MELCOR Accident Consequence Code System (MACCSS)


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Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.
This report describes the MACCS computer code. The purpose of this code is to simulate the impact of severe accidents at nuclear power plants on the surrounding environment. MACCS has been developed for the U.S. Nuclear Regulatory Commission to replace the previously used CRAC2 code, and it incorporates many improvements in modeling flexibility in comparison to CRAC2.

The principal phenomena considered in MACCS are atmospheric transport, mitigative actions based on dose projections, dose accumulation by a number of pathways including food and water ingestion, early and latent health effects, and economic costs.

The MACCS code can be used for a variety of applications. These include (1) probabilistic risk assessment (PRA) of nuclear power plants and other nuclear facilities, (2) sensitivity studies to gain a better understanding of the parameters important to PRA, and (3) cost-benefit analysis.

This report is composed of three volumes. Volume I, the User's Guide, describes the input data requirements of the MACCS code and provides directions for its use as illustrated by three sample problems. Volume II, the Model Description, describes the underlying models that are implemented in the code, and Volume III, the Programmer's Reference Manual, describes the code's structure and database management.
ACKNOWLEDGMENTS

The authors would like to thank Sarbes Acharya of the U.S. Nuclear Regulatory Commission and Chuck Dobbe of the Idaho National Engineering Laboratory for their valuable contributions to this report.
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</tr>
</tbody>
</table>
FOREWORD

This report provides the documentation of the MACCS computer code, which performs probabilistic calculations of potential offsite consequences of the atmospheric releases of radioactive material in reactor accidents. Sandia National Laboratories (SNL) developed the code for the U.S. Nuclear Regulatory Commission (NRC). The report consists of three volumes -- Volume I being the User's Guide; Volume II, the Model Description; and Volume III, the Programmer's Reference Manual.

With the publication of this report, the MACCS code is released for use within the NRC and for the benefit of other interested users. The MACCS code supersedes the earlier NRC consequence codes, namely, CRAC and CRAC2. The code, its formatted data files, and two pre-processor programs, namely, DOSFAC and MAXGC, which generate certain types of data for the code, are available on magnetic tape from the National Energy Software Center, Argonne National Laboratory, 9700 South Cass Avenue, Argonne, Illinois 60439.

The MACCS code has evolved through several draft versions. The current version (i.e., Version 1.5), simply called MACCS, has been substantially improved and subjected to rigorous quality assurance and verification processes. Idaho National Engineering Laboratory (INEL) performed line-by-line checking of the individual code modules to (a) assess the internal and interfacing consistencies and (b) verify that the FORTRAN statements correctly represent the algorithms, statistical techniques, input data requirements, and output capabilities. INEL's efforts were to ensure that the intended models were implemented into a consistent and essentially error-free computer code as specified by state-of-the-art coding standards for large scientific computer programs. Mr. Ulf Tveten, Institute of Energy Technology, Kjeller, Norway, under a subcontract from SNL, performed a comprehensive review of the chronic exposure pathway modeling in MACCS and compared it with those in the latest versions of the consequence codes that are being used, or planned to be completed in the near future, in several member countries of the Organization for Economic Cooperation and Development (OECD). INEL, Mr. Tveten, and SNL were interactively involved in the processes of quality assurance, verification, review, identification of errors and implementation of their correction, and model updating. These processes were largely completed before the MACCS code was used for consequence analysis for the second draft of NUREG-1150. INEL's quality assurance and verification report will be published as NUREG/CR-5376. Mr. Tveten's chronic exposure pathway review report will be published as NUREG/CR-5377.

An NRC effort is under way for comparing MACCS with similar codes of earlier vintage using the benchmark problems of the International Consequence Code Comparison Study. This study was sponsored by the OECD, Nuclear Energy Agency (NEA), Committee on the Safety of Nuclear Installations (CSNI), and was completed in 1983. The staff findings will be published as NUREG-1364. Further, it is also planned that MACCS will participate in the forthcoming NEA/CSNI-sponsored consequence code comparison study scheduled to be completed in 1992. Several other new generation consequence codes from the OECD member countries will also participate in the study. The NRC staff will be assisted by Brookhaven National Laboratory in performing the required analysis using MACCS for the study.
Some of the major new features of MACCS are: (a) improved approximation of the Gaussian crosswind concentration profile, (b) improved health effect models, (c) improved weather sampling, (d) treatment of multiphase release with capability for treatment of change in the wind direction at the reactor between the release phases, (e) detailed chronic exposure pathway modeling, (f) inclusion of inhalation of resuspended radionuclides as an early exposure pathway, (g) provision for more complex emergency response and long-term protective measures, and (h) code flexibility, so that virtually all model parameters can now be provided by the user via input.

The item (h) above is a very useful feature of MACCS that will facilitate the analysis of consequence uncertainties due to uncertainties in the model parameters. However, the user now has to prepare much more data, involving multiple disciplines, for input. This introduces the potential for an inexperienced user to produce distorted results because of improper or inconsistent data.

MACCS continues to use a straight line Gaussian plume dispersion and transport model like its predecessors, CRAC and CRAC2. Although this model is very convenient for probabilistic calculations of consequences using a large number of weather samples, care should be exercised in the MACCS applications to any deterministic, or real-time, situations because of such limitations of the model.

Additional improvements in MACCS will be undertaken in the near future. These include incorporation of latent cancer effect models for high-LET radiation (discussed in the BEIR IV report) and any changes that may be dictated by the recently revised assessment of latent cancer risks of radiation (discussed in the BEIR V report). Research for improvements in these areas is under way. In the longer term, additional areas for improvement will be identified by comparing MACCS with other full-scope consequence codes, such as CONDOR (United Kingdom), UFOMOD (Federal Republic of Germany), and COSYMA (Commission of the European Communities).

The MACCS code represents a significant advancement in the development of severe accident analysis methods. Comments based on use of the code would be greatly appreciated and should be forwarded to the undersigned.

Brian W. Sheron, Director
Division of Systems Research
Office of Nuclear Regulatory Research
1.0 PROGRAMMER'S OVERVIEW

1.1 Introduction

Sandia National Laboratories has developed a new severe accident risk assessment code, MACCS, for the U.S. Nuclear Regulatory Commission. MACCS models the off-site consequences of radioactive releases from nuclear power plant accidents. The following phenomena are modeled in the MACCS code:

- atmospheric transport and deposition,
- mitigative actions,
- dosimetry,
- health effects,
- economic costs.

The MACCS code is available on magnetic tape from the National Energy Software Center, Argonne National Laboratories, 9700 Cass Ave., Argonne, IL, 60439.

The objectives in developing MACCS were (1) to develop a code structure that facilitates the performance of sensitivity and uncertainty analyses, (2) to provide flexibility for performing site-specific consequence analyses, (3) to provide a modular structure that permits incorporation of future modeling improvements, and (4) to provide a portable program which can be used on most large computer systems. The coding conforms to the FORTRAN 77 ANSI standard.

This report describes the modular organization and data structures incorporated in MACCS Version 1.5, hereafter referred to simply as MACCS. The remainder of Chapter 1 presents (1) a description of the structure of MACCS, (2) a brief description of MACCS user input processing, (3) a hierarchical organization chart of the MACCS subprograms, (4) a listing of the MACCS subprograms in the order in which they appear in the code, (5) an alphabetical listing of the subprograms included in the various MACCS modules, (6) a diagram depicting the sequence of calculations performed by the various modules of MACCS, and (7) a diagram illustrating the flow of data between the various modules. Chapter 2 examines the various subprograms contained in MACCS by summarizing their purpose, their external references, and their interactions with other parts of the code. Chapter 3 contains a discussion of the data structures found in MACCS; argument lists, common blocks, and binary files.

It is not the intent of this document to provide a discussion of the input parameters required by the MACCS code nor is it the intent to provide a discussion of the models implemented by the MACCS code. A complete discussion of the input parameters can be found in Volume I, the User's Guide, and a description of the implemented models can be found in Volume II, the Model Description.
1.2 MACCS Structure

This section is intended to provide an understanding of the general sequence of the MACCS calculations.

A detailed picture of the code structure can be obtained from the internal documentation of MACCS. The program itself begins with a set of comment cards which present the hierarchical control structure of MACCS in graphical form. A replica of these comment cards is included in this document as Section 1.4.

Every subroutine or function program unit in MACCS begins with a stylized block of information that states: (1) the purpose of the program unit, (2) the name(s) of the program unit which reference it, (3) a glossary of the variables it utilizes, (4) a glossary of the program units it references, (5) the name and date of its authorship, and (6) a history of its modification.

The program units within MACCS are arranged in the order in which they are first referenced. A chronological listing of routines found in MACCS is included in this document as Section 1.5.

A MACCS calculation consists of three phases: (1) input processing and validation, (2) phenomenological modeling, and (3) output processing.

The calculations begin with the processing of all input to the code. Extensive error checking is utilized so that any detectable input errors are located and diagnosed before attempting to perform the modeling phase of the calculations. Upon the detection of an error, the program will try to validate as much of the subsequent input as possible in order to facilitate the debugging process. However, execution of the program will be terminated before an attempt is made to perform the next phase.

The phenomenological modeling occurs during the second phase of the calculations. The sequence in which the phenomena are evaluated closely follows the temporal order of events in the real world which would occur in the event of a reactor accident. The phenomenological models are for the most part based on empirical data and the solutions they entail are usually analytical in nature and computationally straightforward.

The modeling phase of MACCS is subdivided into three parts: ATMOS, EARLY, and CHRONC. ATMOS treats the atmospheric transport, dispersion, and deposition of radioactive material released to the environment. EARLY models the effect of the accident on the surrounding area during the emergency action period which can have a duration of up to one week. CHRONC considers the impact during all time subsequent to the emergency action period. A partial list of the sequence of phenomenological modeling in the ATMOS, EARLY, and CHRONC modules is given in Chapter 1 of Volume I of this report, the User's Guide.
The data needed to define the ATMOS, EARLY, and CHRONC modules are specified through three user input files with the names: ATMOS, EARLY, and CHRONC.

Though it is necessary to exercise the ATMOS module each time the MACCS code is run, the exercising of the EARLY and CHRONC modules is dependent on the needed output. For instance, if the user is only interested in the air and ground concentrations as a function of distance, only the ATMOS module need be exercised. On the other hand, if a sensitivity study on emergency response assumptions is to be performed, it would not be necessary to exercise the CHRONC module. Of the three phenomenological modules in MACCS, the ATMOS module is the only one which must always be exercised.

The OUTPUT module generates complementary cumulative distribution functions (CCDF's) of the user-requested results from the EARLY and CHRONC modules. There is currently no provision for the production of CCDF results from the ATMOS calculations.

A CCDF is generated internally for all user-requested consequence measures. For each CCDF, the code produces a one-line summary describing various aspects of the distribution function which is written to the List Output File. For any subset of the results, the user can cause the code to print out the entire CCDF table.

The results from the OUTPUT module are presented individually for each emergency response strategy requested, and also as a weighted sum of the combined results. Consequences calculated by both EARLY and CHRONC (e.g., cancer cases) are presented individually as well as combined into overall sums. In addition, the weighting fractions associated with the individual emergency response scenarios of EARLY (up to three are allowed) are combined automatically according to the values of "fraction of the people" or "fraction of the time" as specified by the user.

In addition to being able to handle multiple emergency response scenarios, a single run of the MACCS code can also handle multiple source terms and multiple weather trials (if weather category sampling is being used). The OUTPUT module will print a description of all the results for each source term before going on to the next source term. The code is currently dimensioned to handle up to 60 source terms.

1.3 Input Processing

The user input files for MACCS are processed by a free-field input processor, INPRE, which was developed to facilitate the portability and ease of maintainance of the MACCS code. The INPRE package is portable without modification to any computer system with an ANSI standard FORTRAN compiler.

The format of the input files was designed to maximize their readability. The input processor permits the user to freely intersperse comments with the data making the input files essentially self-documenting. Because
of the requirements of the INPRE free-field processor, certain restrictions are necessary on the format of the input data files. For a detailed description of these restrictions consult Volume I of this report, the User’s Guide.
1.4 Program Structure Charts

The following charts are a graphical representation of the hierarchical control structure of the MACCS code, and appear as a set of comment cards at the beginning of the MACCS code.

The charts should be read from the top down and left to right. A "+" beneath a subprogram name indicates that a graphical representation of that subprogram's external references will follow.
MACCS - (Main Program)

INPUT - (Process all user and auxiliary input)

ATMODL - (ATMOS user input model description)

ATPROB - (ATMOS user input problem description)
**INPMET** - (Process weather definition data)

```
INPM1  INPM2  INPM3  INPM4  INPM5

INPMET  WBNMET  WNDRZB
```

*(INPRE free-format input processing package)*
*(IGET1, IGETN, RGET1, RGETN, ERRLOC, ERRFIL, IMDIGT, IMLOC1, IMMTGR, IMREAL, RDSTRG, SEARCH)*

**EARINF** - (Process input and define the models)

```
INMISC  EDCINP  INEVAC  INPOP  INPMR  INEFAT  INACAN

INORG  INDFAC  INEINJ

CMPTBL  MATCH

EVNETW  EVNETW

EVROOT
```

*(INPRE free-format input processing package)*
*(CGET1, IGET1, IGETN, IGET1, RGET1, RGETN, DOCCDF, ERRLOC, ERRFIL, IMDIGT, IMLOC1, IMMTGR, IMREAL, RDSTRG, SEARCH)*
CHRINP - (Process CHRONC input)

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

OPNLRL   INPCHR    MODLDF    SDINP    EXCINP    STGORD

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

INCHRN  STPATH  IXOT9  IXOT10  IXOT11  IXOT12  CXPTRBL  KMPTRBL  MXCH   CKNIDX

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

* * * * * * *

INCHRN STPATH IXOT9 IXOT10 IXOT11 IXOT12 CXPTRBL KMPTRBL MXCH CKNIDX

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

(RIFRE free-form input processing package)
(CGETI, IGETI, IGETN, LGETI, RGETI, RGETN, DOCCDF, ERRLOC)
(IMDIGT, IMLGCL, IMNTGR, IMREAL, RDSTRG, SEARCH)

OUTCON - (Generates result names and opens output files)

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

HEDEAR   COPCHR    BEDCHR

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

RESNM1  RESNM2  RESNM3  RESNM4  RESNM5  RESNM6  RESNM7  RESNM8  RXSNM9  RXSNM10  RXSNM11  RXSNM12

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

* * * * *

COMPRS

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

DISRAH

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

DAYHOU - (Sampling from a given start time)

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

ADJTIM   WSAMPL   WBNDRY   CONTRL

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

WINCTM   WGTMET
* BINSAM - (Weather bin category sampling) *

**************
* WRANBN RANDOM ADJTIM WSAMPL WBNDRY CONTRL *
* RANDOM ***********
* WINCTM WOTMET

USRSUP - (5 days of weather supplied by user) *

**********
* WBNDRY CONTRL *

CONMET - (Constant weather conditions) *

********
* WBNDRY CONTRL *

RANSAM - (Stratified random sampling) *

************************
* RANDOM ADJTIM WSAMPL WBNDRY CONTRL *
* WINCTM WOTMET

CONTRL - (Simulation executive controller) *

********************
* ATMOUT GETSTG EAROUT CHROUT *
ATMOUT - (Main program for the ATMOS module)

******************************************************************************
* * * * * * * * * * * * * * * * * * * * * *
CAUGHT AREA WASHOU FSGYIN FSGZIN FSGY FSGZ DECAY FLMRIS SIGTEX
* * *
VELADJ

EAROUT - (Main program for the EARLY module)

******************************************************************************
* * * * * * * * * * * * * * * * * * * * * *
CENZER EGEOM EPCALC RELZON ESTAT EMOVE FATRIS INJRI CARRIS CARRIS STOEAR
* + * *
CLSHIN * * * *
* * *
POL2 * * INCOS *
* * *
* * *
EDOSIN CENACU

RELZON - (Relocation zone dosimetry calculations)

******************************************************************************
* * * * * * * * * * * * * * * * * * * * * *
EDOSIN INCOS *
* INCREM ZERREM
* *
* *
* *
CENZER *
* *

******************************************************************************
* *
CENACU

STOEAR - (Generates the EARLY results)

******************************************************************************
* * * * * * * * * * * * * * * * * * * * * *
OUTPT1 OUTPT2 OUTPT3 OUTPT4 OUTPT5 OUTPT6 OUTPT7 OUTPT8
* *
******************************************************************************
* *
EFFGET
CHROUT - (Main program from the CHRONC module)

CHRMDF  SOCPLN  WOCPLN  CRNRSK

LNGTPH - (Long-term phase doses and costs)

LTFROI  CSTEFF  LTACUM

STOCHR - (Generates the CHRONC results)

OXTPT1  OXTPT4  OXTPT5  OXTPT6  OXTPT7  OXTPT8  OXTPT9  OXTPT10  OXTPT11  OXTPT12

OUTPUT - (Generates CCDF and summary tables)

READ1  READ2  PRINT

DOICDF

GMBIN1  GMBIN2  EXFINT

ILOG10
1.5 MACCS Subprograms

The following is a list of the subprograms in the MACCS in the order in which they appear in the code. FORTRAN functions and entry points are noted.

MXXETC
MXXCPU
MXXCLK
MXXDAT
ABORT
INPUT
INPBE<
INPEND
CGET1 (FUNCTION)
DOCDCF (FUNCTION)
IGET1 (FUNCTION)
IGETN
LGET1 (FUNCTION)
LGETN
RGET1 (FUNCTION)
RGETN
RDSTRG
IMLGCL (FUNCTION)
IMNTGR (FUNCTION)
IMDIGT (FUNCTION)
IMREAL (FUNCTION)
SEARCH
SORT
ERRFIL
ERRLOC
ATMODL
INPGE0
INPISO
INPWET
INPDRY
INPDIS
INPEXP
INPLRS
ATPROB
INPWAK
INPREL
PUTSTM
GETSTM (ENTRY POINT IN PUTSTM)
INPMET
INPM1
WRDMET
INPM2
INPM3
INPM4
WBNMET
WNDRZB
INPM5
INPOPT
EARINP
INMISC
INORGA
EDCINP
INEVAC
INPOPU
CMPTBL
MATCH
EVRADE
EVNETW
EVROOT
INPEMR
INDFAC
INEFAT
INEINJ
INACAN
INOUT1
INOUT2
INOUT3
INOUT4
INOUT5
INOUT6
INOUT7
INOUT8
REDSTG
PUTSTG
GETSTG (ENTRY POINT IN PUTSTG)
CHRINP
OPNERL
MODLDF (ENTRY POINT IN OPNERL)
INCHR
INCHRN
STPATH
RDSTB
IXOT9
IXOT10
IXOT11
IXOT12
SDFINP
CXPTBL
KMPTBL (ENTRY POINT IN CXPTBL)
MXTCH
CKINDX
EXCINP
STGRDA
OUTCON
HEDEAR
RESNM1 (FUNCTION)
DISRAN (FUNCTION)
DIST1
COMPRS
RESNM2 (FUNCTION)
RESNM3 (FUNCTION)
RESNM4 (FUNCTION)
RESNM5 (FUNCTION)
RESNM6 (FUNCTION)
RESNM7 (FUNCTION)
RESNM8 (FUNCTION)
COPCHR
HEDCHR
RXSNM9 (FUNCTION)
RXNM10 (FUNCTION)
RXNM11 (FUNCTION)
RXNM12 (FUNCTION)
DAYHOU
RANDOM
RANSAM
USRSUP
CONMET
WBNDRY
ADJTIM
WSAMPL
WGTMET
WINCTM
BINSAM
WRANBN
CONTRL
ATMOUT
AREA (FUNCTION)
CAUGHT (FUNCTION)
VELADJ (FUNCTION)
WASHOU (FUNCTION)
FSGY (FUNCTION)
FSGYIN (ENTRY POINT IN FSGYIN)
FSGZ (FUNCTION)
FSGZIN
DECAY
PLMRIS (FUNCTION)
SIGTEX (FUNCTION)
EAROUT
EGEOM
CLSHIN (FUNCTION)
POL2 (FUNCTION)
EPCALC
RELZON
ESTAT
GENACU
CENZER (ENTRY POINT IN CENACU)
EDOSIN
INCDOS
EMOVE
ZERREM

1-15
DOLCDF
CNBIN1
ILOG10 (FUNCTION)
CNBIN2
PRINT
SOLID
QUANTL
EXPINT (FUNCTION)
NOTFOU (FUNCTION)
1.6 Subprogram Listing By Modules

The MACCS program is organized into four modules: ATMOS, EARLY, CHRONC, AND OUTPUT. This section gives a listing of the subprograms in each module. Within each module, the subprograms are listed in alphabetical order.

ATMOS:

<table>
<thead>
<tr>
<th>Subprogram</th>
<th>LGETN</th>
<th>EPCALE</th>
<th>OUTPT2</th>
<th>DIRDEP</th>
<th>OXPT1</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABORT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADJTIM</td>
<td>PLMRIS</td>
<td>ERRFIL</td>
<td>OUTPT3</td>
<td>DISRAN</td>
<td>OXPT4</td>
</tr>
<tr>
<td>AREA</td>
<td>PUTSTM</td>
<td>ESTAT</td>
<td>OUTPT4</td>
<td>DIST1</td>
<td>OXPT5</td>
</tr>
<tr>
<td>ATMODL</td>
<td>RANDOM</td>
<td>ESTAT</td>
<td>OUTPT5</td>
<td>DOCDF</td>
<td>OXPT6</td>
</tr>
<tr>
<td>ATMOUT</td>
<td>RANSAM</td>
<td>EVNET</td>
<td>OUTPT6</td>
<td>DOSGET</td>
<td>OXPT7</td>
</tr>
<tr>
<td>ATPROB</td>
<td>RDSTRG</td>
<td>EVRADI</td>
<td>OUTPT7</td>
<td>ECCGET</td>
<td>OXPT8</td>
</tr>
<tr>
<td>BINSAM</td>
<td>RGET1</td>
<td>EVROOT</td>
<td>OUTPT8</td>
<td>EMGRPH</td>
<td>OXPT9</td>
</tr>
<tr>
<td>CAUGHT</td>
<td>RGETN</td>
<td>FATRIS</td>
<td>POL2</td>
<td>ERRFIL</td>
<td>RDISTB</td>
</tr>
<tr>
<td>CGET1</td>
<td>SEARCH</td>
<td>HEDEAR</td>
<td>PUTSTG</td>
<td>ERRLOC</td>
<td>RDRSTG</td>
</tr>
<tr>
<td>CONMET</td>
<td>SIGTEX</td>
<td>IGET1</td>
<td>RDSTRG</td>
<td>EXCINP</td>
<td>RGET1</td>
</tr>
<tr>
<td>CONTRL</td>
<td>SORT</td>
<td>IGETN</td>
<td>REDSTG</td>
<td>GETIMP</td>
<td>RGETN</td>
</tr>
<tr>
<td>DAYHOU</td>
<td>USRUP</td>
<td>IMDIGT</td>
<td>RELZON</td>
<td>GNRES</td>
<td>RXNM10</td>
</tr>
<tr>
<td>DEGAY</td>
<td>VELAJD</td>
<td>IMCLGCL</td>
<td>RESNM1</td>
<td>HEDCHR</td>
<td>RXNM11</td>
</tr>
<tr>
<td>ERFIL</td>
<td>WASHOU</td>
<td>INMTGR</td>
<td>RESNM2</td>
<td>IGET1</td>
<td>RXNM12</td>
</tr>
<tr>
<td>ERRLOC</td>
<td>WBNDRY</td>
<td>IMREAL</td>
<td>RESNM3</td>
<td>IGETN</td>
<td>RXSNM9</td>
</tr>
<tr>
<td>FSGY</td>
<td>WBNMET</td>
<td>INACAN</td>
<td>RESNM4</td>
<td>IMDIGT</td>
<td>SDFINP</td>
</tr>
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1.7 **Sequential Flow Diagram**

The following figure illustrates the sequence of calculations performed by the various modules of MACCS. It shows the internal looping structure used to perform calculations for multiple source terms, weather trials, and emergency response assumptions.

![Sequential Flow Diagram](image)

Figure 1.1 Sequential Flow Diagram
1.8 Data Flow Diagram

The following figure illustrates the direction of data flow between the various modules of MACCS.

Figure 1.2 Data Flow Diagram
2.0 MACCS SUBPROGRAMS

2.1 MACCS Subprogram Overview

The MACCS program is organized into the following modules: ATMOS, EARLY, CHRONC, and OUTPUT. Within each module, the subprograms are generally organized in the following order: (1) input processing, (2) modeling or arithmetic calculations, and (3) output processing.

Both SUBROUTINE and FUNCTION statements appear in the code, and ENTRY statements are used in both types of subprograms.

This chapter is intended to give a description of the MACCS code subprograms and their interactions. Section 2.2 contains a tree depicting the calling structure of the code, Section 2.3 contains a description of each subprogram, and Section 2.4 contains a description of the named statement functions found in the MACCS Code.
2.2 Detailed Calling Structure

The calling structure tree found in this section is intended to give an overall picture of the order of the calls made to subprograms within the MACCS code. The flow of the tree is from the top to bottom and from left to right. The layout of the tree makes the levels of the various calls readily apparent to the reader. It should be noted that calls to INPRE routines are accompanied by the name of the variable being fetched in parentheses. When a call to a given routine appears more than once in a subprogram, each call is shown in the structure charts of this chapter. It is possible that the program logic will cause multiple executions of a single call. There is no indication in the tree of whether or not that may occur. The calling structure of individual subroutines is presented in Appendix A. These charts depict the multiple calls made which arise as a result of program logic.

To keep the tree as simple as possible, two blocks of structure have been removed from the main tree and added to the end of this section. The first block starting on page 2-28 contains the structure of the subprograms which are called many times within MACCS. Most notable among these is the INPRE input processing routines. Within the main tree, an asterisk following the subprogram name indicates those routines.

The second block of structure separated from the main tree is the subtree which emanates from the subroutine CONTRL. This subtree begins on page 2-30 and contains the simulation and output processing routines for the EARLY, CHRONC, and OUTPUT modules.

CALLING STRUCTURE TREE OF THE MACCS CODE

MACCS---+MXXETC
! ---+MXXCPU---+ABORT
! ---+MXXDAT
! ---+MXXCLK
! ---+INPUT---+INPBEIG---+ABORT
! ! ! +SEARCH
! ! ! +SORT
! ! ! +ABORT
! ! ! ! '-'ERRLOC
! ! ! +ABORT
! ! +ATMDL---+INPGE0---+IGET1-*
! ! ! ! (NUMRAD)
! ! ! ! !
! ! ! ! +RGETN---+RGET1-*
! ! ! ! ! (SPAEND)
! ! ! ! !
! ! ! ! +ERRLOC
! ! ! ! 2-3
! I ! I ! +INPISO--IGET1-*
! I I ! ! (NUMISO)
! I I ! !
! I I ! ! +IGET1-*
! I I ! ! (MAXGRP)
! I I ! !
! I I ! ! +LGETN---LGET1-*
! I I ! ! (WETDEP)
! I I ! !
! I I ! ! +LGETN---LGET1-*
! I I ! ! (DRYDEP)
! I I ! !
! I I ! ! +CGET1-*
! I I ! ! (NUCNAM)
! I I ! !
! I I ! ! +ERRLOC
! I I ! !
! I I ! ! +CGET1-*
! I I ! ! (PARENT)
! I I ! !
! I I ! ! +ERRLOC
! I I ! !
! I I ! ! +IGETN---IGET1-*
! I I ! ! (IGROUP)
! I I ! !
! I I ! ! +RGETN---RGET1-*
! I I ! ! (HAFLIF)
! I I ! !
! I I ! ! +ERRLOC
! I ! !
! I ! ! +INPWET--RGET1-*
! I ! ! ! (CWASH1)
! I ! ! !
! I ! ! ! +RGET1-*
! I ! ! ! (CWASH2)
! I ! ! !
! I ! ! ! +INPDRY--IGET1-*
! I ! ! ! ! (NPSGRP)
! I ! ! ! !
! I ! ! ! ! +RGETN---RGET1-*
! I ! ! ! ! (VDEPOS)
! I ! ! !
! I ! ! !
! I ! ! ! +INPDIS--RGETN---RGET1-*
! I ! ! ! ! (CYSIGA)
! I ! ! !
! I ! ! ! +RGETN---RGET1-*
! I ! ! ! ! (CYSIGB)
+-RGETN-++RGET1-*(CZSIGA)

+-RGETN-++RGET1-*(CZSIGB)

+-RGET1-*(YSCALE)

+-RGET1-*(ZSCALE)

+-INPEXP-++RGET1-*(TIMBAS)

+-RGET1-*(BRKPNT)

+-RGET1-*(XPFAC1)

+-RGET1-*(XPFAC2)

+-INPLRS-++RGET1-*(SCLCRW)

+-RGET1-*(SCLADP)

+-RGET1-*(SCLEFP)

+-ATPROB-++CGET1-*(ATNAM1)

+-INPWAK-++RGET1-*(BUILDW)

+-RGET1-*(BUILDH)

+-INPREL-++CGET1-*(ATNAM2)

+-IGET1-*(NUMREL)
+-RGETN----+-RGET1-*
  (PLHEAT)

+-RGETN----+-RGET1-*
  (PLHITE)

+-RGETN----+-RGET1-*
  (PLUDUR)

+-RGETN----+-RGET1-*
  (PDELAY)

+-ERRLOC

+-RGET1-*
  (OALARM)

+-IGET1-*
  (MAXRIS)

+-RGETN----+-RGET1-*
  (REFTIM)

+-CGET1-*
  (CORINV)

+-RGET1-*
  (CORINV)

+-ERRLOC
  (+ERRLOC)

+-RGET1-*
  (CORSCA)

+-ERRLOC
  (+RELFRC)

+-DECAY

+-INPMET++INPM1----+-IGET1-*
  (METCOD)

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+-ERRFIL

+-ERRFIL

2-6
+INPBEG+++ABORT
+SEARCH
+SORT
+ABORT

+EARINP+++INMISC+++CGET1-*
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+(ENDAT2)
+(IPLUME)
+(NUMFIN)
+(OVRRID)
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+(IPRINT)
+(RISCAT)
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+(EDCINP+++ERRFIL
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! I ! I ! ! (SHELT1)
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! I ! I ! ! (TIMHOT)
! I ! I ! +-RGET1-*
! I ! I ! ! (TIMNRM)
! I ! I ! +-RGET1-*
! I ! I ! ! (DOSHOT)
! I ! I ! ! (DOSNRM)
! I ! I ! +-CGET1-*
! I ! I ! ! (CRIORG)
! I ! I ! ! ERRLOC
! I ! I ! 
! I ! I ! +-INDFAC--+-RGETN++-RGET1-*
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! (EIFACA)

+-RGETN--+RGET1-*
! (EIFACB)

+-INACAN--+IGET1-*
! (NUMACA)

+-RGET1-*
! (ACTHRE)

+-CGET1-*
! (ACNAME)

+-CGET1-*
! (ACNAME)

+-CGET1-*
! (ORCNAM)

+-ERRLOC

+-RGETN--+RGET1-*
! (ACUSUC)

+-RGETN--+RGET1-*
! (DOSEFA)

+-RGETN--+RGET1-*
! (DOSEFB)

+-RGETN--+RGET1-*
! (CFRISK)

+-RGETN--+RGET1-*
! (CIRISK)

+-INOUT1--+IGET1-*
! (NUM1)

+-CGET1-*
! ('NAME OF THE HEALTH EFFECT')

+-ERRLOC

+-ERRLOC

+-ERRLOC

+-ERRLOC

+-ERRLOC

+-ERRLOC

+-ERRLOC

+-ERRLOC

+-ERRLOC

+-IGETN--+IGET1-*
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  +ERRLOC
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  +DOCCDF-*
  +INOUT6---+IGET1-*
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  (1DIS6)
  +IGETN---+IGET1-*
  (2DIS6)
  +ERRLOC
  +DOCCDF-*
  +INOUT7---+IGET1-*
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  +CGET1-*
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+ERRLOC
+IGETN---+IGET1-*
! (I1DIS7)
+
+IGETN---+IGET1-*
! (I2DIS7)
+
+ERRLOC
+DOCCDF-*
+
+INOUT8---+IGET1-*
! (NUM8)
+
+CGET1-*
! ('NAME OF THE HEALTH EFFECT')
+
+ERRLOC
+ERRLOC
+ERRLOC
+ERRLOC
+ERRLOC
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+IGETN---+IGET1-*
! (I1DIS8)
+
+IGETN---+IGET1-*
! (I2DIS8)
+
+ERRLOC
+DOCCDF-*
+
+ABORT
+ERRLOC
+ABORT
+INPBEG---+ABORT
! +SEARCH
! +SORT
! +ABORT
! +REDSTG---+INEVAC---+CGET1-*
! ! ! (EANAM2)
! ! !
+ CGET1-*
! ! ! (WTNAME)
! ! !

