EPA-454/B-95-003a

USER'S GUIDE FOR THE INDUSTRIAL SOURCE COMPLEX (ISC3) DISPERSION MODELS

VOLUME I - USER INSTRUCTIONS

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September 1995

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PREFACE

This User's Guide provides documentation for the Industrial Source Complex (ISC3) models, referred to hereafter as the Short Term (ISCST3) and Long Term (ISCLT3) models. This volume provides user instructions for the ISCST3 and ISCLT3 models, including the new area source and dry deposition algorithms, both of which are a part of Supplement C to the Guideline on Air Quality Models (Revised).

This volume also includes user instructions for the following algorithms that are not included in Supplement C: pit retention (ISCST3 and ISCLT3), wet deposition (ISCST3 only), and COMPLEX1 (ISCST3 only). The pit retention and wet deposition algorithms have not undergone extensive evaluation at this time, and their use is optional. COMPLEX1 is incorporated to provide a means for conducting screening estimates in complex terrain. EPA guidance on complex terrain screening procedures is provided in Section 5.2.1 of the Guideline on Air Quality Models (Revised).

Volume II of the ISC3 User's Guide provides the technical description of the ISC3 algorithms.

ACKNOWLEDGEMENTS

The User's Guide for the ISC3 Models has been prepared by Pacific Environmental Services, Inc., Research Triangle Park, North Carolina. This effort has been funded by the Environmental Protection Agency (EPA) under Contract No. 68-D30032, with Desmond T. Bailey and Donna B. Schwede as Work Assignment Managers (WAMs). The user instructions for the dry deposition algorithm were developed from material prepared by Sigma Research Corporation and funded by EPA under Contract No. 68-D90067, with Jawad S. Touma as WAM.

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1.0 INTRODUCTION

This section provides an overall introduction to the ISC models and to the ISC User's Guide. It also serves specifically as an introduction to the user instructions contained in this volume for setting up and running the ISC models. Some suggestions are offered on how various users would best benefit from using the manuals. Also provided is an overview of the model's applicability, range of options, basic input data and hardware requirements, and a discussion of the history of the ISC models. The input file needed to run the ISC models is based on an approach that uses descriptive keywords and allows for a flexible structure and format.

1.1 HOW TO USE THE ISC MANUALS

The ISC Model User's Guide has been designed in an attempt to meet the needs of various types of users, depending on their level of experience with the models. This section describes briefly how different types of users would benefit most from their use of the manual.

1.1.1 Novice Users

Novice users are those whose exposure to or experience with the ISC models has been limited. They may be new to dispersion modeling applications in general, or new to the ISC models and therefore unfamiliar with the keyword/parameter approach utilized for the input file. These users should review the remainder of this Introduction to gain an overall perspective of the use of ISC models, particularly for regulatory modeling applications. They should then concentrate their review on Section 2, which provides a brief tutorial on setting up an input file that illustrates the most commonly used options of the ISC Short Term model. Section 2 provides a basic description of the input file structure and explains some

of the advantages of the keyword/parameter approach to specifying modeling options and inputs. As the user becomes more familiar with the operation of the models and encounters the need to use more advanced features of the models, he/she will want to review the contents of Section 3, which provides a more detailed and complete reference of the various options for running the models.

1.1.2 Experienced Modelers

Experienced modelers will have had considerable experience in applying the ISC models in a variety of situations. They should have basic familiarity with the overall goals and purposes of regulatory modeling in general, and with the scope of options available in the ISC models in particular. Experienced modelers who are new to the ISC models will benefit from first reviewing the contents of Section 2 of this volume, which will give them a basic orientation to the structure, organization and philosophy of the keyword/parameter approach used for the input runstream file. Once they have a basic grasp of the input file structure and syntax rules, they will benefit most from using Section 3 of this volume as a reference to learn the overall capabilities of the models, or to understand the mechanics for implementing particular options. The information in Section 3 is organized by pathway, with detailed descriptions of each of the individual keyword options by pathway. Once they are familiar with most or all of the keywords, they may find the functional keyword reference provided in Appendix B useful to quickly review the proper syntax and available options/parameters for a particular keyword. They may also find the Quick Reference available at the end of the user's guide sufficient as a simple reminder of the available keywords for each pathway and to ensure the proper order of parameters for each input image.

Experienced modelers may also have occasion to peruse the contents of Volume II, which describes the technical details of the dispersion modeling algorithms utilized in the ISC models. They may also have an interest in or need to review the contents of Volume III to learn about the structure and organization of the computer code, particularly if they are involved with installing the code on another computer system, or with compiling the code to meet the memory storage requirements for a particular application.

1.1.3 Management/Decision Makers

Those involved in a management or decision-making role for dispersion modeling applications will be especially interested in the remainder of this section, which provides an overview of the models, including their role in various regulatory programs, a brief description of the range of available options, and basic input data and computer hardware requirements needed to run the models. From this information they should understand the basic capabilities of the ISC models well enough to judge the suitability of the models for particular applications. They may also want to review the brief tutorial provided in Section 2 to learn about the nature and structure of the input runstream file, in order to better be able to review the modeling results.

1.1.4 Programmers/Systems Analysts

Programmers and systems analysts, specifically those involved with installing the ISC code on other computer systems or charged with maintaining the code, should review the contents of Volume III. This will acquaint them with the structure and organization of the computer code, give specific details on compiling and linking the code for various situations, and explain in detail the memory storage requirements and control of input and output (I/O). They may

also wish to review the remainder of this Introduction and the brief tutorial in Section 2 of this volume in order to have a basic understanding of the nature and overall capabilities of the models, and to understand the basic input runstream file structure and organization.

1.2 OVERVIEW OF THE ISC MODELS

This section provides an overview of the ISC models, including a discussion of the regulatory applicability of the models, a description of the basic options available for running the models, and an explanation of the basic input data and hardware requirements needed for executing the models.

1.2.1 Regulatory Applicability

The U.S. Environmental Protection Agency (EPA) maintains the Guideline on Air Quality Models (Revised) (hereafter referred to as the "Guideline"[1]) which provides the agency's guidance on regulatory applicability of air quality dispersion models in the review and preparation of new source permits and State Implementation Plan (SIP) revisions. Regulatory application of the ISC models should conform to the guidance set forth in the Guideline, including the most recent Supplements. Any non-guideline application of the models should meet the requirements of the applicable reviewing agency, such as an EPA Regional Office, a State or a local air pollution control agency. In general, regulatory modeling applications should be carried out in accordance with a modeling protocol that is reviewed and approved by the appropriate agency prior to conducting the modeling. The modeling protocol should identify the specific model, modeling options and input data to be used for a particular application.

[1] The Guideline is published as Appendix W to 40 CFR Part 51.

1.2.2 Basic Input Data Requirements

There are two basic types of inputs that are needed to run the ISC models. They are (1) the input runstream file, and (2) the meteorological data file. The runstream setup file contains the selected modeling options, as well as source location and parameter data, receptor locations, meteorological data file specifications, and output options. The ISC models offer various options for file formats of the meteorological data. These are described briefly later in this section, and in more detail in Sections 2 and 3. A third type of input may also be used by the models when implementing the dry deposition and depletion algorithm. The user may optionally specify a file of gridded terrain elevations that are used to integrate the amount of plume material that has been depleted through dry deposition processes along the path of the plume from the source to the receptor. The optional terrain grid file is described in more detail in Section 3. The user also has the option of specifying a separate file of hourly emission rates for the ISCST model.

1.2.3 Computer Hardware Requirements

1.2.3.1 PC Hardware Requirements.

Given the rapid increase in speed and capacity of personal computers (PCs) available for modeling in recent years, and their relative ease of use and access, the PC has become the most popular environment for performing dispersion modeling applications within the modeling community (Bauman and Dehart, 1988; Rorex, 1990). This trend can be expected to continue in the future. The current versions of the ISC models were developed on an IBM-compatible PC using the Microsoft FORTRAN Optimizing Compiler (Version 5.1), and have been designed to run on such machines with a minimum of 640K bytes of RAM and MS-DOS Version 3.2 or higher. In order to handle the input

data files (runstream setup and meteorology) and the output files, it is highly recommended that the system have a hard disk drive. The amount of storage space required on the hard disk for a particular application will depend greatly on the output options selected. Some of the optional output files of concentration data can be rather large. More information on output file products is provided in Sections 2 and 3.

While a math coprocessor chip is optional for execution of the ISC models on a PC, it is highly recommended, especially for the Short Term model, due to the large increase in execution speed that will be experienced. The model may be expected to run about five to ten times faster with a math coprocessor than without one.

For particularly large applications, involving a large number of sources, source groups, receptors and averaging periods, the user may find that the 640K RAM limit available with DOS is not enough. In addition to the DOS executable versions of the models, extended memory versions are available for use on 80386, 80486 or higher PCs with at least 8 MB of RAM for the ISCST model and at least 4 MB of RAM for the ISCLT model. The extended memory versions of the models were developed using the Lahey F77L/EM-32 Fortran Compiler (Version 5.2), and also require a math co-processor to be present. **For larger application scenarios, a Lahey-compiled ISCST executable and 8 MB of RAM are recommended.** Section 4.2.2 of this volume of the ISC User's Guide contains information on increasing the capacity of the model and setting it up to run on systems (with 80386 processors and higher) that make use of extended memory beyond the 640K limit of DOS. There are special requirements for the operating system and Fortran language compiler needed to utilize the extended memory on these machines.

1.2.3.2 DEC VAX Requirements.

The models have also been uploaded and tested on a DEC VAX minicomputer. As with the IBM 3090, the VAX has some advantages of speed and greater memory capacity over the PC environment. There are no particular hardware requirements for running the models on the VAX. The user must be familiar with the operating system and Fortran language compiler being utilized on the VAX in order to properly setup and run the model and control the input and output files. Instructions for setting up and running the models on the DEC VAX are included in this volume and in more detail in Volume III of the User's Guide.

1.2.3.3 IBM 3090 Requirements.

While the models were developed on the PC, they have been uploaded and tested on EPA's IBM 3090 mainframe computer. The mainframe has advantages of speed and greater memory capacity over the PC environment. There are no particular hardware requirements for running the models on the IBM 3090. However, the user must be familiar with the IBM Job Control Language (JCL) and the VS FORTRAN Version 2.0 compiler in order to properly setup and run the models and control the input and output files in the mainframe environment. Instructions for setting up and running the models on the IBM 3090 are included in this volume and in Volume III of the User's Guide.

1.2.4 Overview of Available Modeling Options

The ISC models include a wide range of options for modeling air quality impacts of pollution sources, making them popular choices among the modeling community for a variety of applications. The following sections provide a brief overview of the options available in the ISC models.

1.2.4.1 Dispersion Options.

Since the ISC models are especially designed to support the EPA's regulatory modeling programs, the regulatory modeling options, as specified in the Guideline on Air Quality Models (Revised), are the default mode of operation for the models. These options include the use of stack-tip downwash, buoyancy-induced dispersion, final plume rise (except for sources with building downwash), a routine for processing averages when calm winds occur, default values for wind profile exponents and for the vertical potential temperature gradients, and the use of upper bound estimates for super-squat buildings having an influence on the lateral dispersion of the plume. The user can easily ensure the use of the regulatory default options by selecting a single keyword on the modeling option input card. To maintain the flexibility of the model, the non-regulatory default options have been retained, and by using descriptive keywords to specify these options it is evident at a glance from the input or output file which options have been employed for a particular application.

The Short Term model also incorporates the COMPLEX1 screening model dispersion algorithms for receptors in complex terrain, i.e., where the receptor elevation is above the release height of the source. The user has the option of specifying only simple terrain (i.e., ISCST) calculations, only complex terrain (i.e., COMPLEX1) calculations, or of using both simple and complex terrain algorithms. In the latter case, the model will select the higher of the simple and complex terrain calculations on an hour-by-hour, source-by-source and receptor-by-receptor basis for receptors in intermediate terrain, i.e., terrain between release height and plume height.

The user may select either rural or urban dispersion parameters, depending on the characteristics of the source location. The user also has the option of calculating

concentration values or deposition values for a particular run. For the Short Term model, the user may select more than one output type (concentration and/or deposition) in a single run, depending on the setting for one of the array storage limits. The user can specify several short term averages to be calculated in a single run of the ISC Short Term model, as well as requesting the overall period (e.g. annual) averages.

1.2.4.2 Source Options.

The model is capable of handling multiple sources, including point, volume, area and open pit source types. Line sources may also be modeled as a string of volume sources or as elongated area sources. Several source groups may be specified in a single run, with the source contributions combined for each group. This is particularly useful for Prevention of Significant Deterioration (PSD) applications where combined impacts may be needed for a subset of the modeled background sources that consume increment, while the combined impacts from all background sources (and the permitted source) are needed to demonstrate compliance with the National Ambient Air Quality Standards (NAAQS). The models contain algorithms for modeling the effects of aerodynamic downwash due to nearby buildings on point source emissions, and algorithms for modeling the effects of settling and removal (through dry deposition) of particulates.

The Short Term model also contains an algorithm for modeling the effects of precipitation scavenging for gases or particulates. For the Short Term model, the user may specify for the model to output dry deposition, wet deposition and/or total deposition.

Source emission rates can be treated as constant throughout the modeling period, or may be varied by month, season, hour-of-day, or other optional periods of variation.

These variable emission rate factors may be specified for a single source or for a group of sources. For the Short Term model, the user may also specify a separate file of hourly emission rates for some or all of the sources included in a particular model run.

1.2.4.3 Receptor Options.

The ISC models have considerable flexibility in the specification of receptor locations. The user has the capability of specifying multiple receptor networks in a single run, and may also mix Cartesian grid receptor networks and polar grid receptor networks in the same run. This is useful for applications where the user may need a coarse grid over the whole modeling domain, but a denser grid in the area of maximum expected impacts. There is also flexibility in specifying the location of the origin for polar receptors, other than the default origin at (0,0) in x,y, coordinates.

The user can input elevated receptor heights in order to model the effects of terrain above (or below) stack base, and may also specify receptor elevations above ground level to model flagpole receptors. For simple terrain calculations, any terrain heights input above the release height for a particular source are "chopped-off" at the release height for that source's calculations. The Short Term model includes the complex terrain algorithms from the COMPLEX1 screening model. If these algorithms are used, the model will calculate impacts for terrain above the release height. The Long Term model does not include any complex terrain algorithms.

1.2.4.4 Meteorology Options.

The Short Term model can utilize the unformatted, sequential files of meteorological data generated by the PCRAMMET and the MPRM preprocessors, provided the data file was generated by the same Fortran compiler as was used for the model, and provided the deposition algorithms are not being used. The meteorology options for the deposition algorithms in the ISC models are described later in this section.

The user also has considerable flexibility to utilize formatted ASCII files that contain sequential hourly records of meteorological variables. For these hourly ASCII files, the user may use a default ASCII format, may specify the ASCII read format, or may select free-formatted reads for inputting the meteorological data. A utility program called BINTOASC is provided with the ISC models to convert unformatted meteorological data files of several types to the default ASCII format used by ISCST and ISCEV. This greatly improves the portability of applications to different computer systems. The BINTOASC program is described in Appendix C. The model will process all available meteorological data in the specified input file by default, but the user can easily specify selected days or ranges of days to process.

The Short Term model includes a dry deposition algorithm and a wet deposition algorithm. The dry deposition algorithm requires additional meteorological input variables, such as Monin-Obukhov length and surface friction velocity, that are provided by the PCRAMMET and MPRM preprocessor. The wet deposition algorithm in the Short Term model also needs precipitation data, which is optionally available in the PCRAMMET preprocessed data. When using the dry deposition or wet deposition algorithms in ISCST, the meteorological data must be a formatted ASCII file.

The Long Term model uses joint frequency distributions of wind speed class, by wind direction sector, by stability category, known as STAR (STability ARray) summaries. These STAR summaries are available from the National Climatic Data Center in Asheville, North Carolina. They may also be generated from sequential data files using the STAR utility program available on EPA's SCRAM Bulletin Board System or by the MPRM meteorological processor for on-site data. The meteorological data for ISCLT are read in from a separate data file, and the user may use a default ASCII format or may specify the ASCII read format for the data.

1.2.4.5 Output Options.

The basic types of printed output available with the Short Term model are:

- Summaries of high values (highest, second highest, etc.) by receptor for each averaging period and source group combination;
- Summaries of overall maximum values (e.g., the maximum 50) for each averaging period and source group combination; and
- Tables of concurrent values summarized by receptor for each averaging period and source group combination for each day of data processed. These "raw" concentration values may also be output to unformatted (binary) files, as described below.

For the Long Term model, the user can also select output tables of values for each receptor, and/or tables of overall maximum values. The tables by receptor and maximum value tables can be output for the source group values or for the individual source values, or both. In addition, when maximum values for individual sources are output, the user has the option of specifying whether the values are to be the maximum values for each source independently, or the contribution of each source to the maximum group values, or both.

In addition to the tabular printed output products described above, the ISC models provide options for several types of file output products. One of these options for ISCST is to output an unformatted ("binary") file of all concentration and/or deposition values as they are calculated. These files are often used for special postprocessing of the data. In addition to the unformatted concentration files, ISCST provides options for three additional types of file outputs. One option is to generate an ASCII formatted file with the same results that are included in the unformatted postprocessing file. Another option is to generate a file of (X,Y) coordinates and design values (e.g., the second highest values at each receptor for a particular averaging period and source group combination) that can be easily imported into many graphics plotting packages to generate contour plots of the concentration and/or deposition values. Separate files can be specified for each of the averaging period and source group combinations of interest to the user.

Another output file option of the ISCST model is to generate a file of all occurrences when a concentration or deposition value equals or exceeds a user-specified threshold. Again, separate files are generated for only those combinations of averaging period and source group that are of interest to the user. These files include the date on which the threshold exceedance occurred, the receptor location, and the concentration value.

1.2.4.6 Source Contribution Analyses.

In air quality dispersion modeling applications, the user may have a need to know the contribution that a particular source makes to an overall concentration value for a group of sources. This section provides a brief introduction to how these types of source contribution (sometimes referred to as source culpability) analyses are performed using the ISC

models. More detailed information about exercising these options is provided in Section 3.

Recognizing that source contribution information is important to many short term modeling analyses, the ISCST model has been designed to facilitate performing this type of analysis. This is accomplished with an additional model, referred to as the ISC Short Term - EVENT model (ISCEV). The ISCST model treats source groups independently. The ISCEV (EVENT) model is set up specifically to provide the contributions from individual sources to the concentration values for particular events. These events may be the design concentrations (e.g., the high-second-high 24-hour average concentration for a particular group of sources) that were generated from an execution of the ISCST model. Other events of interest might be occurrences of violations of a particular standard, for which it is necessary to determine whether the source being permitted contributes above a significance level. The models are set up in such a way that both of these types of events can be passed directly from an execution of the ISCST model to an input file for the EVENT model. The user is thus able to run the models in a batch mode to obtain the overall design value results from ISCST and the source contribution information from ISCEV in a single step. The EVENT model can also be run separately and accepts user-specified events for source contribution processing.

In the ISCLT model, the user has an option to have the highest 10 values for each source and source group reported independently, or to have the 10 highest values from the combined source group and the contributions from the individual sources to those highest group values.

1.3 RELATION TO PREVIOUS VERSIONS OF ISC

1.3.1 Brief History of the ISC Models

The ISC3 models are based on revisions to the algorithms contained in the ISC2 models. The latter came about as a result of a major effort to restructure and reprogram the ISC models that began in April 1989, and was completed in March 1992. The reprogramming effort was largely motivated by the need to improve the quality, reliability, and maintainability of the code when numerous "bugs" were discovered after the implementation of the revised downwash algorithms for shorter stacks. It became widely recognized that the code, originally developed in the 1970's and modified numerous times since, had become impossible to reliably modify, debug or maintain. However, the goals of the reprogramming effort also included improving the user interface by modifying the input file structure and the output products, and to provide better "end user" documentation for the revised models. The ISC2 models were developed as replacements for and not updates to the previous versions of the models.

1.3.2 Overview of New Features in the ISC3 Models

The ISC3 models include several new features. A revised area source algorithm and revised dry deposition algorithm have been incorporated in the models. The ISC3 models also include an algorithm for modeling impacts of particulate emissions from open pit sources, such as surface coal mines. The Short Term model includes a new wet deposition algorithm, and also incorporates the COMPLEX1 screening model algorithms for use with complex and intermediate terrain. When both simple and complex terrain algorithms are included in a Short Term model run, the model will select the higher impact from the two algorithms on an hour-by-hour, source-by-source, and receptor-by-receptor basis for receptors located on intermediate

terrain, i.e., terrain located between the release height and the plume height. A more detailed technical description of these new features of the ISC models is included in Volume II of the ISC User's Guide. The Long Term model does not include wet deposition or complex terrain algorithms.

Some of the model input options have changed as a result of the new features contained in the ISC3 models. There are new options available on the CO MODELOPT card for both the Short Term and Long Term models. The source deposition parameters have changed somewhat with the new dry deposition algorithm, and there are new source parameters needed for the wet deposition algorithm in the Short Term model. Both models include a new optional pathway for specifying a terrain grid file that may be used in calculating the effects of plume depletion due to dry removal mechanisms in elevated terrain. There are also new meteorology input requirements for use of the new deposition algorithms. The option for specifying elevation units has been extended to source elevations and terrain grid elevations, in addition to receptor elevations. The CO ELEVUNIT card used to specify receptor elevations in the previous version of ISC is now obsolescent, and is being replaced by a new RE ELEVUNIT card. These new input options are described in Section 3 and summarized in Appendix B.

The utility programs, STOLDNEW, BINTOASC, and METLIST, described in Appendix C, have not been updated. While they may continue to be used as before, they are not applicable to the new deposition algorithms in the ISC3 models.

2.0 GETTING STARTED - A BRIEF TUTORIAL

This section provides a brief tutorial for setting up a simple application problem with the ISC Short Term model, which serves as an introduction for novice users to the ISC models. The example illustrates the usage of the most commonly used options in the ISC models for regulatory applications. A more complete description of the available options for setting up the ISC models is provided in Section 3.

The example problem presented in this section is a simple application of the ISCST model to a single point source. The source is a hypothetical stack at a small isolated facility in a rural setting. Since the stack is below the Good Engineering Practice (GEP) stack height, the emissions from the source are subject to the influence of aerodynamic downwash due to the presence of nearby buildings. The tutorial leads the user through selection and specification of modeling options, specification of source parameters, definition of receptor locations, specification of the input meteorological data, and selection of output options. Since this discussion is aimed at novice users of the ISC models, a general description of the input file keyword/parameter approach is provided first.

2.1 DESCRIPTION OF KEYWORD/PARAMETER APPROACH

The input file for the ISC models makes use of a keyword/parameter approach to specifying the options and input data for running the models. The descriptive keywords and parameters that make up this input runstream file may be thought of as a command language through which the user communicates with the model what he/she wishes to accomplish for a particular model run. The keywords specify the type of option or input data being entered on each line of the input file, and the parameters following the keyword define the specific options selected or the actual input data. Some of

the parameters are also input as descriptive secondary keywords.

The runstream file is divided into six functional "pathways." These pathways are identified by a two-character pathway ID placed at the beginning of each runstream image. The pathways and the order in which they are input to the model are as follows:

CO - for specifying overall job **CO**ntrol options;
SO - for specifying **SO**urce information;
RE - for specifying **RE**ceptor information;
ME - for specifying **ME**teorology information;
TG - for specifying **T**errain **G**rid information; and
OU - for specifying **OU**tput options.

The TG pathway is an optional pathway that is only used for implementing the dry depletion algorithm in elevated terrain.

Each line of the input runstream file consists of a pathway ID, an 8-character keyword, and a parameter list. An example of a line of input from a runstream file, with its various parts identified, is shown below:

```
Column: 12345678901234567890123456789012345678901234567890123456789

        CO MODELOPT DFAULT RURAL CONC
        *    *        *      *     *
        *    *        *      *     *
        *    *        .)))))2)))))2)))))))) Parameters
        *    *
        *    .)))))))))))))))))))))))))))))))))) 8-Character Keyword
        *
        .)))))))))))))))))))))))))))))))))))))))) 2-Character Pathway ID
```

The following sections describe the rules for structuring the input runstream file, and explain some of the advantages of the keyword/parameter approach.

2.1.1 Basic Rules for Structuring Input Runstream Files

While the input runstream file has been designed to provide the user with considerable flexibility in structuring the input file, there are some basic syntax rules that need to be followed. These rules serve to maintain some consistency between input files generated by different users, to simplify the job of error handling performed by the models on the input data, and to provide information to the model in the appropriate order wherever order is critical to the interpretation of the inputs. These basic rules and the various elements of the input runstream file are described in the paragraphs that follow.

One of the most basic rules is that all inputs for a particular pathway must be contiguous, i.e., all inputs for the CO pathway must come first, followed by the inputs for the SO pathway, and so on. The beginning of each pathway is identified with a "STARTING" keyword, and the ending of the pathway with the "FINISHED" keyword. Thus the first functional record of each input file must be "CO STARTING" and the last record of each input file must be "OU FINISHED." The rest of the input images will define the options and input data for a particular run.

Each record in the input runstream file is referred to as a runstream "image." These records are initially read into the model as 132-character images. The information on each input image consists of a "pathway," a "keyword," and one or more "parameters." Each of these "fields" on the runstream image must be separated from other fields by at least one blank space. To simplify the interpretation of the runstream image

by the model, the runstream file must be structured with the two-character pathway in columns 1 and 2, the eight-character keyword in columns 4 through 11, followed by the parameters in columns 13 through 132, as necessary. (For reasons that are explained in Section 2.4.8, the models will accept input files where all inputs are shifted by up to three columns to the right.) For most keywords, the order of parameters following the keyword is important -- the exact spacing of the parameters is not important, as long as they are separated from each other by at least one blank space and do not extend beyond the 132 character limit. The example of a runstream image from the CO pathway shown above is repeated here:

```
Column: 12345678901234567890123456789012345678901234567890123456789

        CO MODELOPT DFAULT RURAL CONC
        *    *       *      *     *
        *    *       *      *     *
        *    *       .)))))))2)))))2)))))))))) Parameters
        *    *
        *    .)))))))))))))))))))))))))))))))) 8-Character Keyword
        *
        .)))))))))))))))))))))))))))))))))))))) 2-Character Pathway ID
```

Alphabetical characters can be input as either lower case or upper case letters. The models convert all character input to upper case letters internally, with the exception of the title fields and file names to be discussed later. Throughout this document, the convention of using upper case letters is followed. For numeric input data, it should be noted that all data are assumed to be in metric units, i.e., length units of meters, speed units of meters per second, temperature units of degrees Kelvin, and emission units of grams per second. In a few instances, the user has the option of specifying units of feet for length and the model will perform the conversion to meters. These exceptions are the input of receptor heights for elevated terrain and the specification of anemometer height,

since these values are often more readily available in feet than in meters.

Certain keywords are mandatory and must be present in every runstream file, such as the MODELOPT keyword shown in the example above which identifies the modeling options. Other keywords are optional and are only needed to exercise particular options, such as the option to allow for the input of flagpole receptor heights. Some of the keywords are repeatable, such as the keywords to specify source parameters, while other keywords may only appear once. The keyword references in Section 3, Appendices A and B and the Quick Reference at the end of this volume identify each keyword as to its type, either mandatory or optional, and either repeatable or non-repeatable.

With a few exceptions that are described below, the order of keywords within each pathway is not critical. For the CO pathway, an exception is that the MODELOPT and POLLUTID keywords must be specified before the DCAYCOEF or HALFLIFE keyword because of the link between the urban default option and the decay coefficient for SO_2. For the SO pathway, the LOCATION keyword must be specified before other keywords for a particular source, and the SRCGROUP keyword must be the last keyword before SO FINISHED. For keywords on the SO pathway that accept a range of source IDs, the source parameters specified by those keywords will only be applied to the sources already defined, and will exclude any sources that are specified latter in the input file.

2.1.2 Advantages of the Keyword Approach

The keyword approach provides some advantages over the type of input file that uses non-descriptive numeric option switches and requires rigidly formatted inputs. One advantage is that the keywords are descriptive of the options and inputs

being used for a particular run, making it easier for a reviewer to ascertain what was accomplished in a particular run by reviewing the input file. Another advantage is that the user has considerable flexibility in structuring the inputs to improve their readability and understandability, as long as they adhere to the few basic rules described above.

Some special provisions have been made to increase the flexibility to the user in structuring the input files. One provision is to allow for blank records in the input file. This allows the user to separate the pathways from each other, or to separate a group of images, such as source locations, from the other images. Another provision is for the use of "comment cards," identified by a "**" in the pathway field. Any input image that has "**" for the pathway ID will be ignored by the model. This is especially useful for labeling the columns in the source parameter input images, as illustrated in the example problem later in this section. It may also be used to "comment out" certain options for a particular run without deleting the options and associated data (e.g., elevated terrain heights) completely from the input file. Because of the descriptive nature of the keyword options and the flexibility of the inputs it is generally much easier to make modifications to an existing input runstream file to obtain the desired result.

Another aspect of the "user-friendliness" of the ISC models is that detailed error-handling has been built into the models. The model provides descriptions of the location and nature of all of the errors encountered for a particular run. Rather than stopping execution at each occurrence of an input error, the new model will read through and attempt to process all input records and report all errors encountered. If a fatal error occurs, then the model will not attempt to execute the model calculations.

2.2 REGULATORY DEFAULT OPTION

The regulatory default option is controlled from the MODELOPT keyword on the CO pathway. As its name implies, this keyword controls the selection of modeling options. It is a mandatory, non-repeatable keyword, and it is an especially important keyword for understanding and controlling the operation of the ISC models. As noted in Section 1, the regulatory default options, as specified in the Guideline on Air Quality Models, are truly the default options for the ISC models. That is to say that, unless specified otherwise through the available keyword options, the ISC models implement the following regulatory options:

- Use stack-tip downwash (except for Schulman-Scire downwash);
- Use buoyancy-induced dispersion (except for Schulman-Scire downwash);
- Do not use gradual plume rise (except for building downwash);
- Use the calms processing routines;
- Use upper-bound concentration estimates for sources influenced by building downwash from super-squat buildings;
- Use default wind profile exponents; and
- Use default vertical potential temperature gradients.

Rather than specifying options with numeric switches, the parameters used for the MODELOPT keyword are character strings, called "secondary keywords," that are descriptive of the option being selected. For example, to ensure that the regulatory default options be used for a particular run, the user would include the secondary keyword "DFAULT" on the MODELOPT input. The presence of this secondary keyword tells the model to override any attempt to use a non-regulatory default option. The model will warn the user if a non-regulatory option is

selected along with the DFAULT option, but will not halt processing. For regulatory modeling applications, it is strongly suggested that the DFAULT switch be set, even though the model defaults to the regulatory options without it.

For any application in which a non-regulatory option is to be selected, the DFAULT switch must not be set, since it would otherwise override the non-regulatory option. The non-regulatory options are also specified by descriptive secondary keywords, such as "NOBID" to specify the option not to use buoyancy-induced dispersion. (A programmer note: these modeling option keywords also correspond to the Fortran logical variable names used to control the options in the ISC computer code. This is one reason why they are limited to six characters, .e.g., DFAULT instead of DEFAULT, since the standard Fortran language (ANSI, 1978) only allows variable names up to six characters in length).

The MODELOPT keyword, which is also used to specify the selection of rural or urban dispersion parameters, and concentration or deposition values, is described in more detail in the Section 3.2.2.

2.3 MODEL STORAGE LIMITS

The ISC models have been designed using a static storage allocation approach, where the model results are stored in data arrays, and the array limits are controlled by PARAMETER statements in the Fortran computer code. These array limits also correspond to the limits on the number of sources, receptors, source groups and averaging periods that the model can accept for a given run. Depending on the amount of memory available on the particular computer system being used, and the needs for a particular modeling application, the storage limits can easily be changed by modifying the PARAMETER statements and recompiling the model. Section 4.2.2 of this volume and Volume

III of the User's Guide provide more information about modifying the storage limits of the models.

The limits on the number of receptors, sources, source groups, averaging periods, and events (for ISCEV model) are initially set as follows for the three models for the DOS and extended memory (EM) versions on the PC:

PARAMETER Name	Limit Controlled	ISCST	ISCEV	ISCLT
NREC	Number of Receptors	500 (DOS) 1200 (EM)	-	500 (DOS) 1200 (EM)
NSRC	Number of Sources	100 (DOS) 300 (EM)	100 (DOS) 500 (EM)	50 (DOS) 300 (EM)
NGRP	Number of Source Groups	2 (DOS) 4 (EM)	25 (DOS) 50 (EM)	3 (DOS) 5 (EM)
NAVE	Number of Short Term Averages	2 (DOS) 4 (EM)	4 (DOS) 4 (EM)	-
NEVE	Number of Events	-	2500 (DOS) 5000 (EM)	-

Fortran PARAMETER statements are also used to specify the array limits for the number of output types (CONC, DEPOS, DDEP, and/or WDEP) available with the ISCST model (NTYP, initially set to 2 for the DOS version and 4 for the EM version); the number of high short term values by receptor to store for the ISCST model (NVAL, initially set to 2 for the DOS version and 6 for the EM version); the number of overall maximum values to store (NMAX, initially set to 50 for ISCST and to 10 for Long Term); and the number of x-coordinates and y-coordinates that may be included in the optional terrain grid file (MXTX and MXTY, initially set to 101 for the DOS version of Short Term, 201 for the DOS version of Long Term, and 601 for the EM version of both models).

