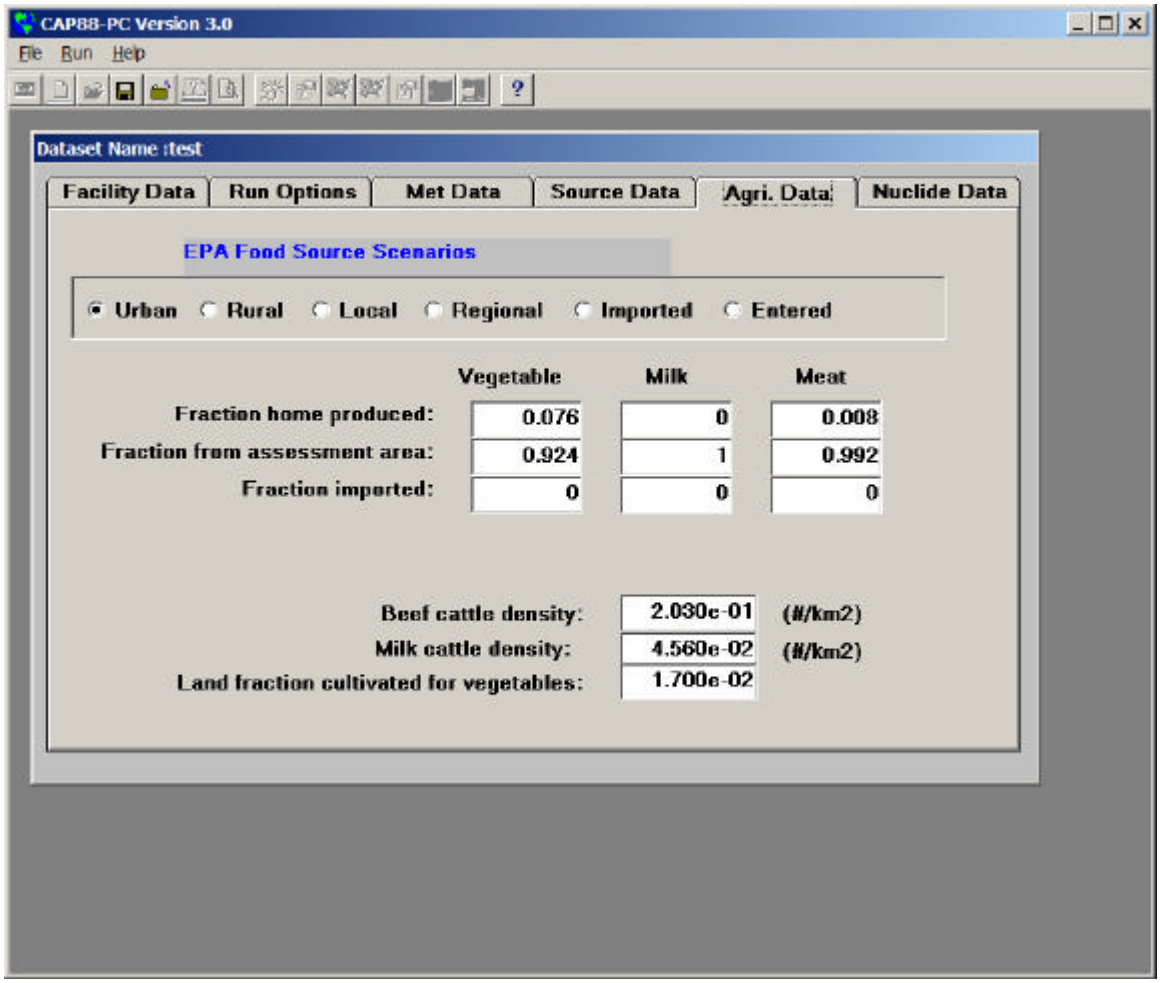
Click <Open>, and the file should be selected for use as the input wind file. The <Met Data> tab should now appear as follows:



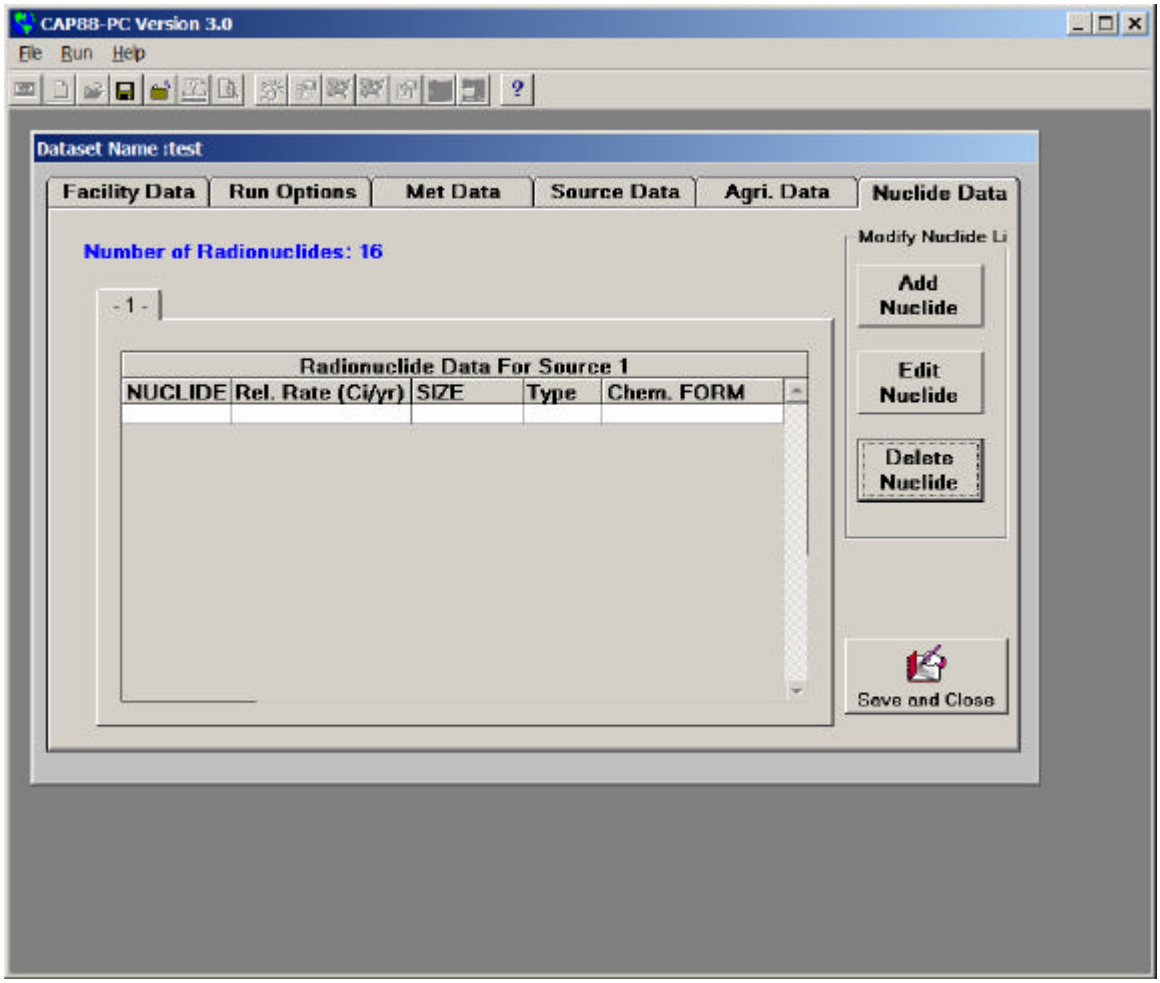
6. Select the <Source Data> tab to enable the fields that describe the physical parameters of the release. This sample dataset only uses a single stack release, but up to 6 sources can be selected. Note that although CAP88-PC allows up to 6 different sources, all sources must be of the same type (area or stack). Also, CAP88-PC models the sources as being co-located, i.e. they have the same physical center point. The displayed screen should be as follows after all data for the sample dataset have been entered:



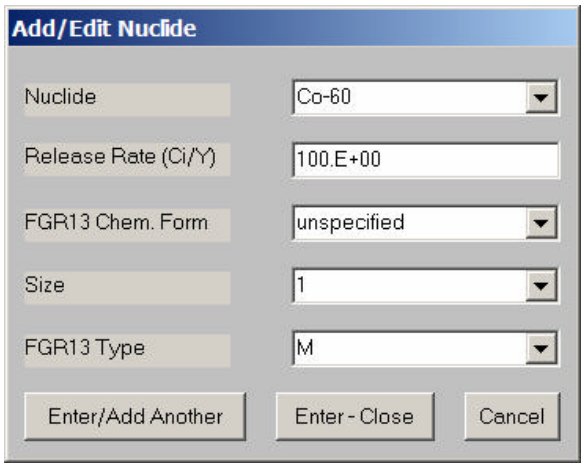
7. The next tab to be selected is the <Agri. Data> tab, which allows entry of the food pathway information for the dataset. The various options for the food sources determine the fraction of the food products grown either local to the analysis location, within the overall assessment area, or from outside the assessment area. Foods produced outside the assessment area are considered in the CAP88-PC code to be uncontaminated. The populated fields for the sample dataset will result in a screen appearing as follows:



8. The final tab to be selected is <Nuclide Data>. This tab has been modified from Version 2.0 to include a <Save and Close> button, and, more significantly, to add a sub-form where all additions or modifications to radionuclide data is performed. Initially, the <Nuclide Data> tab will have the following appearance:



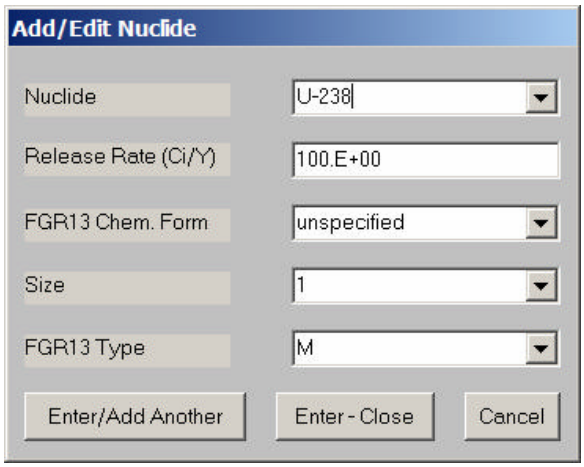
To begin adding nuclides, click <Add Nuclide>, which displays the nuclide data entry sub-form displayed in the next graphic.



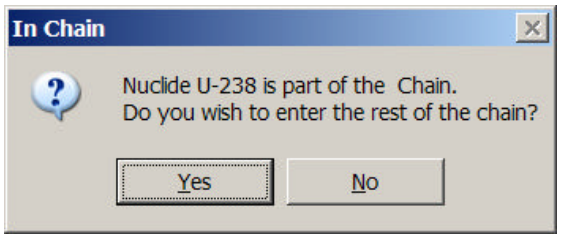
Use the Nuclide drop down list to select the first nuclide to be included in the analysis, which in the sample case is Co-60. After the nuclide is selected, the remaining four nuclide data fields are activated. Enter the release rate for the radionuclide (in Curies per year) from the currently selected source. Use 100 Ci/yr for the sample dataset. Note that in this example only one source tab is available on the form.

Select the particle size, type, and chemical form of the nuclides from their respective drop down lists. The only options available for the nuclides are those that are included in the CAP88-PC data environment, which is derived from the data contained in the FGR 13 dose and risk coefficient files used by CAP88-PC. Since two primary radionuclides are used in the sample dataset, select <Enter/Add Another>

Repeat the selection process for U-238.

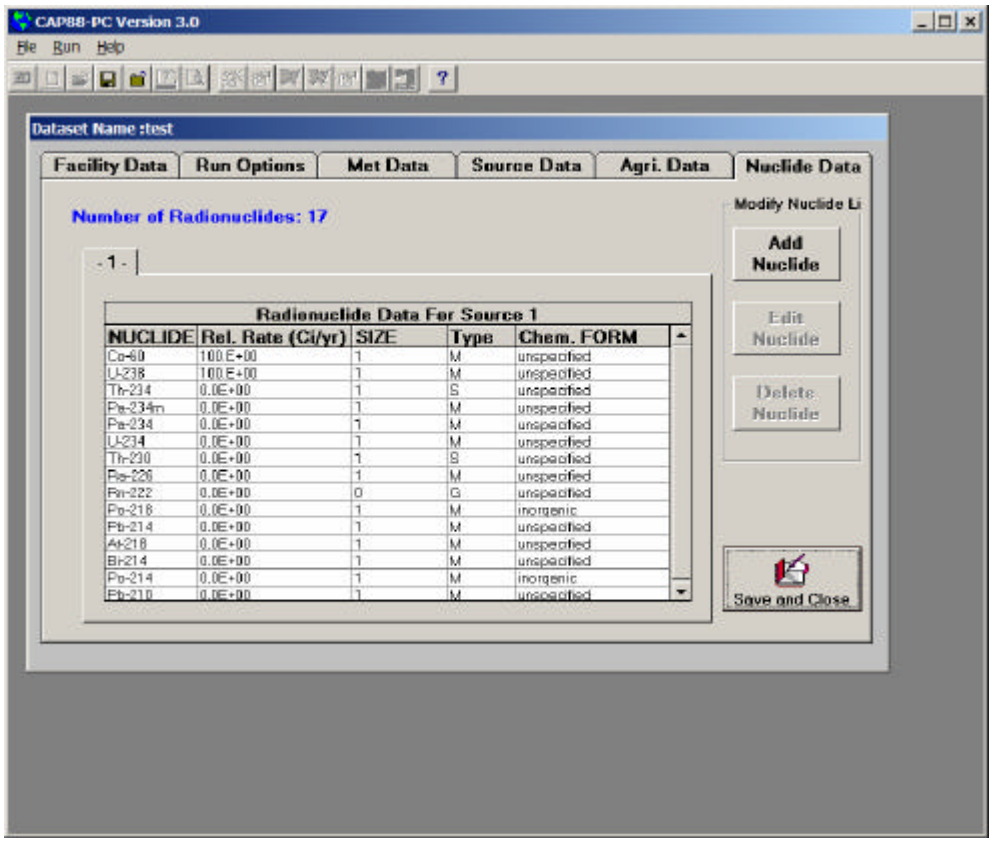


When adding U-238, a prompt will appear asking if you wish to add the rest of the U-238 decay chain.

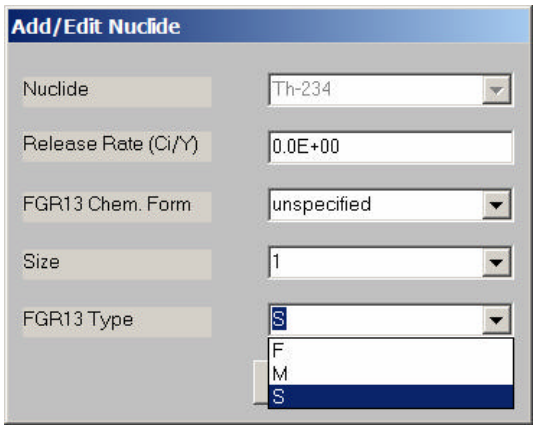


Add the decay chain for the sample problem dataset by clicking <Yes>. Then select <Enter-Close> to terminate entry of radionuclides and return to the <Nuclide Data> tab. If <Enter/Add Another> is erroneously used, clicking <cancel> will terminate entry of nuclide data but will not remove the previously entered information.

The <Nuclide Data> tab should now appear as follows:



Nuclide data may be modified using the <Edit Nuclide> button. Drop down lists will be available for data fields that have options in the FGR 13 database.



Once the data has been completely entered, click <Save and Close> to return to the initial startup form for CAP88-PC Version 3.0. At this time the dataset has been saved as the file named sample1.dat in the Datasets subdirectory of the Cap88-PC Version 3.0 installation directory. The case may be run by selecting <Run>, and <Execute> from the menu bar. Select the [Sample Data] dataset from the Dataset Name dropdown list, and then click <OK>. Output files will be written to the Output subdirectory, and are viewable within the code environment by clicking on the <print preview> icon on the button bar and selecting [Sample Data] from the dataset name dropdown list.

2.4 Uninstall CAP88-PC Version 2.1

The Uninstall process will uninstall only those files that were installed with CAP88-PC Version 3.0. Any extracted or created Population and Wind Files, as well as any Datasets and Output Files, will not be deleted. Uninstall is best performed using the Add/Remove Programs option in the Control Panel.

3. FILE MENU

3.1 New Dataset

Open a New Dataset by providing descriptive information in the New Dataset Information form and selecting OK. A set of six tabbed forms appears to assist in the preparation of an input file (dataset) containing the data needed to execute CAP88-PC.

3.2 Open Dataset

An existing dataset is selected and opened for review and modification. If the dataset name does not appear in the dataset list (down arrow), use the Maintenance option to locate and Restore an existing dataset.

3.3 Close Dataset

Close the open dataset without making any changes. Data revisions for a current session are made to a copy of the dataset. If Close Dataset is selected, the dataset will not have been updated, possibly resulting in a loss of data. If a New Dataset was opened, it will have been created and added to the dataset list, but will not have any data revisions saved.

3.4 Save Dataset

Save all data and any changes made to the opened dataset, using the filename of the opened dataset. The data entry tab forms are then closed. The user must save or close a dataset before the dataset may be used to execute the CAP88 Model (see Run/Execute).

3.5 Save Dataset As

Save all data and any changes made to the opened dataset, using the filename provided by the user. This operation creates a new dataset and a new file. The filename must be unique, or the file with the same name may be overwritten, with user approval.

3.6 Print Setup

This is a standard Windows form for reviewing and setting printer options. The Floating Toolbar can not be selected or moved when this form is open.

3.7 Print Preview

Select Print Preview to display and print CAP88-PC output reports. The output reports have the same filename as the dataset, but with CAP88-PC standard file extensions. Use the tabs on the Print Preview form to move from one report to another. Use the scroll bar to scroll down or up to view each report. When the Print Current View option is selected, the entire report shown in the tab window is printed. To print several reports at once, check the report boxes and choose the Print button.

3.8 Maintenance

There are two maintenance options, File Maintenance and List Maintenance. These options assist the user in archiving, deleting, restoring, and renaming Datasets, Population Files, and Wind Files, as well as maintain the lists that describe the Population Files and Wind Files.

3.9 File Maintenance

This menu item assists the user in archiving, deleting, restoring, and renaming Datasets, Population Files, and Wind Files. File Maintenance will perform the indicated operation and also maintain the file selection lists used in the data entry portion of the program. If the Windows File Manager is used to perform these operations, files selected from drop down lists may not be found.

3.10 List Maintenance

This menu item assists the user in maintaining Location Descriptions and Census Dates or Reference Dates, for Population Files and Wind Files, respectively. Select each file name and enter or revise descriptive information, then select OK to update the lists. If Cancel is selected, the lists will not be updated.

3.11 Convert SCR File

Use this option to locate, read, and reformat a dataset file (.SCR) that was created using the CAP88-PC Version 1 (DOS) program. CAP88-PC Version 3.0 stores and reads dataset files in the format of the INPUT.DAT file that is read by the FORTRAN programs comprising the CAP88 Model. Note that this conversion will not allow version 1.0 input sets to be run under version 3.0.

3.12 Create INPUT.DAT File

Some users may prefer executing the CAP88 FORTRAN programs from Windows by using a shell to DOS. In this case, the user may select this option to write the required input for the FORTRAN codes DEFAULT, AIRDOS, and DARTAB for the selected dataset to a file named INPUT.DAT in the CAP88-PC working directory. (The working directory can be viewed in Windows by selecting the File/Properties menu item when the CAP88-PC 3.0 icon is highlighted.) The user then may exit Windows and, from DOS, change directory (CD) to the working directory and run the following programs to generate desired output (this order is mandatory for proper results):
DEFAULT,
AIRDOS,
DARTAB

After successful completion of these three programs, return to CAP88-PC Version 3.0 to view (Print Preview) the output files or view them from any text viewer. The output files will be in the OUTPUT subdirectory with the same name as the case input file, but different file extensions.

3.13 Exit

Close all files and exit the CAP88-PC Version 3.0 program. Any open dataset should be saved or closed to exit the program properly.

4. RUN MENU

4.1 Execute

This option runs the CAP88-PC model. Before actually executing the assessment, the program will check to make sure that you have selected the following items in the dataset: a State, a Population File (if the run is a population assessment), a Wind File, and at least one Radionuclide. If the preceding items are present, the program will execute the selected dataset by shelling out to DOS to run the FORTRAN programs DEFAULT, AIRDOS, and DARTAB. If one or more of the required data items are missing, a message will be displayed so you will know to modify the dataset accordingly. If, for some reason, a Population File or Wind File has been selected but no longer exists, a message will be displayed and the programs will not be executed. Note that the user may elect to just use the Windows interface to create the input file for that case, and then run the programs DEFAULT, AIRDOS, and DARTAB from the DOS environment. In this case, see Create INPUT.DAT File in section 3.12 for instructions.

4.2 Scan Population File Format

This menu item reads the indicated Population File and determines if the data is in proper format. No guarantees are made to the correctness of the data, though the distance increments are checked to be consecutively increasing.

The Population File Editor can be used to create or modify a Population File and maintain the proper file format. The Population file format should be as follows:

Row 1 should have a dollar sign ($) in the first column. The location description, latitude, and longitude on row 1 are for information only to verify that the file desired is the file the user has selected. The number of distances associated with the population file must be in columns 68 and 69. The number of distances may be any integer between 2 and 20; single digit distances (2-9) should be in column 69.

Distances begin in row 2 and all numbers are right justified. The number of distances found in the file will be the number specified by NRAD. The distances are edgepoints of each sector (the midpoints used in the calculations will be calculated by the program) and are entered in the population file in kilometers. The CAP88 programs will multiply each distance by 1000 before calculating the midpoints and using them in the assessment. For example, the first distance in the sample file, .62 kilometers, will become 620 meters and the midpoint calculated from that will be 310 meters. There can be up to 20 distances, but the typical number of distances is 13. Only distances up to 80 kilometers should be used. The assessment is not valid for distances above 80 kilometers.

The population values are entered with distances across (columns) and directions down (rows); however, each row will not be a new direction. There will be 20 distances for each direction (regardless of the number of distances specified in the population file). The extra distances (usually 7) will simply contain zero. There will always be 8 population values per row with the first value ending at column 10 and each subsequent value ending at multiples of 10 with the last value per row ending in column 80. This means that for the direction N, the population values will be

contained on the first, second and part of the third row of the distance-direction population values. The first population value for the next direction, NNW, will be contained in columns 41 through 50 of the third row and subsequent values for direction NNW will be contained on the remaining part of the third row, the fourth, and part of the fifth row. There are 16 directions in counterclockwise order starting with North.

4.3 Population File Editor

This utility program assists the user in creating or displaying a Population File. An 'empty' Population File, TESTDATA.POP is provided as a template for building a properly formatted Population File. Any Population File intended for use with a CAP88-PC dataset should be able to be read, displayed, or printed by this program.

4.4 Population File Library

This utility program provides Population Files that were distributed with CAP88-PC Version 1. The files in the library are stored in a compressed format. Choose a location from the grid by clicking (highlighting) the grid row and download the Population File by selecting the Extract button. The Extracted Population File is in the proper format to be used by CAP88-PC.

4.5 Scan Wind File Format

This menu item reads the indicated Wind File and determines if the data is in the proper format. No guarantees are made as to the correctness of the data, though the sum of frequencies is checked. Frequencies should sum to 1.0000, within a tolerance of 0.0005 for rounding. The format of a Wind File is as follows:

Record 1 - three hexadecimal file marks are written by the GETWIND program. This record is ignored.
Record 2 - average wind speed (not used). [0000.00000]
Record 3 - wind direction frequency totals for each of the 16 wind directions. [0.0000] The numbers on this record should sum to 1.0000 within a tolerance of .0005 for rounding.
Records 4 through 10 - each record has 16 reciprocal-averaged wind speeds, for each of the 7 stability categories. [0.000]
Records 11 through 17 - each record has 16 true-averaged wind speeds, for each of the 7 stability categories. [0.000]
Records 18 through 33 - each record has frequencies for the 7 stability categories, for each of the 16 wind directions. [00000.0000] The numbers on these 16 records should sum to 1.0000 within a tolerance of .0005 for rounding.

4.6 Wind File Library

This utility program provides Wind File data for many National Weather Service (NWS) stations in a compressed format. The Wind File Library also contains the meteorological data issued with CAP88-PC Version 1. Choose a weather station from the grid by clicking (highlighting) the grid row and download the station file by selecting the Extract button. The Extracted Wind File is in the proper format to be used by CAP88-PC.

4.7 Stability Array/Wind File Generator

The STAR Distribution Program assists the user in extracting and processing National Climactic Data Center (NCDC) or site-specific meteorological data based on several popular methods. Each of the processing methods creates a Stability Array file (.STR) that is then used to create a Wind File for input to CAP88-PC. If the user is not an experienced meteorologist-modeler, it is strongly suggested that the user work with a meteorologist-modeler to prepare NCDC or on-site meteorological data for input to CAP88-PC.

There are 96 records in the Stability Array file, one for each of the 16 wind directions (N, NNE, NE, ENE, E, ESE, SE, SSE, S, SSW, SW, WSW, W, WNW, NW, and NNW) and Stability Category (A-F) Sixteen records are entered for Stability Category A, then Stability Category B, etc., through Stability Category F. Stability Classes used for CAP88-PC are: A - extremely unstable, B - unstable, C - slightly unstable, D - neutral, E - slightly stable, and F - stable.

All records are of the same format. The total of all the frequencies entered on the 96 records should add to 1.00000 within a tolerance of .05 percent. The format of a Stability Array (STAR) record follows:

Column 1 is blank.
Columns 2-4 contain the wind direction, right justified (E would be in column 4, and NE would be in columns 3 and 4). Column 5 is blank.
Column 6 contains the Stability Category, A through F.
Column 7 is blank.
Columns 8-14 contain the frequency for winds 1-3 knots (for example 0.00041).
Columns 15-21 contain the frequency for winds 4-6 knots.
Columns 22-28 contain the frequency for winds 7-10 knots.
Columns 29-35 contain the frequency for winds 11-16 knots.
Columns 36-42 contain the frequency for winds 17-21 knots.
Columns 43-49 contain the frequency for winds greater than 21 knots.

Once a Stability Array file has been created, use the button Create Wind File for CAP88-PC to run the program which converts the STAR file to a Wind File for input to CAP88-PC. A common dialog box will appear for the user to identify the STAR file to be converted. The Create Wind File option runs the program WINDGET.EXE. WINDGET.EXE is identical to the GETWIND.EXE program used by CAP88-PC Version 1, but is now compatible with the filenames and pathnames provided by the call from a Windows program.

For the format of a Wind File, see Scan Wind File Format.

5. NEW DATASET INFORMATION

5.1 New Dataset Information Form

Use this form to locate, name, and describe the dataset to be created. A new dataset is created, even if the user later closes a file without saving changes.

Drive, Dataset
Select a drive that the new dataset will be copied to. The current drive is suggested. Choosing a network drive or a floppy drive that will not always be available to the program will create an error if the drive is not found when the dataset is selected again for modification or execution.

Directory, Dataset
Select a directory that the New Dataset will be copied to. The datasets subdirectory in the program directory is suggested. Change the directory chosen by double-clicking on the main directory and selecting the desired subdirectory.

Name, Dataset
Enter a Dataset Name, up to 20 characters; do not use apostrophes or double quotes. This name will appear in the drop down list on the Select Dataset screen, and in the label of the data entry tabbed forms. The Dataset Name should be descriptive enough to allow accurate selection of a Dataset.

Filename, Dataset
Enter a Dataset Filename, up to 8 characters. This filename must not contain any spaces, piping (vertical dashes), or asterisks, as these are not valid for DOS naming conventions. This filename must be unique in the directory in which it will be created.

Comment, Dataset
Enter Comments, up to 50 characters. Do not use an apostrophe or double quotes, all other characters and spaces are allowed. The Comments should accurately describe the assessment scenario.

Comment Additional, Dataset
Enter Comments, up to 50 additional characters. Do not use an apostrophe or double quotes, all other characters and spaces are allowed. The Comments should accurately describe the assessment scenario.

Cancel Button
Select the Cancel button to exit the New Dataset form without creating a new Dataset.

OK Button
Select the OK button to create the New Dataset with the parameters defined. The New Dataset Information form will be closed and the CAP88-PC data input tab forms will appear.

6. SELECT DATASET INFORMATION

6.1 Select Dataset Form

Use this form to select a dataset for the desired operation. Except for the Dataset Name List, all other fields on this form are read-only and will be filled with appropriate data when a dataset is selected. When the code is run for the first time, no datasets may be available for opening. In this case, the code will produce a message box stating that no datasets are available in the system, and asking if you wish to open from a dataset input file stored elsewhere in the system or if you wish to create a new dataset. If you choose to open a dataset stored elsewhere on the system, you will be provided a file selection box from which you can navigate to the directory where your dataset input file is stored. The default location for stored dataset input files is the Datasets subdirectory of the install directory.

Name List, Dataset
Click on the down arrow to display the list of datasets recognized by CAP88-PC. Select a dataset name from the list by clicking once on the name. To add a dataset to the dataset name list, either open a new dataset or use the file maintenance function to restore an existing dataset.

Cancel Button, Select Dataset
Close the Select Dataset form, without performing the desired operation.

OK Button, Select Dataset
Use the selected dataset for the desired operation. The Select Dataset form will be closed and the CAP88-PC data input tab forms will appear.

7. PRINT/VIEW

7.1 Print/View

Use this form to view CAP88-PC Output Reports and select which reports, if any, will be printed.

Tabs, Output Report
Click on these tabs to change the CAP88-PC Output Report being displayed. If a tab is missing, that report was not created, or was deleted from the directory. Return to the Run Option tab of the data entry form to view report selection information. If necessary, select a new report option (Yes/No), save the data, and re-execute CAP88-PC.

Print Check Boxes , Output Report
Select the boxes next to the report names for reports to be printed (in their entirety). An X will appear in the selected box. Click again to remove the X and un-select a report. The selected reports will not be sent to a printer until the Print button is selected.

Print Current View Button
Print the entire CAP88-PC Output Report shown in the view window. Partial reports cannot be printed with this viewer. If partial reports are desired, another text editor may be used to view and print relevant portion of the report.

Cancel Button, Print Preview
Close the Print Preview form.