2-17
! I ! I I I ! ! ! ! +RGET1-* ! (WTFRAC)
! ! ! ! ! ! ! ! ! (LASEVA)
! ! ! ! ! ! ! ! ! (IEVACU)
! ! ! ! ! ! ! ! ! (INIEVA)
! ! ! ! ! ! ! ! +IGETN-+IGET1-*
! ! ! ! ! ! ! ! ! (LASEVA)
! ! ! ! ! ! ! ! +ERRLOC
! ! ! ! ! ! ! ! +IGETN-+RGET1-*
! ! ! ! ! ! ! ! ! (EDELAY)
! ! ! ! ! ! ! ! +ERRLOC
! ! ! ! ! ! ! ! +EVRADI-+RGET1-*
! ! ! ! ! ! ! ! ! (ESPEED)
! ! ! ! ! ! ! ! +EVNETW-+IGET1-*
! ! ! ! ! ! ! ! ! (ISORC)
! ! ! ! ! ! ! ! +IGET1-*
! ! ! ! ! ! ! ! ! (JSORC)
! ! ! ! ! ! ! ! +IGET1-*
! ! ! ! ! ! ! ! ! (NEXTND)
! ! ! ! ! ! ! ! +IGET1-*
! ! ! ! ! ! ! ! ! (NEXTND)
! ! ! ! ! ! ! ! +IGET1-*
! ! ! ! ! ! ! ! ! (NEXTND)
! ! ! ! ! ! ! ! +ERRLOC
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! ! ! ! ! ! ! ! +ERRLOC
! ! ! ! ! ! ! ! +ERRLOC
+-IGET1-* !(LASHE2) !
+-ERRLOC !
+-RGET1-* !(SHELT2) !
+-RGET1-* !(ENDEMP) !
+-RGET1-* !(TIMHOT) !
+-RGET1-* !(TIMNRM) !
+-RGET1-* !(DOSHOT) !
+-RGET1-* !(DOSNRM) !
+-CGET1-* !(CRIORG) !
+-ERRLOC !
+-ABORT
+-PUTSTG--+-ERRLOC
  +-ERRLOC
  +-(*ENTRY-GETSTG)
+-ABORT
+-INPEND
+-INPBEG--+-ABORT
  +-SEARCH
  +-SORT
  +-ABORT
+-CHRINP--+-OPNERL--+-(*ENTRY-MODLDF)
  +-ERRLOC
+-INPCHR--+-INCHRN--+-CGET1-*
  +-INCHR--+-CHNAME
  *(CHNAME)
  !
+-RGET1-*
  ! (EVACST)
  |
+-RGET1-*
  ! (RELCST)
  |
+-RGET1-*
  ! (TMPIND)
  |
+-RGET1-*
  ! (TMPACT)
  |
+-RGET1-*
  ! (DSCR1)
  |
+-RGET1-*
  ! (DSCRLT)
  |
+-IGET1-*
  ! (LVLDEC)
  |
+-RGETN---+-RGET1-*
  ! (TIMDEC)
  |
+-RGETN---+-RGET1-*
  ! (DSRFT)
  |
+-RGETN---+-RGET1-*
  ! (CPPRM)
  |
+-RGETN---+-RGET1-*
  ! (CDNRM)
  |
+-RGETN---+-RGET1-*
  ! (FRFDL)
  |
+-RGETN---+-RGET1-*
  ! (FRNFDL)
  |
+-RGETN---+-RGET1-*
  ! (TFWKF)
  |
+-RGETN---+-RGET1-*
  ! (TFWKNF)
  |
+-RGET1-*
  ! (DLBCST)


+-RGETN---+RGET1- *
(PSCOTH)

+-CGET1-*
(NAMIPI)

+-ERRLOC
+-RGETN---+RGET1- *
(GCMAXR)

+-RGETN---+RGET1- *
(QROOT)

+-IXOT9---+IGET1-*
(NXUM9)

+-CGET1-*
(ORGNAN)

+-ERRLOC
+-IGETN---+IGET1-*
(IX1DS9)

+-IGETN---+IGET1-*
(IX2DS9)

+-ERRLOC
+-DOCCDF-*

+-IXOT10---+IGET1-*
(NXUM10)

+-IGETN---+IGET1-*
(I1DS10)

+-IGETN---+IGET1-*
(I2DS10)

+-ERRLOC
+-DOCCDF-*

+-IXOT11---+IGET1-*
(NXUM11)

+-LGET1-*
(FLAG11)

+-DOCCDF-*
! ! + - COPCHR
! ! + - HEDCHR + - RXSNM9 + - DISRAN + - DIST1 + - ABORT
! ! + - ABORT
! !
! ! + - RXNM10 + - DISRAN + - DIST1 + - ABORT
! ! + - ABORT
! !
! ! + - RXNM11 + - ABORT
! !
! ! + - RXNM12 + - DISRAN + - DIST1 + - ABORT
! ! + - ABORT
! !
! ! + - ABORT
! !
! ! + - MXCPU + - ABORT
! + - ABORT
! + - GETSTM
! + - DAYHOU + - ADJTIM
! ! + - WSAMPL + - WINCTM
! ! + - WGTMET + - ABORT
! !
! !
! ! + - WBNDRY
! ! + - CONTRL + (CONTINUED ON PAGE 2-30)
! !
! !
! ! + - BINSAM + - WRANBN + - RANDOM
! ! + - RANDOM
! ! + - ADJTIM
! ! + - WSAMPL + - WINCTM
! ! + - WGTMET + - ABORT
! !
! ! + - WBNDRY
! ! + - CONTRL + (CONTINUED ON PAGE 2-30)
! !
! !
! ! + - USRSUP + - WBNDRY
! ! + - CONTRL + (CONTINUED ON PAGE 2-30)
! !
! !
! ! + - CONMET + - WBNDRY
! ! + - CONTRL + (CONTINUED ON PAGE 2-30)
! !
! !
! ! + - RANSAM + - ABORT
! ! + - RANDOM
! ! + - ADJTIM
! ! + - WSAMPL + - WINCTM
! ! + - WGTMET + - ABORT
! !

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* FREQUENTLY USED ROUTINES

CGET1----+--SEARCH
       +-RDSTRG---+-IMLGCL
       +-IMNTGR--+-IMDIGT
       +-IMREAL--+-IMDIGT
       +-IMNTGR

DOCCDF--+-ABORT
       +-SEARCH
       +-RDSTRG---+-IMLGCL
       +-IMNTGR--+-IMDIGT
       +-IMREAL--+-IMDIGT
       +-IMNTGR

IGET1----+--SEARCH
       +-RDSTRG---+-IMLGCL
       +-IMNTGR--+-IMDIGT
       +-IMREAL--+-IMDIGT
       +-IMNTGR

LGET1----+--SEARCH
       +-RDSTRG---+-IMLGCL
       +-IMNTGR--+-IMDIGT
       +-IMREAL--+-IMDIGT
       +-IMNTGR

RDISTB--+-CGET1-*
       ! (NAMISO)
       !
       +-ERRLOC
       +-RGETN---+-RGET1-*
       ! (CLM2VR)
       !
       +-RGETN---+-RGET1-*
       ! (CLM3VR)
       !
       +-RGETN---+-RGET1-*
       ! (CLM4VR)
       !
       +-RGETN---+-RGET1-*
       ! (CLM5VR)
       !
       +-RGETN---+-RGET1-*
       ! (CLM6VR)
       !
       +-RGETN---+-RGET1-*
       ! (CLM7VR)
       !
       +-RGETN---+-RGET1-*
       ! (CLM8VR)

2 - 28
+RGETN---+RGET1-*
  (CLM9VR)
+RGETN---+RGET1-*
  (CLMAVR)
+RGETN---+RGET1-*
  (CLMBVR)

RGET1----+SEARCH
+RDESTG---+IMLGCL
+IMNTGR---+IMDIGT
+IMREAL---+IMDIGT
+IMNTGR
SUBROUTINE CONTRL

CONTRL-+-ATMOUT-+-CAUGHT
!  +-AREA
!  +-AREA
!  +-AREA
!  +-AREA
!  +-WASHOU
!  +-FSGYIN
!  +-FSGZIN
!  +-FSGY-+-(ENTRY-FSGYIN)
!  +-FSGZ-+-(ENTRY-FSGZIN)
!  +-DECAY
!  +-PIMRIS-++-VELADJ
!  +-SIGTEX
!

+GETSTG
+EAROUT-+-CENZER
!  +EGEOM-+-CLSHIN-+POL2-+-ABORT
!  +EPCALC-+-ABORT
!  +RELZON-+-EDOSIN
!  !  +INCDOSS
!  !  +CENACU-+-(**ENTRY-CENZER)
!  !  +ZERREMM
!  !  +EDOSIN
!  !  +INCREM-+-CENZER
!  !  !  +CENACU-+-(**ENTRY-CENZER)
!  !  !
!  !
!  !  +ZERREMM
!  !  +EDOSIN
!  !  +INCREM-+-CENZER
!  !  !  +CENACU-+-(**ENTRY-CENZER)
!  !
!  !
!  !  +ESTAT-+-EDOSIN
!  !  +INCDOSS
!  !  +CENACU-+-(**ENTRY-CENZER)
!  !  +EDOSIN
!  !  +INCDOSS
!  !  +CENACU-+-(**ENTRY-CENZER)
!  !  +EDOSIN
!  !  +INCDOSS
!  !  +CENACU-+-(**ENTRY-CENZER)
!  !  +EDOSIN
!  !  +INCDOSS
!  !  +CENACU-+-(**ENTRY-CENZER)
!  !  +EDOSIN
!  !  +INCDOSS
!  !  +CENACU-+-(**ENTRY-CENZER)
!  !

+TRFRCT
+WTRTRF
+-SGCPLN--+-ABORT
+WGCPLN
+-CRNRSK--+-DIRDEP
++INITLZ
+-EMRGPH
+-INTRPH
+-LNGTPH--+-LTPROJ--+-LTMAC
!
+-CSTEFF--+-CSTDCN
+-LTACUM
+-LOKSEE
+-STOCHR-+-OXPT1--+-CASGET--+-ABORT
+-CASGET--+-ABORT
+-CASGET--+-ABORT
+-CASGET--+-ABORT
+-CASGET--+-ABORT
+-OXPT4--+-ABORT
+-OXPT5
+-OXPT6--+-ABORT
+-OXPT7--+-ABORT
+-OXPT8--+-CASGET--+-ABORT
+-CASGET--+-ABORT
+-CASGET--+-ABORT
+-CASGET--+-ABORT
+-CASGET--+-ABORT
+-OXPT9--+-DOSGET
+-DOSGET
+-DOSGET
+-DOSGET
+-DOSGET
+-OXPT10--+-ECCGET
+-ECCGET
+-ECCGET
+-ECCGET
+-ECCGET
+-ECCGET
+-OXPT11--+-GETIMP
+-GETIMP
+-GETIMP
+-GETIMP

2-32
2.3 **Subprogram Descriptions**

A description of each subprogram in MACCS is given in this section. These profiles are arranged in alphabetical order by the names of the routines. Each profile contains the following information: (1) the name of the subprogram, (2) the type of subprogram, (3) a statement of the general purpose of the subprogram, (4) the specific task accomplished, (5) a list of the subprograms by which it is called, and (7) a list of the subprograms which it calls. The calls made by each subprogram are divided into those which are made unconditionally and those which are made conditionally. When a conditional call is made, the necessary condition is indicated.

**Name:** MACCS  
**Type:** Main program  
**Module:** ATMOS, EARLY, CHRONC, OUTPUT  
**Purpose -**  
- **General:** Overall control  
- **Specific:** Controls the input processing, calculations, and output processing for the ATMOS, EARLY, CHRONC, and OUTPUT modules.

**Called By:**

**Calls:**

- **Unconditional:**  
  - INPUT, MXXETC, MXXCPU, MXXDAT, MXXCLK

- **Conditional:**  
  - ABORT - error was detected in input  
  - GETSTM - more than one source term is being used  
  - OUTPUT - EARLY module is being exercised  
  - Conditional on weather sampling technique desired:  
    - BINSAM - multiple trials using weather category bin sampling,  
    - CONMET - single weather trial with constant conditions,  
    - DAYHOU - single weather sequence starting at user-specified day and hour in the year,  
    - RANSAM - stratified random sampling based on user-specified number of samples per day, or  
    - USRSUP - user-specified day and hour start time for a single weather trial.
Name: ABORT
Type: Subroutine
Module: ATMOS, EARLY, CHRONC, OUTPUT
Purpose -
   General: Error processing
   Specific: Forces an abort and writes an error message to
            identify the routine in which the error was found.
Called By: CASGET, CHRINP, COMPRS, DIST1, DOCCDF, EFFGET,
           EPCALC, EXCINP, HEDCHR, HEDEAR, INPM1, INPUT,
           LTACUM, MACCS, MXXCPU, OUTPT4, OUTPT6, OUTPT7,
           OUTPUT, OXTPT4, OXTPT6, OXTPT7, POL2, RANSAM,
           READ1, READ2, RXNM10, RXNM11, RXNM12, RXSNM9,
           SGCPLN, WGTMET
Calls: None

Name: ADJTIM
Type: Subroutine
Module: ATMOS
Purpose -
   General: Input processing
   Specific: Calculates a new value for the weather sequence
            start time (day and hour) so the release of the
            risk-dominant plume will coincide with the start
            time selected by the weather sampling routines.
Called By: BINSAM, DAYHOU, RANSAM
Calls: None

Name: AREA
Type: Function
Module: ATMOS
Purpose -
   General: Modeling simulation
   Specific: Calculates the area under the line segment which
            starts at the origin and has a specified slope.
Called By: ATMOUT
Calls: None

Name: ATMODL
Type: Subroutine
Module: ATMOS
Purpose -
   General: Input processing
   Specific: Controls the processing of the input data from the
            ATMOS User Input File which defines the following
            characteristics of the atmospheric model:
            geometric grid being used,
            nuclide data (name, parent, half-life),
            wet deposition model,
            dispersion parameter data,
plume expansion factors, and
scaling factors for the plume rise model.

Called By: INPUT
Calls:
  Unconditional:
    INPGEO
  Conditional:
    Number of radial spatial elements and the endpoint distances
    of the radial spatial elements have been read from the input
data files and the values found are within acceptable ranges
    INPDIS, INPDY, INPEXP, INPISO, INPLRS, INPWET

Name: ATMOUT
Type: Subroutine
Module: ATMOS
Purpose -
  General: Modeling simulation
  Specific: Models the dispersion of a single Gaussian plume
    under the influence of constant wind direction using
    the following submodels:
      Pasquill-Gifford-Turner type dispersion
      coefficients,
      plume rise dependent on wind speed, stability
      class, and inversion lid,
      reflection of the plume by the ground and by the
      inversion lid at a constant lid height,
      washout dependent on the rain rate,
      dry deposition dependent on particle size, and
      two-member radioactive decay chains.

Called By: CONTRL
Calls:
  Unconditional:
    DECAY, FSGY
  Conditional:
    AREA - rainfall is occurring
    CAUGHT - plume heat is nonzero for the release
    FSGYIN - explicit multiple reflections are being used and
      there is a change in the stability class
    - explicit multiple reflections are not being used
      and there is a change in the stability class
    FSGZ - explicit multiple reflections are being used
    FSGZIN - explicit multiple reflections are being used and
      there is a change in the stability class
    PLMRIS - plume rise occurs
    SIGTEX - more than the minimal output is desired
    WASHOU - rainfall is occurring

Name: ATPROB
Type: Subroutine
Module: ATMOS
Purpose -
General: Input processing
Specific: Define the characteristics of the atmospheric problem by processing the following input data from the ATMOS User Input File:
- building size for wake effects,
- release inventory of all nuclides,
- weather sampling strategy being used, and
- desired output options.

Called By: INPUT
Calls:
  Unconditional:
    CGET1, INPMET, INPOPT, INPREL, INPWAK

Name: BINSAM
Type: Subroutine
Module: ATMOS
Purpose -
  General: Input processing
  Specific: Performs weather category bin sampling.
Called By: MACCS
Calls:
  Unconditional:
    ADJTIM, CONTRL, RANDOM, WBNDRY, WRANBN, WSAMPL

Name: BLDTBL
Type: Subroutine
Module: CHRONC
Purpose -
  General: Input processing
  Specific: Build daughter table of forward links as well as backward links.
Called By: CHRNDF
Calls: None

Name: CANRIS
Type: Subroutine
Module: EARLY
Purpose -
  General: Modeling simulation
  Specific: Calculates the risk of cancer from acute exposure for all spatial elements.
Called By: EAROUT
Calls: None

Name: CASGET
Type: Subroutine
Module: CHRONC
Purpose -
  General: Model simulation
Specific: Calculates the number of cases of cancer occurring in a specified grid element for all releases which have been requested.

Called By: OXTPT1, OXTPT8

Calls:
Conditional:
ABORT - invalid option code was detected

Name: CAUGHT
Type: Logical Function
Module: ATMOS
Purpose -
General: Modeling simulation
Specific: Determines if the plume is caught in the building wake.

Called By: ATMOUT

Calls: None

Name: CENACU
Type: Subroutine
Entry: CENZER
Module: EARLY
Purpose -
General: Modeling simulation
Specific: Increments the centerline dose arrays for the accumulated doses.

Called By: EMOVE, ESTAT, INCREM, RELZON

Calls: None

Name: CENZER
Type: Entry
Host: CENACU
Module: EARLY
Purpose -
General: Modeling simulation
Specific: Zeroes out the centerline dose arrays to start or restart dose accumulations.

Called By: EAROUT, INCREM

Calls: None

Name: CGET1
Type: Function
Module: ATMOS, EARLY, CHRONC
Purpose -
General: Input processor
Specific: Returns a single character value from the input database.
Called By: ATPROB, INACAN, INCHR, INEFAT, INEINJ, INEVAC, INMISC, INORGA, INOUT1, INOUT3, INOUT4, INOUT5, INOUT6, INOUT7, INOUT8, INPEMR, INPISO, INPOPT, INPOPU, INPREL, IXOT9, STPATH

Calls:
Conditional:
  RDSTRG - no error was detected in the column pointer for finding the data
  SEARCH - no error was detected in the column pointer for finding the data or in the length of the record ID

Name: CHRNDF
Type: Subroutine
Module: CHRONC
Purpose -
  General: Input processing
  Specific: Integrate exposure over various time periods for an initial unit of each nuclide.

Called By: CHROUT

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Calls:
  Unconditional:
    BLDTBL, GNDRES, TRFRCT, WTRTRF

Name: CHROUT
Type: Subroutine
Module: CHRONC
Purpose -
  General: Modeling simulation
  Specific: Controls the CHRONC simulation for a single weather trial.
Called By: CONTRL
Calls:
  Unconditional:
    CRNRSK
  Conditional:
    CHRNDF - initial unit concentrations of each radionuclide
    SGCPLN - straight line dispersion model is being used
    WGCPLN - wind shift dispersion model is being used

Name: CKINDX
Type: Subroutine
Module: CHRONC
Purpose -
  General: Input processing
  Specific: Check to verify that the indices in the array of indices for i spatial intervals and j wind directions do not exceed the upper bound for the indices in that array.
Called By: SDFINP
Calls: None

Name: CLSHIN
Type: Function
Module: EARLY
Purpose -
  General: Modeling simulation
  Specific: Returns the cloudshine correction factor for a given distance (in standard deviations) from a plume of a given size (in meters of sigma y).
Called By: EGEOM
Calls:
  Unconditional:
    POL2

Name: CMPTBL
Type: Subroutine
Module: EARLY
Purpose -
  General: Error processing
  Specific: Check to see if the number of items on the Site Data
  File is the same as the number of items required by
  the model.
Called By: INPOPU
Calls:
  Conditional:
    ERRFIL - number of items defined on Site Data File and the
    number defined by the model are in conflict

Name: COMPRS
Type: Subroutine
Module: EARLY
Purpose -
  General: Output processing
  Specific: Changes multiple blanks in a character string to a
  single blank.
Called By: RESNMJ
Calls:
  Conditional:
    ABORT - found a string too long for the routine to handle

Name: CONMET
Type: Subroutine
Module: ATMOS
Purpose -
  General: Input processing
  Specific: Runs a single trial of constant weather.
Called By: MACCS
Calls:
  Unconditional:
    CONTRL, WBNDRY

Name: CONTRL
Type: Subroutine
Module: ATMOS, EARLY, CHRONC
Purpose -
  General: Modeling simulation
  Specific: Controls the entire modeling simulation of MACCS.
Called By: BINSAM, CONMET, DAYHOU, RANSAM, USRSUP
Calls:
  Unconditional:
    ATMOUT
  Conditional:
    EARLY module is to be exercised.
    EAROUT
    GETSTG - more than one emergency response strategy is
    requested
CHRONC module is to be exercised.

CHROUT

Name: COPCHR
Type: Subroutine
Module: CHRONC
Purpose -
  General: Output processing
  Specific: Sets up the CHRONC code to produce the results that are produced by both EARLY and CHRONC.
Called By: OUTCON
Calls: None

Name: CRNRSK
Type: Subroutine
Module: CHRONC
Purpose -
  General: Modeling simulation
  Specific: Calculates the chronic risks resulting from the current trial.
Called By: CHRINP, CHROUT
Calls: Unconditional:
  DIRDEP, EMRGPH, INITLZ, STOCHR
Conditional:
  Plume passage occurred over the spatial element.
  INTRPH
  LNGTPH
  Flag indicates the table of doses and costs is to be printed.
  LOKSEE

Name: CSTDCN
Type: Subroutine
Module: CHRONC
Purpose -
  General: Modeling simulation
  Specific: Calculates the costs of decontamination of farm property according to the level of decontamination required.
Called By: CSTEFF
Calls: None

Name: CSTEFF
Type: Subroutine
Module: CHRONC
Purpose -
  General: Modeling simulation
Specific: Computes the costs of the projected decontamination and interdiction and decides if it is cost effective to implement these actions.

Called By: LNGTPH
Calls:
  Conditional:
  CSTDCN - decontamination efforts are required

Name: CXPTBL
Type: Subroutine
Entry: KMPTBL
Module: CHRONC
Purpose -
  General: Input processing
  Specific: Check to see that the number of items on the Site Data File is the same as the number of items required by the model.

Called By: SDFINP
Calls: None

Name: DAYHOU
Type: Subroutine
Module: ATMOS
Purpose -
  General: Input processing
  Specific: Sample a specific weather sequence from the Meteorological Data File starting at a user-specified day and hour.

Called By: MACCS
Calls:
  Unconditional:
  ADJTIM, CONTRL, WBNDRY, WSAMPL

Name: DECAY
Type: Subroutine
Module: ATMOS
Purpose -
  General: Modeling simulation
  Specific: Decays all nuclides and stores the new inventory in an array.

Called By: ATMOUT, INPREL
Calls: None

Name: DIRDEP
Type: Subroutine
Module: CHRONC
Purpose -
  General: Modeling simulation
Specific: Compute the food pathway transfer factors from pasture and other crops for directly deposited nuclides.

Called By: CRNRSK
Calls: None

Name: DISRAN
Type: Character*12 Function
Module: EARLY, CHRONC
Purpose -
General: Output processing
Specific: Returns a text string describing the distance range from the beginning of one spatial interval to the end of another spatial interval.

Called By: RESNM1, RESNM4, RESNM5, RESNM6, RESNM7, RESNM8
RXNM10, RXNM12, RXSNM9

Calls:
Unconditional:
DIST1

Name: DIST1
Type: Subroutine
Module: CHRONC
Purpose -
General: Output processing
Specific: Returns a character string describing a distance.

Called By: DISRAN

Calls:
Conditional:
ABORT - spatial intervals exceed the maximum allowable distance

Name: DOICDF
Type: Subroutine
Module: OUTPUT
Purpose -
General: Output processing
Specific: Updates the CCDF for a single consequence value and keeps track of the following values: mean, probability of being non-zero, and peak trial.

Called By: READ2

Calls:
Conditional:
GNBIN1 - binned magnitudes were not previously generated
GNBIN2 - new maximum value was detected

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Name: DOCCDF
Type: Logical Function
Module: EARLY, CHRONC
Purpose -
   General: Input processing
   Specific: Returns a logical value to indicate if a CCDF is requested for a particular input parameter.
Called By: INOUT1, INOUT2, INOUT3, INOUT4, INOUT5, INOUT6, INOUT7, INOUT8, IXOT9, IXOT10, IXOT11, IXOT12,
Calls:
   Unconditional:
      RDSTRG
   Conditional:
      ABORT - data is not found in the correct column of the input record
      SEARCH - no error was detected in the length of the record ID

Name: DOSGET
Type: Subroutine
Module: CHRONC
Purpose -
   General: Modeling simulation
   Specific: Calculates the population dose to a selected organ in a spatial element via the 12 pathways.
Called By: OXTPT9
Calls: None

Name: EARINP
Type: Subroutine
Module: EARLY
Purpose -
   General: Input processing
   Specific: Defines the characteristics of the early effects model by processing the EARLY User Input File.
Called By: INPUT
Calls:
   Unconditional:
      INMISC, INORGA
   Conditional:
      No error was detected in list of organs
      EDCINP, INACAN, INDFAC, INEFAT, INEINJ, INEVAC, INOUT1, INOUT2, INOUT3, INOUT4, INOUT5, INOUT6, INOUT7, INOUT8, INPEMR, INPOPU

Name: EAROUT
Type: Subroutine
Module: EARLY
Purpose -
   General: Modeling simulation

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Specific: Calculates the results from the EARLY module for a single emergency response strategy.

Called By: CONTRL
Calls:
  Unconditional:
    CANRIS, CENZER, EMOVE, ESTAT, FATRIS, INJRIS, RELZON, STOEAR
  Conditional:
    First emergency response strategy is being considered
    EGEOM, EPCALC

Name: ECCGET
Type: Subroutine
Module: CHRONC
Purpose -
  General: Modeling simulation
  Specific: Calculates the 12 cost measures for a single spatial element.

Called By: OXPT10
Calls: None

Name: EDCINP
Type: Subroutine
Module: EARLY
Purpose -
  General: Input processing
  Specific: Reads the dose conversion factors for the EARLY module.

Called By: EARINP
Calls:
  Conditional:
    ERRFIL - an empty Dose Conversion File was encountered

Name: EDOSIN
Type: Subroutine
Module: EARLY
Purpose -
  General: Modeling simulation
  Specific: Calculates the doses received by a person in a spatial element under the plume centerline when that person is in the spatial element during a given time period.