In addition to the parameters mentioned above, parameters are used to specify the number of gridded receptor networks in a particular run (NNET), and the number of x-coordinate (or distance) and y-coordinate (or direction) values (IXM and IYM) for each receptor network. Initially, the models allow up to 5 receptor networks (of any type), and up to 50 x-coordinates (or distances) and up to 50 y-coordinates (or directions). The source arrays also include limits on the number of variable emission rate factors per source (NQF, initially set to 24 for the DOS version of Short Term and 96 for the EM version of Short Term, and to 36 for the DOS version of Long Term and 144 for the EM version of Long Term), the number of sectors for direction-specific building dimensions (NSEC, initially set to 36 for Short Term and 16 for Long Term), and the number of settling and removal categories (NPDMAX, initially set to 10 for the DOS version of Short Term and 20 for the EM version of Short Term and both versions of Long Term).

2.4 SETTING UP A SIMPLE RUNSTREAM FILE

This section goes through a step-by-step description of setting up a simple application problem, illustrating the most commonly used options of the ISCST model. The ISCST input runstream file for the example problem is shown in Figure 2-1. The remainder of this section explains the various parts of the input file for the ISCST model, and also illustrates some of the flexibility in structuring the input file.

```
CO STARTING
CO TITLEONE A Simple Example Problem for the ISCST Model
CO MODELOPT  DFAULT  RURAL  CONC
CO AVERTIME  3  24  PERIOD
CO POLLUTID  SO2
CO RUNORNOT  RUN
CO FINISHED


SO STARTING
SO LOCATION  STACK1 POINT  0.0   0.0    0.0
SO SRCPARAM  STACK1 1.00  35.0  432.0  11.7  2.4
SO BUILDHGT  STACK1 34. 34. 34. 34. 34. 34. 34. 34. 34. 34. 34. 34.
SO BUILDHGT  STACK1 34. 34. 34. 34. 34. 34. 34. 34. 34. 34. 34. 34.
SO BUILDHGT  STACK1 34. 34. 34. 34. 34. 34. 34. 34. 34. 34. 34. 34.
SO BUILDWID  STACK1 35.43 36.45 36.37 35.18 32.92 29.66 25.50 20.56
SO BUILDWID  STACK1 15.00 20.56 25.50 29.66 32.92 35.18 36.37 36.45
SO BUILDWID  STACK1 35.43 33.33 35.43 36.45  0.00 35.18 32.92 29.66
SO BUILDWID  STACK1 25.50 20.56 15.00 20.56 25.50 29.66 32.92 35.18
SO BUILDWID  STACK1 36.37 36.45 35.43 33.33
SO SRCGROUP  ALL
SO FINISHED


RE STARTING
RE GRIDPOLR  POL1  STA
RE GRIDPOLR  POL1  ORIG  0.0   0.0
RE GRIDPOLR  POL1  DIST  100.  200.  300.  500.  1000.
RE GRIDPOLR  POL1  GDIR  36    10.   10.
RE GRIDPOLR  POL1  END
RE FINISHED


ME STARTING
ME INPUTFIL  PREPIT.BIN  UNFORM
ME ANEMHGHT  20 FEET
ME SURFDATA  94823  1964  PITTSBURGH
ME UAIRDATA  94823  1964  PITTSBURGH
ME FINISHED


OU STARTING
OU RECTABLE  ALLAVE  FIRST  SECOND
OU MAXTABLE  ALLAVE  50
OU FINISHED
```

FIGURE 2-1. INPUT RUNSTREAM FILE FOR ISCST MODEL FOR SAMPLE PROBLEM

2.4.1 A Simple Industrial Source Application

For this simple tutorial, an application is selected involving a single point source of SO_2 that is subject to the

influences of building downwash. The source consists of a 35-meter stack with a buoyant release that is adjacent to a building. We will assume that the stack is situated in a rural setting with relatively flat terrain within 50 kilometers of the plant. A polar receptor network will be placed around the stack location to identify areas of maximum impact.

2.4.2 Selecting Modeling Options - CO Pathway

The modeling options are input to the model on the Control pathway. The mandatory keywords for the CO pathway are listed below. A complete listing of all keywords is provided in Appendix B.

STARTING - Indicates the beginning of inputs for the pathway; this keyword is mandatory on each of the pathways.

TITLEONE - A user-specified title line (up to 68 characters) that will appear on each page of the printed output file (an optional second title line is also available with the keyword TITLETWO).

MODELOPT - Controls the modeling options selected for a particular run through a series of secondary keywords.

AVERTIME - Identifies the averaging periods to be calculated for a particular run.

POLLUTID - Identifies the type of pollutant being modeled. At the present time, this option only influences the results if SO_2 is modeled with urban dispersion in the regulatory default mode, when a half-life of 4 hours is used to model exponential decay.

RUNORNOT - A special keyword that tells the model whether to run the full model executions or not. If the user selects not to run, then the runstream setup file will be processed and any input errors reported, but no dispersion calculations will be made.

FINISHED - Indicates that the user is finished with the inputs for this pathway; this keyword is also mandatory on each of the other pathways.

The first two keywords are fairly self-explanatory. As discussed above in Section 2.2, the MODELOPT keyword on the CO pathway is pivotal to controlling the modeling options used for a particular run. For this example, we intend to use the regulatory default options, so we will include the "DFAULT" keyword on our MODELOPT input image. We also need to identify whether the source being modeled is in a rural or an urban environment (see Section 8.2.8 of the Guideline on Air Quality Models for a discussion of rural/urban determinations). For this example we are assuming that the facility is in a rural setting. We also need to identify on this input image whether we want the model to calculate concentration values or deposition values. For this example, we are calculating concentration values. After the first three input records our input file will look something like this:

```
CO STARTING
CO TITLEONE A Simple Example Problem for the ISCST Model
CO MODELOPT  DFAULT  RURAL  CONC
```

Note that the title parameter field does not need to be in quotations, even though it represents a single parameter. The model simply reads whatever appears in columns 13 through 80 of the TITLEONE card as the title field, without changing the lower case to upper case letters. Leading blanks are therefore significant if the user wishes to center the title within the field. Note also that the spacing and order of the secondary

keywords on the MODELOPT card are not significant. A MODELOPT card that looked like this:

```
CO MODELOPT   RURAL   CONC                DFAULT
```

would have an identical result as the example above. It is suggested that the user adopt a style that is consistent and easy to read. A complete description of the available modeling options that can be specified on the MODELOPT keyword is provided in Section 3.

Since the pollutant in this example is SO_2, we will probably need to calculate average values for 3-hour and 24-hour time periods, and we also need to calculate averages for the full annual time period. Our runstream file might therefore look something like this after adding two more keywords:

```
CO STARTING
CO TITLEONE A Simple Example Problem for the ISCST Model
CO MODELOPT  DFAULT  RURAL  CONC
CO AVERTIME  3  24  PERIOD
CO POLLUTID  SO2
```

Note again that the order of the parameters on the AVERTIME keyword is not critical, although the order of the short term averages given on the AVERTIME keyword will also be the order in which the results are presented in the output file. The order of the keywords within each pathway is also not critical in most cases, although the intent of the input runstream file may be easier to decipher if a consistent and logical order is followed. It is suggested that users follow the order in which the keywords are presented in Section 3, in Appendix B, and in the Quick Reference, unless there is a clear advantage to doing otherwise.

The only remaining mandatory keywords for the CO pathway are RUNORNOT and FINISHED. We will set the RUNORNOT switch to RUN for this example. If a user is unsure about the operation of certain options, or is setting up a complex runstream file to run for the first time, it may be desirable to set the model NOT to run, but simply to read and analyze the input file and report any errors or warning messages that are generated. Once the input file has been debugged using these descriptive error/warning messages, then the RUNORNOT switch can be set to RUN, avoiding a possible costly waste of resources generating erroneous results. Even if the model is set NOT to run, all of the inputs are summarized in the output file for the user to review.

Our complete runstream file for the CO pathway may look something like this:

```
CO STARTING
CO TITLEONE A Simple Example Problem for the ISCST2 Model
CO MODELOPT  DFAULT  RURAL  CONC
CO AVERTIME  3  24  PERIOD
CO POLLUTID  SO2
CO RUNORNOT  RUN
CO FINISHED
```

The following set of runstream images has a more structured look, but it is equivalent to the example above:

```
CO STARTING
   TITLEONE A Simple Example Problem for the ISCST2 Model
   MODELOPT  DFAULT  RURAL  CONC
   AVERTIME  3  24  PERIOD
   POLLUTID  SO2
   RUNORNOT  RUN
CO FINISHED
```

Since the pathway ID is required to begin in column 1 (see Section 2.4.8 for a discussion of this restriction), the model

will assume that the previous pathway is in effect if the pathway field is left blank. The model will do the same for blank keyword fields, which will be illustrated in the next section.

In addition to these mandatory keywords on the CO pathway, the user may select optional keywords to specify that elevated terrain heights will be used (the default is flat terrain), to allow the use of receptor heights above ground-level for flagpole receptors, to specify a decay coefficient or a half-life for exponential decay, and to generate an input file containing events for processing with the EVENT model. The user also has the option of having the model periodically save the results to a file for later re-starting in the event of a power failure or other interruption of the model's execution. These options are described in more detail in Section 3 of this volume.

2.4.3 Specifying Source Inputs - SO Pathway

Besides the STARTING and FINISHED keywords that are mandatory for all pathways, the Source pathway has the following mandatory keywords:

LOCATION - Identifies a particular source ID and specifies the source type and location of that source.

SRCPARAM - Specifies the source parameters for a particular source ID identified by a previous LOCATION card.

SRCGROUP - Specifies how sources will be grouped for calculational purposes. There is always at least one group, even though it may be the group of ALL sources and even if there is only one source.

Since the hypothetical source in our example problem is influenced by a nearby building, we also need to include the optional keywords BUILDHGT and BUILDWID in our input file.

The input file for the SO pathway for this example will look something like this:

```
SO STARTING
SO LOCATION  STACK1  POINT  0.0   0.0   0.0
SO SRCPARAM  STACK1  1.00  35.0  432.0  11.7  2.4
SO BUILDHGT  STACK1  34. 34. 34. 34. 34. 34. 34. 34. 34. 34. 34. 34.
SO BUILDHGT  STACK1  34. 34. 34. 34. 34. 34. 34. 34. 34. 34. 34. 34.
SO BUILDHGT  STACK1  34. 34. 34. 34. 34. 34. 34. 34. 34. 34. 34. 34.
SO BUILDWID  STACK1  35.43 36.45 36.37 35.18 32.92 29.66 25.50 20.56
SO BUILDWID  STACK1  15.00 20.56 25.50 29.66 32.92 35.18 36.37 36.45
SO BUILDWID  STACK1  35.43 33.33 35.43 36.45  0.00 35.18 32.92 29.66
SO BUILDWID  STACK1  25.50 20.56 15.00 20.56 25.50 29.66 32.92 35.18
SO BUILDWID  STACK1  36.37 36.45 35.43 33.33
SO SRCGROUP  ALL
SO FINISHED
```

There are a few things to note about these inputs. Firstly, the source ID (STACK1 in this example) is an alphanumeric parameter (up to eight characters) that identifies the inputs for different keywords with a particular source. It is crucial that the source be identified with a LOCATION card before any other keyword makes reference to that source, since this identifies the source type (POINT in this case), and therefore which parameters the model will allow. Besides POINT sources, the ISC models also allow VOLUME, AREA, and OPENPIT sources to be specified.

Another thing to note is that there are 36 building heights and 36 building widths entered on the appropriate keywords, one value for each 10 degree sector beginning with the 10 degree flow vector (direction toward which the wind is blowing), and continuing clockwise. Since the user could not fit all 36 values on a single record, the pathway, keyword and source ID were repeated as many times as were necessary. In this case there were 12 values given on each of three lines for the building heights, and eight values on each of four lines plus a line of four values for building widths. There could have been fewer or more lines as long as exactly 36 values were

entered before starting with a new keyword. Since all of the building heights were the same across the sectors (fairly realistic for the height but not for widths, unless the structure was circular), there is a short cut available for specifying numeric input in the runstream files for the new models. The user can specify "repeat values" by entering a field such as "36*34.0" as a parameter for the BUILDHGT keyword. The model will interpret this as "36 separate entries, each with a value of 34.0," and store the values in the appropriate arrays within the model. Since the model must identify this as a single parameter field, there must not be any spaces between the repeat-value and the value to be repeated.

The final keyword before finishing the SO pathway must be the SRCGROUP keyword. In this example, since there is only one source, we have taken advantage of a short cut provided by the model by specifying a source group ID (which may be up to eight characters) of ALL. Whenever this card appears in an input file, it will generate a source group with a source-group ID of ALL, consisting of all sources defined for that run. The sources do not have to be explicitly identified. In a run involving multiple sources, the user may specify multiple source groups by repeating the SRCGROUP keyword. The use of the SRCGROUP card is explained in more detail in Section 3.

Using some of the formatting options discussed above, the SO pathway for our example may look like this, with the same result as above:

```
SO STARTING
   LOCATION  STACK1  POINT  0.0   0.0   0.0

** Point Source       QS    HS    TS    VS   DS
** Parameters:       ----  ----  ----  ----  ---
   SRCPARAM  STACK1  1.00  35.0  432.  11.7  2.4

   BUILDHGT  STACK1  36*34.
   BUILDWID  STACK1  35.43 36.45 36.37 35.18 32.92 29.66 25.50 20.56
             STACK1  15.00 20.56 25.50 29.66 32.92 35.18 36.37 36.45
             STACK1  35.43 33.33 35.43 36.45  0.00 35.18 32.92 29.66
             STACK1  25.50 20.56 15.00 20.56 25.50 29.66 32.92 35.18
             STACK1  36.37 36.45 35.43 33.33
   SRCGROUP  ALL
SO FINISHED
```

This version of the SO pathway inputs illustrates the use of the comment card to label the stack parameters on the SRCPARAM card, i.e., QS for emission rate (g/s), HS for stack height (m), TS for stack exit temperature (K), VS for exit velocity (m/s), and DS for stack diameter (m). A complete description of the source parameter card, with a list of parameters for each source type, is provided in Section 3.3 and in Appendix B.

Other optional inputs that may be entered on the SO pathway include specifying variable emission rate factors for sources whose emissions vary as a function of month, season, hour-of-day, STAR category, or season and hour-of-day (see Section 3.3.4 for more details). The number of factors entered depends on the option selected, and factors may be input for single sources or for a range of sources. Other keywords allow the user to specify settling velocity categories, mass fractions, and reflection coefficients for sources of large particulates that experience settling and removal of the pollutant as it is dispersed and transported downwind. This option is also explained in more detail in Section 3.

2.4.4 Specifying a Receptor Network - RE Pathway

As mentioned above, this example will illustrate the use of a single polar receptor network centered on the stack location. Other options available on the REceptor pathway include specifying a Cartesian grid receptor network, specifying discrete receptor locations in either a polar or a Cartesian system, and specifying the location of receptors along the boundary around a particular source. These other options are described in more detail in Section 3.4.

For this example we will specify a polar network with receptors located at five downwind distances for every 10-degree flow vector around the plant. There will be a total of 180 receptors. The RE pathway for this example will look something like this:

```
RE STARTING
   GRIDPOLR  POL1  STA
             POL1  ORIG  0.0  0.0
             POL1  DIST  100.  200.  300.  500.  1000.
             POL1  GDIR  36    10.   10.
             POL1  END
RE FINISHED
```

The first thing to note about these inputs is that there is a new set of keywords, including something that looks like a STArting and ENDing. In fact the GRIDPOLR keyword can be thought of as a "sub-pathway," in that all of the information for a particular polar network must be in contiguous records, and that the starting and ending of the sub-pathway are identified. The order of secondary keywords within the sub-pathway is not critical, similar to the main pathways. Each card must be identified with a network ID (up to eight alphanumeric characters), in this case it is "POL1." Multiple networks may be specified in a single model run. The model waits until the END secondary keyword is encountered to set the

variables, which may include terrain heights for receptors on elevated terrain or flagpole receptor heights if those options are being exercised by the user. The use of these optional secondary keywords is described in detail in Section 3.4.

For this example, the ORIG secondary keyword specifies the location of the origin, in (X,Y) coordinates, for the polar network being defined. This network is centered at the same (X,Y) location as the source specified above. The ORIG keyword is optional, and the model will default to an origin of (0.0, 0.0) if it is omitted. The DIST keyword identifies the distances along each direction radial at which the receptors will be located. In this case there are five distances. More could be added by adding values to that input card or by including a continuation card, if needed. The GDIR keyword specifies that the model will Generate DIRection radials for the network, in this case there will be 36 directions, beginning with the 10 degree flow vector and incrementing every 10 degrees clockwise. The user may elect to define Discrete DIRection radials instead by using the DDIR keyword in place of the GDIR keyword.

2.4.5 Specifying the Meteorological Input - ME Pathway

The MEteorolgy pathway has the following three mandatory keywords (besides STARTING and FINISHED, of course):

INPUTFIL - Specifies the filename and format for the input meteorological data file.

ANEMHGHT - Specifies the anemometer height for the wind data to be used for the modeling run.

SURFDATA - Specifies information about the surface meteorological data which will be used in the modeling.

UAIRDATA - Specifies information about the upper air meteorological data (i.e. mixing heights) which will be used in the modeling.

For the purposes of this example we will assume that the meteorological data file is a formatted ASCII file in the default format for ISCST3 that was generated by the PCRAMMET meteorological preprocessor program. The filename is PREPIT.ASC (the sample file that is provided on the SCRAM BBS with the ISCST3 model), and it consists of twenty days of data for Pittsburgh, PA from 1964. The runstream images for the MEteorology pathway would look something like this:

```
ME STARTING
   INPUTFIL  PREPIT.ASC
   ANEMHGHT  20 FEET
   SURFDATA  94823  1964  PITTSBURGH
   UAIRDATA  94823  1964  PITTSBURGH
ME FINISHED
```

The first parameter on the INPUTFIL keyword is the filename, which can be entered as a full DOS pathname, including the drive specification and subdirectories, up to a total of 40 characters. The second parameter is the format of the meteorology data file. In this case the secondary keyword is blank, indicating that the meteorological data file is an ASCII file in the default format for the model. Another option would be to place the secondary keyword UNFORM following the filename, in which case the model will assume an unformatted meteorological data file of the type generated by PCRAMMET. The order of variables assumed for the ASCII file input is as follows: year, month, day, hour, flow vector, wind speed (m/s), temperature (K), stability category, rural mixing height (m), and urban mixing height (m). Other user options for specifying the format for ASCII meteorology files are described more fully in Section 3.5.1.

The ANEMHGHT keyword is important because the input wind speed data are adjusted from the anemometer height to the release height for model calculations, so that differences in anemometer height can significantly effect the modeled results.

For National Weather Service (NWS) data, the user should check records (e.g. the Local Climatological Data summary report) for the particular station to determine the correct anemometer height for the data period used in the modeling, since the anemometer location and height may change over time. The model will assume that the anemometer height is in meters, unless the secondary keyword "FEET" is included in the runstream image, as illustrated in this example. The model will convert inputs in feet to meters.

The final two mandatory inputs identify the location and data period of the input meteorological data. A separate keyword is used for the surface meteorological data and for the upper air (mixing height) data. The parameters on these cards are the station number (e.g. WBAN number for NWS stations), the data period (year), and a station name. It is important that these inputs be provided correctly since the model compares the station number and year from the runstream input file with values provided in the first record of the meteorology file. The user may also optionally input the (X,Y) coordinates for the location of the station(s), although these values are not currently used by the model.

Other optional keywords available on the ME pathway provide the user with options to specify selected days to process from the meteorological data file, a wind direction rotation correction term, and user-specified wind speed profile exponents and/or vertical potential temperature gradients. The wind profile exponents and potential temperature gradients are ignored (and a warning message generated) if the regulatory default option is selected. These optional inputs are described in more detail in Section 3.5.

2.4.6 Selecting Output Options - OU Pathway

All of the keywords on the Output pathway are optional, although the model will warn the user if no printed outputs are requested and will halt processing if no outputs (printed results or file outputs) are selected. The printed table keywords are:

RECTABLE - Specifies the selection of high value by receptor table output options.

MAXTABLE - Specifies the selection of overall maximum value table output options.

DAYTABLE - Specifies the selection of printed results (by receptor) for each day of data processed (this option can produce very large files and such be used with care).

The RECTABLE keyword corresponds to the option for highest, second-highest and third-highest values by receptor available in the old ISCST model. The MAXTABLE keyword corresponds to the maximum 50 table option available in the old ISCST model. For both of these keywords, the user has additional flexibility to specify for which short term averaging periods the outputs are selected. For the MAXTABLE keyword the user can also specify the number of overall maximum values to summarize for each averaging period selected, up to a maximum number controlled by a parameter in the computer code. For this example problem we will select the highest and second-highest values by receptor, and the maximum 50 values for all averaging periods. These OU pathway inputs will look something like this:

```
OU STARTING
   RECTABLE  ALLAVE  FIRST  SECOND
   MAXTABLE  ALLAVE  50
OU FINISHED
```

To simplify the input for users who request the same printed table output options for all averaging periods, these keywords recognize the secondary keyword "ALLAVE" as the first parameter for that purpose. In order to obtain the overall maximum 10 values for the 24-hour averages only, then the OU pathway images would look like this:

```
OU STARTING
   RECTABLE  ALLAVE  FIRST  SECOND
   MAXTABLE  24  10
OU FINISHED
```

It should also be noted that these output table options apply only to the short-term averaging periods, such as the 3-hour and 24-hour averages used in our example. If the user has selected that PERIOD averages be calculated (on the CO AVERTIME keyword), then the output file will automatically include a table of period averages summarized by receptor (the RECTABLE option does not apply since there is only one period value for each receptor). In addition, the printed output file will include tables summarizing the highest values for each averaging period and source group.

Other options on the OU pathway include several keywords to produce output files for specialized purposes, such as generating contour plots of high values, identifying occurrences of violations of a particular threshold value (e.g. a NAAQS), and for postprocessing of the raw concentration data. These options are described in detail in Section 3.6.

The complete input runstream file for this simple example is shown in Figure 2-2. Note that a consistent style has been used for formatting and structuring the file in order to improve its readability. This input file is comparable to the version shown earlier in Figure 2-1, which used a somewhat different style.

```
CO STARTING
   TITLEONE A Simple Example Problem for the ISCST2 Model
   MODELOPT  DFAULT  RURAL  CONC
   AVERTIME  3  24  PERIOD
   POLLUTID  SO2
   RUNORNOT  RUN
CO FINISHED

SO STARTING
   LOCATION  STACK1  POINT  0.0   0.0   0.0

** Point Source       QS    HS    TS    VS   DS
** Parameters:       ----  ----  ----  ----  ---
   SRCPARAM  STACK1  1.00  35.0  432.  11.7  2.4

   BUILDHGT  STACK1  36*34.
   BUILDWID  STACK1  35.43 36.45 36.37 35.18 32.92 29.66 25.50 20.56
             STACK1  15.00 20.56 25.50 29.66 32.92 35.18 36.37 36.45
             STACK1  35.43 33.33 35.43 36.45  0.00 35.18 32.92 29.66
             STACK1  25.50 20.56 15.00 20.56 25.50 29.66 32.92 35.18
             STACK1  36.37 36.45 35.43 33.33
   SRCGROUP  ALL
SO FINISHED

RE STARTING
   GRIDPOLR  POL1  STA
             POL1  ORIG  0.0  0.0
             POL1  DIST  100.  200.  300.  500.  1000.
             POL1  GDIR  36    10.   10.
             POL1  END
RE FINISHED

ME STARTING
   INPUTFIL  PREPIT.ASC
   ANEMHGHT  20 FEET
   SURFDATA  94823  1964  PITTSBURGH
   UAIRDATA  94823  1964  PITTSBURGH
ME FINISHED

OU STARTING
   RECTABLE  ALLAVE  FIRST  SECOND
   MAXTABLE  ALLAVE  50
OU FINISHED
```

FIGURE 2-2. EXAMPLE INPUT RUNSTREAM FILE FOR SAMPLE PROBLEM

2.4.7 Using the Error Message File to Debug the Input Runstream File

The previous sections in this tutorial have lead through the step-by-step construction of a sample runstream input file for ISCST. This simple example problem illustrated the usage

of the most commonly used options of the ISCST model. However, many real-time applications of the model will be much more complex than this example, perhaps involving multiple sources and source groups, multiple receptor networks, the addition of discrete receptor locations, and/or elevated terrain heights. Since humans are prone to make errors from time to time, an effort has been made to develop improved error handling capabilities for the ISC models.

The error handling capabilities of the ISC models are designed to accomplish two things for the user. First, the model should read through the complete input file and report all occurrences of errors or suspect entries before stopping, rather than stopping on the first instance (and every instance thereafter) of an error in the input file. Second, the model should provide error and warning messages that are detailed and descriptive enough that they will help the user in his/her effort to debug the input file. The remainder of this section provides of brief introduction to the use of the model's error handling capabilities. Appendix E of this volume provides more details about the error handling provided by the ISC models, including a listing and explanation of all error and other types of messages generated by the models.

The ISC models generate messages during the processing of the input data and during the execution of model calculations. These messages inform the user about a range of possible conditions including:

- Errors that will halt any further processing, except to identify additional error conditions;
- Warnings that do not halt processing but indicate a possible errors or suspect conditions; and
- Informational messages that may be of interest to the user but have no direct bearing on the validity of the results.

As the model encounters a condition for which a message is generated, the model writes the message to a temporary storage file. At the completion of the setup processing for a run, and at the completion of the model calculations, the model rereads the message file and generates a summary of the messages which is included in the main printed output file. If the processing of the model setup information indicates no errors or warnings, and the user has selected the option to RUN the model calculations on the CO RUNORNOT card, then the model will simply write a statement to the print file that the model setup was completed successfully. Otherwise, the model will report a summary of the messages encountered. The summary of model setup messages that would be generated for the example problem if the option NOT to run was chosen is shown in Figure 2-3. This summary table reports the total number of occurrences for each of the message types, and lists the detailed message for any fatal errors or warning messages that were generated. In this case, since there were no errors or suspicious conditions in the setup file, there are no error or warning messages listed.

An example of the warning message that would have been generated had we left out the card on the RE pathway that specifies the origin of the polar receptor network is shown below:

```
RE W220 39 REPOLR: Missing Origin (Use Default = 0,0) In GRIDPOLR      POL1
*   *   *    *        *                                                 *
*   *   *    *        *                                                 *
*   *   *    *        *                                               Hints
*   *   *    *        *
*   *   *    *      Detailed error/warning message
*   *   *    *
*   *   *  Subroutine from which message is generated
*   *   *
*   *  Line number of file where message occurred
*   *
*  Message code - including message type (E, W, I) and message number
*
Pathway ID where message originated
```

Since this is a warning message, it would have appeared at the end of the message summary table in the output file, but it would not have halted processing of the data. The last item on the message line, "Hints," may include such information as the keyword or parameter name causing the error, the source ID, group ID or (as in this case) the network ID involved, or perhaps the date variable identifying when the message occurred during the processing of the meteorological data, such as an informational message identifying the occurrence of a calm wind.

For new users and for particularly complex applications, it is strongly recommended that the model first be run with the RUNORNOT keyword (on the CO pathway) set NOT to run. In this way, the user can determine if the model is being setup properly by the runstream file before committing the resources to perform a complete run. The user should make a point of examining any warning messages carefully to be sure that the model is operating as expected for their application, since these messages will not halt processing by the model. In most cases, the detailed messages will provide enough information for the user to determine the location and nature of any errors in the runstream setup file. If the intent of the message is not immediately clear, then the user should refer to the more detailed descriptions provided in Appendix E for the particular error code generated.

In deciphering the error and warning messages, the line number provided as part of the message may be particularly helpful in locating the error within the input file. However, if it is an error of omission that is caught by the error checking performed at the completion of inputs for a pathway, then the line number will correspond to the last record for that pathway. The user may need to examine all of the messages carefully before locating the error or errors, especially since a single occurrence of certain types of errors may lead to other error conditions being identified later in the input file which do not really constitute errors in themselves. An example of this is provided in Figure 2-4, which shows some inputs for the SO pathway where the building dimension keywords have been typed incorrectly, and the associated list of error messages. Since continuation cards were being used for the building width inputs, and the keyword was entered incorrectly on the first line, the subsequent records were also taken by the model to be invalid keyword inputs. While the error messages are the same for these records, the message originates from a different part of the model (SUBROUTINE SOCARD) for the records with the blank keyword.

Since the detailed error and warning messages are listed in the output file as part of the message summary table, there will generally not be a need for the user to examine the contents of the detailed message file. For this reason, the default operation of the model is to write the messages that are generated by a particular run to a temporary file that is deleted when the run is completed. If the user wishes to examine the complete list of detailed messages (of all types), there is an optional keyword available on the CO pathway for that purpose. The ERRORFIL keyword, which is described in

detail in Section 3.2.7, allows the user to save the complete list of detailed messages to a user-specified filename.

```
  *** Message Summary For ISC3 Model Setup ***


  --------- Summary of Total Messages ---------

A Total of           0 Fatal Error Message(s)
A Total of           0 Warning Message(s)
A Total of           0 Information Message(s)



   ******** FATAL ERROR MESSAGES ********
               ***  NONE  ***


   ********   WARNING MESSAGES   ********
               ***  NONE  ***


   **********************************
   *** SETUP Finishes Successfully ***
   **********************************
```

FIGURE 2-3. EXAMPLE MESSAGE SUMMARY TABLE FOR RUNSTREAM SETUP

```
SO STARTING
   LOCATION  STACK1  POINT  0.0   0.0   0.0
** Point Source       QS    HS    TS     VS   DS
** Parameters:       ----  ----  ----   ----  ---
   SRCPARAM  STACK1  1.00  35.0  432.0  11.7  2.4
   BUILDHTS  STACK1  36*34.
   BUILDWTS  STACK1  35.43 36.45 36.37 35.18 32.92 29.66 25.50 20.56
             STACK1  15.00 20.56 25.50 29.66 32.92 35.18 36.37 36.45
             STACK1  35.43 33.33 35.43 36.45  0.00 35.18 32.92 29.66
             STACK1  25.50 20.56 15.00 20.56 25.50 29.66 32.92 35.18
             STACK1  36.37 36.45 35.43 33.33
   SRCGROUP  ALL
SO FINISHED
```

```
 *** Message Summary For ISC3 Model Setup ***
 --------- Summary of Total Messages ---------
A Total of           6 Fatal Error Message(s)
A Total of           0 Warning Message(s)
A Total of           0 Information Message(s)

   ******** FATAL ERROR MESSAGES ********
SO E105   17 EXKEY : Invalid Keyword Specified. The Troubled Keyword is BUILDHTS
SO E105   18 EXKEY : Invalid Keyword Specified. The Troubled Keyword is BUILDWTS
SO E105   19 SOCARD: Invalid Keyword Specified. The Troubled Keyword is BUILDWTS
SO E105   20 SOCARD: Invalid Keyword Specified. The Troubled Keyword is BUILDWTS
SO E105   21 SOCARD: Invalid Keyword Specified. The Troubled Keyword is BUILDWTS
SO E105   22 SOCARD: Invalid Keyword Specified. The Troubled Keyword is BUILDWTS

   ********   WARNING MESSAGES   ********
              ***  NONE  ***

   ************************************
   *** SETUP Finishes UN-successfully ***
   ************************************
```

FIGURE 2-4. EXAMPLE OF KEYWORD ERROR AND ASSOCIATED MESSAGE SUMMARY TABLE

2.4.8 Running the Model and Reviewing the Results

Now that we have a complete and error-free runstream input file, we are ready to run the model and then review the results. The PC-executable files available on the SCRAM BBS

open the runstream input and printed output files explicitly within the model, so there is no need to "redirect" the I/O on the command line using the DOS redirection symbols '<' and '>'. The command line to run the sample problem might look something like this on the PC:

```
C:\>ISCST3 TEST-ST.INP TEST-ST.OUT
```

The "c-prompt" of DOS has been represented by the characters "C:\>", but may appear different on different machines. The important points are that the ISCST3.EXE file either be in the directory from which you are attempting to run the model, or in a directory that is included on the DOS PATH command when the system is "booted-up." The runstream input filename must appear first (without any DOS "redirection" symbol), followed by the desired output filename (also without the DOS redirection symbol), and these files must also be located in the directory from which the model is being executed, unless a complete DOS pathname is provided on the command line.