Print Button
Any Output Reports for the dataset that have an X in the check box will be printed (in their entirety).

8. MAINTENANCE OPERATIONS

8.1 File Maintenance Operations Form

The File Maintenance Operations described below will perform the operation described as well as maintain the drop-down file lists supported by CAP88-PC Version 3.0. **Warning:** Using the Windows File Manager to perform these operations will result in the drop-down file program lists not accurately reflecting the true list of available files. Files deleted using the Windows File Manager will not be found when selected from the Dataset list, the Population File list, or the Wind File list. Files renamed or copied using the Windows File Manager will not appear in the Dataset list, Population File list, or the Wind File list until Restored using this option.

Archive, Delete, Restore, Rename
Select the operation to be performed. Archive will copy the selected file(s) to a location (diskette, directory, etc.) indicated by the user and remove the filename from any lists maintained by the CAP88-PC Version 3.0 program. Archive does not compress the files (all CAP88-PC files, excluding Output Reports, are rather small text files). Delete will erase file(s) from the location selected and removes the filename(s) from the Dataset list, Population File list, or Wind File list, as appropriate. Restore copies file(s) from another location and adds the filename(s) to the Dataset list, Population File list, or Wind File list, as appropriate. Restore checks each filename to be restored for uniqueness, and will ask before overwriting a file with the same name. Rename changes the name of the file indicated by the user and revises the Dataset list, Population File list, or Wind File list, as appropriate. For example, the user may wish to rename Wind Files extracted from the Wind File Library to change the filename from the Station ID to a city or location name that is more easily recognizable.

Select Type of File for File Maintenance Operation
Selection of the Dataset file type will allow the user to select an existing dataset from the Dataset Name list. Selection of the Dataset file type will also perform the identical operation on any Output Report files that exist for the Dataset. Selection of the Population File type will remove from, add to or revise the Population File list when files are deleted, restored, or renamed. Selection of the Wind File type will remove from, add to or revise the Wind File list when files are deleted, restored, or renamed. Use the List Maintenance option to revise file descriptions and date information for the Population Files or Wind Files.

Cancel Button, Select Maintenance Operation
This closes the Select Maintenance Operation form.

OK Button, Select Maintenance Operation
If both a File Maintenance Operation and a File Type have been selected, the OK button will submit the request and the appropriate form will appear for selecting the particular file to be altered. If either the File Maintenance Option or the File Type has not been selected, an error message will appear.

8.2 Select File

Select a file from the current directory or locate a file in another directory.

Population File Directory
Choose this option if the Population File appears in the Population File list in the current directory. The current directory is a subdirectory named Popfiles that is subordinate to the directory where CAP88-PC Version 2.1 was installed.

Custom Population File
Choose this option to locate a Population File in a directory other than the Popfiles subdirectory. The user is provided a form to select a drive, directory, and filename for the desired file.

Population File List
If the Population File resides in the Population File Directory, a Population File list will be displayed and a Population File may be chosen from that list. If the Population File is not in the default directory, then select the Locate button to choose the drive and directory of the desired file.

Wind File Directory
Choose this option if the Wind File appears in the Wind File list in the current directory. The current directory is a subdirectory named Wndfiles that is subordinate to the directory that CAP88-PC Version 2.1 was installed to.

Custom Wind File
Choose this option to locate a Wind File in a directory other than the Wndfiles subdirectory. The user is provided a form to select a drive, directory, and filename for the desired file.

Wind File List
If the Wind File resides in the Wndfiles subdirectory, a Wind File list will be displayed and a Wind File may be chosen from that list. If the Wind File is not in the current directory, then select the Locate button to choose the drive and directory of the desired file.

Cancel Button
Close the Select File form.

OK Button
If a filename appears on this form, the next archive form will appear. If no file has been selected, an error message will appear.

8.3 Save File As Form

Change the name of the file if desired. The name of the selected file appears at the top of the form.

Dataset Filename
Filenames are limited to 8 alphanumeric characters and exclude blanks, asterisks, and pipe (vertical dishes) characters.

Population Filename
Filenames are limited to 8 alphanumeric characters and exclude blanks, asterisks, and pipe (vertical dashes) characters.

Wind Filename
Filenames are limited to 8 alphanumeric characters and exclude blanks, asterisks, and pipe (vertical dashes) characters.

Cancel Button
Close the Save File As form.

OK Button
Perform the desired operation.

8.4 Change List Information Form

Use this form to enter list information for both the Population File list and the Wind File list. NO CHANGES ARE MADE UNTIL THE OK BUTTON IS SELECTED, at which time both the Population File list and the Wind File list are updated. If changes are made and the Cancel button is selected, THE LISTS WILL NOT BE UPDATED.

Population File Directory
Choose this option to change the list of Population File information (description and census date) for files in the Popfiles subdirectory.

Population File List
Select the down arrow to display and select the Population File description and census date to be displayed and altered.

Population File Description
Enter a location description, limited to 36 characters, which will identify the Population File.

Population File Census Date
Enter the year that the population assessment was performed.

Wind File Directory
Choose this option to change the list of Wind File information (description and reference dates) for files in the Wndfiles subdirectory.

Wind File List
Select the down arrow to display and select the Wind File description and reference dates to be displayed and altered.

Wind File Description
Enter a weather station description, limited to 36 characters, which will identify the Wind File.

Wind File Period of Record
Enter the year(s) that meteorological data was collected for frequency distribution analysis.

Cancel Button
Close the Change List Information form, WITHOUT updating either the Population or Wind File lists.

OK Button
Close the Change List Information form, after updating both the Population File list and the Wind File list.

9. DATASET DATA

9.1 Facility Data

The Facility Data tab form is used to describe the facility and time period to be modeled. On the Facility Data tab form, a State must be selected from the list provided. The State selected will determine the agricultural values used on the Agricultural Data Tab Form. After all known Facility Information is entered, use the Page Down key to advance to the next tab form.

Facility Name (Optional)
The Facility Name is used for identification purposes only. The Facility Name appears on each Output Report.

Address Line 1 (Optional)
The Facility Address (line 1) appears on each Output Report

Address Line 2 (Optional)
The Facility Address (line 2) appears on each Output Report

City (Optional)
The City that the Facility is located in or near appears on each Output Report.

State Name (Required)
The State name is required because it is used by the program to establish values for agricultural arrays of beef cattle, milk cattle, and crop production according to EPA-accepted state-wide averages. A state name must have been selected for an assessment to be executed. State names are chosen from a list box, which appears when you click on the down arrow when the state field is selected. To use the list box search feature, press any letter key and the list box automatically goes to the first state beginning with that letter. Selection of Hawaii, Alaska, or the District of Columbia will result in zeros being loaded on the Agricultural Data tab form.

Zip Code (Optional)
Enter the Zip Code and Zip+4 Code, if known.

Emission Year (Optional)
Choose the year in which the radionuclide emissions occurred from the drop down list. If a year is desired that is not in the drop down list, advanced users can use a database file editor to add the year to the YEAR table in the DATA.mdb Access database in the Data subdirectory.

Source Category (Optional)
The Source Category is for information only. No particular category is enforced at this time.

Comments Line 1 (Optional)
Comments are restricted to 50 characters and appear on the first page of each Output Report. Comments also appear on the Select Dataset form for additional identification of the dataset.

Comments Line 2 (Optional)
Comments are restricted to 50 characters and appear on the first page of each Output Report. Comments also appear on the Select Dataset form for additional identification of the dataset.

9.2 Run Options

The Run Options tab form is used to describe the population to be assessed and select optional output tables and reports. CAP88-PC Version 3.0 uses population arrays in the same format as the mainframe CAP88 program. A sample population assessment is provided with CAP88-PC Version 3.0. Other population assessments may be downloaded from the Population File Library. Users are encouraged to create their own population arrays using the Population File Editor supplied with the CAP88-PC Version 3.0 program. Census data or population survey data should be obtained for the facility and area to be modeled.

Assessment Run Type
The Assessment Run Type must be selected to determine the source of the population data. If an Individual Assessment is chosen, the midpoint distances for the assessment areas must be entered. If a Population Assessment is chosen, the data will be read in from a Population File. The Population File may be selected from the drop down list.

Location Index of Exposed Individual
When the Individual Assessment is chosen, a button labeled "Location Index of Exposed Individual" will be shown on the screen. Users can click this button to open the "Location Index of Exposed Individual" screen. There are two input boxes to let users enter a direction index and a distance index for the exposed individual. The default values for these indices are 0, which means that users let CAP88 to calculate the maximum exposed individual. Note that these values are sector information, not distances in meters. Circumferential sectors are denoted 1 to 16, with 1 being N, 2 being NNW, and 16 being NNE. Radial sectors are denoted as 1 to j, where j is a number corresponding to the midpoint distances input by the user.

Population File Directory
A Population File is required for a Population Assessment Run Type. The Population File Editor in the Run Menu can be used to generate a Population File in the proper format. Note that when a population is created manually, the distances entered in the population file are endpoint distances for each sector; these are converted to midpoint distances by CAP88-PC. Also, a sample population assessment may be extracted from the Population File Library, which will place that population file name in the population file dropdown list. Population Files that are in the population file dropdown list are assumed by the code to be located and maintained in the Popfiles subdirectory. Alternatively, population files can be selected from another directory by choosing the Custom Population File option.

Custom Population File

If the Population File resides anywhere except in the Popfiles subdirectory, choose this option and select the Locate button to locate and select the Population File for the assessment. The default initial directory for this directory locator box is the POPLIB subdirectory of the CAP88-PC installation directory. This subdirectory contains the distribution library of population files available for extraction. To get a Custom Population File into the Population File Directory, use the File Maintenance option to Restore a Population File, and then use the List Maintenance option to record the population description or location and census date (year of population estimation, adjustment or assessment). Note that it is not required that the population file be located in the Popfiles subdirectory (see below).

Population File Location

Enter the drive, directory, and filename of the desired Population File or select the Locate button to browse the drives and directories to locate the Population File to be used for the assessment.

Create Dose and Risk Factor File?

Select Yes to generate a Dose and Risk Factor Output Report file (.FAC) when this assessment is used to execute CAP88-PC. Dose and Risk are estimated by combining the inhalation and ingestion intake rates, air and ground surface concentrations with the dose and risk conversion factors used in CAP88-PC. The effective dose equivalent is calculated for adults using the weighting factors in ICRP Publication 72 as implemented in Federal Guidance Report 13. Cancer mortality risks are reported for 15 cancer sites using the FGR 13 tabulated values. Dose and risk are reported as a function of radionuclide, pathway, location and organ. CAP88-PC also tabulates the frequency distribution of risk, showing the number of people at various levels of risk. The risk levels are divided into orders of magnitude, from one in ten to one in a million. Dose and Risk estimates from CAP88-PC are applicable only to low-level chronic exposures, since the health effects and dosimetric data are based on low-level chronic intakes. CAP88-PC cannot be used for either short-term or high-level radionuclide intakes.

Create Concentration Table File?

Select Yes to generate a Concentration Table Output Report file (.CON) when this assessment is used to execute CAP88-PC. The Concentration Table may be quite large if many radionuclides are selected. Radionuclide concentrations in air, rates of deposition on ground surfaces, concentrations in food and intake rates to people from ingestion of food produced in the assessment area are calculated by the model. Estimates of the radionuclide concentrations in food, leafy vegetables, milk and meat consumed by humans are made by coupling the output of the atmospheric transport models with the US Nuclear Regulatory Commission Regulatory Guide 1.109 terrestrial food chain models. Version 3 modifies the Regulatory Guide 1.109 method by updating the radionuclide transfer factors used by the model. Regulatory Guide 1.109 did not contain these factors for all the elements included in the new radionuclide list; accordingly, the model now uses transfer factors from NCRP Report 123 (NCRP123).

Create Chi/Q Table File?

Select Yes to generate a Chi/Q analysis (.CHI) of the scenario provided for execution of CAP88-PC. Chi/Q values are used to convert radionuclide release values to concentrations.

Midpoint Distances

Midpoint distances are required for an Individual Assessment. These distances are the distances at which the doses and risks are calculated, in meters. The distances must be integers between 1 and 80000 meters (inclusive). A message will be displayed if you enter a distance outside this range. At least one distance must be entered for the dataset to execute. If no distances are entered, the AIRDOS program will abort. The distances entered in the cells must be contiguous and ascending, that is, no cells can be skipped and the midpoint distances must increase from left to right in each row. Cells (at the end) may be left blank after the midpoint distances have been entered.

Population File List

Select the down arrow to see the descriptive information and Population File names in the Popfiles subdirectory.

Locate Button

Select this button to get a form to browse the drives and directories for a particular Population File.

9.3 Meteorological Data

The Meteorological Data Tab Form is used to supply site meteorological data for the dispersion modeling.

Wind File Directory

A Wind File is required for CAP88 execution. The Wind File Library in the Run Menu can be used to obtain a Wind File in the proper format. These Wind Files were created from the National Weather Service data which is available for many weather station sites. If the user has on-site meteorological data, select the Stability Array Distribution program in the Run Menu to process and convert on-site data to a properly formatted Wind File. Wind Files can be located and maintained in the Wndfiles subdirectory, or can be located by choosing the Custom Wind File option.

Custom Wind File

If the Wind File resides anywhere except in the Wndfiles subdirectory, choose this option and select the Locate button to locate and select the Wind File for the assessment. The default initial directory for this directory locator box is the WINDLIB subdirectory of the CAP88-PC installation directory. This subdirectory contains the distribution library of wind files available for extraction. To get a Custom Wind File into the Wind File Directory, use the File Maintenance option to Restore a Wind File, and then use the List Maintenance option to record the location and dates for which the meteorological data was collected. Note that it is not necessary to use a wind file that is located in the Wndfile subdirectory (see below).

Wind File Location

Enter the drive, directory, and filename of the desired Wind File or select the LOCATE button to browse the drives and directory to locate the Wind File to be used for the assessment.

Annual Precipitation

Enter the average annual precipitation (in centimeters) at or near the site.

Annual Ambient Temperature
Enter the average annual ambient temperature (in degrees Celsius) at or near the site. Temperatures above 200 degrees are assumed to be in degrees Kelvin and will be converted and shown as degrees Celsius when the dataset is re-opened.

Height of Lid
This value represents the height of the troposphere mixing layer (in meters) at or near the site. This field must contain a positive non-zero value. A zero value will cause the AIRDOS program to abort when the dataset is executed.

Absolute Humidity
Enter the absolute humidity in air (in grams per cubic meter) at or near the site. This value is used for the dose and risk calculation of tritium ingestion. This field must contain a positive non-zero value. A zero value will cause the AIRDOS program to abort when the dataset is executed.

9.4 Source Data

The Source Data Tab Form is used to identify the type of emitting source and the dimensions of each emitting source being assessed. Stack and Area Sources cannot be mixed in a single assessment. While up to six stack or area sources can be modeled, all the sources are modeled as if located at the same point. The same plume rise mechanism (Buoyant, Momentum, Fixed, or Zero) is used for each source. In the CAP88-PC implementation of the Gaussian Plume model, area sources are treated as uniform and variation in radionuclide concentrations due to complex terrain cannot be modeled. Errors arising from these assumptions will have a negligible effect for assessments where the distance to exposed individuals is large compared to the stack height, area, or facility size.

Source Type
The emitting sources must be identified as stacks (point) or area sources. While up to six stack or area sources can be modeled, all the sources are modeled as if located at the same point. The same plume rise mechanism (Buoyant, Momentum, Fixed, or Zero) is used for each source.

Number of Sources
Up to six (6) emitting sources (stacks or areas) may be modeled. The fields for Height, Diameter/Area, and Plume Rise Type (if Momentum or Buoyant) change as the number of emitting sources change, so select the number of sources before entering any associated data.

Area Dimensions
This value is the height (in meters) and area (in square meters) of the Area Source.

Plume Rise Type
Select the Plume Rise Type for the dispersion modeling. The choices are Buoyant, Momentum, Fixed, and Zero. The same plume rise mechanism is used for each source.

Plume Rise for Pasquill Categories
Plume Rise for each Pasquill Category for a Fixed Plume Rise Type. Enter the actual plume rise (in meters) for each of the seven Pasquill Categories (A through G) if a Fixed Plume Rise Type is selected. If a Zero Plume Rise Type is selected, zero is entered for each of the seven Pasquill Categories (A through G), and no further action is required.

Heat Release Rate or Exit Velocity
Enter the heat release rate (in calories per second) for a Buoyant Plume Rise Type or enter the exit velocity (in meters per second) for a Momentum Plume Rise Type.

Stack Dimensions
This parameter specifies height (in meters) and diameter (in meters) of each stack or point source.

9.5 Agricultural Data

The Agricultural Data Tab Form is used to enter agricultural factors which will be applied to the dispersion data to estimate uptake of emitted radionuclides into the food chain.

EPA Food Source Scenarios
Selection of each EPA Food Source Scenario (Urban, Rural, Local, Regional, and Imported) will result in different fractions appearing in the 9 cells which describe the fraction of Vegetable, Milk, and Meat produced in the area, or imported to the area. The fractions are not editable unless the Entered scenario is selected, in which case fractions must be entered by the user. The Entered fractions must total to 1.0 for each column or the user will be asked to re-enter the fractions or make another scenario selection.

EPA Food Source Scenarios - Fractions
Selection of each EPA Food Source Scenario will result in different fractions appearing in the 9 cells which describe the fraction of Vegetable, Milk, and Meat produced in the area or imported to the area. These fractions are not editable unless the Entered scenario is selected, in which case fractions must be entered by the user. The Entered fractions must total to 1.0 for each column, otherwise, the user will be asked to re-enter the fractions or make another scenario selection.

Beef Cattle Density
Sample distributions of beef cattle density are provided by EPA for the assessment area using average agricultural productivity data for each of the fifty states. Since data was not available for Alaska, Hawaii, and the District of Columbia, the user must supply relevant agricultural data for these areas. Using zero in this field will result in an error when the program is executed.

Milk Cattle Density
Sample distributions of milk cattle density are provided by EPA for the assessment area using average agricultural productivity data for each of the fifty states. Since data was not available for Alaska, Hawaii, and the District of Columbia, the user must supply relevant agricultural data for these areas. Using zero in this field will result in an error when the program is executed.

Land Fraction Cultivated for Vegetable Crops
Sample distributions of crop productivity are provided by EPA for the assessment area using average agricultural productivity data for each of the fifty states. Since data was not available for Alaska, Hawaii, and the District of Columbia, the user must supply relevant agricultural data for these areas. Using zero in this field will result in an error when the program is executed.

9.6 Nuclide Data

The Nuclide Data Tab Form is used to display, select, and describe characteristics of the radionuclides emitted by each source. Information for a source is entered by first selecting the tab number corresponding to the source number. Radionuclide data for that source is then entered or modified using the Add/Edit Nuclide subform to this Nuclide Data Tab Form. To access the Add/Edit Nuclide subform, use the Add Nuclide button or the Edit Nuclide button located to the right of the nuclide data display table.

The <Save And Close> button on this form will save the current dataset using the dataset filename entered when the dataset was first opened for creation.

Nuclide List
At least one nuclide should be selected, otherwise the dataset will not be saved or executed (the dataset may, however, be closed). After clicking the Add Nuclide button, select a nuclide from the drop down list by clicking on the down arrow in the nuclide field and entering the first letter of the nuclide name. The list will jump to nuclides starting with the letter selected. Click on the nuclide name to be added. Nuclide names appear for each emitting source, but a release rate of zero will show that the nuclide is not emitted from a particular source. If the nuclide selected is a member of a chain, a message will appear to request if the nuclide will be treated as an individual or whether the chain members should be entered (see below). After each nuclide is selected, the nuclide's release rate, size, chemical form, and type information may be entered using their respective data entry fields or drop down selections. The nuclide size, chemical form, and type data applies to the nuclide emitted from every source. It is recommended that the user verify the applicability of the default values prior to running the analysis.

Once data entry for a nuclide is complete, use the <Enter/Add Another> button to continue with another nuclide, or select Enter-Close to complete data entry for the last nuclide.

Adding Chains
Beginning with Version 3.0 of CAP88-PC, the code system now contains separate routines which can develop all decay chains contained in the FGR 13 data. When a radionuclide that is a member of a decay chain modeled in the FGR 13 data is selected, a dialogue box will appear with the information that the nuclide is the beginning of a chain, and asking if the chain should be added. If Yes is selected, the entire chain will be added to the list. If No is selected, then only the individual nuclide will be added to the list.

Nuclide Release Rate
The release rates can be entered in decimal or exponential notation. If a source does not emit a nuclide in the list, the Release Rate will be zero for that source. The list of nuclides will be the same for all sources, since the code only contains one nuclide list. However, the release rate for a nuclide does not have to be the same for each source. If a nuclide is not part of the release for a source, then set that nuclide's release rate to zero for that source.

Particle Size
The default particle size will appear for the selected nuclide. Select the down arrow to change the particle size, if necessary. Select one of the allowed Activity Medium Aerodynamic Diameter Micrometers (AMAD) for particulates. Particle size (AMAD) in micrometers for inhaled particles is now limited to 1.0, according to the FGR 13 data model. Vapors and gases are assigned a particle size of 0.

Nuclide Type
In Version 3, the lung clearance model data was updated to incorporate the new FGR 13 nomenclature for lung clearance categories. This new nomenclature changed the lung clearance rate attribute from "Class" to "Type". Types F-M-S are analogous to Classes D-W-Y. Select one of the allowed lung clearance categories for inhaled particles. If a Type field contains 'None', then Type is not applicable to that particular radionuclide. After each nuclide has been selected, the default clearance category appears. Some nuclides are restricted in their clearance type allowances. Use the drop down list as a guide to the valid classes for each nuclide.

10. DEFAULT FILE CHANGES

10.1 Purpose Of Default Value

The DEFAULT.DAT file contains various types of default data for CAP88-PC. The file is divided into two segments. The first segment contains default values that can, with great caution, be changed by the user. The second segment contains permanent defaults which are values that must **never** be changed by the user since any changes would corrupt the assessments.

10.1.1 User Changeable Defaults

The defaults contained in the DEFAULT.DAT file for meteorological data, inhalation and ingestion rates, water use and agricultural productivity are the values approved by EPA to demonstrate compliance as required by 40 CFR 61.93(a).

> **CAUTION: Any modification to the DEFAULT.DAT file must be approved by EPA if the modified parameters are used to demonstrate compliance per 40 CFR 61.93(a).**

There may be users who, in rare instances, might need to change one or more of these values for a specific purpose. The user, however, should be fully aware that these values must only be changed when and if the user fully understands the full impact that the change(s) will have upon the assessments run with the user specified values.

> **CAUTION: If any of these values are changed without full knowledge of the impact of the change(s), the resulting assessments could be invalid for the intended purpose.**

10.1.2 Permanent Defaults

The default values found in the second segment of the file contains defaults that must not be changed by the user. These values are contained in the DEFAULT.DAT file so that if directed by EPA, applicable defaults can be easily changed within this file and promptly disseminated to all users. This will preclude the necessity of modifying program code and disseminating new executable programs.

10.2 Changeable Defaults

10.2.1 Variable Names and Descriptions

The following is a list of variable names whose values can be changed by the user. Also included are their units of measure, default values and a brief description. The variable names here will match the names you will see in the DEFAULT.DAT file. They are grouped in categories such as meteorological, agricultural, etc.

VARIABLE	UNITS	DEFAULT	DESCRIPTION
		Meteorological Defaults	
TG	^{0}K/m	.0728 .1090 .1455	Vertical temperature gradient for Pasquill categories E, F, and G (three element array)
		Default Rates	
BRTHRT	cm^3/hr	9.167E+5	Inhalation rate of man
DD1		0.5	Fraction of radioactivity retained on leafy vegetables and produce after washing
UF	kg/yr	85.0	Ingestion rate of meat by man
UL	kg/yr	18.0	Ingestion rate of leafy vegetables by man
UM	liter/yr	112.0	Ingestion rate of milk by man
UV	kg/yr	176.0	Ingestion rate of produce by man
		Water Defaults	
DILFAC	cm	1.0	Depth of water for dilution for water immersion doses
USEFAC		0.0	Fraction of time spent swimming

Agricultural Defaults

FSUBG		1.0	Fraction of produce ingested grown in garden of interest
FSUBL		1.0	Fraction of leafy vegetables grown in garden of interest
FSUBP		0.4	Fraction of year animals graze on pasture
FSUBS		0.43	Fraction of daily feed that is pasture grass when animal grazes on pasture
LAMW	hr^{-1}	2.9E-3	Removal rate constant for physical loss by weathering
MSUBB	kg	200.0	Muscle mass of animal at slaughter
P	kg/m^2	215.0	Effective surface density of soil, dry weight (assumes 15 cm plow layer)
QSUBF	kg/day	15.6	Consumption rate of contaminated feed or forage by an animal (dry weight)
R1		0.57	Fallout interception fraction-pasture
R2		0.2	Fallout interception fraction-vegetables
TAUBEF		3.81E-3	Fraction of animal herd slaughtered per day
TSUBE1	hr	720.0	Period of exposure during growing season--pasture grass
TSUBE2	hr	1440.0	Period of exposure during growing season--crops or leafy vegetables
TSUBF	day	2.0	Transport time: animal feed-milk-man
TSUBH1	hr	0.0	Time delay--ingestion of pasture grass by animals
TSUBH2	hr	2160.0	Time delay--ingestion of stored feed by animals

TSUBH3	hr	336.0	Time delay--ingestion of leafy vegetables by man
TSUBH4	hr	336.0	Time delay--ingestion of produce by man
TSUBS	day	20.0	Average time from slaughter of meat animal to consumption
VSUBM	liter/day	11.0	Milk production of cow
YSUBV1	kg/m^2	0.28	Agricultural productivity by unit area (grass-cow-milk-man pathway)
YSUBV2	kg/m^2	0.716	Agricultural productivity by unit area (produce or leafy vegetables ingested by man)
TSUBB	yr	100.0	Period of long-term buildup for activity in soil
		Miscellaneous Input Values	
ILOC		0	Direction index of the single location used for individual calculations
JLOC		0	Distance index of the single location used for individual calculations
PLOC		100.0	The percentile of the total risk to use in choosing the location for the exposure array used for the individual tables. When ILOC and JLOC are both 0, PLOC is used.
GSCFAC		0.5	A scaling factor used to correct ground surface dose factors for surface roughness

10.2.2 Changing Default Values

The DEFAULT.DAT file is located in the CAP88PC directory of the drive you have chosen to load the system on. Go to this directory. Before you change anything in this file, you may want to make a copy of the original DEFAULT.DAT file giving it a different extension or save it on a floppy disk so that it can be easily retrieved.

Access DEFAULT.DAT (an ASCII file) using a word processor or a text editor. Find the variable name whose value you want to change and simply replace the default value with the value you want to use. The following are some conditions the user needs to be aware of.

- **!** Additional digits can be included, exponential notation can be used in place of decimal numbers and decimal numbers can replace exponential notation. Integer values should remain integers.

- **!** Do not delete any variables. The program will not abort but either zero or some unpredictable value will be used which will invalidate the assessment results.

- **!** Do not move the variables around. They must remain in the original order and category. Each category begins with an Ampersand (&) followed by four or more descriptive characters. Each category ends with &END. The &END must follow the last variable in the category or be on a line by itself immediately following the last variable.

- **!** The beginning of a category must be at the beginning of a line and there must be one or more spaces separating it from the first variable in the category.

- **!** Do not change the order or delete any of the categories. If the order is changed or any category is eliminated the CAP88-PC system will abort and/or produce totally invalid assessment results.

- **!** Additional lines can be added and variables moved from one line to another as long as the order of the variables does not change.

- **!** There is no required number of spaces between variables but the variables must be separated by commas. A comma is not required between the last variable in a category and &END.

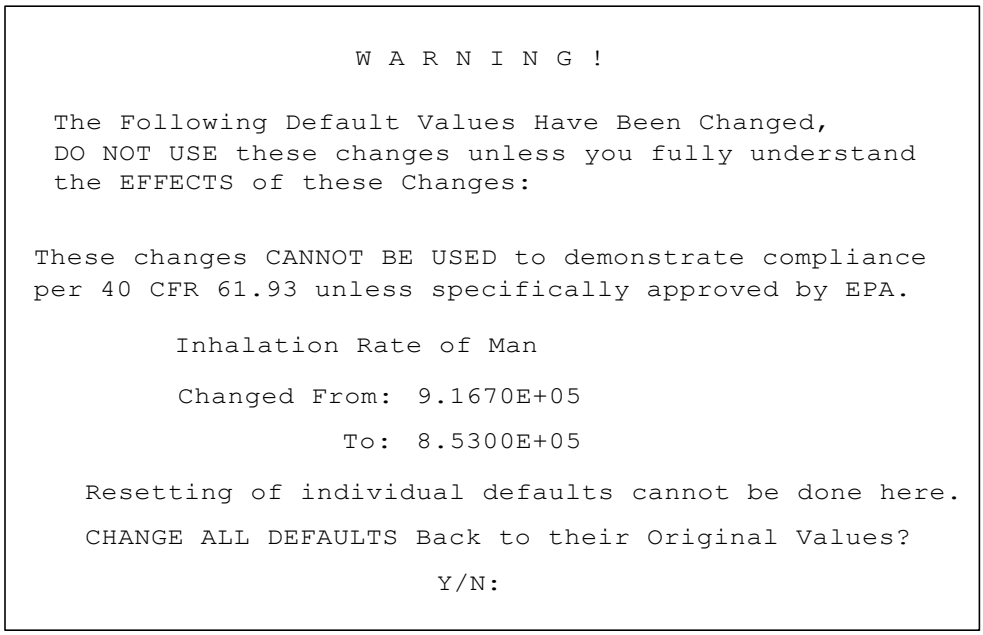
- **!** Be sure not to eliminate the equal (=) sign between the variable and the value or values in the case of an array. The variable TG is a three element array; therefore, TG is followed by a single = sign which is then followed by three values separated by commas. TG(1) will contain .0728, TG(2) and TG(3) will contain the next two values respectively. If any or all of these values should ever be changed, be sure the values are entered in the correct order.

- **!** Change only the variables listed in 10.2.1 (Variable Names and Descriptions). Do not alter in any way the variables and values in the categories that follow the &INPUT category.

Save the user altered file into DEFAULT.DAT after making sure that you have saved the original DEFAULT.DAT so that it will not be destroyed by your altered file. The new file is then ready to be used with the CAP88-PC System.