Called By: EMOVE, ESTAT, RELZON
Calls: None

Name: EFFGET
Type: Function
Module: EARLY
Purpose -
General: Modeling simulation
Specific: Returns the number of a given health effect within a spatial element.
Called By: OUTPT1, OUTPT8
Calls:
Conditional:
   ABORT - invalid output code was detected

Name: EGEOM
Type: Subroutine
Module: EARLY
Purpose -
General: Modeling simulation
Specific: Calculates the following geometric factors for the early dosimetry model:
   average height of the Gaussian over the fine grid elements, and
   cloudshine correction factors for the fine grid elements.
Called By: EAROUT
Calls:
Conditional:
   CLSHIN - mean of sigma-z is nonzero

Name: EMOVE
Type: Subroutine
Module: EARLY
Purpose -
General: Modeling simulation
Specific: Accumulates the doses over the fine grid elements for moving individuals.
Called By: EAROUT
Calls:
Conditional:
   Evacuation occurs
      EDOSIN
   Straight line dispersion model is being used and the plume travels over the grid element
      CENACU

Name: EMRGPH
Type: Subroutine
Module: CHRONC
Purpose -
General: Modeling simulation
Specific: Calculates the emergency phase cost parameters.
Called By: CRNRSK
Calls: None

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Name: EPCALC
Type: Subroutine
Module: EARLY
Purpose -
  General: Modeling simulation
  Specific: Calculates the intermediate dosimetry parameters for all spatial intervals and all plume segments.
Called By: EAROUT
Calls:
  Conditional:
    ABORT - invalid dispersion flag value was detected
    - wind direction data is unavailable when using wind-shift model

Name: ERRFIL
Type: Subroutine
Module: ATMOS, EARLY, CHRONC
Purpose -
  General: Input error processing
  Specific: Identify errors encountered within the auxiliary input data files and identify the location of the error.
Called By: CMPTBL, EDCINP, INPOPU, MATCH, WRDMET
Calls: None

Name: ERRLOC
Type: Subroutine
Module: ATMOS, EARLY, CHRONC
Purpose -
  General: Input error monitoring
  Specific: Identify calling subroutine and variable name if an error was encountered during the search for input data.
Called By: EVNETW, INACAN, INEFAT, INEINJ, INEVAC, INMISC, INORGA, INOUT1, INOUT3, INOUT4, INOUT5, INOUT6, INOUT7, INOUT8, INPEMR, INPGE0, INPISO, INPM4, INPOPT, INPREL, INPUT, IXOT9, IXOT10, IXOT12, MODLDF, PUTSTG, PUTSTM, RDISTB, STPATH
Calls: None

Name: ESTAT
Type: Subroutine
Module: EARLY
Purpose -
  General: Modeling stimulation
  Specific: Accumulates the doses to stationary individuals in the sheltering and evacuation rings of the emergency response zone.
Called By: EAROUT
Calls:
Conditional:
People are in an evacuation or sheltering zone
  EDOSIN - normal activity before sheltering or evacuation
  - sheltering or evacuation occurs
  INCDOS - normal activity before sheltering or evacuation
  - sheltering or evacuation occurs
Straight line dispersion model is being used
  CENACU - normal activity before sheltering or evacuation
  - sheltering or evacuation occurs

Name: EVNETW
Type: Subroutine
Module: EARLY
Purpose -
  General: Input processing
  Specific: Defines the evacuation network data making a list of
           the root nodes.
Called By: INEVAC
Calls:
  Unconditional:
    IGET1
  Conditional:
    ERRLOC - spatial element in the movement zone is duplicated
    - missing spatial element in the movement zone
    No error was detected in the definition of the spatial
    elements in the movement zone
    ERRLOC - nonadjacent spatial elements are being used in
    the evacuation network
    - null destination is incorrectly used for a
    spatial element in the evacuation network
    - loop in the evacuation network was detected
    EVROOT - no error was detected in the definition of the
    evacuation network.

Name: EVRADI
Type: Subroutine
Module: EARLY
Purpose -
  General: Input processing
  Specific: Define the radial evacuation data and create an
           evacuation network to represent it making a list of
           the root nodes for the network.
Called By: INEVAC
Calls:
  Unconditional:
    RGET1
Name: EVROOT
Type: Subroutine
Module: EARLY
Purpose -
  General: Input processing
  Specific: Makes a list of the root nodes within an evacuation zone.
Called By: EVNETW
Calls: None

Name: EXCINP
Type: Subroutine
Module: CHRONC
Purpose -
  General: Input processing
  Specific: Read in the dose conversion factors to CHRONC.
Called By: CHRINP
Calls:
  Conditional:
    ABORT - empty data file was encountered

Name: EXPINT
Type: Function
Module: OUTPUT
Purpose -
  General: Output processing
  Specific: Returns a logarithmic base 10 interpolation to find the consequence value corresponding to a particular quantile.
Called By: QUANTL
Calls: None

Name: FATRIS
Type: Subroutine
Module: EARLY
Purpose -
  General: Modeling simulation
  Specific: Calculates the risk of early fatality from short term exposure (1 - 7 days) for all spatial elements.
Called By: EAROUT
Calls: None

Name: FSGY
Type: Function
Entry: FSGYIN
Module: ATMOS
Purpose -
  General: Modeling simulation
Specific: Uses the Pasquill-Gifford formula to calculate $\sigma_y$ as a function of the stability class and the along-wind distance.

Called By: ATMOUT
Calls: None

Name: FSGYIN
Type: Entry
Host: FSGY
Module: ATMOS
Purpose -
  General: Modeling simulation
  Specific: Uses the Pasquill-Gifford formula to calculate $\sigma_y$ as a function of the stability class and the along-wind distance.

Called By: ATMOUT
Calls: None

Name: FSGZ
Type: Function
Entry: FSGZIN
Module: ATMOS
Purpose -
  General: Modeling simulation
  Specific: Uses the Pasquill-Gifford formula to calculate $\sigma_z$ as a function of stability class and along-wind distance

Called By: ATMOUT
Calls: None

Name: FSGZIN
Type: Entry
Host: FSGZ
Module: ATMOS
Purpose -
  General: Modeling simulation
  Specific: Uses the Pasquill-Gifford formula to calculate $\sigma_z$ as a function of stability class and along-wind distance

Called By: ATMOUT
Calls: None

Name: GETIMP
Type: Subroutine
Module: CHRONC
Purpose -
  General: Modeling simulation
Specific: Calculates the extent of the following long-term actions:
   - Decontamination,
   - Interdiction,
   - Condemnation,
   - Milk disposal, and
   - Crop disposal.

Called By: OXPT11, OXPT12
Calls: None

Name: GETSTG
Type: Entry
Host: PUTSTG
Module: EARLY
Purpose -
   General: Input processing
   Specific: Fetches the evacuation strategy input parameters when more than one evacuation strategy is being used.

Called By: CONTRL
Calls: None

Name: GETSTM
Type: Entry
Host: PUTSTM
Module: ATMOS
Purpose -
   General: Input processing
   Specific: Fetch the additional source term data blocks if there is more than one source term being used.

Called By: MACCS
Calls: None

Name: GNBIN1
Type: Subroutine
Module: OUTPUT
Purpose -
   General: Output processing
   Specific: Generates the initial bin magnitudes for a single result (binning always starts at a power of ten).

Called By: D01CDF
Calls:
   Unconditional:
     ILOG10

Name: GNBIN2
Type: Subroutine
Module: OUTPUT
Purpose -
General: Output processing
Specific: Regenerates bin magnitudes for a single result when a new maximum consequence is found.
Called By: DO1CDF
Calls: None

Name: GNDRES
Type: Subroutine
Module: CHRONC
Purpose -
General: Input processing
Specific: Compute the groundshine or resuspension pathway dosimetry factors.
Called By: CHRNDF
Calls: None

Name: HEDCHR
Type: Subroutine
Module: CHRONC
Purpose -
General: Output processing
Specific: Loads the data necessary to generate results for the CHRONC module.
Called By: OUTCON
Calls:
Unconditional:
RXXM10, RXXM11, RXXM12, RXSM9
Conditional:
ABORT - number of results requested exceeds the maximum allowed

Name: HEDEAR
Type: Subroutine
Module: EARLY
Purpose -
General: Output processing
Specific: Prepares the list of requested results for the EARLY module.
Called By: OUTCON
Calls:
Unconditional:
RESMN1, RESMN2, RESMN3, RESMN4, RESMN5, RESMN6
RESMN7, RESMN8
Conditional:
ABORT - number of results requested exceeds the maximum allowed
Name: IGET1
Type: Function
Module: ATMOS, EARLY, CHRONC
Purpose -
General: Input processor
Specific: Returns a single integer value from the input database.
Called By: EVNETW, IGETN, INACAN, INCHRN, INEFAT, INEINJ, INEVAC, INMISC, INORGA, INOUT1, INOUT2, INOUT3, INOUT4, INOUT5, INOUT6, INOUT7, INOUT8, INPDRY, INPEMR, INPGE0, INPISO, INPM1, INPM2, INPM3, INPM4, INPOPT, INPOPU, INPREL, IXOT9, IXOT10, IXOT12, STPATH,
Calls:
Conditional:
RDSTRG - no error was detected in the column pointer for finding data
SEARCH - no error was detected in the column pointer for finding the data or in the length of the record ID

Name: IGETN
Type: Subroutine
Module: ATMOS, EARLY, CHRONC
Purpose -
General: Input processor
Specific: Returns an array of integer values from the input database.
Called By: INCHRN, INEVAC, INOUT1, INOUT4, INOUT5, INOUT6, INOUT7, INOUT8, INPISO, INPM4, INPM5, IXOT9, IXOT10, IXOT12
Calls:
Conditional:
IGET1 - no error was detected in the length of the record ID

Name: ILOG10
Type: Function
Module: OUTPUT
Purpose -
General: Output processing
Specific: Returns the nearest power of 10 less than the argument.
Called By: GNBIN1
Calls: None

Name: IMDICT
Type: Logical Function
Module: ATMOS, EARLY, CHRONC
Purpose -
General: Input processing
Specific: Determines if a character string is composed of only numeric digits.
Called By: IMNTGR, IMREAL
Calls: None

Name: IMLGCL
Type: Logical Function
Module: ATMOS, EARLY, CHRONC
Purpose -
General: Input processing
Specific: Determines if a character string is of type logical.
Called By: RDSTRG
Calls: None

Name: IMNTGR
Type: Logical Function
Module: ATMOS, EARLY, CHRONC
Purpose -
General: Input processing
Specific: Determines if a character string is of type integer.
Called By: RDSTRG, IMREAL
Calls:
Conditional:
IMDIGT - no error was detected in the length of the string to be read

Name: IMREAL
Type: Logical Function
Module: ATMOS, EARLY, CHRONC
Purpose -
General: Input processing
Specific: Determines if a character string is of type real.
Called By: RDSTRG
Calls:
Conditional:
No error was detected in length or content of the string to be read.
IMDIGT, IMNTGR

Name: INACAN
Type: Subroutine
Module: EARLY
Purpose -
General: Input processing
Specific: Defines the model for the cancer risk from acute exposure.
Called By: EARINP
Calls:
  Unconditional:
    IGET1
  Conditional:
    Number of cancer types is nonzero and is correctly defined.
    CGET1
    ERRLOC - organ name is not on the list of organs
    IGET1
    RGET1
    RGETN

Name: INCDOS
Type: Subroutine
Module: EARLY
Purpose -
  General: Modeling simulation
  Specific: Accumulates the doses to stationary individuals over the fine grid.
Called By: ESTAT, RELZON
Calls: None

Name: INCHRN
Type: Subroutine
Module: CHRONC
Purpose -
  General: Input processing
  Specific: Processes the user input for the CHRONC models.
Called By: INPCHR
Calls:
  Unconditional:
    CGET1, IGET1, IGETN, RGET1, RGETN

Name: INCREM
Type: Subroutine
Module: EARLY
Purpose -
  General: Modeling simulation
  Specific: Recalculates the dose received by individuals in a spatial element for a single plume segment if either hot spot or normal relocation is required.
Called By: RELZON
Calls:
  Conditional:
    Straight line dispersion model is being used with no angular displacement from the center of the spatial element
    CENZER - first plume is being considered
    CENACU
Name: INDFAC
Type: Subroutine
Module: EARLY
Purpose -
  General: Input processing
  Specific: Defines protection and exposure factors for the EARLY dosimetry model.
Called By: EARINP
Calls:
  Unconditional:
    RGET1, RGETN

Name: INEFAT
Type: Subroutine
Module: EARLY
Purpose -
  General: Input processing
  Specific: Processes input data for the early fatality risk model.
Called By: EARINP
Calls:
  Unconditional:
    IGET1, CGET1
  Conditional:
    Number of early fatality effects is nonzero and is correctly defined.
    ERRLOC - organ name is not found on the list of organs
    CGET1
    RGETN

Name: INEINJ
Type: Subroutine
Module: EARLY
Purpose -
  General: Input processing
  Specific: Processes the input data for the early injury models.
Called By: EARINP
Calls:
  Unconditional:
    IGET1
  Conditional:
    Number of early injury effects is nonzero and is correctly defined.
    CGET1
    ERRLOC - organ name is not found on the list of organs
    RGETN
Name: INEVAC
Type: Subroutine
Module: EARLY
Purpose -
  General: Input processing
  Specific: Processes the evacuation data.
Called By: EARINP, REDSTG
Calls:
  Unconditional:
    CGET1, IGET1, IGETN, RGET1, RGETN
  Conditional:
    Evacuation zone exists and the outermost ring of zone is correctly defined
      IGET1
    Innermost ring of the evacuation zone is correctly defined
      ERRLOC - evacuation rings are not concentric
      - nonzero delay time has been defined
      for an undefined evacuation ring
      EVNETW - network evacuation is to be used
      EVRADI - radial evacuation is to be used

Name: INITLZ
Type: Subroutine
Module: CHRONC
Purpose -
  General: Modeling simulation
  Specific: Initializes all CHRONC cost, dose, and action arrays.
Called By: CRNRSK
Calls: None

Name: INJRIS
Type: Subroutine
Module: EARLY
Purpose -
  General: Modeling simulation
  Specific: Calculates the risk of early injury for all spatial elements.
Called By: EAROUT
Calls: None

Name: INMISC
Type: Subroutine
Module: EARLY
Purpose -
  General: Input processing
Specific: Defines the following input information for the run:

- EARLY scenario for title card,
- flag to skip the CHRONC module,
- flag for the kind of plume travel pattern,
- number of fine grid subdivisions within each coarse grid element,
- flag if a windrose is to be supplied by user,
- windrose array if it is user-supplied,
- level of debug output desired, and
- flag if the output is to include a breakdown of the relative contribution to the mean from each weather category bin.

Called By: EARINP

Calls:

Unconditional:
- CGET1, IGET1, LGET1, RGETN

Conditional:
- ERRLOC - odd number of fine grid elements is being used in each coarse grid element
- error is detected in the windrose array data

Name: INORGA
Type: Subroutine
Module: EARLY
Purpose -

General: Input processing
Specific: Defines the list of organs for the early health effects.

Called By: EARINP

Calls:

Unconditional:
- CGET1, IGET1

Conditional:
- ERRLOC - skin appears on the list of organs more than once
- an organ other than skin is designated as organ number 1

Name: INOUT1
Type: Subroutine
Module: EARLY
Purpose -

General: Input processing
Specific: Defines the options for result number 1:
- Total number of given health effects within a range of distances,
- Early deaths and early injuries, and
- Latent cancer deaths and injuries.

Called By: EARINP

Calls:
Unconditional:
IGET1
Conditional:
Number of health effects desired is nonzero and is correctly defined
CGET1
Names of the health effects are correctly defined
ERRLOC - no early fatality model is defined
- name of injury was not found on the list of injuries
- no latent cancer models is defined
- name of cancer death or cancer injury was not found on the list of cancer names
- invalid effect name is being used
IGETN
All input data for the health effects is correctly defined
ERRLOC - inner ring of the region of interest lies outside the outer ring
DOCCDF

Name: INOUT2
Type: Subroutine
Module: EARLY
Purpose -
General: Input processing
Specific: Defines the options for result number 2:
  Furthest distance at which a given probability of death is exceeded.
Called By: EARINP
Calls:
Unconditional:
IGET1
Conditional:
Number of types of effect is nonzero and is correctly defined
RGETN
All input data for the health effects is correctly defined
DOCCDF

Name: INOUT3
Type: Subroutine
Module: EARLY
Purpose -
General: Input processing
Specific: Defines the options for result number 3:
  Number of people whose "acute" dose to a given organ exceeds a given threshold.
Called By: EARINP
Calls:
   Unconditional:
       IGET1
   Conditional:
       Number of health effects is nonzero and is correctly defined
       CGET1
       DOCCDF
       ERRLOC - organ name is not found on the list of organs
       - incorrect flag value was found for type of dose being calculated
       - acute dose factors for an organ have been requested but were not defined
       IGETN

Name: INOUT4
Type: Subroutine
Module: EARLY
Purpose -
   General: Input processing
   Specific: Defines the options for result number 4:
   Average individual risk of a given effect at a given distance.
Called By: EARINP

Calls:
   Unconditional:
       IGET1
   Conditional:
       Number of effects is nonzero and is correctly defined
       CGET1
       IGETN
       Names of health effects is correctly defined
       DOCCDF
       ERRLOC - no early fatality model is defined
       - injury name is not found on the list of injuries
       - no latent cancer model is defined
       - cancer death name or cancer injury name is not found on the list of latent cancers
       IGETN

Name: INOUT5
Type: Subroutine
Module: EARLY
Purpose -
   General: Input processing
   Specific: Defines the options for result number 5:
   Total population dose to a given organ between two distances.
Called By: EARINP
Calls:
Unconditional:
   IGET1
Conditional:
   Number of results is nonzero and is correctly defined
   CGET1
   ERRLOC - organ name is not found on the list of organs
   IGETN
   All input data for health effects is correctly defined
   ERRLOC - outer ring of the region of interest is not outside the inner ring
   DOCCDF

Name: INOUT6
Type: Subroutine
Module: EARLY
Purpose -
   General: Input processing
   Specific: Defines the options for result number 6:
   Centerline dose by pathway between a range of distances.
Called By: EARINP
Calls:
   Unconditional:
   IGET1
   Conditional:
   Number of health effects is nonzero and is correctly defined
   CGET1
   ERRLOC - radial evacuation is not being used for a straightline plume
   - organ name is not found on the list of organs
   - acute doses have been requested but have not been defined
   - pathway name is not on the list of pathway names
   IGETN
   All input data for health effects is correctly defined
   DOCCDF

Name: INOUT7
Type: Subroutine
Module: EARLY
Purpose -
   General: Input processing
   Specific: Defines the options for result number 7:
   Centerline risk of a given effect between a range of distances,
   Early deaths and injuries, and
   Latent cancer deaths and injuries.
Called By: EARINP
Calls:
Unconditional:
IGET1
Conditional:
Number of health effects is nonzero and correctly defined
CGET1
ERRLOC - radial evacuation is not used with a straightline plume
Name of the organ is correctly defined
ERRLOC - name of the injury is not found on the list of injuries
- no latent cancer model is defined
- name of cancer death or cancer injury is not on the list of latent cancers
- invalid name for the health effect was detected
IGETN
All input data for the health effect is correctly defined
ERRLOC - outer ring of the region of interest is not outside the inner ring
DOCCDF

Name: INOUT8
Type: Subroutine
Module: EARLY
Purpose:
General: Input processing
Specific: Defines the options for result number 8:
Population weighted risk of a given health effect between two distances.
Called By: EARINP
Calls:
Unconditional:
IGET1
Conditional:
Number of health effects is correctly defined
CGET1
Name of the health effect is correctly defined
ERRLOC - early fatality model is not defined
- name of early injury is not found on the early injury list
- latent cancer model is not defined
- name of latent cancer death or injury is not found on the cancer list
- invalid effect name was detected
All input data for health effects is correctly defined
ERRLOC - inner ring of the region of interest lies outside the outer ring
IGETN
DOCCDF
Name: INPBEG
Type: Subroutine
Module: ATMOS, EARLY, CHRONC
Purpose -
   General: Input processing
   Specific: Sets up a database for storing the user input data
            for a single file.
Called By: INPUT
Calls:
   Unconditional: SORT
   Conditional:
            SEARCH - multiple source terms or more than one emergency
            response strategy is being used

Name: INPCHR
Type: Subroutine
Module: CHRONC
Purpose -
   General: Input processing
   Specific: Controls the processing of the CHRONC User
            Input File.
Called By: CHRINP
Calls:
   Unconditional:
            INCHRn, IXOT9, IXOT10, IXOT11, IXOT12, STPATH

Name: INPDIS
Type: Subroutine
Module: ATMOS
Purpose -
   General: Input processing
   Specific: Loads the dispersion parameter data from the ATMOS
            User Input File needed for defining the atmospheric
            model.
Called By: ATMODL
Calls:
   Unconditional:
            RGET1, RGETN

Name: INPDRY
Type: Subroutine
Module: ATMOS
Purpose -
   General: Input processing
   Specific: Loads the dry deposition data from the ATMOS User
            Input File needed to define the atmospheric model.
Called By: ATMODL

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Name: INFER
Type: Subroutine
Module: EARLY
Purpose -
  General: Input processing
  Specific: Defines the emergency response zone.
Called By: EARINP, REDSTG
Calls:
  Unconditional:
    CGET1, IGET1, RGET1
  Conditional:
    ERRLOC - outer shelter zone is not outside the evacuation zone

Name: INPEND
Type: Subroutine
Module: ATMOS, EARLY, CHRONC
Purpose -
  General: Input processing
  Specific: Closes a user input file when it is no longer needed.
Called By: INPUT
Calls: None

Name: INPEXP
Type: Subroutine
Module: ATMOS
Purpose -
  General: Input processing
  Specific: Defines the plume expansion factor parameters.
Called By: ATMODL
Calls:
  Unconditional:
    RGET1

Name: INPGE
Type: Subroutine
Module: ATMOS
Purpose -
  General: Input processing
  Specific: Defines the geometric grid to be used.
Called By: ATMODL
Calls:
Unconditional:
IGETI
Conditional:
No error was detected in the number or range of spatial elements in the radial direction.
ERRLOC - spatial endpoint distances are not increasing
RGETN

Name: INPISO
Type: Subroutine
Module: ATMOS
Purpose -
General: Input processing
Specific: Defines nuclide data used in the atmospheric model.
Called By: ATMODL
Calls:
Unconditional:
IGETI
Conditional:
ERRLOC - duplicate nuclide name was detected
- unrecognizable parent name was detected
- daughter and parent have the same half-life
Number of nuclides is correctly defined
IGETI
Number of nuclide groups is correctly defined
CGETI
ERRLOC - duplicate nuclide name was detected
IGETN
LGETN
RGETN
No duplicate nuclide name is used
CGETI
ERRLOC - unrecognizable parent was detected
All input data for nuclides and parents is correctly defined
ERRLOC - daughter and parent have the same half-life

Name: INPLRS
Type: Subroutine
Module: ATMOS
Purpose -
General: Input processing
Specific: Defines the critical wind speed and the scaling factors to allow for modification of the plume rise model:
critical wind speed,
A-D plume rise, and
E-F plume rise.
Called By: ATMODL
Calls:
  Unconditional:
    RGET1

Name: INPM1
Type: Subroutine
Module: ATMOS
Purpose:
  General: Input processing
  Specific: Defines the meteorological code and loads the weather file with a year's weather data into a storage array.

Called By: INPMET
Calls:
  Unconditional:
    IGET1
  Conditional:
    ABORT - error was found in the augmented T-M-Y meteorological data file
    WRDMET - meteorological code is 1, 2, or 5

Name: INPM2
Type: Subroutine
Module: ATMOS
Purpose:
  General: Input processing
  Specific: Loads the weather sampling boundary condition weather parameters.

Called By: INPMET
Calls:
  Unconditional:
    IGET1
    RGET1

Name: INPM3
Type: Subroutine
Module: ATMOS
Purpose:
  General: Input processing
  Specific: Loads the accident start time (day and hour) for weather sampling.

Called By: INPMET
Calls:
  Unconditional:
    IGET1
Name: INPM4
Type: Subroutine
Module: ATMOS
Purpose -
   General: Input processing
   Specific: Loads the rain bin data for weather sampling.
Called By: INPMET
Calls:
   Unconditional:
      ERRLOC - rain interval distances not monotonically increasing
      - rain interval endpoints and spatial interval endpoints do not coincide
      - rain intensity breakpoints not monotonically increasing
      - error was detected in the specification of the rain intensity intervals
      IGET1
      RGETN
      WBNMET
      No weather samples are to be taken from each bin
      IGET1
      IGETN

Name: INPM5
Type: Subroutine
Module: ATMOS
Purpose -
   General: Input processing
   Specific: Loads 120 hours of weather data for the weather sampling.
Called By: INPMET
Calls:
   Unconditional:
      IGETN, RGETN

Name: INPMET
Type: Subroutine
Module: ATMOS
Purpose -
   General: Input processing
   Specific: Defines the characteristics of the weather sampling to be used by processing data from the ATMOS User Input File.
Called By: ATPROB
Calls:
   Unconditional:
      INPM1
Conditional:
User-specified day and hour of a single sequence on the meteorological file to be used
INPM2, INPM3
Weather category bin sampling or random sampling stratified by day of the year to be used
INPM2, INPM4
ATMOS user input file specifies 120 hours of weather to be used
INPM2, INPM3, INPM5
Single weather trial with constant conditions to be used
INPM2, INPM3

Name: INPOPT
Type: Subroutine
Module: ATMOS
Purpose -
General: Input processing
Specific: Defines output options for the ATMOS module.
Called By: ATPROB
Calls:
Unconditional:
IGET1, LGET1
Conditional:
Name of the nuclide is needed on the dispersion listing
CGET1
ERRLOC - nuclide name was not found

Name: INPOPU
Type: Subroutine
Module: EARLY
Purpose -
General: Input processing
Specific: Defines the population distribution surrounding the site (can either be uniform density or user-supplied on Site Data File).
Called By: EARINP
Calls:
Unconditional:
CGET1
Conditional:
ERRFIL - empty data file was encountered
- incorrect designation was made of the population distribution to be used
Population surrounding the site is correctly defined
Uniform population is being used
RGET1
Population density is correctly defined
IGET1
Population location is correctly defined
CMPTBL
MATCH
Spatial distances are correctly defined
ERRFIL - spatial intervals defined in the Site Data File conflict with those in the model
MATCH

Name: INPREL
Type: Subroutine
Module: ATMOS
Purpose -
General: Input processing
Specific: Processes input data defining the release description of the plume.
Called By: ATPROB, INPUT
Calls:
Unconditional:
CGET1, IGET1, RGETN
Conditional:
Plume duration is correctly defined
RGETN
Time of release is correctly defined
CGET1
ERRLOC - plume segment overlaps the preceding plume
- error was detected in the particle size distribution
- duplicate core inventory specifications are given for a nuclide
- no core inventory specifications are given for a nuclide
IGET1
RGET1
RGETN - core inventory specifications are correctly defined
RGETN
All input data for the release is correctly defined
DECAY

Name: INPUT
Type: Subroutine
Module: ATMOS, EARLY, CHRONC
Purpose -
General: Input processing
Specific: Controls the processing of all user input for the ATMOS, EARLY, AND CHRONC modules and sets the framework for the simulation portion of the calculations.
Called By: MACCS

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Calls:

Unconditional:
ATMODL, INPBEG

Conditional:

**ABORT** - more than 60 source terms are being requested
- error was detected in the ATMOS model definition
- error was detected in the release description input data
- error was detected in processing the change cards in the ATMOS User Input File
- error was detected in the EARLY model input data
- more than 3 emergency response strategies are being requested
- error was detected in the input data when more than one emergency response strategy is being used
- error was detected in processing the change cards in the EARLY User Input File
- error was detected in the input data for the CHRONC module

**ATPROB** - no errors were detected in the ATMOS model definition

**CHRINP** - CHRONC module is to be exercised

**EARINP** - no errors were detected in the input data for the ATMOS module

**ERRLOC** - more than 60 source terms are being requested
- more than 3 emergency response strategies are being requested

**INPBEG** - more than one source term is being supplied
- no errors were detected in the input data for the ATMOS module and EARLY is to be exercised
- more than one emergency response strategy is being used
- no errors were detected in the input data for the EARLY module and CHRONC is to be exercised

**INPEND** - more than one source term is being supplied and no error was detected in the ATMOS input data
- more than one emergency response strategy is being used and no error was detected in the EARLY input data
- want to exercise the CHRONC module and no error was detected in input data

**INPREL** - more than one source term being supplied

**OUTCON** - no errors were detected in the input data for all modules being exercised

**PUTSTG** - no error was detected in the EARLY change case when more than one emergency response strategy is being requested

**PUTSTM** - more than one source term is being supplied and there were no errors detected in the release description input data

**REDSTG** - more than one emergency response strategy is being requested

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Name: INPWAK
Type: Subroutine
Module: ATMOS
Purpose -
  General: Input processing
  Specific: Processes input data defining the building dimensions (width and height) to be used in the treatment of the building wake effects.
Called By: ATPROB
Calls:
  Unconditional:
    RGET1

Name: INPWET
Type: Subroutine
Module: ATMOS
Purpose -
  General: Input processing
  Specific: Loads the wet deposition data from the ATMOS User Input File.
Called By: ATMODL
Calls:
  Unconditional:
    RGET1

Name: INTRPH
Type: Subroutine
Module: CHRONC
Purpose -
  General: Modeling simulation
  Specific: Establishes the intermediate phase response.
Called By: CRNRSK
Calls: None

Name: IXOT9
Type: Subroutine
Module: CHRONC
Purpose -
  General: Input processing
  Specific: Defines the options for result number 9:
    Long-term population dose broken down by the 12 long-term pathways.
Called By: INPCHR
Calls:
  Unconditional:
    IGET1
  Conditional:
    Number of results is nonzero and is correctly defined
    CGET1
ERRLOC - organ name is not found on the organ list
IGETN
No error was detected in the input data
ERRLOC - inner ring of the region of interest is outside the outer ring
DOCCDF

Name: IXOT10
Type: Subroutine
Module: CHRONC
Purpose -
  General: Input processing
  Specific: Defines the options for result number 10:
    Economic cost measures:
    Total costs,
    Decontamination costs,
    Interdiction costs,
    Condemnation costs,
    Milk disposal costs, and
    Crop disposal costs.