As mentioned above, the SCRAM PC-executable files for ISC open the input and output files explicitly. One reason for this is to allow for the models to write an update on the status of processing to the PC terminal screen. For the ISCST model, the model first indicates that setup information is being processed and then gives the Julian day currently being processed. If no status message is seen then the model did not load into memory properly. If the model stops after completing the setup processing, then either the RUNORNOT option was set NOT to run, or a fatal error was encountered during the setup processing. Another reason for not sending the printed output to the default output device (i.e., to the screen or redirected to a file), is so that any DOS error messages will be visible on the screen and not be written to the printed file. One such message might be that there is insufficient memory available to run the program. Handling of DOS error messages may require

some knowledge of DOS, unless the meaning of the message is obvious.

The order of contents and organization of the main output file for the ISC models is presented in Figure 2-5.

```
Echo of Input Runstream Images

Summary of Runstream Setup Messages

Summary of Inputs
     Summary of Modeling Options
     Summary of Source Data
     Summary of Receptor Data
     Summary of Meteorology Data

Model Results

     Daily Results for Each Averaging Period and Output Type
         Selected for Each Day Processed (If Applicable)
         - DAYTABLE Keyword

     PERIOD or ANNUAL Results for Each Source Group and
         Output Type (If Applicable)
         - PERIOD or ANNUAL Parameter on AVERTIME Keyword

     Short Term Average Results (High, Second High, etc.) by
         Receptor for Each Source Group and Output Type (If
         Applicable)
         - RECTABLE Keyword

     Overall Maximum Short Term Average Results for Each
         Source Group and Output Type (If Applicable)
         - MAXTABLE Keyword

Summary Tables of High Values for Each Averaging Period,
     Source Group and Output Type (Always provided if PERIOD
     or ANNUAL averages or the RECTABLE keyword are used)

Summary of Complete Model Execution Messages
```

FIGURE 2-5. ORGANIZATION OF ISCST MODEL OUTPUT FILE

The references to "Output Type" in Figure 2-5 refer to the option with the Short Term model to output concentration, total deposition, dry deposition, and/or wet deposition in a single model run. Each page of the output file, except for the echo

of the input file images, is labeled with the model name and version number, user-specified title(s), page number, and, for the PC version of the model, the date and time of the particular run. Also included as part of the header information for each page is a one-line summary of the modeling options used for that particular run. The modeling options are listed as the secondary keywords used to control the options, such as URBAN or RURAL, CONC or DEPOS, DFAULT, NOCALM, etc. (Details about the date/time routines and other PC-specific features of the computer code are discussed in Section 4.0 of this Volume and in Volume III.)

Since the complete input file is normally echoed back as part of the output file, and since processing of the inputs stops when the OU FINISHED card is reached, the run can be duplicated by simply specifying the output filename as the input runstream file. Alternatively, the input records could be "cut and pasted" from the output file to a separate file using a text editor. This allows for the model run to be duplicated even if the original runstream file is not available.

By default, the models will echo each line of the input runstream file to the printed output file. This provides a convenient record of the inputs as originally read into the model, without any rounding of numerical values that may appear in the input summary tables. As noted above, it also means that the output file can be used as an input file to the model to reproduce a particular application. However, for some applications, the length of the input runstream file may be too cumbersome to include the entire set of inputs at the beginning of each output file. This may happen, for example, if a large number of sources are being defined or if a large number of discrete receptor locations are used. For this reason, the user is provided with the option to "turn off" the echoing of the input file at any point within the runstream file. This is

accomplished by entering the keywords "NO ECHO" in the first two fields anywhere within the runstream file. In other words, place NO in the pathway field, followed by a space and then ECHO. None of the input runstream images after the NO ECHO will be echoed to the output file. Thus, a user may choose to place NO ECHO after the Control pathway in order to keep the control options echoed, but suppress echoing the rest of the input file.

The details of the message summary tables were discussed in the previous section. A portion of the summary of modeling option inputs is shown in Figure 2-6 for the simple example described in this section. For the new model, the summary of source parameter input data includes separate tables for each source type, rather than combining all sources onto a single table. In this way the column headings are specific to the source type.

Figure 2-7 presents an example of the results output for the second highest values by receptor for our sample problem. These values are the second highest 24-hour averages at each receptor location. Note that several of the numbers are followed by a 'c.' This flag indicates that the average included at least one calm hour during the averaging period. The number in parentheses following each concentration value is the date corresponding to each value. The date is given as an eight digit integer variable that includes the year (2-digits), month, day, and hour corresponding to the end of the averaging period. Since these are 24-hour averages and are based on block (end-to-end) rather than running averages, all of the dates end on hour 24.

For each of the different types of model result tables, the controlling keyword is identified above at the end of the description. All of the outputs of the same type, e.g. high values by receptor, are printed together, and the order of

tables loops through all source groups for a particular averaging period, and then loops through all averaging periods. The summary tables of high values at the end of the model results follow the same order of loops. An example of the summary tables for our sample problem is shown in Figure 2-8. The summaries for all averaging periods have been combined onto a single figure, but would appear on separate pages of the actual output file.

```
 *** ISCST3 - VERSION 95250 ***    *** A Simple Example Problem for the ISCST Model                          ***
09/07/95
                                  ***                                                                      ***
12:00:00

PAGE   1
**MODELOPTs: CONC                        RURAL  FLAT          DFAULT


                                        ***     MODEL SETUP OPTIONS SUMMARY       ***
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
- -
**Intermediate Terrain Processing is Selected

**Model Is Setup For Calculation of Average CONCentration Values.

  --  SCAVENGING/DEPOSITION LOGIC --
**Model Uses NO DRY DEPLETION.  DDPLETE =  F
**Model Uses NO WET DEPLETION.  WDPLETE =  F
**NO WET SCAVENGING Data Provided.
**Model Does NOT Use GRIDDED TERRAIN Data for Depletion Calculations

**Model Uses RURAL Dispersion.

**Model Uses Regulatory DEFAULT Options:
           1. Final Plume Rise.
           2. Stack-tip Downwash.
           3. Buoyancy-induced Dispersion.
           4. Use Calms Processing Routine.
           5. Not Use Missing Data Processing Routine.
           6. Default Wind Profile Exponents.
           7. Default Vertical Potential Temperature Gradients.
           8. "Upper Bound" Values for Supersquat Buildings.
           9. No Exponential Decay for RURAL Mode

**Model Assumes Receptors on FLAT Terrain.

**Model Assumes No FLAGPOLE Receptor Heights.

**Model Calculates  2 Short Term Average(s) of:   3-HR  24-HR
    and Calculates PERIOD Averages

**This Run Includes:    1 Source(s);      1 Source Group(s); and    180 Receptor(s)
```

```
**The Model Assumes A Pollutant Type of:  SO2

**Model Set To Continue RUNning After the Setup Testing.

**Output Options Selected:
         Model Outputs Tables of PERIOD Averages by Receptor
         Model Outputs Tables of Highest Short Term Values by Receptor (RECTABLE Keyword)
         Model Outputs Tables of Overall Maximum Short Term Values (MAXTABLE Keyword)
```

FIGURE 2-6. SAMPLE OF MODEL OPTION SUMMARY TABLE FROM AN ISC MODEL OUTPUT FILE

```
 *** ISCST3 - VERSION 95250 ***    *** A Simple Example Problem for the ISCST Model                        ***
09/07/95
                                  ***                                                                    ***
12:00:30

PAGE  13
**MODELOPTs: CONC                        RURAL  FLAT          DFAULT


                             *** THE   2ND HIGHEST 24-HR AVERAGE CONCENTRATION   VALUES FOR SOURCE GROUP:  ALL      ***
                                 INCLUDING SOURCE(S):      STACK1  ,

                                  *** NETWORK ID: POL1     ;  NETWORK TYPE: GRIDPOLR ***
                                       ** CONC OF SO2      IN MICROGRAMS/M**3                          **
DIRECTION |                                                 DISTANCE (METERS)
(DEGREES) |          100.00                 200.00                 300.00                 500.00
1000.00
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
- - - - -
     10.0 |      0.00038 (64010524)      0.00759 (64010324)      0.00223 (64010224)      0.00058 (64010224)      0.00012
(64010224)
     20.0 |      0.00032 (64010224)      0.73597 (64010324)      0.46271 (64010324)      0.22714 (64010324)      0.08851
(64010324)
     30.0 |      0.06544 (64010324)      3.09471 (64010224)      2.05010 (64010224)      1.00969 (64010224)      0.46573
(64010224)
     40.0 |      2.24546 (64010524)      7.13027 (64010324)      4.90821 (64010324)      2.56813 (64010524)      1.20217
(64010524)
     50.0 |     17.05618 (64010524)     12.96035 (64010524)      8.87260 (64010524)      4.40116 (64010524)      2.17334
(64010524)
     60.0 |      9.40921 (64010224)      6.06938 (64010224)      4.17845 (64010224)      2.05521 (64010224)      0.94001
(64010224)
```

70.0	4.98424 (64011024)	4.83446 (64011024)	3.64057 (64011024)	1.93861 (64011024)	0.96955 (64011024)
80.0	1.10668 (64010424)	1.32557 (64010124)	0.99239 (64010124)	0.55702 (64010124)	0.38055 (64010124)
90.0	0.33531 (64010424)	0.89549 (64010424)	0.76865 (64010424)	0.55710 (64010424)	0.68970 (64011024)
100.0	1.14289 (64011024)	1.66369 (64011024)	1.30464 (64011024)	0.77602 (64010924)	0.45574 (64011024)
110.0	1.38580 (64010424)	1.41520 (64010424)	1.09491 (64010424)	0.59547 (64010424)	0.32417 (64010424)
120.0	1.46832c(64010724)	0.72598c(64010724)	0.41049c(64010724)	0.12771c(64010724)	0.06649c(64010724)
130.0	0.73820 (64010924)	0.50974 (64010924)	0.36027 (64010924)	0.16093 (64010924)	0.07651 (64010924)
140.0	0.00385 (64010924)	0.00152 (64010924)	0.00072 (64010924)	0.00020 (64010924)	0.00004 (64010924)
150.0	0.00000 (64010924)	0.00000 (64010124)	0.00000 (64010124)	0.00000 (64010124)	0.00000 (64010124)
160.0	0.00000 (64010924)	0.00203 (64010124)	0.00054 (64010124)	0.00005 (64010124)	0.00003 (64010124)
170.0	0.00000 (0)	0.12191 (64010124)	0.04290 (64010124)	0.00504 (64010124)	0.00702 (64010124)
180.0	0.00000 (0)	0.04481 (64010124)	0.01473 (64010124)	0.00161 (64010124)	0.00183 (64010124)
190.0	0.00000 (64010124)	0.00008 (64010124)	0.00002 (64010124)	0.00000 (64010124)	0.00000 (64010124)
200.0	0.00000 (64010124)	0.00000 (64010124)	0.00000 (64010124)	0.00003 (64010124)	0.00087 (64010124)
210.0	0.00000c(64010724)	0.00014 (64010124)	0.00003 (64010124)	0.00020 (64010124)	0.00315c(64010724)
220.0	0.00000c(64010724)	0.00021c(64010724)	0.00005c(64010724)	0.00000c(64010724)	0.00000c(64010724)
230.0	0.00017 (64010824)	0.00004 (64010824)	0.00001 (64010824)	0.00000 (64010824)	0.00000 (64010824)
240.0	0.82936 (64010824)	0.52206 (64010824)	0.34721 (64010824)	0.10982 (64010824)	0.06490 (64010824)
250.0	2.85290 (64010124)	2.16804 (64010124)	1.36673 (64010824)	0.46188 (64010824)	0.34731 (64010824)
260.0	0.93134 (64010824)	0.90262 (64010824)	0.43338 (64010824)	0.15206 (64010824)	0.12491 (64010824)
270.0	0.01273 (64010824)	0.02553 (64010824)	0.02055 (64010824)	0.01631 (64010824)	0.05295 (64010824)
280.0	0.44666 (64010924)	0.36178 (64010924)	0.24921 (64010924)	0.10171 (64010924)	0.05489 (64010924)

```
    290.0 |      1.99281 (64010924)      1.57520 (64010924)      1.11347 (64010924)      0.47971 (64010924)      0.25976
(64010924)
    300.0 |      3.26315 (64010924)      2.22510 (64010924)      1.53359 (64010924)      0.69664 (64010924)      0.33747
(64010924)
    310.0 |      1.61856 (64010824)      1.02108 (64010824)      0.68047 (64010824)      0.27048 (64010824)      0.11362
(64010824)
    320.0 |      1.08368 (64010624)      2.99288 (64010924)      2.00757 (64010924)      0.98393 (64010924)      0.44887
(64010924)
    330.0 |      0.00133 (64010124)      1.34910 (64010924)      0.95774 (64010924)      0.49932 (64010524)      0.26437
(64010924)
    340.0 |      0.00000 (64010124)      0.18219 (64010924)      0.11241 (64010924)      0.05144 (64010924)      0.01881
(64010924)
    350.0 |      0.01162 (64010524)      0.01620 (64010624)      0.00568 (64010624)      0.00109 (64010624)      0.00032
(64010624)
    360.0 |      2.22860c(64010724)      1.25950 (64010924)      0.83449c(64010724)      0.67738c(64010724)
0.38261c(64010724)
```

FIGURE 2-7. EXAMPLE OUTPUT TABLE OF HIGH VALUES BY RECEPTOR

```
 *** ISCST3 - VERSION 95250 ***    *** A Simple Example Problem for the ISCST Model                        ***
09/07/95
                                  ***                                                                    ***
12:00:00

PAGE  16
**MODELOPTs: CONC                       RURAL  FLAT          DFAULT


                                     *** THE SUMMARY OF MAXIMUM PERIOD (   240 HRS) RESULTS ***

                                   ** CONC OF SO2      IN MICROGRAMS/M**3                          **
                                                                                                  NETWORK
GROUP ID                       AVERAGE CONC                RECEPTOR  (XR, YR, ZELEV, ZFLAG)   OF TYPE  GRID-ID
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

ALL      1ST HIGHEST VALUE IS       5.59843 AT (      76.60,       64.28,      0.00,      0.00)  GP   POL1
         2ND HIGHEST VALUE IS       4.46934 AT (     153.21,      128.56,      0.00,      0.00)  GP   POL1
         3RD HIGHEST VALUE IS       3.96137 AT (      86.60,       50.00,      0.00,      0.00)  GP   POL1
         4TH HIGHEST VALUE IS       3.17067 AT (     229.81,      192.84,      0.00,      0.00)  GP   POL1
         5TH HIGHEST VALUE IS       2.88217 AT (     128.56,      153.21,      0.00,      0.00)  GP   POL1
         6TH HIGHEST VALUE IS       2.72413 AT (     173.21,      100.00,      0.00,      0.00)  GP   POL1


                                     *** THE SUMMARY OF HIGHEST  3-HR RESULTS ***
```

```
                                   ** CONC OF SO2      IN MICROGRAMS/M**3                          **

                                                          DATE
NETWORK
GROUP ID                          AVERAGE CONC     (YYMMDDHH)            RECEPTOR  (XR, YR, ZELEV, ZFLAG)     OF TYPE
GRID-ID
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
- - - -

ALL      HIGH  1ST HIGH VALUE IS      58.49796  ON 64010524: AT (       0.00,      100.00,      0.00,      0.00)  GP
POL1
         HIGH  2ND HIGH VALUE IS      42.91793  ON 64010218: AT (      76.60,       64.28,      0.00,      0.00)  GP
POL1


                                          *** THE SUMMARY OF HIGHEST 24-HR RESULTS ***

                                   ** CONC OF SO2      IN MICROGRAMS/M**3                          **

                                                          DATE
NETWORK
GROUP ID                          AVERAGE CONC     (YYMMDDHH)            RECEPTOR  (XR, YR, ZELEV, ZFLAG)     OF TYPE
GRID-ID
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
- - - -

ALL      HIGH  1ST HIGH VALUE IS      19.16219  ON 64010224: AT (      76.60,       64.28,      0.00,      0.00)  GP
POL1
         HIGH  2ND HIGH VALUE IS      17.05618  ON 64010524: AT (      76.60,       64.28,      0.00,      0.00)  GP
POL1

  *** RECEPTOR TYPES:  GC = GRIDCART
                       GP = GRIDPOLR
                       DC = DISCCART
                       DP = DISCPOLR
                       BD = BOUNDARY
```

FIGURE 2-8. EXAMPLE OF RESULT SUMMARY TABLES FOR THE ISC SHORT TERM MODEL

2.5 MODIFYING AN EXISTING RUNSTREAM FILE

As noted earlier, one of the advantages of the keyword/parameter approach and the flexible format adopted for the input runstream file is that it will be easier for the user to make modifications to the runstream file and obtain the desired result. This section briefly illustrates some examples of how a runstream file can be modified. It is assumed that the reader is familiar with the operation of and basic editing commands for a text editor (i.e., a program that edits ASCII files), and is familiar with the previous sections of this tutorial.

2.5.1 Modifying Modeling Options

Depending on the type of analysis being performed, the user may need to modify the modeling options and run the model again. Because of the descriptive nature of the keywords and the secondary keywords used to control the modeling options, this can easily be done with the new runstream file, and usually without having to refer back to the user's guide each time a modification is attempted.

One example where a modeling option might need to be changed is if a modeler wanted to obtain both concentration estimates and estimates of dry deposition for a source or sources of large particulates. The only change needed to accomplish this is to replace the secondary keyword of CONC (for CONCentration) with the secondary keyword of DEPOS (for DEPOSition) on the MODELOPT input card. None of the source information needs to be changed since the model automatically converts the emission rates to the proper units for deposition calculations. For an ISCST run, both concentration and deposition can be

estimated in the same model run. It is equally easy to modify a run to use urban dispersion instead of rural dispersion (or vice versa) by replacing the RURAL secondary keyword with URBAN on the MODELOPT card. As noted earlier, the order and exact spacing of the secondary keywords on the MODELOPT card is not important.

Another modeling option change that will be discussed here is switching between flat and elevated terrain modeling. As noted earlier, the model assumes flat terrain, i.e., all receptors are assumed to be at the same elevation as the base elevation for the source as the default mode of operation. If the user wishes to model receptors on elevated terrain, then the TERRHGTS keyword must be included on the CO pathway. This keyword, which is described in more detail in Section 3.2.3, accepts one of two possible secondary keywords, either FLAT or ELEV. Their meaning should be obvious. Note that the input runstream image:

```
CO TERRHGTS   FLAT
```

has the same effect as having no TERRHGTS keyword at all. If the user elects to perform FLAT terrain modeling for a particular application, the model will ignore any elevated terrain height information given on the RE pathway. Processing will continue as flat terrain, and warning messages will be generated to warn the user that elevated terrain heights were present in the file, but ignored for processing. The advantage of this approach is that if an application is setup for elevated terrain modeling, a simple change of the secondary keyword on the TERRHGTS card from ELEV to FLAT is all that is needed to run the model in flat terrain mode. The terrain height information does not need to be removed from the input file.

2.5.2 Adding or Modifying a Source or Source Group

Modifying the input file to add a source or a source group, or to add a source to a source group, is as simple as just adding it. There is no need to specify the total number of sources in the run, which would then have to be changed if more sources were added. The same applies to the number of groups, or the number of sources per group. If the user attempts to input more than the total number of sources or groups allowed for a particular run, an error message will be generated to that effect. Also, modifying a source group to delete a source is as easy as just deleting it from the input card, without having to change any other inputs.

Another way of "deleting" a source or a group from an input file is to place a "**" in the pathway field of the card or cards which define the source or group to "comment out" those inputs. This approach, which was discussed above in Section 2.1.2, has the advantage of leaving the input data for the source or group in the input file for possible later use. It doesn't matter whether the "**" is entered with the text editor in "insert" mode, in which case the other inputs of that line are moved over, or if it is in "overtype" mode, which would replace the pathway ID that was already there.

2.5.3 Adding or Modifying a Receptor Network

As with source data, adding to or modifying the receptor information in the ISC models is relatively straight forward. The problem of having to make several changes to accomplish one small modification, such as adding a distance to a polar receptor network, has been avoided in the new model. All that the user needs to do is to add the new distance on the appropriate input card, which is easily identifiable because of the

use of descriptive keywords. The model checks to ensure that the user does not attempt to specify more than the maximum number of receptors for a particular run, and generates an appropriate message if too many are input.

2.5.4 Modifying Output Options

Modifying the output options involves many of the same principles that are described above. In addition, all of the output options are structured in a way that allows the user to select options for specific averaging periods, so that the user may find it useful to copy a record or group of records set up for one averaging period and simply change the averaging period parameter. The other important short cut that is available for the printed table output options is to use the secondary keyword ALLAVE to indicate that the option applies to all averaging periods that are calculated. In this way, there will be no need to change the output options if a new averaging period is added to a run or if one is deleted.

3.0 DETAILED KEYWORD REFERENCE

This section of the ISC User's Guide provides a detailed reference for all of the input keyword options for the ISC Short Term and Long Term models. The information provided in this section is more complete and detailed than the information provided in the Brief Tutorial in Section 2. Since this section is intended to meet the needs of experienced modelers who may need to understand completely how particular options are implemented in the model, the information for each keyword should stand on its own. This section assumes that the reader has a basic understanding of the keyword/parameter approach used by the new models for specification of input options and data. Novice users should first review the contents of Section 2 in order to obtain that understanding.

The information in this section is organized by function, i.e., the keywords are grouped by pathway, and are in a logical order based on their function within the model. The order of keywords presented here is the same as the order used in the functional keyword reference in Appendix B, and the Quick Reference section at the end of the volume. The syntax for each keyword is provided, and the keyword type is specified - either mandatory or optional and either repeatable or non-repeatable. Unless noted otherwise, there are no special requirements for the order of keywords within each pathway, although the order in which the keywords are presented here and in Appendix B is recommended. Any keyword which has special requirements for its order within the pathway is so noted following the syntax and type description.

The syntax descriptions in the following sections use certain conventions. Parameters that are in all capital letters and underlined in the syntax description are

secondary keywords that are to be entered as indicated for that keyword. Other parameters are given descriptive names to convey the meaning of the parameter, and are listed with an initial capital letter. Many of the parameter names used correspond to variable names used in the computer code of the models. Parentheses around a parameter indicate that the parameter is optional for that keyword. The default that is taken when an optional parameter is left blank is explained in the discussion for that keyword.

3.1 AN OVERVIEW OF SHORT TERM VS. LONG TERM MODEL INPUTS

One of the goals of the ISC reprogramming effort was to make the inputs for the new Short Term and Long Term models as consistent as possible. As a result, the majority of keywords are the same for both models. Because of this similarity, and because the Short Term model is the more widely used of the two, the discussions in the following sections are oriented toward the Short Term model. Any differences in the parameters for a keyword for the Long Term model are highlighted so that they are easily distinguishable. Also, any keyword that applies to only one of the models includes a note to that effect. There is no separate reference for the Long Term model inputs in the user's guide.

Also, unless otherwise noted, the input keywords described below apply to both the ISCST and the ISCEV (EVENT) Short Term models. In addition to the isolated keywords noted that apply to only one or the other model, the entire REceptor pathway applies only to ISCST, and the EVent pathway applies only to the ISCEV model.

3.2 CONTROL PATHWAY INPUTS AND OPTIONS

The **CO**ntrol pathway contains the keywords that provide the overall control of the model run. These include the dispersion options, averaging time options, terrain height options, and others that are described below. The CO pathway must be the first pathway in the runstream input file.

3.2.1 Title Information

There are two keywords that allow the user to specify up to two lines of title information that will appear on each page of the main output file from the model. The first keyword, TITLEONE, is mandatory, while the second keyword, TITLETWO, is optional. The syntax and type for the keywords are summarized below:

Syntax:	CO TITLEONE Title1 CO TITLETWO Title2
Type:	TITLEONE - Mandatory, Non-repeatable TITLETWO - Optional, Non-repeatable

The parameters Title1 and Title2 are character parameters of length 68, which are read as a single field from columns 13 to 80 of the input record. The title information is taken as it appears in the runstream file without any conversion of lower case to upper case letters. If the TITLETWO keyword is not included in the runstream file, then the second line of the title in the output file will appear blank.

3.2.2 Dispersion Options

The dispersion options are controlled by the MODELOPT keyword on the CO pathway. The syntax, type, and order of the MODELOPT keyword are summarized below:

Syntax:	Short Term model: CO MODELOPT [DFAULT] [CONC / DEPOS / DDEP and/or WDEP] [DRYDPLT] [WETDPLT] [RURAL / URBAN] [GRDRIS] [NOSTD] [NOBID] [NOCALM] [MSGPRO] [NOSMPL / NOCMPL] Long Term model: CO MODELOPT [DFAULT] [CONC / DEPOS / DDEP] [DRYDPLT] [RURAL / URBAN] [GRDRIS] [NOSTD] [NOBID]
Type:	Mandatory, Non-repeatable
Order:	Must precede POLLUTID, HALFLIFE and DCAYCOEF

where the secondary keyword parameters are described below (the order and spacing of these parameters is not critical):

DFAULT - Specifies that the regulatory default options will be used;

CONC - Specifies that concentration values will be calculated;

DEPOS - Specifies that total deposition flux values (both dry and wet) will be calculated for Short Term and dry deposition flux values for Long Term;

DDEP - Specifies that dry deposition flux values only will be calculated (same as DEPOS for Long Term);

WDEP - Specifies that wet deposition flux values only will be calculated (Short Term only);

DRYDPLT -Specifies that plume depletion due to dry removal mechanisms will be included in calculations;

WETDPLT -Specifies that plume depletion due to wet removal mechanisms will be included in calculations (Short Term only);

RURAL - Specifies that rural dispersion parameters will be used;

URBAN - Specifies that urban dispersion parameters will be used;

GRDRIS - Specifies that the non-default option of gradual plume rise will be used;

NOSTD - Specifies that the non-default option of no stack-tip downwash will be used;

NOBID - Specifies that the non-default option of no buoyancy-induced dispersion will be used;

NOCALM - Specifies that the non-default option to bypass the calms processing routine will be used (Short Term only);

MSGPRO - Specifies that the non-default option of the missing data processing routine will be used (Short Term only);

NOSMPL - Specifies that no simple terrain calculations will be made, i.e., uses COMPLEX1 algorithms only (Short Term only);

NOCMPL - Specifies that no complex terrain calculations will be made, i.e., uses ISCST algorithms only (Short Term only).

If the DFAULT secondary keyword is included among the parameter fields, then any non-default option will be overridden. This includes the non-default options that may be specified on the MODELOPT keyword, and also any attempt to enter non-default values

of the wind profile exponents (see keyword WINDPROF on the ME pathway) or vertical potential temperature gradients (see keyword DTHETADZ on the ME pathway). If the DFAULT parameter is not specified, then the regulatory default options will still be used unless a non-default option is specified in the input runstream. The model will also assume RURAL dispersion if neither the RURAL or URBAN keywords are present, and will assume CONCentration calculations if neither the CONC, DEPOS, DDEP or WDEP keywords are used. Non-fatal warning messages are generated in either case. For the Short Term model, the user may select any or all of the output types (CONC, DEPOS, DDEP and/or WDEP) to be generated in a single model run (up to the number of output types available, which is controlled by the NTYP parameter in the MAIN1.INC file). The order of these secondary keywords on the MODELOPT card has no effect on the order of results in the output files. If both the NOCMPL and the NOSMPL keywords are omitted from the MODELOPT card, then the model will implement both simple and complex terrain algorithms and also apply intermediate terrain processing.

The regulatory default options are identified in Appendix A of the Guideline on Air Quality Models (Revised) (EPA, 1987b), and include the following:

- Use stack-tip downwash (except for Schulman-Scire downwash);
- Use buoyancy-induced dispersion (except for Schulman-Scire downwash);
- Do not use gradual plume rise (except for building downwash);
- Use the calms processing routines;
- Use upper-bound concentration estimates for sources influenced by building downwash from super-squat buildings;
- Use default wind speed profile exponents; and

- Use default vertical potential temperature gradients.

Other model options, such as complex terrain, are not affected by the regulatory default options.

The default wind profile exponents and vertical potential temperature gradients are provided below:

Pasquill Stability Category	Rural Wind Profile Exponent	Urban Wind Profile Exponent	Rural Temperature Gradient (K/m)	Urban Temperature Gradient (K/m)
A	0.07	0.15	0.0	0.0
B	0.07	0.15	0.0	0.0
C	0.10	0.20	0.0	0.0
D	0.15	0.25	0.0	0.0
E	0.35	0.30	0.020	0.020
F	0.55	0.30	0.035	0.035

The depletion options (DRYDPLT and WETDPLT) may be used with CONC, DEPOS, DDEP or WDEP, but particle information must be specified in the SO pathway (see Section 3.3.6) if DRYDPLT is included, and scavenging coefficients must be specified on the SO pathway if WETDPLT is included. When particles are modeled, a settling velocity and a deposition velocity are calculated for each size category. The settling velocity causes the plume to "tilt" towards the surface (if the plume is elevated) as it travels downwind, while the deposition velocity is used to calculate the flux of matter deposited at the surface. If the depletion parameters (DRYDPLT and WETDPLT) are <u>not</u>

included as model options, then the mass of particles deposited on the surface from gravitational settling and/or precipitation scavenging is not removed from the plume. However, plume settling is still modeled if particle information is included on the SO pathway, and wet deposition is still modeled if scavenging coefficients are included on the SO pathway. The no depletion option may be acceptable if deposition is weak, and it will result in an overestimate of both concentrations and deposition. When DRYDPLT and/or WETDPLT are included, particle mass is removed from the plume as it is deposited on the surface, thereby conserving mass. However, the additional calculations required for dry depletion corrections will result in significantly longer execution times for the model, since the model must integrate along the plume path between the source and receptor. The amount of increase in execution time will vary depending on source characteristics and the terrain grid option used, but could be a factor of 10 or more for typical applications.

The missing data processing routines, that are included in the ISC Short Term model as a non-regulatory option, allow the model to handle missing meteorological data in the processing of short term averages. With this option selected, the model treats missing meteorological data in the same way as the calms processing routine, i.e., it sets the concentration (or deposition) values to zero for that hour, and calculates the short term averages according to EPA's calms policy. Calms and missing values are tracked separately for the purpose of flagging the short term averages. An average that includes a calm hour is flagged with a 'c', an average that includes a missing hour is flagged with an 'm', and an average that includes both calm and missing hours is flagged with a 'b'. If missing meteorological data are encountered without the missing data processing option, then the model will continue to read through and check the meteorological data, but will not perform any dispersion calculations.

3.2.3 Averaging Time Options

The averaging periods for both the Short Term and Long Term models are selected using the AVERTIME keyword. Since the averaging period options are different between the Short Term and Long Term models, the syntax for the AVERTIME keyword is somewhat different.

3.2.3.1 Short Term Model Options.

The syntax and type of the Short Term AVERTIME keyword are summarized below:

Syntax:	CO AVERTIME Time1 Time2 Time3 Time4 MONTH PERIOD or ANNUAL
Type:	Mandatory, Non-repeatable

where the parameters Time1 . . . Time4 refer to the user-specified short term averaging periods of 1, 2, 3, 4, 6, 8, 12, or 24 hours, the secondary keyword MONTH refers to monthly averages (for calendar months), the secondary keyword PERIOD refers to the average for the entire data period, and the secondary keyword ANNUAL refers to an annual average. Any of the short term averaging periods listed above may be selected for a given run, up to the maximum number of short term averages set in the computer code by the parameter NAVE. The initial values for NAVE are given in Sections 2.3 and 4.2.2. The monthly averages are treated as short term averages, and selection of the MONTH average counts toward the limit of NAVE. Since the monthly averages are treated as short term averages, the user can select appropriate output options, such as the second

highest values by receptor, on the OUtput pathway. The user may specify either the PERIOD keyword or the ANNUAL keyword, but not both. For concentration calculations, the PERIOD and ANNUAL keywords produce the same results. They both may be used to calculate the annual average for a full year of meteorological data, or to calculate the period average for a period other than a year. For deposition calculations, the PERIOD keyword will provide a total deposition flux for the full period of meteorological data that is modeled in units of g/m^2, including multiple-year data files, whereas the ANNUAL keyword will provide an annualized rate of the deposition flux in units of $g/m^2/yr$. For meteorological periods of less than a year, the ANNUAL deposition rate is determined by dividing by the length of the period in years. For meteorological periods of longer than a year, the model will assume that full years of data are provided and divide by the number of years, rounded to the nearest whole number. The treatment of short term averages with multiple-year data files is comparable to their treatment when the CO MULTYEAR option is used (see Section 3.2.11).

The location of the PERIOD or ANNUAL keyword in the parameter list is not critical. The order of the short term averaging periods (including MONTH) is also not critical, although it does control the order of the averaging period result tables in the main output file. Generally, it is recommended that the short term averaging periods be input in increasing order, unless there is a clear advantage in doing otherwise.