10.2.3 Restoring DEFAULT.DAT Values

When an assessment is executed The DEFAULT.DAT file is checked for changes. If changes have been made to defaults listed in Section 10.2.1, the changes will be printed to the screen as shown in the figure below.



The changes shown will include the description, the original default value and the user specified value. After all changes have been printed to the screen, the user is given the opportunity to reset **all defaults** back to their original values with a response of Y or N. It is not possible to reset individual values at this point. Individual changes can only be made directly by accessing the DEFAULT.DAT file using a text editor or word processor as described in Section 10.2.2.

If the user elects to have all defaults reset, all defaults will be overwritten with the original defaults. The overwritten DEFAULT.DAT file will look a little different from the original file; however, the only actual difference will be the spacing of the variables. The variable names and values will be closer together using fewer lines.

10.2.4 Alternative DEFAULT.DAT Files

The user may want to create alternative default files with user specified values. Before initiating the CAP88-PC system the user would copy the default file they need for a given run into DEFAULT.DAT.

> WARNING: CAP88-PC must have a DEFAULT.DAT file available in order for it to run.

It is not possible to alter any of the specified default values once CAP88-PC has been initiated except to reset all defaults to their original values. Therefore, when a user needs alternative default

values it is the user's responsibility to assure that the appropriate alternative DEFAULT.DAT file is available when CAP88-PC is initiated.

When a DEFAULT.DAT file containing user altered default values is used, there will be a CAUTION message on the beginning page of the SYNOPSIS Report stating that defaults have been changed. The specific changes will be listed on the following page including the default description, the original default value, and the user specified value. This will alert the originators and anyone using the outputs that defaults have been changed and what changes have been made.

10.3 PERMANENT DEFAULTS

The DEFAULT.DAT file contains defaults that must not be changed by the user. All defaults beginning with &ORGAN through the end of the file must contain the original default values which can only be changed at the direction of EPA.

If any of the permanent defaults are changed, except at the direction of EPA, the CAP88-PC system

> Permanent Defaults that MUST NOT BE ALTERED by the user have been changed. They will be RESET to prevent CAP88-PC from producing invalid results.

will detect those changes and reset them to their original values. In this case, a message similar to the one shown above will be printed to the screen informing the user that these permanent defaults have been reset. If the user has changed default values defined as changeable by the user, the system will not reset those user changeable values except at the direction of the user.

11. CONVERTING WEATHER DATA WITH GETWIND

11.1 Purpose

GETWIND is a utility program that allows users to customize CAP88-PC by supplying their own meteorological data, in stability array (STAR) format, to the selection of weather data files. A listing of weather data provided with CAP88-PC is provided in Appendix D. Users are encouraged to use site-specific weather data.

See Appendix B for an example of the STAR (Stability Array) format. The file SAMPLE.STR, which is included with CAP88-PC, also contains a copy of this STAR format file. This file can be used as a guide for creating meteorological files in STAR format.

11.2 Program Input

The user must supply the program with the name of the file that contains the STAR formatted meteorological data and the name of the file that will contain the converted STAR data (the CAP88-PC wind data file).

It is assumed that all the data files used by this program reside in the same directory as GETWIND. For this reason space is provided for only 12 characters name with a three character extension. Create or copy your file containing the STAR formatted meteorological data to your directory which contains GETWIND and run the program.

All valid DOS file names are accepted by the program, subject to the length restriction. However, file names must end with the extension ".WND", and be copied to the CAP88PC\WNDFILES subdirectory on your hard disk, in order to be recognized by CAP88-PC.

11.3 Program Output

Converted STAR wind data is written to the file specified by the user. It is a valid CAP88-PC wind file and can be chosen as a wind data file from the list box which is available in the Meteorological Data screen, provided a copy of the file is made to the CAP88PC\WNDFILES subdirectory on your hard disk.

11.4 Running GETWIND

Use DOS to get into the directory where the GETWIND.EXE program resides. Make sure that a copy of the file to be converted for use by CAP88-PC resides in this same directory.

To run the program, type:

GETWIND <**Enter**>

The following message appears:

THIS PROGRAM CONVERTS STAR FORMAT WIND DATA

TO AIRDOS-EPA FORMAT

FILE WHICH CONTAINS THE WIND DATA TO BE CONVERTED:

<CNTRL> BREAK TO ABORT

Enter the name of the file and press <enter>. If you have entered a valid DOS file name and the file can be found in the current directory, the following message is then displayed:

> FILE TO CONTAIN THE AIRDOS FORMATTED WIND DATA
> MUST HAVE THE EXTENSION .WND

Enter the name of the file that will contain the converted meteorological data. This is the file that you will be able to select in the list box located in the Meteorological Data input screen. If the file name already exists, the following message is displayed on the screen:

> WARNING OUTPUT FILE ALREADY EXISTS
> DO YOU WANT TO OVERWRITE IT? (Y/N):

Enter <**Y**> or <**y**> to overwrite the file. Press any other key to allow you to enter another file name.

While the data is being read and converted, informative messages are displayed on the screen. When the program is finished you will be returned to DOS.

Pressing <**ctrl**> <**break**> together at any time will cause the program to abort, and you will be returned to DOS.

11.5 Error Messages

FILE NAME CANNOT BE GREATER THAN 12 CHARACTERS
PRESS ANY KEY TO CONTINUE

If you type in a file name that has more than 12 characters, the above message is displayed. A DOS file name can only have eight characters followed by a '.' and a three character extension. Think of a shorter file name and enter it again.

ERROR INPUT FILE DOES NOT EXIST...
PRESS ANY KEY TO CONTINUE

If the name of the input file which contains the meteorological data cannot be

found in the current directory, the above message is displayed. Make sure you have spelled the name of the file correctly, and that it is located in the current directory.

FILE EXTENSION MUST BE .WND
PRESS ANY KEY TO CONTINUE

If the name of the file entered that is to contain the converted meteorological data does not end in '.wnd', the above message is displayed. All CAP88-PC wind data files must have the file extension '.wnd'. These are the only files that will be displayed for selection in the list box in the Meteorological Data input screen. Retype the file name and make sure the file extension is '.wnd'.

12. MATHEMATICAL MODELS

The purpose of this chapter is to present the mathematical models and equations used in CAP88-PC for environmental transport and estimation of dose and risk. In order to facilitate comparison of the programs with the theoretical model by interested users, the actual variable names used in the CAP88-PC FORTRAN code have been included in brackets, where applicable, following the explanation of the mathematical symbols used in the formulas.

12.1 Environmental Transport

CAP88-PC incorporates a modified version of the AIRDOS-EPA (Mo79) program to calculate environmental transport. Relevant portions of this document are reproduced here, as referenced.

12.1.1 Plume Rise

CAP88-PC calculates plume rise in the subroutine CONCEN using either Rupp's equation (Ru48) for momentum dominated plume rise, or Briggs' equations (Br69) for hot buoyant plumes (Mo79). CAP88-PC also accepts user-supplied values for plume rise for each Pasquill stability class. The plume rise, Δh, is added to the actual physical stack height, h [PH], to determine the effective stack height, H. The plume centerline is shifted from the physical height, h, to H as it moves downwind. The plume centerline remains at H unless gravitational settling of particulates produces a downward tilt, or until meteorological conditions change.

Rupp's equation for momentum dominated plumes is:

$$\Delta h = \frac{1.5\ vd}{\mu} \qquad \text{(Equation 1)}$$

where:

Δh = plume rise [PR]
v = effluent stack gas velocity (m/sec) [VEL]
d = inside stack diameter (m) [DIA]
μ = wind velocity (m/sec) [U]

CAP88-PC models Briggs' buoyant plume rise for stability categories A, B, C, and D with:

$$\Delta h = \frac{1.6\ F^{1/3}\ x^{2/3}}{\mu} \qquad \text{(Equation 2)}$$

where:

Δh = plume rise [PR]
F = $3.7 \times 10^{-5}\ Q_H$

Q_H = heat emission from stack gases (cal/sec) [QH]
x = downwind distance (m)
μ = wind speed (m/sec) [U]

This equation is valid until the downwind distance is approximately ten times the stack height, 10h, where the plume levels off. For downwind distances greater than 10h, the equation used is:

$$\Delta h = \frac{1.6\, F^{1/3} (10h)^{2/3}}{\mu} \qquad \text{(Equation 3)}$$

Equation (2) is also used to a distance of $X = 2.4\, \mu S^{-½}$ for stable categories E, F, and G, beyond which the plume is assumed to level off. For higher values of x, the stability parameter, S, is used in the equation:

$$\Delta h = 2.9(F/\mu S)^{1/3} \qquad \text{(Equation 4)}$$

in which:

$S = (g/T_a)(dT_a/dz+\Gamma)$ (Equation 5)
g = gravitational acceleration (m/sec^2)
T_a = air temperature (^oK) [TEMPERATURE]
dT_a/dz = vertical temperature gradient ($^oK/m$) [TG]
z = vertical distance above stack (m)
Γ = adiabatic lapse rate of atmosphere ($0.0098^oK/m$)

The value of the vertical temperature gradient, dT_a/dz, is positive for stable categories. In CAP88-PC, dT_a/dz values are:

7.280E-02 $^oK/m$ for Pasquill category E
1.090E-01 $^oK/m$ for Pasquill category F
1.455E-01 $^oK/m$ for Pasquill category G

The true-average wind speed for each Pasquill stability category is used in CAP88-PC to estimate plume rise, as it is greater than the reciprocal-averaged wind speed, and produces a smaller, more conservative plume rise. This procedure does not risk underestimating the significant contribution of relatively calm periods to downwind nuclide concentrations which could result from direct use of a plume rise calculated for each separate wind-speed category. This procedure avoids calculating an infinite plume rise when wind speed is zero (during calms), since both momentum and buoyancy plume rise equations contain wind speed in the denominator (Mo79).

CAP88-PC also accepts user-supplied plume rise values, for situations where actual measurements are available or the supplied equations are not appropriate. For example, plume rises of zero may be used to model local turbulence created by building wakes.

12.1.2 Plume Dispersion

Plume dispersion is modeled in the subroutine CONCEN with the Gaussian plume equation of Pasquill (Pa61, Mo79), as modified by Gifford:

$$\chi = \frac{Q}{2\pi\sigma_y\sigma_z\mu}\exp[-\tfrac{1}{2}(y/\sigma_y)^2]\{\exp[-\tfrac{1}{2}((z-H)/\sigma_z)^2]+\exp[-\tfrac{1}{2}((z+H)/\sigma_z)^2]\} \quad \text{(Equation 6)}$$

where:

χ	=	concentration in air (chi) at x meters downwind, y meters crosswind, and z meters above ground (Ci/m^3) [ACON]
Q	=	Release rate from stack (Ci/sec) [REL]
μ	=	wind speed (m/sec) [U]
σ_y	=	horizontal dispersion coefficient (m)
σ_z	=	vertical dispersion coefficient (m)
H	=	effective stack height (m)
y	=	crosswind distance (m)
z	=	vertical distance (m)

The downwind distance x comes into Equation (6) through σ_y and σ_z, which are functions of x as well as the Pasquill atmospheric stability category applicable during emission from the stack. CAP88-PC converts χ in Equation (6) and other plume dispersion equations from units of curies per cubic meter to units of picocuries per cubic centimeter.

Annual-average meteorological data sets usually include frequencies for several wind-speed categories for each wind direction and Pasquill atmospheric stability category. CAP88-PC uses reciprocal-averaged wind speeds in the atmospheric dispersion equations, which permit a single calculation for each wind-speed category. Equation (6) is applied to ground-level concentrations in air at the plume centerline by setting y and z to zero, which results in:

$$\chi = \frac{Q}{\pi\sigma_y\sigma_z\mu}\exp[-\tfrac{1}{2}(H/\sigma_z)^2] \quad \text{(Equation 7)}$$

The average ground-level concentration in air over a sector of 22.5^o can be approximated by the expression:

$$\chi_{ave} = f\chi \quad \text{(Equation 8)}$$

where f is the integral of the exponential expression:

$$\exp[-\tfrac{1}{2}(y/\sigma_y)^2]$$

in Equation (6) from a value of y equals zero to infinity divided by y_s, the value of y at the edge of the 22.5^o sector, which is the value of the downwind distance, x, multiplied by the tangent of half the sector angle. The expression is:

$$f = \frac{\int_0^{\infty} \exp\left[-\left(0.5 / s_y^2\right) y^2\right] dy}{y_s} \qquad \text{(Equation 9)}$$

The definite integral in the numerator of Equation (9) is evaluated as

$$\sigma_y (\pi/2)^{1/2}$$

Since $y_s = x \tan(11.25^o)$,

$$f = \frac{6.300836\ \sigma_y}{x} \qquad \text{(Equation 10)}$$

The equation for sector-averaged ground level concentration in air is therefore:

$$\chi = \frac{Q}{0.15871\ \pi\ x\ \sigma_z\ \mu} \exp[-\tfrac{1}{2}(H/\sigma_z)^2] \qquad \text{(Equation 11)}$$

This method of sector-averaging compresses the plume within the bounds of each of the sixteen 22.5^o sectors for unstable Pasquill atmospheric stability categories in which horizontal dispersion is great enough to extend significantly beyond the sector edges. It is not a precise method, however, because the integration over the y-axis, which is perpendicular to the downwind direction, x, involves increasing values for x as y is increased from zero to infinity.

An average lid for the assessment area is provided as part of the input data. The lid is assumed not to affect the plume until x becomes equal to $2x_L$, where x_L is the value of x for which $s_z = 0.47$ times the height of the lid (Tu69). For values of x greater than $2x_L$, vertical dispersion is restricted and radionuclide concentration in air is assumed to be uniform from ground to lid.

The average concentration between ground and lid, which is the ground-level concentration in air for values of x greater than $2x_L$, may be expressed by:

$$c_{ave} = \int_0^{\infty} \frac{c}{L} dz \qquad \text{(Equation 12)}$$

where χ is taken from Equation (6) and L is lid height. The value of H in Equation (6) may be set at zero since χ_{ave} is not a function of the effective stack height.

The resulting simplified expression may be evaluated for constant x and y values (σ_y and σ_z held constant) by using a definite integral similar to that in Equation (10):

$$c_{ave} = \left(\frac{1}{L}\right)\int_0^{\infty}\left(\frac{Q}{p s_y s_z}\right)\exp\left(\frac{-z^2}{2s_z^2}\right)\exp\left(\frac{-z^2}{2s_y^2}\right)dz \qquad \text{(Equation 13)}$$

The result is:

$$\chi_{ave} = \frac{Q}{2.5066\ \sigma_y\ L\ \mu}\exp(-y^2/2\sigma_y^2) \qquad \text{(Equation 14)}$$

One obtains the sector-averaged concentration at ground level by replacing the exponential expression containing y by f in Equation (11):

$$\chi_{ave} = Q/(0.397825 \text{ x } L\ \mu) \qquad \text{(Equation 15)}$$

It should be noted at this point that for values of the downwind distance greater than $2x_L$ dispersion, as expressed in Equation (16), no longer can be said to be represented by the Pasquill equation. The model is simply a uniform distribution with a rectangle of dimensions LID and 2x tan (11.25^o).

Gravitational settling is handled by tilting the plume downward after it has leveled off at height H by subtracting V_g x/μ from H in the plume dispersion equations. For CAP88-PC V_g is set at the default value of zero and cannot be changed by the user.

12.1.3 Dry Deposition

Dry deposition is modeled in the subroutine CONCEN as being proportional to the ground-level concentration of the radionuclide (Mo79):

$$R_d = V_d\ \chi \qquad \text{(Equation 16)}$$

where:

R_d = surface deposition rate (pCi/cm^2-sec)
V_d = deposition velocity (cm/sec) [VD]
χ = ground-level concentration (chi) in air (pCi/cm^3) [ACON]

Although V_d has units of velocity, it is only a proportionality constant and is usually higher than the actual, measured velocity of radionuclides falling to the ground. The proportionality constant must include deposition from fallout interception by foliage, which subsequently falls to the ground and so adds to ground deposition. Defaults for deposition velocity used by CAP88-PC are 3.5E-2 m/sec for Iodine, 1.8E-3 m/sec for particulates and zero for gases.

12.1.4 Precipitation Scavenging

The deposition rate from precipitation scavenging (Mo79), which occurs when rain or snow removes particles from the plume, is modeled in CONCEN with:

$$R_s = \Phi \chi_{ave} L \qquad \text{(Equation 17)}$$

where:

R_s = surface deposition rate (pCi/cm^2-sec)
Φ = scavenging coefficient (sec^{-1}) [SC]
χ_{ave} = average concentration in plume up to lid height (pCi/cm^3) [ACON]
L = lid height (tropospheric mixing layer) (cm) [LID]

The scavenging coefficient, F (in sec^{-1}), is calculated in CAP88-PC by multiplying the rainfall rate, [RR] (in cm/yr), by 1E-7 yr/cm-sec.

12.1.5 Plume Depletion

Radionuclides are depleted from the plume by precipitation scavenging, dry deposition and radioactive decay. Depletion is accounted for by substituting a reduced release rate, Q^1, for the original release rate Q for each downwind distance x (Sl68). The ratio of the reduced release rate to the original is the depletion fraction. The overall depletion fraction used in CAP88-PC is the product of the depletion fractions for precipitation scavenging, dry deposition and radioactive decay.

For precipitation scavenging the depletion fraction for each downwind distance (x) is:

$$\frac{Q^1}{Q} = e^{-\Phi t} \qquad \text{(Equation 18)}$$

where:

Φ = scavenging coefficient (sec^{-1}) [SC]
t = time (sec) required for the plume to reach the downwind distance x

The depletion fraction for dry deposition is derived by using Equation (6) with z set to zero for ground-level concentrations, and subtracting the quantity (V_g x)/U from H for a tilted plume (Va68, Mo79):

$$\frac{Q^1}{Q} = \exp\left\{ -\left(\frac{2}{p}\right)^{\frac{1}{2}} \left(\frac{V_d}{m}\right) \int_0^x \frac{\exp\left[-\left(H - V_g x / m \right)^2 / 2\sigma_z^2 \right]}{\sigma_z} dx \right\} \qquad \text{(Equation 19)}$$

where:

V_d	=	deposition velocity (m/sec) [VD]
μ	=	wind speed (m/sec) [U]
σ_z	=	vertical dispersion coefficient (m)
V_g	=	gravitational velocity (m/sec) [VG]
H	=	effective stack height (m)
x	=	downwind distance (m)

The integral expression must be evaluated numerically. Values for the vertical dispersion coefficient σ_z are expressed as functions of x in the form x^D/F where D and F are constants with different values for each Pasquill atmospheric stability category, to facilitate integrations over x. Values for the depletion fraction for cases where V_g is zero are obtained from the subroutine QY in CAP-88. Subroutine QY obtains depletion fractions for the conditions V_d = 0.01 m/sec and μ = 1 m/sec for each Pasquill stability category from the data file REFA.DAT. This file contains values for release heights (meters) of:

1, 1.5, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12.5, 15, 17.5, 20, 25, 30, 35, 40, 50, 60, 70, 80, 90, 100, 120, 140, 160, 180, 200, 240, 260, 300 and 400.

and for downwind distances (meters) of:

35, 65, 100, 150, 200, 300, 400, 500, 650, 800, 1,000, 1,500, 2,000, 4,000, 7,000, 10,000, 25,000, 60,000, 90,000, and 200,000.

The stored depletion fractions were calculated numerically with a Simpson's rule routine. QY uses a linear interpolation to produce a fraction for the required downwind value, release height and Pasquill category for V_d = 0.01 m/sec and μ = 1 m/sec. The value is then converted to the appropriate value for the actual deposition velocity and wind speed by use of the equation:

$$(Q^1/Q)_2 = (Q^1/Q)_1^{\,100\,Vd/\mu} \qquad \text{(Equation 20)}$$

in which subscript 2 refers to the desired value and subscript 1 refers to the value for V_d = 0.01 m/sec and μ = 1 m/sec.

For downwind distances greater than $2x_L$ where Equation 15 applies to the ground-level concentrations in air, the depletion is modeled with (Mo79):

$$\frac{Q_x^1}{Q_{2x_L}^1} = \exp\left[-V_d\left(x - 2x_L\right) \Big/ Lm\right] \qquad \text{(Equation 21)}$$

Which shows the reduced release rates at distances x and $2x_L$, respectively.

The depletion fraction for radioactive decay is:

$$\frac{Q^1}{Q} = \exp\left(-l_r t\right) \qquad \text{(Equation 22)}$$

where:

λ_r = effective decay constant in plume [ANLAM]
t = time required for plume travel

The decay constant used is referred to as the "effective decay constant" since it is not the true radiological decay constant in all cases. For example, if a radionuclide is a short-lived decay product in equilibrium with a longer-lived parent, the effective decay constant would be equal to the true radiological decay constant of the parent.

The atmospheric dispersion equations use the reciprocal-averaged wind speed, but neither this value nor the true average wind speed can adequately be used to calculate reduced release rates to account for radiological decay and scavenging losses because averaging of exponential terms is required. CAP88-PC uses an approximate method of calculation for this purpose, which establishes three wind speeds (1 m/sec, the average wind speed, and 6 m/sec) to simulate the actual wind-speed spectrum for each specific wind direction and Pasquill category. The wind speeds 1 and 6 m/sec were chosen because they approximate the upper and lower bounds in most meteorological data sets.

If f_1, f_2 and f_3 are designated as the time fractions for the three wind speeds, then:

$$f_1 + (\mu_a f_2) + 6f_3 = \mu,$$

$$f_1 + (f_2/\mu_a) + f_3/6 = 1/\mu_r$$

and

$$f_1 + f_2 + f_3 = 1$$

where:

μ_a = Arithmetic-average wind speed [UDAV]
μ_r = Reciprocal-average wind speed [UDCAT]

Solving the three simultaneous equations yields:

$$f_1 = 1 - f_2 - f_3$$

$$f_2 = \frac{(7/6) - (\mu_a/6) - (1/\mu_r)}{(7/6) - (\mu_a/6) - (1/\mu_a)}$$

$$f_3 = \frac{(\mu_a - 1)(1 - f_2)}{5}$$

The depletion fraction to account for radioactive decay is then approximated by:

$$f_1 \exp(-\lambda_r x) + f_2 \exp[-\lambda_r(x/\mu_a)] + f_3 \exp[-\lambda_r(x/6)]$$

where:

λ_r	=	effective decay constant in plume (sec^{-1}) [ANLAM]
μ_a	=	Arithmetic-average wind speed [UDAV]
x	=	downwind distance (m)

For precipitation scavenging losses, the depletion fraction is:

$$f_1 \exp(-\Phi x) + f_2 \exp[-\Phi(x/\mu_a)] + f_3 \exp[-\Phi(x/6)]$$

where Φ is the scavenging coefficient (sec^{-1}).

The overall depletion fraction is calculated by multiplying the depletion fraction for dry deposition by the fraction for radioactive decay and precipitation scavenging.

12.1.6 Dispersion Coefficients

Horizontal and vertical dispersion coefficients (σ_y and σ_z) used for dispersion calculation in CONCEN and for depletion fraction determination in QY are taken from recommendations by G.A. Briggs of the Atmospheric Turbulence and Diffusion Laboratory at Oak Ridge, Tennessee (Mo79, Gi76). The coefficients are different functions of the downwind distance x for each Pasquill stability category for open-country conditions, as shown:

Pasquill category	σ_y (m)	σ_z (m)
A	$0.22 x (1+0.0001x)^{-½}$	$0.20 x$
B	$0.16 x (1+0.0001x)^{-½}$	$0.12 x$
C	$0.11 x (1+0.0001x)^{-½}$	$0.08 x (1+0.0002x)^{-½}$
D	$0.08 x (1+0.0001x)^{-½}$	$0.06 x (1+0.0015x)^{-½}$
E	$0.06 x (1+0.0001x)^{-½}$	$0.03 x (1+0.0003x)^{-1}$
F	$0.04 x (1+0.0001x)^{-½}$	$0.016 x (1+0.0003x)^{-1}$
G	calculated by subtracting half the difference between values for categories E and F from the value for category F.	

where:

x	=	downwind distance

CAP88-PC uses the functions in the form of

$$\sigma_y = x^A / C$$
$$\sigma_z = x^D / F$$

to facilitate integrations over x. Values for A, C, D, and F for each stability category and downwind distance are stored in a data statement.

12.1.7 Area Sources

Uniform area sources are modeled in CAP88-PC using a method described by Mills and Reeves, as modified by Christopher Nelson, EPA, and implemented by Culkowski and Patterson (Mo79). The method transforms the original area source into an annular segment with the same area. The transformation is dependent on the distance between the centroid of the area source and the receptor. At large distances (where the distance/diameter ratio is 2.5), the area source is modeled as a point source; at close distances it becomes a circular source centered at the receptor. A point source model is also used if the area source is 10 meters in diameter or less.

The principle of reciprocity is used to calculate the effective chi/Q. The problem is equivalent to interchanging source and receptor and calculating the mean chi/Q from a point source to one or more sector segments according to the angular width of the transformed source. The mean value of chi/Q for each sector segment is estimated by calculating chi/Q at the distance which would provide the exact value of the mean if the variation in chi/Q were proportional to $r^{-1.5}$ for distances from the point source to location within the sector segment. The chi/Q for the entire transformed source is the sum of the chi/Q values for each sector weighted by the portion of the total annular source contained in that sector.

12.1.8 Carbon-14 and Tritium

Special consideration is given to the radionuclides hydrogen-3 (tritium), carbon-14, and radon-222. The specific activity of tritium in air is calculated based on the input absolute humidity, which has a default value of 8 g/m3. The specific activity of atmospheric carbon-14 is calculated for a carbon dioxide concentration of 330 ppm by volume. Concentrations of these nuclides in vegetation are calculated on the assumption that the water and carbon content in vegetation are from the atmosphere and have the same specific activity as in the atmosphere. Drinking water is assumed to be one percent (1%) tritiated.

12.1.9 Rn-222 Working Levels

The radon decay product concentration (in working level units) is estimated using an equilibrium fraction that varies as a function of travel time, assuming a wind speed of 3.5 meters/second, with a final equilibrium fraction of 0.7.

Equilibrium fractions for radon decay products are calculated as a function of downwind distance, starting at 0.267 at 150 meters and reaching a final equilibrium fraction of 0.698 at 19,551 meters. Equilibrium fractions for specific distances are calculated by linear interpolation, using this table:

Distance (meters)	Equilibrium Fraction
150	.267
200	.273
250	.276
300	.278
400	.284
500	.289
600	.293
800	.302
1000	.311
1500	.331
2000	.349
2500	.366
3000	.382
4000	.414
5000	.443
6000	.471
8000	.522
10000	.566
15000	.650
19551	.698

12.1.10 Ground Surface Concentrations

Ground surface and soil concentrations are calculated for those nuclides subject to deposition due to dry deposition and precipitation scavenging. The deposition accumulation time, [TSUBB], is assumed to be 100 years. This value corresponds to establishing a 100-year cutoff for the time following a release when any significant intake or external exposure associated with deposition on soil might take place.

Ingrowth from a parent radionuclide is calculated using a decay product ingrowth factor. The ingrowth factor is the ratio of the decay product concentration resulting from a unit deposition rate of the parent and the decay product respectively. The factors are for a 100 year accumulation time and a removal rate from soil of 2 percent per year.

12.2 Dose and Risk Estimates

CAP88-PC uses a database of dose and risk factors provided in Federal Guidance Report 13 (EPA99) for estimating dose and risk. Relevant portions of these documents are reproduced here, as referenced.

Dose and risk conversion factors include the effective dose equivalent calculated according to the methods in ICRP Publication Number 72 (ICRP72). Although FGR 13 contains age–dependent dose factors, CAP88-PC only uses the adult factors in order to retain consistency with previous versions. The risk factors used are those for lifetime fatal cancer risk (mortality) per FGR 13. Dose and risk factors for the pathways of ingestion and inhalation intake, ground level air immersion and

ground surface irradiation are used in order to remain consistent with versions 1 and 2 of CAP88-PC. Factors are further broken down by particle size [SIZE], clearance category [FMSTYPE], chemical form [CHEMFORM], and gut-to-blood [GI_ING and GI_INH] transfer factors. These factors are stored in a database for use by the program.

For assessments where Rn-222 decay products are not considered, estimates of dose and risk are made by combining the inhalation and ingestion intake rates, air and ground surface concentrations with the appropriate dose and risk conversion factors. CAP88-PC lists the dose and risk to the maximum individual and the collective population. CAP88-PC calculates dose to the 23 internal organs modeled in FGR 13, in addition to the 50 year effective dose equivalent. Risks are estimated for the 15 cancer sites modeled in FGR 13. Doses and risks can be further tabulated as a function of radionuclide, pathway, location and organ.

For assessments of Rn-222 decay products, CAP88-PC calculates working levels, not concentrations of specific radionuclides. A working level [WLEVEL] is defined as any combination of short-lived radon decay products in 1 liter of air that will result in the ultimate emission of 1.3×10^5 MeV of alpha particle energy. CAP88-PC calculates risk, but not dose, from the working level calculations. Risk to the maximum individual and the collective population are tabulated. The radon methods were not modified in Version 3 of CAP88-PC from those in Version 2.1.

For each assessment, CAP88-PC tabulates the frequency distribution of risk, that is, the number of people at various levels of risk (lifetime risk). The risk categories are divided into powers of ten, from 1 in ten to one in a million. The number of health effects is also tabulated for each risk category.

12.2.1 Air Immersion

Individual dose is calculated for air immersion with the general equation:

$$\frac{E_{ij}(k)\ DF_{ijl}\ K_j}{P(k)}$$

where:

$E_{ij}(k)$	=	exposure rate, person-pCi/cm^3 [EXPP]
DF_{ijl}	=	Dose rate factor, mrem/nCi-yr/m^3 [DOSE]
$P(k)$	=	number of exposed people [POP]
K_j	=	0.001 nCi/pCi x 1,000,000 cm^3/m^3 (proportionality factor) [FAC]

Risk is calculated similarly, by substituting the risk conversion factor, RF_{ijl} [RISK], for DF_{ijl} [DOSE]. The risk conversion factor is in units of risk/nCi-yr/m^3.