Called By: INPCHR
Calls:
  Unconditional:
    IGET1
  Conditional:
    Number of results is nonzero and is correctly defined
    IGETN
    No error was detected in the input data
    ERRLOC - inner ring of the region of interest is outside the outer ring
    DOCCDF

Name: IXOT11
Type: Subroutine
Module: CHRONC
Purpose -
  General: Input processing
  Specific: Defines the options for result number 11:
    Maximum distance of a specified long-term action:
    Decontamination,
    Interdiction,
    Condemnation,
    Milk disposal, and
    Crop disposal.

Called By: INPCHR
Calls:
  Unconditional:
    LGET1
Conditional:
   Distance results flag is correctly defined
   DOCCDF

Name: IXOT12
Type: Subroutine
Module: CHRONC
Purpose: 
   General: Input processing
   Specific: Defines the options for result number 12:
   Impact of a specified long-term action:
   Area of decontamination, interdiction, condemnation, milk disposal, crop
   disposal, and
   Population residing on decontaminated, interdicted, or condemned land.
Called By: INPCHR
Calls: 
   Unconditional: 
   IGET1
   Conditional: 
   Number of results is nonzero and is correctly defined 
   IGETN
   No error was detected in the input data 
   ERRLOC - inner ring of the region of interest is
   outside the outer ring 
   DOCCDF

Name: KMPTBL
Type: Entry
Host: CXPTBL
Module: CHRONC
Purpose: 
   General: Input processing
   Specific: Checks to see that the number of items on the Site
   Data File is the same as the number of items
   required by the model.
Called By: SDFINP
Calls: None

Name: LGET1
Type: Function
Module: ATMOS, EARLY, CHRONC
Purpose: 
   General: Input processor
   Specific: Returns a single logical value from the input
   database.
Called By: INMISC, INFOPT, IXOT11, LGETN, STPATH

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Calls:
  Conditional:
  RDSTRG - no error was detected in the column pointer
  for finding the data
  SEARCH - no error detected in column pointer for finding
  data or in length of record ID

Name: LGETN
Type: Subroutine
Module: ATMOS, EARLY, CHRONC
Purpose -
  General: Input processor
  Specific: Returns an array of logical values from the input
  database
Called By: INPISO
Calls:
  Conditional:
  LGETL - no error was detected in the length of the
  record ID

Name: LNGTPH
Type: Subroutine
Module: CHRONC
Purpose -
  General: Modeling simulation
  Specific: Controls the calculation of the long-term chronic
dose and economic risk.
Called By: CRNRSK
Calls:
  Unconditional:
  CSTEFF, LTACUM, LTPROJ

Name: LOKSEE
Type: Subroutine
Module: CHRONC
Purpose -
  General: Output processing
  Specific: Prints a summary of the resulting doses and costs
  for a given spatial interval which were accumulated
during the long-term phase.
Called By: CRNRSK
Calls: None

Name: LTACUM
Type: Subroutine
Module: CHRONC
Purpose -
  General: Modeling simulation
Specific: Accumulates the doses and costs resulting from the actions taking place in the long-term phase.

Called By: LNGTPH
Calls: None

Name: LTMACT
Type: Subroutine
Module: CHRONC
Purpose -
  General: Modeling simulation
  Specific: Computes the required long-term actions to meet the habitability criteria (the level of decontamination and any subsequent period of decay required).

Called By: LTPROJ
Calls: None

Name: LTPROJ
Type: Subroutine
Module: CHRONC
Purpose -
  General: Modeling simulation
  Specific: Calculates the long-term actions required to meet long-term dose criteria.

Called By: LNGTPH
Calls: Conditional:
  LTMACT - land was declared uninhabitable

Name: MATCH
Type: Subroutine
Module: EARLY
Purpose -
  General: Error monitoring
  Specific: Check to see that Site Data File key separator is the same as the separator read from the Site Data File.

Called By: INPOPU
Calls: Conditional:
  ERFIL - separator read from Site Data File does not match the key separator

Name: MODLDF
Type: Entry
Host: OPNERL
Module: CHRONC
Purpose -
  General: Input processing
Specific: Copies common blocks used by EARLY into common
blocks used by CHRONC.
Called By: CHRINP
Calls:
Conditional:
ERRFIL - invalid value of POPFLG used

Name: MXTCH
Type: Subroutine
Module: CHRONC
Purpose -
General: Input processing
Specific: Check to see that the Site Data File key separator
is the same as the separator read from the Site Data
File.
Called By: SDFINP
Calls: None

Name: MXXCLK
Type: Subroutine
Module: MAIN
Purpose -
General: Arm of the operating system
Specific: Gets the current time.
Called By: MACCS
Calls: None

Name: MXXCPU
Type: Subroutine
Module: MAIN
Purpose -
General: Arm of the operating system
Specific: Gets the CPU clock.
Called By: MACCS
Calls:
Conditional:
ABORT - VAX/VMS is not being used

Name: MXXDAT
Type: Subroutine
Module: MAIN
Purpose -
General: Arm of the operating system
Specific: Gets the date.
Called By: MACCS
Calls: None
Name: MXXETC
Type: Subroutine
Module: MAIN
Purpose -
  General: Arm of the operating system
  Specific: Defines the computer and operating system, and contains any necessary machine dependent initialization.
Called By: MACCS
Calls: None

Name: NOTFOU
Type: Function
Module: OUTPUT
Purpose -
  General: Output processing
  Specific: Returns the character string "not-found" if the value of the variable in question equals -1, otherwise it returns the value of variable.
Called By: PRINT
Calls: None

Name: OPNERL
Type: Subroutine
Entry: MODLDF
Module: CHRONC
Purpose -
  General: Input processing
  Specific: Copies the modeling data from common blocks used by EARLY into common blocks used by CHRONC.
Called By: CHRINP
Calls: Conditional:
  ERRLOC - invalid flag value is used to indicate population data

Name: OUTCON
Type: Subroutine
Module: EARLY, CHRONC
Purpose -
  General: Output processing
  Specific: Prepares for writing the results from both EARLY and CHRONC and writes the header records on each file used to control the output module.
Called By: INPUT
Calls: None
Conditional:
Exercising the EARLY module
HENEAR
COPCHR
Exercising the CHRONC module
HEDCHR

Name: OUTPT1
Type: Subroutine
Module: EARLY
Purpose -
General: Modeling simulation
Specific: Calculates result number 1:
Total number of a given health effect due to the
dose received during the emergency phase for
people within a range of distances:
Early deaths and injuries, and
Latent cancer deaths and injuries.
Called By: STOEAR
Calls:
Conditional:
Straightline dispersion model is being used
EFFGET
EFFGET - complex rotation around the circle is needed
because the spatial element is not under the
plume but the element is contaminated
Wind shift dispersion model with rotation is being used and
the element is contaminated
EFFGET
Wind shift dispersion model without rotation is being used
and the element is contaminated
EFFGET

Name: OUTPT2
Type: Subroutine
Module: EARLY
Purpose -
General: Modeling simulation
Specific: Calculates result number 2:
Furthest distance at which a given probability of
an early death is exceeded.
Called By: STOEAR
Calls: None

Name: OUTPT3
Type: Subroutine
Module: EARLY
Purpose -
General: Modeling simulation
Specific: Calculates result number 3:
Number of people whose dose to a given organ exceeds a specified threshold (either acute or lifetime dose may be used for the calculation).

Called By: STOEAR
Calls: None

Name: OUTPT4
Type: Subroutine
Module: EARLY
Purpose -
General: Modeling simulation
Specific: Calculates result number 4:
Average risk of a given effect at a given distance through 360 degrees.

Called By: STOEAR
Calls: Conditional:
ABORT - invalid output request was detected

Name: OUTPT5
Type: Subroutine
Module: EARLY
Purpose -
General: Modeling simulation
Specific: Calculates result number 5:
Total long-term population dose to a given organ between two distances.

Called By: STOEAR
Calls: None

Name: OUTPT6
Type: Subroutine
Module: EARLY
Purpose -
General: Modeling simulation
Specific: Calculates result number 6:
Centerline dose to a selected organ by various pathways at various distances.

Called By: STOEAR
Calls: Conditional:
ABORT - invalid output request was detected
Name: OUTPT7
Type: Subroutine
Module: EARLY
Purpose -
  General: Modeling simulation
  Specific: Calculates result number 7:
          Centerline risk of a given effect at various distances,
          Early deaths and injuries, and
          Latent cancer deaths and injuries.
Called By: STOEAR
Calls:
  Conditional:
    ABORT - invalid output request was detected
    - invalid option code was detected

Name: OUTPT8
Type: Subroutine
Module: EARLY
Purpose -
  General: Modeling simulation
  Specific: Calculates result number 8:
          Population weighted risk of a given health effect between 2 distances.
Called By: STOEAR
Calls:
  Conditional:
    Population in the spatial element is nonzero and
    straightline dispersion model is being used
    EFFGET
    EFFGET - complex rotation around circle is needed
    because the spatial element is not under the plume but the element is contaminated
    Wind shift dispersion model with rotation is being used
    and the element is contaminated
    EFFGET
    Wind shift dispersion model without rotation is being used and the element is contaminated
    EFFGET

Name: OUTPUT
Type: Subroutine
Module: OUTPUT
Purpose -
  General: Output processing
  Specific: Controls the generation of the summary output information.
Called By: MACCS
Calls:
Unconditional:
READ1
Conditional:
ABORT - error was detected in the header records for the result files
No error was detected in the header records for the result files
READ2
PRINT

Name: OXTPT1
Type: Subroutine
Module: CHRONC
Purpose -
General: Model simulation
Specific: Calculates result number 1:
Total cases of a given health effect resulting from material deposited between a range of distances:
Cancer injury,
Cancer death, and
Total cancer.

Called By: STOCHR
Calls:
Conditional:
Straightline dispersion model is being used
CASGET
CASGET - complex rotation around circle is needed because the spatial element is not under the plume but the element is contaminated
Wind shift dispersion model with rotation is being used and the element is contaminated
CASGET
Wind shift dispersion model without rotation is being used and the element is contaminated
CASGET

Name: OXTPT4
Type: Subroutine
Module: CHRONC
Purpose -
General: Model simulation
Specific: Calculates result number 4:
Average on-grid risks of a given effect at a given distance through 360 degrees.

Called By: STOCHR
Calls:
Conditional:
ABORT - invalid option code was detected
Name: OXTPT5
Type: Subroutine
Module: CHRONC
Purpose -
  General: Model simulation
  Specific: Calculates result number 5:
  Total population dose to a given organ
  resulting from material deposited between
  two distances.
Called By: STOCHR
Calls: None

Name: OXTPT6
Type: Subroutine
Module: CHRONC
Purpose -
  General: Model simulation
  Specific: Calculates result number 6:
  Peak occurrence dose vs distance for a
  selected organ by a specified pathway.
Called By: STOCHR
Calls:
  Conditional:
  ABORT - invalid option was requested

Name: OXTPT7
Type: Subroutine
Module: CHRONC
Purpose -
  General: Model simulation
  Specific: Calculates result number 7:
  Peak occurrence risk vs distance of a given
  effect,
  Individual latent cancer deaths, and
  Individual latent cancer injuries.
Called By: STOCHR
Calls:
  Conditional:
  ABORT - invalid option code was detected

Name: OXTPT8
Type: Subroutine
Module: CHRONC
Purpose -
  General: Model simulation
  Specific: Calculates result number 8:
  Population-weighted risk of a given health
  effect between two distances.
Called By: STOCHR
Calls:

Conditional:
Straightline dispersion model is being used
CASGET
CASGET - complex rotation around circle is needed
because the spatial element is not under the
plume but the element is contaminated
Wind shift dispersion model with rotation is being used and
the element is contaminated
CASGET
wind shift dispersion model without rotation is being used
and the element is contaminated
CASGET

Name: OXTPT9
Type: Subroutine
Module: CHRONC
Purpose -
General: Model simulation
Specific: Calculates result number 9:
Population dose to the selected organ
in a given region by the 12 pathways.
Called By: STOCHR
Calls:
Conditional:
Straightline dispersion model is being used
DOSGET
DOSGET - complex rotation around circle is needed
because the spatial element is not under the
plume but the element is contaminated
Wind shift dispersion model with rotation is being used and
the element is contaminated
DOSGET
Wind shift dispersion model without rotation is being used
and the element is contaminated
DOSGET

Name: OXPT10
Type: Subroutine
Module: CHRONC
Purpose -
General: Model simulation
Specific: Calculates result number 10:
Set of 12 economic cost measures produced
for a user-specified region.
Called By: STOCHR
Calls:
Conditional:
Straightline dispersion model is being used
ECCGET
ECCGET - complex rotation around circle is needed
because the spatial element is not under
the plume but the element is contaminated
Wind shift dispersion model with rotation is being used and
the element is contaminated
ECCGET
Wind shift dispersion model without rotation is being used
the element is contaminated
ECCGET

Name: OXPT11
Type: Subroutine
Module: CHRONC
Purpose -
General: Model simulation
Specific: Calculates result number 11:
Maximum impact distance of a given long-term
action:
  Decontamination,
  Interdiction,
  Condemnation,
  Milk disposal, and
  Crop disposal.

Called By: STOCHR
Calls:
Conditional:
Straightline dispersion model is being used
GETIMP
GETIMP - complex rotation around circle is needed
because the spatial element is not under the
plume but the element is contaminated
Wind shift dispersion model with rotation is being used and
the element is contaminated
GETIMP
Wind shift dispersion model without rotation is being used and the element is contaminated
GETIMP

Name: OXPT12
Type: Subroutine
Module: CHRONC
Purpose -
General: Model simulation
Specific: Calculates result number 12:
Impact of the long-term actions (measures of
farmland area and number of people
affected by the actions):
Decontamination, Interdiction, Condemnation, Milk disposal, and Crop disposal.

Called By: STOCHR
Calls:
  Conditional:
    Straightline dispersion model is being used
    GETIMP
    GETIMP - complex rotation around circle is needed because the spatial element is not under the plume but the element is contaminated
    Wind shift dispersion model with rotation is being used and the element is contaminated
    GETIMP
    Wind shift dispersion model without rotation is being used and the element is contaminated
    GETIMP

Name: PLMRIS
Type: Function
Module: ATMOS
Purpose -
  General: Modeling simulation
  Specific: Calculates change in plume height resulting from plume rise.

Called By: ATMOUT
Calls:
  Unconditional:
    VELADJ

Name: POL2
Type: Function
Module: EARLY
Purpose -
  General: Modeling simulation
  Specific: Performs bilinear interpolation from a table of values.

Called By: CLSHIN
Calls:
  Conditional:
    ABORT - value desired in the x- or y- direction is outside the intended endpoints in that direction

Name: PRINT
Type: Subroutine
Module: OUTPUT
Purpose -
General: Output processing
Specific: Prints the results for each cohort and an overall result for a single source term.
Called By: OUTPUT
Calls: NOTFOU, QUANTL, SOLID

Name: PUTSTG
Type: Subroutine
Entry: GETSTG
Module: EARLY
Purpose -
General: Input processing
Specific: Stores the evacuation strategy input parameters when more than one evacuation strategy is being used.
Called By: INPUT
Calls:
Conditional:
   ERRLOC - error was detected in the identifiers for the different emergency response strategies
   - error was detected in the weighting fractions

Name: PUTSTM
Type: Subroutine
Entry: GETSTM
Module: ATMOS
Purpose -
General: Input processing
Specific: Stores the source term data when more than one source term is being used.
Called By: INPUT
Calls:
Conditional:
   ERRLOC - repetition of a source term name was detected
   - identical source term change cases was detected

Name: QUANTL
Type: Subroutine
Module: OUTPUT
Purpose -
General: Output processing
Specific: Estimates quantile values for a CCDF table.
Called By: PRINT
Calls: EXPINT
Name: RANDOM
Type: Subroutine
Module: ATMOS
Purpose -
  General: Input processing
  Specific: Returns a pseudo-random number on the interval 0 to 1 using a shuffled linear-congruential generator.
Called By: BINSAM, RANSAM, WRANBN
Calls: None

Name: RANSAM
Type: Subroutine
Module: ATMOS
Purpose -
  General: Input processing
  Specific: Performs a random stratified sampling based on a user-specified number of daily stratified random samples to be taken.
Called By: MACCS
Calls:
  Conditional:
    ABORT - invalid number of samples was requested
    No error was detected in the number of samples requested
      ADJTIM, CONTRL, RANDOM, WBNDRY, WSAMPL

Name: RDISTB
Type: Subroutine
Module: CHRONC
Purpose -
  General: Input processing
  Specific: Processes tables of ingestion pathway nuclide data from the CHONC User Input File.
Called By: STPATH
Calls:
  Unconditional:
    CGET1
  Conditional:
    No error detected in reading the nuclide name
    ERRLOC - error was detected in the order of the nuclide names
    Ordering of the nuclide names was correct
    RGETN - one call per food ingestion model crop

Name: RDSTRG
Type: Subroutine
Module: ATMOS, EARLY, CHRONC
Purpose -
General: Input processing
Specific: Converts a record string to a character value, a logical value, a real value, or an integer value.
Called By: CGET1, IGET1, DOCCDF, LGET1, RGET1
Calls:
  Conditional:
  End of record was not encountered and the string length and format length are compatible
  IMLGCL
  IMNTGR - record string is not logical
  IMREAL - record string is not logical or an integer

Name: READ1
Type: Subroutine
Module: OUTPUT
Purpose -
  General: Output processing
  Specific: Reads the header records on the binary results files being processed in order to ensure their validity and to obtain the information necessary to generate the CCDF bins.
Called By: OUTPUT
Calls:
  Conditional:
  ABORT - no CHRONC result files were found
  - run ID mismatch was detected
  - error was detected while reading the CHRONC result file
  - number of CHRONC results exceeds the maximum allowed
  - duplicate results were detected
  - error was detected in the layout of the CHRONC result file

Name: READ2
Type: Subroutine
Module: OUTPUT
Purpose -
  General: Output processing
  Specific: Reads all result files to accumulate the probability distribution (CCDF) of each result for all cohorts for a single source term.
Called By: OUTPUT
Calls: ABORT, DO1CDF
Name: REDSTG
Type: Subroutine
Module: EARLY
Purpose -
  General: Input processing
  Specific: Loads the common blocks used to define the emergency response strategy.
Called By: INPUT
Calls:
  Unconditional:
    INEVAC, INPEMR

Name: RELZON
Type: Subroutine
Module: EARLY
Purpose -
  General: Modeling simulation
  Specific: Calculates the doses received by all individuals exposed outside the emergency response zone with consideration given to relocation.
Called By: EAROUT
Calls:
  Unconditional:
    EDOSIN, INCADOS
  Conditional:
    Straight line dispersion is being used
      CENACU
    Normal relocation occurs in the spatial element
      EDOSIN
      INCREM
      ZERREM
    Hot spot relocation occurs in the spatial element
      EDOSIN
      INCREM
      ZERREM

Name: RESNM1
Type: Function
Module: EARLY
Purpose -
  General: Output processing
  Specific: Returns the name of the requested type 1 effect:
        Total cases of a given health effect within a range of distances:
        Early deaths and injuries, and
        Latent cancer deaths and injuries.
Called By: HEDEAR
Calls:
  Unconditional
    DISRAN
Name: RESNM2
Type: Function
Module: EARLY
Purpose -
  General: Output processing
  Specific: Returns the name of the requested type 2 effect:
    Furthest distance at which a given probability of early death is exceeded.
Called By: HEDEAR
Calls: None

Name: RESNM3
Type: Function
Module: EARLY
Purpose -
  General: Output processing
  Specific: Returns the name of the requested type 3 effect:
    Number of people whose dose to a given organ exceeds a threshold (dose used can be either acute or lifetime).
Called By: HEDEAR
Calls:
  Unconditional:
    COMPRS

Name: RESNM4
Type: Function
Module: EARLY
Purpose -
  General: Output processing
  Specific: Returns the name of the requested type 4 effect:
    Average risk of a given health effect at a given distance through 360 degrees.
Called By: HEDEAR
Calls:
  Unconditional:
    DISRAN

Name: RESNM5
Type: Function
Module: EARLY
Purpose -
  General: Output processing
  Specific: Returns the name of the requested type 5 effect:
    Total population dose to a given organ between two distances.
Called By: HEDEAR
Calls:
  Unconditional:
    DISRAN
Name: RESNM6  
Type: Function  
Module: EARLY  
Purpose -  
  General: Output processing  
  Specific: Returns the name of the requested type 6 effect: Dose to an organ via a specific pathway between two distances.

Called By: HEDEAR  
Calls:  
  Unconditional: DISRAN

Name: RESNM7  
Type: Function  
Module: EARLY  
Purpose -  
  General: Output processing  
  Specific: Returns the name of the requested type 7 effect: Centerline risk versus distance for a given effect: Early deaths and injuries, and Latent cancer deaths and injuries.

Called By: HEDEAR  
Calls:  
  Unconditional: DISRAN

Name: RESNM8  
Type: Function  
Module: EARLY  
Purpose -  
  General: Output processing  
  Specific: Returns the name of the requested type 8 effect: Population-weighted risk of a given health effect between two distances.

Called By: HEDEAR  
Calls:  
  Unconditional: DISRAN

Name: RGET1  
Type: Function  
Module: ATMOS, EARLY, CHRONC  
Purpose -  
  General: Input processor  
  Specific: Returns a single real value from the input database
Called By: EVRADI, INACAN, INCHRZN, INDFAC, INEVAC, INPDIS, INPEMR, INPESP, INPLRS, INPM2, INPOP, INPREL, INPWAK, INPWET, RGETN

Calls:
Conditional:
RDSTRG - no error was detected in the column pointer for finding data
SEARCH - no error was detected in the column pointer for finding the data or in the length of the record ID

Name: RGETN
Type: Subroutine
Module: ATMOS, EARLY, CHRONC
Purpose -
General: Input processor
Specific: Returns an array of real values from the input database.
Called By: INACAN, INCHRZN, INDFAC, INEFAT, INEINJ, INEVAC, INMISC, INOUT2, INOUT3, INPDIS, INPDRY, INPGEO, INPISO, INPM4, INPM5, INPREL, RDISTB, STPATH,
Calls:
Conditional:
RGET1 - no error was detected in the length of the record ID

Name: RXNM10
Type: Function
Module: CHRONC
Purpose -
General: Output processing
Specific: Returns the name of the requested type 10 effect:
Cost of requested economic effect:
Total, and Decontamination.
Called By: HEDCHR
Calls:
Conditional:
ABORT - invalid number of results were requested
DISRAN - no error was detected in the number of results requested

Name: RXNM11
Type: Function
Module: CHRONC
Purpose -
General: Output processing
Specific: Returns the name of the requested type 11 effect:
Population and area dependent distances for mitigative actions:
Decontamination, Interdiction, Condemnation, and Disposal.

Called By: HEDCHR
Calls:
Conditional:
   ABORT - invalid number of results were requested

Name: RXNM12
Type: Function
Module: CHRONC
Purpose -
   General: Output processing
   Specific: Returns the name of the requested type 12 effect:
       Area and population involved in mitigative action:
       Decontamination, Interdiction, Condemnation, Milk disposal, and
       Crop disposal.

Called By: HEDCHR
Calls:
Conditional:
   ABORT - invalid number of results were requested
   DISRAN - no error was detected in the number of results requested

Name: RXSNM9
Type: Function
Module: CHRONC
Purpose -
   General: Output processing
   Specific: Returns the name of the requested type 9 effect:
       Long-term population dose in a given region by specified pathway.

Called By: HEDCHR
Calls:
Conditional:
   ABORT - invalid number of results were requested
   DISRAN - no error was detected in the number of results requested

Name: SDFINP
Type: Subroutine
Module: CHRONC
Purpose -
   General: Input processing

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Specific: Processes and checks input data from the Site Data File.
Called By: CHRINP
Calls:
Unconditional:
  CXPTBL, KMPTBL
Conditional:
  No error was detected in reading the number of watersheds
    KMPTBL
  No error was detected in reading the input data
    CKINDX
    MXTCH

Name: SEARCH
Type: Subroutine
Module: ATMOS, EARLY, CHRONC
Purpose -
  General: Input processing
  Specific: Locate a record with a specific ID using a binary search.
Called By: CGET1, DOCCDF, IGET1, INPBEG, LGET1, RGET1,
Calls: None

Name: SGCPLN
Type: Subroutine
Module: CHRONC
Purpose -
  General: Modeling simulation
  Specific: Calculates ground concentrations for the spatial grid elements
Called By: CHROUT
Calls:
  Conditional:
    ABORT - error was detected in the definition of the number of fine grid elements over which the plume passes

Name: SIGTEX
Type: Function
Module: ATMOS
Purpose -
  General: Modeling simulation
  Specific: Returns the character string "uniform" if uniform mixing is being used or returns a character string with the value of sigma z.
Called By: ATMOUT
Calls: None
Name: SOLID
Type: Subroutine
Module: OUTPUT
Purpose -
  General: Output processing
  Specific: Writes a page of characters to help locate sections
           of the output listing.
Called By: PRINT
Calls: None

Name: SORT
Type: Subroutine
Module: ATMOS, EARLY, CHRONC
Purpose -
  General: Input processing
  Specific: Sorts n values of a character array cards in
            increasing order of the first m characters of the
            cards by using a pointer array.
Called By: INPBEG,
Calls: None

Name: STGRDA
Type: Subroutine
Module: CHRONC
Purpose -
  General: Input processing
  Specific: Define the regional characteristics when the Site
            Data File is not being used.
Called By: CHRINP
Calls: None

Name: STOCHR
Type: Subroutine
Module: CHRONC
Purpose -
  General: Modeling simulation
  Specific: Controls the calculation of the chronic effects and
            economic costs needed for the requested output.
Called By: CRNRSK
Calls:
  Unconditional:
    OXTPT1, OXTPT4, OXTPT5, OXTPT6, OXTPT7, OXTPT8,
    OXTPT9, OXPT10, OXPT11, OXPT12

Name: STOEAR
Type: Subroutine
Module: EARLY
Purpose -
  General: Modeling simulation
**Name:** STPATH  
**Type:** Subroutine  
**Module:** CHRONC  

**Purpose:**  
- **General:** Input processing  
- **Specific:** Processes the input data for the ingestion pathway for both food and water ingestion.

**Called By:** INPCHR  
**Calls:**  
- **Unconditional:** IGET1, LGET1  
- **Conditional:**  
  - No error was detected in the number of defined crops in the food ingestion pathway  
  - Crop names were defined correctly  
  - ERRLOC - crop name was used twice  
  - IGET1  
  - RGETN  
  - No error was detected in the number of water pathway nuclides  
  - CGET1  
  - No error was detected in the names of the water pathway nuclides  
  - ERRLOC - water ingestion nuclide was not found in the nuclide table  
  - IGET1  
  - RGETN  
  - No error detected in the number of nuclides in the food ingestion pathway  
  - CGET1  
  - No error was detected in the names of the nuclides in food ingestion pathway  
  - ERRLOC - food ingestion pathway nuclide was specified twice  
  - ordering of food ingestion nuclides and water ingestion nuclides was incorrect  
  - food ingestion pathway nuclide was not on the list of nuclides  
  - crop name mismatch occurred  

- IGET1  
- RDISTB  
- RGETN
Crop names were correctly defined
   CGET1
   RGETN

Water ingestion nuclide was correctly defined
   CGET1
   ERRLOC - mismatch occurred in the
   nuclide name
   RGETN

No mismatch occurred in the nuclide name
   RGETN

Name:  TRFRCT
Type:  Subroutine
Module:  CHRONC
Purpose -
   General:  Input processing
   Specific:  Compute the current growing season and the long-term
              transfer factors for crops, milk,
              and meat.
Called By:  CHRNDF
Calls:  None

Name:  USRSUP
Type:  Subroutine
Module:  ATMOS
Purpose -
   General:  Input processing
   Specific:  Uses the five days of user-supplied weather data for
              a single weather trial.
Called By:  MACCS
Calls:  Unconditional:
        COURL, WBNDRY

Name:  VELADJ
Type:  Function
Module:  ATMOS
Purpose -
    General:  Modeling simulation
    Specific:  Adjusts the wind speed to account for the height of
              the plume.
Called By:  PLMRIS
Calls:  None

Name:  WASHOU
Type:  Function
Module:  ATMOS
Purpose
  General: Modeling simulation
  Specific: Calculates the fraction of material remaining after
  wet deposition.
Called By: ATMOUT
Calls: None

Name: WBNDRY
Type: Subroutine
Module: ATMOS
Purpose -
  General: Input processing
  Specific: Defines the weather boundary data.
Called By: BINSAM, CONMET, DAYHOU, RANSAM, USRSUP
Calls: None

Name: WBNMET
Type: Subroutine
Module: ATMOS
Purpose -
  General: Input processing
  Specific: Determine bins (groupings) for one year of
  meteorological data by scanning the meteorological
  input data.
Called By: INPM4
Calls:
  Unconditional: WNDRZB

Name: WGCPLN
Type: Subroutine
Module: CHRONC
Purpose -
  General: Modeling simulation
  Specific: Calculates the wind shift ground concentrations in
  the plane.
Called By: CHROUT
Calls: None

Name: WGTMET
Type: Subroutine
Module: ATMOS
Purpose -
  General: Input processing
  Specific: Takes current meteorological hour and prepares the
  following data needed for the user-specified hour:
  Stability,
Wind velocity and direction, 
Mixing height, and 
Rate of precipitation.