3.2.3.2 Long Term Model Options.

The syntax and type of the Long Term AVERTIME keyword are summarized below:

Syntax:	CO AVERTIME JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC WINTER SPRING SUMMER FALL QUART1 QUART2 QUART3 QUART4 MONTH SEASON QUARTR ANNUAL PERIOD
Type:	Mandatory, Non-repeatable

where all of the parameters are secondary keywords that relate to an averaging period or periods associated with a single STAR data summary or a group of STAR summaries. The keywords for individual months, seasons and quarters are fairly self-explanatory. If the secondary keyword of SEASON is used, then it is assumed that all four seasons are present in the STAR data file, and averages are calculated for each season. Similarly, if the keyword MONTH or QUARTR is used, then the model assumes that all twelve months or all four quarters are present in the STAR data file, and averages are calculated for each averaging period. The MONTH and SEASON keywords or the MONTH and QUARTR keywords can also be used together in the same run. However, seasonal STAR summaries and quarterly STAR summaries cannot be used together in the same run, since the seasons and quarters occupy the same locations in data storage. It is assumed that the STAR summaries for the individual seasons, months or quarters are in the order listed in above. Thus, the following two cards produce the same result:

```
CO AVERTIME  WINTER  SPRING  SUMMER  FALL
```

and

```
CO AVERTIME  SEASON
```

The ANNUAL secondary keyword indicates that averages are to be calculated for an annual STAR summary. This differs from the PERIOD secondary keyword, which refers to an average calculated for all STAR summaries included in the data file. The PERIOD keyword may be used to calculate the annual average from a data file consisting of STAR summaries for each of the four seasons or for each of the twelve months. Thus, the ANNUAL and PERIOD keywords cannot both be present on the AVERTIME card. The PERIOD average cannot be used when monthly STARs are included with seasonal or quarterly STARs in the same data file.

The following card can be used to calculate the averages for each of the four seasons and for the annual period from a data file consisting of five STAR summaries, one for each season and one for the annual period:

```
CO AVERTIME  SEASON  ANNUAL
```

whereas the following card will calculate the averages for each of the four seasons, and will then rewind the meteorology file and calculate the averages for the annual period from the four seasonal STAR summaries:

```
CO AVERTIME  SEASON  PERIOD
```

The AVERTIME keyword works in conjunction with the STARDATA keyword on the ME pathway to control which averaging periods are calculated. Both of these keywords recognize the same set of secondary keywords. The CO AVERTIME card defines which averaging periods are to be calculated, and is a mandatory keyword. The ME STARDATA card defines which STAR summaries are included in the data file. The STARDATA keyword is optional, unless the AVERTIME card includes only the PERIOD average, in which case the STARDATA keyword is mandatory in order to define which STAR summaries are included in the period average. If the ME STARDATA keyword is omitted, then the ISCLT model assumes that the meteorological data file contains only the STAR summaries identified on the CO AVERTIME card.

3.2.4 Specifying the Pollutant Type

The POLLUTID keyword is used to identify the type of pollutant being modeled for a particular run. The syntax, type, and order of the POLLUTID keyword are summarized below:

Syntax: CO POLLUTID Pollut

Type:	Mandatory, Non-repeatable
Order:	Must follow MODELOPT and precede HALFLIFE and DCAYCOEF

where the Pollut parameter may be name of up to eight characters. Examples include SO2, NOX, CO, PM10, TSP, and OTHER. The only choices that currently have any impact on the results are the selection of SO2 in conjunction with URBAN dispersion and the regulatory default option, and the selection of PM10 (or PM-10) with the multi-year option for generating the high-sixth-high in five years. For the urban SO_2 default case, the model uses a half life of 4 hours for exponential decay of the SO2.

3.2.5 Modeling With Exponential Decay

The models provide the option to use exponential decay of the pollutant being modeled. Two keywords are available for this purpose, the HALFLIFE and DCAYCOEF keywords. The syntax, type, and order of these keywords are summarized below:

Syntax:	CO HALFLIFE Haflif CO DCAYCOEF Decay
Type:	Optional, Non-repeatable
Order:	Must follow MODELOPT and POLLUTID

where the Haflif parameter is used to specify the half life for exponential decay in seconds, and the parameter Decay is used to specify the decay coefficient in units of s^{-1}. The relationship between these parameters is DECAY = 0.693/HAFLIF.

Only one of these keywords may be specified in a given run. If more than one is encountered, a non-fatal warning message is generated and the first specification is used in the modeling. Also, since the regulatory default option includes a half life of 4 hours for exponential decay of SO_2 in urban settings, any HALFLIFE or DCAYCOEF input conflicting with that option will be overridden if the DFAULT option is selected on the CO MODELOPT card.

3.2.6 Options for Elevated Terrain

Two optional keywords are available on the Control pathway to control the receptor options for modeling elevated terrain - the TERRHGTS and ELEVUNIT keywords.

The TERRHGTS keyword controls whether the model assumes flat or elevated terrain. For elevated terrain, the terrain height should be specified for each receptor. The syntax and type of the TERRHGTS keyword are summarized below:

Syntax:	CO TERRHGTS FLAT or ELEV
Type:	Optional, Non-repeatable

where the FLAT secondary keyword forces flat terrain calculations to be used throughout, regardless of any terrain heights that may be entered on the Receptor pathway. Any terrain heights that are entered on the Receptor pathway are ignored if FLAT terrain is specified, and a non-fatal warning message is generated. The ELEV secondary keyword indicates that terrain heights are allowed/expected on the Receptor pathway. The default terrian height of 0.0 meters is used if no value is given. For terrain above the release height (i.e., complex terrain), the models automatically truncate ("chop")

the terrain to the physical release height(s) when modeling impacts at those receptors using the simple terrain (ISC) algorithm. Terrain above the release height is not truncated when the COMPLEX1 algorithm is used in ISCST. The models assume flat terrain as the default if no TERRHGTS keyword is present in the input runstream.

The ELEVUNIT keyword for the CO pathway is obsolescent. It has been replaced by ELEVUNIT keywords on the SO, RE and TG pathways. The new RE ELEVUNIT card is equivalent to the CO ELEVUNIT card, and should be used in its place. For compatibility with existing input files, the ISC models will process the CO ELEVUNIT keyword in the same way as done by the previous version of the models, but will write a warning message to indicate that it is obsolescent. The CO ELEVUNIT keyword specifies the units for terrain elevation data included in the RE pathway. The syntax and type of the ELEVUNIT keyword are summarized below:

Syntax:	CO ELEVUNIT METERS or FEET
Type:	Optional, Non-repeatable

The default units for terrain elevation data is meters.

3.2.7 Flagpole Receptor Height Option

The FLAGPOLE keyword specifies that receptor heights above local ground level (i.e. flagpole receptors) are allowed on the REceptor pathway. The FLAGPOLE keyword may also be used to specify a default flagpole receptor height other than 0.0 meters. The syntax and type of the FLAGPOLE keyword are summarized below:

Syntax:	CO FLAGPOLE (Flagdf)
Type:	Optional, Non-repeatable

where Flagdf is an optional parameter to specify a default flagpole receptor height. If no parameter is provided, then a default flagpole receptor height of 0.0 meters is used. Any flagpole receptor heights that are entered on the Receptor pathway are ignored if the FLAGPOLE keyword is not present on the Control pathway, and a non-fatal warning message is generated.

3.2.8 To Run or Not to Run - That is the Question

Because of the improved error handling and the "defensive programming" that has been employed in the design of the ISC model, it is intended that the model will read through all of the inputs in the runstream file regardless of any errors or warnings that may be encountered. If a fatal error occurs in processing of the runstream information, then further model calculations will be aborted. Otherwise, the model will attempt to run. Because of the great many options available in the ISC models, and the potential for wasted resources if a large run is performed with some incorrect input data, the RUNORNOT keyword has been included on the Control pathway to allow the user to specify whether to RUN the model and perform all of the calculations, or NOT to run and only process the input runstream data and summarize the setup information. The syntax and type of the RUNORNOT keyword are summarized below:

Syntax:	CO RUNORNOT RUN or NOT
Type:	Mandatory, Non-repeatable

3.2.9 Generating an Input File for the Short Term EVENT Model (ISCEV)

The Short Term model consists of two executable files - one is used for routine processing (ISCST) and the other is used for EVENT processing (ISCEV). The EVENTFIL keyword controls whether or not the ISCST model will generate an input file for use with the EVENT model, and applies only to the ISCST model. The syntax and type of the EVENTFIL keyword are summarized below:

Syntax:	CO EVENTFIL (Evfile) (Evopt)
Type:	Optional, Non-repeatable

where the optional Evfile parameter specifies the name of the EVENT input file to be generated (up to 40 characters), and the optional parameter, Evopt, specifies the level of detail to be used in the EVENT output file. Valid inputs for the Evopt parameter are the secondary keywords of SOCONT and DETAIL (see the EVENTOUT keyword on the OUtput pathway, Section 3.7.2). The default filename used if no parameters are specified is PASSTWO.INP, and the default for the level of detail is DETAIL. If only one parameter is present, then it is taken to be the Evfile, and the default will be used for Evopt.

The primary difference between routine ISCST and EVENT processing is in the treatment of source group contributions. The ISCST model treats the source groups independently. The EVENT model is designed to provide source contributions to particular events, such as the design concentrations determined from ISCST, or user specified events. The user may specify the "events" to process using the EVent pathway, which lists specific combinations of receptor location, source group, and averaging

period. By specifying the EVENTFIL keyword, an input runstream file will be generated that can be used directly with the EVENT model. The events included in the generated EVENT model input file are the design concentrations defined by the RECTABLE keyword and the threshold violations identified by the MAXIFILE keyword on the OU pathway. If more than one output type (CONC, DEPOS, DDEP, and/or WDEP) is selected for the ISCST model, only the events associated with the first output type, in the order stated above, will be included in the EVENT model input file. This is because the EVENT model can only process one type of output at a time.

3.2.10 The Model Re-start Capability

The ISCST model has an optional capability to store intermediate results into an unformatted file, so that the model run can be continued later in case of a power failure or a user interrupt. This re-start option is controlled by the SAVEFILE and INITFILE keywords on the CO pathway. The syntax and type of these keywords are summarized below:

Syntax:	CO SAVEFILE (Savfil) (Dayinc) (Savfl2) CO INITFILE (Inifil)
Type:	Optional, Non-repeatable

The SAVEFILE keyword instructs the model to save the intermediate results to a file, and controls the save options. All three parameters for this keyword are optional. If the user specifies only the Savfil parameter, then the intermediate results are saved to the same file (and overwritten) each time. If the user specifies both the Savfil and the Savfl2 parameters, then the model alternates between the two files for storing

intermediate results. The latter approach requires additional disk space to handle two storage files. However, selecting two files avoids the potential problem that the power failure or interrupt might occur while the temporary file is open and the intermediate results are being copied to it. In such a case, the temporary results file would be lost.

The optional Dayinc parameter allows the user to specify the number of days between successive dumps. The default is to dump values at the end of each day, i.e., Dayinc = 1. For larger modeling runs, where the SAVEFILE option is most useful, the additional execution time required to implement this option is very small compared to the total runtime. To be most effective, it is recommended that results be saved at least every 5 days.

If no parameters are specified for the SAVEFILE keyword, then the model will store intermediate results at the end of each day using a default filename of SAVE.FIL.

The INITFILE keyword works in conjunction with the SAVEFILE keyword, and instructs the model to initialize the results arrays from a previously saved file. The optional parameter, Inifil, identifies the unformatted file of intermediate results to use for initializing the model. If no Inifil parameter is specified, then the model assumes the default filename of SAVE.FIL. If the file doesn't exist or if there are any errors encountered in opening the file, then a fatal error message is generated and processing is halted.

Note: It is important to note that if both the SAVEFILE and INITFILE keywords are used in a the same model run, then different filenames must be specified for the Savfil

and Inifil parameters. Otherwise, the model will encounter an error in opening the files, and further processing will be halted.

3.2.11 Performing Multiple Year Analyses for PM-10

The MULTYEAR keyword on the CO pathway provides an option for the user to perform a multiple year analysis such as would be needed to determine the "high-sixth-high in five years" design value for determining PM-10 impacts. In the past, such modeling would require extensive postprocessing of ISCST binary concentration files. Since the multiple year option makes use of the model re-start capabilities described in the previous section, the MULTYEAR keyword is not compatible with the SAVEFILE or INITFILE keywords. The model will generate a fatal error message if the user attempts to exercise both options in a single run. The syntax and type of this keyword is summarized below:

Syntax:	CO MULTYEAR Savfil (Inifil)
Type:	Optional, Non-repeatable

where the Savfil parameter specifies the filename for saving the results arrays at the end of each year of processing, and the Inifil parameter specifies the filename to use for initializing the results arrays at the beginning of the current year. The Inifil parameter is optional, and should be left blank for the first year in the multi-year series of runs.

The MULTYEAR option works by accumulating the high short term average results from year to year through the mechanism of the re-start save file. The model may be setup to

run in a batch file with several years of meteorological data, and at the end of each year of processing, the short term average results reflect the cumulative high values for the years that have been processed. The PERIOD average results are given for only the current year, but the model carries the highest PERIOD values from year to year and includes the cumulative highest PERIOD averages in the summary table at the end of the run.

When setting up a batch file to perform a multiple year analysis, the user would first create an input runstream file for the first year with all of the applicable modeling options, the source inventory data, the receptor locations, the meteorology options for the first year and the output file options. To obtain the PM-10 design value, be sure to include the SIXTH highest value on the OU RECTABLE card (see Section 3.8.1). For the CO MULTYEAR card for the first year, the user would only specify the Savfil parameter, and may use a card such as:

```
CO MULTYEAR  YEAR1.SAV
```

For the subsequent years, the user could copy the input file created for Year-1, and edit the files to change the year parameters and meteorology filename on the ME pathway (and possibly in the title information), and edit the MULTYEAR cards. For the subsequent years, both the Savfil and Inifil parameters must be specified, with the

Savfil for Year-1 becoming the Inifil for Year-2, and so on. The MULTYEAR cards (one for each ISCST run) might look like this:

```
CO MULTYEAR  YEAR1.SAV (First year)
CO MULTYEAR  YEAR2.SAV  YEAR1.SAV (Second year)
CO MULTYEAR  YEAR3.SAV  YEAR2.SAV (Third year)
CO MULTYEAR  YEAR4.SAV  YEAR3.SAV (Fourth year)
CO MULTYEAR  YEAR5.SAV  YEAR4.SAV (Sixth year)
```

The MULTYEAR keyword option is separate from the ability of the ISCST model to process a multiple-year meterological data file in a single model run. The latter capability is primarily intended for applications of the model to long term risk assessments where the average impacts over a long time period are of concern rather than the maximum annual average determined from five individual years. The use of the ISCST model with multiple-year data sets is discussed in more detail in Section 3.5.1.1.

3.2.12 Detailed Error Listing File

The ERRORFIL keyword on the CO pathway allows the user to request a detailed listing file of all the messages generated by the model. This includes the error and warning messages that are listed as part of the message summaries provided in the main output file, and also any informational messages (such as occurrences of calm winds) and quality assurance messages that are generated. The syntax and type of the ERRORFIL keyword are summarized below:

Syntax:	CO ERRORFIL (Errfil) (DEBUG)
Type:	Optional, Non-repeatable

where the Errfil parameter is the name of the detailed message file, and the DEBUG secondary keyword implements an option to obtain detailed output results including plume heights, sigmas, etc., for each hour calculated for debugging purposes. Note: The DEBUG option generates very large files and should be used with CAUTION! If the optional Errfil parameter is left blank, then the model will use a default filename of ERRORS.LST. A complete description of the error and other types of messages generated by the models is provided in Appendix E.

3.3 SOURCE PATHWAY INPUTS AND OPTIONS

The **SO**urce pathway contains the keywords that define the source information for a particular model run. The model currently handles four source types, identified as point, volume, area or open pit sources. The input parameters vary depending on the source type. For point sources, the user can also identify building dimensions for nearby structure that cause aerodynamic downwash influences on the source. The user can also identify groups of sources for which the models will combine the results. With the exception of the variable emission rate options on the EMISFACT keyword, all of the SO pathway inputs are identical between the Short Term and Long Term models.

The LOCATION keyword, which identifies the source type and location, must be the first card entered for each source. The only other requirement for order of the keywords is that the SRCGROUP keyword must be the last keyword before the SO FINISHED card. The user may group all of the LOCATION cards together, then group the source

parameter cards together, or they may want to group all input cards for a particular source together as was done in the old ISC input file. All sources are given a source ID by the user, which is used to link the source parameter inputs to the correct source or sources. The source ID can be any alphanumeric string of up to eight characters.

The number of sources allowed in a given run is controlled by a Fortran PARAMETER statement in the computer code. The initial storage limits for each of the models is given in Section 2.3, which discusses storage allocation in general. These limits can easily be modified by the user and the code recompiled to accommodate different user needs.

3.3.1 Identifying Source Types and Locations

The LOCATION keyword is used to identify the source type and the location of each source to be modeled. The LOCATION card must be the first card entered for each source since it identifies the source type, and dictates which parameters are needed and/or accepted. The syntax, type and order of the LOCATION keyword are summarized below:

Syntax:	SO LOCATION Srcid Srctyp Xs Ys (Zs)
Type:	Mandatory, Repeatable
Order:	Must be first card for each source input

where the Srcid parameter is the alphanumeric source ID defined by the user (up to eight characters), Srctyp is the source type, which is identified by one of the secondary keywords - POINT, VOLUME, AREA, or OPENPIT - and Xs, Ys, and Zs are the x, y, and z coordinates of the source location in meters. Note that the source elevation, Zs, is an

optional parameter. If the source elevation is omitted, it will be given a default value of 0.0, but the source elevation is only used if the CO TERRHGTS ELEV option is selected. While the default units of Zs are meters, the user may also specify source elevations to be in feet by adding the SO ELEVUNIT FEET card immediately following the SO STARTING card. The x (east-west) and y (north-south) coordinates are for the center of the source for POINT and VOLUME sources, and are for the southwest corner of the source for AREA and OPENPIT sources. The source coordinates may be input as Universal Transverse Mercator (UTM) coordinates, or may be referenced to a user-defined origin.

Certain types of line sources can be handled in ISC using either a string of volume sources, or as an elongated area source. The volume source algorithms are most applicable to line sources with some initial plume depth, such as conveyor belts and rail lines. Section 1.2.2 of Volume II provides technical information on how to model a line source with multiple volume sources. The use of the ISC area source algorithm for elongated rectangles would be most applicable to near ground level line sources, such as a viaduct. Also, as shown in Section 1.2.3 of Volume II, irregularly shaped areas may be modeled with the ISC Models by subdividing the area.

The source ID entered on the LOCATION card identifies that source for the remainder of the SO pathway inputs. Since the model accepts alphanumeric strings of up to eight characters for the source ID, the sources can be identified with descriptive names, such as STACK1, STACK2, BOILER3, SLAGPILE, etc. This may also be useful if line sources or irregularly-shaped area sources are being modeled as multiple volume or areas, as discussed above. Since they are part of the same physical source, they can be given names that will identify them as being related, such as LINE1A, LINE1B, LINE1C, etc.

3.3.2 Specifying Source Release Parameters

The main source parameters are input on the SRCPARAM card, which is a mandatory keyword for each source being modeled. Since the input parameters vary depending on the source type, the four source types handled by the ISC models (POINT, VOLUME, AREA and OPENPIT) are discussed separately.

3.3.2.1 POINT Source Inputs.

The ISC POINT source algorithms are used to model releases from stacks and isolated vents, as well as other kinds of sources. The syntax, type and order for the SRCPARAM card for POINT sources are summarized below:

Syntax:	SO SRCPARAM Srcid Ptemis Stkhgt Stktmp Stkvel Stkdia
Type:	Mandatory, Repeatable
Order:	Must follow the LOCATION card for each source input

where the Srcid parameter is the same source ID that was entered on the LOCATION card for a particular source, and the other parameters are as follows:

Ptemis - point emission rate in g/s,

Stkhgt - release height above ground in meters,

Stktmp - stack gas exit temperature in degrees K,

Stkvel - stack gas exit velocity in m/s, and

Stkdia - stack inside diameter in meters.

It should be noted that the same emission rate is used for both concentration and deposition calculations in the ISC models. An example of a valid SRCPARAM input card for a point source is given below:

```
SO SRCPARAM  STACK1  16.71  35.0  444.0  22.7  2.74
```

where the source ID is STACK1, the emission rate is 16.71 g/s, the release height is 35.0 m, the exit temperature is 444.0 K, the exit velocity is 22.7 m/s, and the inside stack diameter is 2.74 m. All of the parameters must be present on the input card.

Since the ISC models use direction-specific building dimensions for all sources subject to building downwash, there are no building parameters entered on the SRCPARAM card. Building dimensions are entered on the BUILDHGT and BUILDWID cards described below in Section 3.3.3.

3.3.2.2 VOLUME Source Inputs.

The ISC VOLUME source algorithms are used to model releases from a variety of industrial sources, such as building roof monitors, multiple vents, and conveyor belts. The syntax, type and order for the SRCPARAM card for VOLUME sources are summarized below:

Syntax:	SO SRCPARAM Srcid Vlemis Relhgt Syinit Szinit
Type:	Mandatory, Repeatable
Order:	Must follow the LOCATION card for each source input

where the Srcid parameter is the same source ID that was entered on the LOCATION card for a particular source, and the other parameters are as follows:

Vlemis - volume emission rate in g/s,

Relhgt - release height (center of volume) above ground, in meters,

Syinit - initial lateral dimension of the volume in meters, and

Szinit - initial vertical dimension of the volume in meters.

It should be noted that the same emission rate is used for both concentration and deposition calculations in the ISC models. The following table, which is explained in more detail in Section 1.2.2 of Volume II of the User's Guide, summarizes the suggested procedures to be used for estimating the initial lateral and vertical dimensions for various types of volume and line sources.

TABLE 3-1.

SUMMARY OF SUGGESTED PROCEDURES FOR ESTIMATING

INITIAL LATERAL DIMENSIONS F_{yo} AND

INITIAL VERTICAL DIMENSIONS F_{zo} FOR VOLUME AND LINE SOURCES

Type of Source	Procedure for Obtaining Initial Dimension
(a) Initial Lateral Dimensions (F_{yo})	
Single Volume Source	F_{yo} = length of side divided by 4.3
Line Source Represented by Adjacent Volume Sources (see Figure 1-8(a) in Volume II)	F_{yo} = length of side divided by 2.15
Line Source Represented by Separated Volume Sources (see Figure 1-8(b) in Volume II)	F_{yo} = center to center distance divided by 2.15
(b) Initial Vertical Dimensions (F_{zo})	
Surface-Based Source (h_e - 0)	F_{zo} = vertical dimension of source divided by 2.15
Elevated Source (h_e > 0) on or Adjacent to a Building	F_{zo} = building height divided by 2.15
Elevated Source (h_e > 0) not on or Adjacent to a Building	F_{zo} = vertical dimension of source divided by 4.3

3.3.2.3 AREA Source Inputs

The ISC AREA source algorithms are used to model low level or ground level releases with no plume rise (e.g., storage piles, slag dumps, and lagoons). The ISC models use a numerical integration approach for modeling impacts from area sources. The ISC models accept rectangular areas that may also have a rotation angle specified relative to a

north-south orientation. The rotation angle is specified relative to the vertex used to define the source location on the SO LOCATION card (e.g., the southwest corner). The syntax, type and order for the SRCPARAM card for AREA sources are summarized below:

Syntax:	SO SRCPARAM Srcid Aremis Relhgt Xinit (Yinit) (Angle) (Szinit)
Type:	Mandatory, Repeatable
Order:	Must follow the LOCATION card for each source input

where the Srcid parameter is the same source ID that was entered on the LOCATION card for a particular source, and the other parameters are as follows:

Aremis - area emission rate in g/(s-m^2),

Relhgt - release height above ground in meters,

Xinit - length of X side of the area (in the east-west direction if Angle is 0 degrees) in meters,

Yinit - length of Y side of the area (in the north-south direction if Angle is 0 degrees) in meters (optional),

Angle - orientation angle for the rectangular area in degrees from North, measured positive in the clockwise direction (optional), and

Szinit - initial vertical dimension of the area source plume in meters (optional).

The same emission rate is used for both concentration and deposition calculations in the ISC models. It should also be noted that the emission rate for the area source is an emission rate per unit area, which is different from the point and volume source emission rates, which are total emissions for the source.

If the optional Yinit parameter is omitted, then the model assumes that the area is a square, i.e., Yinit = Xinit. If the optional Angle parameter is omitted, then the model assumes that the area is oriented in the north-south and east-west directions, i.e., Angle = 0.0. If the Angle parameter is input, and the value does not equal 0.0, then the model will rotate the area clockwise around the vertex defined on the SO LOCATION card for this source. Figure 3-1 illustrates the relationship between the Xinit, Yinit, and Angle parameters and the source location, (Xs,Ys), for a rotated rectangle. The Xinit dimension is measured from the side of the area that is counterclockwise along the perimeter from the vertex defined by (Xs,Ys), while the Yinit dimension is measured from the side of the area that is clockwise from (Xs,Ys). The Angle parameter is measured as the orientation relative to North of the side that is clockwise from (Xs,Ys), i.e. the side with length Yinit. The Angle parameter may be positive (for clockwise rotation) or negative (for counterclockwise rotation), and a warning message is generated if the absolute value of Angle is greater than 180 degrees. The selection of the vertex to use for the source location is not critical, as long as the relationship described above for the Xinit, Yinit, and Angle parameters is maintained. However, for consistency with the previous versions of ISCST and ISCLT, it is recommended that the user select the vertex that occurs in the southwest quadrant as the location of the area source.

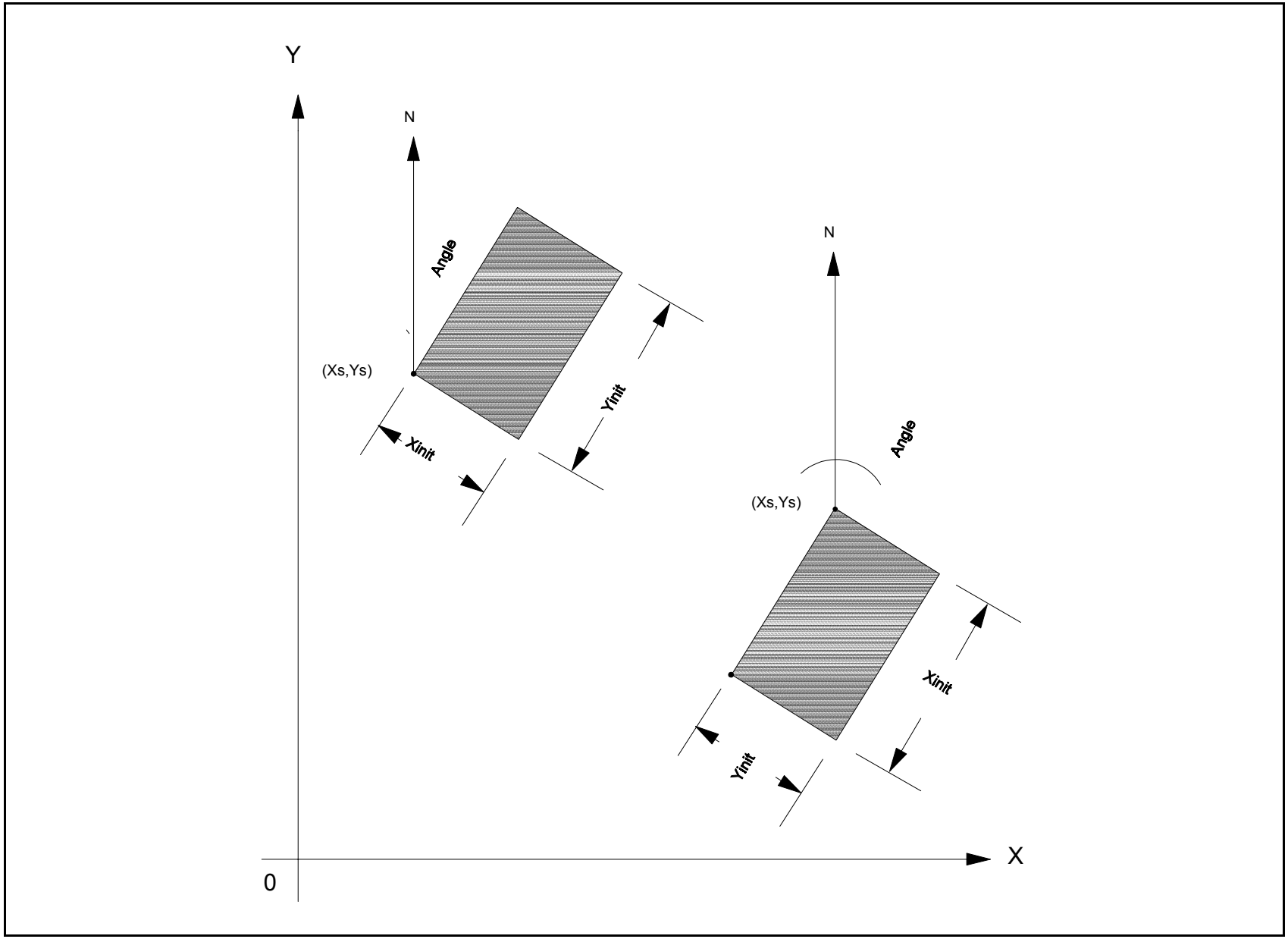
Y
N
Angle
(Xs,Ys)
Xinit
Yinit
N
Angle
(Xs,Ys)
Xinit
Yinit
0
X

FIGURE 3-1. RELATIONSHIP OF AREA SOURCE PARAMETERS FOR ROTATED RECTANGLE

By making the Yinit and Angle parameters optional, the area source input data for the previous versions of ISC that were limited to square areas with a north-south orientation can still be used with the new algorithm. The aspect ratio (i.e., length/width) for area sources should be less than 10 to 1. If this is exceeded, then the area should be subdivided to achieve a 10 to 1 aspect ratio (or less) for all subareas.

The optional Szinit parameter may be used to specify an initial vertical dimension to the area source plume, similar to the use of the Szinit parameter for volume sources. This parameter may be important when the area source algorithm is used to model mechanically generated emission sources, such as mobile sources. In these cases, the emissions may be turbulently mixed near the source by the process that is generating the emissions, and therefore occupy some initial depth. For more passive area source emissions, such as evaporation or wind erosion, the Szinit parameter may be omitted, which is equivalent to using an initial sigma-z of zero.

An example of a valid SRCPARAM input card for a rectangular area source is given below:

```
SO SRCPARAM  SLAGPILE  0.0015  5.0  50.0  100.0  30.0
```

where the source ID is SLAGPILE, the emission rate is 0.0015 g/(s-m^2), the release height is 5.0 m, the X-dimension is 50.0 m, the Y-dimension is 100.0 m, and the orientation angle is 30.0 degrees clockwise from North. Note that if the orientation

angle is zero, the Y-dimension is North and the X-dimension is east, which is the standard convention.

In order to model irregularly-shaped areas, the user may have to subdivide the area into smaller areas of varying shapes, sizes, and orientations. However, with the ability to specify rectangular shapes and orientation angles, the user has considerable flexibility in subdividing the area. Since the numerical integration algorithm can handle elongated areas with aspect ratios of up to 10 to 1, the ISC area source algorithm may be useful for modeling certain types of line sources. There are no restrictions on the placement of receptors relative to area sources for the ISC models. Receptors may be placed within the area and at the edge of an area. The ISC models will integrate over the portion of the area that is upwind of the receptor. However, since the numerical integration is not performed for portions of the area that are closer than 1.0 meter upwind of the receptor, caution should be used when placing receptors within or adjacent to areas that are less than a few meters wide. More technical information about the application of the ISC area source algorithm is provided in Sections 1.2.3 and 2.2.3 of Volume II of the User's Guide.

3.3.2.4 OPENPIT Source Inputs

The ISC OPENPIT source algorithms are used to model particulate emissions from open pits, such as surface coal mines and rock quarries. The OPENPIT algorithm uses an effective area for modeling pit emissions, based on meteorological conditions, and then utilizes the numerical integration area source algorithm to model the impact of emissions from the effective area sources. The ISC models accept rectangular pits with an optional rotation angle specified relative to a north-south orientation. The

rotation angle is specified relative to the vertex used to define the source location on the SO LOCATION card (e.g., the southwest corner). The syntax, type and order for the SRCPARAM card for OPENPIT sources are summarized below:

Syntax:	SO SRCPARAM Srcid Opemis Relhgt Xinit Yinit Pitvol (Angle)
Type:	Mandatory, Repeatable
Order:	Must follow the LOCATION card for each source input

where the Srcid parameter is the same source ID that was entered on the LOCATION card for a particular source, and the other parameters are as follows:

Opemis -open pit emission rate in g/(s-m^2),

Relhgt -average release height above the base of the pit in meters,

Xinit -length of X side of the open pit (in the east-west direction if Angle is 0 degrees) in meters,

Yinit -length of Y side of the open pit (in the north-south direction if Angle is 0 degrees) in meters,

Pitvol -volume of open pit in cubic meters, and

Angle -orientation angle for the rectangular open pit in degrees from North, measured positive in the clockwise direction (optional).

The same emission rate is used for both concentration and deposition calculations in the ISC models. It should also be noted that the emission rate for the open pit source is an emission rate per unit area, which is different from the point and volume source emission rates, which are total emissions for the source. The Relhgt parameter cannot

exceed the effective depth of the pit, which is calculated by the model based on the length, width and volume of the pit. A Relhgt of 0.0 indicates emissions that are released from the base of the pit.