12.2.2 Surface Exposure

Individual dose is calculated for ground surface exposure with the general equation:

$$\frac{E_{ij}(k)\ DF_{ijl}\ K_j}{P(k)}$$

where:

$E_{ij}(k)$	=	exposure rate, person-pCi/cm^2 [EXPP]
DF_{ijl}	=	Dose rate factor, mrem/nCi-yr/m^2 [DOSE]
P(k)	=	number of exposed people [POP]
K_j	=	0.001 nCi/pCi x 10,000 cm^2/m^2 (proportionality factor) [FAC]

Risk is calculated by substituting the risk conversion factor, RF_{ijl} [RISK], for DF_{ijl} [DOSE]. The risk conversion factor is in units of risk/nCi-yr/m^2.

12.2.3 Ingestion and Inhalation

Individual dose is calculated for the ingestion and inhalation exposure pathway with the general equation:

$$\frac{E_{ij}(k)\ DF_{ijl}\ K_j}{P(k)}$$

where:

$E_{ij}(k)$	=	exposure rate, person-pCi/cm^3 [EXPP]
DF_{ijl}	=	Dose rate factor, mrem/nCi-yr/m^3 [DOSE]
P(k)	=	number of exposed people [POP]
K_j	=	0.001 nCi/pCi x 1,000,000 cm^3/m^3 (proportionality factor) [FAC]

Risk is calculated by substituting the risk conversion factor, RISK (risk/nCi), for DOSE.

12.2.4 Maximally-Exposed Individual

Doses for the maximally-exposed individual in population runs are estimated by CAP88-PC for the location, or sector-segment in the radial assessment grid, of highest risk where at least one individual actually resides. The effective dose equivalent for the maximally-exposed individual is tabulated in mrem/yr for a 50 year exposure. Risk is estimated as total lifetime risk for a lifetime exposure.

12.2.5 Collective Population

Collective population dose and risk are found by summing, for all sector segments, the intake and exposure rates multiplied by the appropriate dose or risk conversion factors (ORNL5692). Collective population dose is reported by person-Rem/yr (not millirem), and collective risk is reported in deaths/yr. Note that collective risk is reported as annual risk, while maximally-exposed individual risk is reported as lifetime risk.

13. REFERENCES

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APPENDIX A
Nuclides Available in CAP88PC Version 3.0

Ac-223	Ag-115	As-70	Au-199	Bi-202	Br-76
Ac-224	Al-26	As-71	Au-200	Bi-203	Br-77
Ac-225	Al-28	As-72	Au-200m	Bi-204	Br-80
Ac-226	Am-237	As-73	Au-201	Bi-205	Br-80m
Ac-227	Am-238	As-74	Ba-126	Bi-206	Br-82
Ac-228	Am-239	As-76	Ba-128	Bi-207	Br-83
Ag-102	Am-240	As-77	Ba-131	Bi-210	Br-84
Ag-103	Am-241	As-78	Ba-131m	Bi-210m	C-11
Ag-104	Am-242	At-207	Ba-133	Bi-211	C-14
Ag-104m	Am-242m	At-211	Ba-133m	Bi-212	Ca-41
Ag-105	Am-243	At-215	Ba-135m	Bi-213	Ca-45
Ag-106	Am-244	At-216	Ba-137m	Bi-214	Ca-47
Ag-106m	Am-244m	At-217	Ba-139	Bk-245	Ca-49
Ag-108	Am-245	At-218	Ba-140	Bk-246	Cd-104
Ag-108m	Am-246	Au-193	Ba-141	Bk-247	Cd-107
Ag-109m	Am-246m	Au-194	Ba-142	Bk-249	Cd-109
Ag-110	Ar-37	Au-195	Be-10	Bk-250	Cd-113
Ag-110m	Ar-39	Au-195m	Be-7	Br-74	Cd-113m
Ag-111	Ar-41	Au-198	Bi-200	Br-74m	Cd-115
Ag-112	As-69	Au-198m	Bi-201	Br-75	Cd-115m
Cd-117	Cl-38	Co-60m	Cs-138	Es-251	Fe-55
Cd-117m	Cl-39	Co-61	Cu-57	Es-253	Fe-59
Ce-134	Cm-238	Co-62m	Cu-60	Es-254	Fe-60
Ce-135	Cm-240	Cr-48	Cu-61	Es-254m	Fm-252
Ce-137	Cm-241	Cr-49	Cu-62	Eu-145	Fm-253

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Nuclides Available in CAP88PC Version 3.0

Ce-137m	Cm-242	Cr-51	Cu-64	Eu-146	Fm-254
Ce-139	Cm-243	Cs-125	Cu-66	Eu-147	Fm-255
Ce-141	Cm-244	Cs-126	Cu-67	Eu-148	Fm-257
Ce-143	Cm-245	Cs-127	Dy-155	Eu-149	Fr-219
Ce-144	Cm-246	Cs-128	Dy-157	Eu-150a	Fr-220
Cf-244	Cm-247	Cs-129	Dy-159	Eu-150b	Fr-221
Cf-246	Cm-248	Cs-130	Dy-165	Eu-152	Fr-222
Cf-248	Cm-249	Cs-131	Dy-166	Eu-152m	Fr-223
Cf-249	Cm-250	Cs-132	Er-161	Eu-154	Ga-65
Cf-250	Co-55	Cs-134	Er-165	Eu-155	Ga-66
Cf-251	Co-56	Cs-134m	Er-167m	Eu-156	Ga-67
Cf-252	Co-57	Cs-135	Er-169	Eu-157	Ga-68
Cf-253	Co-58	Cs-135m	Er-171	Eu-158	Ga-70
Cf-254	Co-58m	Cs-136	Er-172	F-18	Ga-72
Cl-36	Co-60	Cs-137	Es-250	Fe-52	Ga-73
Gd-145	Hf-173	Hg-206	I-128	In-116m	Ir-194m
Gd-146	Hf-175	Ho-155	I-129	In-117	Ir-195
Gd-147	Hf-177m	Ho-157	I-130	In-117m	Ir-195m
Gd-148	Hf-178m	Ho-159	I-131	In-119	K-38
Gd-149	Hf-179m	Ho-161	I-132	In-119m	K-40
Gd-151	Hf-180m	Ho-162	I-132m	Ir-182	K-42
Gd-152	Hf-181	Ho-162m	I-133	Ir-184	K-43
Gd-153	Hf-182	Ho-164	I-134	Ir-185	K-44
Gd-159	Hf-182m	Ho-164m	I-135	Ir-186a	K-45
Ge-66	Hf-183	Ho-166	In-109	Ir-186b	Kr-74

APPENDIX A
Nuclides Available in CAP88PC Version 3.0

Ge-67	Hf-184	Ho-166m	In-110a	Ir-187	Kr-76
Ge-68	Hg-193	Ho-167	In-110b	Ir-188	Kr-77
Ge-69	Hg-193m	I-120	In-111	Ir-189	Kr-79
Ge-71	Hg-194	I-120m	In-111m	Ir-190	Kr-81
Ge-75	Hg-195	I-121	In-112	Ir-190m	Kr-81m
Ge-77	Hg-195m	I-122	In-113m	Ir-190n	Kr-83m
Ge-78	Hg-197	I-123	In-114	Ir-191m	Kr-85
H-3	Hg-197m	I-124	In-114m	Ir-192	Kr-85m
Hf-170	Hg-199m	I-125	In-115	Ir-192m	Kr-87
Hf-172	Hg-203	I-126	In-115m	Ir-194	Kr-88
La-131	Lu-177m	Na-24	Nd-149	O-14	Pa-232
La-132	Lu-178	Nb-88	Nd-151	O-15	Pa-233
La-134	Lu-178m	Nb-89a	Ne-19	O-19	Pa-234
La-135	Lu-179	Nb-89b	Ni-56	Os-180	Pa-234m
La-137	Md-257	Nb-90	Ni-57	Os-181	Pb-195m
La-138	Md-258	Nb-93m	Ni-59	Os-182	Pb-198
La-140	Mg-28	Nb-94	Ni-63	Os-185	Pb-199
La-141	Mn-51	Nb-95	Ni-65	Os-189m	Pb-200
La-142	Mn-52	Nb-95m	Ni-66	Os-190m	Pb-201
La-143	Mn-52m	Nb-96	Np-232	Os-191	Pb-202
Lu-169	Mn-53	Nb-97	Np-233	Os-191m	Pb-202m
Lu-170	Mn-54	Nb-97m	Np-234	Os-193	Pb-203
Lu-171	Mn-56	Nb-98	Np-235	Os-194	Pb-204m
Lu-172	Mo-101	Nd-136	Np-236a	P-30	Pb-205
Lu-173	Mo-90	Nd-138	Np-236b	P-32	Pb-209

APPENDIX A
Nuclides Available in CAP88PC Version 3.0

Lu-174	Mo-93	Nd-139	Np-237	P-33	Pb-210
Lu-174m	Mo-93m	Nd-139m	Np-238	Pa-227	Pb-211
Lu-176	Mo-99	Nd-141	Np-239	Pa-228	Pb-212
Lu-176m	N-13	Nd-141m	Np-240	Pa-230	Pb-214
Lu-177	Na-22	Nd-147	Np-240m	Pa-231	Pd-100
Pd-101	Po-210	Pt-186	Pu-243	Rb-86	Rh-101m
Pd-103	Po-211	Pt-188	Pu-244	Rb-87	Rh-102
Pd-107	Po-212	Pt-189	Pu-245	Rb-88	Rh-102m
Pd-109	Po-213	Pt-191	Pu-246	Rb-89	Rh-103m
Pm-141	Po-214	Pt-193	Ra-222	Re-177	Rh-105
Pm-142	Po-215 0	Pt-193m	Ra-223	Re-178	Rh-106
Pm-143	Po-216	Pt-195m	Ra-224	Re-180	Rh-106m
Pm-144	Po-218	Pt-197	Ra-225	Re-181	Rh-107
Pm-145	Pr-136	Pt-197m	Ra-226	Re-182a	Rh-99
Pm-146	Pr-137	Pt-199	Ra-227	Re-182b	Rh-99m
Pm-147	Pr-138	Pt-200	Ra-228	Re-184	Rn-218
Pm-148	Pr-138m	Pu-234	Rb-77	Re-184m	Rn-219
Pm-148m	Pr-139	Pu-235	Rb-79	Re-186	Rn-220
Pm-149	Pr-142	Pu-236	Rb-80	Re-186m	Rn-222
Pm-150	Pr-142m	Pu-237	Rb-81	Re-187	Ru-103
Pm-151	Pr-143	Pu-238	Rb-81m	Re-188	Ru-105
Po-203	Pr-144	Pu-239	Rb-82	Re-188m	Ru-106
Po-205	Pr-144m	Pu-240	Rb-82m	Re-189	Ru-94
Po-207	Pr-145	Pu-241	Rb-83	Rh-100	Ru-97
Po-209	Pr-147	Pu-242	Rb-84	Rh-101	S-35

APPENDIX A
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Sb-115	Sb-130	Si-32	Sn-125	Ta-177	Tb-156m
Sb-116	Sb-131	Sm-141	Sn-126	Ta-178a	Tb-156n
Sb-116m	Sc-43	Sm-141m	Sn-127	Ta-178b	Tb-157
Sb-117	Sc-44	Sm-142	Sn-128	Ta-179	Tb-158
Sb-118	Sc-44m	Sm-145	Sr-80	Ta-180	Tb-160
Sb-118m	Sc-46	Sm-146	Sr-81	Ta-180m	Tb-161
Sb-119	Sc-47	Sm-147	Sr-82	Ta-182	Tc-101
Sb-120a	Sc-48	Sm-151	Sr-83	Ta-182m	Tc-104
Sb-120b	Sc-49	Sm-153	Sr-85	Ta-183	Tc-93
Sb-122	Se-70	Sm-155	Sr-85m	Ta-184	Tc-93m
Sb-124	Se-72	Sm-156	Sr-87m	Ta-185	Tc-94
Sb-124m	Se-73	Sn-110	Sr-89	Ta-186	Tc-94m
Sb-124n	Se-73m	Sn-111	Sr-90	Tb-147	Tc-95
Sb-125	Se-75	Sn-113	Sr-91	Tb-149	Tc-95m
Sb-126	Se-77m	Sn-117m	Sr-92	Tb-150	Tc-96
Sb-126m	Se-79	Sn-119m	Ta-172	Tb-151	Tc-96m
Sb-127	Se-81	Sn-121	Ta-173	Tb-153	Tc-97
Sb-128a	Se-81m	Sn-121m	Ta-174	Tb-154	Tc-97m
Sb-128b	Se-83	Sn-123	Ta-175	Tb-155	Tc-98
Sb-129	Si-31	Sn-123m	Ta-176	Tb-156	Tc-99
Tc-99m	Th-229	Tl-208	U-239	Xe-131m	Yb-167
Te-116	Th-230	Tl-209	U-240	Xe-133	Yb-169
Te-121	Th-231	Tl-210	V-47	Xe-133m	Yb-175
Te-121m	Th-232 1	Tm-162	V-48	Xe-135	Yb-177
Te-123	Th-234	Tm-166	V-49	Xe-135m	Yb-178

Te-123m	Ti-44	Tm-167	W-176	Xe-138	Zn-62
Te-125m	Ti-45	Tm-170	W-177	Y-86	Zn-63
Te-127	Tl-194	Tm-171	W-178	Y-86m	Zn-65
Te-127m	Tl-194m	Tm-172	W-179	Y-87	Zn-69
Te-129	Tl-195	Tm-173	W-181	Y-88	Zn-69m
Te-129m	Tl-197	Tm-175	W-185	Y-90	Zn-71m
Te-131	Tl-198	U-230	W-187	Y-90m	Zn-72
Te-131m	Tl-198m	U-231	W-188	Y-91	Zr-86
Te-132	Tl-199	U-232	Xe-120	Y-91m	Zr-88
Te-133	Tl-200	U-233	Xe-121	Y-92	Zr-89
Te-133m	Tl-201	U-234	Xe-122	Y-93	Zr-93
Te-134	Tl-202	U-235	Xe-123	Y-94	Zr-95
Th-226	Tl-204	U-236 2	Xe-125	Y-95	Zr-97
Th-227	Tl-206	U-237	Xe-127	Yb-162	
Th-228	Tl-207	U-238	Xe-129m	Yb-166	

Appendix B

STAR FILE FORMAT

This is a **ST**ability **AR**ay (**STAR**) file. It shows the frequencies of occurrence that the wind is blowing **FROM** a particular direction, at a particular stability, at a particular speed. GETWIND converts the star array to a WIND file which shows wind blowing **TOWARD** (not **FROM**) particular directions. The frequencies are in x.xxxxx format, unspaced. The format is:

column	1	:	Blank
	2-4	:	Wind Direction
	5	:	Blank
	6	:	Stability Category
	7	:	Blank
	8	:	Start of the Wind Speed Categories (knots)
	8-14	:	Wind Speeds 1-3 (knots)
	15-21	:	Wind Speeds 4-6 (knots)
	22-28	:	Wind Speeds 7-10 (knots)
	29-35	:	Wind Speeds 11-16 (knots)
	36-42	:	Wind Speeds 17-21 (knots)
	43-49	:	Wind Speeds > 21 (knots)

```
  N    A 0.000080.000660.000000.000000.000000.00000
 NNE   A 0.000160.000330.000000.000000.000000.00000
 NE    A 0.000160.000160.000000.000000.000000.00000
 ENE   A 0.000080.000000.000000.000000.000000.00000
  E    A 0.000000.000000.000000.000000.000000.00000
 ESE   A 0.000000.000000.000000.000000.000000.00000
 SE    A 0.000160.000160.000000.000000.000000.00000
 SSE   A 0.000410.000490.000000.000000.000000.00000
  S    A 0.000160.000330.000000.000000.000000.00000
 SSW   A 0.000330.000410.000000.000000.000000.00000
 SW    A 0.000740.000410.000000.000000.000000.00000
 WSW   A 0.000570.000410.000000.000000.000000.00000
  W    A 0.000570.001070.000000.000000.000000.00000
 WNW   A 0.000330.000330.000000.000000.000000.00000
 NW    A 0.000330.000570.000000.000000.000000.00000
 NNW   A 0.000160.000490.000000.000000.000000.00000
  N    B 0.001860.001390.000250.000000.000000.00000
 NNE   B 0.001800.000820.000000.000000.000000.00000
 NE    B 0.002130.000660.000000.000000.000000.00000
 ENE   B 0.000410.000160.000000.000000.000000.00000
  E    B 0.000410.000160.000000.000000.000000.00000
 ESE   B 0.000330.000820.000080.000000.000000.00000
 SE    B 0.000740.001880.000000.000000.000000.00000
 SSE   B 0.001480.002620.000250.000000.000000.00000
  S    B 0.001560.002460.000080.000000.000000.00000
 SSW   B 0.001230.001720.000160.000000.000000.00000
 SW    B 0.001390.001800.000330.000000.000000.00000
 WSW   B 0.002130.002130.000740.000000.000000.00000
  W    B 0.003120.002300.000160.000000.000000.00000
 WNW   B 0.001880.002460.000330.000000.000000.00000
 NW    B 0.001310.003610.000250.000000.000000.00000
 NNW   B 0.002050.003440.000080.000000.000000.00000
  N    C 0.003440.003280.000900.000080.000000.00000
 NNE   C 0.002620.001480.000080.000000.000000.00000
```

NE	C	0.00312	0.00082	0.00008	0.00000	0.00000	0.00000
ENE	C	0.00139	0.00107	0.00016	0.00000	0.00000	0.00000
E	C	0.00107	0.00131	0.00025	0.00000	0.00000	0.00000
ESE	C	0.00057	0.00082	0.00090	0.00000	0.00000	0.00000
SE	C	0.00139	0.00246	0.00279	0.00041	0.00000	0.00000
SSE	C	0.00197	0.00590	0.00426	0.00033	0.00000	0.00000
S	C	0.00139	0.00574	0.00188	0.00033	0.00000	0.00000
SSW	C	0.00139	0.00279	0.00131	0.00008	0.00000	0.00000
SW	C	0.00180	0.00443	0.00377	0.00049	0.00000	0.00000
WSW	C	0.00221	0.00402	0.00426	0.00082	0.00000	0.00000
W	C	0.00394	0.00631	0.00336	0.00033	0.00000	0.00000
WNW	C	0.00270	0.00484	0.00238	0.00008	0.00000	0.00000
NW	C	0.00303	0.00590	0.00312	0.00008	0.00000	0.00000
NNW	C	0.00361	0.00689	0.00172	0.00008	0.00000	0.00000
N	D	0.01000	0.01336	0.00730	0.00107	0.00000	0.00000
NNE	D	0.00557	0.00730	0.00287	0.00025	0.00008	0.00000
NE	D	0.00459	0.00320	0.00057	0.00016	0.00000	0.00000
ENE	D	0.00287	0.00377	0.00107	0.00016	0.00000	0.00000
E	D	0.00221	0.00443	0.00246	0.00066	0.00000	0.00000
ESE	D	0.00279	0.00328	0.00656	0.00295	0.00057	0.00008
SE	D	0.00262	0.00746	0.02517	0.01549	0.00123	0.00000
SSE	D	0.00230	0.01303	0.02631	0.01066	0.00049	0.00008
S	D	0.00230	0.01058	0.01131	0.00549	0.00049	0.00016
SSW	D	0.00410	0.00713	0.00582	0.00525	0.00107	0.00016
SW	D	0.00541	0.01607	0.01656	0.00984	0.00098	0.00016
WSW	D	0.00303	0.01025	0.01885	0.01139	0.00066	0.00000
W	D	0.00385	0.01123	0.02131	0.01402	0.00221	0.00016
WNW	D	0.00410	0.00894	0.01583	0.01123	0.00074	0.00016
NW	D	0.00746	0.01320	0.01959	0.01148	0.00033	0.00000
NNW	D	0.01107	0.01320	0.01451	0.00361	0.00008	0.00008
N	E	0.00746	0.01418	0.00115	0.00000	0.00000	0.00000
NNE	E	0.00607	0.01148	0.00033	0.00000	0.00000	0.00000
NE	E	0.00377	0.00812	0.00025	0.00000	0.00000	0.00000
ENE	E	0.00394	0.00721	0.00025	0.00000	0.00000	0.00000
E	E	0.00467	0.01246	0.00033	0.00000	0.00000	0.00000
ESE	E	0.00377	0.00705	0.00188	0.00000	0.00000	0.00000
SE	E	0.00238	0.01197	0.00812	0.00000	0.00000	0.00000
SSE	E	0.00262	0.00959	0.00451	0.00000	0.00000	0.00000
S	E	0.00238	0.00713	0.00246	0.00000	0.00000	0.00000
SSW	E	0.00246	0.00426	0.00098	0.00000	0.00000	0.00000
SW	E	0.00262	0.00394	0.00230	0.00000	0.00000	0.00000
WSW	E	0.00139	0.00279	0.00180	0.00000	0.00000	0.00000
W	E	0.00279	0.00902	0.00361	0.00000	0.00000	0.00000
WNW	E	0.00377	0.01041	0.00213	0.00000	0.00000	0.00000
NW	E	0.00648	0.01262	0.00344	0.00000	0.00000	0.00000
NNW	E	0.01025	0.01812	0.00352	0.00000	0.00000	0.00000
N	F	0.00041	0.00107	0.00000	0.00000	0.00000	0.00000
NNE	F	0.00057	0.00197	0.00000	0.00000	0.00000	0.00000
NE	F	0.00098	0.00090	0.00000	0.00000	0.00000	0.00000
ENE	F	0.00033	0.00221	0.00000	0.00000	0.00000	0.00000
E	F	0.00123	0.00180	0.00000	0.00000	0.00000	0.00000
ESE	F	0.00066	0.00148	0.00000	0.00000	0.00000	0.00000
SE	F	0.00033	0.00082	0.00000	0.00000	0.00000	0.00000
SSE	F	0.00008	0.00049	0.00000	0.00000	0.00000	0.00000
S	F	0.00016	0.00025	0.00000	0.00000	0.00000	0.00000
SSW	F	0.00016	0.00000	0.00000	0.00000	0.00000	0.00000

SW	F	0.000000.000080.000000.000000.000000.00000
WSW	F	0.000160.000080.000000.000000.000000.00000
W	F	0.000080.000490.000000.000000.000000.00000
WNW	F	0.000740.001230.000000.000000.000000.00000
NW	F	0.000410.001070.000000.000000.000000.00000
NNW	F	0.000250.001720.000000.000000.000000.00000

94823.STR is a sample file containing typical data which can be found on the installation disk.

Appendix C

STATE AGRICULTURAL PRODUCTIVITY

The following values are Beef Cattle Densities, Milk Cattle Densities, and Vegetable Crop Food Fractions by state.

State	Beef	Milk	Vegetable
Alabama	1.520E-01	7.020E-03	4.160E-03
Alaska	0.000E+0	0.000E+0	0.000E+0
Arkansas	1.270E-01	5.900E-03	1.460E-03
Arizona	3.730E-02	2.800E-03	2.900E-03
California	8.810E-02	2.850E-02	1.180E-02
Colorado	1.130E-01	3.500E-03	1.390E-02
Connecticut	3.600E-02	2.500E-03	7.930E-03
Wash. D.C.	0.000E+0	0.000E+0	0.000E+0
Delaware	6.480E-02	2.720E-02	5.850E-02
Florida	1.280E-01	1.370E-02	6.920E-03
Georgia	1.430E-01	8.630E-03	2.170E-03
Hawaii	0.000E+0	0.000E+0	0.000E+0
Idaho	7.190E-02	8.560E-03	7.150E-02
Illinois	3.330E-01	2.160E-02	2.800E-02
Indiana	3.340E-01	2.800E-02	2.720E-02
Iowa	7.400E-01	3.140E-02	2.430E-02
Kansas	2.900E-01	8.000E-03	5.970E-02
Kentucky	2.650E-01	2.570E-02	3.980E-03
Louisiana	1.080E-01	9.620E-03	4.350E-02
Maine	7.650E-03	8.070E-03	5.970E-02
Maryland	1.090E-01	6.110E-02	1.110E-02
Massachusetts	2.900E-02	3.130E-02	4.960E-03
Michigan	7.900E-02	3.510E-02	1.700E-02
Minnesota	1.850E+0	4.880E-02	3.050E-02
Mississippi	1.750E-01	8.700E-03	1.070E-03
Missouri	3.430E-01	1.890E-02	8.140E-03
Montana	7.290E-02	9.270E-04	8.780E-03
Nebraska	3.500E-01	8.780E-03	2.390E-02
Nevada	1.840E-02	5.650E-04	8.920E-03
New Hampshire	1.400E-02	1.580E-02	6.690E-02
New Jersey	4.250E-02	3.290E-02	1.820E-02
New Mexico	4.130E-02	1.140E-03	1.380E-03

State	Beef	Milk	Vegetable
New York	5.830E-02	8.560E-02	1.880E-02
North Carolina	1.020E-01	1.260E-02	6.320E-03
North Dakota	1.180E-01	6.250E-03	6.290E-02
Ohio	2.030E-01	4.560E-02	1.700E-02
Oklahoma	2.680E-01	7.130E-03	2.800E-02
Oregon	4.560E-02	4.530E-03	1.590E-02
Pennsylvania	9.630E-02	6.460E-02	1.320E-02
Rhode Island	2.500E-02	2.300E-02	4.540E-02
South Carolina	8.870E-02	7.020E-03	1.840E-03
South Dakota	2.320E-01	8.850E-03	1.200E-02
Tennessee	2.110E-01	2.000E-03	2.720E-03
Texas	1.900E-01	5.300E-03	5.770E-03
Utah	2.840E-02	4.460E-03	1.830E-03
Vermont	4.710E-02	8.880E-02	1.080E-03
Virginia	1.310E-01	1.840E-02	8.700E-03
Washington	5.620E-02	1.500E-02	5.200E-02
West Virginia	6.230E-02	6.000E-03	1.160E-03
Wisconsin	1.810E-01	1.430E-01	1.789E-02
Wyoming	5.120E-02	5.790E-04	1.590E-03

Appendix D

WEATHER DATA LIBRARY

ALABAMA

HSV0544	Huntsville, AL	60/1-64/12

ARIZONA:

INW0314	Winslow, AZ	49/1-54/12
PNX0309	Phoenix, AZ	55/1-64/12

ARKANSAS:

LIT0516	Little Rock, AR	55/1-64/12
LIT0165	Little Rock, AR	72/2-73/2

CALIFORNIA:

BUR1051	Burbank, CA	60/1-64/12
LAX0304	Los Angeles, CA	64/5-69/4
LGB1052	Long Beach, CA	60/1-64/12
NZY0380	San Diego, CA	67/1-71/12
OAK0319	Oakland, CA	60/1-64/12
SAC0320	Sacramento, CA	66/1-70/12
SBA0313	Santa Barbara, CA	60/1-64/12
SNA1467	Santa Ana, CA	72/1-76/12
SUU0316	Fairfield/Travis CA	60/1-64/12

COLORADO:

DEN0618	Denver, CO	60/1-64/12
DEN0952	Denver, CO	70/1-74/12
EEE1420	Eagle Co., CO	76/1-76/12
GJT0476	Grand Junction, CO	60/1-64/12
PUB0564	Pueblo, CO	66/1-70/12

CONN:

BDL1262	Hartford, CT	55/1-64/12
BDR0558	Bridgeport, CT	65/1-69/12
NHZ0180	Brunswick, CT	60/1-69/12

DELAWARE

ILG1058	Wilmington, DE	60/1-64/12

DISTRICT OF COLUMBIA:

DCA1047	Washington, DC	68/1-73/12

FLORIDA:

MIA0979	Miami, FL	70/1-74/12
PBI0054	West Palm Beach, FL	70/1-70/12
TLH0663	Tallahassee, FL	60/1-64/12
TPA0662	Tampa, FL	60/1-64/12
TPA0915	Tampa, FL	69/1-73/12
MCO0838	Orlando, FL	74/1-74/12

GEORGIA:

AGS1018	Augusta, GA	70/1-74/12
AMB0771	Alma, GA	54/1-58/12
CSG0767	Columbus, GA	69/1-73/12

IDAHO:

BOI0653	Boise, ID	60/1-64/12
MLP1448	Mullan Pass, ID	50/1-54/12
PIH0359	Pocatello, ID	58/1-62/12

ILLINOIS:

MDW0675	Chicago/Midway, IL	73/1-73/12
MLI0269	Moline/Quad City IL	67/1-71/12
ORD0452	Chicago/OHare, IL	65/1-69/12
PIA0716	Peoria, IL	65/1-69/12
RAN0234	Rantoul/Chanute AFB IL	63/1-67/12
SPI0415	Springfield, IL	67/1-71/12

INDIANA:

EVV0406	Evansville, IN	60/1-64/12
FWA1156	Ft. Wayne, IN	60/1-64/12
IND1080	Indianapolis, IN	55/1-74/12
SBN0257	South Bend, IN	67/1-71/12

IOWA:

ALO0729	Waterloo, IA	60/1-64/12
DSM0753	Des Moines, IA	72/1-72/12

KANSAS:

FLV0561	Ft Leavenworth, KS	62/1-70/12
MKC1323	Kansas City, KS	67/1-71/12
TOP0534	Topeka, KS	63/1-72/12

KENTUCKY:

CVG0403	Covington, KY	58/1-62/12
CVG1916	Covington, KY	70/1-74/12
PAH0479	Paducah, KY	60/1-64/12

LOUISIANA:

BTR0169	Baton Rouge, LA	72/1-72/12
BTR0166	Baton Rouge, LA	55/1-64/12
NBG1379	New Orleans, LA	67/1-71/12

MARYLAND:

BAL1059	Baltimore, MD	69/1-73/12
FME1207	Ft Meade, MD	60/1-64/12
NHK1306	Patuxent River, MD	75/1-75/12

MASS:

BED0181	Bedford, MA	63/1-67/12
BOS0211	Boston/Logan, MA	67/1-71/12
CEF0182	Chicopee Falls MA	60/1-64/12
NZW1144	So. Weymouth, MA	70/1-74/12

MICHIGAN:

BTL1460	Battle Creek, MI	50/1-54/12
TVC0844	Traverse City, MI	74/1-74/12
MKG0251	Muskegon County, MI	67/1-71/12
YIP1061	Detroit, MI	63/10-68/9

MINNESOTA

MSP0267	Minneapolis/St. Pl, MN	67/1-71/12

MISSOURI:

COU0170	Columbia, MO	64/1-68/12
STL0603	St. Louis, MO	60/1-64/12

MISSISSIPPI:

BIX0538	Biloxi, MS	60/1-64/12
CGM0670	Columbus, MS	66/1-70/12
SGF0178	Springfield, MS	66/1-70/12
JAN1169	Jackson, MS	55/1-64/12