Called By: WSAMPL
Calls:
  Conditional:
    ABORT - mixing layer height was defined below the minimum allowed

Name: WINCTM
Type: Subroutine
Module: ATMOS
Purpose -
  General: Input processing
  Specific: Increments the hour and day for weather sampling.
Called By: WSAMPL
Calls: None

Name: WNDRZB
Type: Subroutine
Module: ATMOS
Purpose -
  General: Input processing
  Specific: Compute the windrose from the meteorological data in the bins.
Called By: WBNMET
Calls: None

Name: WRANBN
Type: Subroutine
Module: ATMOS
Purpose -
  General: Input processing
  Specific: Initializes the weather bin codes used for weather category bin sampling.
Called By: BINSAM
Calls:
  Unconditional:
    RANDOM

Name: WRDMET
Type: Subroutine
Module: ATMOS
Purpose -
  General: Input processing
  Specific: Reads the augmented T-M-Y meteorological data (yearly weather data).
Called By: INPM1

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Calls:
Unconditional:
ERRFIL - an empty data file was found
- morning mixing height in season was not within
  the valid range
- afternoon mixing height in season was not within
  the valid range

Name: WSAMPL
Type: Subroutine
Module: ATMOS
Purpose -
  General: Input processing
  Specific: Fills array with 120 consecutive hours of weather
           data from the Meteorological Data File.
Called By: BINSAM, DAYHOU, RANSAM
Calls:
  Unconditional:
    WGTMET
  Conditional:
    WINCTM - hour of data considered was not the first

Name: WTRTRF
Type: Subroutine
Module: CHRONC
Purpose -
  General: Input processing
  Specific: Compute the transfer factors for the water ingestion
           pathway which correspond to direct deposition onto
           the waterbody or washoff to the waterbody.
Called By: CHRNDF
Calls: None

Name: ZERREM
Type: Subroutine
Module: EARLY
Purpose -
  General: Modeling simulation
  Specific: Zeroes out the dose accumulated for each of the grid
           elements which require hot spot or normal relocation
           so new doses can be accumulated.
Called By: RELZON
Calls: None
2.4 Statement Functions

In addition to function subprograms, several statement functions have been incorporated into the MACCS code. A description is given for each of these named statement functions. Included in the description are the following: (1) the name, (2) the module in which it is found, (3) the definition, and (4) the subprogram(s) in which it is found.

Name: AVLINT
   Module: EARLY
   Definition: A linearly interpolated value for the single decay constant which fits the two data points corresponding to the 8-hour dose and the 168-hour dose
   Host Subprogram(s): EPCALC

Name: DOSFRM
   Module: CHRONC
   Definition: The farm area dependent dose
   Host Subprogram(s): OXTPT5

Name: DOSPOP
   Module: CHRONC
   Definition: The resident population dependant dose
   Host Subprogram(s): OXTPT5

Name: DOSWAT
   Module: CHRONC
   Definition: The water ingestion dose
   Host Subprogram(s): OXTPT5, OXTPT7

Name: GAUHIT
   Module: ATMOS
   Definition: The average height of the Gaussian distribution between a range of sigmas from the centerline
   Host Subprogram(s): EGEOM

Name: GAUINT
   Module: ATMOS
   Definition: A linearly interpolated value for the area under the Gaussian curve from 0 to X
   Host Subprogram(s): EGEOM
Name: IMXHT
Module: ATMOS
Definition: The mixing height for the specified current meteorological hour
Host Subprogram(s): WGTMET

Name: IRANE
Module: ATMOS
Definition: The rate of precipitation for the specified current meteorological hour
Host Subprogram(s): WGTMET

Name: ISTAB
Module: ATMOS
Definition: The weather stability for the specified current meteorological hour
Host Subprogram(s): WBNMET, WGTMET

Name: IWDIR
Module: ATMOS
Definition: The wind direction for the specified current meteorological hour
Host Subprogram(s): WBNMET, WGTMET

Name: IWSPD
Module: ATMOS
Definition: The wind speed for the specified current meteorological hour
Host Subprogram(s): WBNMET, WGTMET

Name: MRAIN
Module: ATMOS
Definition: The rate of precipitation for the specified current meteorological hour
Host Subprogram(s): WBNMET
3.0 MACCS DATA STRUCTURES

3.1 Database Management

The MACCS code uses three means of data storage and transmission: argument lists on external references, COMMON blocks, and binary sequential files. These database management techniques are all implemented in a straightforward fashion and their significant features are described in this chapter.

The use of argument lists to transmit information between program units is well documented internally within MACCS and there is no need to describe their usage in this document. Every Subroutine and Function of MACCS contains a stylized glossary at its beginning which includes a brief description of all the FORTRAN variables it utilizes. All of the variables in the argument lists are described in these glossaries.

COMMON blocks are used extensively to transmit information between the various program units of MACCS. As with the variables in argument lists, the glossary of each routine provides a brief description of every variable in COMMON which it references. Hidden EQUIVALENCE statements are implemented by using different variable lists for the same COMMON block for the following COMMON blocks: CDATE, IRAIN, M2, REUSE1, AND REUSE2.

The only aspect of COMMON usage which needs to be explained is the reuse of memory in order to minimize the amount of memory necessary to run the code. After the input processing phase of the calculations is completed, the code calculates all of the consequence measures for a single weather trial before going on to the next trial.

For each weather trial, the code first uses the ATMOS module to calculate the atmospheric transport and deposition, following this, the EARLY module calculates the consequences resulting from the emergency phase period, and the CHRONC module in turn calculates the long-term consequences.

Both the EARLY and the CHRONC module store their calculated consequences on binary sequential files for later processing by the OUTPUT module. When all of the consequences have been calculated and stored, control transfers to the OUTPUT module which reads the files of consequence measures and constructs the CCDFs.

Because of the way in which the calculations are distributed among these modules, two large common blocks in the code are used for more than one purpose. This is done among the EARLY, CHRONC, and OUTPUT modules as follows.

In the EARLY module, COMMON /REUSE1/ is used to store the doses it calculates. It is referenced for this purpose in EAROUT, RELZON, INCDOS, EMOVE, ZERREM, FATRIS, INJRIS, CANRIS, OUTPT3, and OUTPT5.
In the CHRONC module, COMMON /REUSE1/ is used to store doses. It is referenced for this purpose in INITLZ, INTRPH, CSTEFF, CSTDCN, LTACUM, LOKSEE, CASGET, OXTPT4, OXTPT5, OXTPT6, OXTPT7, and DOSGET.

In the CHRONC module, COMMON /REUSE2/ is used to store ground concentrations. It is referenced for this purpose in SGCPLN, WGCPLN, LNGTPH, LTMACT, CSTDCN, and LTACUM.

In the OUTPUT module, COMMON /REUSE1/ is used to store the probability of exceeding specified consequence levels for the CCDFs (the bin probabilities). It is referenced for this purpose in READ2, DO1CDF, GNBIN2, and PRINT.

In the OUTPUT module, COMMON /REUSE2/ is used to store the consequence level associated with each bin of the CCDF (the bin magnitudes). It is referenced for this purpose in READ2, DO1CDF, GNBIN1, GNBIN2, and PRINT.

The EARLY module can calculate consequences for up to three emergency response strategies. These are stored as binary sequential files on FORTRAN unit numbers 31 to 33. If the CHRONC module is being exercised, it writes a similar file to unit 34.

At the beginning of each of these files is a header record which uniquely determines the date and time of the MACCS run which produced it. This header is written by Subroutine STOEAR on the EARLY result files, and by Subroutine STOCHR on the CHRONC result file. Subroutine READ1 of the OUTPUT module reads this header record from all of the result files and verifies that all of the result files were produced by the same run of MACCS.

For each weather trial, Subroutine STOEAR writes a record of information on the EARLY result files which specifies the trial number, weather sequence probability, weather category, day, and hour. The actual consequence measures are written to the EARLY result files by Subroutines OUTPT1, OUTPT2, OUTPT3, OUTPT4, OUTPT5, OUTPT6, OUTPT7, and OUTPT8.

Analogously to STOEAR, Subroutine STOCHR writes the same information identifying the weather trial on the CHRONC result file. The actual consequence measures are written to the CHRONC result file by Subroutines OXTPT1, OXTPT4, OXTPT5, OXTPT6, OXTPT7, OXTPT8, OXTPT9, OXPT10, OXPT11, and OXPT12.

The binary result files produced by both EARLY and CHRONC are then processed by Subroutine READ2 in order to generate the CCDFs.

The remainder of Chapter 3 is devoted to the COMMON blocks found in the MACCS code. Section 3.2 provides a description of the named COMMON blocks, Section 3.3 gives a description of each use of unnamed COMMON blocks, Section 3.4 provides a trail of the subprograms in which each named COMMON block variable is used, and Section 3.5 provides a description of each COMMON block variable used in the MACCS code.
3.2 Named COMMON Blocks Usage

A description of each COMMON block used in MACCS is given in this section. Included in each description are the following: (1) the name, (2) the variables and arrays it contains, and (3) a list of the routines by which it is used.

MACCS NAMED COMMON BLOCK USAGE

Name: ACANCR
Contains -
  Variables: ACTHRE, NUMACA
  Arrays: ACSUSC, CFRISK, CIRISK, DOSEFA, DOSEFB, INDXAC
Used by: INACAN, INOUT1, INOUT4, INOUT7, INOUT8, OPNERL, CANRIS, EFFGET, OUTPT4, OUTPT7

Name: ACNAME
Contains -
  Variables: ACNAME
  Arrays: ACNAME
Used by: INACAN, INOUT1, INOUT4, INOUT7, INOUT8, OPNERL, CANRIS

Name: ATMDAT
Contains -
  Variables: MAXRIS, OALARM
  Arrays: AIRCON, AVGHIT, GRNCON, HTFCTR, IDIREC, SIGYM, SIGZM, TIMCEN, TIMOVH
Used by: INPREL, PUTSTM, ADJTIM, CONTRL, ATMOUT, EGEOM, EPCALC, ESTAT, EMOVE, SGCPLN, WGCPLN

Name: ATMOPT
Contains -
  Variables: IDEBUG, NUCOUT
  Arrays:
Used by: INPOPT, DAYHOU, RANSAM, WSAMPL, BINSAM, ATMOUT

Name: ATNAM1
Contains -
  Variables: ATNAM1
  Arrays:
Used by: ATPROB, PRINT
Name: ATNAM2
Contains -
Variables: ATNAM2
Arrays: ATNAM2
Used by: INPREL, PUTSTM, PRINT

Name: BILWAK
Contains -
Variables: BUILDH, BUILDW
Arrays:
Used by: INPWAK, ATMOUT, CAUGHT

Name: BINAVG
Contains -
Variables: BINAVG
Arrays: BINAVG
Used by: READ2, DO1CDF, PRINT

Name: BINNED
Contains -
Variables: BINNED
Arrays: BINNED
Used by: READ2, DO1CDF

Name: CCANCR
Contains -
Variables: NUMCNC
Arrays: ACFRSK, ACIRSK, INDXCA
Used by: OPNERL, CASGET, OXTPT4, OXTPT7

Name: CCDF
Contains -
Variables: CCDF
Arrays: CCDF
Used by: HEDEAR, HEDCHR, PRINT

Name: CDATE
Contains -
Variables: KDAY, KHOUR
Arrays:
Used by: DAYHOU, RANSAM, WSAMPL, BINSAM

Contains -
Variables: JDAY, JHOUR
Arrays:
Used by: WGTMET, WINCTM

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Name: CENCAN
Contains -
   Variables:
      Arrays: CCANFA, CCANIN
Used by: CANRIS, OUTPT7

Name: CENDOS
Contains -
   Variables:
      Arrays: CENCOD, CENGD, CENPID, CENRES, CENSKI
Used by: EAROUT, CENACU, FATRIS, INJRIS, CANRIS, OUTPT6

Name: CENFAT
Contains -
   Variables:
      Arrays: CENFAT
Used by: FATRIS, CANRIS, OUTPT7

Name: CENINJ
Contains -
   Variables:
      Arrays: CENINJ
Used by: INJRIS, OUTPT7

Name: CHNAME
Contains -
   Variables: CHNAME
      Arrays:
Used by: INCHRN, PRINT

Name: CNTDTA
Contains -
   Variables: DTACNT
      Arrays:
Used by: WBNMET

Name: COHAVG
Contains -
   Variables:
      Arrays: COHAVG
Used by: READ2, DO1CDF, PRINT
Name: COUPLD
Contains -
Variables: COUPLD
Arrays: 
Used by: STPATH, LTPROJ

Name: CROPDT
Contains -
Variables:
Arrays: FRCTCB, FRCTCH, FRCTCM, FRCTFL
Used by: STPATH, SDFINP, TRFRCT

Name: CRPTIM
Contains -
Variables: THRST, TIMACC, TSEEDG
Arrays: TGSBEG, TGSEND
Used by: STPATH, SDFINP, CHROUT, DIRDEP, LTPROJ, LTACUM

Name: CRPTRF
Contains -
Variables: NTTRM
Arrays: CTCOEF, CTHALF
Used by: STPATH, DIRDEP

Name: CRTOCR
Contains -
Variables: CRTOCR
Arrays: 
Used by: OPNERL, INCHRN

Name: CSTINT
Contains -
Variables: 
Arrays: CSTIF, CSTINF
Used by: INITLZ, CSTEFF, LOKSEE, ECCGET, GETIMP

Name: DAUTR
Contains -
Variables: 
Arrays: IDAUGT
Used by: BLDTBL, GNDRES
Name: DCCOST
Contains -
  Variables:
    Arrays: CSTDF, CSTDNF, CSTLF, CSTLNF, TRMDRL
Used by: INITLZ, CSTEFF, CSTDCN, LOKSEE, ECCGET, GETIMP

Name: DCFACT
Contains -
  Variables:
    Arrays: CDCF, GRDCF, IDCF, IGDGF, SDCF, SDV
Used by: EDCINP, INOUT3, INOUT6, EPCALC

Name: DECMOD
Contains -
  Variables: LVLDEC
    Arrays: CDFRM, CDNFRM, DLBCST, DSRFCT, FRFDL, FRNFDL, TFWKF, TFWKNF, TIMDEC
Used by: INCHRPN, CHRNDF, LTMACT, CSTDCN, LTACUM

Name: DIRB
Contains -
  Variables:
    Arrays: IDRB
Used by: WBNMET, WNDRZB

Name: DIRCTF
Contains -
  Variables:
    Arrays: DTFMLK, DTFOTH
Used by: DIRDEF, LTACUM

Name: DISPY
Contains -
  Variables: YSCALE
    Arrays: CYSIGA, CYSIGL
Used by: INPDIS, FSGY, FSGYIN

Name: DISPZ
Contains -
  Variables: ZSCALE
    Arrays: CZSIGA, CZSIGB
Used by: INPDIS, FSGZ, FSCZIN

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Name: DOSFAC
   Contains -
   Variables: RESCON, RESLAM
   Arrays: AVL168, CLDFAC, GAULEV, IWINDT, MAXFIN, PCF,
          PGF168, PGPF, PIF, PRSF, PSF, SIGMAY,
          TSTART, TSTOP
   Used by: INDFAC, EGEOM, EPCALC, RELZON, ESTAT, CENACU,
            EDOSIN, INCDOS, EMOVE, INCREM, SGCPNL, WGCPLN

Name: DOSFAX
   Contains -
   Variables:
   Arrays: GDF, RDF
   Used by: EXCINP, CHRNDF

Name: DOSTIM
   Contains -
   Variables: DSCRLT, DSCRTI, TMIPND, TMIPND, TMPACT
   Arrays: TINTRD
   Used by: OPNERL, INCHRN, CHRNDF, INTRPH, LTPROJ, LTMACT,
       LTACUM

Name: DRYCON
   Contains -
   Variables: NPSGRP
   Arrays: VDEPOS
   Used by: INPDRY, INPREL, ATMOUT

Name: DSPFLG
   Contains -
   Variables:
   Arrays: DSPCRP, DSPMLK
   Used by: INITLZ, LTPROJ, LTACUM, LOKSEE, ECCGET, GET1MP

Name: DTFRCT
   Contains -
   Variables:
   Arrays: DTFBPT, DTFCPT, DTFMPT
   Used by: TRFRCT, DIRDEP

Name: DTTRFT
   Contains -
   Variables:
   Arrays: DTFBP, DTFCP, DTFMP
   Used by: DIRDEP

3-8
Name: EADFAC
Contains -
  Variables:
    Arrays: BRRATE, CSFACT, GSHFAC, PROTIN, SKPFAC
Used by: INDFAC, OPNERL, EPCALC, EDOSIN

Name: EANAM1
Contains -
  Variables: EANAM1
  Arrays:
Used by: INMISC, PRINT

Name: EANAM2
Contains -
  Variables:
    Arrays: EANAM2
Used by: INEVAC, PUTSTG, PRINT

Name: ECNDTA
Contains -
  Variables:
    Arrays: ASFP, DPF, FRMFRC, VFRM, VNFRM
Used by: SDFINP, STGRDA, CASGET, OXTPT5, DOSGET, ECCGET

Name: EDOSES
Contains -
  Variables:
    Arrays: CD, GD, PID, RESID, SDD
Used by: CENACU, EDOSIN, INCLOS, EMOVE, INCREM

Name: EFATAL
Contains -
  Variables: NUMEFA
    Arrays: EFFACA, EFFACB, EFFTHR, INDXEF
Used by: INEFAT, INOUT1, INOUT4, INOUT7, INOUT8, PATRIS

Name: EFFEC1
Contains -
  Variables:
    Arrays: EFFEC1
Used by: OUTPT1, OXTPT1,
Name: EFFNM1
Contains -
  Variables: EFFNM1
  Arrays: EFFNM1
Used by: INOUT1, RESNM1

Name: EFFNM4
Contains -
  Variables: EFFNM4
  Arrays: EFFNM4
Used by: INOUT4, RESNM4

Name: EFFNM7
Contains -
  Variables: EFFNM7
  Arrays: EFFNM7
Used by: INOUT7, RESNM7

Name: EFFNM8
Contains -
  Variables: EFFNM8
  Arrays: EFFNM8
Used by: INOUT8, RESNM8

Name: EINAME
Contains -
  Variables: EINAME
  Arrays: EINAME
Used by: INEINJ, INOUT1, INOUT4, INOUT7, INOUT8, INJRIS

Name: EINJUR
Contains -
  Variables: NUMEIN
  Arrays: EIFACA, EIFACB, EISUSC, EITHRE, INDXEI
Used by: INEINJ, INOUT1, INOUT4, INOUT7, INOUT8, INJRIS, EFFGET, OUTPT4, OUTPT7

Name: ERLCST
Contains -
  Variables: EVACST, EVCOST, RELCST, RLCOST
  Arrays:
Used by: INCHRN, ECCGET
Name: EXPAND
Contains -
  Variables: BRKPNT, TIMBAS, XPFAC1, XPFAC2
  Arrays:
Used by: INPEXP, CONTRL

Name: EXPFAC
Contains -
  Variables: EXPFAC
  Arrays:
Used by: CONTRL, FSGY

Name: FDINGM
Contains -
  Variables: NFICRP, NFIISO
  Arrays: NDXFII
Used by: STPATH, RDIISTB, SDFINP, EXCINP, TRFRCT, WTRTRF, DIRDEP, LTPROJ, LTACUM

Name: FRACLD
Contains -
  Variables: FRACLD
  Arrays:
Used by: INCHRN, STGRDA

Name: FRCFRM
Contains -
  Variables: DPFRCT, FRCFRM, FRMPRD
  Arrays:
Used by: INCHRN, STGRDA

Name: FRCLND
Contains -
  Variables: FRCLND
  Arrays: FRCLND
Used by: SDFINP, STGRDA, CASGET, OXTPT5, DOSGET

Name: FRMDAT
Contains -
  Variables: FMAREA
  Arrays: FMAREA
Used by: STGRDA, ECCGET, GETIMP

3-11
Name: GLOBAL
Contains -
Variables: ANCMAX, IEVACU, IPLUME, NUMCOR, NUMFIN, NUMISO, NUMORG, NUMRAD, NUMREL, NUMTRI
Arrays: SPACEN, SPAEND, SPALEN
Used by: MACCS, INPGEO, INPISO, INPREL, INPM2, INPM4, WBNMET, INPOPT, INMISC, INORGA, EDCINP, INEVAC, INPOPU, EVRADE, EVNETW, EVROOT, INPEMR, INEFAT, INEINJ, INACAN, INOUT1, INOUT3, INOUT4, INOUT5, INOUT6, INOUT7, INOUT8, CHRINP, OPNERL, STPATH, IXT07, IXT010, IXT012, SDFINP, CKINDX, EXCINP, STGRDA, HEDEAR, DIST1, HEDCHR, DAYHOU, RANSAM, USRSUP, CONMET, CTRL, ATMOUT, DECAY, EAROUT, EGEOM, EPCALC, RELZON, ESTAT, CENACU, CENZER, EDOS1N, INCODS, EMOVE, ZERREM, INCREM, PATRIS, INJNIS, CANRIS, OUTPT1, OUTPT2, OUTPT3, OUTPT4, OUTPT5, OUTPT6, OUTPT7, OUTPT8, CHROUT, BLDTBL, GNDRES, SGCPLN, WGCPLN, CRNRSK, INITLZ, INTRPH, LTPOJ, LTMACT, CSTDCN, LTACUM, LOKSEE, OXPTT1, OXPTT4, OXPTT5, OXPTT6, OXPTT7, OXPTT8, OXPTT9, OXPTT10, OXPTT11, OXPTT12, READ2

Name: GRDDTA
Contains -
Variables:
Arrays: AREA
Used by: STGRDA, CASGET, OXPTT5, DOSGET

Name: GSWTHR
Contains -
Variables: GSF, NGWTRM
Arrays: GWCOEF, TGWHLF
Used by: OPNERL, INCHRN, CHRNDF

Name: HEADER
Contains -
Variables: HEADER
Arrays:
Used by: MACCS, STOEAR, STOCHR, READ1, PRINT,

Name: HGTMIvX
Contains -
Variables:
Arrays: HGTMIvX
Used by: WRDMET, WGTMET
Name: ICRTRO  
Contains -  
Variables: ICRTRO  
Arrays:  
Used by: OPNERL, CHRNDF, INTRPH

Name: IDNTFI  
Contains -  
Variables: IDNTFI  
Arrays:  
Used by: INPOPU, CMPTBL, SDFINP, CXPTBL

Name: IFF  
Contains -  
Variables: IFF  
Arrays:  
Used by: MACCS, RANDOM

Name: IHITIT  
Contains -  
Variables: IHITIT  
Arrays:  
Used by: EPCALC, ESTAT, FATRIS, INJRIS, CANRIS, OUTPT1, OUTPT2, OUTPT5, OUTPT8, CRNRSK, LOKSEE, OXPT1, OXPT5, OXPT8, OXPT9, OXPT10, OXPT11, OXPT12

Name: INDREG  
Contains -  
Variables: INDREG  
Arrays:  
Used by: SDFINP, STGRDA, CASGET, OXPT5, DOSGET, ECCGET

Name: INDWTR  
Contains -  
Variables: INDWTR  
Arrays:  
Used by: SDFINP, STGRDA, CASGET, OXPT5, DOSGET

Name: INDXS  
Contains -  
Variables: IDIR, INTRVL  
Arrays:  
Used by: CRNRSK, EMRGPH, INTRPH, LTPROJ, LTMACT, CSTEFF, CSTDCLN, LTACUM, LOKSEE

3-13
Name: IPOINT
Contains -
 Variables: IC, IPOINT
 Arrays: 
 Used by: CGET1, DOCCDF, IGET1, LGET1, RGET1

Name: INPRC2
Contains -
 Variables: 
 Arrays: CRDFLG, IPNT
 Used by: INPBEG, INPEND, CGET1, SEARCH, SORT, DOCCDF, IGET1, LGET1, RGET1

Name: INPRC3
Contains -
 Variables: NBLANK, NCHANG, NCMMNT, NDPLCT, NREC, NRECT, NTRMNT
 Arrays: 
 Used by: INPBEG, INPEND, SEARCH, SORT

Name: IPRINT
Contains -
 Variables: IPRINT
 Arrays: 
 Used by: INMISC, EDCINP, EAROUT, EGEOM, EPCALC, ESTAT, FATRIS, INJРИS, CANRIS

Name: IRAIN
Contains -
 Variables: 
 Arrays: MRAIN
 Used by: WRDMET, WGMTMЕT, BINSAM

Contains -
 Variables: 
 Arrays: KRAIN
 Used by: WBNMET

Name: ISOCRР
Contains -
 Variables: 
 Arrays: DCYPCB, DCYPCH, DCYPCM, FPLSCH
 Used by: STPATH, TRFRCT
Name: ISOGRP
Contains -
  Variables: MAXGRP
  Arrays: HAFLIF, IGROUP, LAMBDA, PARENT
Used by: INPISO, INPREL, EDCINP, ATMOUT, DECAY, BLDTBL, GNDRES, WTRTRF, DIRDEP

Name: ISONAM
Contains -
  Variables:
  Arrays: NUCNAM
Used by: INPISO, INPREL, INPOPT, EDCINP, STPATH, EXCINP, ATMOUT

Name: ISOORG
Contains -
  Variables:
  Arrays: DFING
Used by: EXCINP, TRFRCT, WTRTRF

Name: ISOTDT
Contains -
  Variables:
  Arrays: DCYPBH, DCYPMH, TFBF, TFMLK
Used by: STPATH, TRFRCT

Name: ITERMS
Contains -
  Variables:
  Arrays: TRMRYL
Used by: INITLZ, INTRPH, LOKSEE, ECCGET

Name: IUNIT
Contains -
  Variables:
  Arrays: IUNIT
Used by: READ1, READ2

Name: IXOUTI
Contains -
  Variables: NXUMI
  Arrays: IX1DSI, IX2DSI, IXCODI
Used by: COPCHR, OXTPTI
Name: IXOUT4
Contains -
  Variables: NXUM4
  Arrays: IX1DS4, IXCOD4
Used by: COPCHR, OXTPT4

Name: IXOUT5
Contains -
  Variables: NXUM5
  Arrays: IX1DS5, IX2DS5, IXDEX5
Used by: COPCHR, OXTPT5

Name: IXOUT6
Contains -
  Variables: NXUM6
  Arrays: IX1DS6, IX2DS6, IXDEX6, IXPATH
Used by: COPCHR, OXTPT6

Name: IXOUT7
Contains -
  Variables: NXUM7
  Arrays: IX1DS7, IX2DS7, IXCOD7
Used by: COPCHR, OXTPT7

Name: IXOUT8
Contains -
  Variables: NXUM8
  Arrays: IX1DS8, IX2DS8, IXCOD8
Used by: COPCHR, OXTPT8

Name: KKPRNT
Contains -
  Variables: KTDPNT, KTRPNT
  Arrays:
Used by: CHRINP, INCHR, EXCINP

Name: KOPRNT
Contains -
  Variables: KSWDSC, KSWRSK
  Arrays:
Used by: INCHR, CRNRSK

3-16
Name: KPRINT
Contains -
  Variables: KCEPNT, KDFPNT, KDTPNT, KGCPNT, KLTPNT, KWTPNT
  Arrays:
Used by: INCHRN, TRFRCT, DIRDEP, EMRGPH

Name: LASEMFR
Contains -
  Variables: LASEMFR
  Arrays:
Used by: RELZON, ESTAT

Name: LONZTF
Contains -
  Variables:
  Arrays: TFLMLK, TFLOTH
Used by: TRFRCT, LTACUM

Name: LRACRN
Contains -
  Variables:
  Arrays: LRACRN
Used by: INITLZ, LTGROJ, CSTEFF, CSTDCN, LTACUM, LOKSEE, ECCGET, GETIMP

Name: LACTCN
Contains -
  Variables:
  Arrays: LACTCN, LVELDC
Used by: INITLZ, LTMACT, CSTEFF, CSTDCN, LTACUM, LOKSEE, ECCGET, GETIMP

Name: LTFCTR
Contains -
  Variables:
  Arrays: TFLBPT, TFLCPT, TFLMPT
Used by: TRFRCT

Name: M1
Contains -
  Variables: METCOD
  Arrays:
Used by: MACCS, INPMET, INPM1, INPM4, INMISC
Name: M2
Contains -
  Variables: BNDMXH, BNDRAN, BNDWND, IBDSTB, LIMSPA
  Arrays:
  Used by: INPM2, WBNDRY

Contains -
  Variables: BNDMXH, BNDRAN, BNDWND, IBDSTB, LIMSPA
  Arrays:
  Used by: CONMET

Name: M3
Contains -
  Variables: ISTRDY, ISTRHR
  Arrays:
  Used by: INPM3, DAYHOU, USRSUP, CONMET

Name: M4
Contains -
  Variables: IRSEED, NRNINT, NRINTN, NSBINS, NSMPLS
  Arrays: INDXBN, INWGHT, IRRRAT, RDISTS, RNRATE
  Used by: INPM4, WBNMNET, RANSAM, RANDOM

Name: M5
Contains -
  Variables:
  Arrays: HRMXHT, HRRAIN, HRWNDV, IHRDIR, IHRSTB
  Used by: INPM5, USRSUP

Name: MACHIN
Contains -
  Variables: MACHIN
  Arrays:
  Used by: MXXETC, MXXCPU, MXXCLK, MXDAT

Name: MAXNRS
Contains -
  Variables: MAXNRS
  Arrays:
  Used by: HEDEAR, HEDCHR, READ1

Name: MAXOCU
Contains -
  Variables:
  Arrays: CONMAX, MAXDIR, MAXTRI
  Used by: READ2, DO1CDF, PRINT

3-18
Name: METB
Contains -
  Variables: NBIN, NTOT
  Arrays: IDRBIN, IRAND, IWGHT, SPACE
Used by: INPM4, WBNMET, WNDRZB, BINSAM, WRANBN