If the optional Angle parameter is input, and the value does not equal 0.0, then the model will rotate the open pit clockwise around the vertex defined on the SO LOCATION card for this source. The relationship between the Xinit, Yinit, and Angle parameters and the source location, (Xs,Ys), for a rotated pit is the same as that shown in Figure 3-1 for area sources. The Xinit dimension is measured from the side of the area that is counterclockwise along the perimeter from the vertex defined by (Xs,Ys), while the Yinit dimension is measured from the side of the open pit that is clockwise along the perimeter from (Xs,Ys). Unlike the area source inputs, the Yinit parameter is not optional for open pit sources. The Angle parameter is measured as the orientation relative to North of the side that is clockwise from (Xs,Ys), i.e. the side with length Yinit. The Angle parameter may be positive (for clockwise rotation) or negative (for counterclockwise rotation), and a warning message is generated if the absolute value of Angle is greater than 180 degrees. The selection of the vertex to use for the source location is not critical, as long as the relationship described above for the Xinit, Yinit, and Angle parameters is maintained.

The aspect ratio (i.e., length/width) of open pit sources should be less than 10 to 1. However, since the pit algorithm generates an effective area for modeling emissions from the pit, and the size, shape and location of the effective area is a function of wind direction, an open pit cannot be subdivided into a series of smaller sources. Aspect ratios of greater than 10 to 1 will be flagged by a warning message in the output file, and processing will continue. Since open pit sources cannot be subdivided, the

user should characterize irregularly-shaped pit areas by a rectangular shape of equal area. Receptors should not be located within the boundaries of the pit; concentration and/or deposition at such receptors will be set to zero. Such receptors will be identified during model setup and will be flagged in the summary of inputs.

An example of a valid SRCPARAM input card for an open pit source is given below:

```
SO SRCPARAM  NORTHPIT  1.15E-4  0.0  150.0  500.0  3.75E+6  30.0
```

where the source ID is NORTHPIT, the emission rate is 1.15E-4 g/(s-m^2), the release height is 0.0 m, the X-dimension is 150.0 m, the Y-dimension is 500.0 m, the pit volume is 3.75E+6 cubic meters (corresponding to an effective pit depth of about 50 meters) and the orientation angle is 30.0 degrees clockwise from North.

Since the OPENPIT algorithm is applicable for particulate emissions, the particle categories for an open pit source must be defined using the PARTDIAM, MASSFRAX, and PARTDENS keywords on the SO pathway.

3.3.3 Specifying Building Downwash Information

As noted above, the ISC models include algorithms to model the effects of buildings downwash on emissions from nearby or adjacent point sources. The building downwash algorithms do not apply to volume, area or open pit sources. For a technical description of the building downwash algorithms, the user is referred to Volume II of

the ISC User's Guide. The ISC models use direction-specific information for all building downwash cases.

There are three keywords that are used to specify building downwash information, BUILDHGT, BUILDWID, and LOWBOUND. The syntax, type and order for the BUILDHGT keyword, used to input direction specific building heights, are summarized below:

Syntax:	SO BUILDHGT Srcid (or Srcrng) Dsbh(i),i=1,36 (16 for LT)
Type:	Optional, Repeatable
Order:	Must follow the LOCATION card for each source input

where the Srcid parameter is the same source ID that was entered on the LOCATION card for a particular source. The user also has the option of specifying a range of sources (the Srcrng parameter) for which the building heights apply, instead of identifying a single source. This is accomplished by two source ID character strings separated by a dash, e.g., STACK1-STACK10. Since the model reads the source range as a single input field there must not be any spaces between the source IDs. The model then places the building heights that follow (the Dsbh(i) parameter) into the appropriate arrays for all Srcid's that fall within that range, including STACK1 and STACK10.

When comparing a source ID to the range limits for a Srcrng parameter, the model separates the source IDs into three parts: an initial alphabetical part, a numerical part, and then the remainder of the string. Each part is then compared to the corresponding parts of the source range, and all three parts must satisfy the respective ranges in order for the source ID to be included. If there is no numeric part, then the ID consists of only one alphabetical part. If the ID begins with a numeric character,

then the initial aphabetical part defaults to a single blank. If there is no trailing alphabetical part, then the third part also defaults to a single blank part. If the trailing part consists of more than one alphabetical or numeric field, it is all lumped into one character field. For example, the source ID 'STACK2' consists of the parts 'STACK' plus '2' plus a single trailing blank, ' '. By comparing the separate parts of the source IDs, it can be seen that STACK2 falls between the range 'STACK1-STACK10.' For a three-part example, it can also be seen that VENT1B falls within the range of VENT1A-VENT1C. However, VENT2 does not fall within the range of VENT1A to VENT3B, since the third part of VENT2 is a single blank, which does not fall within the range of A to C. This is because a blank character will preceed a normal alphabetical character. Normally, the source ranges will work as one would intuitively expect for simple source names. Most importantly, for names that are made up entirely of numeric characters, such as for old input files converted using STOLDNEW (see Appendix C), the source ranges will be based simply on the relative numerical values. The user is strongly encouraged to check the summary of model inputs to ensure that the source ranges were interpreted as expected, and also to avoid using complex source names in ranges, such as AA1B2C-AB3A3C. Since the order of keywords within the SO pathway is quite flexible, it is also important to note that the building heights will only be applied to those sources that have been defined previously in the input file.

Following the Srcid or the Srcrng parameter, the user inputs 36 direction-specific building heights (Dsbh parameter) in meters for the Short Term model, beginning with the 10 degree flow vector (wind blowing toward 10 degrees from north), and incrementing by 10 degrees in a clockwise direction. For the Long Term model, the Dsbh parameter consists of 16 direction-specific building heights beginning with the flow vector for

the north sector, and proceeding clockwise to north-northwest. Some examples of building height inputs are presented below:

```
SO BUILDHGT  STACK1  34. 34. 34. 34. 34. 34. 34. 34. 34. 34. 34. 34.
SO BUILDHGT  STACK1  34. 34. 34. 34. 34. 34. 34. 34. 34. 34. 34. 34.
SO BUILDHGT  STACK1  34. 34. 34. 34. 34. 34. 34. 34. 34. 34. 34. 34.

SO BUILDHGT  STACK1  36*34.0

SO BUILDHGT  STACK1-STACK10  33*34.0  3*0.0

SO BUILDHGT  STACK1  35.43 36.45 36.37 35.18 32.92 29.66 25.50 20.56
SO BUILDHGT  STACK1  15.00 20.56 25.50 29.66 32.92 35.18 36.37 36.45
SO BUILDHGT  STACK1  35.43 33.33 35.43 36.45  0.00 35.18 32.92 29.66
SO BUILDHGT  STACK1  25.50 20.56 15.00 20.56 25.50 29.66 32.92 35.18
SO BUILDHGT  STACK1  36.37 36.45 35.43 33.33
```

The first example illustrates the use of repeat cards if more than one card is needed to input all of the values. The values are processed in the order in which they appear in the input file, and are identified as being repeat cards by repeating the Srcid parameter. The first and second examples produce identical results within the model. The second one illustrates the use of a repeat value that can simplify numerical input in some cases. The field "36*34.0" is interpreted by the model as "repeat the value 34.0 a total of 36 times." This is also used in the third example where the building height is constant for directions of 10 degrees through 330 degrees, and then is set to 0.0 (e.g. the stack may be outside the region of downwash influence) for directions 340 through 360. The third example also uses a source range rather than a single source ID. The last example illustrates building heights which vary by direction, and shows that the number of values on each card need not be the same. For improved readability of the

input file, the user may want to put the numerical inputs into "columns," but there are no special rules regarding the spacing of the parameters on this keyword.

The BUILDWID keyword is used to input direction-specific building widths for downwash analyses. The syntax for this keyword, which is very similar to the BUILDHGT keyword, is summarized below, along with the type and order information:

Syntax:	SO BUILDWID Srcid (or Srcrng) Dsbw(i),i=1,36 (16 for LT)
Type:	Optional, Repeatable
Order:	Must follow the LOCATION card for each source input

For a description of the Srcid and Srcrng parameters, and for a discussion and examples of the numeric input options, refer to the BUILDHGT keyword above. The Dsbw(i) parameter contains the direction-specific building widths, 36 for the Short Term model, and 16 for the Long Term model. The directions proceed in a clockwise direction, beginning with the 10 degree flow vector for the Short Term model and beginning with the flow vector for the north sector for the Long Term model.

The LOWBOUND keyword is used to exercise the non-regulatory default option of calculating "lower bound" concentration or deposition values for downwash sources subject to enhanced lateral plume spread by super-squat buildings (width is more than five times the height). The syntax, type and order of this keyword is summarized below:

Syntax:	SO LOWBOUND Srcid (or Srcrng) Idswak(i),i=1,36 (16 for LT)
Type:	Optional, Repeatable
Order:	Must follow the LOCATION card for each source input

where the Srcid and Srcrng parameters are described above for the BUILDHGT keyword, and the Idswak(i) parameter is an array of lower bound wake option switches beginning with the 10 degree flow vector and incrementing by 10 degrees clockwise for the Short Term model and beginning with the flow vector for the north sector for the Long Term model. A value of 0 means to use the upper bound (regulatory default) for that sector, and a value of 1 means to use the lower bound for that sector. The use of repeat values is permitted for inputting the Idswak array, e.g., a field of '36*1' indicates to use the lower bound for all 36 sectors. Since this is a non-regulatory default option, if the DFAULT option has been selected on the MODELOPT keyword (CO pathway), then any LOWBOUND inputs will be ignored, and the model will calculate the upper bound estimates. The model will generate a non-fatal warning message in such a case.

For a technical description of the "lower bound" option, the reader is referred to Section 1.1.5.3 of Volume II.

3.3.4 Using Variable Emission Rates

The ISC models provide the option of specifying variable emission rate factors for individual sources or for groups of sources. The factors may vary on different time scales, such as by season, hour-of-day, etc. Since the Short Term and Long Term models work on different averaging periods, the variable emission rate factors are somewhat

different. Therefore the models are discussed separately. See Section 3.3.8 for ISCST.

3.3.4.1 Short Term Model Options.

The EMISFACT keyword provides the user the option of specifying variable emission rate factors for sources modeled by the Short Term model. The syntax, type and order of this keyword are summarized below:

Syntax:	SO EMISFACT Srcid (or Srcrng) Qflag Qfact(i),i=1,n
Type:	Optional, Repeatable
Order:	Must follow the LOCATION card for each source input

where the Srcid parameter is the same source ID that was entered on the LOCATION card for a particular source. The user also has the option of using the Srcrng parameter for specifying a range of sources for which the emission rate factors apply, instead of identifying a single source. This is accomplished by two source ID character strings separated by a dash, e.g., STACK1-STACK10. The use of the Srcrng parameter is explained in more detail in Section 3.3.3 above for the BUILDHGT keyword.

The parameter Qflag is the variable emission rate flag, and is one of the following secondary keywords:

SEASON - emission rates vary seasonally (n=4),

MONTH - emission rates vary monthly (n=12),

HROFDY - emission rates vary by hour-of-day (n=24),

STAR - emission rates vary by speed and stability category (n=36), and

SEASHR - emission rates vary by season and hour-of-day (n=96)

The Qfact array is the array of factors, where the number of factors is shown above for each Qflag option. The EMISFACT card may be repeated as many times as necessary to input all of the factors, and repeat values may be used for the numerical inputs. An example of each of these options is presented below, with column headers to indicate the order in which values are to be input.

```
**                          WINTER  SPRING  SUMMER  FALL
SO EMISFACT STACK1 SEASON    0.50    0.50    1.00   0.75

**                          JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
SO EMISFACT STACK1 MONTH    0.1 0.2 0.3 0.4 0.5 0.5 0.5 0.6 0.7 1.0 1.0 1.0

**                           1   2   3   4   5   6   7 8   9  10  11  12
SO EMISFACT STACK1 HROFDY   0.0 0.0 0.0 0.0 0.0 0.5 1.0  1.0 1.0 1.0 1.0
1.0

**                          13  14  15  16  17  18  19 20  21  22  23  24
SO EMISFACT STACK1 HROFDY   1.0 1.0 1.0 1.0 1.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0


** or, equivalently:         1-5    6    7-17   18 19-24
SO EMISFACT STACK1 HROFDY   5*0.0  0.5  11*1.0  0.5 6*0.0

**            Stab. Cat.:    A      B      C      D E      F (6 WS Cat.)
SO EMISFACT STACK1 STAR    6*0.5  6*0.6  6*0.7  6*0.8 6*0.9  6*1.0

SO EMISFACT STACK1 SEASHR   enter 24 hourly scalars for each of the four
                            seasons (winter, spring, summer, fall)
```

The ISCST model also has the option of specifying hourly emission rates in a separate file, as described in Section 3.3.8.

3.3.4.2 Long Term Model Options.

The EMISFACT keyword provides the user the option of specifying variable emission rate factors for sources modeled by the Long Term model. The syntax, type and order of this keyword are summarized below:

Syntax:	SO EMISFACT Srcid (or Srcrng) Qflag Qfact(i),i=1,n
Type:	Optional, Repeatable
Order:	Must follow the LOCATION card for each source input

where the Srcid parameter is the same source ID that was entered on the LOCATION card for a particular source. The user also has the option of specifying a range of sources for which the emission rate factors apply, instead of identifying a single source. This is accomplished by two source ID character strings separated by a dash, e.g., STACK1-STACK10. The use of the Srcrng parameter is explained in more detail in Section 3.3.3 above for the BUILDHGT keyword.

The parameter Qflag is the variable emission rate flag, and is one of the following secondary keywords:

SEASON - emission rates vary seasonally (n=4),

QUARTR - emission rates vary by quarter (n=4),

MONTH - emission rates vary monthly (n=12),

SSTAB - emission rates vary by season and stability (n=24),

SSPEED - emission rates vary by season and speed (n=24),

STAR - emission rates vary by speed and stability only(n=36), and

SSTAR - emission rates vary by season, speed and stability (n=144),

The Qfact array is the array of factors, where the number of factors is shown above for each Qflag option. The EMISFACT card may be repeated as many times as necessary to input all of the factors, and repeat values may be used for the numerical inputs. An example of each of these options is presented below, with column headers to indicate the order in which values are to be input.

```
**                          WINTER  SPRING  SUMMER FALL
SO EMISFACT STACK1 SEASON    0.50    0.50    1.00 0.75
**                          QUART1  QUART2  QUART3 QUART4
SO EMISFACT STACK1 QUARTR    0.50    0.50    1.00 0.75
**                         JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
SO EMISFACT STACK1 MONTH   0.1 0.2 0.3 0.4 0.5 0.5 0.5 0.6 0.7 1.0 1.0 1.0
**                           WINTER    SPRING    SUMMER FALL (6 Stab Cat.)
SO EMISFACT STACK1 SSTAB     6*0.50    6*0.50    6*1.00 6*0.75
**                           WINTER    SPRING    SUMMER FALL (6 WS Cat.)
SO EMISFACT STACK1 SSPEED    6*0.50    6*0.50    6*1.00 6*0.75
**            Stab. Cat.:    A      B      C      D E      F (6 WS Cat.)
SO EMISFACT STACK1 STAR    6*0.5  6*0.6  6*0.7  6*0.8 6*0.9  6*1.0
**            Stab. Cat.:    A      B      C      D E      F (6 WS Cat.)
**              Season 1:
SO EMISFACT STACK1 SSTAR   6*0.5  6*0.6  6*0.7  6*0.8 6*0.9  6*1.0
**              Season 2:
SO EMISFACT STACK1 SSTAR   6*0.5  6*0.6  6*0.7  6*0.8 6*0.9  6*1.0
**              Season 3:
SO EMISFACT STACK1 SSTAR   6*0.5  6*0.6  6*0.7  6*0.8 6*0.9  6*1.0
**              Season 4:
SO EMISFACT STACK1 SSTAR   6*0.5  6*0.6  6*0.7  6*0.8 6*0.9  6*1.0
```

If a monthly emission rate variation is selected, then the factors will only to apply to monthly STAR summaries. A warning message will be generated if no monthly averages are to be calculated. For the other variable emission rate choices, the model will determine the correct season or quarter and apply that factor to any monthly STAR summaries for which calculations are made. Also, if quarterly averages are being calculated, then none of the emission rate factors involving seasonal variation may be used (SEASON, SSTAB, SSPEED, or SSTAR). If a seasonal variation of emission rates is needed in the calculation of quarterly averages, then it must be implemented through the use of the MONTHly variable emission rate option.

3.3.5 Adjusting the Emission Rate Units for Output

The default emission rate units for the ISC models are grams per second for point and volume sources, and grams per second per square meter for area sources. By default, the models convert these input units to output units of micrograms per cubic meter for concentration calculations and grams per square meter for deposition calculations. This is accomplished by applying a default emission rate unit factor of 1.0E06 for concentration and 3600 for deposition. The deposition factor essentially converts the emission rate to grams per hour for total deposition calculations. For the Long Term model, an additional factor is applied for deposition calculations to adjust the emissions for the number of hours in the STAR data period. This is done automatically by the ISCLT model, which allows the user to use the same set of source parameter inputs whether the model is calculating concentration or deposition in either model.

The EMISUNIT keyword on the SO pathway allows the user to specify a different unit conversion factor, and to specify the appropriate label for the output units for either

concentration or deposition calculations. The syntax and type of the EMISUNIT keyword are summarized below:

Syntax:	SO EMISUNIT Emifac Emilbl Conlbl (or Deplbl)
Type:	Optional, Non-repeatable

where the parameter Emifac is the emission rate unit factor, Emilbl is the label for the emission units (up to 40 characters), and Conlbl and Deplbl are the output unit labels (up to 40 characters) for concentration and deposition calculations, respectively. For example, to produce output concentrations in milligrams per cubic meter, assuming input units of grams per sec, the following card could be input:

```
SO EMISUNIT  1.0E3  GRAMS/SEC   MILLIGRAMS/M**3
```

since there are 1.0E3 milligrams per gram. The emission rate unit factor applies to all sources for a given run. Since the model uses one or more spaces to separate different fields on the input runstream images, it is important that there not be any spaces within the label fields on this card. Thus, instead of entering 'GRAMS PER SECOND' for the emission label, a label of 'GRAMS/SECOND', or 'GRAMS-PER-SECOND' or an equivalent variation should be used.

Since the ISCST model allows for both concentration and deposition to be output in the same model run, the EMISUNIT keyword cannot be used to specify emission unit factors if more than one output type is being generated. The ISCST model therefore allows for concentration and deposition units to be specified separately through the CONCUNIT and

DEPOUNIT keywords, respectively. The syntax and type of the CONCUNIT keyword are summarized below:

Syntax:	SO CONCUNIT Emifac Emilbl Conlbl
Type:	Optional, Non-repeatable

where the parameter Emifac is the emission rate unit factor, Emilbl is the label for the emission units (up to 40 characters), and Conlbl is the output unit label (up to 40 characters) for concentration calculations. The syntax and type of the DEPOUNIT keyword are summarized below:

Syntax:	SO DEPOUNIT Emifac Emilbl Deplbl
Type:	Optional, Non-repeatable

where the parameter Emifac is the emission rate unit factor, Emilbl is the label for the emission units (up to 40 characters), and Deplbl is the output unit label (up to 40 characters) for deposition calculations.

3.3.6 Specifying Variables for Settling, Removal and Deposition Calculations

The ISC models include algorithms to handle the gravitational settling and removal by dry deposition of particulates. The input of source variables for settling and removal are controlled by three keywords on the SO pathway, PARTDIAM, MASSFRAX, and PARTDENS. As with building dimensions and variable emission rate factors described above, the settling and removal variables may be input for a single source, or may be applied to a range of sources.

The syntax, type and order for these three keywords are summarized below:

Syntax:	SO PARTDIAM Srcid (or Srcrng) Pdiam(i),i=1,Npd SO MASSFRAX Srcid (or Srcrng) Phi(i),i=1,Npd SO PARTDENS Srcid (or Srcrng) Pdens(i),i=1,Npd
Type:	Optional, Repeatable
Order:	Must follow the LOCATION card for each source input

where the Srcid or Srcrng identify the source or sources for which the inputs apply, and where the Pdiam array consists of the particle diameter (microns) for each of the particle size categories (up to a maximum of 20 set by the NPDMAX PARAMETER in the computer code), the Phi array is the corresponding mass fractions (between 0 and 1) for each of the categories, and the Pdens array is the corresponding particle density (g/cm^3)
for each of the categories. The use of the Srcrng parameter is explained in more detail in Section 3.3.3 above for the BUILDHGT keyword.

The number of categories for a particular source is Npd. The user does not explicitly tell the model the number of categories being input, but if continuation cards are used all inputs of a keyword for a particular source or source range must be contiguous, and the number of categories must agree for each of the three keywords input for a particular source. As many continuation cards as needed may be used to define the inputs for a particular keyword. The model checks the inputs to ensure that the mass fractions sum to 1.0 (within 2 percent) for each source input, and that the mass fractions are within the proper range (between 0 and 1).

For a technical description of the ISC dry deposition algorithms, refer to Sections 1.3 and 2.3 of Volume II of the User's Guide.

3.3.7 Specifying Variables for Precipitation Scavenging and Wet Deposition Calculations

The ISC Short Term (ISCST) model also includes algorithms to handle the scavenging and removal by wet deposition (i.e., precipitation scavenging) of gases and particulates. For wet deposition of particulates, the user must input the source particle variables controlled by the PARTDIAM, MASSFRAX, and PARTDENS keywords on the SO pathway. As with building dimensions and variable emission rate factors described above, the scavenging coefficients may be input for a single source, or may be applied to a range of sources. A separate scavenging coefficient is input for liquid precipitation and for frozen precipitation.

For particulates, the scavenging coefficients are input through the PARTSLIQ and PARTSICE keywords for liquid and frozen precipitation, respectively. The syntax, type and order for these two keywords are summarized below:

Syntax:	SO PARTSLIQ Srcid (or Srcrng) Scavcoef(i),i=1,Npd SO PARTSICE Srcid (or Srcrng) Scavcoef(i),i=1,Npd
Type:	Optional, Repeatable
Order:	Must follow the LOCATION card for each source input

where the Srcid or Srcrng identify the source or sources for which the inputs apply, and where the Scavcoef array consists of the scavenging coefficients $(s\text{-}mm/hr)^{-1}$ for each of

the particle size categories defined on the SO PARTDIAM card (up to a maximum of 20 set by the NPDMAX PARAMETER in the computer code).

The scavenging coefficients for gaseous emissions are specified by a single keyword, GAS-SCAV, which uses a secondary keyword, LIQ or ICE, to distinguish between liquid and frozen precipitation scavenging. The syntax, type and order for this keyword are summarized below:

Syntax:	SO GAS-SCAV Srcid (or Srcrng) LIQ or ICE Scavcoef
Type:	Optional, Repeatable
Order:	Must follow the LOCATION card for each source input

where the Srcid or Srcrng identify the source or sources for which the inputs apply, and where the Scavcoef parameter is the scavenging coefficient $(s\text{-}mm/hr)^{-1}$ for either liquid precipitation (secondary keyword of LIQ) or for frozen precipitation (secondary keyword of ICE).

3.3.8 Specifying an Hourly Emission Rate File

The source (SO) pathway includes an option for inputting hourly emission rates for the ISCST model, controlled by the HOUREMIS keyword. ISCST allows for a single hourly emission file to be used with each model run. The syntax, type and order for this keyword are summarized below:

Syntax:	SO HOUREMIS Emifil Srcid's (and/or Srcrng's)
Type:	Optional, Repeatable
Order:	Must follow the LOCATION card for each source input

where the Emifil parameter specifies the filename (up to 40 characters) for the hourly emission file, and Srcid or Srcrng identify the source or sources for which hourly emission rates are included. Source ranges, which are described in more detail in the description of the BUILDHGT keyword (Section 3.3.3), are input as two source IDs separated by a dash, e.g., STACK1-STACK10. The user may include more than one HOUREMIS card in a runstream file, if needed to specify additional sources, but there can be only one hourly emissions file, and therefore the filename must be the same on all HOUREMIS cards.

The format of each record of the hourly emissions file includes a pathway and keyword (SO HOUREMIS), followed by the Year, Month, Day, Hour, Source ID, emission rate (in the appropriate units), and for point sources the stack gas exit temperature (K), and stack gas exit velocity (m/s). The hourly emissions file is processed using the same routines used to process the runstream input file, therefore each of the parameters must be separated by at least one space, but otherwise the format is variable

(parameters are not required to be specific columns). It is also not necessary to include the SO HOUREMIS on each line, as long as the parameters (Year, Month, etc.) do not begin before column 13.

The data in the hourly emission file must include the exact same dates as are included in the meteorological input files, and the source IDs must correspond to the source IDs defined on the SO LOCATION cards and be in the same order. Multiple records are required to define the emissions for one hour if more than one source is referenced. The model will check for a date mismatch between the hourly emissions file and the meteorological data, and also for a source ID mismatch. An error will occur if a data or ID mismatch is found. However, it is not necessary to process the entire hourly emissions file on each model run, i.e., the correct emissions data will be read if the ME DAYRANGE or the ME STARTEND cards (see Section 3.5.5) are used, as long as all the dates (including those that are processed and those that are skipped) match the meteorological data files. An example of several lines from an hourly emissions file for two point sources is provided below:

```
SO HOUREMIS  88  8 16  1  STACK1  52.467   382.604   12.27
SO HOUREMIS  88  8 16  1  STACK2  44.327   432.326   22.17
SO HOUREMIS  88  8 16  2  STACK1  22.321   377.882   9.27
SO HOUREMIS  88  8 16  2  STACK2  42.166   437.682   19.67
SO HOUREMIS  88  8 16  3  STACK1  51.499   373.716   11.87
SO HOUREMIS  88  8 16  3  STACK2  41.349   437.276   18.77
SO HOUREMIS  88  8 16  4  STACK1  36.020   374.827   9.63
SO HOUREMIS  88  8 16  4  STACK2  43.672   437.682   18.23
```

The model will use the stack release height and stack inside diameter defined on the SO SRCPARAM card, but will use the emission rate, exit temperature and exit velocity from the hourly emission file. If the emission rate, exit temperature and exit velocity are not included for a particular hour, i.e, any or all of those fields are blank, the model will interpret emissions data for that hour as missing and will set the parameters to zero. Since the emission rate will be zero, there will be no calculations made for that hour and that source.

3.3.9 Using Source Groups

The ISC models allow the user to group contributions from particular sources together. Several source groups may be setup in a single run, and they may, for example, be used to model impacts from the source being permitted, the group of increment consuming PSD sources, and the group of all sources for comparison to a NAAQS in a single run. There is always at least one source group in a run, which may consist of all sources, so the SRCGROUP keyword has been made mandatory in the ISC models. The syntax, type and order of the SRCGROUP keyword are summarized below:

Syntax:	SO SRCGROUP Grpid Srcid's and/or Srcrng's
Type:	Mandatory, Repeatable
Order:	Must be the last keyword in the SO pathway before FINISHED

where the Grpid parameter is an alphanumeric string of up to eight characters that identifies the group name. The Srcid's and Srcrng's are the individual source IDs and/or source ranges that make up the group of sources. Source ranges, which are described in more detail in the description of the BUILDHGT keyword (Section 3.3.3), are

input as two source IDs separated by a dash, e.g., STACK1-STACK10. Individual source IDs and source ranges may be used on the same card. If more than one input card is needed to define the sources for a particular group, then additional cards may be input, repeating the pathway, keyword and group ID.

A special group ID has been reserved for use in specifying the group of all sources. When Grpid = ALL, the model will automatically setup a source group called ALL that includes all sources modeled for that particular run. If desired, the user can setup a group of all sources with a different group ID by explicitly specifying all sources on the input card(s).

As described in Section 2.3, the maximum number of source groups is controlled by a Fortran PARAMETER statement in the computer code. If the user attempts to define more than the allowable number of source groups, the model will generate an appropriate error message.

As discussed in Sections 1.2.4.6 and 3.2.9, it is sometimes important for a user to know the contribution of a particular source to the total result for a group. These source contribution analyses are facilitated in the Short Term model by the introduction of the EVENT model. The EVENT model uses the same source groups that are identified by ISCST (when the input file is generated using the CO EVENTFIL option), but the model is structured in a way that it retains individual source results for particular events. The Long Term model is able to provide source contribution information in the first pass, because of the different data structures and memory requirements for that model. Refer to the sections noted above for a more complete description of the EVENT model and its uses.

3.4 RECEPTOR PATHWAY INPUTS AND OPTIONS

The **RE**ceptor pathway contains keywords that define the receptor information for a particular model run. The receptor pathway inputs are identical between the ISCST model and the ISCLT model. The RE pathway is not used at all by the ISCEV (EVENT) model, since the receptor locations are defined on the EVent pathway in combination with particular time periods.

The RE pathway contains keywords that allow the user to define Cartesian grid receptor networks and/or polar grid receptor networks, with either uniform or non-uniform grid spacing, as well as discrete receptor locations referenced to a Cartesian or a polar system. The program is initially setup to allow five (5) gridded receptor networks of either (or both) types in a single run, plus discrete receptors of either type, up to a maximum limit on the total number of receptors. The limit on the number of receptors in a given run is controlled by a Fortran PARAMETER in the computer code (see Sections 2.3 and 4.2.2). The number of receptor networks allowed is also controlled by a PARAMETER statement and may be easily changed by the user.

The default units for receptor elevations for the ISC models are in meters, however, the user may specify receptor elevations to be in units of feet by adding the RE ELEVUNIT FEET card immediately after the RE STARTING card. This optional card has the same effect as the obsolescent CO ELEVUNIT FEET card.

3.4.1 Defining Networks of Gridded Receptors

Two types of receptor networks are allowed by the ISC models. A Cartesian grid network, defined through the GRIDCART keyword, includes an array of points identified by their x (east-west) and y (north-south) coordinates. A polar network, defined by the GRIDPOLR keyword, is an array of points identified by direction and distance from a user-defined origin. Each of these keywords has a series of secondary keywords associated with it that are used to define the network, including any receptor elevations for elevated terrain and flagpole receptor heights. The GRIDCART and GRIDPOLR keywords can be thought of as "sub-pathways," since their secondary keywords include a STArt and an END card to define the start and end of inputs for a particular network.

3.4.1.1 Cartesian Grid Receptor Networks.

Cartesian grid receptor networks are defined by use of the GRIDCART keyword. The GRIDCART keyword may be thought of as a "sub-pathway," in that there are a series of secondary keywords that are used to define the start and the end of the inputs for a particular network, and to select the options for defining the receptor locations that make up the network. The syntax and type of the GRIDCART keyword are summarized below:

Syntax:	RE GRIDCART Netid STA XYINC Xinit Xnum Xdelta Yinit Ynum Ydelta or XPNTS Gridx1 Gridx2 Gridx3 .... Gridxn, and YPNTS Gridy1 Gridy2 Gridy3 .... Gridyn ELEV Row Zelev1 Zelev2 Zelev3 ... Zelevn FLAG Row Zflag1 Zflag2 Zflag3 ... Zflagn END
Type:	Optional, Repeatable

where the parameters are defined as follows:

Netid	Receptor network identification code (up to eight alphanumeric characters)
STA	Indicates the STArt of GRIDCART inputs for a particular network, repeated for each new Netid
XYINC	Keyword identifying uniform grid network generated from x and y increments
Xinit	Starting x-axis grid location in meters
Xnum	Number of x-axis receptors
Xdelta	Spacing in meters between x-axis receptors
Yinit	Starting y-axis grid location in meters
Ynum	Number of y-axis receptors
Ydelta	Spacing in meters between y-axis receptors
XPNTS	Keyword identifying grid network defined by a series of discrete x and y coordinates (used with YPNTS)
Gridx1	Value of first x-coordinate for Cartesian grid (m)
Gridxn	Value of 'nth' x-coordinate for Cartesian grid (m)

YPNTS Gridy1 Gridyn	Keyword identifying grid network defined by a series of discrete x and y coordinates (used with XPNTS) Value of first y-coordinate for Cartesian grid (m) Value of 'nth' y-coordinate for Cartesian grid (m)
ELEV Row Zelev	Keyword to specify that receptor elevations follow (optional) Indicates which row (y-coordinate fixed) is being input (Row=1 means first, i.e., southmost row) An array of receptor terrain elevations (m) for a particular Row (default units of meters may be changed to feet by use of RE ELEVUNIT or CO ELEVUNIT keyword), number of entries per row equals the number of x-coordinates for that network
FLAG Row Zflag	Keyword to specify that flagpole receptor heights follow (optional) Indicates which row (y-coordinate fixed) is being input (Row=1 means first, i.e., southmost row) An array of receptor heights (m) above local terrain elevation for a particular Row (flagpole receptors), number of entries per row equals the number of x-coordinates for that network
END	Indicates the END of GRIDCART inputs for a particular network, repeated for each new Netid

The ELEV and FLAG keywords are optional inputs, and are only needed if elevated terrain or flagpole receptor heights are to be used. If the ELEV keyword is used and the model is being run with the flat terrain option (see Section 3.2.6), then the elevated terrain height inputs will be ignored by the model, and a non-fatal warning message will be generated. If the elevated terrain option is selected, and no elevated terrain heights are entered, the elevations will default to 0.0 meters, and warning messages will also be generated. The model handles flagpole receptor height inputs in a similar manner.