MONTANA:

BIL0331	Billings, MT	67/1-71/12
BTM0357	Butte, MT	56/1-60/12

NEBRASKA:

LNK1142	Lincoln, NE	59/1-63/12
OMA0991	Omaha/Eppley, NB	55/1-64/12

NEVADA:

UCC1026	Yucca Flats, NV	61/12-64/11

NEW JERSEY

NEL0505	Lakehurst, NJ	68/1-72/12

NEW MEXICO:

ABQ0282	Albuquerque, NM	60/1-64/12
CNM1741	Carlsbad, NM	50/1-54/12
FMN0285	Farmington, NM	63/5-68/4
GNT1246	Grants, NM	54/1-54/12
SAF1184	Santa Fe, NM	50/1-54/12

NEW YORK:

ALB0523	Albany, NY	60/1-64/12
BUF0741	Buffalo, NY	73/1-73/12
HPN0429	White Plain, NY	49/1-53/12
IAG0905	Niagra Falls, NY	55/1-59/12
LEA0189	New York/LaGuardia	65/1-70/12
LEA0435	NY/Ft Totte, NY	65/1-69/12
ROC0598	Rochester, NY	55/1-64/12
SWF0185	Newburgh, NY	65/1-69/12

NORTH CAROLINA:

CLT0682	Charlotte, NC	69/1-73/12
FBG0075	Ft Bragg, NC	66/1-70/12
HAT0392	Cape Hatteras, NC	66/1-70/12
INT0531	Winston Salem, NC	60/1-64/12
NKT0106	Cherry Pt, NC	67/1-71/12
ILM0104	Wilmington, NC	66/1-70/12
RDU0083	Raleigh, NC	66/1-70/12

NORTH DAKOTA:

DIK0509	Dickinson, ND	60/1-64/12

OHIO:

CLE1140	Cleveland, OH	70/1-74/12
CMH0243	Columbus, OH	60/1-64/12
DAY0404	Dayton, OH	65/1-69/12
DAY1502	Dayton, OH	76/1-76/12
IBG0745	Perry, OH	49/1-49/12
TOL0990	Toledo, OH	60/1-64/12

OREGON

PDX0364	Portland, OR	67/1-71/12

PENNSYLVANIA:

AVP0499	Wilkes-Barre, PA	60/1-64/12
ERI0610	Erie, PA	64/1-73/12
HAR0631	Harrisburg, PA	64/1-64/12
RDG0184	Reading, PA	49/1-49/12

RHODE ISLAND:

PVD0560	Providence, RI	68/1-72/12

SOUTH CAROLINA:

CAE1371	Columbia, SC	56/1-75/12
FLO0600	Florence/Gilbert SC	60/1-64/12
GSP0528	Greenville/Sparta SC	68/1-72/12
MYR1027	Myrtle Beach, SC	66/1-70/12

SOUTH DAKOTA:

RAP0336	Rapid City, SD	67/1-71/12

TENNESSEE:

BNA0149	Nashville, TN	66/1-70/12
CHA0711	Chattanooga, TN	68/1-73/12
MEM0143	Memphis, TN	67/1-71/12
TRI1191	Bristol, TN	74/1-74/12
TYS1328	Knoxville, TN	55/1-64/12

TEXAS:

AMA0621	Amarillo, TX	55/1-64/12
CRP1459	Corpus Christi, TX	73/7-77/6
SAT0064	San Antonio, TX	60/1-64/12

UTAH:

HV40302	Hanksville, UT	49/1-54/12
SLC1411	Salt Lake City, UT	72/1-76/12

VIRGINIA:

IAD0398	Wash/Dulles, VA	66/1-70/12
GVE0824	Gordonsville, VA	56/1-60/12
ROA0526	Roanoke, VA	68/1-72/12

WASHINGTON:

GEG0360	Spokane, WA	67/1-71/12
MWH0486	Moses Lake, WA	61/1-65/12
YKM0484	Yakima, WA	50/1-54/12

WEST VIRGINIA:

CRW0655	Charleston, WV	68/1-73/12
HTS0019	Huntington, WV	67/1-71/12

WISCONSIN:

EAU0715	Eau Claire, WI	69/1-73/12
ERB0776	Green Bay, WI	64/1-73/12

WYOMING:

CPR0335	Casper, WY	67/1-71/12
LND1100	Lander, WY	70/1-74/12
RWL1261	Rawlins, WY	55/1-64/12
RKS1588	Rocky Springs, WY	71/1-75/12

Appendix E
DIFFERENCES WITH MAINFRAME VERSIONS OF AIRDOS-EPA/DARTAB

There are a few differences between CAP88-PC and earlier versions of AIRDOS, PREPAR and DARTAB. CAP88-PC is optimized for doing population assessments. Population arrays must always be supplied to the program as a file, using the same format as the mainframe version of CAP88. Sample population files are supplied with CAP88-PC, the user may modify the supplied files to reflect their own population distributions. Population files for the mainframe version of CAP88 may be downloaded in ASCII format and used with CAP88-PC. CAP88-PC is programmed to use the distances in the population array to determine the distances used to calculate concentrations, to eliminate human error. CAP88-PC only uses circular grids; square grids are not an option. Direct user input of concentrations is also not an option. Agricultural arrays are generated automatically, as a function of state-specific productivity data, requiring the user to supply only the State abbreviation or agricultural productivity values.

CAP88-PC is also modified to do either "Radon-only" or "Non-Radon" runs, to conform to the format of the 1988 Clean Air Act NESHAPS Rulemaking. "Radon-only" assessments, which only have Rn-222 in the source term, automatically include working level calculations; any other source term ignores working levels. Synopsis reports customized to both formats are automatically generated.

Organs and weighting factors are modified to follow the ICRP 72 Effective Dose Equivalent calculation, which eliminates flexibility on specifying organs and weighting factors. The calculation of deposition velocity and the default scavenging coefficient is also modified to incorporate current EPA policy.

Organs and Weighting Factors

The FGR 13 model includes 23 organs and their associated weighting factors. The data in the model also include a '24th organ', the effective dose equivalent. CAP88PC Version 3 uses this new data structure to directly calculate total effective dose equivalent rather than using the weighted sum of the organ doses. This method is also used for the risk calculations. The list of organs contained in Version 3.0 is:

Adrenals	B Surface	Breasts	St Wall
ULI Wall	Kidneys	Lungs	Ovaries
Red Marrow	Spleen	Thymus	Uterus
Blood Wall	Brain	Esophagus	SI Wall
LLI Wall	Liver	Muscle	Pancreas
Skin	Testes	Thyroid	Effective

ULI = Upper Large Intestine
LLI = Lower large Intestine
SI = Small Intestine

Changing the organ list or the weighting factors will invalidate the results.

Cancer Risk Sites

The FGR 13 data in CAP88PC Version 3 includes cancer morbidity and mortality risk factors for 15 cancer induction sites, including the total risk listed as the 15th factor. CAP88PC Version 3 only outputs results for cancer mortality risk, not cancer morbidity risk. This is done to retain consistency with previous versions of the CAP88 model. The cancer sites included in CAP88PC Version 3 are:

Esophagus	Stomach	Colon	Liver	Lung
Bone	Skin	Breast	Ovaries	Bladder
Kidneys	Thyroid	Leukemia	Residual	Total

As with the organ data, changing the cancer site information will invalidate the results.

Population Arrays

Population arrays must be entered only as a file. In the 1985 CAAC version of AIRDOSEPA/DARTAB, population arrays could be entered as instream data in PREPAR. Population files for the mainframe version of CAP88 may be downloaded in ASCII format and used with CAP88-PC. Sample population files are supplied with CAP88-PC, the user may modify the supplied files to reflect their own population distributions. The distances at the top of the population file are used by CAP88-PC to determine the distances used in the assessment. This was programmed to eliminate errors caused by mismatching the distances used to calculate concentrations with the distances used to generate the population array. Distances used for calculating concentrations are now automatically set in CAP88-PC so as to calculate concentrations for the midpoint of each sector.

Distances

In population assessments, distances for calculating concentrations (IDIST) are calculated automatically as a function of the distances in the population array file. CAP88-PC is written to only allow user assignments of IDIST for individual assessments.

Agricultural Arrays

Arrays of milk cattle, beef cattle and agricultural crop area are automatically generated by the CAP88-PC; the user is not required to supply the arrays. The arrays are generated to match the distances used in the population arrays supplied to the code, and use State-specific agricultural productivity values. The state name (standard two letter abbreviation) must be provided to the variable STATE. Users are given the option to override the default agricultural productivity values.

Radon-222 Assessments

Assessments for Radon-222 automatically include Working Level calculations. When the only radionuclide entered is Rn-222, CAP88-PC assumes the run is a 'Radon Only' run; in this case the code generates total effective dose and mortality risk resulting from the Working Level calculations and omits the organ calculations. If Rn-222 is included as part of a case that has multiple radioisotopes in the release source, then organ dose and risk calculations are performed for the nuclides in the list, and the Working Level calculations of total effective dose and mortality risk are also performed and reported. Working Level calculations are only omitted if Rn-222 is not included in the isotope list.

Square Grids

Option 2 in earlier versions of AIRDOS-EPA allowed users to choose either a square (0) or circular grid (1). Since CAP88-PC requires a circular grid for population assessments, this option is not available.

Scavenging Coefficient

The subroutine SETSC (from PREPAR) is no longer used. The default scavenging coefficient (SC) is now calculated as a function of rainfall rate (RR). The formula used is: SC = RR * 1E-7. Users are given the option of overriding the default value.

Direct Input of Concentrations

In CAP88-PC, the user may not supply concentrations as input. The subroutine DIRECT has been removed.

Deposition Velocity

The subroutine SETVD is no longer used to calculate deposition velocity (VD). VD is set as follows:

Class	VD (m/sec)
Iodine	3.5E-2
Particulate	1.8E-3
Gas	0

Equilibrium Fractions

CAP88-PC has the capability to vary equilibrium fractions; previously they were set to a constant of 0.7. The new method varies the equilibrium fractions depending on the distance from the source. Linear interpolation is used to determine the equilibrium fractions for distances that do not match the set distances given. The equation is as follows:

EFY = EFX + ((EFZ - EFX) * ((Y - X) / (Z - X)))

Where you have X_____Y_____Z

X and Z are the set distances given and Y is the user given distance (between X and Z). The new method finds the equilibrium fraction for EFX, and EFZ is the value returned by the subroutine SET_EQUIL_FRACTIONS corresponding to the set distances.

DOSMIC Subroutine

DOSMIC was modified to print only Working Levels. Working Levels are only output for RN-222. Checks are performed before DOSMIC is called to determine if Working Levels are needed.

Water Arrays

Arrays of water areas are not used in CAP88-PC
.

NOMA fix

CAP88-PC uses a slightly different approach in calculating NOMA, following discovery of a potential error in the 1985 CAAC version of AIRDOS-EPA. In the earlier version, this error caused multiple point sources to be treated as an area source if the nuclides emitted from each stack had identical characteristics. This may cause some differences with previous assessments.

Wind Frequencies

The GETWND routine has been modified to accept wind speeds greater than 10 m/sec. Earlier versions would only accept wind speeds less than 10 m/sec, and there was a problem with some facilities, which had high wind speeds, generating overflow errors in the wind speed arrays. In order to accommodate higher wind speeds, and remain compatible with existing wind data sets, precision limits force the calculations to truncate the last digit in the wind speed data. This may cause a slight variation in the determination of PERD, the wind frequency for each direction, caused by roundup error. This may cause a variation in concentrations as compared with earlier versions of PREPAR and AIRDOS.

Appendix F

POPULATION FILE FORMAT

Users are encouraged to use site-specific population arrays with CAP88-PC. Users who have been operating the CAP88 mainframe software may download their population files for use on the CAP88-PC system. In order for CAP88-PC to recognize the new population files, they must be copied to the \CAP88PC\POPFILES subdirectory, and the filename must have the .POP extension. They must be in the same format as the following file.

It is critical that all information be in the same exact locations with the "$" sign being in the first column of the first row of the file.

The population file name, latitude, and longitude on row 1 are information only for the purpose of verifying that the file desired is the file the user has selected.

NRADS is the number of distances within the population file. The value associated with NRADS must be in columns 68 and 69 of row 1 of the population file and the last digit must always found column 69 (right justified).

Distances begin in row 2 and all numbers are right justified. The number of distances found in the file will be the number specified by NRAD. The distances are edge points of each sector (the midpoints used in the calculations will be calculated by the program) and are entered in the population file in kilometers. The CAP88 programs will multiply each distance by 1000 before calculating the midpoints and using them in the assessment. For example, the first distance in the file, .62 kilometers, will become 620 meters and the midpoint calculated from that will be 310 meters. There can be up to 20 distances, but the typical number of distances is 13.

The population values are entered with distances across (columns) and directions down (rows); however, each row will not be a new direction. There will be 20 distances for each direction (regardless of the number of distances specified in the population file). The extra distances (usually 7) will simply contain zero. There will always be 8 population values per row with the first value ending at column 10 and each subsequent value ending at multiples of 10 with the last value per row ending in column 80. This means that for the direction N, the population values will be contained on the first, second and part of the third row of the distance-direction population values. The first population value for the next direction, NNW, will be contained in columns 41 through 50 of the third row and subsequent values for direction NNW will be contained on the remaining part of the third row, the fourth and part of the fifth row. There are 16 directions in counterclockwise order starting with North.

The following is the population file RMICOMPY.POP used in the sample assessment.

```
$ RMICOMPY              LAT= 41.8900 LON= 80.7767 NSEC=16 NRADS=13
     .62      1.0      2.0      3.0      4.0      5.0     10.0     20.0
    30.0     40.0     50.0     60.0     80.0
      0.       0.       0.    1043.       0.       0.       0.       0.
      0.       0.       0.       0.       0.       0.       0.       0.
      0.       0.       0.       0.       0.       6.       0.     113.
      0.       0.       0.       0.       0.       0.       0.       0.
      0.       0.       0.       0.       0.       0.       0.       0.
      0.       0.    1987.       0.       0.       0.       0.       0.
      0.       0.       0.       0.       0.       0.       0.       0.
      0.       0.       0.       0.       0.       0.       0.    2218.
```

0. 0. 0. 0. 0. 0. 0. 0.
0. 0. 0. 0. 0. 0. 0. 0.
0. 0. 0. 2435. 3014. 288. 183. 380.
0. 0. 0. 0. 0. 0. 0. 0.
0. 0. 0. 0. 0. 0. 421. 810.
0. 293. 1108. 779. 15354. 8786. 48943. 63357.
319944. 0. 0. 0. 0. 0. 0. 0.
0. 0. 0. 0. 2435. 0. 1688. 3376.
3448. 7591. 6999. 23331. 187240. 0. 0. 0.
0. 0. 0. 0. 0. 0. 0. 4350.
407. 4223. 3024. 3059. 3396. 3128. 6847. 8940.
27255. 0. 0. 0. 0. 0. 0. 0.
0. 0. 0. 0. 2002. 0. 534. 8224.
2252. 2388. 5752. 7858. 140074. 0. 0. 0.
0. 0. 0. 0. 0. 0. 101. 0.
0. 0. 0. 984. 1792. 3659. 3759. 7416.
80933. 0. 0. 0. 0. 0. 0. 0.
0. 0. 0. 0. 0. 0. 974. 1388.
2021. 3148. 5123. 4351. 14935. 0. 0. 0.
0. 0. 0. 0. 0. 0. 0. 851.
0. 0. 125. 3161. 827. 3252. 3712. 25127.
15531. 0. 0. 0. 0. 0. 0. 0.
0. 0. 0. 780. 0. 89. 793. 265.
1693. 5397. 1338. 11236. 17820. 0. 0. 0.
0. 0. 0. 0. 1. 0. 0. 55.
0. 0. 0. 14641. 6332. 5986. 13324. 45833.
150138. 0. 0. 0. 0. 0. 0. 0.
0. 0. 0. 0. 0. 0. 0. 0.
0. 0. 0. 0. 0. 0. 0. 0.
0. 0. 0. 0. 0. 0. 0. 0.
0. 0. 0. 0. 0. 0. 0. 0.
0. 0. 0. 0. 0. 0. 0. 0.
0. 0. 0. 0. 0. 0. 0. 0.
0. 0. 0. 0. 0. 0. 0. 0.
0. 0. 0. 0. 0. 0. 0. 0.
0. 0. 0. 0. 0. 0. 0. 0.
0. 0. 0. 0. 0. 0. 0. 0.
0. 0. 0. 0. 0. 0. 0. 0.
0. 0. 0. 0. 0. 0. 0. 0.
0. 0. 0. 0. 0. 0. 0. 0.
0. 0. 0. 0. 0. 0. 0. 0.

Appendix G, Output Files for Modtest Sample Case

File 1; Synopsis Output File

Modtest.syn

C A P 8 8 - P C

Version 3.0

Clean Air Act Assessment Package - 1988

S Y N O P S I S R E P O R T

Non-Radon Population Assessment
Sep 30, 2002 12:05 am

Facility: CAP88 Test Site
Address: B Street
City: Somewhere
State: CA Zip: 89898

Source Category: 1 Area
Source Type: Area
Emission Year: 1995

Comments: CAP88 Distribution Sample Case
Co-60 and K-43

Effective Dose Equivalent (mrem/year)
1.34E+02

At This Location: 250 Meters South

Dataset Name: Modtest
Dataset Date: 9/30/2002 12:05:00 AM
Wind File: C:\Trinity\CAP8821\newsource\CAP88PCv2p1\WINDLIB\UCC1026.WND
Population File: C:\Trinity\CAP8821\newsource\CAP88PCv2p1\POPLIB\UFCBERKL.POP

Sep 30, 2002 12:05 am SYNOPSIS
Page 1

MAXIMALLY EXPOSED INDIVIDUAL

Location Of The Individual: 250 Meters South
Lifetime Fatal Cancer Risk: 3.70E-03

ORGAN DOSE EQUIVALENT SUMMARY

Organ	Selected Individual (mrem/y)	Collective Population (person-rem/y)
Adrenals	1.18E+02	4.59E+02
B Surfac	1.28E+02	4.98E+02
Breasts	1.80E+02	6.98E+02
St Wall	1.25E+02	4.84E+02
ULI Wall	1.35E+02	5.26E+02
Kidneys	1.15E+02	4.45E+02
Lungs	1.26E+02	4.90E+02
Ovaries	1.25E+02	4.88E+02
R Marrow	1.26E+02	4.91E+02
Spleen	1.30E+02	5.09E+02
Thymus	1.28E+02	4.99E+02
Uterus	1.27E+02	4.94E+02
Brain	1.41E+02	5.50E+02
Esophagu	1.18E+02	4.59E+02
SI Wall	1.19E+02	4.61E+02
LLI Wall	1.35E+02	5.23E+02
Liver	1.60E+02	6.21E+02
Muscle	1.27E+02	4.92E+02
Pancreas	1.41E+02	5.49E+02
Skin	1.22E+02	4.72E+02
Testes	1.30E+02	5.05E+02
Thyroid	1.23E+02	4.78E+02
EFFEC	1.34E+02	5.19E+02

FREQUENCY DISTRIBUTION OF LIFETIME FATAL CANCER RISKS

Risk Range	# of People	# of People in This Risk Range or Higher	Deaths/Year in This Risk Range	Deaths/Year in This Risk Range or Higher
1.0E+00 TO 1.0E-01	0	0	0.00E+00	0.00E+00
1.0E-01 TO 1.0E-02	0	0	0.00E+00	0.00E+00
1.0E-02 TO 1.0E-03	1129	1129	5.90E-02	5.90E-02
1.0E-03 TO 1.0E-04	9143	10272	3.33E-02	9.23E-02
1.0E-04 TO 1.0E-05	180328	190600	5.53E-02	1.48E-01
1.0E-05 TO 1.0E-06	1019185	1209785	3.42E-02	1.82E-01
LESS THAN 1.0E-06	3829015	5038800	2.18E-02	2.04E-01

RADIONUCLIDE EMISSIONS DURING THE YEAR 1995

Nuclide	Class	Size	Source #1 Ci/y	TOTAL Ci/y
K-43	M	0.00	1.0E+01	1.0E+01
Co-60	M	0.00	1.0E+00	1.0E+00

SITE INFORMATION

Temperature:	10	degrees C
Precipitation:	100	cm/y
Humidity:	8	g/cu m
Mixing Height:	1000	m

SOURCE INFORMATION

Source Number: 1

Source Height (m): 0.00
Area (sq m): 100.00

Plume Rise Momentum (m/s): 2.00
(Exit Velocity)

AGRICULTURAL DATA

	Vegetable	Milk	Meat
Fraction Home Produced:	0.080	0.000	0.010
Fraction From Assessment Area:	0.920	1.000	0.990
Fraction Imported:	0.000	0.000	0.000

Beef Cattle Density: 8.81E-02
Milk Cattle Density: 2.85E-02
Land Fraction Cultivated for Vegetable Crops: 1.18E-02

POPULATION DATA

	Distance (m)						
Direction	250	750	1500	2500	3500	4500	7500
N	0	0	419	978	0	0	0
NNW	0	966	1063	2655	2660	2166	5919
NW	0	0	2031	2966	4817	5501	43544
WNW	1388	1375	3027	2461	4967	8003	5311
W	0	1916	3674	6014	5796	344	0
WSW	0	0	1321	5938	7322	341	87
SW	0	0	4144	4862	4947	3999	1979
SSW	0	0	8956	6322	6621	7995	29139
S	1129	2477	3362	3972	5593	7333	75595
SSE	0	0	3111	1993	2650	4137	40174
SE	0	0	250	2026	0	1844	12153
ESE	0	0	320	0	0	0	3882
E	0	0	0	0	0	0	8190
ENE	0	0	0	0	1444	0	6602
NE	0	0	0	0	0	0	0
NNE	0	0	1168	0	0	0	0

	Distance (m)					
Direction	15000	25000	35000	45000	55000	70000
N	26082	69252	17794	50333	21754	3220
NNW	31295	1375	916	8262	18605	86075
NW	51259	8481	41802	12053	44253	91465
WNW	8926	70567	32603	2209	2197	1587
W	7824	41597	764	1491	0	0
WSW	114451	120561	0	0	0	0
SW	148756	367654	58587	0	0	0
SSW	14742	22139	127109	17783	919	0
S	52561	0	105101	163799	35767	929
SSE	157777	120541	93038	137340	191419	884034
SE	17933	59197	35639	44391	16767	55433
ESE	12868	31761	32734	48654	6423	11025
E	51309	17142	3084	6023	5055	16794
ENE	57143	108500	58430	31916	4913	3207
NE	25617	18077	4707	0	3889	3333
NNE	3700	17120	1752	59005	53296	19576

Appendix G, Output Files for Modtest Sample Case

File 2; Summary Output File

Modtest.sum

C A P 8 8 - P C

Version 3.0

Clean Air Act Assessment Package - 1988

D O S E A N D R I S K E Q U I V A L E N T S U M M A R I E S

Non-Radon Population Assessment
Sep 30, 2002 12:05 am

Facility: CAP88 Test Site
Address: B Street
City: Somewhere
State: CA Zip: 89898

Source Category: 1 Area
Source Type: Area
Emission Year: 1995

Comments: CAP88 Distribution Sample Case
Co-60 and K-43

Dataset Name: Modtest
Dataset Date: 9/30/2002 12:05:00 AM
Wind File: C:\Trinity\CAP8821\newsource\CAP88PCv2p1\WINDLIB\UCC1026.WND
Population File: C:\Trinity\CAP8821\newsource\CAP88PCv2p1\POPLIB\UFCBERKL.POP

ORGAN DOSE EQUIVALENT SUMMARY

Organ	Selected Individual (mrem/y)	Collective Population (person-rem/y)
Adrenals	1.18E+02	4.59E+02
B Surfac	1.28E+02	4.98E+02
Breasts	1.80E+02	6.98E+02
St Wall	1.25E+02	4.84E+02
ULI Wall	1.35E+02	5.26E+02
Kidneys	1.15E+02	4.45E+02
Lungs	1.26E+02	4.90E+02
Ovaries	1.25E+02	4.88E+02
R Marrow	1.26E+02	4.91E+02
Spleen	1.30E+02	5.09E+02
Thymus	1.28E+02	4.99E+02
Uterus	1.27E+02	4.94E+02
Bld Wall	1.36E+02	5.25E+02
Brain	1.41E+02	5.50E+02
Esophagu	1.18E+02	4.59E+02
SI Wall	1.19E+02	4.61E+02
LLI Wall	1.35E+02	5.23E+02
Liver	1.60E+02	6.21E+02
Muscle	1.27E+02	4.92E+02
Pancreas	1.41E+02	5.49E+02
Skin	1.22E+02	4.72E+02
Testes	1.30E+02	5.05E+02
Thyroid	1.23E+02	4.78E+02
EFFEC	1.34E+02	5.19E+02

PATHWAY EFFECTIVE DOSE EQUIVALENT SUMMARY

Pathway	Selected Individual (mrem/y)	Collective Population (person-rem/y)
INGESTION	5.09E-02	1.30E+00
INHALATION	1.03E+00	3.24E+00
AIR IMMERSION	1.62E-01	5.05E-01
GROUND SURFACE	1.32E+02	5.14E+02
INTERNAL	1.08E+00	4.54E+00
EXTERNAL	1.32E+02	5.15E+02
TOTAL	1.34E+02	5.19E+02

NUCLIDE EFFECTIVE DOSE EQUIVALENT SUMMARY

Nuclides	Selected Individual (mrem/y)	Collective Population (person-rem/y)
K-43	6.99E-01	2.37E+00
Co-60	1.33E+02	5.17E+02
TOTAL	1.34E+02	5.19E+02

CANCER RISK SUMMARY

Cancer	Selected Individual Total Lifetime Fatal Cancer Risk	Total Collective Population Fatal Cancer Risk (Deaths/y)
Esophagu	6.60E-05	3.63E-03
Stomach	2.55E-04	1.40E-02
Colon	6.60E-04	3.66E-02
Liver	9.62E-05	5.31E-03
LUNG	6.67E-04	3.65E-02
Bone	8.52E-06	4.68E-04
Skin	7.96E-06	4.38E-04
Breast	3.27E-04	1.80E-02
Ovary	8.38E-05	4.62E-03
Bladder	1.55E-04	8.53E-03
Kidneys	3.32E-05	1.83E-03
Thyroid	2.07E-05	1.14E-03
Leukemia	3.78E-04	2.08E-02
Residual	9.37E-04	5.16E-02
Total	3.70E-03	2.04E-01

PATHWAY RISK SUMMARY

Pathway	Selected Individual Total Lifetime Fatal Cancer Risk	Total Collective Population Fatal Cancer Risk (Deaths/y)
INGESTION	2.89E-06	1.04E-03
INHALATION	3.90E-05	1.73E-03
AIR IMMERSION	4.42E-06	1.94E-04
GROUND SURFACE	3.65E-03	2.01E-01
INTERNAL	4.19E-05	2.78E-03
EXTERNAL	3.66E-03	2.01E-01
TOTAL	3.70E-03	2.04E-01

NUCLIDE RISK SUMMARY

Nuclide	Selected Individual Total Lifetime Fatal Cancer Risk	Population Fatal Cancer Risk (Deaths/y)
K-43	2.07E-05	9.85E-04
Co-60	3.68E-03	2.03E-01
TOTAL	3.70E-03	2.04E-01

INDIVIDUAL EFFECTIVE DOSE EQUIVALENT RATE (mrem/y)
(All Radionuclides and Pathways)

	Distance (m)						
Direction	250	750	1500	2500	3500	4500	7500
N	0.0E+00	0.0E+00	1.6E+00	7.5E-01	0.0E+00	0.0E+00	0.0E+00
NNW	0.0E+00	3.0E+00	9.4E-01	4.3E-01	2.6E-01	1.8E-01	9.1E-02
NW	0.0E+00	0.0E+00	1.2E+00	5.4E-01	3.3E-01	2.4E-01	1.2E-01
WNW	1.2E+01	1.6E+00	5.0E-01	2.3E-01	1.4E-01	9.8E-02	4.9E-02
W	0.0E+00	3.8E+00	1.2E+00	5.2E-01	3.1E-01	2.2E-01	0.0E+00
WSW	0.0E+00	0.0E+00	4.7E-01	2.1E-01	1.2E-01	8.6E-02	4.1E-02
SW	0.0E+00	0.0E+00	1.6E+00	7.1E-01	4.3E-01	3.0E-01	1.4E-01
SSW	0.0E+00	0.0E+00	1.9E+00	8.7E-01	5.3E-01	3.7E-01	1.8E-01
S	1.3E+02	1.7E+01	5.3E+00	2.4E+00	1.4E+00	1.0E+00	4.9E-01
SSE	0.0E+00	0.0E+00	2.1E+00	9.2E-01	5.6E-01	3.9E-01	1.9E-01
SE	0.0E+00	0.0E+00	2.0E+00	8.6E-01	0.0E+00	3.6E-01	1.7E-01
ESE	0.0E+00	0.0E+00	5.6E-01	0.0E+00	0.0E+00	0.0E+00	4.9E-02
E	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.8E-02
ENE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.1E-01	0.0E+00	3.9E-02
NE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NNE	0.0E+00	0.0E+00	9.5E-01	0.0E+00	0.0E+00	0.0E+00	0.0E+00

	Distance (m)					
Direction	15000	25000	35000	45000	55000	70000
N	6.6E-02	3.3E-02	2.2E-02	1.6E-02	1.2E-02	8.1E-03
NNW	3.8E-02	1.9E-02	1.2E-02	8.9E-03	6.7E-03	4.6E-03
NW	4.9E-02	2.4E-02	1.6E-02	1.1E-02	8.4E-03	5.6E-03
WNW	2.1E-02	1.0E-02	6.6E-03	4.7E-03	3.5E-03	2.3E-03
W	4.2E-02	1.9E-02	1.2E-02	8.6E-03	0.0E+00	0.0E+00
WSW	1.6E-02	7.2E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SW	5.8E-02	2.6E-02	1.7E-02	0.0E+00	0.0E+00	0.0E+00
SSW	7.1E-02	3.3E-02	2.1E-02	1.5E-02	1.1E-02	0.0E+00
S	2.0E-01	0.0E+00	6.0E-02	4.3E-02	3.1E-02	1.9E-02
SSE	7.6E-02	3.6E-02	2.3E-02	1.7E-02	1.2E-02	7.5E-03
SE	6.9E-02	3.2E-02	2.1E-02	1.5E-02	1.0E-02	6.3E-03
ESE	1.9E-02	8.5E-03	5.5E-03	3.9E-03	2.8E-03	1.7E-03
E	3.0E-02	1.3E-02	8.6E-03	6.0E-03	4.3E-03	2.6E-03
ENE	1.5E-02	7.3E-03	4.8E-03	3.5E-03	2.6E-03	1.7E-03
NE	4.5E-02	2.2E-02	1.4E-02	0.0E+00	7.7E-03	5.2E-03
NNE	3.9E-02	2.0E-02	1.3E-02	9.5E-03	7.2E-03	5.1E-03