Name: METDAT
Contains -
  Variables: LIMSP1
  Arrays: HTMXLR, ISTAB, RMNM, WINDIR, WINDSP
Used by: WBNDRY, WSAMPL, CONTRL, ATMOUT, CONMET

Name: METDTA
Contains -
  Variables:
    Arrays: HEIGHT, MONTHS, ROSE
Used by: WRDMET, WBNMET, WGTMET

Name: METOUT
Contains -
  Variables: IBINUM, IDAY, IHOUR, ISECON, ITRIAL,
    PRBMET
  Arrays:
Used by: MACCS, WBNMET, DAYHOU, RANSAM, USRSUP, CONMET,
    ADJTIM, BINSAM, CONTRL, STOEAR, CHROUT, STOCHR

Name: MULREL
Contains -
  Variables:
    Arrays: PDELAY, PLHEAT, PLHITE, PLUDUR, PSDIST,
      REFTIM, RELINV
Used by: INPREL, PUTSTM, ADJTIM, CONTRL, ATMOUT

Name: NAMCRP
Contains -
  Variables:
    Arrays: NAMCRP
Used by: STPATH, SDFINP, DIRDEP

Name: NAMRGN
Contains -
  Variables:
    Arrays: NMRGN
Used by: SDFINP, STGRDA
Name: NAMWPI
Contains -
  Variables: NAMWPI
  Arrays: NAMWPI
Used by: STPATH, RDISTB, SDFINP, EXCINP

Name: NCHRFL
Contains -
  Variables: NCHRFL
  Arrays:
Used by: OUTCON, READ1

Name: NETWOR
Contains -
  Variables: INIEVA, LASMOV
  Arrays: EDELAY, LASEVA, NEXTND
Used by: INEVAC, EVRADI, EVNETW, EVROOT, INPEMR, PUTSTG, RELZON, ESTAT, EMOVE

Name: NUMGRD
Contains -
  Variables: NEND, NINC, NINCM1, NUMFNT
  Arrays:
Used by: CHRINP, SGCPlN, WGCPlN

Name: NUMPAG
Contains -
  Variables: NUMPAG
  Arrays:
Used by: OUTPUT, PRINT

Name: NUMRES
Contains -
  Variables: NUMRES
  Arrays:
Used by: HEDEAR, HEDCHR, READ1, READ2, PRINT

Name: NUMVAL
Contains -
  Variables:
  Arrays: NUMVAL
Used by: HEDEAR, COPCHR, OUTPT1, OUTPT3, OUTPT5, OUTPT8, READ1, READ2, DO1CDF
Name: NXMORG
Contains - Variables: NXMORG
Arrays:
Used by: OPNERL, IXOT9, EXCINP, COPCHR, CHRNDF, TRFRCT, WTRTRF, DIRDEP, INITLZ, INTREFH, CSTEFF, CSTDCN, LTACUM, LOKSEE, CASGET

Name: NXMRES
Contains - Variables: NXMRES
Arrays:
Used by: COPCHR, HEDCHR, READ1

Name: NXMVAL
Contains - Variables:
Arrays: NXMVAL
Used by: COPCHR, HEDCHR, OXPT1, OXPT5, OXPT8, OXPT9, OXPT10, OXPT11, OXPT12, READ1

Name: ORGNAM
Contains - Variables:
Arrays: ORGNAM
Used by: INORGA, EDCINP, INEFAT, INEINJ, INACAN, INOUT3, INOUT5, INOUT6, OPNERL, RESNM3, RESNM5, RESNM6, COPCHR, EAROUT, EPCALC, INJNIS

Name: ORGNDX
Contains - Variables: MEND, MSTRT
Arrays:
Used by: CHRNDF, GNDRES

Name: OUTCOM
Contains - Variables: IBEGIN, NFILES
Arrays: IRESID
Used by: READ1, READ2, PRINT

Name: OXGNAM
Contains - Variables:
Arrays: OXGNAM
Used by: OPNERL, IXOT9, EXCINP, COPCHR, RXSNM9, LOKSEE,
Name: PATHNM
Contains -
  Variables: PATHNM
  Arrays: PATHNM
Used by: EARINP, INOUT6, RESNM6

Name: PHYCON
Contains -
  Variables: PI, SQRHPI, SQR2PI, TWOPI
  Arrays: MACCS, INPOPU, STGRDA, ATMOUT, EMOVE, PATRIS,
          INJRI, CANRIS, GEGEM, OUTPT1, OUTPT3, OUTPT4,
          OUTPT5, OUTPT8, OXPT1, OXPT4, OXPT5, OXPT8,
          OXPT9, OXPT10, OXPT11, OXPT12

Name: PLUMRS
Contains -
  Variables: SCLADP, SCLCRW, SCLEFP
  Arrays: INPLRS, CAUGHT, PLMRIS

Name: PNZERO
Contains -
  Variables: PNZERO
  Arrays: PNZERO
Used by: READ2, DO1CDF, PRINT

Name: POPDAT
Contains -
  Variables: POPDAT
  Arrays: POPDAT
Used by: INPOPU, EFFGET, OUTPT3, OUTPT5, OUTPT8, CASGET,
        OXPT5, OXPT8, DOSGET, ECCGET, GETIMP

Name: POPFLG
Contains -
  Variables: POPFLG
  Arrays: POPFLG
Used by: INPOPU, OPNERL

Name: PSCDIR
Contains -
  Variables: PSCMLK, PSCOTH
  Arrays: STPATH, LTPOJ

.  3-22
Name: RELOCA
Contains -
   Variables: DOSHOT, DOSNRM, ENDEMP, INDORG, TIMHOT, TIMNRM
   Arrays:
   Used by: INPEMR, PUTSTG, OPNERL, EPCALC, RELZON, EDOSIN, EMRGPH

Name: RESLT1
Contains -
   Variables: NUM1
   Arrays: CCDF1, IDIS1, I2DIS1, IECOD1
   Used by: INOUT1, HEDEAR, RESNM1, COPCHR, OUTPT1

Name: RESLT2
Contains -
   Variables: NUM2
   Arrays: CCDF2, RISTHR
   Used by: INOUT2, HEDEAR, RESNM2, COPCHR, OUTPT2

Name: RESLT3
Contains -
   Variables: NUM3
   Arrays: CCDF3, DOSH3, IDOSE3, INDEX3
   Used by: INOUT3, HEDEAR, RESNM3, COPCHR, OUTPT3

Name: RESLT4
Contains -
   Variables: NUM4
   Arrays: CCDF4, IDIS4, IECOD4
   Used by: INOUT4, HEDEAR, RESNM4, COPCHR, OUTPT4

Name: RESLT5
Contains -
   Variables: NUM5
   Arrays: CCDF5, IDIS5, I2DIS5, INDEX5
   Used by: INOUT5, HEDEAR, RESNM5, COPCHR, OUTPT5

Name: RESLT6
Contains -
   Variables: NUM6
   Arrays: CCDF6, IDIS6, I2DIS6, INDEX6, IPATHW
   Used by: INOUT6, HEDEAR, RESNM6, COPCHR, OUTPT6
Name: RESLT7
Contains -
  Variables: NUM7
  Arrays: CCDF7, I1DIS7, I2DIS7, IECOD7
Used by: INOUT7, HEDEAR, RESNM7, COPCHR, OUTPT7

Name: RESLT8
Contains -
  Variables: NUM8
  Arrays: CCDF8, I1DIS8, I2DIS8, IECOD8
Used by: INOUT8, HEDEAR, RESNM8, COPCHR, OUTPT8

Name: RESLT9
Contains -
  Variables: NXUM9
  Arrays: CXDF9, IX1DS9, IX2DS9, IXCOD9
Used by: IXOT9, HEDCHR, RXSNM9, OXTPT9

Name: RESNAM
Contains -
  Variables:
  Arrays: RESNAM
Used by: HEDEAR, COPCHR, READ1, PRINT

Name: RETCOD
Contains -
  Variables: RETCOD
  Arrays: RETCOD
Used by: RELZON, ESTAT, EMRGPH, LOKSEE

Name: REUSE1
Contains -
  Variables:
    Arrays: PADIT1, T1DOSE, T2DOSE
Used by: EAROUT, RELZON, INCLOS, EMOVE, ZERREM, INCREM, FATRIS, INJRIS, CANRIS, OUTPT3, OUTPT5
Contains -
  Variables:
    Arrays: DMDOSE, DODOSE, DSDXPS, DSFOOD, DSWKF, DSWKNF, GSDOSE, PADIT1, REDOSE, RMDOSE, RODOSE, WDDDOSE, WDDOSE
Used by: INITLZ, INTRPH, CSTEFF, CSTDNC, LTACUM, LOKSEE, CASGET, OXTPT4, OXTPT5, OXTPT6, OXTPT7, DOSGET
Name: REUSE1 (continued)
Contains - 
   Variables:  
       Arrays: BINPRB
Used by: READ2, DO1CDF, GNBIN2, PRINT

Name: REUSE2
Contains - 
   Variables:  
       Arrays: AGRNDC, PADIT2
Used by: SGCPLN, WGCP1N, INTRPH, LTPROJ, LTMACT, CSTDCN, LTACUM

Contains - 
   Variables:  
       Arrays: BINMAG
Used by: READ2, DO1CDF, GNBIN1, GNBIN2, PRINT

Name: REWTHR
Contains - 
   Variables:  
       Arrays: RWC0EF, TRWHLF
Used by: OPNERL, INCHR, CHRNDF

Name: RISCAN
Contains - 
   Variables:  
       Arrays: CANINJ, CANFAT
Used by: CANRIS, EFFGET, OUTPT4

Name: RISCAT
Contains - 
   Variables:  
       Arrays: 
Used by: INMISC, PRINT

Name: RISFAT
Contains - 
   Variables:  
       Arrays: FATAVG, RISFAT
Used by: EAROUT, FATRIS, CANRIS, EFFGET, OUTPT2, OUTPT4

Name: RISINJ
Contains - 
   Variables:  
       Arrays: RISINJ
Used by: INJRIS, EFFGET, OUTPT4

3-25
Name: ROOTS
Contains -
  Variables: NROOTS
  Arrays: ROOT
Used by: EVRADI, EVROOT, PUTSTG, EMOVE

Name: ROSEBI
Contains -
  Variables:
  Arrays: ROSEBI
Used by: WNDRZB, INMISC, OPNERL, DOLCDF

Name: ROTATE
Contains -
  Variables: OVRRID
  Arrays: WINROS
Used by: INMISC, OPNERL

Name: RSLT10
Contains -
  Variables: NXUM10
  Arrays: CXDF10, I1DS10, I2DS10
Used by: IXOT10, HEDCHR, RXNM10, OXPT10

Name: RSLT11
Contains -
  Variables: CXDF11, NXUM11
  Arrays: 
  
  Used by: IXOT11, HEDCHR, OXPT11

Name: RSLT12
Contains -
  Variables: NXUM12
  Arrays: CXDF12, I1DS12, I2DS12
Used by: IXOT12, HEDCHR, RXNM12, OXPT12

Name: RTINTR
Contains -
  Variables: 
  Arrays: GCMAXR, QROOT
Used by: STPATH, LTPROJ, LTACUM
Name: RXSNAM
Contains -
Variables: RXSNAM
Arrays: RXSNAM
Used by: COPCHR, HEDCHR, READ1

Name: SAVMET
Contains -
Variables: IBINUM, IDAY, IHOUR, PRBMET
Arrays: IBINUM, IDAY, IHOUR, PRBMET
Used by: READ2, DO1CDF, PRINT

Name: SITEDT
Contains -
Variables: DPRATE, DSRATE, FRFIM, FRNFIM, POPCST, VALWF, VALWNF
Arrays:
Used by: INCHRN, STGRDA, CSTEFF, ECCGET

Name: SRCTRM
Contains -
Variables: ISRCTM, NSRCTM
Arrays:
Used by: MACCS, INPUT, INPREL, PUTSTM, CONTRL, STOEAR, STOCHR, OUTPUT, PRINT

Name: SRZONE
Contains -
Variables: LASHE1, LASHE2, SHELT1, SHELT2, TTOSH1, TTOSH2
Arrays:
Used by: INPEMR, PUTSTG, RELZON, ESTAT

Name: STOPME
Contains -
Variables: ENDAT1, ENDAT2
Arrays:
Used by: MACCS, INPUT, INPOPT, INMISC, OUTCON, CONTRL, READ1, PRINT

Name: STRTGY
Contains -
Variables: ISTRTG, NSTRTG
Arrays:
Used by: INPUT, INEVAC, PUTSTG, CONTRL, EAROUT, STOEAR, READ1, READ2, PRINT

3-27
Name: TDECON
Contains -
Variables: TDECON
Arrays:
Used by: LTPROJ, LTMACT, CSSTEFF, LTACUM

Name: TERMS
Contains -
Variables:
Arrays: TRMEVA, TRMREL
Used by: EMRGPH, INITLZ, LOKSEE, ECCGET

Name: TCMCPP
Contains -
Variables:
Arrays: TCROOT
Used by: STPATH, TRFRCT

Name: UNFSWT
Contains -
Variables: UNFSWT
Arrays:
Used by: CHRINP, OPNERL, STGRDA

Name: WATRM
Contains -
Variables: NUMWPA, NUMWPI
Arrays:
Used by: STPATH, SDFINP, WTRTRF, LTACUM

Name: WETCON
Contains -
Variables: CWASH1, CWASH2
Arrays:
Used by: INPWET, WASHOU

Name: WETDRY
Contains -
Variables:
Arrays: DRYDEP, WETDEP
Used by: INPISO, ATMOUT, BLDTBL
Name: WTFRAC
Contains -
  Variables: WTFRAC
  Arrays: WTFRAC
Used by: INEVAC, PUTSTG, READ2, PRINT

Name: WTNNAME
Contains -
  Variables: WTNNAME
  Arrays:
Used by: INEVAC, READ2, PRINT

Name: WTRDAT
Contains -
  Variables:
  Arrays: TFLPD, TLPW
Used by: WTRTRF, LTACUM

Name: WTRDTA
Contains -
  Variables:
  Arrays: WINGF, WSHFRI, WSHRTA
Used by: STPATH, SDFINP, WTRTRF
3.3 Unnamed COMMON Block Usage

A description of the usage of the unnamed COMMON block is given in this section. The description includes: (1) a listing of the incorporated variables and arrays, and (2) the subprograms which use those contents.

Contains -
Variables:  CLOC
Arrays:   CARD
Used by:  INPEND, CGET1, DOCCDF, IGET1, LGET1, RGET1, SEARCH, SORT

Contains -
Variables:  APDCLG, APDCLR, APDCWG, APINLG, APINLR, APNOLG, APNOLR, PPAPIG, PPAPIR, PPDCLG, PPDCLR, PPINLG, PPINLR, PPNOLG, PPNOLR
Arrays:   APDCLG, APDCLR, APDCWG, APINLG, APINLR, APNOLG, APNOLR, PPAPIG, PPAPIR, PPDCLG, PPDCLR, PPINLG, PPINLR, PPNOLG, PPNOLR
Used by:  MACCS, CHRNDF, INTRPH, LTPROJ, LTMACT, CSTDCN, LTACUM
3.4 Variable Trail

In this section, a description is given of the way in which each COMMON block variable and array is utilized in the various subprograms of the MACCS code. For each variable or array, the description includes the following: (1) the name of the parameter, (2) the name of the common block in which it is included, (3) the names of the subprograms which utilize that variable, and (4) the use made of the variable.

When a variable is used by a subprogram, an indication is made as to whether the current value of the parameter is used without modification or whether the parameter value is modified within that subprogram. Two types of modification procedures are included: those in which the value is modified by direct assignment of a new value and those in which the value is modified when the variable or array is used as a parameter in the argument list for a called subprogram.

Common Block Variables and Arrays

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3.6 **COMMON Block Variable Definitions**

In this section each variable and array found in either named or unnamed COMMON blocks is defined. When a variable or array is a component of a named COMMON block, the name of that COMMON block is indicated at the end of the definition.

- **ACFRSK** - combined alpha dose effectiveness factors and cancer death risk factor for each cancer effect /CCANCR/
- **ACIRSK** - combined alpha dose effectiveness factors and cancer injury risk factor for each cancer effect /CCANCR/
- **ACNAME** - names of cancer effects that can result from acute exposure /ACNAME/
- **ACSUSC** - fraction of the population which is susceptible to each cancer effect /ACANCR/
- **ACTHRE** - dose threshold for using the linear dose response formula /ACANCR/
- **AGRNDC** - average ground concentration of each nuclide in each coarse grid element /REUSE2/
- **AIRCON** - time integrated air concentration at the plume height /ATMDAT/
- **ANGMAX** - greatest value of halfwidth in radians of the plume over all spatial intervals /GLOBAL/
- **APDCLG** - long-term groundshine dose accumulation after decontamination
- **APDCLR** - long-term resuspension inhalation dose accumulation after decontamination
- **APDCWG** - long-term groundshine dose accumulation for decontamination workers
- **APINLG** - long-term groundshine dose accumulation after interdiction
- **APINLR** - long-term resuspension inhalation dose accumulation after interdiction
- **APNOLG** - long-term groundshine dose accumulation when no mitigative actions are taken
- **APNOLR** - long-term resuspension inhalation dose accumulation when no mitigative actions are taken
- **AREA** - area of each grid element /GRDDTA/
ASFP - average annual farm sales for each region /ECNDTA/

ATNAM1 - descriptive title for the ATMOS input /ATNAM1/

ATNAM2 - descriptive title for the particular single choice of assumptions being made about the plume /ATNAM2/

AVGHIT - average plume height over a given spatial interval /ATMDAT/

AVL168 - intermediate value used in interpolating the groundshine dose /DOSFAC/

BINAVG - accumulated mean consequence for each weather sampling bin /BINAVG/

BINMAG - consequence values for each bin of the CCDF table /REUSE2/

BINNED - flag indicating that the bin magnitudes have been generated /BINNED/

BINPRB - probabilities for each bin of the CCDF table /REUSE1/

BNDMXX - boundary weather mixing layer height in meters /M2/

BNDRAN - boundary weather rain rate /M2/

BNDWND - boundary weather wind speed /M2/

BRKPNT - break point for the expansion formula change /EXPAND/

BRRATE - breathing rate for the following:
- evacuees while moving
- normal activity in sheltering and evacuation zone
- sheltered activity /EADFAC/

BUILDH - building width /BILWAK/

BUILDW - building height /BILWAK/

CANFAT - risk of cancer fatality from acute exposure in each coarse grid element /RISCAN/

CANINJ - risk of cancer injury for acute exposure in each coarse grid element /RISCAN/

CARD - input record

CCANFA - centerline risk of cancer fatality /CENCAN/

CCANIN - centerline risk of cancer injury /CENCAN/
CCDF  - flag indicating whether a CCDF table is to be produced

CCDF1 - flag indicating that a CCDF table is being requested for a type 1 EARLY effect

CCDF2 - flag indicating that a CCDF table is being requested for a type 2 EARLY effect

CCDF3 - flag indicating that a CCDF table is being requested for a type 3 EARLY effect

CCDF4 - flag indicating that a CCDF table is being requested for a type 4 EARLY effect

CCDF5 - flag indicating that a CCDF table is being requested for a type 5 EARLY effect

CCDF6 - flag indicating that a CCDF table is being requested for a type 6 EARLY effect

CCDF7 - flag indicating that a CCDF table is being requested for a type 7 EARLY effect

CCDF8 - flag indicating that a CCDF table is being requested for a type 8 EARLY effect

CD  - centerline cloudshine dose

CDCF  - cloudshine dose conversion factor for each nuclide-organ pair

CDFRM  - cost per unit area of farm decontamination for the various LVLDEC levels

CDNFRM  - cost per person of the nonfarm decontamination for the various LVLDEC levels

GENCD  - centerline cloudshine dose

CENFAT  - centerline risk of fatality

CENGD  - centerline groundshine dose

CENINJ  - centerline risk of injury

CENPID  - centerline plume inhalation cloudshine dose

CENRES  - centerline resuspension inhalation dose

CENSKI  - centerline skin deposition dose

CFRISK  - cancer death risk factor
CHNAME - descriptive title for the CHRONC input file /CHNAME/

CIRISK - cancer injury risk factor /ACANCR/

CLDFAC - cloudshine correction factor for each fine spatial element /DOSFAC/

CLOC - temporary storage used during input processing

COHAVG - accumulated mean consequence value for a given result for a given cohort /COHAVG/

CONMAX - maximum consequence value observed for a given result for a given cohort /MAXOCU/

COUPLD - flag indicating the long-term and growing season mitigative actions are to be performed in a dependent fashion /COUPLD/

CRDFLG - flag for record accessed for value during input /INPRC2/

CRTOCR - critical organ name for the chronic resuspension pathway /CRTOCR/

CSFACT - cloudshine shielding factors for the following groups:
- evacuees while moving
- normal activity in sheltering and evacuation zone
- sheltered activity /EADFAC/

CSTDF - cost of farm decontamination per unit area for each coarse grid element /DCCOST/

CSTDNF - cost of non-farm decontamination per person for each coarse grid element /DCCOST/

CSTIF - depreciation cost per unit area from the temporary interdiction of farm property in each coarse grid element /CSTINT/

CSTINF - depreciation cost per person from the temporary interdiction of non-farm property in each coarse grid element /CSTINT/

CSTLF - labor cost per unit area for the decontamination of farm property for each coarse grid element /DCCOST/

CSTLNF - labor cost per person for the decontamination of non-farm property for each coarse grid element /DCCOST/

CTCOEF - direct deposition transfer coefficients for the CHRONC ingestion model /CRPTRF/

CTHALF - direct deposition transfer half-lives for the CHRONC ingestion model /CRPTRF/
CWASH1 - washout coefficient number 1, linear factor /WETCON/
CWASH2 - washout coefficient number 2, exponential factor /WETCON/
CXDF9 - flag indicating that a CCDF table is being requested for the type 9 CHRONC result /RSLT9/
CXDF10 - flag indicating that a CCDF table is being requested for the type 10 CHRONC result /RSLT10/
CXDF11 - flag indicating that a CCDF table is being requested for the type 11 CHRONC result /RSLT11/
CXDF12 - flag indicating that a CCDF table is being requested for the type 12 CHRONC result /RSLT12/
CYSIGA - linear term of the expression for sigma-y for the six stability classes /DISPY/
CYSIGB - exponential term of the expression for sigma-y for the six stability classes /DISPY/
CZSIGA - linear term of the expression for sigma-z for the six stability classes /DISPZ/
CZSIGB - exponential term of the expression for sigma-z for the six stability classes /DISPZ/
DCYPBH - retention fractions for the nuclides in meat following losses due to processing and decay /ISOTDT/
DCYPCB - retention fractions for the nuclides in the crops for the time period between harvest and the time of consumption by dairy animals /ISOCRIP/
DCYPCH - retention fractions for the nuclides in the crops for the time period between harvest and the time of consumption by man /ISOCRIP/
DCYPCM - retention fractions for the nuclides in the crops for the time period between harvest the time of consumption by meat animals /ISOCRIP/
DCYPMH - retention fractions for the nuclides in milk following losses due to processing and decay /ISOTDT/
DFING - ingestion dose factor for each nuclide /ISOORG/
DLBCST - labor cost of decontamination worker /DECMOD/
DMDOSE - direct deposition dose to each organ via milk from a given spatial grid element /REUSE1/
DODOSE - direct deposition dose to each organ via non-milk crops from a given spatial grid element /REUSE1/

DOSEFA - dose effectiveness factor alpha for cancer from acute exposure /ACANCR/

DOSEFB - dose effectiveness factor beta for cancer from acute exposure /ACANCR/

DOS Shot - hot spot relocation groundshine dose criterion threshold /RELOCA/

DOSNRM - normal relocation groundshine dose criterion threshold /RELOCA/

DOSTH3 - dose thresholds use for type 3 EARLY result /RESLT3/

DPF - fraction of the regional farm sales that comes from dairy products /ECNDTA/

DPFRCT - average fraction of farm sales resulting from dairy products in the economic region /FRCFRM/

DPRATE - depreciation rate during interdiction period /SITEDT/

DRYDEP - flag to indicate if dry deposition occurs for each nuclide /WETDRY/

DSCRLT - dose criterion for long-term phase relocation /DOSTIM/

DSCRIT - dose criterion for intermediate phase relocation /DOSTIM/

DSDXPS - direct exposure dose for a given organ in a given grid element /REUSE1/

DSFOOD - food ingestion dose for a given organ in a given grid element /REUSE1/

DSPCRP - flag indicating disposal of non-milk crops will occur /DSPFLG/

DSPMLK - flag indicating disposal of milk crop will occur /DSPFLG/

DSRATE - annual societal discount rate during interdiction period /SITEDT/

DSRFCT - dose reduction factors corresponding to various levels of decontamination /DECMOD/

DSWKF - dose to decontamination workers for farmland area in a given grid element /REUSE1/

DSWKNF - dose to decontamination workers for non-farm property in a given grid element /REUSE1/
DTACNT - bin count /CNTDTA/
DTFBP - direct transfer factor for meat dose to the population for each nuclide-crop-organ triplet /DTTRFT/
DTFBPT - direct transfer fraction for meat dose term /DTFRCT/
DTFCP - direct transfer factor for crop dose to the population for each nuclide-crop-organ triplet /DTTRFT/
DTFCPT - direct transfer fraction for crop dose term /DTFRCT/
DTFMLK - direct transfer factor for the milk pathway for each nuclide-organ pair /DIRCTF/
DTFMP - direct transfer factor for milk dose to the population for each nuclide-crop-organ triplet /DTTRFT/
DTFMPT - direct transfer fraction for milk dose term /DTFRCT/
DTFOTH - direct transfer factor for non-milk pathway for each nuclide-organ pair /DIRCTF/
EANAM1 - descriptive title for the EARLY input file /EANAM1/
EANAM2 - description of the emergency response scenario being used /EANAM2/
EDELAY - evacuation delay times for the three evacuation zones /NETWOR/
EFFACA - early fatality parameter alpha for all early fatalities /EFATAL/
EFFACB - early fatality parameter beta for all early fatalities /EFATAL/
EFFEC1 - total cases of the given type 1 (EARLY or CHRONIC) health effect /EFFEC1/
EFFNM1 - name of the health effect associated with each type 1 EARLY effect /EFFNM1/
EFFNM4 - name of the health effect associated with each type 4 EARLY effect /EFFNM4/
EFFNM7 - name of the health effect associated with each type 7 EARLY effect /EFFNM7/
EFFNM8 - name of the health effect associated with each type 8 EARLY effect /EFFNM8/
EFFTHR - early fatality threshold dose /EFATAL/
EIFACA - early fatality hazard function alpha factors for all early injuries /EINJUR/
EIFACB - early fatality hazard function beta factors for all early injuries /EINJUR/
EINAME - names of early injuries defined in the model /EINAME/
EISUSC - susceptible population fraction table /EINJUR/
EITHRE - early injury dose threshold table /EINJUR/
ENDAT1 - flag to indicate that only the ATMOS module is to be run /STOPME/
ENDAT2 - flag to indicate that CHRONC will not be run /STOPME/
ENDEMP - duration of the emergency phase expressed in seconds from plume arrival /RELOCA/
EVACST - evacuation cost /ERLCST/
EVCOST - evacuation cost /ERLCST/
EXPFAC - expansion factor for a given plume segment /EXPFAC/
FATAVG - average risk of fatality in a given coarse grid element /RISFAT/
FMAREA - farm area in each spatial grid element /FRMDAT/
FPLSCH - retention fractions following processing and preparation of crop prior to consumption by man /ISOCRPI
FRACLD - fraction of the area in the region that is land /FRACLD/
FRCFRM - fraction of land in the region that is devoted to farming /FRCFRM/
FRCLND - total land fraction of each grid element /FRCLND/
FRCTCB - fraction of the crop consumed by meat animals /CROPDT/
FRCTCH - fraction of the crop consumed by man /CROPDT/
FRCTCM - fraction of the crop consumed by dairy animals /CROPDT/
FRCTFL - fraction of farmland in region devoted to that crop /CROPDT/
FRFDL - fraction of the farmland decontamination cost is due to labor for the various decontamination levels /DECMOD/
FRFIM - fraction of farm wealth of the region is due to improvements /SITEDT/
FRMFRC - regional farmland fraction /ECNDTA/
average value of annual farm production in the region /FRCFRM/
fraction of the non-farm decontamination cost which is due to labor for the various LVLDEC levels /DECMOD/
fraction of the non-farm wealth of the region which is due to improvements /SITEDT/
average height of the Gaussian over all fine grid elements /DOSFAC/
maximum permissible ground concentration for long-term ingestion model /RTINTR/
centerline groundshine dose /EDOSES/
groundshine dose rate factor /DOSFAX/
groundshine dose conversion factor /DCFAC/
ground concentration at midpoint of a given spatial element /ATMDAT/
groundshine dose to a given organ in a given coarse grid element /REUSE1/
groundshine shielding factor for the site /GSWTHR/
groundshine shielding factor for the following groups:
- evacuees while moving
- normal activity in sheltering and evacuation zone
- sheltered activity /EADFAC/
groundshine weathering coefficients /GSWTHR/
radiological half-lives of all the nuclides /ISOGRP/
identification information for the current set of user input assumptions /HEADER/
mixing layer height /METDTA/
mixing layer height /HCTMIX/
mixing layer heights for 120 hours /M5/
rainfall rates for 120 hours /M5/
wind speeds for 120 hours /M5/
ratio of ground level to centerline air concentration /ATMDAT/
HTMXLR - mixing layer height for each hour /METDAT/

I1DIS1 - inner limit on the region of interest for type 1 EARLY results /RESLT1/

I1DIS4 - inner limit on the region of interest for type 4 EARLY results /RESLT4/

I1DIS5 - inner limit on the region of interest for type 5 EARLY results /RESLT5/

I1DIS6 - inner limit on the region of interest for type 6 EARLY results /RESLT6/

I1DIS7 - inner limit on the region of interest for type 7 EARLY results /RESLT7/

I1DIS8 - inner limit on the region of interest for type 8 EARLY results /RESLT8/

I1DS10 - inner limit on the region of interest for type 10 CHRONC results /RSLT10/