The order of cards within the GRIDCART subpathway is not important, as long as all inputs for a particular network are contiguous and start with the STA secondary keyword and end with the END secondary keyword. It is not even required that all ELEV cards be contiguous, although the input file will be more readable if a logical order is followed. The network ID is also not required to appear on each runstream image (except for the STA card). The model will assume the previous ID if none is entered, similar to the use of continuation cards for pathway and keywords. Thus, the following two examples produce the same 8 X 4 Cartesian grid network:

```
RE GRIDCART CAR1 STA
RE GRIDCART CAR1 XPNTS  -500.  -400.  -200.  -100. 100.  200.  400.  500.
RE GRIDCART CAR1 YPNTS  -500.  -250.   250.  500.
RE GRIDCART CAR1 ELEV  1  10.  10.  10.  10.  10.  10. 10.  10.
RE GRIDCART CAR1 ELEV  2  20.  20.  20.  20.  20.  20. 20.  20.
RE GRIDCART CAR1 ELEV  3  30.  30.  30.  30.  30.  30. 30.  30.
RE GRIDCART CAR1 ELEV  4  40.  40.  40.  40.  40.  40. 40.  40.
RE GRIDCART CAR1 FLAG  1  10.  10.  10.  10.  10.  10. 10.  10.
RE GRIDCART CAR1 FLAG  2  20.  20.  20.  20.  20.  20. 20.  20.
RE GRIDCART CAR1 FLAG  3  30.  30.  30.  30.  30.  30. 30.  30.
RE GRIDCART CAR1 FLAG  4  40.  40.  40.  40.  40.  40. 40.  40.
RE GRIDCART CAR1 END
```

```
RE GRIDCART CAR1 STA
                 XPNTS  -500.  -400.  -200.  -100. 100.  200.  400.  500.
                 YPNTS  -500.  -250.   250.  500.
                 ELEV  1  8*10.
                 FLAG  1  8*10.
                 ELEV  2  8*20.
                 FLAG  2  8*20.
                 ELEV  3  8*30.
                 FLAG  3  8*30.
                 ELEV  4  8*40.
                 FLAG  4  8*40.
RE GRIDCART CAR1 END
```

The Row parameter on the ELEV and FLAG inputs may be entered as either the row number, i.e., 1, 2, etc., or as the actual y-coordinate value, e.g., -500., -250., etc. in the example above. The model sorts the inputs using Row as the index, so the result is the same. The above example could therefore be entered as follows, with the same result:

```
RE GRIDCART CAR1 STA
                 XPNTS  -500.  -400.  -200.  -100.  100.  200.  400.  500.
                 YPNTS  -500.  -250.   250.  500.
                 ELEV   -500.  8*10.
                 FLAG   -500.  8*10.
                 ELEV   -250.  8*20.
                 FLAG   -250.  8*20.
                 ELEV    250.  8*30.
                 FLAG    250.  8*30.
                 ELEV    500.  8*40.
                 FLAG    500.  8*40.
RE GRIDCART CAR1 END
```

Of course, one must use either the row number or y-coordinate value consistently within each network to have the desired result.

The following simple example illustrates the use of the XYINC secondary keyword to generate a uniformly spaced Cartesian grid network. The resulting grid is 11 x 11, with

a uniform spacing of 1 kilometer (1000. meters), and is centered on the origin (0., 0.). No elevated terrain heights or flagpole receptor heights are included in this example.

```
RE GRIDCART CG1 STA
                XYINC  -5000.  11  1000.  -5000.  11 1000.
RE GRIDCART CG1 END
```

3.4.1.2 Polar Grid Receptor Networks.

Polar receptor networks are defined by use of the GRIDPOLR keyword. The GRIDPOLR keyword may also be thought of as a "sub-pathway," in that there are a series of secondary keywords that are used to define the start and the end of the inputs for a particular network, and to select the options for defining the receptor locations that make up the network. The syntax and type of the GRIDPOLR keyword are summarized below:

Syntax:

```
RE GRIDPOLR Netid  STA
                   ORIG  Xinit  Yinit,
                or ORIG  Srcid
                   DIST  Ring1  Ring2  Ring3 ...  Ringn
                   DDIR  Dir1   Dir2   Dir3 ...  Dirn,
                or GDIR  Dirnum Dirini Dirinc
                   ELEV  Dir  Zelev1  Zelev2 Zelev3  ...
          Zelevn
                   FLAG  Dir  Zflag1  Zflag2 Zflag3  ...
          Zflagn
                   END
```

Type: Optional, Repeatable

where the parameters are defined as follows:

Netid	Receptor network identification code (up to eight alphanumeric characters)
STA	Indicates STArt of GRIDPOLR inputs for a particular network, repeat for each new Netid
ORIG Xinit Yinit Srcid	Keyword to specify the origin of the polar network (optional) x-coordinate for origin of polar network y-coordinate for origin of polar network Source ID of source used as origin of polar network
DIST Ring1 Ringn	Keyword to specify distances for the polar network Distance to the first ring of polar coordinates Distance to the 'nth' ring of polar coordinates
DDIR Dir1 Dirn	Keyword to specify discrete direction radials for the polar network First direction radial in degrees (1 to 360) The 'nth' direction radial in degrees (1 to 360)
GDIR Dirnum Dirini Dirinc	Keyword to specify generated direction radials for the polar network Number of directions used to define the polar system Starting direction of the polar system Increment (in degrees) for defining directions
ELEV Dir Zelev	Keyword to specify that receptor elevations follow (optional) Indicates which direction is being input An array of receptor terrain elevations for a particular direction radial (default units of meters may be changed to feet by use of RE ELEVUNIT or CO ELEVUNIT keyword), number of entries per radial equals the number of distances for that network
FLAG Dir Zflag	Keyword to specify that flagpole receptor heights follow (optional) Indicates which direction is being input An array of receptor heights above local terrain elevation for a particular direction (flagpole receptors)

END	Indicates END of GRIDPOLR subpathway, repeat for each new Netid

The ORIG secondary keyword is optional for the GRIDPOLR inputs. If omitted, the model assumes a default origin of (0., 0.,) in x,y coordinates. The ELEV and FLAG keywords are also optional inputs, and are only needed if elevated terrain or flagpole receptor heights are to be used. If the ELEV keyword is used and the model is being run with the flat terrain option (see Section 3.2.6), then the elevated terrain height inputs will be ignored by the model, and a non-fatal warning message will be generated. If the elevated terrain option is selected, and no elevated terrain heights are entered, the elevations will default to 0.0 meters, and warning messages will also be generated. The model handles flagpole receptor height inputs in a similar manner.

As with the GRIDCART keyword described above, the order of cards within the GRIDPOLR subpathway is not important, as long as all inputs for a particular network are contiguous and start with the STA secondary keyword and end with the END secondary keyword. It is not even required that all ELEV cards be contiguous, although the input file will be more readable if a logical order is followed. The network ID is also not required to appear on each runstream image (except for the STA card). The model assumes the previous ID if none is entered, similar to the use of continuation cards for pathway and keywords.

The following example of the GRIDPOLR keyword generates a receptor network consisting of 180 receptor points on five concentric distance rings centered on an assumed default origin of (0.,0.). The receptor locations are placed along 36 direction

radials, beginning with 10. degrees and incrementing by 10. degrees in a clockwise fashion.

```
RE GRIDPOLR POL1 STA
                 DIST  100.  300.  500.  1000.  2000.
                 GDIR  36    10.   10.
RE GRIDPOLR POL1 END
```

Another example is provided showing the use of a non-zero origin, discrete direction radials and the specification of elevated terrain and flagpole receptor heights:

```
RE GRIDPOLR POL1 STA
                ORIG  500.  500.
                DIST  100.  300.  500.  1000.  2000.
                DDIR  90.   180.  270.  360.
                ELEV  90.  5. 10. 15. 20. 25.
                ELEV  180. 5. 10. 15. 20. 25.
                ELEV  270. 5. 10. 15. 20. 25.
                ELEV  360. 5. 10. 15. 20. 25.
                FLAG  90.  5. 10. 15. 20. 25.
                FLAG  180. 5. 10. 15. 20. 25.
                FLAG  270. 5. 10. 15. 20. 25.
                FLAG  360. 5. 10. 15. 20. 25.
RE GRIDPOLR POL1 END
```

As with the GRIDCART keyword described above, the user has the option of specifying the radial number (e.g. 1, 2, 3, etc.) on the ELEV and FLAG inputs, or the actual direction associated with each radial.

For purposes of model calculations, all receptor locations, including those specified as polar, are stored in the model arrays as x, y and z coordinates and flagpole heights. For the purposes of reporting the results by receptor in the main print file, the tables are labeled with the polar inputs, i.e., directions and distances.

3.4.2 Using Multiple Receptor Networks

For some modeling applications, the user may need a fairly coarsely spaced network covering a large area to identify the area of significant impacts for a plant, and a denser network covering a smaller area to identify the maximum impacts. To accommodate this modeling need, the ISC models allow the user to specify multiple receptor networks

in a single model run. The user can define either Cartesian grid networks or polar networks, or both. With the use of the ORIG option in the GRIDPOLR keyword, the user can easily place a receptor network centered on the facility being permitted, and also place a network centered on another background source known to be a significant contributor to high concentrations. Alternatively, the polar network may be centered on a receptor location of special concern, such as a nearby Class I area.

As noted in the introduction to this section (3.4), the model initially allows up to 5 receptor networks in a single run. This limit can be changed by modifying the Fortran PARAMETER statement and recompiling the model. The variables that define each array, e.g., the distances and directions for a polar network, are stored in arrays, so that results can be presented for each network separately in the main output file of the model. Thus, increasing the number of networks allowed will increase the amount of memory needed to run the model, although the increase is relatively small. There are also limits on the number of distances or directions (or the number of x-points and the number of y-points for Cartesian grids) that can be specified for each network. These are initially set to 50 distances or x-points and 50 directions or y-points. These limits are also controlled by Fortran PARAMETER statements, and may be modified. More information on controlling the storage limits of the models is provided in Section 4.2.2.

3.4.3 Specifying Discrete Receptor Locations

In addition to the receptor networks defined by the GRIDCART and GRIDPOLR keywords described above, the user may also specify discrete receptor points for modeling impacts at specific locations of interest. This may be used to model critical receptors, such

as the locations of schools or houses, nearby Class I areas, or locations identified as having high concentrations by previous modeling analyses. The discrete receptors may be input as either Cartesian x,y points (DISCCART keyword) or as polar distance and direction coordinates (DISCPOLR keyword). Both types of receptors may be identified in a single run. In addition, for discrete polar receptor points the user specifies the source whose location is used as the origin for the receptor.

A special option has been included in the ISC models, controlled by the BOUNDARY keyword, which simplifies the input of plant boundary distances in a polar framework. This option is described in Section 3.4.4 below.

3.4.3.1 Discrete Cartesian Receptors.

Discrete Cartesian receptors are defined by use of the DISCCART keyword. The syntax and type of this keyword are summarized below:

Syntax:	RE DISCCART Xcoord Ycoord (Zelev) (Zflag)
Type:	Optional, Repeatable

where the Xcoord and Ycoord parameters are the x-coordinate and y-coordinate (m), respectively, for the receptor location. The Zelev parameter is an optional terrain elevation (m) for the receptor for use in elevated terrain modeling. The Zflag parameter is the optional receptor height above ground (m) for modeling flagpole receptors. All of the parameters are in units of meters, except for Zelev, which defaults to meters but may be specified in feet by use of the RE ELEVUNIT or CO ELEVUNIT keyword.

If neither the elevated terrain option (Section 3.2.6) nor the flagpole receptor height option (Section 3.2.7) are used, then the optional parameters are ignored if present. If only the elevated terrain height option is used (no flagpoles), then the third parameter (the field after the Ycoord) is read as the Zelev parameter. If only the flagpole receptor height option is used (no elevated terrain), then the third parameter is read as the Zflag parameter. If both options are used, then the parameters are read in the order indicated for the syntax above. If the optional parameters are left blank, then default values will be used. The default value for Zelev is 0.0, and the default value for Zflag is defined by the CO FLAGPOLE card (see Section 3.2.7). Note: If both the elevated terrain and flagpole receptor height options are used, then the third parameter will always be used as Zelev, and it is not possible to use a default value for Zelev while entering a specific value for the Zflag parameter.

3.4.3.2 Discrete Polar Receptors.

Discrete polar receptors are defined by use of the DISCPOLR keyword. The syntax and type of this keyword are summarized below:

Syntax:	RE DISCPOLR Srcid Dist Direct (Zelev) (Zflag)
Type:	Optional, Repeatable

where the Srcid is the alphanumeric source identification for one of the sources defined on the SO pathway which will be used to define the origin for the polar receptor location. The Dist and Direct parameters are the distance in meters and direction in degrees for the discrete receptor location. Degrees are measured clockwise from north. The Zelev parameter is an optional terrain elevation for the receptor for use in

elevated terrain modeling. The units of Zelev are in meters, unless specified as feet by the RE ELEVUNIT or CO ELEVUNIT keyword. The Zflag parameter is the optional receptor height above ground (meters) for modeling flagpole receptors.

If neither the elevated terrain option (Section 3.2.6) nor the flagpole receptor height option (Section 3.2.7) are used, then the optional parameters are ignored if present. If only the elevated terrain height option is used (no flagpoles), then the third parameter (the field after the Ycoord) is read as the Zelev parameter. If only the flagpole receptor height option is used (no elevated terrain), then the third parameter is read as the Zflag parameter. If both options are used, then the parameters are read in the order indicated for the syntax above. If the optional parameters are left blank, then default values will be used. The default value for Zelev is 0.0, and the default value for Zflag is defined by the CO FLAGPOLE card (see Section 3.2.7). Note: If both the elevated terrain and flagpole receptor height options are used, then fourth parameter will always be used as Zelev, and it is not possible to use a default value for Zelev while entering a specific value for the Zflag parameter.

3.4.4 Specifying Plant Boundary Distances

The ISC models include a special option to simplify the input of discrete receptor locations for plant boundary distances. This option is controlled by the BOUNDARY keyword. The syntax and type of this keyword are summarized below:

Syntax:	RE BOUNDARY Srcid Dist(i),i=1,36
Type:	Optional, Repeatable

where the Srcid is the alphanumeric source identification for one of the sources defined on the SO pathway for which the boundary distances are to be defined. The location of the source will serve as the origin for 36 discrete polar receptors located at every 10 degrees around the source. The Dist array includes the distances (in meters) for each of the directions, beginning with the 10 degree radial and incrementing every 10 degrees clockwise. While the BOUNDARY keyword generates 36 discrete polar receptors, the results for these receptors are summarized separately from receptors defined by the DISCPOLR keyword in the main output file. The RE BOUNDARY card may be repeated for the source as many times as needed to input the 36 distances.

A related keyword, BOUNDELV, is used to define terrain elevations for the receptor locations identified with the BOUNDARY keyword. The BOUNDELV keyword defines the terrain elevations in meters (or feet if the RE ELEVUNIT or CO ELEVUNIT FEET card appears) for each of the 36 boundary receptor points. The syntax and type for this keyword are summarized below:

Syntax:	RE BOUNDELV Srcid Zelev(i),i=1,36
Type:	Optional, Repeatable

The purpose of the BOUNDARY and BOUNDELV keywords is to provide a short-cut for inputting the discrete polar receptors for the plant boundary. There is no corresponding keyword for inputting boundary receptor flagpole heights. The easiest way to input boundary receptors with flagpole receptor heights is to define them as discrete polar receptors using the DISCPOLR keyword. This method provides better assurance that the flagpole heights are associated with the correct receptor, and makes it easier to check and debug the input file. For applications where a uniform flagpole receptor

height is used for all receptors, which can be specified as a parameter on the CO FLAGPOLE input card, those flagpole receptor heights will also apply to any boundary receptors identified through the BOUNDARY keyword.

3.5 METEOROLOGY PATHWAY INPUTS AND OPTIONS

The **ME**teorology pathway contains keywords that define the input meteorological data for a particular model run. Because of differences in the meteorological data needs for the Short Term and Long Term models, some of the ME pathway inputs are different between the two models. These differences are highlighted in the discussions below. An effort has been made to keep the inputs as similar as possible between the Short Term and Long Term models.

3.5.1 Specifying the Input Data File and Format

The input meteorological data filename and format are identified by the INPUTFIL keyword on the ME pathway. The syntax of this keyword is very similar between the Short Term and Long Term models, but there are some differences due to the different formats of data available for the two types of models. Therefore the Short Term and Long Term model inputs are described separately.

3.5.1.1 Short Term Model Options.

The ISC Short Term model uses hourly meteorological data as one of the basic model inputs. The user has several options for specifying the format of the meteorological data using the INPUTFIL keyword. The syntax and type of this keyword are summarized below:

Syntax:	ME INPUTFIL Metfil (Format)
Type:	Mandatory, Non-repeatable

where the Metfil parameter is a character field of up to 40 characters that identifies the filename for the meteorological data file. For running the model on an IBM-compatible PC, the Metfil parameter may include the complete DOS pathname for the file, or will assume the current directory if only the filename is given. The optional Format parameter specifies the format of the meteorological data file. The user has the following five options for specifying the Format:

1) Use the default ASCII format for a sequential hourly file (if Format is left blank);

2) Specify the Fortran READ format for an ASCII sequential hourly file;

3) Use free-formatted READs for an ASCII sequential hourly file, by inputting the secondary keyword of FREE;

4) Use unformatted file generated by the PCRAMMET or MPRM preprocessors, by inputting the secondary keyword of UNFORM; or

5) Use "card image" data using a default ASCII format by specifying the secondary keyword of CARD - this option differs from option 1) by the addition of hourly wind profile exponents and hourly vertical potential temperature gradients in the input file.

Since the deposition algorithms require additional meteorological variables, the exact format of ASCII meteorological data will depend on whether the dry and/or wet deposition algorithms are being used. If the deposition algorithms are being used, then the unfomatted data file (option 4 above) cannot be used.

The first record of the meteorological data input file contains the station number and year for both the surface station and the upper air (mixing height) station. For the formatted ASCII files, these four integer variables are read using a free-format READ, i.e., the variables must be separated by either a comma or by one or more blank spaces. For the UNFORMatted files, the four variables are read as integers without any format specification. The order of these variables is as follows:

Surface Station Number, e.g., WBAN Number for NWS Stations
Year for Surface Data (2 or 4 digits)
Upper Air Station Number (for Mixing Height Data)
Year for Upper Air Data (2 or 4 digits)

The model checks these variables against the values input by the user on the ME SURFDATA and ME UAIRDATA cards (see Section 3.5.3 below).

The rest of the records in the file include the sequential meteorological data. The order of the meteorological variables for the formatted ASCII files and the default ASCII format are as follows:

Variable	Fortran Format	Columns
Year (last 2 digits)	I2	1-2
Month	I2	3-4
Day	I2	5-6
Hour	I2	7-8
Flow Vector (deg.)	F9.4	9-17
Wind Speed (m/s)	F9.4	18-26
Ambient Temperature (K)	F6.1	27-32
Stability Class (A=1, B=2, ... F=6)	I2	33-34
Rural Mixing Height (m)	F7.1	35-41
Urban Mixing Height (m)	F7.1	42-48
Wind Profile Exponent (CARD only)	F8.4	49-56
Vertical Potential Temperature Gradient (K/m) (CARD only)	F8.4	57-65
Friction Velocity (m/s) (Dry or Wet Deposition Only)	F9.4	49-57 (66-74 for CARD)
Monin-Obukhov Length (m) (Dry or Wet Deposition Only)	F10.1	58-67 (75-84 for CARD)
Surface Roughness Length (m) (Dry or Wet Deposition Only)	F8.4	68-75 (85-92 for CARD)
Precipitation Code (00-45) (Wet Deposition Only)	I4	76-79 (93-96 for CARD)

Precipitation Rate (mm/hr) (Wet Deposition Only)	F7.2	80-86 (97-103 for CARD)

Thus the following two cards would have the same effect, one using the default read format (Format parameter left blank) and the other explicitly providing the ASCII read format described above:

```
ME INPUTFIL  C:\DATA\METDATA.INP
ME INPUTFIL  C:\DATA\METDATA.INP (4I2,2F9.4,F6.1,I2,2F7.1,F9.4,F10.1,F8.4,I4,F7.2)
```

The user-specified ASCII format is input as a character field of up to 60 characters, and may be used to specify the READ format for files that differ from the default format. The variables are identified in the READ format in the order given above, but by using the Fortran tab edit descriptor (Tx, where x is the column number), the order of variables within the file may be different. A utility program, BINTOASC, is available for converting unformatted PCRAMMET meteorological files to the default ASCII format for applications that do not involve dry deposition. The BINTOASC utility program is described in Appendix C.

For FREE-formatted reads, the model uses a Fortran free-format READ statement, meaning that the variables in the meteorological data file must be in the order listed above, and must be separated from each other by a comma or at least one blank. The

format does not need to be the same on each record as long as the variables are appropriately delimited.

The UNFORM secondary keyword indicates to the model that the meteorological data are in an unformatted (sometimes called a "binary") file that was generated by the RAMMET or the MPRM preprocessor. The preprocessed data files consist of unformatted records that include 24 hours of meteorology per record. The variables are read from the unformatted records in the following order:

Year
Month
Julian Day (1-366)
Stability Class (hours 1 to 24)
Wind Speed, m/s (hours 1 to 24)
Ambient Temperature, K (hours 1 to 24)
Flow Vector, deg. (hours 1 to 24)
Randomized Flow Vector, deg. (hours 1 to 24)
Mixing Heights, m (hr 1 rural, hr 1 urban, ... to hr 24)

The following example illustrates the use of the unformatted file option:

```
ME INPUTFIL  C:\BIN\PREPIT.BIN  UNFORM
```

where the Metfil parameter has been used to identify a complete DOS pathname.

The ASCII file input options on the INPUTFIL card allow the user to read the "card image" meteorological data. This includes the option for inputting hourly wind profile

exponents and vertical potential temperature gradients through use of the CARD format option. If the CARD format is not used, then the default values of wind profile exponents and vertical potential temperature gradients are used unless the user specifies non-default inputs using the ME WINDPROF or ME DTHETADZ keyword options.

The meteorological data file for the Short Term model normally consists of a single complete year of meteorological data, beginning with hour 0100 of January 1 and ending with hour 2400 of December 31. For certain applications, such as long term risk assessments, it may be desirable to obtain averages calculated over a period longer than a single year. For these applications, the Short Term model is able to read multiple-year meteorological data files in any of the ASCII formats described above. At the present time, the model is not able to read multiple-year UNFORMatted meteorological data files.

The simplest way to obtain these multiple-year data files is by using the DOS COPY command to concatenate preprocessed ASCII data files. An example of using the DOS COPY command for this purpose is shown below for concatenating five years of meteorological data:

```
COPY RDU86.ASC+RDU87.ASC+RDU88.ASC+RDU89.ASC+RDU90.ASC RDU86-90.ASC
```

To use this five-year ASCII data file, simply include the new file name on the ME INPUTFIL card with the appropriate ASCII file format, and include the year corresponding to the first data file on the ME SURFDATA and ME UAIRDATA cards, described below in

Section 3.5.3. By using the DOS COPY command, the header record at the beginning of each yearly data file will be included within the multiple-year data file. The model will read the embedded header records if they are present, and check for agreement of the surface and upper air station IDs with the values input on the SURFDATA and UAIRDATA cards. The model is also able to read the multiple-year data file if the header records for subsequent years have been removed. See Section 3.2.3.1 for a discussion of how different averaging time options are handled when multiple-year data files are used with the Short Term model.

3.5.1.2 Long Term Model Options.

The ISC Long Term model uses a standard STability ARray (STAR) meteorological data file in place of sequential hourly meteorological data used in the Short Term model. The meteorological data in the STAR file consists of a joint frequency distribution of wind speed and wind direction by stability category. The input of other variables to the Long Term model, (temperature, mixing height, and surface roughness (z_0)) are controlled by separate ME pathway keywords described later in this section. The Monin-Obukhov lenght (L) and friction velocity (u_*) are calculated internally when needed for dry deposition modeling.

The ISCLT model reads the STAR meteorological data from a separate data file. The STAR data filename and format are specified following the INPUTFIL keyword. The following syntax is used:

Syntax:	ME INPUTFIL Metfil (Format)
Type:	Optional, Non-repeatable

where the Metfil parameter is a character field of up to 40 characters that identifies the filename for the meteorological data file. For running the model on an IBM-compatible PC, the Metfil parameter may include the complete DOS pathname for the file; the current directory is assumed if only the filename is given. The optional FORMAT parameter specifies the format
for the STAR data. The user has the following three options for specifying the Format:

1) Use the default ASCII format for the STAR file (if Format is left blank);

2) Specify the Fortran READ format for the ASCII STAR file; or

3) Use free-formatted READs for the ASCII STAR file, by inputting the secondary keyword of FREE.

The default ASCII format corresponds to the format of the data files generated by EPA's STAR utility program for the ISCLT model. Each record of STAR meteorological data consists of six values (default format of 6F10.0) corresponding to the six wind speed classes for a particular wind direction and stability category. The program reads stability category A first, and the first record contains the six values for the north wind direction. There are 16 cards for each stability category corresponding to the 16 wind direction categories entered clockwise from north (north, north-northeast, etc.). This pattern is repeated for each of the six stability categories, A through F.

The frequency data may be input as normalized frequencies, in which case the total of all frequencies for a particular STAR summary will add up to 1.0, or as the number of

occurrences for each combination. If the total of normalized frequencies is not within 2 percent of 1.0, then the model will generate a non-fatal warning message. If the total adds up to 2.0 or more and is a whole number, then the model divides the number of occurrences for each STAR category by the total number to obtain the normalized frequency.

Without the optional STARDATA keyword (described in Section 3.5.4), it is assumed that the STAR summaries in the input file corresponds to the averaging periods selected on the CO AVERTIME card (see Section 3.2.3.1). If SEASON averages are selected, then the model will assume that the meteorological data file consists of four seasons in the order of WINTER, SPRING, SUMMER, and FALL. If an ANNUAL average is to be calculated from an annual STAR summary, then the annual STAR should follow any seasonal STAR summaries to be used. For example, the following runstream image calculates averages for each of the four seasons and the annual average from a data file consisting of five STAR summaries (winter, spring, summer, fall, and annual):

```
CO AVERTIME  SEASON  ANNUAL
```

The following example calculates averages for the four seasons, and then calculates an annual average as a period average for the four seasons combined:

```
CO AVERTIME  SEASON  PERIOD
```

and the input meteorological file for this example would include only the four seasonal STAR summaries.

3.5.2 Specification of Anemometer Height

An important input for both the Short Term and the Long Term models is the specification of the anemometer height, i.e., the height above ground at which the wind speed data were collected. Since the models adjust the input wind speeds from the anemometer height to the release height (see Section 1.1.3 of Volume II), the accurate specification of anemometer height is important to obtaining the correct model results. The syntax and type of the ANEMHGHT keyword are summarized below:

Syntax:	ME ANEMHGHT Zref (Zrunit)
Type:	Mandatory, Non-repeatable

where the parameter Zref is the height of the anemometer measurement above ground, and the optional parameter Zrunit is used to specify the units of Zref. Valid inputs for Zrunit are the secondary keywords METERS or FEET. The default units for Zref are in meters if Zrunit is left blank.

3.5.3 Specifying Station Information

Two keywords are used to specify information about the meteorological stations, SURFDATA for the surface meteorological station, and UAIRDATA for the upper air station used in the determination of mixing heights. The syntax and type of these keywords are summarized below:

Syntax:	ME SURFDATA Stanum Year (Name) (Xcoord) (Ycoord)
Syntax:	ME UAIRDATA Stanum Year (Name) (Xcoord) (Ycoord)
Type:	Mandatory, Non-repeatable

where Stanum is the station number, e.g. the 5-digit WBAN number for NWS stations, Year is the year of data being processed (either 2 or 4 digits), Name is an optional character field (up to 40 characters with no blanks) specifying the name of the station, and Xcoord and Ycoord are optional parameters for specifying the x and y coordinates for the location of the stations. At the present time, the station locations are not utilized in the models. Therefore, no units are specified for Xcoord and Ycoord at this time, although meters are suggested in order to be consistent with the source and receptor coordinates.

3.5.4 Specifying the Meteorological STAR Data (Applies Only to ISCLT)

The STARDATA keyword is used to define what STAR meteorological data summaries are actually included in the data file. The syntax and type of this keyword is summarized below:

Syntax: ME STARDATA	JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC WINTER SPRING SUMMER FALL QUART1 QUART2 QUART3 QUART4 MONTH SEASON QUARTR ANNUAL PERIOD
Type:	Optional, Non-repeatable

This keyword works is conjunction with the CO AVERTIME keyword (Section 3.2.3) to determine which STAR summaries are processed for a particular run. If the STARDATA keyword is omitted, then the model assumes that the meteorological data file consists only of the STAR summaries identified on the CO AVERTIME keyword. While the STARDATA keyword is identified as being optional, it is required in the case where the CO AVERTIME card specifies only the PERIOD average to be calculated. In this case, the model needs the STARDATA input in order to determine what STAR summaries are included in the data file to properly calculate the PERIOD average. A fatal error message will be generated (and processing aborted) if the STARDATA card is omitted for cases with only PERIOD averages being calculated.

The STARDATA keyword allows the user considerable flexibility in controlling which averaging periods to calculate from one run to another. As an example, suppose that the user has a STAR data file consisting of 12 monthly STAR summaries. This would be identified to the model by including the following card on the ME pathway:

```
ME STARDATA  MONTH
```

The user could then generate annual average results by specifying only PERIOD on the CO AVERTIME card. The emission rate factor may be varied by month in the process. With the same meteorological data file, the user could also calculate results for the first quarter only by changing the AVERTIME card to read:

```
CO AVERTIME  JAN  FEB  MAR  PERIOD
```

This would result in results being produced for each of the first three months of the year and for the combined period of JAN-MAR. Each quarter could be calculated in turn simply by changing the AVERTIME card as follows:

```
CO AVERTIME  APR  MAY  JUN  PERIOD  (for Quarter 2)
CO AVERTIME  JUL  AUG  SEP  PERIOD  (for Quarter 3)
CO AVERTIME  OCT  NOV  DEC  PERIOD  (for Quarter 4)
```

By specifying MONTH on the ME STARDATA card, the model will be able to retrieve the correct STAR summary for each of these cases. The only requirement is that STAR summaries always be included in the following order within the meteorological data file:

```
JAN, FEB, MAR, ..., DEC, WINTER (or QUART1), SPRING (or QUART2),
SUMMER (or QUART3), FALL (or QUART4), and ANNUAL
```

Any number of STAR summaries may be included, up to a maximum of 17 (for 12 months, plus 4 seasons or quarters, plus 1 annual.

3.5.5 Specifying a Data Period to Process (Applies Only to ISCST)

There are two keywords that allow the user to specify particular days or ranges of days to process from the sequential meteorological file input for the ISCST model. The STARTEND keyword controls which period within the meteorological data file is read by the model, while the DAYRANGE keyword controls which days or ranges of days (of those that are read) for the model to process. The default for the model is to read the entire meteorological data file (up to a full year) and to process all days within that period.

The syntax and type for the STARTEND keyword are summarized below:

Syntax:	ME STARTEND Strtyr Strtmn Strtdy (Strthr) Endyr Endmn Enddy (Endhr)
Type:	Optional, Non-repeatable

where the Strtyr Strtmn Strtdy parameters specify the year, month and day of the first record to be read (e.g., 87 01 31 for January 31, 1987), and the parameters Endyr Endmn Enddy specify the year, month and day of the last record to be read. The Strthr and Endhr are optional parameters that may be used to specify the start and end hours for the data period to be read. If either Strthr or Endhr is to be specified, then both must be specified. Any records in the data file that occur before the start date are ignored, as are any records in the data file that occur after the end date. In fact, once the end date has been reached, the model does not read any more data from the meteorological file. If Strthr and Endhr are not specified, then processing begins with hour 1 of the start date, and ends with hour 24 of the end date, unless specific days are selected by the DAYRANGE card described below.

Any PERIOD or ANNUAL averages calculated by the model will apply only to the period of data actually processed. Therefore, if someone wanted to calculate a six-month average, they could select PERIOD averages on the CO AVERTIME card, and then specify the period as follows:

```
ME STARTEND  87 01 01  87 06 30
```

for the period January 1, 1987 through June 30, 1987. The difference between the PERIOD and ANNUAL averages in the Short Term model is described in Section 3.2.3.1.

The syntax and type for the DAYRANGE keyword are summarized below:

Syntax:	ME DAYRANGE Range1 Range2 Range3 ... Rangen
Type:	Optional, Repeatable

where the Range parameters specify particular days or ranges of days to process. The days may be specified as individual days (e.g. 1 2 3 4 5) or as a range of days (e.g. 1-5). The user also has the option of specifying Julian day numbers, from 1 to 365 (366 for leap years), or specifying month and day (e.g., 1/31 for January 31). Any combination of these may also be used. For example the following card will tell the model to process the days from January 1 (Julian day 1) through January 31 (1/31):

```
ME DAYRANGE  1-1/31
```

The DAYRANGE keyword is also repeatable, so that as many cards as needed may be included in the ME pathway.