COLLECTIVE EFFECTIVE DOSE EQUIVALENT (person rem/y)
(All Radionuclides and Pathways)

	Distance (m)						
Direction	250	750	1500	2500	3500	4500	7500
N	0.0E+00	0.0E+00	6.9E-01	7.3E-01	0.0E+00	0.0E+00	0.0E+00
NNW	0.0E+00	2.9E+00	1.0E+00	1.1E+00	6.9E-01	4.0E-01	5.4E-01
NW	0.0E+00	0.0E+00	2.4E+00	1.6E+00	1.6E+00	1.3E+00	5.1E+00
WNW	1.7E+01	2.2E+00	1.5E+00	5.6E-01	6.9E-01	7.8E-01	2.6E-01
W	0.0E+00	7.3E+00	4.3E+00	3.1E+00	1.8E+00	7.5E-02	0.0E+00
WSW	0.0E+00	0.0E+00	6.2E-01	1.2E+00	9.1E-01	2.9E-02	3.5E-03
SW	0.0E+00	0.0E+00	6.6E+00	3.5E+00	2.1E+00	1.2E+00	2.9E-01
SSW	0.0E+00	0.0E+00	1.7E+01	5.5E+00	3.5E+00	2.9E+00	5.2E+00
S	1.5E+02	4.3E+01	1.8E+01	9.5E+00	8.1E+00	7.4E+00	3.7E+01
SSE	0.0E+00	0.0E+00	6.4E+00	1.8E+00	1.5E+00	1.6E+00	7.6E+00
SE	0.0E+00	0.0E+00	4.9E-01	1.7E+00	0.0E+00	6.7E-01	2.1E+00
ESE	0.0E+00	0.0E+00	1.8E-01	0.0E+00	0.0E+00	0.0E+00	1.9E-01
E	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.4E-01
ENE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.6E-01	0.0E+00	2.5E-01
NE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NNE	0.0E+00	0.0E+00	1.1E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

	Distance (m)					
Direction	15000	25000	35000	45000	55000	70000
N	1.7E+00	2.3E+00	3.9E-01	7.9E-01	2.6E-01	2.6E-02
NNW	1.2E+00	2.6E-02	1.1E-02	7.4E-02	1.3E-01	4.0E-01
NW	2.5E+00	2.1E-01	6.6E-01	1.4E-01	3.7E-01	5.1E-01
WNW	1.8E-01	7.1E-01	2.1E-01	1.0E-02	7.6E-03	3.6E-03
W	3.3E-01	8.1E-01	9.5E-03	1.3E-02	0.0E+00	0.0E+00
WSW	1.8E+00	8.7E-01	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SW	8.6E+00	9.7E+00	1.0E+00	0.0E+00	0.0E+00	0.0E+00
SSW	1.0E+00	7.3E-01	2.7E+00	2.7E-01	1.0E-02	0.0E+00
S	1.0E+01	0.0E+00	6.3E+00	7.0E+00	1.1E+00	1.8E-02
SSE	1.2E+01	4.3E+00	2.2E+00	2.3E+00	2.3E+00	6.7E+00
SE	1.2E+00	1.9E+00	7.3E-01	6.4E-01	1.8E-01	3.5E-01
ESE	2.5E-01	2.7E-01	1.8E-01	1.9E-01	1.8E-02	1.9E-02
E	1.6E+00	2.3E-01	2.7E-02	3.6E-02	2.2E-02	4.3E-02
ENE	8.8E-01	8.0E-01	2.8E-01	1.1E-01	1.3E-02	5.5E-03
NE	1.1E+00	3.9E-01	6.7E-02	0.0E+00	3.0E-02	1.7E-02
NNE	1.4E-01	3.4E-01	2.3E-02	5.6E-01	3.9E-01	9.9E-02

INDIVIDUAL LIFETIME RISK (deaths)
(All Radionuclides and Pathways)

	Distance (m)						
Direction	250	750	1500	2500	3500	4500	7500
N	0.0E+00	0.0E+00	4.5E-05	2.1E-05	0.0E+00	0.0E+00	0.0E+00
NNW	0.0E+00	8.2E-05	2.6E-05	1.2E-05	7.2E-06	5.1E-06	2.5E-06
NW	0.0E+00	0.0E+00	3.3E-05	1.5E-05	9.2E-06	6.5E-06	3.2E-06
WNW	3.3E-04	4.4E-05	1.4E-05	6.3E-06	3.9E-06	2.7E-06	1.4E-06
W	0.0E+00	1.1E-04	3.2E-05	1.4E-05	8.7E-06	6.1E-06	0.0E+00
WSW	0.0E+00	0.0E+00	1.3E-05	5.7E-06	3.4E-06	2.4E-06	1.1E-06
SW	0.0E+00	0.0E+00	4.4E-05	2.0E-05	1.2E-05	8.3E-06	4.0E-06
SSW	0.0E+00	0.0E+00	5.4E-05	2.4E-05	1.5E-05	1.0E-05	4.9E-06
S	3.7E-03	4.8E-04	1.5E-04	6.6E-05	4.0E-05	2.8E-05	1.4E-05
SSE	0.0E+00	0.0E+00	5.7E-05	2.5E-05	1.5E-05	1.1E-05	5.2E-06
SE	0.0E+00	0.0E+00	5.4E-05	2.4E-05	0.0E+00	1.0E-05	4.8E-06
ESE	0.0E+00	0.0E+00	1.6E-05	0.0E+00	0.0E+00	0.0E+00	1.4E-06
E	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.2E-06
ENE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.1E-06	0.0E+00	1.1E-06
NE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NNE	0.0E+00	0.0E+00	2.6E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00

	Distance (m)					
Direction	15000	25000	35000	45000	55000	70000
N	1.8E-06	9.2E-07	6.1E-07	4.4E-07	3.3E-07	2.3E-07
NNW	1.1E-06	5.2E-07	3.5E-07	2.5E-07	1.9E-07	1.3E-07
NW	1.4E-06	6.8E-07	4.5E-07	3.2E-07	2.4E-07	1.6E-07
WNW	5.8E-07	2.9E-07	1.9E-07	1.4E-07	1.0E-07	6.9E-08
W	1.2E-06	5.4E-07	3.5E-07	2.4E-07	0.0E+00	0.0E+00
WSW	4.5E-07	2.1E-07	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SW	1.6E-06	7.4E-07	4.8E-07	0.0E+00	0.0E+00	0.0E+00
S	5.5E-06	0.0E+00	1.7E-06	1.2E-06	8.7E-07	5.4E-07
SSE	2.1E-06	1.0E-06	6.5E-07	4.6E-07	3.4E-07	2.2E-07
SE	1.9E-06	8.9E-07	5.8E-07	4.1E-07	3.0E-07	1.8E-07
ESE	5.3E-07	2.4E-07	1.6E-07	1.1E-07	8.4E-08	5.4E-08
E	8.5E-07	3.8E-07	2.4E-07	1.7E-07	1.3E-07	7.8E-08
ENE	4.3E-07	2.1E-07	1.4E-07	1.0E-07	7.8E-08	5.4E-08
NE	1.2E-06	6.1E-07	4.0E-07	0.0E+00	2.2E-07	1.5E-07
NNE	1.1E-06	5.5E-07	3.7E-07	2.7E-07	2.1E-07	1.5E-07

COLLECTIVE FATAL CANCER RATE (deaths/y)
(All Radionuclides and Pathways)

	Distance (m)						
Direction	250	750	1500	2500	3500	4500	7500
N	0.0E+00	0.0E+00	2.7E-04	2.9E-04	0.0E+00	0.0E+00	0.0E+00
NNW	0.0E+00	1.1E-03	3.9E-04	4.4E-04	2.7E-04	1.6E-04	2.1E-04
NW	0.0E+00	0.0E+00	9.5E-04	6.3E-04	6.3E-04	5.1E-04	2.0E-03
WNW	6.6E-03	8.5E-04	5.9E-04	2.2E-04	2.7E-04	3.1E-04	1.0E-04
W	0.0E+00	2.9E-03	1.7E-03	1.2E-03	7.1E-04	2.9E-05	0.0E+00
WSW	0.0E+00	0.0E+00	2.4E-04	4.8E-04	3.6E-04	1.2E-05	1.4E-06
SW	0.0E+00	0.0E+00	2.6E-03	1.4E-03	8.3E-04	4.7E-04	1.1E-04
SSW	0.0E+00	0.0E+00	6.8E-03	2.1E-03	1.4E-03	1.2E-03	2.0E-03
S	5.9E-02	1.7E-02	7.0E-03	3.7E-03	3.2E-03	2.9E-03	1.5E-02
SSE	0.0E+00	0.0E+00	2.5E-03	7.1E-04	5.8E-04	6.3E-04	3.0E-03
SE	0.0E+00	0.0E+00	1.9E-04	6.8E-04	0.0E+00	2.6E-04	8.3E-04
ESE	0.0E+00	0.0E+00	7.1E-05	0.0E+00	0.0E+00	0.0E+00	7.5E-05
E	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.5E-04
ENE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.4E-05	0.0E+00	1.0E-04
NE	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NNE	0.0E+00	0.0E+00	4.4E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00

	Distance (m)					
Direction	15000	25000	35000	45000	55000	70000
N	6.8E-04	9.0E-04	1.5E-04	3.1E-04	1.0E-04	1.0E-05
NNW	4.7E-04	1.0E-05	4.5E-06	3.0E-05	5.1E-05	1.6E-04
NW	9.9E-04	8.1E-05	2.6E-04	5.4E-05	1.5E-04	2.1E-04
WNW	7.3E-05	2.8E-04	8.7E-05	4.2E-06	3.2E-06	1.6E-06
W	1.3E-04	3.2E-04	3.8E-06	5.2E-06	0.0E+00	0.0E+00
WSW	7.3E-04	3.5E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SW	3.4E-03	3.8E-03	4.0E-04	0.0E+00	0.0E+00	0.0E+00
SSW	4.1E-04	2.9E-04	1.1E-03	1.1E-04	4.0E-06	0.0E+00
S	4.1E-03	0.0E+00	2.5E-03	2.7E-03	4.4E-04	7.0E-06
SSE	4.7E-03	1.7E-03	8.6E-04	9.0E-04	9.2E-04	2.7E-03
SE	4.9E-04	7.4E-04	2.9E-04	2.6E-04	7.0E-05	1.4E-04
ESE	9.7E-05	1.1E-04	7.3E-05	7.8E-05	7.6E-06	8.3E-06
E	6.1E-04	9.1E-05	1.1E-05	1.5E-05	9.0E-06	1.8E-05
ENE	3.5E-04	3.2E-04	1.2E-04	4.6E-05	5.4E-06	2.5E-06
NE	4.5E-04	1.6E-04	2.7E-05	0.0E+00	1.2E-05	7.1E-06
NNE	5.7E-05	1.3E-04	9.1E-06	2.2E-04	1.6E-04	4.0E-05

Appendix G, Output Files for Modtest Sample Case

File 3; Air Dispersion (CHI/Q) Output File

Modtest.chi

C A P 8 8 - P C

Version 3.0

Clean Air Act Assessment Package - 1988

C H I / Q T A B L E S

Non-Radon Population Assessment
Sep 30, 2002 12:05 am

Facility: CAP88 Test Site
Address: B Street
City: Somewhere
State: CA Zip: 89898

Source Category: 1 Area
Source Type: Area
Emission Year: 1995

Comments: CAP88 Distribution Sample Case
Co-60 and K-43

Dataset Name: Modtest
Dataset Date: 9/30/2002 12:05:00 AM
Wind File: C:\Trinity\CAP8821\newsource\CAP88PCv2p1\WINDLIB\UCC1026.WND
Population File: C:\Trinity\CAP8821\newsource\CAP88PCv2p1\POPLIB\UFCBERKL.POP

Sep 30, 2002 12:05 am CHIQ
Page 1

GROUND-LEVEL CHI/Q VALUES FOR K-43
CHI/Q TOWARD INDICATED DIRECTION (SEC/CUBIC METER)

	Distance (meters)						
Dir	250	750	1500	2500	3500	4500	7500
N	2.224E-05	2.706E-06	7.675E-07	3.145E-07	1.791E-07	1.198E-07	5.225E-08
NNW	1.292E-05	1.533E-06	4.269E-07	1.725E-07	9.717E-08	6.433E-08	2.745E-08
NW	1.631E-05	1.901E-06	5.215E-07	2.081E-07	1.161E-07	7.624E-08	3.196E-08
WNW	6.891E-06	7.923E-07	2.151E-07	8.521E-08	4.734E-08	3.097E-08	1.289E-08
W	1.743E-05	1.993E-06	5.423E-07	2.159E-07	1.204E-07	7.892E-08	3.262E-08
WSW	7.314E-06	8.366E-07	2.286E-07	9.151E-08	5.126E-08	3.375E-08	1.404E-08
SW	2.402E-05	2.849E-06	7.999E-07	3.273E-07	1.867E-07	1.251E-07	5.428E-08
SSW	2.904E-05	3.485E-06	9.888E-07	4.081E-07	2.346E-07	1.583E-07	6.983E-08
S	7.927E-05	9.624E-06	2.758E-06	1.148E-06	6.637E-07	4.506E-07	2.014E-07
SSE	3.050E-05	3.712E-06	1.066E-06	4.443E-07	2.572E-07	1.747E-07	7.826E-08
SE	2.973E-05	3.569E-06	1.016E-06	4.209E-07	2.427E-07	1.643E-07	7.283E-08
ESE	8.838E-06	1.040E-06	2.917E-07	1.194E-07	6.822E-08	4.574E-08	1.980E-08
E	1.401E-05	1.640E-06	4.578E-07	1.867E-07	1.063E-07	7.102E-08	3.059E-08
ENE	6.163E-06	7.439E-07	2.115E-07	8.727E-08	5.007E-08	3.372E-08	1.482E-08
NE	1.618E-05	1.993E-06	5.720E-07	2.372E-07	1.365E-07	9.213E-08	4.087E-08
NNE	1.263E-05	1.584E-06	4.581E-07	1.905E-07	1.097E-07	7.414E-08	3.307E-08

	Distance (meters)					
Dir	15000	25000	35000	45000	55000	70000
N	1.820E-08	7.601E-09	4.535E-09	2.996E-09	2.065E-09	1.217E-09
NNW	9.492E-09	3.842E-09	2.284E-09	1.497E-09	1.019E-09	5.826E-10
NW	1.118E-08	4.477E-09	2.645E-09	1.712E-09	1.144E-09	6.222E-10
WNW	4.547E-09	1.782E-09	1.045E-09	6.680E-10	4.364E-10	2.207E-10
W	1.101E-08	4.026E-09	2.310E-09	1.443E-09	9.143E-10	4.344E-10
WSW	4.673E-09	1.667E-09	9.521E-10	5.926E-10	3.739E-10	1.766E-10
SW	1.884E-08	7.387E-09	4.346E-09	2.797E-09	1.836E-09	9.190E-10
SSW	2.478E-08	1.015E-08	6.071E-09	3.976E-09	2.664E-09	1.395E-09
S	7.253E-08	3.072E-08	1.861E-08	1.235E-08	8.417E-09	4.587E-09
SSE	2.818E-08	1.197E-08	7.257E-09	4.823E-09	3.294E-09	1.813E-09
SE	2.594E-08	1.064E-08	6.389E-09	4.193E-09	2.809E-09	1.461E-09
ESE	6.819E-09	2.614E-09	1.533E-09	9.805E-10	6.364E-10	3.096E-10
E	1.046E-08	3.965E-09	2.313E-09	1.473E-09	9.516E-10	4.634E-10
ENE	5.170E-09	2.105E-09	1.250E-09	8.176E-10	5.517E-10	3.054E-10
NE	1.430E-08	5.986E-09	3.570E-09	2.355E-09	1.616E-09	9.316E-10
NNE	1.161E-08	4.998E-09	2.996E-09	1.997E-09	1.394E-09	8.392E-10

GROUND-LEVEL CHI/Q VALUES FOR Co-60
CHI/Q TOWARD INDICATED DIRECTION (SEC/CUBIC METER)

	Distance (meters)						
Dir	250	750	1500	2500	3500	4500	7500
N	2.227E-05	2.715E-06	7.722E-07	3.177E-07	1.816E-07	1.219E-07	5.378E-08
NNW	1.294E-05	1.538E-06	4.300E-07	1.746E-07	9.882E-08	6.573E-08	2.844E-08
NW	1.633E-05	1.909E-06	5.259E-07	2.110E-07	1.184E-07	7.814E-08	3.329E-08
WNW	6.902E-06	7.960E-07	2.171E-07	8.652E-08	4.836E-08	3.183E-08	1.348E-08
W	1.747E-05	2.003E-06	5.481E-07	2.197E-07	1.233E-07	8.142E-08	3.434E-08
WSW	7.327E-06	8.411E-07	2.311E-07	9.313E-08	5.253E-08	3.483E-08	1.478E-08
SW	2.406E-05	2.860E-06	8.062E-07	3.315E-07	1.901E-07	1.280E-07	5.638E-08
SSW	2.908E-05	3.497E-06	9.957E-07	4.129E-07	2.384E-07	1.616E-07	7.222E-08
S	7.936E-05	9.655E-06	2.775E-06	1.160E-06	6.734E-07	4.589E-07	2.076E-07
SSE	3.053E-05	3.724E-06	1.073E-06	4.488E-07	2.609E-07	1.779E-07	8.062E-08
SE	2.977E-05	3.582E-06	1.023E-06	4.258E-07	2.467E-07	1.677E-07	7.533E-08
ESE	8.851E-06	1.045E-06	2.942E-07	1.211E-07	6.958E-08	4.691E-08	2.064E-08
E	1.403E-05	1.647E-06	4.619E-07	1.895E-07	1.085E-07	7.293E-08	3.196E-08
ENE	6.170E-06	7.466E-07	2.130E-07	8.829E-08	5.088E-08	3.442E-08	1.533E-08
NE	1.620E-05	1.999E-06	5.753E-07	2.394E-07	1.383E-07	9.369E-08	4.201E-08
NNE	1.264E-05	1.588E-06	4.602E-07	1.919E-07	1.109E-07	7.512E-08	3.379E-08

	Distance (meters)					
Dir	15000	25000	35000	45000	55000	70000
N	1.927E-08	8.302E-09	5.122E-09	3.488E-09	2.462E-09	1.466E-09
NNW	1.018E-08	4.282E-09	2.651E-09	1.802E-09	1.262E-09	7.314E-10
NW	1.213E-08	5.099E-09	3.165E-09	2.147E-09	1.492E-09	8.408E-10
WNW	4.980E-09	2.066E-09	1.282E-09	8.655E-10	5.940E-10	3.166E-10
W	1.220E-08	4.743E-09	2.896E-09	1.917E-09	1.278E-09	6.320E-10
WSW	5.177E-09	1.957E-09	1.186E-09	7.800E-10	5.141E-10	2.463E-10
SW	2.032E-08	8.328E-09	5.130E-09	3.447E-09	2.346E-09	1.199E-09
SSW	2.650E-08	1.128E-08	7.028E-09	4.780E-09	3.309E-09	1.769E-09
S	7.701E-08	3.375E-08	2.120E-08	1.455E-08	1.021E-08	5.676E-09
SSE	2.989E-08	1.313E-08	8.242E-09	5.660E-09	3.975E-09	2.227E-09
SE	2.773E-08	1.182E-08	7.388E-09	5.033E-09	3.482E-09	1.848E-09
ESE	7.400E-09	2.971E-09	1.828E-09	1.223E-09	8.235E-10	4.069E-10
E	1.140E-08	4.533E-09	2.781E-09	1.855E-09	1.245E-09	6.148E-10
ENE	5.525E-09	2.329E-09	1.437E-09	9.718E-10	6.732E-10	3.747E-10
NE	1.510E-08	6.512E-09	4.011E-09	2.725E-09	1.914E-09	1.111E-09
NNE	1.212E-08	5.351E-09	3.296E-09	2.252E-09	1.604E-09	9.756E-10

Appendix G, Output Files for Modtest Sample Case

File 4; Concentration Output File

Modtest.con

C A P 8 8 - P C

Version 3.0

Clean Air Act Assessment Package - 1988

C O N C E N T R A T I O N T A B L E S

Non-Radon Population Assessment
Sep 30, 2002 12:05 am

Facility: CAP88 Test Site
Address: B Street
City: Somewhere
State: CA Zip: 89898

Source Category: 1 Area
Source Type: Area
Emission Year: 1995

Comments: CAP88 Distribution Sample Case
Co-60 and K-43

Dataset Name: Modtest
Dataset Date: 9/30/2002 12:05:00 AM
Wind File: C:\Trinity\CAP8821\newsource\CAP88PC v2p1\WINDLIB\UCC1026.WND
Population File: C:\Trinity\CAP8821\newsource\CAP88PC v2p1\POPLIB\UFCBERKL.POP

Sep 30, 2002 12:05 am CONCEN
Page 1

ESTIMATED RADIONUCLIDE CONCENTRATIONS
AT VARIOUS LOCATIONS IN THE ENVIRONMENT

Wind Toward	Distance (meters)	Nuclide	Air Concentration (pCi/m3)	Dry Deposition Rate (pCi/cm2/s)	Wet Deposition Rate (pCi/cm2/s)	Ground Deposition Rate (pCi/cm2/s)
N	250	K-43	7.1E+00	1.3E-06	8.8E-08	1.4E-06
N	250	Co-60	7.1E-01	1.3E-07	8.8E-09	1.4E-07
N	750	K-43	8.6E-01	1.5E-07	2.9E-08	1.8E-07
N	750	Co-60	8.6E-02	1.5E-08	2.9E-09	1.8E-08
N	1500	K-43	2.4E-01	4.4E-08	1.4E-08	5.8E-08
N	1500	Co-60	2.4E-02	4.4E-09	1.4E-09	5.8E-09
N	2500	K-43	1.0E-01	1.8E-08	8.3E-09	2.6E-08
N	2500	Co-60	1.0E-02	1.8E-09	8.3E-10	2.6E-09
N	3500	K-43	5.7E-02	1.0E-08	5.8E-09	1.6E-08
N	3500	Co-60	5.8E-03	1.0E-09	5.9E-10	1.6E-09
N	4500	K-43	3.8E-02	6.8E-09	4.4E-09	1.1E-08
N	4500	Co-60	3.9E-03	7.0E-10	4.5E-10	1.1E-09
N	7500	K-43	1.7E-02	3.0E-09	2.6E-09	5.5E-09
N	7500	Co-60	1.7E-03	3.1E-10	2.6E-10	5.7E-10
N	15000	K-43	5.8E-03	1.0E-09	1.2E-09	2.2E-09
N	15000	Co-60	6.1E-04	1.1E-10	1.2E-10	2.3E-10
N	25000	K-43	2.4E-03	4.3E-10	6.4E-10	1.1E-09
N	25000	Co-60	2.6E-04	4.7E-11	6.9E-11	1.2E-10
N	35000	K-43	1.4E-03	2.6E-10	4.3E-10	6.9E-10
N	35000	Co-60	1.6E-04	2.9E-11	4.7E-11	7.6E-11
N	45000	K-43	9.5E-04	1.7E-10	3.1E-10	4.8E-10
N	45000	Co-60	1.1E-04	2.0E-11	3.5E-11	5.5E-11
N	55000	K-43	6.5E-04	1.2E-10	2.4E-10	3.5E-10
N	55000	Co-60	7.8E-05	1.4E-11	2.7E-11	4.1E-11
N	70000	K-43	3.9E-04	6.9E-11	1.7E-10	2.4E-10
N	70000	Co-60	4.6E-05	8.4E-12	2.0E-11	2.8E-11
NNW	250	K-43	4.1E+00	7.4E-07	5.5E-08	7.9E-07
NNW	250	Co-60	4.1E-01	7.4E-08	5.5E-09	7.9E-08
NNW	750	K-43	4.9E-01	8.7E-08	1.8E-08	1.1E-07
NNW	750	Co-60	4.9E-02	8.8E-09	1.8E-09	1.1E-08
NNW	1500	K-43	1.4E-01	2.4E-08	8.7E-09	3.3E-08
NNW	1500	Co-60	1.4E-02	2.5E-09	8.7E-10	3.3E-09
NNW	2500	K-43	5.5E-02	9.8E-09	5.1E-09	1.5E-08
NNW	2500	Co-60	5.5E-03	1.0E-09	5.1E-10	1.5E-09
NNW	3500	K-43	3.1E-02	5.5E-09	3.6E-09	9.1E-09
NNW	3500	Co-60	3.1E-03	5.6E-10	3.6E-10	9.3E-10
NNW	4500	K-43	2.0E-02	3.7E-09	2.7E-09	6.4E-09
NNW	4500	Co-60	2.1E-03	3.8E-10	2.8E-10	6.5E-10
NNW	7500	K-43	8.7E-03	1.6E-09	1.6E-09	3.1E-09
NNW	7500	Co-60	9.0E-04	1.6E-10	1.6E-10	3.2E-10
NNW	15000	K-43	3.0E-03	5.4E-10	7.2E-10	1.3E-09
NNW	15000	Co-60	3.2E-04	5.8E-11	7.6E-11	1.3E-10
NNW	25000	K-43	1.2E-03	2.2E-10	3.8E-10	6.0E-10
NNW	25000	Co-60	1.4E-04	2.4E-11	4.2E-11	6.6E-11
NNW	35000	K-43	7.2E-04	1.3E-10	2.5E-10	3.8E-10
NNW	35000	Co-60	8.4E-05	1.5E-11	2.8E-11	4.3E-11
NNW	45000	K-43	4.7E-04	8.5E-11	1.8E-10	2.6E-10

ESTIMATED RADIONUCLIDE CONCENTRATIONS
AT VARIOUS LOCATIONS IN THE ENVIRONMENT

Wind Toward	Distance (meters)	Nuclide	Air Concentration (pCi/m3)	Dry Deposition Rate (pCi/cm2/s)	Wet Deposition Rate (pCi/cm2/s)	Ground Deposition Rate (pCi/cm2/s)
NNW	45000	Co-60	5.7E-05	1.0E-11	2.1E-11	3.1E-11
NNW	55000	K-43	3.2E-04	5.8E-11	1.3E-10	1.9E-10
NNW	55000	Co-60	4.0E-05	7.2E-12	1.6E-11	2.3E-11
NNW	70000	K-43	1.8E-04	3.3E-11	9.2E-11	1.3E-10
NNW	70000	Co-60	2.3E-05	4.2E-12	1.1E-11	1.6E-11
NW	250	K-43	5.2E+00	9.3E-07	7.7E-08	1.0E-06
NW	250	Co-60	5.2E-01	9.3E-08	7.7E-09	1.0E-07
NW	750	K-43	6.0E-01	1.1E-07	2.5E-08	1.3E-07
NW	750	Co-60	6.1E-02	1.1E-08	2.5E-09	1.3E-08
NW	1500	K-43	1.7E-01	3.0E-08	1.2E-08	4.2E-08
NW	1500	Co-60	1.7E-02	3.0E-09	1.2E-09	4.2E-09
NW	2500	K-43	6.6E-02	1.2E-08	7.2E-09	1.9E-08
NW	2500	Co-60	6.7E-03	1.2E-09	7.3E-10	1.9E-09
NW	3500	K-43	3.7E-02	6.6E-09	5.0E-09	1.2E-08
NW	3500	Co-60	3.8E-03	6.8E-10	5.1E-10	1.2E-09
NW	4500	K-43	2.4E-02	4.4E-09	3.8E-09	8.2E-09
NW	4500	Co-60	2.5E-03	4.5E-10	3.9E-10	8.4E-10
NW	7500	K-43	1.0E-02	1.8E-09	2.2E-09	4.0E-09
NW	7500	Co-60	1.1E-03	1.9E-10	2.3E-10	4.2E-10
NW	15000	K-43	3.5E-03	6.4E-10	9.7E-10	1.6E-09
NW	15000	Co-60	3.8E-04	6.9E-11	1.1E-10	1.7E-10
NW	25000	K-43	1.4E-03	2.6E-10	5.0E-10	7.6E-10
NW	25000	Co-60	1.6E-04	2.9E-11	5.7E-11	8.6E-11
NW	35000	K-43	8.4E-04	1.5E-10	3.2E-10	4.7E-10
NW	35000	Co-60	1.0E-04	1.8E-11	3.8E-11	5.6E-11
NW	45000	K-43	5.4E-04	9.8E-11	2.2E-10	3.2E-10
NW	45000	Co-60	6.8E-05	1.2E-11	2.7E-11	4.0E-11
NW	55000	K-43	3.6E-04	6.5E-11	1.6E-10	2.3E-10
NW	55000	Co-60	4.7E-05	8.5E-12	2.1E-11	2.9E-11
NW	70000	K-43	2.0E-04	3.6E-11	1.1E-10	1.4E-10
NW	70000	Co-60	2.7E-05	4.8E-12	1.4E-11	1.9E-11
WNW	250	K-43	2.2E+00	3.9E-07	3.3E-08	4.3E-07
WNW	250	Co-60	2.2E-01	3.9E-08	3.3E-09	4.3E-08
WNW	750	K-43	2.5E-01	4.5E-08	1.1E-08	5.6E-08
WNW	750	Co-60	2.5E-02	4.5E-09	1.1E-09	5.6E-09
WNW	1500	K-43	6.8E-02	1.2E-08	5.2E-09	1.7E-08
WNW	1500	Co-60	6.9E-03	1.2E-09	5.3E-10	1.8E-09
WNW	2500	K-43	2.7E-02	4.9E-09	3.0E-09	7.9E-09
WNW	2500	Co-60	2.7E-03	4.9E-10	3.1E-10	8.0E-10
WNW	3500	K-43	1.5E-02	2.7E-09	2.1E-09	4.8E-09
WNW	3500	Co-60	1.5E-03	2.8E-10	2.2E-10	4.9E-10
WNW	4500	K-43	9.8E-03	1.8E-09	1.6E-09	3.4E-09
WNW	4500	Co-60	1.0E-03	1.8E-10	1.7E-10	3.5E-10
WNW	7500	K-43	4.1E-03	7.4E-10	9.1E-10	1.6E-09
WNW	7500	Co-60	4.3E-04	7.7E-11	9.6E-11	1.7E-10
WNW	15000	K-43	1.4E-03	2.6E-10	4.0E-10	6.6E-10
WNW	15000	Co-60	1.6E-04	2.8E-11	4.4E-11	7.2E-11