I1DS12 - inner limit on the region of interest for type 12 CHRONC results /RSLT12/

I2DIS1 - outer limit on the region of interest for type 1 EARLY results /RESLT1/

I2DIS5 - outer limit on the region of interest for type 5 EARLY results /RESLT5/

I2DIS6 - outer limit on the region of interest for type 6 EARLY results /RESLT6/

I2DIS7 - outer limit on the region of interest for type 7 EARLY results /RESLT7/

I2DIS8 - outer limit on the region of interest for type 8 EARLY results /RESLT8/

I2DS10 - outer limit on the region of interest for type 10 CHRONC results /RSLT10/

I2DS12 - outer limit on the region of interest for type 12 CHRONC results /RSLT12/

IBDSTB - boundary weather stability class /M2/

IBEGIN - spatial interval at which the population begins /OUTCOM/

IBINUM - bin number for given weather trial /METOUT/ /SAVMET/
IC - column counter for reading input data /IPOINT/
ICRTRO - index of the critical organ for the long-term model /ICRTRO/
IDAUGT - index of daughters of a given nuclide /DAUTR/
IDAY - day in the year of given weather trial start time /METOUT/ /SAVMET/
IDBSTB - stability class for constant weather option /M2/
IDCF - inhalation dose conversion factor for each nuclide-organ pair /DCFACT/
IDEBUG - debug print option controller /ATMOPT/
IDIR - direction index /INDXS/
IDIREC - direction in which a given plume travels /ATMDAT/
IDNTFI - identifier of one site data characteristic /IDNTFI/
IDOSE3 - flag indicating the type of dose to use for type 3 EARLY result /RESLT3/
IDRB - weather bin data summaries for each weather class in each direction /DIRB/
IDRBN - weather bin data summaries for each weather class in each direction /METB/
IECOD1 - type 1 EARLY health effects code /RESLT1/
IECOD4 - type 4 EARLY health effects code /RESLT4/
IECOD7 - type 7 EARLY health effects code /RESLT7/
IECOD8 - type 8 EARLY health effects code /RESLT8/
IEVACU - evacuation model flag /GLOBAL/
IFF - flag to force reinitialization of the random number generator (not used with current random number generator) /IFF/
IGDCF - groundshine dose conversion factor following plume passage for each nuclide-organ pair /DCFACT/
IGROUP - nuclide group number for each nuclide /ISOGRP/
IHITIT - logical flag indicating ground contamination in a given spatial grid element /IHITIT/
IHOUR - hour in the day of a given weather trial start time /METOUT/
/SAVMET/

IHRDIR - wind directions for 120 hours /M5/

IHRSTB - stability class indices for 120 hours /M5/

INDEX3 - indices to the organs used for type 3 EARLY results /RESLT3/

INDEX5 - indices to the organs used for type 5 EARLY results /RESLT5/

INDEX6 - indices to the organs used for type 6 EARLY results /RESLT6/

INDORG - index to the critical organ for relocation /RELOCA/

INDREG - economic regional index for each grid element /INDREG/

INDWTR - regional watershed index for each grid element /INDWTR/

INDXAC - index to the cancer effect organs /ACANCR/

INDXBN - bin number index /M4/

INDXCA - organ index for the cancer effects /CCANCR/

INDXEF - index to the early fatality organs /EFATAL/

INDXEI - index to the early injury organs /EINJUR/

INIEVA - first spatial interval in the evacuation zone /NETWOR/

INTRVL - index to the current spatial interval /INDXS/

INWGHT - number of weather sequences requested from each bin /M4/

IPATHW - pathway codes for type 6 EARLY results /RESLT6/

IPLUME - dispersion model option code:
1 straightline
2 wind-shift with rotation
3 wind-shift without rotation /GLOBAL/

IPNT - pointer array for sorting records during input /INPRC2/

IPOINT - pointer for reading datum on an input record /IPOINT/

IPRINT - level of debug output desired /IPRINT/

IRAND - random number /METB/

IRESID - residence code for module(s) /OUTCOM/
IRNRAT - table of rain intensity breakpoints /M4/
IRSEED - initial seed for random number generator /M4/
ISECON - start time in seconds /METOUT/
ISRCTM - loop counter on the source terms used by ATMOS /SRCTRM/
ISTAB - stability class for each hour /METDAT/
ISTRDY - day of the year for start time /M3/
ISTRHR - hour of the day for start time /M3/
ISTRTG - loop counter on the emergency response scenarios used by EARLY /STRTGY/
ITRIAL - sequence number of a given weather trial /METOUT/
IUNIT - unit number from which to read the user input file /IUNIT/
IWGHT - bin weights /METB/
IWINDT - transformed wind direction used in the dosimetry calculations /DOSFAC/
IX1DS1 - inner limit on the region of interest for type 1 CHRONC results /IXOUT1/
IX1DS4 - inner limit on the region of interest for type 4 CHRONC results /IXOUT4/
IX1DS5 - inner limit on the region of interest for type 5 CHRONC results /IXOUT5/
IX1DS6 - inner limit on the region of interest for type 6 CHRONC results /IXOUT6/
IX1DS7 - inner limit on the region of interest for type 7 CHRONC results /IXOUT7/
IX1DS8 - inner limit on the region of interest for type 8 CHRONC results /IXOUT8/
IX1DS9 - inner limit on the region of interest for type 9 CHRONC results /RESLT9/
IX2DS1 - outer limit on the region of interest for type 1 CHRONC results /IXOUT1/
IX2DS5 - outer limit on the region of interest for type 5 CHRONC results /IXOUT5/
IX2DS6 - outer limit on the region of interest for type 6 CHRONC results /IXOUT6/
IX2DS7 - outer limit on the region of interest for type 7 CHRONC results /IXOUT7/
IX2DS8 - outer limit on the region of interest for type 8 CHRONC results /IXOUT8/
IX2DS9 - outer limit of the region of interest for type 9 CHRONC results /RESLT9/
IXCOD1 - type 1 CHRONC health effects code /IXOUT1/
IXCOD4 - type 4 CHRONC health effects code /IXOUT4/
IXCOD7 - type 7 CHRONC health effects code /IXOUT7/
IXCOD8 - type 8 CHRONC health effects code /IXOUT8/
IXCOD9 - index to the CHRONC organ to be used for the type 9 CHRONC result /RESLT9/
IXDEX5 - indices to the organs used for type 5 CHRONC results /IXOUT5/
IXDEX6 - indices to the organs used for type 6 CHRONC results /IXOUT6/
IXPATH - pathway codes to type 6 CHRONC results /IXOUT6/
JDAY - start day for weather sampling /CDATE/
JHOUR - start hour for weather sampling /CDATE/
KCEPNT - print control for chronic/economic detail print /KPRINT/
KDAY - starting day for weather sampling /CDATE/
KDFPNT - print control for dose factor print /KPRINT/
KDTPNNT - print control for direct deposit transfer factor print /KPRINT/
KGCPNT - print control for ground concentration print /KPRINT/
KHHOUR - starting hour for weather sampling /CDATE/
KLTPNT - print control for long-term transfer factor print /KPRINT/
KRAIN - measure of rain which fell /IRAIN/
KSWDSC - print control switch for chronic doses and costs /KOPRNT/
KSWRSK - print control switch for chronic risks /KOPRNT/
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3-101
2 weather category bin sampling  
3 120 hours of weather specified on the atmos user 
   input file  
4 constant met (boundary weather used from the start)  
5 stratified random samples for each day of the year 
/M1/

MONTHS - monthly array used for weather sampling /METDTA/
MRAIN - measure of rain which fell /IRAIN/
MSTRT - starting index for organs /ORGNDX/
NAMCRP - crop name /NAMCRP/
NAMWPI - water ingestion pathway nuclide name /NAMWPI/
NBIN - number of defined weather bins /METB/
NBLANK - number of blank records encountered during input /INPRC3/
NCHANG - number of change records encountered during input /INPRC3/
NCHRFL - number of CHRONC results files /NCHRFL/
NCMMNT - number of comment records encountered during input 
   /INPRC3/
NDPLCT - number of duplicate records encountered during input 
   /INPRC3/
NDXFII - nuclide index for each food ingestion nuclide /FDINGM/
NEND - one more than one-half the number of fine grid 
   subdivisions used by the model /NUMGRD/
NEXTND - triplets representing the path from each spatial element 
   /NETWOR/
NFICRP - number of defined crops in the chronic food ingestion 
   model /FDINGM/
NFIISO - number of nuclides in the chronic food ingestion model 
   /FDINGM/
NFILES - total number of result files to be processed /OUTCOM/
NGWTRM - number of terms in the groundshine weathering /GSWTHR/
NINC - one-half the number of fine grid subdivisions used by the model 
   /NUMGRD/
NINCMI - one less than one-half the number of fine grid subdivisions used by the model /NUMGRD/
NMRGN - name of the economic region /NAMRGN/
NPSGRP - number of particle size groups defined in the model /DRYCON/
NREC - counter for number of input records /INPRC3/
NRECT - counter for total number of input records read /INPRC3/
NRINTN - number of rain intensity levels for the rain bins /M4/
NRNINT - number of rain distance intervals for the rain bins /M4/
NROOTS - number of root nodes in the evacuation network /ROOTS/
NRWTRM - number of terms in the resuspension weathering equation /REWTHR/
NSBINS - number of bins to be sampled /M4/
NSMPLS - number of samples to be taken per bin /M4/
NRCTM - total number of the source terms being used by ATMOS /SRCTRM/
NSTRTG - total number of emergency response scenarios used by EARLY /STRTGY/
NTOT - /METB/
NTRMNT - number of terminator records read during input /INPRC3/
NTTRM - number of terms in the crop transfer function /CRPTRF/
NUCNAM - name of each nuclide /ISONAM/
NUCOUT - name of the nuclide requested /ATMOPT/
NUM1 - number of type 1 EARLY results requested /RESLT1/
NUM2 - number of type 2 EARLY results requested /RESLT2/
NUM3 - number of type 3 EARLY results requested /RESLT3/
NUM4 - number of type 4 EARLY results requested /RESLT4/
NUM5 - number of type 5 EARLY results requested /RESLT5/
NUM6 - number of type 6 EARLY results requested /RESLT6/
NUM7 - number of type 7 EARLY results requested /RESLT7/

NUM8 - number of type 8 EARLY results requested /RESLT8/

NUMACA - number of acute exposure cancer effects /ACANCR/

NUMCNC - number of types of cancer that can result from chronic exposure /CCANCR/

NUMCOR - number of coarse grid elements in the angular direction /GLOBAL/

NUMEFA - number of early fatality effects /EFATAL/

NUMEIN - number of early injury effects /EINJUR/

NUMFIN - number of fine grid subdivisions used by the model /GLOBAL/

NUMFNT - total number of fine grid subdivisions /NUMGRD/

NUMISO - number of nuclides defined in the model /GLOBAL/

NUMORG - number of organs defined for the health effects model /GLOBAL/

NUMPAG - page counter on the output listing /NMPAG/

NUMRAD - number of radial spatial elements /GLOBAL/

NUMREL - number of plume segments released /GLOBAL/

NUMRES - total number of results to be written on the EARLY output file /NUMRES/

NUMTRI - number of weather trials in the run /GLOBAL/

NUMVAL - number of result values to be produced for each result in a single trial /NUMVAL/

NUMWPA - number of watersheds /WATRM/

NUMWPI - number of nuclides in the water ingestion pathway model /WATW/

NXMORG - number of organs used by the CHRONC module /NXMORG/

NXMRES - total number of results to be written to the CHRONC output file /NXMRES/

NXMVAL - number of consequence values written for all CHRONC results /NXMVAL/

NXUM1 - number of type 1 CHRONC results requested /IXOUT1/
NXUM4 - number of type 4 CHRONC results requested /IXOUT4/
NXUM5 - number of type 5 CHRONC results requested /IXOUT5/
NXUM6 - number of type 6 CHRONC results requested /IXOUT6/
NXUM7 - number of type 7 CHRONC results requested /IXOUT7/
NXUM8 - number of type 8 CHRONC results requested /IXOUT8/
NXUM9 - number of type 9 CHRONC results requested /RESLT9/
NXUM10 - number of type 10 CHRONC results requested /RSLT10/
NXUM11 - number of type 11 CHRONC results requested /RSLT11/
NXUM12 - number of type 12 CHRONC results requested /RSLT12/

OALARM - time after accident initiation when accident reaches general emergency conditions, or when plant personnel can reliably predict that general emergency conditions will be attained /ATMDAT/

ORGNAM - names of organs defined for the health effects /ORGNAM/
OVRRID - flag indicating an override of the windrose for ATMOS /ROTATE/
OXGNAM - names of the organs defined in the CHRONC model /OXGNAM/
PARENT - array of parent of each nuclide /ISOCRP/
PATHNM - pathway names for EARLY results of type 6 /PATHNM/
PCF - precalculated cloudshine dose factor /DOSFAC/
PDELAY - time of release for each plume (after scram) /MULREL/
PGF168 - precalculated 168 hour groundshine dose factor /DOSFAC/
PGPF - precalculated groundshine dose factor used during plume passage /DOSFAC/
PI - geometric pi /PHYCON/
PID - centerline plume inhalation dose /EDOSES/
PIF - precalculated direct inhalation dose factor /DOSFAC/
PLHEAT - heat content of each release segment /MULREL/
PLHITE - height of each plume segment at release /MULREL/
PLUDUR - duration of release of each plume segment /MULREL/
PNZERO - probability of exceeding zero for a given result /PNZERO/
POPCST - urban population removal cost /SITEDT/
POPDAT - population residing in the coarse grid spatial element /POPDAT/
POPFLG - flag indicating whether uniform or site file population
distribution is being used /POPFLG/
PPAPIG - projection/accumulation groundshine dose for intermediate phase
PPAPIR - projection/accumulation resuspension inhalation dose for the intermediate phase
PPDCLG - projected long-term groundshine dose following decontamination
PPDCLR - projected long-term resuspension inhalation dose following decontamination
PPINLG - projected long-term groundshine dose following interdiction
PPINLR - projected long-term resuspension inhalation dose following interdiction
PPNOLG - projected long-term groundshine dose without mitigative actions
PPNOLR - projected long-term resuspension inhalation dose without mitigative actions
PRBMET - probability of any given weather trial /METOUT/ /SAVMET/
PROTIN - protection factor for inhalation for the following groups:
  - evacuees while moving
  - normal activity in sheltering and evacuation zone
  - sheltered activity /EADFAC/
PRSF - precalculated resuspension inhalation dose factor /DOSFAC/
PSCMLK - permissible ground concentration for milk production /PSCDIR/
PSCOTH - permissible ground concentration for non-milk production /PSCDIR/
PSDIST - particle size distribution for each nuclide group /MULREL/
PSF - precalculated skin dose factor /DOSFAC/
QROOT - annual depletion rate for a nuclide in the soil /RTINTR/
RDF - resuspension inhalation dose factor /DOSFAX/
RDISTS - interval endpoints for rain /M4/
REDOSE - resuspension dose to a given organ from a given grid element /REUSE1/
REFTIM - reference times for dispersion and radioactive decay /MULREL/
RELCST - relocation cost /ERLCST/
RELINV - release inventory for each nuclide /MULREL/
RESCON - resuspension inhalation model concentration coefficient /DOSFAC/
RESID - resuspension inhalation dose /EDOSES/
RESLAM - resuspension decay constant /DOSFAC/
RESNAM - result names /RESNAM/
RETCOD - return codes for each coarse grid element /RETCOD/
RINHL - inhalation rate for individuals /REWTHR/
RISCAT - flag indicating the breakdown of risk by weather category bins is to be presented to show their relative contribution to the mean /RISCAT/
RISFAT - risk of early death in each fine spatial element /RISFAT/
RISINJ - risk of a given injury in a given coarse grid element /RISINJ/
RISTHR - risk threshold for early death (fatal radius definition) /RESLT2/
RLCOST - relocation cost /ERLCST/
RMDOSE - long-term root uptake milk dose to a given organ from a given coarse grid element /REUSE1/
RNMM - rain rate for each hour /METDAT/
RNRATE - rain intensity breakpoints for the weather binning /M4/
RODOSE - long-term root uptake non-milk dose to a given organ from a given coarse grid element /REUSE1/
ROOT - pointers to the root nodes in the network /ROOTS/
ROSE - /METB/
ROSEBI - windrose probability for each bin for the wind blowing in each direction /ROSEBI/

RPF - resuspension protection factor /REWTHR/

RWCOEF - resuspension concentration coefficients /REWTHR/

RXSNAM - names of the chronic results /RXSNAM/

SCLADP - scaling factor for the A-D stability plume rise formula /PLUMRS/

SCLCRW - scaling factor for the critical wind speed for the entrainment of a buoyant plume /PLUMRS/

SCLEFP - scaling factor for the E-F stability plume rise formula /PLUMRS/

SDCF - skin dose conversion factor for each nuclide /DCFACT/

SDD - skin deposition dose /EDOSES/

SDV - skin dose deposition velocity for each nuclide /DCFACT/

SHELTI - shelter duration in the inner shelter zone /SRZONE/

SHELTI2 - shelter duration in the outer shelter zone /SRZONE/

SIGMAY - sigma-y at each spatial element centerpoint /DOSFAC/

SIGYM - average sigma y over the spatial interval /ATMDAT/

SIGZM - average sigma z over the spatial interval /ATMDAT/

SKPFAC - skin protection factor for the following groups:
  - evacuees while moving
  - normal activity in sheltering and evacuation zone
  - sheltered activity /EADFAC/

SPACE - spacing in bins for random sampling of weather /METB/

SPACEN - distances to the spatial element centerpoints /GLOBAL/

SPAEND - radial distances to the spatial element endpoints /GLOBAL/

SPALEN - length of each spatial interval /GLOBAL/

SQR2PI - square root of two pi /PHYCON/

SQRHPI - square root to one-half pi /PHYCON/

T1DOSE - doses for acute effects /REUSE1/
T2DOSE - doses for latent effects /REUSE1/
TCROOT - transfer factor from soil-to-plant by root-uptake /TRCMPL/
TDECON - time at which projected dose satisfies the long-term dose criterion /TDECON/
TFBF - biological transfer fractions for meat /ISOTDT/
TFLBPT - long-term transfer factor for meat dose term /LTFCTR/
TFLCPT - long-term transfer factor for crop dose term /LTFCTR/
TFLMLK - long-term transfer factor for milk pathway /LTFCTR/
TFLMPT - long-term transfer factor for milk dose term /LTFCTR/
TFLOTH - long-term transfer factor for non-milk pathway /LTFCTR/
TFLPD - direct liquid pathway transfer factor from the water pathway for each nuclide-organ pair for each watershed /WTRDAT/
TFLPW - washoff liquid pathway transfer factor from the water pathway for each nuclide-organ pair for each watershed /WTRDAT/
TFLMLK - biological transfer fractions for milk /ISOTDT/
TFWKF - fraction of the time workers in the farm areas spend in decontamination work for the various levels of decontamination /DECMOD/
TFWKNF - fraction of the time workers in the non-farm areas spend in decontamination work for the various levels of decontamination /DECMOD/
TGSBEG - growing season start time /CRPTIM/
TGSEND - growing season end time /CRPTIM/
TGWHLF - half-life for groundshine weathering terms /GSWTHR/
THRVST - time of the harvest season /CRPTIM/
TIMACC - time of the accident /CRPTIM/
TIMBAS - time base for the expansion factor /EXPAND/
TIMCEN - time from scram for plume to reach the center of a given spatial interval /ATMDAT/
TIMDEC - decontamination times corresponding to the various levels of decontamination /DECMOD/

TIMHOT - hot spot relocation time in sec. from plume arrival /RELOCA/

TIMNRM - normal relocation time in sec. from plume arrival /RELOCA/

TIMOVH - time duration over which plume is over center of a given spatial interval /ATMDAT/

TINTRD - interdiction periods corresponding to the tabulated pathway factors stored in: PPINLG, PPINLR, APINLG, APINLR /DOSTIM/

TMEPND - time at which the emergency phase ends /DOSTIM/

TMIPND - end of the intermediate phase period measured from the time of accident initiation /DOSTIM/

TMPACT - action period (i.e. the projection period) from the start of the long-term phase /DOSTIM/

TRMDRL - relocation period of temporary interdiction for decontamination of a given grid element /DCCOST/

TRMEVA - duration of the evacuation period from a given grid element /TERMS/

TRMIRL - duration of the intermediate phase relocation from a given grid element /ITERMS/

TRMREL - duration of relocation from a given grid element /TERMS/

TRWHLF - half-lives corresponding to the resuspension concentration coefficients RWCOEF /REWTHR/

TSEEDG - day of the year on which a given crop is planted /CRPTIM/

TSTART - time at which exposure starts at centerpoint of each spatial element /DOSFAC/

TSTOP - time at which exposure stops at centerpoint of each spatial element /DOSFAC/

TTOSHL - time to take shelter in the inner shelter zone given in seconds from OALARM /SRZONE/

TTOSH2 - time to take shelter in the outer shelter zone given in seconds from OALARM /SRZONE/

TWOPI - two times pi /PHYCON/

UNFSWT - uniform regional data switch to use Site Data File /UNFSWT/
VALWF - value of farm wealth /SITEDT/
VALWNF - non-farm wealth, property and improvements for the region /SITEDT/
VDEPOS - deposition velocity of each particle size group /DRYCON/
VFRM - average regional farm value /ECNDTA/
VNFRM - average regional non-farm value /ECNDTA/
WDDOSE - direct water deposition dose to a given organ in a given coarse grid element /REUSE1/
WETDEP - flag to indicate if washout occurs for each nuclide /WETDRY/
WINDIR - wind direction for each hour /METDAT/
WINDSP - wind speed for each hour /METDAT/
WINGF - water ingestion factor /WTRDTA/
WINROS - table of windrose probabilities /ROTATE/
WSHFRI - initial washoff fraction /WTRDTA/
WSHRTA - annual washoff rate /WTRDTA/
WTFRAC - weighting fraction applicable to the emergency response scenario being used /WTFRAC/
WTNAME - type of weighting (time or people) to be applied to the emergency scenarios /WTNAME/
WWDOSE - washoff water deposition dose to a given organ in a given coarse grid element via a given watershed /REUSE1/
XPFAC1 - exponential expansion factor number 1 /EXPAND/
XPFAC2 - exponential expansion factor number 2 /EXPAND/
YSCALE - linear scaling factor for the sigma-y function /DISPY/
ZSCALE - linear scaling factor for the sigma-z function /DISPZ/
A detailed individualized calling structure chart is depicted for both the main program and any subprograms which themselves call other subprograms during their execution. The calling structure charts are intended to give the programmer a visual depiction of the following: (1) the sequence of calls being made within a given subprogram, (2) an indication of whether there are single or multiple calls of a particular subprogram, and (3) whether the calls are unconditional or conditional. It is not the intention that the calling structure charts give an intricate accounting of all the flow patterns through any given subprogram, only those patterns which affect the routines being called.

Not all subprograms found in MACCS are depicted in the following charts. Only those subprograms which themselves call more than one subprogram are, in fact, represented. The subprograms are presented in the same order in which they appear in the MACCS code. An outline of the included subprograms precedes the presentation of the calling structure charts as an aid in determining whether or not a particular subroutine has been included. The numbering system used in the outline is based on the "level" at which a particular subroutine is found within MACCS. The main program of MACCS is considered to be the first level, any routine called by the main program to be at the second level, any routine called by a second level subprogram to be at the third level, etc. The numbering system used to identify the structure calling charts has the following consecutive parts:

Roman numeral - indicates the second level subprogram (i.e., a subprogram called by the Main Program) which eventually leads to the call of subroutine being considered.

Capital letter - indicates the third level subprogram (i.e., a subprogram called by a second level routine) which eventually leads to the call of the subprogram being considered.

Number - ...fourth level...

Small letter - ...fifth level...

Number - ...sixth level...

Small letter - etc.

Each calling structure chart is read from the top down and left to right unless otherwise dictated by a direction arrow. Each diagram has a
main line of flow from top to bottom along the left side with loop and branching structures emanating from that line of flow. Three types of structures are depicted within the charts as shown below:

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

IF-ENDIF

or

IF-ELSE-ENDIF

Additional symbols used within the charts and their associated meanings are described in Table A.1.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>*</td>
<td>Normal flow of the subprogram</td>
</tr>
<tr>
<td>^</td>
<td>The indicated subroutine will subsequently be depicted with a calling structure chart</td>
</tr>
<tr>
<td>x</td>
<td>IF and ENDIF statements at the first level</td>
</tr>
<tr>
<td>o</td>
<td>ELSEIF</td>
</tr>
<tr>
<td>xx</td>
<td>IF and ENDIF statements when in constraints a previous IF statement</td>
</tr>
<tr>
<td>$</td>
<td>Assignment of a function value</td>
</tr>
<tr>
<td>&gt;&gt;&gt; or &lt;&lt;&lt;</td>
<td>Return</td>
</tr>
<tr>
<td>&gt; and &lt;</td>
<td>GO TO and subsequent reentry point from GO TO</td>
</tr>
<tr>
<td>&lt; and &gt;</td>
<td></td>
</tr>
<tr>
<td>n</td>
<td>Nested do loops when outer loops do not directly affect the call</td>
</tr>
<tr>
<td>m</td>
<td>IF-ELSIF-ELSEIF-...-ENDIF structure which allows call to subprogram to be bypassed</td>
</tr>
</tbody>
</table>
When a subprogram makes a single call to a single subprogram, no chart is provided to illustrate the calling structure. Instead, when the calling subprogram first appears on a structure chart an indication is made that it in turn will make a single call and the following symbols are used to indicate if the subsequent call is unconditional or conditional:

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>((!** called subprogram))</td>
<td>Unconditional call</td>
</tr>
<tr>
<td>((?** called subprogram))</td>
<td>Conditional call</td>
</tr>
</tbody>
</table>
A.2 Outline for Individualized Calling Structure Charts

PROGRAM STRUCTURE CHARTS OUTLINE

MACCS

1. INPUT
   1A. INPBEG
   1B. ATMOOL
      1B1. INPGE0
         1B1a. IGET1
         1B1b. RGETN
      1B2. INPSO
         1B2a. LGETN
         1B2b. CGET1
         1B2c. IGETN
      1B3. INPWET
         1B3a. LGET1
      1B4. INPDRY
      1B5. INPDIS
      1B6. INPEXP
      1B7. INPLRS

1C. ATPROB
   1C1. INPWAK
   1C2. INPMET
      1C2a. INPM1
         1C2a1. WDMET
      1C2b. INPM2
      1C2c. INPM3
      1C2d. INPM4
      1C2e. INPM5
   1C3. INPOPT
      1C3a. LGET1
ID. INPREL
IE. PUTSTM
IF. EARINP

IF1. INMISC
IF2. INORGA
IF3. INEVAC

IF3a. EVNETW

IF4. INPOPU
IF5. INPEMR
IF6. INDFAC
IF7. INEFAT
IF8. INEINJ
IF9. INACAN
IF10. INOUT1

IF10a. DOCCDF

IF11. INOUT2
IF12. INOUT3
IF13. INOUT4
IF14. INOUT5
IF15. INOUT6
IF16. INOUT7
IF17. INOUT8

IG. REDSTG
IH. PUTSTG
II. CHRINP

II1. OPNERL
II2. INPCHR

II2a. INCHRN
II2b. STPATH

II2b1. RDISTB

II2c. IXOT9
II2d. IXOT10
II2e. IXOT11
II2f. IXOT12

II3. MODLDF - E
II4. SDFINP

IJ. OUTCON

IJ1. HEDEAR
A.3 Individualized Subroutine Calling Structure Charts

MACCS

* MXXETC
* MXXCPU - ((?*** ABORT))
* MXXDAT
* MXXCLK
* INPUT
* MXXCPU
* x*****
  x ABORT
  ****
    x******
    x (GETSTM*)
    x******
    x********
    x******************************
    o******************************
    o******************************
    o******************************
    o RANSAM^ CONMET^ USRSUP^ BINSAM^ DAYHOU^
    o ********
    x******************************
    ****

MXXCPU
x*****
  OUTPUT^
  ********
* MXXCPU
I. SUBROUTINE INPUT

* 
INPBEG
**
* ERRLOC
ATMODL
* 
ABORT
xx****
* ATPROB
xx****
x************
x ABORT
x
**
xxx
* INPBEG
* * 
* INPREL
* * 
* xx********
* * 
* xx**xx ABORT
* * 
* PUTSTM
* * 
* xx********
x*** ****xx ABORT

INPEND
x***
* 
INPBEG
* 
EARINP
**
x************
x ABORT
x
**
* ERRLOC
* * 
* xx****
* * 
* INPBEG ABORT
* * 
* REDSTG
* * 
* xx********
* * 
* xx**xx ABORT
* * 
* PUTSTG
* * 
* xx********
oo** ****xx ABORT
x
INPEND
x***
* 
INPBEG
* 
CHRINP
* 
CHINP
x
* 
xx********
x ABORT
* 
INPEND
***
OUTCON
* 

IA. SUBROUTINE INPBEG

•
***<************
X**>************
•
X**>************
•
X*****
•
XX*****
• SEARCH
•
XX*****
•
X*****
•
X***>************
•
***>************
•
SORT
***>>
***<************
•

IB. SUBROUTINE ATMODL

•
INPEGO^ X***>
•
INPISO^
•
INPWET^
•
INPDRY^
•
INPDIS^
•
INPEXP^
•
INPLRS^
•

IB1. SUBROUTINE INPGEO

•
[GET1'] - (NUMRAD)
X***>
•
RGETN' - (SPAEND)
X***>
•
X • ****
**** X*****
• * X ERRLOC
• **** **>>
•
IB1a. FUNCTION IGET1