As with the STARTEND keyword, any PERIOD or ANNUAL averages calculated by the model will apply only to the period of data actually processed. If the STARTEND keyword is also used, then only those days selected on the DAYRANGE cards that fall within the

period from the start date to the end date will be processed. Thus, if the ME pathway included the following two cards:

```
ME STARTEND  87 02 01  87 12 31
ME DAYRANGE  1-31
```

then no data would be processed, since the days 1 through 31 fall outside the period 2/1 to 12/31.

3.5.6 Correcting Wind Direction Alignment Problems

The WDROTATE keyword allows the user to correct the input meteorological data for wind direction alignment problems. All input wind directions or flow vectors are rotated by a user-specified amount. Since the model results at particular receptor locations are often quite sensitive to the transport wind direction, this optional keyword should be used only with extreme caution and with clear justification.

The syntax and type of this keyword are summarized below:

Syntax:	ME WDROTATE Rotang
Type:	Optional, Non-repeatable

where the Rotang parameter specifies the angle in degrees to rotate the input wind direction measurements. The value of Rotang is subtracted from the wind direction

measurements. It may be used to correct for known (and documented) calibration errors, or to adjust for the alignment of a valley if the meteorological station is located in a valley with a different alignment than the source location. Since the Short Term models use the flow vector (direction toward which the wind is blowing) as the basic input, the WDROTATE keyword may also be used to convert input data as wind direction (from which the wind is blowing) to flow vector by setting the parameter Rotang = 180.

3.5.7 Specifying Wind Speed Categories

Some of the parameters that may be input to the models are allowed to vary by wind speed category. Examples of such inputs are user-specified wind speed profile exponents, vertical potential temperature gradients, and variable emission rate factors. The models use six wind speed categories, and these are defined by the upper bound wind speed for the first five categories (the sixth category is assumed to have no upper bound). The default values for the wind speed categories are as follows: 1.54, 3.09, 5.14, 8.23, and 10.8 m/s. The syntax and type of the WINDCATS keyword, which may be used to specify different category boundaries, are summarized below:

Syntax:	ME WINDCATS Ws1 Ws2 Ws3 Ws4 Ws5
Type:	Optional, Non-repeatable

where the Ws1 through Ws5 parameters are the upper bound wind speeds of the first through fifth categories in meters per second. The upper bound values are inclusive, i.e., a wind speed equal to the value of Ws1 will be placed in the first wind speed category.

3.5.8 Specifying Wind Profile Exponents

While the model uses default wind profile exponents if the regulatory default option is selected (see the CO MODELOPT description in Section 3.2.2), for non-regulatory default applications the user can specify wind profile exponents through use of the WINDPROF keyword on the ME pathway. The syntax and type of this keyword are summarized below:

Syntax:	ME WINDPROF Stab Prof1 Prof2 Prof3 Prof4 Prof5 Prof6
Type:	Optional, Repeatable

where the Stab parameter specifies the stability category for the following six values, and Prof1 through Prof6 are the wind profile exponents for each of the six wind speed categories. The Stab parameter may be input either alphabetically (A through F) or numerically (1 for A through 6 for F). The WINDPROF cards do not need to be input in any particular order.

The wind speed categories are either the default categories used by the model (with upper bound speeds of 1.54, 3.09, 5.14, 8.23, and 10.8 m/s for the first five categories - the sixth category is assumed to have no upper bound), or the categories specified by the user on the optional ME WINDCATS keyword (Section 3.5.6).

The following example will input the default exponents for the rural mode, and illustrates the use of a repeat value for applying the exponents to all six wind speed categories:

```
ME WINDPROF  A  6*0.07
ME WINDPROF  B  6*0.07
ME WINDPROF  C  6*0.10
ME WINDPROF  D  6*0.15
ME WINDPROF  E  6*0.35
ME WINDPROF  F  6*0.55
```

If the regulatory default option has been selected, then any inputs on the WINDPROF keyword are ignored by the model, and a non-fatal warning message is generated.

3.5.9 Specifying Vertical Temperature Gradients

While the model uses default vertical potential temperature gradients if the regulatory default option is selected (see the CO MODELOPT description in Section 3.2.2), for non-regulatory default applications the user can specify vertical potential temperature gradients through use of the DTHETADZ keyword on the ME pathway. The syntax and type of this keyword are summarized below:

Syntax:	ME DTHETADZ Stab Dtdz1 Dtdz2 Dtdz3 Dtdz4 Dtdz5 Dtdz6
Type:	Optional, Repeatable

where the Stab parameter specifies the stability category for the following six values, and Dtdz1 through Dtdz6 are the vertical potential temperature gradients for each of the six wind speed categories. The Stab parameter may be input either alphabetically (A through F) or numerically (1 for A through 6 for F). The DTHETADZ cards do not need to be input in any particular order.

The wind speed categories are either the default categories used by the model (with upper bound speeds of 1.54, 3.09, 5.14, 8.23, and 10.8 m/s for the first five categories - the sixth category is assumed to have no upper bound), or the categories specified by the user on the optional ME WINDCATS keyword (Section 3.5.6).

The following example will input the default values of DTDZ, and illustrates the use of a repeat value for applying the inputs to all six wind speed categories:

```
ME DTHETADZ  A  6*0.00
ME DTHETADZ  B  6*0.00
ME DTHETADZ  C  6*0.00
ME DTHETADZ  D  6*0.00
ME DTHETADZ  E  6*0.020
ME DTHETADZ  F  6*0.035
```

If the regulatory default option has been selected, then any inputs on the DTHETADZ keyword are ignored by the model, and a non-fatal warning message is generated.

3.5.10 Specifying Average Wind Speeds for the Long Term Model

The ISC Long Term model uses joint frequencies of wind speed class by wind direction sector by stability category as the basic meteorological input to the model. These STAR summaries (for STability ARray) are described in more detail in Section 3.5.1.2. The optional AVESPEED keyword on the ME pathway allows the user to specify the median wind speed for each of the wind speed categories in the STAR summary. The syntax and type of this keyword are summarized below:

Syntax:	ME AVESPEED Ws1 Ws2 Ws3 Ws4 Ws5 Ws6
Type:	Optional, Non-repeatable

where the Ws1 through Ws6 parameters are the median wind speeds (m/s) for each of the six wind speed categories. The default values used by the model in the absence of the AVESPEED keyword are as follows: 1.50, 2.50, 4.30, 6.80, 9.50, and 12.50 m/s.

3.5.11 Specifying Average Temperatures for the Long Term Model

For the ISC Long Term model, the user must specify average values of ambient temperature following the AVETEMPS keyword. The following syntax is used:

Syntax:	ME AVETEMPS Aveper Ta1 Ta2 Ta3 Ta4 Ta5 Ta6
Type:	Mandatory, Repeatable

where the Aveper parameter specifies the long term averaging period for the following inputs, and must be one of the secondary keywords used on the Long Term AVERTIME card

described in Section 3.2.3.2 (e.g., JAN, WINTER, ANNUAL, etc.). The Ta1 through Ta6 parameters are the average ambient temperatures (K) for each of the six stability categories, A through F. The AVETEMPS keyword is repeated for each of the averaging periods being processed. Common practice is to apply the average daily maximum temperature for the time period being modeled to stability classes A, B and C, the average daily minimum temperature to stability classes E and F, and the average daily temperature to stability class D. These average temperatures may be obtained from various climatological summaries, including the Local Climatological Data - Annual Summary published for major National Weather Service stations by the National Climatic Data Center in Asheville, North Carolina.

The following example illustrates the use of the AVETEMPS keyword:

```
ME AVETEMPS  WINTER  3*280.0  275.0  2*270.0
ME AVETEMPS  SPRING  3*285.0  280.0  2*275.0
ME AVETEMPS  SUMMER  6*293.0
ME AVETEMPS   FALL   280. 280. 275. 270. 265. 265.
```

where repeat values have been used for the unstable and stable classes for winter and spring, and for all classes for summer.

3.5.12 Specifying Average Mixing Heights for the Long Term Model

Fop the ISC Long Term model, the user must specify average values of mixing height following the AVEMIXHT keyword. The following syntax is used:

Syntax:	ME AVEMIXHT Aveper Stab Mixht1 Mixht2 Mixht3 Mixht4 Mixht5 Mixht6
Type:	Mandatory, Repeatable

where the Aveper parameter specifies the long term averaging period for the following inputs, and must be one of the secondary keywords used on the Long Term AVERTIME card described in Section 3.2.3.2 (i.e., JAN, WINTER, ANNUAL, etc.) The Stab parameter specifies the stability category (A through F or 1 through 6). The Mixht1 through Mixht6 parameters are the average mixing heights (m) for each of the six wind speed categories. The AVEMIXHT keyword is repeated for each stability category and for each of the averaging periods being processed. For mixing heights in rural areas, the common practice is to apply the mean afternoon mixing height given by Holzworth (1972) to stability classes B, C and D, and 1.5 times the mean afternoon mixing height to stability class A. For mixing heights in urban areas, the common practice is to apply the mean afternoon mixing height given by Holzworth (1972) to stability classes B and C, 1.5 times the mean afternoon mixing height to stability class A, and the average of the mean early morning and afternoon mixing heights to stability class D. The ISCLT model assumes unlimited mixing for stability classes E and F for both rural and urban conditions, and a large value such as 10,000 meters may be input for those classes. It is also common practice to apply the average mixing height to all wind speed classes for a particular stability class, although if better information is available, separate values may be input by wind speed class.

The following example illustrates the use of the AVEMIXHT keyword:

```
ME AVEMIXHT  WINTER  A  6*2250.0
ME AVEMIXHT  WINTER  B  6*2000.0
ME AVEMIXHT  WINTER  C  6*1500.0
ME AVEMIXHT  WINTER  D  6*1000.0
ME AVEMIXHT  WINTER  E  6*500.0
ME AVEMIXHT  WINTER  F  6*300.0
```

where repeat values have been used to apply the mixing heights to each of the wind speed categories.

3.5.13 Specifying Average Surface Roughness for the Long Term Model

When using the dry deposition algorithms in ISCLT, the user must specify average values of surface roughness length following the AVEROUGH keyword. The following syntax is used:

Syntax:	ME AVEROUGH Aveper Z_0
Type:	Optional, Repeatable

where the Aveper parameter specifies the long term averaging period for the following input, and must be one of the secondary keywords used on the Long Term AVERTIME card described in Section 3.2.3.2 (e.g., JAN, WINTER, ANNUAL, etc.). The Z_0 parameter is the average surface roughness length in meters for the specified averaging period. Only one roughness length is supplied for each averaging period. Surface roughness lengths representative of several land-use types are given in Table 3-2 by season. Depending on the land-use type and climate, surface roughness may vary considerable by season, as shown for deciduous forests in Table 3-2.

TABLE 3-2

SURFACE ROUGHNESS LENGTH, METERS, FOR LAND-USE TYPES AND SEASONS, FROM SHIEH ET AL., 1979

	Land-Use Type	Spring	Summer	Autumn	Winter
1.	Water Surface	0.0001	0.0001	0.0001	0.0001
2.	Deciduous Forest	1.00	1.30	0.80	0.50
3.	Coniferous Forest	1.30	1.30	1.30	1.30
4.	Swamp	0.20	0.20	0.20	0.05
5.	Cultivated Land	0.03	0.20	0.05	0.01
6.	Grassland	0.05	0.10	0.01	0.001
7.	Urban	1.00	1.00	1.00	1.00
8.	Desert Shrubland	0.30	0.30	0.30	0.15

Definitions of Seasons:

Spring: Periods when vegetation is emerging or partially green. This is a transitional situation that applies for 1-2 months after the last killing frost in spring.

Summer: Periods when vegetation is lush and healthy, typical of mid-summer, but also of other seasons where frost is less common.

Autumn: Periods when freezing conditions are common, deciduous trees are leafless, crops are not yet planted or are already harvested (bare soil exposed),

3.6 TERRAIN GRID PATHWAY INPUTS AND OPTIONS

The **T**errain **G**rid pathway contains keywords that define the input terrain grid data used in calculating dry depletion in elevated or complex terrain. The TG pathway is an optional pathway for the ISC models. If dry depletion is not being calculated, then the TG pathway may be omitted. If dry depletion is being calculated and the TG pathway is omitted, then the model will linearly interpolate between the source base elevation and the receptor elevation when calculating dry depletion.

The TG pathway includes two mandatory, non-repeatable keywords, and one optional keyword. The INPUTFIL keyword identifies the name of the input file containing the TG data. The syntax and type of the TG INPUTFIL keyword are summarized below:

Syntax:	TG INPUTFIL Tgfile
Type:	Mandatory, Non-repeatable

where the Tgfile parameter is a character field of up to 40 characters that identifies the filename for the terrain grid data file. The Tgfile parameter may include the complete DOS pathname for the file when running the model on an IBM-compatible PC.

The TG LOCATION keyword is used to specify the location of the terrain grid data relative to the coordinate system used to define the source and receptor locations. The terrain grid data file must be in UTM coordinates, while the source/receptor coordinates may be in a user specified coordinate system, such as plant coordinates. The syntax and type of the TG LOCATION keyword are summarized below:

Syntax:	TG LOCATION Xorig Yorig (Units)
Type:	Mandatory, Non-repeatable

where the Xorig and Yorig parameters are the values needed to transform the locations given in user-specified coordinates for sources and receptors to UTM coordinates. The user coordinates are transformed by adding Xorig and Yorig to the x-coordinates and y-coordinates, respectively, of the sources and receptors. The optional Units parameter is used to specify the units for the Xorig and Yorig parameters only. The units may be specified as FEET, KM, or METERS. The default units for Xorig and Yorig is in meters if the Units parameter is omitted. For example, if the source and receptor coordinates in the runstream file are in UTM coordinates, then the TG LOCATION card should have a value of 0.0 for Xorig and Yorig, since no conversion is needed to match up the source/receptor locations to the terrain grid data. If the source and receptor coordinates in the runstream file are in a different (non-UTM) coordinate system, such as a plant-based system, then the Xorig and Yorig parameters should be the UTM coordinates for the origin (x=0, y=0) of the source/receptor coordinate system. The values of Xorig and Yorig are added to the source and receptor coordinates to convert them to UTM coordinates. An example of the TG pathway is shown below:

```
TG STARTING
TG INPUTFIL  C:\TERRAIN\GRIDELEV.MSL
TG LOCATION  532.2  4391.74  KM
TG FINISHED
```

The terrain grid file contains 1 header record, followed by any number of data records. The file is read as a free-format ASCII file. The header record contains the following information:

nx, ny, xllm, yllm, xurm, yurm, sizem

where:

nx, ny	number of data points in x (Easting) and y (Northing) directions;
xllm, yllm	UTM coordinates (in meters) of the point at the lower left corner of the grid;
xurm, yurm	UTM coordinates (in meters) of the point at the upper right corner of the grid; and
sizem	spacing between grid points in both the x and y directions, in meters.

The data records are ordered by rows. The first row contains nx terrain elevations ordered from west to east, starting at point (XLLM, YLLM). Row 2 contains the data for the next row to the north in the grid. There are a total of ny rows of data in the terrain grid file. The default units for terrain elevations in the terrain grid file are meters MSL. However, the user may specify terrain elevations to be in units of feet by adding the optional TG ELEVUNIT FEET card. The order of the ELEVUNIT card on the TG pathway is not important. The maximum number of points in the terrain grid file is controlled by the MXTX and MXTY parameters in the DEPVAR.INC file.

3.7 EVENT PATHWAY INPUTS AND OPTIONS (APPLIES ONLY TO ISCEV)

The ISCEV (EVENT) model is specifically designed to facilitate analysis of source contributions to specific events for short term averages (less than or equal to 24 hours). These events may be design concentrations generated by the ISCST model, occurrences of violations of an air quality standard, or user-specified events. These events are input to the ISCEV model through the **EV**ent pathway. Each event is defined by an averaging period and specific data period, a source group, and a receptor location. Since the locations are only of interest in combination with particular averaging and data periods, the REceptor pathway is not used by the EVENT model.

There are two keywords that are used to define the events on the EV pathway. The EVENTPER keyword defines the averaging period, data period and source group, while the EVENTLOC keyword defines the receptor location for the event. Each event is also given an alphanumeric name that links the two input cards for that event.

The syntax and type of the EVENTPER and EVENTLOC keywords are summarized below:

Syntax:	EV EVENTPER Evname Aveper Grpid Date
Syntax:	EV EVENTLOC Evname XR= Xr YR= Yr (Zelev) (Zflag) or Evname RNG= Rng DIR= Dir (Zelev) (Zflag)
Type:	Mandatory, Repeatable

where the parameters are as follows:

Evname - event name (an alphanumeric string of up to 8 characters),

Aveper - averaging period for the event (e.g. 1, 3, 8, 24 hr)

Grpid - source group ID for the event (must be defined on SO pathway),

Date - date for the event, input as an eight digit integer for the ending hour of the data period (YYMMDDHH), e.g. 84030324 defines a data period ending at hour 24 on March 3, 1984. The length of the period corresponds to Aveper.

XR= - X-coordinate (m) for the event location, referenced to a Cartesian coordinate system

YR= - Y-coordinate (m) for the event location, referenced to a Cartesian coordinate system

RNG= - distance range (m) for the event location, referenced to a polar coordinate system with an origin of (0., 0.)

DIR= - radial direction (deg.) for the event location, referenced to a polar coordinate system with an origin of (0., 0.)

Zelev - optional terrain elevation for the event location (m)

Zflag - optional receptor height above ground (flagpole receptor) for the event location (m)

Each event is defined by the two input cards EVENTPER and EVENTLOC, and these inputs are linked by the event name, which must be unique among the events being processed in a given run. There is no particular requirement for the order of cards on the EV pathway. Note that the location for the event may be specified by either Cartesian coordinates or by polar coordinates, however, the polar coordinates must be relative to an origin of (0,0).

3.7.1 Using Events Generated by the ISCST Model

Since the ISCEV (EVENT) model was designed to work in conjunction with the ISCST model, the ISCST model has an option (CO EVENTFIL described in Section 3.2.9) to generate an input file for the ISCEV model. When this option is used, the ISCST model copies relevant inputs from the ISCST runstream input file to the ISCEV model input file, and generates the inputs for the EVent pathway from the results of the modeling run. These events are the design concentrations identified by the OU RECTABLE keyword (see Section 3.8.1.1), such as the highest and high-second-high 24-hour averages, etc., and any threshold violations identified by the OU MAXIFILE keyword (see Section 3.8.1.2). The inputs generated by the ISCST model correspond to the syntax described above for the EVENTPER and EVENTLOC keywords. The locations for events generated by the ISCST model are always provided as Cartesian coordinates.

To easily identify the events generated by the ISCST model, and to provide a mechanism for the ISCST model to manage the events generated from the model run, a naming convention is used for the EVNAME parameter. The following examples illustrate the event names used by the ISCST model:

H1H01001 - High-first-high 1-hour average for source group number 1

H2H24003 - High-second-high 24-hour average for source group number 3

TH030010 - Threshold violation number 10 for 3-hour averages

TH240019 - Threshold violation number 19 for 24-hour averages

The high value design concentrations are listed first in the ISCEV model input file, followed by the threshold violations (grouped by averaging period). To make it easier for the user to review the ISCEV model input file generated by the ISCST model, and determine which events are of most concern, the actual concentration or deposition value associated with the event is included as the last field on the EVENTPER card. This field is ignored by the ISCEV model, and is included only for informational purposes. The user should be aware that the same event may appear in the ISCEV model input file as both a design value and as a threshold violation, depending on the options selected and the actual results. Since the model processes the events by date sequence and outputs the results for each event as it is processed, the order of events in the output file will generally not follow the order of events in the input file, unless all of the events were generated by the MAXIFILE option.

3.7.2 Specifying Discrete Events

The user can specify discrete events by entering the EVENTPER and EVENTLOC cards as described above. The averaging period and source group selected for the event must be among those specified on the CO AVERTIME and SO SRCGROUP cards. If the ISCEV model input file was generated by the ISCST model, the user may include additional events for those averaging periods and source groups used in the original ISCST model run. They may also add averaging periods or define new source groups in the ISCEV model input file in order to define additional events.

3.8 OUTPUT PATHWAY INPUTS AND OPTIONS

The **OU**tput pathway contains keywords that define the output options for the model runs. Since the output options are somewhat different for each of the three models, the OU pathway options for the models are discussed separately.

3.8.1 Short Term Model Options

The ISCST model has three keywords that control different types of tabular output for the main output file of the model, and four keywords that control separate output file options for specialized purposes. The user may select any combination of output options for a particular application. For each tabular output option specified by the user, the model will cycle through the selected output types in the following order - CONC, DEPOS, DDEP, and/or WDEP. For the POSTFILE and PLOTFILE output options, the model will list the selected output types in the order given above, as described below for each file option. For the MAXIFILE and TOXXFILE output options, the output will only include the first output type selected from the list given above, since outputs from these options are based on a value exceeding a threshold.

3.8.1.1 Selecting Options for Tabular Printed Outputs.

The three tabular printed output options are controlled by the following keywords:

RECTABLE - Controls output option for high value summary tables by receptor;

MAXTABLE - Controls output option for overall maximum value summary tables; and

DAYTABLE - Controls output option for tables of concurrent values summarized by receptor for each day processed.

The keywords are described in more detail in the order listed above.

The syntax and type for the RECTABLE keyword are summarized below:

Syntax:	OU RECTABLE Aveper FIRST SECOND ... SIXTH or 1ST 2ND ... 6TH
Type:	Optional, Repeatable

where the Aveper parameter is the short term averaging period (e.g. 1, 3, 8 or 24 hr or MONTH) for which the receptor table is selected, and the secondary keywords, FIRST, SECOND, etc., indicate which high values are to be summarized by receptor for that averaging period. The RECTABLE card may be repeated for each averaging period. For cases where the user wants the same RECTABLE options for all short term averaging periods being modeled, the input may be simplified by entering the secondary keyword ALLAVE for the Aveper parameter. The following example will select summaries of the highest, second highest and third highest values by receptor for all averaging periods:

```
OU RECTABLE  ALLAVE  FIRST  SECOND  THIRD
```

The model will also recognize a range of high values on the RECTABLE input card, and therefore the following card will have the effect:

```
OU RECTABLE  ALLAVE  FIRST-THIRD
```

The output file will include tables for only the high values selected. Tables for all source groups for a particular averaging period are grouped together, and the averaging periods are output in the order that they appear the CO AVERTIME card. For each averaging period and source group combination, the tables of high values for the receptor networks (if any) are printed first, followed by any discrete Cartesian receptors, any discrete polar receptors, and any boundary receptors.

The number of high values per receptor that the model can store is controlled by the NVAL PARAMETER in the Fortran computer code. The value of NVAL is initially set at 2 for the DOS version of ISCST and 6 for the extended memory version. The NVAL PARAMETER can be changed (up to 10), and the model recompiled in order to meet other modeling needs, such as the highest of the sixth highest values by receptor for PM-10 modeling, assuming sufficient memory is available for the model's storage requirements. Changing the model storage limits is discussed in more detail in Section 4.2.2.

If the CO EVENTFIL keyword has been used to generate an input file for the ISCEV (EVENT) model, then the design values identified by the RECTABLE options, e.g., the high-second-high 24-hour average, are included in the events that are defined in the ISCEV model input file.

The syntax and type for the MAXTABLE keyword are summarized below:

Syntax:	OU MAXTABLE Aveper Maxnum
Type:	Optional, Repeatable

where the Aveper parameter is the short term averaging period (e.g. 1, 3, 8 or 24 hr or MONTH) for which the receptor table is selected, and the Maxnum parameter specifies the number of overall maximum values to be summarized for each averaging period. The MAXTABLE card may be repeated for each averaging period. As with the RECTABLE keyword, for cases where the user wants the same MAXTABLE options for all short term averaging periods being modeled, the input may be simplified by entering the secondary keyword ALLAVE for the Aveper parameter. The following example will select the maximum 50 table for all averaging periods:

```
OU MAXTABLE  ALLAVE  50
```

A separate maximum overall value table is produced for each source group. The maximum value tables follow the RECTABLE outputs in the main print file. All source group tables for a particular averaging period are grouped together, and the averaging periods are output in the order that they appear on the CO AVERTIME card.

The number of overall maximum values that the model can store for each averaging period and source group is controlled by the NMAX PARAMETER in the Fortran computer code. The value of NMAX is initially set at 50. The NMAX PARAMETER can be changed (up

or down), and the model recompiled in order to meet other modeling needs, assuming sufficient memory is available for the model's storage requirements. Changing the model storage limits is discussed in more detail in Section 4.2.2.

The syntax and type for the DAYTABLE keyword are summarized below:

Syntax:	OU DAYTABLE Avper1 Avper2 Avper3 . . .
Type:	Optional, Non-repeatable

where the Avpern parameters are the short term averaging periods (e.g. 1, 3, 8 or 24 hr or MONTH) for which the daily tables are selected. The DAYTABLE card is non-repeatable, but as with the RECTABLE and MAXTABLE keywords, for cases where the user wants daily tables for all short term averaging periods being modeled, the input may be simplified by entering the secondary keyword ALLAVE for the first parameter. The following example will select the daily tables for all averaging periods:

```
OU DAYTABLE  ALLAVE
```

For each averaging period for which the DAYTABLE option is selected, the model will print the concurrent averages for all receptors for each day of data processed. The receptor networks (if any) are printed first, followed by any discrete Cartesian receptors, discrete polar receptors, and boundary receptors. Results for each source group are output. For example, if 1, 3, and 24-hour averages are calculated, and the OU DAYTABLE ALLAVE option is used, then for the first day of data processed, there will be

24 sets of tables of hourly averages (one for each hour in the day), eight sets of 3-hour averages (one for each 3-hour period in the day), and one set of 24-hour averages. The averages are printed as they are calculated by the model, but for hours where more than one averaging period is calculated (e.g., hour 24 is the end of an hourly average, a 3-hour average, and a 24-hour average), the order in which the averages are output will follow the order used on the CO AVERTIME card. Note: This option can produce very large output files, especially when used with a full year of data and very short period averages, such 1-hour and 3-hour. It should therefore be used with CAUTION.

3.8.1.2 Selecting Options for Special Purpose Output Files.

The ISCST model provides options for four types of output files for specialized purposes. One option produces files of all occurrences of violations of user-specified threshold values (MAXIFILE keyword), another option produces files of concurrent (raw) results at each receptor suitable for post-processing (POSTFILE keyword), and a third option produces files of design values that can be imported into graphics packages in order to produce contour plots (PLOTFILE keyword), and a fourth option produces unformatted files of raw results above a threshold value with a special structure for use with the TOXX model component of TOXST (TOXXFILE keyword). Each of these options is described in detail below.

The syntax and type for the MAXIFILE keyword are summarized below:

Syntax:	OU MAXIFILE Aveper Grpid Thresh Filnam (Funit)
Type:	Optional, Repeatable

where the Aveper parameter is the short term averaging period (e.g. 3, 8, 24 for 3, 8 and 24-hour averages, or MONTH for monthly averages) and Grpid is the source group ID for which the MAXIFILE option is selected. The Thresh parameter is the user-specified threshold value, and Filnam is the name of the file where the MAXIFILE results are to be written. The optional Funit parameter allows the user the option of specifying the Fortran logical file unit for the output file. The user-specified file unit must be in the range of 20-100, inclusive. By specifying the same filename and unit for more than one MAXIFILE card, results for different source groups and/or averaging periods may be combined into a single file. If the Funit parameter is omitted, then the model will dynamically allocate a unique file unit for this file (see Section 3.9.2).

The MAXIFILE card may be repeated for each combination of averaging period and source group, and a different filename should be used for each file. The resulting maximum value file will include several header records identifying the averaging period, source group and the threshold value for that file, and a listing of every occurrence where the result for that averaging period/source group equals or exceeds the threshold value. Each of these records includes the averaging period, source group ID, date for the threshold violation (ending hour of the averaging period), the x, y, z and flagpole receptor height for the receptor location where the violation occurred, and the concentration or deposition value. If more than one output type is selected in a model run, then the MAXIFILE threshold will only apply to the first output type selected among the list of CONC, DEPOS, DDEP, and/or WDEP, and only the corresponding value will be output in the maximum value file.

Each of the threshold violations, except for monthly averages, identify events that may be modeled for source contribution information with the ISCEV (EVENT) model by selecting the CO EVENTFIL option (see Sections 3.2.9 and 3.7). Each of the threshold violations is included as an event on the EV pathway, and is given a name of the form THxxyyyy, where xx is the averaging period, and yyyy is the violation number for that averaging period. For example, an event name of TH240019 identifies the 19th threshold violation for 24-hour averages. Monthly average threshold violations are included in the file specified on the MAXIFILE card, but are not included in the ISCEV model input file since the ISCEV model currently handles only averaging periods of up to 24 hours.

The following examples illustrate the use of the MAXIFILE option:

```
OU MAXIFILE  24  ALL   364.0  MAX24ALL.OUT
OU MAXIFILE  24  PSD    91.0  MAXPSD.OUT    50
OU MAXIFILE   3  PSD   365.0  MAXPSD.OUT    50
OU MAXIFILE   3  PLANT  25.0  C:\OUTPUT\MAXI3HR.FIL
OU MAXIFILE MONTH  ALL  10.0  MAXMONTH.OUT
```

where the 3-hour example illustrates the use of a DOS pathname for the PC, and the last example illustrates the use of monthly averages. The FILNAM parameter may be up to 40 characters in length. It should also be noted that only one MAXIFILE card may be used for each averaging period/source group combination. Note: The MAXIFILE option may produce very large files for runs involving a large number of receptors if a significant percentage of the results exceed the threshold value.

The syntax and type for the POSTFILE keyword are summarized below:

Syntax:	OU POSTFILE Aveper Grpid Format Filnam (Funit)
Type:	Optional, Repeatable

where the Aveper parameter is the averaging period (e.g. 3, 8, 24 for 3, 8 and 24-hour averages, MONTH for monthly averages, PERIOD for period averages, or ANNUAL for annual averages) and Grpid is the source group ID for which the POSTFILE option is selected. The Format parameter specifies the format of the POSTFILE output, and may either be the secondary keyword UNFORM for unformatted concentration files, or the secondary keyword PLOT to obtain formatted files of receptor locations (x- and y-coordinates) and concentrations suitable for plotting contours of concurrent values. The Filnam parameter is the name of the file where the POSTFILE results are to be written. The optional Funit parameter allows the user the option of specifying the Fortran logical file unit for the output file. The user-specified file unit must be in the range of 20-100, inclusive. By specifying the same filename and unit for more than one POSTFILE card, results for different source groups and/or averaging periods may be combined into a single file. If the Funit parameter is omitted, then the model will dynamically allocate a unique file unit for this file (see Section 3.9.2).

The POSTFILE card may be repeated for each combination of averaging period and source group, and a different filename should be used for each file. If UNFORM is specified for the Format parameter, then the resulting unformatted file includes a constant-length record for each of the selected averaging periods calculated during the model run. The first variable of each record is an integer variable (4 bytes) containing the ending date (YYMMDDHH) for the averages on that record. The second

variable for each record is an integer variable (4 bytes) for the number of hours in the averaging period. The third variable for each record is a character variable of length eight containing the source group ID. The remaining variables of each record contain the calculated average concentration or total deposition values for all receptors, in the order in which they were defined in the input runstream.

The following examples illustrate the use of the POSTFILE option:

```
OU POSTFILE  24  ALL    UNFORM   PST24ALL.BIN
OU POSTFILE  24  PSD    UNFORM   PST24PSD.BIN
OU POSTFILE   3  PLANT  UNFORM   C:\BINOUT\PST3HR.FIL
OU POSTFILE  MONTH ALL    PLOT   PSTMONTH.PLT
OU POSTFILE PERIOD ALL    PLOT   PSTANN.PLT
```

where the 3-hour example illustrates the use of a DOS pathname for the PC, and the last example illustrates the use of monthly averages. The Filnam parameter may be up to 40 characters in length. The use of separate files for each averaging period/source group combination allows the user flexibility to select only those results that are needed for post-processing for a particular run, and also makes the resulting unformatted files manageable. Note: The POSTFILE option can produce very large files, and should be used with some caution. For a file of hourly values for a full year (8760 records) and 400 receptors, the resulting file will use about 14 megabytes of disk space. To estimate the size of the file (in bytes), use the following equation:

(# of Hrs/Yr)

$$\text{File Size (bytes)} = \frac{\text{\# of Rec + 4}}{\text{\# of Hrs/Ave}} * (\text{\# of Rec + 4}) * 4$$

Divide the result by 1000 to estimate the number of kilobytes (KB) and divide by 1.0E6 to estimate the number of megabytes (MB).

When more than one output type is selected among the list of CONC, DEPOS, DDEP, and/or WDEP, the post-processing output file will include all of the output types selected, in the order listed here. For the unformatted post-processing file, the results for each output type will be included on a single record for each averaging period and source group. For the PLOT-formatted post-processing file, the results for each output type will be printed in separate columns, one record per receptor, in the order given above.