ESTIMATED RADIONUCLIDE CONCENTRATIONS
AT VARIOUS LOCATIONS IN THE ENVIRONMENT

Wind Toward	Distance (meters)	Nuclide	Air Concentration (pCi/m3)	Dry Deposition Rate (pCi/cm2/s)	Wet Deposition Rate (pCi/cm2/s)	Ground Deposition Rate (pCi/cm2/s)
WNW	25000	K-43	5.7E-04	1.0E-10	2.0E-10	3.0E-10
WNW	25000	Co-60	6.6E-05	1.2E-11	2.3E-11	3.5E-11
WNW	35000	K-43	3.3E-04	6.0E-11	1.2E-10	1.8E-10
WNW	35000	Co-60	4.1E-05	7.3E-12	1.5E-11	2.3E-11
WNW	45000	K-43	2.1E-04	3.8E-11	8.4E-11	1.2E-10
WNW	45000	Co-60	2.7E-05	4.9E-12	1.1E-11	1.6E-11
WNW	55000	K-43	1.4E-04	2.5E-11	6.0E-11	8.5E-11
WNW	55000	Co-60	1.9E-05	3.4E-12	8.2E-12	1.2E-11
WNW	70000	K-43	7.0E-05	1.3E-11	3.8E-11	5.0E-11
WNW	70000	Co-60	1.0E-05	1.8E-12	5.5E-12	7.3E-12
W	250	K-43	5.5E+00	1.0E-06	6.5E-08	1.1E-06
W	250	Co-60	5.5E-01	1.0E-07	6.5E-09	1.1E-07
W	750	K-43	6.3E-01	1.1E-07	2.1E-08	1.3E-07
W	750	Co-60	6.4E-02	1.1E-08	2.1E-09	1.4E-08
W	1500	K-43	1.7E-01	3.1E-08	9.9E-09	4.1E-08
W	1500	Co-60	1.7E-02	3.1E-09	1.0E-09	4.1E-09
W	2500	K-43	6.8E-02	1.2E-08	5.8E-09	1.8E-08
W	2500	Co-60	7.0E-03	1.3E-09	5.9E-10	1.8E-09
W	3500	K-43	3.8E-02	6.9E-09	4.0E-09	1.1E-08
W	3500	Co-60	3.9E-03	7.0E-10	4.1E-10	1.1E-09
W	4500	K-43	2.5E-02	4.5E-09	3.0E-09	7.5E-09
W	4500	Co-60	2.6E-03	4.6E-10	3.1E-10	7.8E-10
W	7500	K-43	1.0E-02	1.9E-09	1.7E-09	3.5E-09
W	7500	Co-60	1.1E-03	2.0E-10	1.8E-10	3.7E-10
W	15000	K-43	3.5E-03	6.3E-10	7.3E-10	1.4E-09
W	15000	Co-60	3.9E-04	7.0E-11	8.0E-11	1.5E-10
W	25000	K-43	1.3E-03	2.3E-10	3.5E-10	5.8E-10
W	25000	Co-60	1.5E-04	2.7E-11	4.1E-11	6.8E-11
W	35000	K-43	7.3E-04	1.3E-10	2.2E-10	3.5E-10
W	35000	Co-60	9.2E-05	1.7E-11	2.7E-11	4.3E-11
W	45000	K-43	4.6E-04	8.2E-11	1.4E-10	2.3E-10
W	45000	Co-60	6.1E-05	1.1E-11	1.9E-11	3.0E-11
W	55000	K-43	2.9E-04	5.2E-11	1.0E-10	1.5E-10
W	55000	Co-60	4.1E-05	7.3E-12	1.4E-11	2.1E-11
W	70000	K-43	1.4E-04	2.5E-11	6.3E-11	8.7E-11
W	70000	Co-60	2.0E-05	3.6E-12	9.3E-12	1.3E-11
WSW	250	K-43	2.3E+00	4.2E-07	2.3E-08	4.4E-07
WSW	250	Co-60	2.3E-01	4.2E-08	2.3E-09	4.4E-08
WSW	750	K-43	2.7E-01	4.8E-08	7.1E-09	5.5E-08
WSW	750	Co-60	2.7E-02	4.8E-09	7.2E-10	5.5E-09
WSW	1500	K-43	7.2E-02	1.3E-08	3.4E-09	1.6E-08
WSW	1500	Co-60	7.3E-03	1.3E-09	3.4E-10	1.7E-09
WSW	2500	K-43	2.9E-02	5.2E-09	2.0E-09	7.2E-09
WSW	2500	Co-60	3.0E-03	5.3E-10	2.0E-10	7.3E-10
WSW	3500	K-43	1.6E-02	2.9E-09	1.4E-09	4.3E-09
WSW	3500	Co-60	1.7E-03	3.0E-10	1.4E-10	4.4E-10
WSW	4500	K-43	1.1E-02	1.9E-09	1.0E-09	3.0E-09

ESTIMATED RADIONUCLIDE CONCENTRATIONS
AT VARIOUS LOCATIONS IN THE ENVIRONMENT

Wind Toward	Distance (meters)	Nuclide	Air Concentration (pCi/m3)	Dry Deposition Rate (pCi/cm2/s)	Wet Deposition Rate (pCi/cm2/s)	Ground Deposition Rate (pCi/cm2/s)
WSW	4500	Co-60	1.1E-03	2.0E-10	1.1E-10	3.0E-10
WSW	7500	K-43	4.5E-03	8.0E-10	5.7E-10	1.4E-09
WSW	7500	Co-60	4.7E-04	8.4E-11	6.0E-11	1.4E-10
WSW	15000	K-43	1.5E-03	2.7E-10	2.5E-10	5.1E-10
WSW	15000	Co-60	1.6E-04	3.0E-11	2.7E-11	5.7E-11
WSW	25000	K-43	5.3E-04	9.5E-11	1.2E-10	2.2E-10
WSW	25000	Co-60	6.2E-05	1.1E-11	1.4E-11	2.5E-11
WSW	35000	K-43	3.0E-04	5.4E-11	7.5E-11	1.3E-10
WSW	35000	Co-60	3.8E-05	6.8E-12	9.1E-12	1.6E-11
WSW	45000	K-43	1.9E-04	3.4E-11	5.1E-11	8.5E-11
WSW	45000	Co-60	2.5E-05	4.5E-12	6.5E-12	1.1E-11
WSW	55000	K-43	1.2E-04	2.1E-11	3.7E-11	5.8E-11
WSW	55000	Co-60	1.6E-05	2.9E-12	4.8E-12	7.7E-12
WSW	70000	K-43	5.6E-05	1.0E-11	2.3E-11	3.4E-11
WSW	70000	Co-60	7.8E-06	1.4E-12	3.2E-12	4.6E-12
SW	250	K-43	7.6E+00	1.4E-06	6.9E-08	1.4E-06
SW	250	Co-60	7.6E-01	1.4E-07	6.9E-09	1.4E-07
SW	750	K-43	9.0E-01	1.6E-07	2.2E-08	1.8E-07
SW	750	Co-60	9.1E-02	1.6E-08	2.2E-09	1.9E-08
SW	1500	K-43	2.5E-01	4.6E-08	1.1E-08	5.6E-08
SW	1500	Co-60	2.6E-02	4.6E-09	1.1E-09	5.7E-09
SW	2500	K-43	1.0E-01	1.9E-08	6.2E-09	2.5E-08
SW	2500	Co-60	1.1E-02	1.9E-09	6.3E-10	2.5E-09
SW	3500	K-43	5.9E-02	1.1E-08	4.3E-09	1.5E-08
SW	3500	Co-60	6.0E-03	1.1E-09	4.4E-10	1.5E-09
SW	4500	K-43	4.0E-02	7.1E-09	3.3E-09	1.0E-08
SW	4500	Co-60	4.1E-03	7.3E-10	3.4E-10	1.1E-09
SW	7500	K-43	1.7E-02	3.1E-09	1.8E-09	4.9E-09
SW	7500	Co-60	1.8E-03	3.2E-10	1.9E-10	5.1E-10
SW	15000	K-43	6.0E-03	1.1E-09	8.2E-10	1.9E-09
SW	15000	Co-60	6.4E-04	1.2E-10	8.8E-11	2.0E-10
SW	25000	K-43	2.3E-03	4.2E-10	4.1E-10	8.3E-10
SW	25000	Co-60	2.6E-04	4.8E-11	4.6E-11	9.3E-11
SW	35000	K-43	1.4E-03	2.5E-10	2.7E-10	5.1E-10
SW	35000	Co-60	1.6E-04	2.9E-11	3.1E-11	6.0E-11
SW	45000	K-43	8.9E-04	1.6E-10	1.9E-10	3.5E-10
SW	45000	Co-60	1.1E-04	2.0E-11	2.2E-11	4.2E-11
SW	55000	K-43	5.8E-04	1.0E-10	1.4E-10	2.4E-10
SW	55000	Co-60	7.4E-05	1.3E-11	1.7E-11	3.0E-11
SW	70000	K-43	2.9E-04	5.2E-11	9.0E-11	1.4E-10
SW	70000	Co-60	3.8E-05	6.8E-12	1.1E-11	1.8E-11
SSW	250	K-43	9.2E+00	1.7E-06	7.9E-08	1.7E-06
SSW	250	Co-60	9.2E-01	1.7E-07	7.9E-09	1.7E-07
SSW	750	K-43	1.1E+00	2.0E-07	2.5E-08	2.2E-07
SSW	750	Co-60	1.1E-01	2.0E-08	2.5E-09	2.2E-08
SSW	1500	K-43	3.1E-01	5.6E-08	1.2E-08	6.9E-08
SSW	1500	Co-60	3.2E-02	5.7E-09	1.2E-09	6.9E-09

ESTIMATED RADIONUCLIDE CONCENTRATIONS
AT VARIOUS LOCATIONS IN THE ENVIRONMENT

Wind Toward	Distance (meters)	Nuclide	Air Concentration (pCi/m3)	Dry Deposition Rate (pCi/cm2/s)	Wet Deposition Rate (pCi/cm2/s)	Ground Deposition Rate (pCi/cm2/s)
SSW	2500	K-43	1.3E-01	2.3E-08	7.1E-09	3.0E-08
SSW	2500	Co-60	1.3E-02	2.4E-09	7.2E-10	3.1E-09
SSW	3500	K-43	7.4E-02	1.3E-08	5.0E-09	1.8E-08
SSW	3500	Co-60	7.6E-03	1.4E-09	5.0E-10	1.9E-09
SSW	4500	K-43	5.0E-02	9.0E-09	3.8E-09	1.3E-08
SSW	4500	Co-60	5.1E-03	9.2E-10	3.8E-10	1.3E-09
SSW	7500	K-43	2.2E-02	4.0E-09	2.1E-09	6.1E-09
SSW	7500	Co-60	2.3E-03	4.1E-10	2.2E-10	6.3E-10
SSW	15000	K-43	7.9E-03	1.4E-09	9.5E-10	2.4E-09
SSW	15000	Co-60	8.4E-04	1.5E-10	1.0E-10	2.5E-10
SSW	25000	K-43	3.2E-03	5.8E-10	4.8E-10	1.1E-09
SSW	25000	Co-60	3.6E-04	6.4E-11	5.3E-11	1.2E-10
SSW	35000	K-43	1.9E-03	3.5E-10	3.1E-10	6.6E-10
SSW	35000	Co-60	2.2E-04	4.0E-11	3.6E-11	7.6E-11
SSW	45000	K-43	1.3E-03	2.3E-10	2.2E-10	4.5E-10
SSW	45000	Co-60	1.5E-04	2.7E-11	2.6E-11	5.3E-11
SSW	55000	K-43	8.4E-04	1.5E-10	1.6E-10	3.2E-10
SSW	55000	Co-60	1.0E-04	1.9E-11	2.0E-11	3.8E-11
SSW	70000	K-43	4.4E-04	8.0E-11	1.1E-10	1.9E-10
SSW	70000	Co-60	5.6E-05	1.0E-11	1.3E-11	2.3E-11
S	250	K-43	2.5E+01	4.5E-06	2.0E-07	4.7E-06
S	250	Co-60	2.5E+00	4.5E-07	2.0E-08	4.7E-07
S	750	K-43	3.1E+00	5.5E-07	6.4E-08	6.1E-07
S	750	Co-60	3.1E-01	5.5E-08	6.4E-09	6.2E-08
S	1500	K-43	8.7E-01	1.6E-07	3.1E-08	1.9E-07
S	1500	Co-60	8.8E-02	1.6E-08	3.1E-09	1.9E-08
S	2500	K-43	3.6E-01	6.6E-08	1.8E-08	8.4E-08
S	2500	Co-60	3.7E-02	6.6E-09	1.8E-09	8.4E-09
S	3500	K-43	2.1E-01	3.8E-08	1.3E-08	5.1E-08
S	3500	Co-60	2.1E-02	3.8E-09	1.3E-09	5.1E-09
S	4500	K-43	1.4E-01	2.6E-08	9.6E-09	3.5E-08
S	4500	Co-60	1.5E-02	2.6E-09	9.8E-10	3.6E-09
S	7500	K-43	6.4E-02	1.1E-08	5.4E-09	1.7E-08
S	7500	Co-60	6.6E-03	1.2E-09	5.6E-10	1.7E-09
S	15000	K-43	2.3E-02	4.1E-09	2.5E-09	6.6E-09
S	15000	Co-60	2.4E-03	4.4E-10	2.6E-10	7.0E-10
S	25000	K-43	9.7E-03	1.8E-09	1.3E-09	3.0E-09
S	25000	Co-60	1.1E-03	1.9E-10	1.4E-10	3.3E-10
S	35000	K-43	5.9E-03	1.1E-09	8.4E-10	1.9E-09
S	35000	Co-60	6.7E-04	1.2E-10	9.3E-11	2.1E-10
S	45000	K-43	3.9E-03	7.1E-10	6.0E-10	1.3E-09
S	45000	Co-60	4.6E-04	8.3E-11	6.8E-11	1.5E-10
S	55000	K-43	2.7E-03	4.8E-10	4.5E-10	9.3E-10
S	55000	Co-60	3.2E-04	5.8E-11	5.2E-11	1.1E-10
S	70000	K-43	1.5E-03	2.6E-10	3.0E-10	5.6E-10
S	70000	Co-60	1.8E-04	3.2E-11	3.5E-11	6.7E-11
SSE	250	K-43	9.7E+00	1.7E-06	7.5E-08	1.8E-06

ESTIMATED RADIONUCLIDE CONCENTRATIONS
AT VARIOUS LOCATIONS IN THE ENVIRONMENT

Wind Toward	Distance (meters)	Nuclide	Air Concentration (pCi/m3)	Dry Deposition Rate (pCi/cm2/s)	Wet Deposition Rate (pCi/cm2/s)	Ground Deposition Rate (pCi/cm2/s)
SSE	250	Co-60	9.7E-01	1.7E-07	7.5E-09	1.8E-07
SSE	750	K-43	1.2E+00	2.1E-07	2.4E-08	2.4E-07
SSE	750	Co-60	1.2E-01	2.1E-08	2.4E-09	2.4E-08
SSE	1500	K-43	3.4E-01	6.1E-08	1.2E-08	7.2E-08
SSE	1500	Co-60	3.4E-02	6.1E-09	1.2E-09	7.3E-09
SSE	2500	K-43	1.4E-01	2.5E-08	6.8E-09	3.2E-08
SSE	2500	Co-60	1.4E-02	2.6E-09	6.9E-10	3.2E-09
SSE	3500	K-43	8.2E-02	1.5E-08	4.7E-09	1.9E-08
SSE	3500	Co-60	8.3E-03	1.5E-09	4.8E-10	2.0E-09
SSE	4500	K-43	5.5E-02	1.0E-08	3.6E-09	1.4E-08
SSE	4500	Co-60	5.6E-03	1.0E-09	3.7E-10	1.4E-09
SSE	7500	K-43	2.5E-02	4.5E-09	2.0E-09	6.5E-09
SSE	7500	Co-60	2.6E-03	4.6E-10	2.1E-10	6.7E-10
SSE	15000	K-43	8.9E-03	1.6E-09	9.3E-10	2.5E-09
SSE	15000	Co-60	9.5E-04	1.7E-10	9.8E-11	2.7E-10
SSE	25000	K-43	3.8E-03	6.8E-10	4.8E-10	1.2E-09
SSE	25000	Co-60	4.2E-04	7.5E-11	5.1E-11	1.3E-10
SSE	35000	K-43	2.3E-03	4.1E-10	3.2E-10	7.3E-10
SSE	35000	Co-60	2.6E-04	4.7E-11	3.5E-11	8.2E-11
SSE	45000	K-43	1.5E-03	2.8E-10	2.3E-10	5.0E-10
SSE	45000	Co-60	1.8E-04	3.2E-11	2.6E-11	5.8E-11
SSE	55000	K-43	1.0E-03	1.9E-10	1.7E-10	3.6E-10
SSE	55000	Co-60	1.3E-04	2.3E-11	2.0E-11	4.2E-11
SSE	70000	K-43	5.8E-04	1.0E-10	1.1E-10	2.2E-10
SSE	70000	Co-60	7.1E-05	1.3E-11	1.3E-11	2.6E-11
SE	250	K-43	9.4E+00	1.7E-06	7.0E-08	1.8E-06
SE	250	Co-60	9.4E-01	1.7E-07	7.0E-09	1.8E-07
SE	750	K-43	1.1E+00	2.0E-07	2.2E-08	2.3E-07
SE	750	Co-60	1.1E-01	2.0E-08	2.2E-09	2.3E-08
SE	1500	K-43	3.2E-01	5.8E-08	1.1E-08	6.9E-08
SE	1500	Co-60	3.2E-02	5.8E-09	1.1E-09	6.9E-09
SE	2500	K-43	1.3E-01	2.4E-08	6.2E-09	3.0E-08
SE	2500	Co-60	1.4E-02	2.4E-09	6.3E-10	3.1E-09
SE	3500	K-43	7.7E-02	1.4E-08	4.3E-09	1.8E-08
SE	3500	Co-60	7.8E-03	1.4E-09	4.4E-10	1.8E-09
SE	4500	K-43	5.2E-02	9.4E-09	3.3E-09	1.3E-08
SE	4500	Co-60	5.3E-03	9.6E-10	3.3E-10	1.3E-09
SE	7500	K-43	2.3E-02	4.2E-09	1.8E-09	6.0E-09
SE	7500	Co-60	2.4E-03	4.3E-10	1.9E-10	6.2E-10
SE	15000	K-43	8.2E-03	1.5E-09	8.2E-10	2.3E-09
SE	15000	Co-60	8.8E-04	1.6E-10	8.7E-11	2.5E-10
SE	25000	K-43	3.4E-03	6.1E-10	4.1E-10	1.0E-09
SE	25000	Co-60	3.7E-04	6.7E-11	4.5E-11	1.1E-10
SE	35000	K-43	2.0E-03	3.6E-10	2.7E-10	6.3E-10
SE	35000	Co-60	2.3E-04	4.2E-11	3.0E-11	7.2E-11
SE	45000	K-43	1.3E-03	2.4E-10	1.9E-10	4.3E-10
SE	45000	Co-60	1.6E-04	2.9E-11	2.2E-11	5.1E-11

ESTIMATED RADIONUCLIDE CONCENTRATIONS
AT VARIOUS LOCATIONS IN THE ENVIRONMENT

Wind Toward	Distance (meters)	Nuclide	Air Concentration (pCi/m3)	Dry Deposition Rate (pCi/cm2/s)	Wet Deposition Rate (pCi/cm2/s)	Ground Deposition Rate (pCi/cm2/s)
SE	55000	K-43	8.9E-04	1.6E-10	1.4E-10	3.0E-10
SE	55000	Co-60	1.1E-04	2.0E-11	1.7E-11	3.7E-11
SE	70000	K-43	4.6E-04	8.3E-11	9.2E-11	1.8E-10
SE	70000	Co-60	5.9E-05	1.1E-11	1.1E-11	2.2E-11
ESE	250	K-43	2.8E+00	5.0E-07	2.1E-08	5.3E-07
ESE	250	Co-60	2.8E-01	5.1E-08	2.1E-09	5.3E-08
ESE	750	K-43	3.3E-01	5.9E-08	6.6E-09	6.6E-08
ESE	750	Co-60	3.3E-02	6.0E-09	6.6E-10	6.6E-09
ESE	1500	K-43	9.2E-02	1.7E-08	3.2E-09	2.0E-08
ESE	1500	Co-60	9.3E-03	1.7E-09	3.2E-10	2.0E-09
ESE	2500	K-43	3.8E-02	6.8E-09	1.8E-09	8.6E-09
ESE	2500	Co-60	3.8E-03	6.9E-10	1.9E-10	8.8E-10
ESE	3500	K-43	2.2E-02	3.9E-09	1.3E-09	5.2E-09
ESE	3500	Co-60	2.2E-03	4.0E-10	1.3E-10	5.3E-10
ESE	4500	K-43	1.5E-02	2.6E-09	9.6E-10	3.6E-09
ESE	4500	Co-60	1.5E-03	2.7E-10	9.8E-11	3.7E-10
ESE	7500	K-43	6.3E-03	1.1E-09	5.3E-10	1.7E-09
ESE	7500	Co-60	6.5E-04	1.2E-10	5.5E-11	1.7E-10
ESE	15000	K-43	2.2E-03	3.9E-10	2.3E-10	6.2E-10
ESE	15000	Co-60	2.3E-04	4.2E-11	2.5E-11	6.7E-11
ESE	25000	K-43	8.3E-04	1.5E-10	1.1E-10	2.6E-10
ESE	25000	Co-60	9.4E-05	1.7E-11	1.3E-11	2.9E-11
ESE	35000	K-43	4.9E-04	8.7E-11	7.3E-11	1.6E-10
ESE	35000	Co-60	5.8E-05	1.0E-11	8.4E-12	1.9E-11
ESE	45000	K-43	3.1E-04	5.6E-11	5.1E-11	1.1E-10
ESE	45000	Co-60	3.9E-05	7.0E-12	6.1E-12	1.3E-11
ESE	55000	K-43	2.0E-04	3.6E-11	3.7E-11	7.4E-11
ESE	55000	Co-60	2.6E-05	4.7E-12	4.5E-12	9.2E-12
ESE	70000	K-43	9.8E-05	1.8E-11	2.4E-11	4.2E-11
ESE	70000	Co-60	1.3E-05	2.3E-12	3.0E-12	5.3E-12
E	250	K-43	4.4E+00	8.0E-07	3.5E-08	8.3E-07
E	250	Co-60	4.4E-01	8.0E-08	3.5E-09	8.4E-08
E	750	K-43	5.2E-01	9.4E-08	1.1E-08	1.0E-07
E	750	Co-60	5.2E-02	9.4E-09	1.1E-09	1.1E-08
E	1500	K-43	1.5E-01	2.6E-08	5.3E-09	3.1E-08
E	1500	Co-60	1.5E-02	2.6E-09	5.4E-10	3.2E-09
E	2500	K-43	5.9E-02	1.1E-08	3.1E-09	1.4E-08
E	2500	Co-60	6.0E-03	1.1E-09	3.1E-10	1.4E-09
E	3500	K-43	3.4E-02	6.1E-09	2.1E-09	8.2E-09
E	3500	Co-60	3.4E-03	6.2E-10	2.2E-10	8.4E-10
E	4500	K-43	2.3E-02	4.1E-09	1.6E-09	5.7E-09
E	4500	Co-60	2.3E-03	4.2E-10	1.7E-10	5.8E-10
E	7500	K-43	9.7E-03	1.7E-09	8.9E-10	2.6E-09
E	7500	Co-60	1.0E-03	1.8E-10	9.3E-11	2.8E-10
E	15000	K-43	3.3E-03	6.0E-10	3.9E-10	9.9E-10
E	15000	Co-60	3.6E-04	6.5E-11	4.2E-11	1.1E-10
E	25000	K-43	1.3E-03	2.3E-10	1.9E-10	4.1E-10

ESTIMATED RADIONUCLIDE CONCENTRATIONS
AT VARIOUS LOCATIONS IN THE ENVIRONMENT

Wind Toward	Distance (meters)	Nuclide	Air Concentration (pCi/m3)	Dry Deposition Rate (pCi/cm2/s)	Wet Deposition Rate (pCi/cm2/s)	Ground Deposition Rate (pCi/cm2/s)
E	25000	Co-60	1.4E-04	2.6E-11	2.1E-11	4.7E-11
E	35000	K-43	7.3E-04	1.3E-10	1.2E-10	2.5E-10
E	35000	Co-60	8.8E-05	1.6E-11	1.4E-11	3.0E-11
E	45000	K-43	4.7E-04	8.4E-11	8.3E-11	1.7E-10
E	45000	Co-60	5.9E-05	1.1E-11	1.0E-11	2.1E-11
E	55000	K-43	3.0E-04	5.4E-11	6.0E-11	1.1E-10
E	55000	Co-60	3.9E-05	7.1E-12	7.5E-12	1.5E-11
E	70000	K-43	1.5E-04	2.6E-11	3.8E-11	6.5E-11
E	70000	Co-60	1.9E-05	3.5E-12	4.9E-12	8.4E-12
ENE	250	K-43	2.0E+00	3.5E-07	1.7E-08	3.7E-07
ENE	250	Co-60	2.0E-01	3.5E-08	1.7E-09	3.7E-08
ENE	750	K-43	2.4E-01	4.2E-08	5.5E-09	4.8E-08
ENE	750	Co-60	2.4E-02	4.3E-09	5.6E-10	4.8E-09
ENE	1500	K-43	6.7E-02	1.2E-08	2.7E-09	1.5E-08
ENE	1500	Co-60	6.8E-03	1.2E-09	2.7E-10	1.5E-09
ENE	2500	K-43	2.8E-02	5.0E-09	1.6E-09	6.6E-09
ENE	2500	Co-60	2.8E-03	5.0E-10	1.6E-10	6.6E-10
ENE	3500	K-43	1.6E-02	2.9E-09	1.1E-09	4.0E-09
ENE	3500	Co-60	1.6E-03	2.9E-10	1.1E-10	4.0E-10
ENE	4500	K-43	1.1E-02	1.9E-09	8.3E-10	2.8E-09
ENE	4500	Co-60	1.1E-03	2.0E-10	8.5E-11	2.8E-10
ENE	7500	K-43	4.7E-03	8.5E-10	4.7E-10	1.3E-09
ENE	7500	Co-60	4.9E-04	8.8E-11	4.9E-11	1.4E-10
ENE	15000	K-43	1.6E-03	3.0E-10	2.2E-10	5.1E-10
ENE	15000	Co-60	1.8E-04	3.2E-11	2.3E-11	5.4E-11
ENE	25000	K-43	6.7E-04	1.2E-10	1.1E-10	2.3E-10
ENE	25000	Co-60	7.4E-05	1.3E-11	1.2E-11	2.5E-11
ENE	35000	K-43	4.0E-04	7.1E-11	7.4E-11	1.5E-10
ENE	35000	Co-60	4.6E-05	8.2E-12	8.2E-12	1.6E-11
ENE	45000	K-43	2.6E-04	4.7E-11	5.4E-11	1.0E-10
ENE	45000	Co-60	3.1E-05	5.5E-12	6.0E-12	1.2E-11
ENE	55000	K-43	1.7E-04	3.1E-11	4.0E-11	7.2E-11
ENE	55000	Co-60	2.1E-05	3.8E-12	4.6E-12	8.5E-12
ENE	70000	K-43	9.7E-05	1.7E-11	2.8E-11	4.5E-11
ENE	70000	Co-60	1.2E-05	2.1E-12	3.2E-12	5.4E-12
NE	250	K-43	5.1E+00	9.2E-07	5.2E-08	9.8E-07
NE	250	Co-60	5.1E-01	9.2E-08	5.2E-09	9.8E-08
NE	750	K-43	6.3E-01	1.1E-07	1.7E-08	1.3E-07
NE	750	Co-60	6.3E-02	1.1E-08	1.7E-09	1.3E-08
NE	1500	K-43	1.8E-01	3.3E-08	8.2E-09	4.1E-08
NE	1500	Co-60	1.8E-02	3.3E-09	8.2E-10	4.1E-09
NE	2500	K-43	7.5E-02	1.4E-08	4.8E-09	1.8E-08
NE	2500	Co-60	7.6E-03	1.4E-09	4.8E-10	1.9E-09
NE	3500	K-43	4.3E-02	7.8E-09	3.4E-09	1.1E-08
NE	3500	Co-60	4.4E-03	7.9E-10	3.4E-10	1.1E-09
NE	4500	K-43	2.9E-02	5.3E-09	2.6E-09	7.8E-09
NE	4500	Co-60	3.0E-03	5.3E-10	2.6E-10	8.0E-10

ESTIMATED RADIONUCLIDE CONCENTRATIONS
AT VARIOUS LOCATIONS IN THE ENVIRONMENT

Wind Toward	Distance (meters)	Nuclide	Air Concentration (pCi/m3)	Dry Deposition Rate (pCi/cm2/s)	Wet Deposition Rate (pCi/cm2/s)	Ground Deposition Rate (pCi/cm2/s)
NE	7500	K-43	1.3E-02	2.3E-09	1.5E-09	3.8E-09
NE	7500	Co-60	1.3E-03	2.4E-10	1.5E-10	3.9E-10
NE	15000	K-43	4.5E-03	8.2E-10	6.9E-10	1.5E-09
NE	15000	Co-60	4.8E-04	8.6E-11	7.2E-11	1.6E-10
NE	25000	K-43	1.9E-03	3.4E-10	3.7E-10	7.1E-10
NE	25000	Co-60	2.1E-04	3.7E-11	4.0E-11	7.7E-11
NE	35000	K-43	1.1E-03	2.0E-10	2.5E-10	4.5E-10
NE	35000	Co-60	1.3E-04	2.3E-11	2.7E-11	5.0E-11
NE	45000	K-43	7.5E-04	1.3E-10	1.8E-10	3.2E-10
NE	45000	Co-60	8.6E-05	1.6E-11	2.0E-11	3.6E-11
NE	55000	K-43	5.1E-04	9.2E-11	1.4E-10	2.3E-10
NE	55000	Co-60	6.1E-05	1.1E-11	1.6E-11	2.7E-11
NE	70000	K-43	3.0E-04	5.3E-11	1.0E-10	1.5E-10
NE	70000	Co-60	3.5E-05	6.3E-12	1.1E-11	1.8E-11
NNE	250	K-43	4.0E+00	7.2E-07	4.7E-08	7.7E-07
NNE	250	Co-60	4.0E-01	7.2E-08	4.7E-09	7.7E-08
NNE	750	K-43	5.0E-01	9.0E-08	1.5E-08	1.1E-07
NNE	750	Co-60	5.0E-02	9.1E-09	1.5E-09	1.1E-08
NNE	1500	K-43	1.5E-01	2.6E-08	7.5E-09	3.4E-08
NNE	1500	Co-60	1.5E-02	2.6E-09	7.5E-10	3.4E-09
NNE	2500	K-43	6.0E-02	1.1E-08	4.5E-09	1.5E-08
NNE	2500	Co-60	6.1E-03	1.1E-09	4.5E-10	1.5E-09
NNE	3500	K-43	3.5E-02	6.3E-09	3.1E-09	9.4E-09
NNE	3500	Co-60	3.5E-03	6.3E-10	3.2E-10	9.5E-10
NNE	4500	K-43	2.4E-02	4.2E-09	2.4E-09	6.6E-09
NNE	4500	Co-60	2.4E-03	4.3E-10	2.4E-10	6.7E-10
NNE	7500	K-43	1.0E-02	1.9E-09	1.4E-09	3.3E-09
NNE	7500	Co-60	1.1E-03	1.9E-10	1.4E-10	3.4E-10
NNE	15000	K-43	3.7E-03	6.6E-10	6.6E-10	1.3E-09
NNE	15000	Co-60	3.8E-04	6.9E-11	6.9E-11	1.4E-10
NNE	25000	K-43	1.6E-03	2.9E-10	3.7E-10	6.5E-10
NNE	25000	Co-60	1.7E-04	3.1E-11	3.9E-11	6.9E-11
NNE	35000	K-43	9.5E-04	1.7E-10	2.5E-10	4.2E-10
NNE	35000	Co-60	1.0E-04	1.9E-11	2.7E-11	4.6E-11
NNE	45000	K-43	6.3E-04	1.1E-10	1.9E-10	3.0E-10
NNE	45000	Co-60	7.1E-05	1.3E-11	2.0E-11	3.3E-11
NNE	55000	K-43	4.4E-04	8.0E-11	1.4E-10	2.2E-10
NNE	55000	Co-60	5.1E-05	9.2E-12	1.6E-11	2.5E-11
NNE	70000	K-43	2.7E-04	4.8E-11	1.0E-10	1.5E-10
NNE	70000	Co-60	3.1E-05	5.6E-12	1.2E-11	1.7E-11

Appendix G, Output Files for Modtest Sample Case

File 5; Dose/Risk Conversion Factors Output File

Modtest.fac

C A P 8 8 - P C

Version 3.0

Clean Air Act Assessment Package - 1988

D O S E A N D R I S K C O N V E R S I O N F A C T O R S

Non-Radon Population Assessment
Sep 30, 2002 12:05 am

Facility: CAP88 Test Site
Address: B Street
City: Somewhere
State: CA Zip: 89898

Source Category: 1 Area
Source Type: Area
Emission Year: 1995

Comments: CAP88 Distribution Sample Case
Co-60 and K-43

Dataset Name: Modtest
Dataset Date: 9/30/2002 12:05:00 AM
Wind File: C:\Trinity\CAP8821\newsource\CAP88PC v2p1\WINDLIB\UCC1026.WND
Population File: C:\Trinity\CAP8821\newsource\CAP88PC v2p1\POPLIB\UFCBERKL.POP

DOSE AND RISK FACTOR UNITS

The units for each type of dose rate conversion factor are shown below, by pathway:

Pathway	Units
Ingestion	millirem/picoCurie
Inhalation	millirem/picoCurie
Immersion	millirem-cubic cm/microCurie-year
Surface	millirem-square cm/microCurie-year

Risks for internal exposures (inhalation and ingestion) are the lifetime risk of premature death in a birth cohort of 100,000 people for a 1 picoCurie/year intake rate, where the average lifetime is 70.7565 years.