* $ x*>>>
  x
  ****************
  x************   *
  * SEARCH      *
  * xx*>>>      *
  x***********xx *
  ROSTRG^ x***>************* *

IB1b. SUBROUTINE RGETN

* x*>>> x
  *
  * ******
  * * [RGET1]
  **** x*>>> x
  * ******x

*
IB2. SUBROUTINE INPISO

* [IGET1] - (NUMISO)
  * X*>>>X
* [IGET1] - (MAXGRP)
  * X*>>>X
* LGETN* - (WETDEP)
  * LGETN - (DRYDEP)
  * *****
  * [CGET1] - (NUCNAM)
    * X*>******
    * X
    * X*** ****
    * X*** xx***
    * X*** **xx ERRLOC
    * *****
  * *****
  * [CGET1] - (PARENT)
    * X*>******
    * X
    * X*>******
    * X***
    * X ERRLOC
    * ****<********
  * *****
  * <**************
* LGETN* - (IGROUP)
  * RGETN - (HAFLIF)
    * X*>>>X
    * ****
    * X***
    * X*** xx***
    * X*xx ERRLOC
    * **** **>>>

IB2a. SUBROUTINE LGETN

* X*>>>X
  * *****
  * [LGET1]
    * X*>>>X
    * *****X
IB2b. FUNCTION CGET1
*
$ 
x*>>>
*
****<****************

x***********
*
SEARCH *
*
xx*>>>
*
*********xx
*
RDSTRG *

x***>
***********
*

x*** 
*
xx**
*
*
xx**
*
*****
*

IB2c. SUBROUTINE IGETN
*

x*>>> 
*

********
*

[IGET1]
*

x*>>> 
*

******x
*

IB3. SUBROUTINE INPWET
*

[RGET1] - (CWASH1)
*

[RGET1] - (CWASH2)
*
183a. FUNCTION RGET1

* $ X*>>>
* X ***************
* ************** *
* SEARCH *
* XX*>>> *
* ********** *
RDSTRG$ X***,***************
* X***
* XX**
* * $
* XX**
* X***
 *

184. SUBROUTINE INPDRY

* [IGET1] - (NPSGRP)
* RGETN - (VDEPOS)
 *

185. SUBROUTINE INPDIS

* RGETN - (CYSIGA)
* RGETN - (CYSIGB)
* RGETN - (CZSIGA)
* RGETN - (CZSIGB)
* [RGET1] - (YSCALE)
* [RGET1] - (ZSCALE)
 *

A-15
186. SUBROUTINE INPEXP

* 
[RGET1] - (TIMBAS)
* 
[RGET1] - (BRKPNT)
* 
[RGET1] - (XPFAC1)
* 
[RGET1] - (XPFAC2)

187. SUBROUTINE INPLRS

* 
[RGET1] - (SCLCRW)
* 
[RGET1] - (SCLADP)
* 
[RGET1] - (SCLEFP)

1C. SUBROUTINE ATPROB

* 
[RGET1] - (ATNAM1)
* 
INPWAK'
* 
INPREL
* 
INPMET'
* 
INPOPT'

1C1. SUBROUTINE INPWAK

* 
[RGET1] - (BUILDW)
* 
[RGET1] - (BUILDH)
*
IC2. SUBROUTINE INPMET

* INPM1
* x******************************
  o******************************
  o******  * INPM2  *
  * INPM2  INPM2  * INPM2^*
  * *  * INPM3  *
  * INPM3  INPM3^  * INPM3^*
  * *  * INPM5^  *
  x******************************

IC2a. SUBROUTINE INPM1

  [CGET1] - (METCOD)
  *
  x******
  * WRDMET^
  x******
  *
  x******
  x ABORT

IC2a1. SUBROUTINE WRDMET

  x*>>> x
  * ****
  * * x****
  * @ ERRFIL
  **** x****
  * * x****
  * @ ERRFIL
  * @ ERRFIL
  ****
  *
  x*>>> *
  * ERRFIL

IC2b. SUBROUTINE INPM2

  [IGET1] - (LIMSPA)
  *
  [RGET1] - (BNDMXH)
  *
  [IGET1] - (IBDSTB)
  *
  [RGET1] - (BNDORAN)
  *
  [RGET1] - (BNDWAND)

A-17
IC2c. SUBROUTINE INPM3

* [IGET1] - (ISTRDY)
* [IGET1] - (ISTRHR)
*

IC2d. SUBROUTINE INPM4

* [IGET1] - (NSMPLS)
* [IGET1] - (IRSEED)
* x*>>>
* [IGET1] - (NRNINT)
* RGETN - (RNOSTS)
*
* ****
* * ******
* * x****
* * * x******
* * * * ERRLOC
* * * * ****
* * ****
* **
* * x******
* **** ERRLOC
* * x****
* * ***
* * *
* * ****
* * ********
* * *<********
* [IGET1] - (NRINTN)
* RGETN - (RNRATE)

x*>>***********
* * ****
* * * ****
* * ****
* * ** Errloc
* * ****
* * x****>
* * x Errloc
* * ***>
* x***********
* [IGET1] - (NSBINS)
* * IGETN - (INDXBN)
* * IGETN - (INWGHT)
* x********
* WBNMET - ((** WNDRZB))
IC2e. SUBROUTINE INPMS

*    
RGETN - (HRMXHT)  
*    
IGETN - (IHRSIB)  
*    
RGETN - (HRRAIN)  
*    
RGETN - (HRWNDV)  
*    
IGETN - (IHREDIR)  
* 

IC3. SUBROUTINE INPOPT

*    
[LGET1^] - (ENDAT1)  
*    
[IGET1] - (IDEBUG)  
X*>>>  
*    
[CGET1] - (NUCOUT)  
X*>>>  
X*****  
* ERRLOC  
X*****  
*  

IC3a. FUNCTION LGET1

*    
$  
X*>>>  
X  
X-------------------------  
X**********  
* SEARCH  
*  
X*>>>  
X**********XX  
RSTIN  
X*>>>**********  
*    
X***  
* XX**  
*  
XXX**  
X***  
*
ID. SUBROUTINE INPREL
*
[CGETI] - (ATNAM2)
*
[IGETI] - (NUMREL)
*
RGET - (PLHEAT)
*
RGET - (PLHITE)
*
RGET - (PLUDUR)
*
X
X
RGET - (PDELAY)
X

****

***

ERRLOC
*

***

*

RGET - (PSDIST)
*

###

*

ERRLOC
*

###

*

*

RGET - (OALARM)
*

[IGETI] - (MAXRIS)
*

RGET - (REFTIM)
*

**********

*

[CGETI] - (NAME)
*

**

****

*

**

XX

ERRLOC [RGETI] - (CORINV)
*

**

ERRLOC
*

XX

********

*

<**********<

*

********

[RGETI] - (CORSCA)
*

**

****

*

XX

ERRLOC
*

XX

********

*

<**********<

*

*********

[RGETI] - (RELFRC)
*

*********

****

DECAY
*

**
IE. SUBROUTINE PUTSTM

*  
*  
*  
*  
*  
*  
*  
*  
*  
*  
*  
*  
*  
*  
*  
*  
*  
*  
*  
*  
*  
*  
*  
GETSTM - E

IF. SUBROUTINE EARINP

*  
*  
*  
*  
*  
*  
*  
*  
*  
*  
*  
*  
*  
*  
*  
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*  
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*  
*  
*  
*  
*  
*  
*  
*  
*  
EDCINP - ((?ERFIL))
IF1. SUBROUTINE INMISC

* [CGET1] - (EANAM1)
* [LGET1] - (ENDAT2)
* [IGET1] - (IPLUME)
* [IGET1] - (NUMFIN)
  x*****
  * ERLCO
  x*****
[LGET1] - (OVRRID)
  x*****
  * RGETN - (WINROS)
  x********
  * ERRLOC
  x********
[IGET1] - (IPRINT)
* [LGET1] - (RISCAT)
*

IF2. SUBROUTINE INORGA

* [IGET1] - (NUMORG)
* 
  x********
  * ERLCO
  x********
  * ERRLOC  * xx ERRLOC
  x********
IF3. SUBROUTINE INEVAC

* [CGET1] - (EANAM2)
* [CGET1] - (WTNAME)
* [RGET1] - (WTFRAC)
* [IGET1] - (LASMOV)
  X>>>>
  X
* [IGET1] - (IEVACU)
* [IGET1] - (INIEVA)
  X>>>>
  X
  IGETN - (LASEVA)
  X>>>>
  X
  X*****
  * ERRLOC
  X*****
RGETN - (EDELAY)
  X*** ****
  * * XX****
  * **** * ERRLOC
  * * XX****
  X*** ****
  X************
  Q***** *
  * EVNETW^ EVRADI - (((** [RGET1 - (ESPEED) )))
  * * *
  X************
  *

A-23
IF3a. SUBROUTINE EVNETW

* 
** *****
* * IGET11-I(SORC) 
* * xx>**************************************
* * x 
* * IGET11-I(SORC) 
* * xx>**************************************
* * x 
** *****
* * IGET11-I(nextnd) x
* * xx>**************************************
* * ERRLOC IGET11-I(nextnd) x
* * xx>**************************************
* * IGET11-I(nextnd) x
* * xx>**************************************
* * x
***<*******************************************************************************
* nnnn
***n xx****
* n x ERRLOC 
* nnnn x*>>>
* nnnn
* n x***
* n n xx****
* n n * ERRLOC 
***n n xx****
* n n xx****
* n n * ERRLOC 
* n n xx****
* n x***
* nnnn
* nnnn
* n xx****
***n n ERRLOC 
* n xx****
* n n n xx****
* nnnx ERRLOC 
* x*>>>
**
* EVROOT 
**
IF4. SUBROUTINE INPOPU

* 
[CGET1] - (POPFILG)
X****
* 
X****************************
C***** [RGET1] - (POPDEN)
* ERRFIL XX*>
* X*** [IGET1] - (IBEGIN)
* XX*>
X**********************
X**>X**********************
CMPTBL - ((?? ERRFIL)) *
* CMPTBL *
X****
MATCH - ((?? ERRFIL)) *
X***
* **** *
* ***** X***** *
* ****X ERRFIL *
MATCH X*>
X***
****<**********************
ERRFIL *

IF5. SUBROUTINE INPEMR

* 
[RGET1] - (TTOSH1)
* 
[RGET1] - (SHELT1)
* 
[RGET1] - (LASHE2)
* 
X*****
* ERRLOC
X***** *
* 
[RGET1] - (TTOSH1)
* 
[RGET1] - (SHELT2)
* 
[RGET1] - (ENDEMP)
* 
[RGET1] - (TIMHOT)
* 
[RGET1] - (TIMWRM)
* 
[RGET1] - (DOSHOT)
* 
[RGET1] - (DOSNW)
* 
[RGET1] - (CRIORG)
* 
X*** ****
* ***** XX*>
* ***XX *
* * *
* ERRLOC
X***** *
IF6. SUBROUTINE INDFAC

*RGETN - (CSFACT)
*RGETN - (PROTIN)
*RGETN - (BRRATE)
*RGETN - (SKPFAC)
*RGETN - (GSHFAC)
*RGETN - (RESCON)
*RGETN - (RESHAF)

IF7. SUBROUTINE INEFAC

*IGET1 - (NUMEFA)

X*>>> X
* ********
* [GET1] - (NAME)
* X***** ****
**** ERRLOC **** X>>*
* X***** **XX *
* ********
***<**********
RGETN - (EFFACA)
* RGETN - (EFFACB)
* RGETN - (EFFTHR)
*

IF8. SUBROUTINE INEIMJ

*IGET1 - (NUMEIN)

X*>>> X
* ********
* [GET1] - (EINAME)
**** X*>>** X********
* ******** X
***<********** X
* ********
* [GET1] - (NAME)
* X***** ****
* X***** **** X>>*
**** X* **XX *
* ** ERRLOC *
* X***** *
* ****<********** X
* ********
RGETN - (EISUSC)
* RGETN - (EITHRE)
* RGETN - (EIFACA)
* RGETN - (EIFACB)
SUBROUTINE INACAN

*  
 [IGET1] - (NUMACA)
 = X
 [RGET1] - (ACMRE)
  *  
  *  
  *  
 [CGET1] - (ACNAME)
  *  
  *  
  *  
  *  
[RGETN] - (ACUSC)
 [RGETN] - (DOSEFA)
 [RGETN] - (DOSEFB)
 [RGETN] - (CFRISK)
 [RGETN] - (CIRISK)
IF10. SUBROUTINE INOUT1
*
[IGET1] - (NUM1)
  X>>> 
  X  ********
  *  *********
  *  [GET1] - (NAME)
  *  X>>> 
  *  X
  *  X************************
  *  o*****  Xx*****
  *  xXx>*****    ERRLOC  Xx*****
  *  *  *  Xx*****
  *  *  ERRLOC  *
  *  *  ***>********************
  *  *  ***<****    *
  *  *  ********************
  *  *  *
  *  o*****  xXmmmmmmmmmmmmmm
  *  *  xXx********>> ERRLOC  Xx*****
  *  ****  ERRLOC  *  m  *
  *  *  ***>********************
  *  *  ***<****    m  *
  *  *  xXmmmmmmmmmmmmmm
  *  *  ********************
  *  *  *
  *  o*****  xXmmmmmmmmmmmmmm
  *  *  xXx>******** ERRLOC  Xx*****
  *  *  ERRLOC  *  m  *
  *  *  ***>********************
  *  *  ***<****    m  *
  *  *  xXmmmmmmmmmmmmmm
  *  *  ********************
  *  *  *
  *  o*****  xXmmmmmmmmmmmmmm
  *  *  xXx>******** ERRLOC  Xx*****
  *  *  ERRLOC  *  m  *
  *  *  ***>********************
  *  *  ***<****    m  *
  *  *  xXmmmmmmmmmmmmmm
  *  *  ********************
  *  *  *
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  *  *****  [DCCD]  Xx*****
  *  Xx*****
IF10a. LOGICAL FUNCTION DOCCDF
  *
  
  IF11. SUBROUTINE INOUT2
    *
    
    IF12. SUBROUTINE INOUT3
      *
      
      A-29
SUBROUTINE INOUT5

* [IGET1] - (NUM5)
  X*>>>
  X
  * ********
  * [CGET1] - (NAME)
  * = X*****
  * = X*****
  * = ERROLOC
  * = X*****
  * = ********

IGETN - (I1D1S5)

IGETN - (I2D1S5)

* ****
* X*****
**** ERROLOC
* X*****
* ****
* ********
**** [DOCCDF]
* ********
IF15. SUBROUTINE INOUT6

* [IGET1] - (NUM6)
   X*>>>
   X
   X*****
   X ERRLOC
   * **>>>
   *
   * ********
   * [CGET1] - (NAME)
   *  
   X*****
   ****  
   X***>>>***
   ***  
   ERRLOC *
   *  
   X*****
   *  
   ***<********
   *  
   *
   * ********
   * [CGET1] - (NAME)
   *  
   X*****
   ****  
   X*****
   ****  
   X****** XMMMM
   ****  
   *  
   ERRLOC ****>
   *  
   X******
   *  
   ***<********
   *  
   *

IGETM - (11DIS6)
*
IGETM - (12DIS6)
X*>>>
*
   ****
   X***
   ****  
   ERRLOC
   *  
   X*****
   *  
   *
   *
   *
   **** [DOCCDF]
   *  
   *
SUBROUTINE IOUT7

* [IGET1] - (NUM7)
* X**>
* X******
* ERRLOC
* X**>

* [CGET1] - (NAME)
* X**>
* X******
* ERRLOC
* X******
* ********

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IGETN - (11DIS7)
*
IGETN - (12DIS7)
X**>
X***
X******
* ERRLOC
X*****
* ****
* ********
* [DOCCDF]
* ********
*
IF17. SUBROUTINE INOUT8

* [IGET1] - (NJMB)
  * x**>
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IG. SUBROUTINE REDSTG

* INEVAC
* INPEMR
*

IH. SUBROUTINE PUTSTG

* X>>> x
XERRLOC
* X***>
* XERRLOC
XERRLOC
X***
GETSTG - E
*

II. SUBROUTINE CHINP

* OPNRL
* INPCHR
X*****
X ABORT
*(MOULDF*)
X*****
X ABORT
*
X*****
X SFINP
X**x
**ABORT
*
EXCINP - ((?? ABORT))
X*****
X ABORT
*
STGROA
*

III. SUBROUTINE OPERNL

* X****
* MOULDF - E
*
X*****
ERRLOC
X*****
*
II2. SUBROUTINE INPCHR

* INCHRN*
* SPATH*
* IXOT9*
* IXOT10*
* IXOT11*
* IXOT12*

II2a. SUBROUTINE INCHRN

* [CGET1] - (CHNAME)
* [RGET1] - (EVACST)
* [RGET1] - (RELCST)
* [RGET1] - (TMPIND)
* [RGET1] - (TMPACT)
* [RGET1] - (DSCRTI)
* [RGET1] - (DSCRLT)
* [CGET1] - (CRTOCR)
* [IGET1] - (LVLDEC)
* RGETN - (TIMDEC)
* RGETN - (DSRFCT)
* RGETN - (CDFRM)
* RGETN - (CDNFRM)
* RGETN - (FRFDL)
* RGETN - (FRNFDL)
* RGETN - (TFWKF)
* RGETN - (TFWKNF)
* [RGET1] - (DLBCST)
* [RGET1] - (DPRATE)
* [RGET1] - (DSRATE)
* [RGET1] - (POPCST)
* [IGET1] - (NGWTRM)

(continued on next page)
* RGETN - (GWCOEF)
* RGETN - (TGWLFL)
* [IGET1] - (NRWTRM)
* RGETN - (RMCOEF)
* RGETN - (TRWHLF)
* [IGET1] - (FRACLD)
* [IGET1] - (FRCFRM)
* [IGET1] - (FRMFRD)
* [IGET1] - (DPFRCT)
* [IGET1] - (VALWF)
* [IGET1] - (FRFIM)
* [IGET1] - (VALWIF)
* [IGET1] - (FRWFIM)
* IGETN - (KSWTCH)
*

I12b. SUBROUTINE STPATH
*
* [IGET1] - (COUPLD)
* [IGET1] - (NFCRCP)
  **X****
  **X****
* [IGET1] - (NAMCRP)
  **X****
  **X****
  **X****
  **X****
  **ERRLOC
  **X****
* RGETN - (FRCTCH)
* RGETN - (FRCTCM)
* RGETN - (FRCTCB)
* [IGET1] - (NUMWPI)
  **X****
  **X****
  **X****
  **X****
  **X****
  **ERRLOC
  **X****
* (continued on next page)
* ******
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RGETN - (WSHFRI)
  *
RGETN - (WSHRTA)
  *
RGETN - (WINGF)
  *
IGET1 - (NFIISO)
  x
  *
 ******
  * [IGET1] - (NAMIPI)
  * x
  ******
  * ******
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RGETN - (DCYPMH)
  *
RGETN - (DCYPBH)
  *
RGETN - (TFMLK)
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RGETN - (TFBF)
  *
RDISTB - (TCROOT)
  *
RDISTB - (DCYPCH)
  *
RDISTB - (DCYPCH)
  *
RDISTB - (DCYPCB)
  *
RDISTB - (DCYPCB)
  *
RDISTB - (FPLSCH)
  *
IGET1 - (NTTRM)
  *
 ******
  * RDISTB - (CTCOEF)
  ******
  * RDISTB - (CTHALF)
  ******

(continued on next page)
II2b1. SUBROUTINE RDISTB

* ******
* [CGET1] - (NAMISO)
* x**>>>
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RGETN - (CLM2NM)
RGETN - (CLM3NM)
RGETN - (CLM4NM)
RGETN - (CLM5NM)
RGETN - (CLM6NM)
RGETN - (CLM7NM)
RGETN - (CLM8NM)
RGETN - (CLM9NM)
RGETN - (CLMANM)
RGETN - (CLMBNM)
II2c. SUBROUTINE IXOT9

* [IGET1] - (NXUM9)
  X*>>>
  X
* *****
* * [IGET1] - (ORGWAM)
  X***** ****
  * * .... ** *
  * * ERRLOC
  * * X*****
  * **********
  *
IGETN - (IX1DS9)

IGETN - (IX2DS9)
  X*>>>
  X
* ****
* * X*****
  **** ERRLOC
  * * X*****
  * ****
  *
* ********
  **** [DOCCDF]
  * ********

II2d. SUBROUTINE IXOT10

* [IGET1] - (NXUM10)
  X*>>>
  X
IGETN - (IXDS10)

IGETN - (IX2DS10)
  X*>>>
  X
* ****
  * * X*****
  **** ERRLOC
  * * X*****
  * ****
  *
* ********
  **** [DOCCDF]
  * ********

II2e. SUBROUTINE IXOT11

* [LGET1] - (FLAG11)
  X*>>>
  X
[DOCCDF]

A-41
II2f. SUBROUTINE IXOT12

* 
[IGET1] - (NXUM12)
   X**>>>
   X

IGETN - (11DS12)
* 
IGETN - (12DS12)
   X**>>>
   X ****
   *  X*****
   **** ERRLOC
   *  X*****
   ****
   *  
   *****
   **** [DOCCDF]
   *  

II3. ENTRY MODLDF
(DEPicted in SUBROUTINE OPERNL - II1A)
114. SUBROUTINE SDIFNP

* CKPTBL - (((I*** KMPTBL - E))
* CKPTBL
* CKPTBL
* CKPTBL
* CKPTBL
* (KMPTBL)
  X*>>>
  X
  (KMPTBL)
  X*>>>
  X
  MXTCH
  X*>>>

  ****
  *** x***
  **** Xx*>>>
  ** x***
  ****

  MXTCH
  X*>>>
  MXTCH
  X*>>>
  MXTCH
  X*>>>
  MXTCH
  X*>>>
  CKINDX

  MXTCH
  X*>>>
  
  nnnnn
  n x***
  ***n n xx*>>>
  n x***
  nnnnn

  ****
  *** x***
  **** Xx*>>>
  ** x***
  ****

  MXTCH
  X*>>>
  
  nnnnn
  n x***
  ***n n xx*>>>
  n x***
  nnnnn

  MXTCH
  X*>>>
  ****
  *** x***
  **** Xx*>>>
  ** x***
  ****

  *
IJJ. SUBROUTINE OUTCON

* 
HEDEAR^ 
* 
COPCHR 
* 
****** 
* HEDCHR^ 
******@ 
* 

IJJ1. SUBROUTINE HEDEAR

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* ******* 
* ******* 
* ******* 
****** 
* xABORT 
* 
A-44
IJ1a. FUNCTION DISRAN

DIST1 - (??*** ABORT))

DIST1

*
$
$
$
$

IJ3a. FUNCTION RXSNM9

********
ABORT [DISRAN]

$
$
$
$

IJ3. SUBROUTINE HEDCHR

*

********

********

********

********

********

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********

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********

********

********

ABORT
IJ3b. FUNCTION RXNM10
    *
    *********
    ABORT [DISRAN]
    $            
    *********

IJ3c. FUNCTION RXNM11
    *
    *********
    ABORT $            
    *********

IJ3d. FUNCTION RXNM12
    *
    *********
    ABORT [DISRAN]
    *            
    *********

II. ENTRY GETSTM
    (DEPicted IN SUBROUTINE PUTSTM - IE)

III. SUBROUTINE DAYHOU
    *
    ADJTIM
    *            
    WSAMPL
    *            
    WBNDRY
    *            
    CONTL
    *

IIIa. SUBROUTINE WSAMPL
    *
    ********
    *      * x********
    *      *   WINCTM
    ****   x********
    *      *   WGTMET - (?*** ABORT))
    *      *   *      *

A-46
III.B. SUBROUTINE CONTRL

  * ATMOUT*
  *   *
  *       * (GETSTG*)
  *   *
  *   *

   CHROUT^* 
   *

III.B1. SUBROUTINE ATMOUT

  * [CAUGHT]
  *   *
  *   *
  *   *
  * [AREA] *
  *   *
  * [AREA] *
  *   *
  * [AREA] *
  *   *
  * [AREA] *
  *   *
  * [WASHOU] *
  *   *
  * WASHOU* 
  *   *

   *****************************************************************
  *   *
  *   *
  *   *
  *   *
  * [FSGY]
  *   *
  * [FSGY] - (((FSGY - E))
  *   *
  * [FSGZ] - (((FSGZ - E))
  *   *

   **************************************************************
  *   *
  *   *
  *   *
  *   *
  * [PLMRIS] - (((VELADJ))
  *   *
  *   *
  * [SIGTEX]
  *   *

   **
IIIB2. ENTRY GETSTG
(DEPICTED IN SUBROUTINE PUTSTG - IH)

IIIB3. SUBROUTINE EAROUT
*
CENZER
*
X*****
*
* EGEOM - ((?***[CLSHIN])) - ((?***[POLZ])) - ((?***ABORT))
*
* EPCALC - ((?*** ABORT)
X*****
*
RELZON^*
*
ESTAT^*
*
EMOVE^*
*
FATRIS*
*
INJRIS*
*
CANRIS*
*
STOEAR^*
SUBROUTINE RELZON

*  nnnnnn
* n EDOSIN
* n n
***n INCDOS
* n x****
* n n CENACU - ((**** CENZER - E))
* n x****
* nnnnnn
*
** ****
* * **** x****
* * **** ZERREM
* * ****
* * ****
* * **** EDOSIN ****
* * **** ******** INCREM
* * **** x****
*
** ****
* * **** x****
* * **** ZERREM
* * **** x****
* * ****
* * **** x**** EDOSIN
* * ****
* * ****
* * **** x****
* * **** x****
* * ****
* * **** x****
* * ****
*
SUBROUTINE INCREM

* x****
* CENZER
x****
CENACU
*
IIIB3b. SUBROUTINE ESTAT

WHERE (#) IS THE FOLLOWING PIECE OF CODE

EDOSIN

INCDOS

CENACU

IIIB3c. SUBROUTINE EMOVE
III183d. SUBROUTINE STOEAR

* OUTPT1 - ((?*** EFFGET)) - ((?*** ABORT))
* OUTPT2
* OUTPT3
* OUTPT4 - ((?*** ABORT))
* OUTPT5
* OUTPT6 - ((?*** ABORT))
* OUTPT7 - ((?*** ABORT))
* OUTPT8 - ((?*** EFFGET))

III184. SUBROUTINE CHRROUT

* x********
*    CHRNDF^
x********
* x********
* UGCPLN SGCPLN - ((?*** ABORT))
x********
* CRNRSK^
IIIB4a. SUBROUTINE CHNDF
*
  BLTBL
*  GNDRES
  GNDRES
  GNDRES
  GNDRES
  GNDRES
  GNDRES
  GNDRES
  GNDRES
  GNDRES
  GNDRES
  GNDRES
  GNDRES
  GNDRES
  GNDRES
  GNDRES
  TRFRCT
  WTRTRF
*

IIIB4b. SUBROUTINE CRNRSK
*
  DIRDRP
*  INITLZ
  **** ******
  *  *  *  *  EMAGPH
  *  *  *  *  x******
  *  *  *  INTRPH
  *  *  ****  *
  *****  *  LNTPH*
  *  *  *  *  x******
  *  *  *  *  *  x******
  *  x******
  *  *  LOKSEE
  *  *  x******
  *  ****
  *  STOCHR*
*
I1184b1. SUBROUTINE LNGTPH
   * 
     LTPROJ - ((?*** LTMACT))
   * 
     CSTEFF - ((?*** CSTDCM))
   * 
     LTACUM
   *

I1184b2. SUBROUTINE STOCHR
   * 
     OXPT1 - ((?*** CASGET)) - ((?*** ABORT))
   * 
     OXPT4 - ((?*** ABORT))
   * 
     OXPT5
   * 
     OXPT6 - ((?*** ABORT))
   * 
     OXPT7 - ((?*** ABORT))
   * 
     OXPT8 - ((?*** CASGET))
   * 
     OXPT9 - ((?*** DOSGET))
   * 
     OXPT10 - ((?*** ECCGET))
   * 
     OXPT11 - ((?*** GETIMP))
   * 
     OXPT12 - ((?*** GETIMP))
   *

IV. SUBROUTINE BIKSAM
   * 
     WRANBN - ((?*** RANDOM))
   * 
     RANDOM
   * 
     ADJTIM
   * 
     WSAMPL
   * 
     WBNDRY
   * 
     CONTRL
   *

V. SUBROUTINE USRSUP
   * 
     WBNDRY
   * 
     CONTRL
   *
VI. SUBROUTINE CONMET

* 
* WBNDRY
* CONTRL
* 

VII. SUBROUTINE RANSAM

* 
* X******
* X ABORT
* 
* ADJTIM
* WSAMPL
* WBNDRY
* CONTRL
* 

VIII. SUBROUTINE OUTPUT

* 
* READ1 * ((?*** ABORT))
* 
* *****
* X ABORT
* 
* *****
* ***** READ2^ 
* *****
* 
* PRINT^ 
* 
*
VIII.B. SUBROUTINE READ2

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

VIII.B1. SUBROUTINE DO1CDF

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

A-55
VIIIC. SUBROUTINE PRINT

* x*****
  * SOLID
  x*****
* ******
* ****** x*****
* ****** SOLID *
* ****** x*****
* ******
* ****** nnnn
* ****** n x***>%%%%%%%%%%%%%%%%
* ****** n x*****
* ****** n n QUANTL - ((?? EXPINT))
* ****** n n [NOTFOU]
* ****** n n [NOTFOU]
* ****** n n [NOTFOU]
* ****** n n [NOTFOU]
* ****** n n [NOTFOU]
* ****** n n [NOTFOU]
* ****** n x*****
* ****** n n**<%%%%%%%%%%%%%%%%
* ****** nnnn

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