This is simplified to lifetime risk per 100,000 picoCuries.

The units for each type of risk conversion factor are shown below, by pathway:

Pathway	Units
Ingestion	lifetime risk/100,000 picoCuries
Inhalation	lifetime risk/100,000 picoCuries
Immersion	lifetime risk-cubic cm/100,000 picoCurie-years
Surface	lifetime risk-square cm/100,000 picoCurie-years

****
* NUCLIDE K-43 *
****

DOSE RATE CONVERSION FACTORS

Organ	Ingestion	Inhalation	Air Immersion	Ground Surface
Adrenals	7.241E-07	2.438E-07	4.392E+09	9.460E+05
B Surfac	7.648E-07	1.676E-07	4.380E+09	1.018E+06
Breasts	6.997E-07	2.091E-07	9.471E+09	1.643E+06
St Wall	5.628E-07	1.574E-07	5.615E+09	1.001E+06
ULI Wall	5.324E-07	2.108E-07	6.081E+09	1.122E+06
Kidneys	6.434E-07	2.743E-07	4.345E+09	9.052E+05
Lungs	2.289E-06	4.988E-07	4.683E+09	1.003E+06
Ovaries	7.833E-07	1.760E-07	4.171E+09	9.763E+05
R Marrow	1.106E-06	2.446E-07	4.357E+09	9.949E+05
Spleen	1.366E-06	2.925E-07	4.252E+09	1.012E+06
Thymus	6.901E-07	1.772E-07	4.718E+09	1.011E+06
Uterus	6.845E-07	2.209E-07	4.742E+09	1.007E+06
Bld Wall	6.268E-07	7.074E-06	5.277E+09	1.065E+06
Brain	6.190E-07	1.926E-07	5.149E+09	1.151E+06
Esophagu	7.585E-07	1.682E-07	4.019E+09	1.043E+06
SI Wall	8.258E-07	2.405E-07	4.136E+09	9.238E+05
LLI Wall	6.579E-07	2.038E-07	5.079E+09	1.078E+06
Liver	5.036E-07	1.371E-07	8.283E+09	3.355E+06
Muscle	7.300E-07	2.178E-07	4.776E+09	1.010E+06
Pancreas	6.112E-07	1.334E-07	5.324E+09	1.165E+06
Skin	6.434E-07	2.743E-07	4.893E+09	1.011E+06
Testes	6.386E-07	2.023E-07	5.417E+09	1.108E+06
Thyroid	7.448E-07	1.647E-07	4.066E+09	9.751E+05
EFFEC	9.331E-07	1.327E-06	5.068E+09	1.095E+06

RISK CONVERSION FACTORS

Cancer	Ingestion	Inhalation	Air Immersion	Ground Surface
Esophagu	4.588E-08	1.943E-08	2.499E+02	5.208E-02
Stomach	6.438E-07	1.325E-07	9.437E+02	2.027E-01
Colon	1.005E-06	2.072E-07	2.225E+03	5.173E-01
Liver	6.845E-08	2.035E-08	3.594E+02	7.631E-02
LUNG	4.385E-07	3.681E-06	2.580E+03	5.208E-01
Bone	4.199E-09	1.186E-09	4.497E+01	7.805E-03
Skin	3.589E-09	8.972E-10	4.130E+01	1.672E-02
Breast	1.787E-07	6.623E-08	1.468E+03	2.709E-01
Ovary	6.198E-08	1.432E-08	2.860E+02	7.398E-02
Bladder	1.175E-07	2.461E-08	5.295E+02	1.229E-01
Thyroid	1.534E-08	4.329E-09	8.621E+01	1.765E-02
Leukemia	2.405E-07	6.808E-08	1.427E+03	3.023E-01
Residual	7.751E-07	2.201E-07	3.390E+03	7.514E-01
Total	3.626E-06	4.458E-06	1.375E+04	2.959E+00

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* NUCLIDE Co-60 *
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DOSE RATE CONVERSION FACTORS

Organ	Ingestion	Inhalation	Air Immersion	Ground Surface
Adrenals	9.150E-06	2.551E-05	1.212E+10	2.377E+06
B Surfac	9.616E-06	9.128E-06	1.212E+10	2.586E+06
Breasts	7.615E-06	1.455E-05	2.074E+10	3.623E+06
St Wall	5.047E-06	7.233E-06	1.561E+10	2.516E+06
ULI Wall	4.999E-06	2.284E-05	1.619E+10	2.726E+06
Kidneys	6.408E-06	2.707E-05	1.247E+10	2.307E+06
Lungs	9.505E-06	1.689E-05	1.293E+10	2.540E+06
Ovaries	1.558E-05	1.247E-05	1.200E+10	2.528E+06
R Marrow	2.421E-05	1.464E-05	1.223E+10	2.540E+06
Spleen	4.307E-05	1.794E-05	1.223E+10	2.621E+06
Thymus	8.839E-06	1.491E-05	1.305E+10	2.586E+06
Uterus	1.657E-05	3.181E-05	1.316E+10	2.551E+06
Bld Wall	6.608E-06	1.940E-04	1.445E+10	2.645E+06
Brain	7.122E-06	1.410E-05	1.410E+10	2.854E+06
Esophagu	1.594E-05	1.163E-05	1.247E+10	2.377E+06
SI Wall	9.650E-06	2.129E-05	1.177E+10	2.388E+06
LLI Wall	7.988E-06	1.627E-05	1.433E+10	2.714E+06
Liver	4.751E-06	8.898E-06	1.689E+10	3.215E+06
Muscle	7.733E-06	1.973E-05	1.316E+10	2.551E+06
Pancreas	6.730E-06	7.178E-06	1.433E+10	2.854E+06
Skin	6.408E-06	2.707E-05	1.363E+10	2.447E+06
Testes	6.331E-06	1.411E-05	1.480E+10	2.621E+06
Thyroid	1.131E-05	1.047E-05	1.165E+10	2.481E+06
EFFEC	1.265E-05	3.770E-05	1.386E+10	2.680E+06

RISK CONVERSION FACTORS

Cancer	Ingestion	Inhalation	Air Immersion	Ground Surface
Esophagu	7.067E-07	1.632E-06	7.165E+02	1.328E-01
Stomach	4.126E-06	3.700E-06	2.610E+03	5.126E-01
Colon	2.868E-05	9.768E-06	6.291E+03	1.328E+00
Liver	2.405E-06	2.590E-06	9.961E+02	1.934E-01
LUNG	8.510E-06	1.006E-04	7.048E+03	1.293E+00
Bone	6.715E-08	7.400E-08	9.844E+01	1.718E-02
Skin	5.439E-08	4.644E-08	8.446E+01	1.602E-02
Breast	3.145E-06	5.920E-06	3.914E+03	6.582E-01
Ovary	1.598E-06	8.639E-07	8.854E+02	1.689E-01
Bladder	1.924E-06	1.178E-06	1.462E+03	3.128E-01
Kidneys	4.366E-07	4.236E-07	3.396E+02	6.699E-02
Thyroid	2.905E-07	2.461E-07	2.353E+02	4.171E-02
Leukemia	3.830E-06	4.754E-06	4.019E+03	7.631E-01
Residual	1.602E-05	1.654E-05	9.436E+03	1.887E+00
Total	7.178E-05	1.484E-04	3.815E+04	7.398E+00

Appendix G, Output Files for Modtest Sample Case

File 6; General Data Output File

Modtest.gen

C A P 8 8 - P C

Version 3.0

Clean Air Act Assessment Package - 1988

G E N E R A L D A T A

Non-Radon Population Assessment
Sep 30, 2002 12:05 am

Facility: CAP88 Test Site
Address: B Street
City: Somewhere
State: CA Zip: 89898

Source Category: 1 Area
Source Type: Area
Emission Year: 1995

Comments: CAP88 Distribution Sample Case
Co-60 and K-43

Dataset Name: Modtest
Dataset Date: 9/30/2002 12:05:00 AM
Wind File: C:\Trinity\CAP8821\newsource\CAP88PCv2p1\WINDLIB\UCC1026.WND
Population File: C:\Trinity\CAP8821\newsource\CAP88PCv2p1\POPLIB\UFCBERKL.POP

VALUES FOR RADIONUCLIDE-DEPENDENT PARAMETERS

Nuclide	Clearance Class	Particle Size (microns)	Scavenging Coefficient (per second)	Dry Deposition Velocity (m/s)
K-43	M	0.0	1.00E-05	1.80E-03
Co-60	M	0.0	1.00E-05	1.80E-03

VALUES FOR RADIONUCLIDE-DEPENDENT PARAMETERS

	DECAY CONSTANT (PER DAY)			TRANSFER COEFFICIENT	
Nuclide	Radio-active (1)	Surface	Water	Milk (2)	Meat (3)
K-43	7.36E-01	5.48E-05	0.00E+00	7.00E-03	2.00E-02
Co-60	0.00E+00	5.48E-05	0.00E+00	2.00E-03	3.00E-02

FOOTNOTES: (1) Effective radioactive decay constant in plume; set to zero if less than 1.0E-2

(2) Fraction of animal's daily intake of nuclide which appears in each L of milk (days/L)

(3) Fraction of animal's daily intake of nuclide which appears in each kg of meat (days/kg)

VALUES FOR RADIONUCLIDE-DEPENDENT PARAMETERS

	CONCENTRATION UPTAKE FACTOR		GI UPTAKE FRACTION	
Nuclide	Forage (1)	Edible (2)	Inhalation	Ingestion
K-43	3.00E+00	3.00E-01	1.00E+00	1.00E+00
Co-60	2.00E+00	8.00E-02	1.00E-01	1.00E-01

FOOTNOTES: (1) Concentration factor for uptake of nuclide from soil for pasture and forage (in pCi/kg dry weight per pCi/kg dry soil)
(2) Concentration factor for uptake of nuclide from soil by edible parts of crops (in pCi/kg wet weight per pCi/kg dry soil)

NUMBER OF BEEF CATTLE

	Distance (meters)						
Direction	250	750	1500	2500	3500	4500	7500
N	0	1	5	9	12	16	130
NNW	0	1	5	9	12	16	130
NW	0	1	5	9	12	16	130
WNW	0	1	5	9	12	16	130
W	0	1	5	9	12	16	130
WSW	0	1	5	9	12	16	130
SW	0	1	5	9	12	16	130
SSW	0	1	5	9	12	16	130
S	0	1	5	9	12	16	130
SSE	0	1	5	9	12	16	130
SE	0	1	5	9	12	16	130
ESE	0	1	5	9	12	16	130
E	0	1	5	9	12	16	130
ENE	0	1	5	9	12	16	130
NE	0	1	5	9	12	16	130
NNE	0	1	5	9	12	16	130

	Distance (meters)					
Direction	15000	25000	35000	45000	55000	70000
N	519	865	1211	1557	1903	4844
NNW	519	865	1211	1557	1903	4844
NW	519	865	1211	1557	1903	4844
WNW	519	865	1211	1557	1903	4844
W	519	865	1211	1557	1903	4844
WSW	519	865	1211	1557	1903	4844
SW	519	865	1211	1557	1903	4844
SSW	519	865	1211	1557	1903	4844
S	519	865	1211	1557	1903	4844
SSE	519	865	1211	1557	1903	4844
SE	519	865	1211	1557	1903	4844
ESE	519	865	1211	1557	1903	4844
E	519	865	1211	1557	1903	4844
ENE	519	865	1211	1557	1903	4844
NE	519	865	1211	1557	1903	4844
NNE	519	865	1211	1557	1903	4844

NUMBER OF MILK CATTLE

	Distance (meters)						
Direction	250	750	1500	2500	3500	4500	7500
N	0	0	2	3	4	5	42
NNW	0	0	2	3	4	5	42
NW	0	0	2	3	4	5	42
WNW	0	0	2	3	4	5	42
W	0	0	2	3	4	5	42
WSW	0	0	2	3	4	5	42
SW	0	0	2	3	4	5	42
SSW	0	0	2	3	4	5	42
S	0	0	2	3	4	5	42
SSE	0	0	2	3	4	5	42
SE	0	0	2	3	4	5	42
ESE	0	0	2	3	4	5	42
E	0	0	2	3	4	5	42
ENE	0	0	2	3	4	5	42
NE	0	0	2	3	4	5	42
NNE	0	0	2	3	4	5	42

	Distance (meters)					
Direction	15000	25000	35000	45000	55000	70000
N	168	280	392	504	616	1567
NNW	168	280	392	504	616	1567
NW	168	280	392	504	616	1567
WNW	168	280	392	504	616	1567
W	168	280	392	504	616	1567
WSW	168	280	392	504	616	1567
SW	168	280	392	504	616	1567
SSW	168	280	392	504	616	1567
S	168	280	392	504	616	1567
SSE	168	280	392	504	616	1567
SE	168	280	392	504	616	1567
ESE	168	280	392	504	616	1567
E	168	280	392	504	616	1567
ENE	168	280	392	504	616	1567
NE	168	280	392	504	616	1567
NNE	168	280	392	504	616	1567

AREA OF VEGETABLE CROP PRODUCTION (M**2)

	Distance (meters)						
Direction	250	750	1500	2500	3500	4500	7500
N	0.0E+00	1.7E+03	7.0E+03	1.2E+04	1.6E+04	2.1E+04	1.7E+05
NNW	0.0E+00	1.7E+03	7.0E+03	1.2E+04	1.6E+04	2.1E+04	1.7E+05
NW	0.0E+00	1.7E+03	7.0E+03	1.2E+04	1.6E+04	2.1E+04	1.7E+05
WNW	0.0E+00	1.7E+03	7.0E+03	1.2E+04	1.6E+04	2.1E+04	1.7E+05
W	0.0E+00	1.7E+03	7.0E+03	1.2E+04	1.6E+04	2.1E+04	1.7E+05
WSW	0.0E+00	1.7E+03	7.0E+03	1.2E+04	1.6E+04	2.1E+04	1.7E+05
SW	0.0E+00	1.7E+03	7.0E+03	1.2E+04	1.6E+04	2.1E+04	1.7E+05
SSW	0.0E+00	1.7E+03	7.0E+03	1.2E+04	1.6E+04	2.1E+04	1.7E+05
S	0.0E+00	1.7E+03	7.0E+03	1.2E+04	1.6E+04	2.1E+04	1.7E+05
SSE	0.0E+00	1.7E+03	7.0E+03	1.2E+04	1.6E+04	2.1E+04	1.7E+05
SE	0.0E+00	1.7E+03	7.0E+03	1.2E+04	1.6E+04	2.1E+04	1.7E+05
ESE	0.0E+00	1.7E+03	7.0E+03	1.2E+04	1.6E+04	2.1E+04	1.7E+05
E	0.0E+00	1.7E+03	7.0E+03	1.2E+04	1.6E+04	2.1E+04	1.7E+05
ENE	0.0E+00	1.7E+03	7.0E+03	1.2E+04	1.6E+04	2.1E+04	1.7E+05
NE	0.0E+00	1.7E+03	7.0E+03	1.2E+04	1.6E+04	2.1E+04	1.7E+05
NNE	0.0E+00	1.7E+03	7.0E+03	1.2E+04	1.6E+04	2.1E+04	1.7E+05

	Distance (meters)					
Direction	15000	25000	35000	45000	55000	70000
N	7.0E+05	1.2E+06	1.6E+06	2.1E+06	2.5E+06	6.5E+06
NNW	7.0E+05	1.2E+06	1.6E+06	2.1E+06	2.5E+06	6.5E+06
NW	7.0E+05	1.2E+06	1.6E+06	2.1E+06	2.5E+06	6.5E+06
WNW	7.0E+05	1.2E+06	1.6E+06	2.1E+06	2.5E+06	6.5E+06
W	7.0E+05	1.2E+06	1.6E+06	2.1E+06	2.5E+06	6.5E+06
WSW	7.0E+05	1.2E+06	1.6E+06	2.1E+06	2.5E+06	6.5E+06
SW	7.0E+05	1.2E+06	1.6E+06	2.1E+06	2.5E+06	6.5E+06
SSW	7.0E+05	1.2E+06	1.6E+06	2.1E+06	2.5E+06	6.5E+06
S	7.0E+05	1.2E+06	1.6E+06	2.1E+06	2.5E+06	6.5E+06
SSE	7.0E+05	1.2E+06	1.6E+06	2.1E+06	2.5E+06	6.5E+06
SE	7.0E+05	1.2E+06	1.6E+06	2.1E+06	2.5E+06	6.5E+06
ESE	7.0E+05	1.2E+06	1.6E+06	2.1E+06	2.5E+06	6.5E+06
E	7.0E+05	1.2E+06	1.6E+06	2.1E+06	2.5E+06	6.5E+06
ENE	7.0E+05	1.2E+06	1.6E+06	2.1E+06	2.5E+06	6.5E+06
NE	7.0E+05	1.2E+06	1.6E+06	2.1E+06	2.5E+06	6.5E+06
NNE	7.0E+05	1.2E+06	1.6E+06	2.1E+06	2.5E+06	6.5E+06

VALUES FOR RADIONUCLIDE-INDEPENDENT PARAMETERS

HUMAN INHALATION RATE	
Cubic centimeters/hr	9.17E+05
SOIL PARAMETERS	
Effective surface density (kg/sq m, dry weight)	
(Assumes 15 cm plow layer)	2.15E+02
BUILDUP TIMES	
For activity in soil (years)	1.00E+02
For radionuclides deposited on ground/water (days)	3.65E+04
DELAY TIMES	
Ingestion of pasture grass by animals (hr)	0.00E+00
Ingestion of stored feed by animals (hr)	2.16E+03
Ingestion of leafy vegetables by man (hr)	3.36E+02
Ingestion of produce by man (hr)	3.36E+02
Transport time from animal feed-milk-man (day)	2.00E+00
Time from slaughter to consumption (day)	2.00E+01
WEATHERING	
Removal rate constant for physical loss (per hr)	2.90E-03
CROP EXPOSURE DURATION	
Pasture grass (hr)	7.20E+02
Crops/leafy vegetables (hr)	1.44E+03
AGRICULTURAL PRODUCTIVITY	
Grass-cow-milk-man pathway (kg/sq m)	2.80E-01
Produce/leafy veg for human consumption (kg/sq m)	7.16E-01
FALLOUT INTERCEPTION FRACTIONS	
Vegetables	2.00E-01
Pasture	5.70E-01
GRAZING PARAMETERS	
Fraction of year animals graze on pasture	4.00E-01
Fraction of daily feed that is pasture grass	
when animal grazes on pasture	4.30E-01

VALUES FOR RADIONUCLIDE-INDEPENDENT PARAMETERS

ANIMAL FEED CONSUMPTION FACTORS	
Contaminated feed/forage (kg/day, dry weight)	1.56E+01
DAIRY PRODUCTIVITY	
Milk production of cow (L/day)	1.10E+01
Muscle mass of animal at slaughter (kg)	2.00E+02
Fraction of herd slaughtered (per day)	3.81E-03
DECONTAMINATION	
Fraction of radioactivity retained after washing for leafy vegetables and produce	5.00E-01
FRACTIONS GROWN IN GARDEN OF INTEREST	
Produce ingested	1.00E+00
Leafy vegetables ingested	1.00E+00
INGESTION RATIOS:	
IMMEDIATE SURROUNDING AREA/TOTAL WITHIN AREA	
Vegetables	8.00E-02
Meat	1.00E-02
Milk	0.00E+00
MINIMUM INGESTION FRACTIONS FROM OUTSIDE AREA (Actual fractions of food types from outside area can be greater than the minimum fractions listed below.)	
Vegetables	0.00E+00
Meat	0.00E+00
Milk	0.00E+00
HUMAN FOOD UTILIZATION FACTORS	
Produce ingestion (kg/y)	1.76E+02
Milk ingestion (L/y)	1.12E+02
Meat ingestion (kg/y)	8.50E+01
Leafy vegetable ingestion (kg/y)	1.80E+01
SWIMMING PARAMETERS	
Fraction of time spent swimming	0.00E+00
Dilution factor for water (cm)	1.00E+00

Appendix G, Output Files for Modtest Sample Case

File 7; Weather Data Output File

Modtest.wea

C A P 8 8 - P C

Version 3.0

Clean Air Act Assessment Package - 1988

W E A T H E R D A T A

Non-Radon Population Assessment
Sep 30, 2002 12:05 am

Facility: CAP88 Test Site
Address: B Street
City: Somewhere
State: CA Zip: 89898

Source Category: 1 Area
Source Type: Area
Emission Year: 1995

Comments: CAP88 Distribution Sample Case
Co-60 and K-43

Dataset Name: Modtest
Dataset Date: 9/30/2002 12:05:00 AM
Wind File: C:\Trinity\CAP8821\newsource\CAP88PCv2p1\WINDLIB\UCC1026.WND
Population File: C:\Trinity\CAP8821\newsource\CAP88PCv2p1\POPLIB\UFCBERKL.POP

Sep 30, 2002 12:05 am WEATHER
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HARMONIC AVERAGE WIND SPEEDS (WIND TOWARDS)

	Pasquill Stability Class							
Dir	A	B	C	D	E	F	G	Wind Freq
N	0.988	1.487	4.200	6.840	3.495	1.193	0.000	0.108
NNW	1.066	1.486	3.671	5.762	3.564	1.130	0.000	0.050
NW	1.120	1.230	2.728	4.903	3.239	1.154	0.000	0.050
WNW	0.956	1.138	2.486	4.564	3.545	1.197	0.000	0.017
W	1.083	0.987	2.174	3.896	3.469	1.062	0.000	0.032
WSW	1.140	1.082	2.732	6.491	3.779	1.026	0.000	0.014
SW	1.120	1.039	2.663	6.771	3.722	1.298	0.000	0.062
SSW	0.983	1.071	2.320	6.790	3.914	1.404	0.000	0.077
S	0.983	1.037	2.082	6.366	4.032	1.489	0.000	0.216
SSE	0.000	0.988	2.261	6.441	4.077	1.469	0.000	0.086
SE	1.356	1.074	2.568	6.098	3.965	1.418	0.000	0.068
ESE	1.356	1.230	2.146	6.109	3.689	1.224	0.000	0.017
E	1.011	1.085	2.000	5.841	3.694	1.167	0.000	0.026
ENE	0.983	1.226	4.784	6.545	3.720	1.204	0.000	0.020
NE	1.083	1.386	5.023	7.016	3.851	1.300	0.000	0.074
NNE	1.356	1.537	5.599	7.838	3.731	1.410	0.000	0.081

ARITHMETIC AVERAGE WIND SPEEDS (WIND TOWARDS)

	Pasquill Stability Class						
Dir	A	B	C	D	E	F	G
N	1.334	2.417	5.938	8.260	3.727	1.681	0.000
NNW	1.482	2.358	4.925	6.911	3.789	1.588	0.000
NW	1.572	1.950	3.763	5.986	3.472	1.624	0.000
WNW	1.268	1.755	3.456	6.250	3.773	1.686	0.000
W	1.510	1.452	3.177	5.443	3.703	1.475	0.000
WSW	1.603	1.737	3.930	7.638	3.969	1.410	0.000
SW	1.572	1.641	3.823	7.925	3.923	1.815	0.000
SSW	1.326	1.699	3.532	8.001	4.071	1.930	0.000
S	1.326	1.542	3.155	7.501	4.155	2.011	0.000
SSE	0.000	1.461	3.268	7.490	4.186	1.992	0.000
SE	1.880	1.662	3.727	7.376	4.108	1.945	0.000
ESE	1.880	1.999	3.653	7.299	3.896	1.722	0.000
E	1.380	1.758	3.838	6.894	3.900	1.643	0.000
ENE	1.326	1.725	6.550	7.606	3.921	1.695	0.000
NE	1.510	2.356	7.185	7.973	4.024	1.817	0.000
NNE	1.880	2.537	7.475	8.743	3.931	1.936	0.000

FREQUENCIES OF STABILITY CLASSES (WIND TOWARDS)

	Pasquill Stability Class						
Dir	A	B	C	D	E	F	G
N	0.0059	0.0884	0.2002	0.5766	0.0719	0.0570	0.0000
NNW	0.0141	0.1606	0.2890	0.3941	0.0656	0.0767	0.0000
NW	0.0179	0.2831	0.2640	0.2729	0.0617	0.1005	0.0000
WNW	0.0334	0.3742	0.2389	0.1612	0.0484	0.1439	0.0000
W	0.0121	0.2791	0.2554	0.1618	0.0828	0.2088	0.0000
WSW	0.0183	0.1833	0.2001	0.3111	0.0751	0.2121	0.0000
SW	0.0073	0.0787	0.1235	0.5124	0.0951	0.1830	0.0000
SSW	0.0051	0.0551	0.0687	0.5100	0.1790	0.1821	0.0000
S	0.0012	0.0198	0.0431	0.4936	0.2662	0.1761	0.0000
SSE	0.0000	0.0109	0.0309	0.5169	0.2761	0.1652	0.0000
SE	0.0019	0.0262	0.0488	0.4511	0.2475	0.2245	0.0000
ESE	0.0076	0.0516	0.0849	0.4359	0.1681	0.2519	0.0000
E	0.0271	0.0557	0.0942	0.4030	0.1727	0.2474	0.0000
ENE	0.0064	0.0337	0.0917	0.5951	0.1581	0.1150	0.0000
NE	0.0053	0.0270	0.1166	0.6776	0.0996	0.0739	0.0000
NNE	0.0016	0.0314	0.1512	0.7103	0.0620	0.0434	0.0000
TOTAL	0.0062	0.0736	0.1194	0.4988	0.1596	0.1423	0.0000

ADDITIONAL WEATHER INFORMATION

Average Air Temperature: 9.8 degrees C
283.00 K
Precipitation: 100.0 cm/y
Humidity: 8.0 g/cu m
Lid Height: 1000 meters
Surface Roughness Length: 0.010 meters
Height Of Wind Measurements: 10.0 meters
Average Wind Speed: 5.502 m/s

Vertical Temperature Gradients:
STABILITY E 0.073 k/m
STABILITY F 0.109 k/m
STABILITY G 0.146 k/m