The syntax and type for the PLOTFILE keyword are summarized below:

Syntax:	OU PLOTFILE Aveper Grpid Hivalu Filnam (Funit), or OU PLOTFILE PERIOD Grpid Filnam (Funit) OU PLOTFILE ANNUAL Grpid Filnam (Funit)
Type:	Optional, Repeatable

where the Aveper parameter is the averaging period (e.g. 3, 8, 24 for 3, 8 and 24-hour averages, MONTH for monthly averages, PERIOD for period averages, or ANNUAL for annual averages), Grpid is the source group ID for which the PLOTFILE option is selected, and Hivalu specifies which short term high values are to be output (FIRST for the first highest at each receptor, SECOND for the second highest at each receptor, etc.) Note that the Hivalu parameter is not specified for PERIOD or ANNUAL averages, since there is

only one period or annual average for each receptor. The Filnam parameter is the name of the file where the PLOTFILE results are to be written. The optional Funit parameter allows the user the option of specifying the Fortran logical file unit for the output file. The user-specified file unit must be in the range of 20-100, inclusive. By specifying the same filename and unit for more than one PLOTFILE card, results for different source groups and/or averaging periods may be combined into a single file. If the Funit parameter is omitted, then the model will dynamically allocate a unique file unit for this file (see Section 3.9.2).

The PLOTFILE card may be repeated for each combination of averaging period, source group, and high value, and a different filename should be used for each file. The resulting formatted file includes several records with header information identifying the averaging period, source group and high value number of the results, and then a record for each receptor which contains the x and y coordinates for the receptor location, the appropriate high value at that location, and the averaging period, source group and high value number. The data are written to the file in the order of x-coord, y-coord, concentration (or deposition) so that the file can easily be imported into a graphics package designed to generate contour plots. Many such programs will read the PLOTFILEs directly without any modification, ignoring the header records, and produce the desired plots.

The following examples illustrate the use of the PLOTFILE option:

```
OU PLOTFILE  24  ALL    FIRST  PLT24ALL.FST
OU PLOTFILE  24  ALL    SECOND PLT24ALL.SEC
OU PLOTFILE  24  PSD      2ND  PLTPSD.OUT      75
OU PLOTFILE   3  PSD      2ND  PLTPSD.OUT      75
OU PLOTFILE   3  PLANT    1ST  C:\PLOTS\PLT3HR.FIL
OU PLOTFILE MONTH ALL   THIRD  PLTMONTH.OUT
OU PLOTFILE PERIOD ALL         PSTANN.PLT
```

where the 3-hour example illustrates the use of a DOS pathname for the PC, and the last example illustrates the use of monthly averages. As illustrated by the second and third examples, the high value parameter may also be input as secondary keywords using the standard abbreviations of 1ST, 2ND, 3RD, . . . 10TH. The Filnam parameter may be up to 40 characters in length. The use of separate files for each averaging period, source group, high value combination allows the user flexibility to select only those results that are needed for plotting from a particular run.

When more than one output type is selected among the list of CONC, DEPOS, DDEP, and/or WDEP, the PLOTFILE output file will include all of the output types selected, in the order listed here. The results for each output type will be printed in separate columns, one record per receptor, in the order given above.

The syntax and type for the TOXXFILE keyword are summarized below:

Syntax:	OU TOXXFILE Aveper Cutoff Filnam (Funit)
Type:	Optional, Repeatable

where the Aveper parameter is the short term averaging period (e.g. 1, 3, 8, 24 for 1, 3, 8 and 24-hour averages, or MONTH for monthly averages) for which the TOXXFILE option has been selected. The Cutoff (threshold) parameter is the user-specified threshold cutoff value in g/m^3, and Filnam is the name of the file where the TOXXFILE results are to be written. It is important to note that the units of the Cutoff parameter are g/m^3, regardless of the input and output units selected with the SO EMISUNIT card. The optional Funit parameter allows the user the option of specifying the Fortran logical file unit for the output file. The user-specified file unit must be in the range of 20-100, inclusive. If the Funit parameter is omitted, then the model will dynamically allocate a unique file unit for this file (see Section 3.8.2). While the TOXXFILE option may be specified for any of the short term averaging periods that are identified on the CO AVERTIME card for a particular run, a non-fatal warning message will be generated if other than 1-hour averages are specified. This is because the TOXST model currently supports only 1-hour averages.

The TOXXFILE card may be repeated for each averaging period, but a different filename should be used for each file since the structure of the output file generated by the TOXXFILE option does not allow for a clear way to distinguish between results for different averaging periods. The resulting output file for the Short Term model is an unformatted file with several header records identifying the title, averaging period, receptor information, and the threshold value for that file, followed by records listing every occurrence where the result for any source group for that averaging period equals or exceeds the threshold value. When one of the source groups exceeds the threshold value, the results for all source groups for that averaging period and receptor location are output. Each concentration that is output through the TOXXFILE option is paired with an integer ID variable that identifies the averaging period (hour number of the

year), the source group number, and the receptor number corresponding to that value. The concentration values and corresponding ID variables are stored in buffer arrays, and the arrays are then written to the unformatted output file when full. The size of the arrays is controlled by the NPAIR PARAMETER defined in the MAIN1.INC file, and is initially set at 100. At the end of the modeling run, any values remaining in the buffer arrays are written to the file, padded to the right with zeroes. The structure of the output file generated by the TOXXFILE option is described in more detail in Section 3.8.2 and in Appendix F. When using the TOXXFILE option, the user will normally place a single source in each source group, and may need to modify the array storage PARAMETERs in MAIN1.INC to accommodate certain modeling needs. The user should refer to the user's guide for TOXST for further instructions on the application of the TOXXFILE option of the ISCST model.

The following examples illustrate the use of the TOXXFILE option:

```
OU TOXXFILE   1  1.0E-5   TOXX1HR.BIN
OU TOXXFILE  24  2.5E-3   TOXX24HR.BIN    50
```

The Filnam parameter may be up to 40 characters in length. It should be noted that only one TOXXFILE card may be used for each averaging period. Note: The TOXXFILE option may produce very large files for runs involving a large number of receptors if a significant percentage of the results exceed the threshold value. If more than one output type is selected in a model run, then the TOXXFILE threshold will only apply to the first output type selected among the list of CONC, DEPOS, DDEP, and/or WDEP, and only the corresponding value will be output in the TOXXFILE output file.

3.8.2 Short Term EVENT Model (ISCEV) Options

The ISC Short Term EVENT model (ISCEV) is designed specifically to perform source contribution analyses for short term average (less than or equal to 24-hour) events. The events may either be generated by the ISCST model, or they may be user-specified events, or both. Because of this rather narrow focus of applications for the ISCEV model, the output options are limited to a single keyword. The EVENTOUT keyword controls the level of detail in the source contribution output from the EVENT model. The syntax and type of the EVENTOUT keyword are summarized below:

Syntax:	OU EVENTOUT SOCONT DETAIL
Type:	Mandatory, Non-repeatable

where the SOCONT secondary keyword specifies the option to produce only the source contribution information in the output file, and the DETAIL secondary keyword specifies the option to produce more detailed summaries in the output file. The SOCONT option provides the average concentration (or total deposition) value (i.e., the contribution) from each source for the period corresponding to the event for the source group. The basic source contribution information is also provided with the DETAIL option. In addition, the DETAIL option provides the hourly average concentration (or total deposition) values for each source for every hour in the averaging period, and a summary of the hourly meteorological data for the event period. In general, the DETAIL option produces a larger output file than the SOCONT file, especially if there are a large number of sources. There is no default setting for the EVENTOUT options.

3.8.3 Long Term Model Options

The ISCLT model has three keywords available on the OU pathway to specify the output options. The RECTABLE and MAXTABLE keywords are similar to the corresponding keywords for the ISCST model in that RECTABLE specifies the options for tabular summaries of results by receptor, and MAXTABLE specifies options for tabular summaries of overall maximum results. The third keyword, PLOTFILE, is also similar to the corresponding keyword for ISCST, and allows the user to generate separate output files suitable for importing into graphics packages to generate contour plots. However, the parameters on these keywords differ between the two models because of the different data structures of the models.

For the Short Term model there are several short term averages during the data period, from which the model sorts and stores the highest, second highest and third highest values at each location, whereas for the Long Term model, there is only one long term average result at each location. Because of these differences in the data structure, the Long Term model is able to store the results for all sources at each receptor location, in addition to the combined source group values. Therefore, the output keywords for Long Term include options to summarize results for each source or for the source groups, and also to provide source contribution information for the maximum source group values (thereby eliminating the need for a Long Term EVENT model).

The syntax and type for the Long Term RECTABLE keyword are summarized below:

Syntax:	OU RECTABLE INDSRC and/or SRCGRP
Type:	Optional, Non-repeatable

where the INDSRC secondary keyword specifies that summaries of individual sources for each receptor are to be output, and the secondary keyword SRCGRP specifies that summaries of source group values for each receptor are to be provided. The user may select either option or both options in a given run. The individual source values are presented first in the output file, with the results by receptor network followed by any discrete Cartesian receptors, discrete polar receptors and boundary receptors. The source group results follow the same pattern as the individual source tables. A complete set of summary tables is output for each STAR summary processed, and for the PERIOD averages, if calculated.

The syntax and type for the Long Term MAXTABLE keyword are summarized below:

Syntax:	OU MAXTABLE Maxnum INDSRC and/or SRCGRP and/or SOCONT
Type:	Optional, Non-repeatable

where the Maxnum parameter specifies the number of maximum values to summarize, and where the INDSRC and SRCGRP secondary keywords specify that summaries of maximum values for individual sources and for source groups, respectively, are to be provided. The individual source maximum values are treated independently of the source group maxima with the INDSRC option. To obtain the contribution from each source to the maximum source group values (similar to the information obtained from ISCEV), the user may select the SOCONT option. The user may select any combination of these options in a given run. If the SOCONT option is selected, and the SRCGRP option has not been

selected, the model will automatically determine the maximum source group values so that the source contribution analysis can be performed, but the maximum source group values will not be included in the output file. The individual source values are presented first in the output file, followed by the maximum source group values, and the source contribution results, according to the options selected. A complete set of maximum value summary tables is output for each STAR summary processed, and for the PERIOD averages, if calculated.

The number of overall maximum values that the model can store for each source and source group is controlled by the NMAX PARAMETER in the Fortran computer code. The value of NMAX is initially set at 10 for the Long Term model. The NMAX PARAMETER can be changed (up or down), and the model recompiled in order to meet other modeling needs, assuming sufficient memory is available for the model's storage requirements. Changing the model storage limits is discussed in more detail in Section 4.2.2.

The syntax and type for the Long Term PLOTFILE keyword are summarized below:

Syntax:	OU PLOTFILE Aveper Grpid Filnam (Funit)
Type:	Optional, Repeatable

where the Aveper parameter is the long term averaging period (e.g. WINTER, SPRING, etc.) and Grpid is the source group ID for which the PLOTFILE option is selected. The Filnam parameter is the name of the file where the PLOTFILE results are to be written. The optional Funit parameter allows the user the option of specifying the Fortran logical file unit for the output file. The user-specified file unit must be in the range of 20-100, inclusive. If the Funit parameter is omitted, then the model will dynamically

allocate a unique file unit for this file (see Section 3.8.2). The PLOTFILE card may be repeated for each combination of averaging period and source group, and a different filename should be used for each file. The resulting formatted file includes several records with header information identifying the averaging period and source group of the results, and then a record for each receptor which contains the x and y coordinates for the receptor location, the long term average value at that location, the averaging period and the source group ID. The data are written to the file in the order of x-coord, y-coord, concentration (or deposition) so that the file can easily be imported into a graphics package designed to generate contour plots. Many such programs will read the PLOTFILEs directly without any modification, although the user may have to delete the header records to produce the desired plots.

The syntax and type for the Long Term TOXXFILE keyword are summarized below:

Syntax:	OU TOXXFILE Aveper Grpid Filnam (Funit)
Type:	Optional, Repeatable

where the Aveper parameter is the long term averaging period (e.g. WINTER, SPRING, etc.) and Grpid is the source group ID for which the TOXXFILE option is selected. The PERIOD average, if selected on the CO AVERTIME card, may also be specified for the Aveper parameter for period averages. The optional Funit parameter allows the user the option of specifying the Fortran logical file unit for the output file. The user-specified file unit must be in the range of 20-100, inclusive. If the Funit parameter is omitted, then the model will dynamically allocate a unique file unit for this file (see Section 3.8.2). The TOXXFILE card may be repeated for each combination of averaging period and

source group, and a different filename should normally be used for each file. The resulting formatted file includes several records with header information identifying the averaging period and source group of the results, and then a record for each receptor which contains the x and y coordinates for the receptor location, the long term average value at that location, the averaging period and the source group ID. The data are written to the file in the order of x-coord, y-coord, concentration (or deposition) so that the file can easily be imported into a graphics package designed to generate contour plots. Many such programs will read the TOXXFILEs directly without any modification, although the user may have to delete the header records to produce the desired plots. Each TOXXFILE output file includes the results for each source in the specified source group, in the order in which they are defined on the SO pathway.

The example below illustrates the use of various Long Term model output options:

```
OU RECTABLE  INDSRC  SRCGRP
OU MAXTABLE  10  INDSRC  SRCGRP  SOCONT
OU PLOTFILE  WINTER  ALL  PLTWINT.OUT
OU PLOTFILE  SPRING  PSD  PSDSPRG.PLT
OU PLOTFILE  ANNUAL  PLANT C:\PLOTS\PLANT.ALL
OU TOXXFILE  WINTER  ALL     WINTTOXX.OUT   25
OU TOXXFILE  PERIOD  GROUP1  PERTOX.OUT
```

where all of the tabular printed output options have been selected, and several PLOTFILE and TOXXFILE options have also been selected.

3.9 CONTROLLING INPUT AND OUTPUT FILES

This section describes the various input and output files used by the ISC models, and discusses control of input and output (I/O) on the IBM-compatible PC environment. Much of this discussion also applies to operating the models in other environments.

3.9.1 Description of ISC Input Files

The two basic types of input files needed to run all of the ISC models are the input runstream file containing the modeling options, source data and receptor data, and the input meteorological data file. Each of these is discussed below, as well as a special file that may be used to initialize the ISCST model with intermediate results from a previous run.

3.9.1.1 Input Runstream File.

The input runstream file contains the user-specified options for running the various ISC models, includes the source parameter data and source group information, defines the receptor locations, specifies the location and parameters regarding the meteorological data, and specifies the output options. The basic structure of the input runstream file is the same for all three models, although the list of available keywords for defining options, and the exact syntax for certain keywords are slightly different between the Short Term and Long Term models. Details regarding the keywords and parameters used in the input runstream file are provided in Section 3, and Appendix B.

For the PC-executable versions of the models available on the SCRAM BBS, the runstream file is explicitly opened by the models using a Fortran OPEN statement, and the integer variable, INUNIT, specifies the unit number for the file. The variable INUNIT is initialized to a value of 5 in a BLOCK DATA subprogram of the model, which corresponds to the default input unit for Fortran. The INUNIT variable is included in a named COMMON block (FUNITS) in the MAIN1.INC include file, and is therefore available to all of the necessary subroutines.

Since the input runstream file is opened explicitly by the PC-executable versions of the models, the model will take the first parameter on the command line when running the model as the input filename. No DOS redirection symbol should be used preceding the runstream filename.

3.9.1.2 Meteorological Data File.

The input meteorological data is read into the models from a separate data file for all three models. The meteorological filename and format are specified within the input runstream file using the ME INPUTFIL keyword. The Short Term models accept meteorological data from unformatted sequential files generated by the PCRAMMET and MPRM preprocessors, and also accept a wide range of formatted ASCII files of hourly sequential records. The Long Term model accepts STability ARray (STAR) meteorological data from sequential ASCII files using either a default READ format, a user-specified READ format or free-formatted READs.

The meteorological data file is explicitly opened by the models using a Fortran OPEN statement, and the integer variable, MFUNIT, specifies the unit number for the

file. The variable MFUNIT is initialized to a value of 19 in a BLOCK DATA subprogram of the model. The MFUNIT variable is included in a named COMMON block (FUNITS) in the MAIN1.INC include file, and is therefore available to all of the necessary subroutines.

3.9.1.3 Initialization File for Model Re-start.

The ISCST model has an optional capability to store intermediate results to an unformatted (sometimes called binary) file for later re-starting of the model in the event of a power failure or user interrupt. This unformatted file may therefore be used as an input file to initialize the model. This option is controlled by the SAVEFILE (saves intermediate results to a file) and the INITFILE (initialize result arrays from a previously saved file) keywords on the CO pathway.

When initializing the model for the re-start option, the user specifies the name of the unformatted results file on the INITFILE keyword. The default filename used if no parameter is provided is SAVE.FIL. The initialization file is explicitly opened by the ISCST model, and the integer variable, IRSUNT, specifies the unit number for the file. The variable IRSUNT is initialized to a value of 15 in a BLOCK DATA subprogram of the model. The IRSUNT variable is included in a named COMMON block (FUNITS) in the MAIN1.INC include file, and is therefore available to all of the necessary subroutines.

3.9.2 Description of ISC Output Files

The ISC models produce a variety of output files, including the main print file of model results, an unformatted file of intermediate results for later re-start of the

model (ISCST only), and several output data files for specialized purposes. These files are described in detail below.

3.9.2.1 Output Print File.

Each of the ISC models produces a main output print file of model results. The contents and organization of this file for the ISCST model were shown in Figure 2-5. This file includes an echo of the input runstream images at the beginning of the file (up until a NO ECHO input is encountered). A summary of runstream setup messages and a summary of the inputs follow the echo of inputs. The input summary includes a summary of modeling options, source data, receptor data, and meteorological data, following the same order as the pathways in the runstream file. If model calculations are performed, then the model results are summarized next. The content and order of the model result summaries depend on the output options selected and on the particular model being run. Following the detailed model results are summary tables of the high values for each averaging period and source group (ISCST only). The final portion of the main output print file is the summary of messages for the complete model run.

For the PC-executable versions of the models available on the SCRAM BBS, the main print output file is explicitly opened by the models using a Fortran OPEN statement, and the integer variable, IOUNIT, specifies the unit number for the file. The variable IOUNIT is initialized to a value of 6 in a BLOCK DATA subprogram of the model, which corresponds to the default output unit for Fortran. The IOUNIT variable is included in a named COMMON block (FUNITS) in the MAIN1.INC include file, and is therefore available to all of the necessary subroutines.

Since the main print output file is opened explicitly, the model will take the second parameter on the command line when running the model as the output filename. No DOS redirection symbol should be used preceding the output filename. If an output file is not given on the command line, then the model will return an error message and abort execution.

By opening the printed output file explicitly, the outputs are not automatically formatted for the printer. This formatting is accomplished using the CARRIAGE CONTROL specifier in the OPEN statement for the Lahey extended memory version of the models, and by explicitly writing the ASCII form feed character to the file for the Microsoft DOS version.

3.9.2.2 Detailed Error Message File.

The user may select an option for the model to save a separate file of detailed error and other messages, through use of the CO ERRORFIL keyword. The format and syntax of these messages is described in Appendix E. The order of messages within the file is the order in which they were generated by the model. The file includes all types of messages that were generated.

The error message file is explicitly opened by the model using a Fortran OPEN statement, and the integer variable, IERUNT, specifies the unit number for the file. The variable IERUNT is initialized to a value of 10 in a BLOCK DATA subprogram of the model. The IERUNT variable is included in a named COMMON block (FUNITS) in the MAIN1.INC include file, and is therefore available to all of the necessary subroutines.

3.9.2.3 Intermediate Results File for Model Re-start.

The ISCST model has an optional capability to store intermediate results to an unformatted (sometimes called binary) file for later re-starting of the model in the event of a power failure or user interrupt. This unformatted file may therefore be used as an input file to initialize the model. This option is controlled by the SAVEFILE (saves intermediate results to a file) and the INITFILE (initialize result arrays from a previously saved file) keywords on the CO pathway.

When saving the intermediate results for the re-start option, the user specifies the name of the unformatted results file on the SAVEFILE keyword. The user has the option of specifying a single filename, two filenames (for alternate saves), or specifying no filename. The default filename used if no parameter is provided is SAVE.FIL. If a single file is used, then the intermediate results file is overwritten on each successive dump, with the chance that the file will be lost if the interrupt occurs during the time that the file is opened. If two filenames are provided, then the model also saves to the second file on alternate dumps, so that the next most recent dump will always be available. The main save file is explicitly opened by the ISCST model, and the integer variable, IDPUNT, specifies the unit number for the file. The variable IDPUNT is initialized to a value of 12 in a BLOCK DATA subprogram of the model. If a second save file is used, then it is also opened explicitly, and the integer variable IDPUN2, initialized to a value of 14, specifies the unit number.

3.9.2.4 Maximum Value/Threshold File.

The user may select an option for the ISCST model to generate a file or files of concentration (or deposition) values exceeding a user-specified threshold. The OU MAXIFILE keyword controls this option. The user may select separate files for each averaging period and source group combination for which a list of threshold violations may be needed. Each file includes several records with header information identifying the averaging period, source group and threshold value, and then a record for every occurrence where the result for that averaging period/source group equals or exceeds the threshold value. Each of these records includes the averaging period, source group ID, date for the threshold violation (ending hour of the averaging period), the x, y, z and flagpole receptor height for the receptor location where the violation occurred, and the concentration or deposition value.

The structure of the threshold violation file is described in more detail in Appendix F. Each of the files selected by the user is opened explicitly by the model as an formatted file. The filenames are provided on the input runstream image. The user may specify the file unit on the MAXIFILE card through the optional FUNIT parameter. User-specified units must be greater than or equal to 20, and are recommended to be less than or equal to 100. If no file unit is specified, then the file unit is determined internally according to the following formula:

IMXUNT = 100 + IGRP*10 + IAVE

where IMXUNT is the Fortran unit number, IGRP is the source group number (the order in which the group is defined in the runstream file), and IAVE is the averaging period

number (the order of the averaging period as specified on the CO AVERTIME card). This formula will not cause any conflict with other file units used by the model for up to 9 source groups and up to 9 short term averaging periods.

3.9.2.5 Sequential Results File for Postprocessing.

The user may select an option for the ISCST model to generate a file or files of concentration (or deposition) values suitable for postprocessing. The OU POSTFILE keyword controls this option. The user may select separate files for each averaging period and source group combination for which postprocessing may be needed. For each file requested, the user has the option of specifying whether to use unformatted files suitable for postprocessing or to use a plot format which could allow for inporting the x,y,conc files into a graphics package for plotting. For the unformatted file option, each file consists of sequential unformatted records of values at each receptor location for every averaging period calculated. For the plot file format option, each file consists of formatted records listing the x-coordinate, y-coordinate and concurrent concentration (or deposition) values for each receptor and for all averaging periods calculated. For certain applications, these files may become quite large, and should only be used when needed, especially when using the plot format.

The structure of both types of postprocessing file is described in more detail in Appendix F. Each of the postprocessing files selected by the user is opened explicitly by the model as either an unformatted or a formatted file, depending on the option selected. The filenames are provided on the input runstream image. The user may specify the file unit on the POSTFILE card through the optional FUNIT parameter. User-specified units must be greater than or equal to 20, and are recommended to be less

than or equal to 100. If no file unit is specified, then the file unit is determined internally according to the following formulas:

```
IPSUNT = 200 + IGRP*10 + IAVE     for short term averages
IAPUNT = 300 + IGRP*10 - 5        for PERIOD averages
```

where IPSUNT and IAPUNT are the Fortran unit numbers, IGRP is the source group number (the order in which the group is defined in the runstream file), and IAVE is the averaging period number (the order of the averaging period as specified on the CO AVERTIME card). This formula will not cause any conflict with other file units used by the model for up to 9 source groups and up to 9 short term averaging periods.

3.9.2.6 High Value Summary File for Plotting.

The user may select an option for the ISCST model to generate a file or files of the highest concentration (or deposition) values at each receptor suitable for importing into a graphics package in order to generate contour plots. The OU PLOTFILE keyword controls this option. The user may select separate files for each averaging period, source group and high value combination for which a plot file may be needed. Each file includes several records with header information identifying the averaging period, source group and high value number of the results, and then a record for each receptor which contains the x and y coordinates for the receptor location, the appropriate high value at that location, and the averaging period, source group and high value number.

The structure of the plot file is described in more detail in Appendix F. Each of the plot files selected by the user is opened explicitly by the model as an formatted

file. The filenames are provided on the input runstream image. The user may specify the file unit on the PLOTFILE card through the optional FUNIT parameter. User-specified units must be greater than or equal to 20, and are recommended to be less than or equal to 100. If no file unit is specified, then the file unit is determined internally according to the following formulas:

```
IPLUNT = (IVAL+3)*100 + IGRP*10 + IAVE  for short term aver.
IPPUNT = 300 + IGRP*10                  for PERIOD averages
```

where IPLUNT and IPPUNT are the Fortran unit numbers, IVAL is the high value number (1 for FIRST highest, 2 for SECOND highest, etc.), IGRP is the source group number (the order in which the group is defined in the runstream file), and IAVE is the averaging period number (the order of the averaging period as specified on the CO AVERTIME card). This formula will not cause any conflict with other file units used by the model for up to 9 source groups and up to 9 short term averaging periods.

3.9.2.7 TOXX Model Input Files

The user may select an option for the ISCST model to generate an unformatted file or files of concentration (or deposition) values exceeding a user-specified threshold for use with the TOXX model component of TOXST. The OU TOXXFILE keyword controls this option. The user may select separate files for each averaging period for which a threshold violation file may be needed. Each file includes several records with header information identifying the title, averaging period, threshold value, and receptor network information, and then records including every occurrence where the result of any source group for that averaging period equals or exceeds the threshold value. Records

are also output that identify the averaging period (hour number of the year), source group number and receptor number corresponding to the concentration values.

The structure of the threshold exceedance file for use with the TOXX model component of TOXST is described in more detail in Appendix F. Each of the files selected by the user is opened explicitly by the model as an unformatted file. The filenames are provided on the input runstream image. The user may specify the file unit on the TOXXFILE card through the optional Funit parameter. User-specified units must be greater than or equal to 20, and are recommended to be less than or equal to 100. If no file unit is specified, then the file unit is determined internally according to the following formula:

```
ITXUNT = 300 + IAVE
```

where ITXUNT is the Fortran unit number, and IAVE is the averaging period number (the order of the averaging period as specified on the CO AVERTIME card). This formula will not cause any conflict with other file units used by the model for up to 4 short term averaging periods.

The user may also select an option for the ISCLT model to generate an output for use with the RISK model component of TOXLT. The OU TOXXFILE keyword also controls this option. The user can specify a separate TOXXFILE for each long term averaging period and source group combination. The TOXXFILE option may also be used for PERIOD averages with the ISCLT model. The structure of the TOXXFILE output for ISCLT is very similar to the long term PLOTFILE output, except that results are output for each individual source in the specified source group. The structure of the long term TOXXFILE is described in

more detail in Appendix F. Each of the files selected by the user is opened explicitly by the model as a formatted file. The filenames are provided on the input runstream image. The user may specify the file unit on the TOXXFILE card through the optional Funit parameter. User-specified units must be greater than or equal to 20, and are recommended to be less than or equal to 100. If no file unit is specified, then the file unit is determined internally according to the following formulas:

```
ITXUNT = 500 + IAVE*10 + IGRP      for long term averages
IPXUNT = 700 + IGRP*10             for PERIOD averages
```

where ITXUNT and IPXUNT are the Fortran unit numbers, IAVE is the averaging period number (in the order of months, seasons or quarters, and annual), and IGRP is the source group number (in the order is which the groups are defined in the SO pathway). This formula will not cause any conflict with other file units used by the model for up to 9 source groups.

3.9.3 Control of File Inputs and Outputs (I/O)

3.9.3.1 Control of I/O on DOS PCs.

The main input runstream file and the main output print file are both specified on the command line when running the models on a PC. Since the PC-executable file provided explicitly opens these two files, there is no need to use DOS redirection of input and output. Therefore, a standard command line to execute the ISCST model might look something like this:

```
C:\>ISCST3 TEST-ST.INP TEST-ST.OUT
```

where the "DOS prompt" has been given as "C:\>", but may look different on different systems, or may include a subdirectory specification. Since DOS redirection is not used for the output file, an output filename must be specified or the model will not execute properly. This is done to allow for the model to write an update to the PC terminal on the status of processing. The output file generated by the DOS version includes page feeds that are written directly to the file as part of the header for each page, rather than using the Fortran carriage control of '1'.

3.9.3.2 Controlling I/O on Other Computer Systems.

The PC-executable versions of the models that are available on the SCRAM BBS includes certain features that are specific to operating the models in a PC environment. These include specifying the input and output file names on the command line and writing an update on the status of the processing to the computer screen. In order to accomplish the latter, the output file is opened explicitly. The PC versions also include writing a date and time for the run on each page of the printed output file. The Fortran computer code that is used to implement these PC-specific features has been commented out in the source code files available on SCRAM. This is done in order to make the most use of the features available for the PC while at the same time making the Fortran source code as "portable" to other computer systems as reasonably possible. This section briefly addresses the control of model input and output for non-PC computer systems.

With the PC-specific code commented out in the ISC source code, the models will use the default input unit (Fortran unit 5) for reading the input runstream file, and the default output unit (Fortran unit 6) for writing the printed output file. These files are not opened explicitly by the models with the PC code commented out. These files have to be defined, using the $DEFINE command in VAX/VMS and using the DD statement in the JCL for the IBM/MVS. Refer to Section 4.3 for additional information about running the models in other environments.

4.0 COMPUTER NOTES

This section provides information regarding the computer aspects of the ISC models, including the minimum hardware requirements for executing the models on a PC, instructions regarding compiling and running the models on a PC, and information regarding porting the models to other computer systems. A more detailed Programmer's Guide is provided in Volume III of the ISC Model User's Guide, including details regarding the design of the computer code.

4.1 MINIMUM HARDWARE REQUIREMENTS

4.1.1 Requirements for Execution on a PC

The ISC models were developed on an IBM-compatible PC, and were designed to run on PCs with certain minimum hardware requirements. The basic requirements are as follows:

- 80x86 processor (e.g., 8086, 80286, 80386, 80486)
- 640 K of RAM
- Hard Disk with sufficient storage space to handle the executable file, input data files, and output files (file sizes will vary, generally about 2 MB will be sufficient for routine applications)

While a math coprocessor (80x87 chip) is optional for execution of the DOS versions of the ISC models on a PC, it is highly recommended, especially for the ISCST model, due to the large increase in execution speed that will be experienced. The model may be expected to run about five to ten times faster with a math coprocessor than without one.

The DOS models are compiled using an emulator library, meaning that a math coprocessor will be used if one is present, but the models will also run without one.

The ISC models were designed assuming a PC with a minimum of 640 K of RAM, with the minimum amount of available RAM for loading the various models (as provided on the SCRAM BBS) of about 510 K. Because additional memory is needed (for buffers) when the models open files (such as the input runstream file, the printed output file, the error message file, etc.), the amount of memory needed to actually run the models will be somewhat larger than the minimum load size for the executable file. Depending on the number of externally files being used for a particular application, an additional 10K of memory may be required.

The amount of available memory on a particular machine will depend on the machine configuration including the amount of memory used by the operating system, memory used by any special device drivers, and any memory-resident utility programs. Generally, a 640K PC with minimal memory overhead will have about 550 to 580K of RAM available for applications, such as the ISC models. The amount of available RAM can be determined by executing the DOS CHKDSK command. This is done by entering the command 'CHKDSK C:' to check the C: drive. Refer to the DOS manual for more information about CHKDSK.

For particularly large applications, involving a large number of sources, source groups, receptors and averaging periods, the user may find that the 640K RAM limit available with DOS is not enough. This section contains information on increasing the capacity of the model and setting it up to run on systems (with 80386 processors and higher) that make use of extended memory beyond the 640K limit of DOS. There are

special requirements for the operating system and Fortran language compiler needed to utilize the extended memory on these machines.

4.1.2 Requirements for Execution on a DEC VAX Minicomputer

ISCST will run on any DEC VAX minicomputer or workstation which has enough main memory to do the real application run. More than 5 MBytes user disk space is recommended.

4.1.3 Requirements for Execution on an IBM Mainframe

ISCST will run on any IBM 3090 or above mainframe as long as the machine supports enough memory. The size of the desired memory depends on the size of the application case run. At least 5 MBytes user disk space is recommended.

4.2 COMPILING AND RUNNING THE MODELS ON A PC

As mentioned earlier, the ISC models were developed on an IBM-compatible PC, using the Microsoft Optimizing FORTRAN Compiler (Version 5.1). This section provides details regarding compiling and running the models on a PC.

4.2.1 Microsoft Compiler Options

The DOS versions of the executable files (.EXE) of the models provided on the SCRAM BBS were compiled with the Microsoft Optimizing FORTRAN Compiler (Version 5.1) using the following command line:

```
FL /c /FPi /AH /DMICRO *.FOR
```

where /c instructs the compiler to compile without linking; the /FPi option instructs the compiler to use in-line instructions for floating point operations and link with an emulator library (uses 80x87 coprocessor if present); the /AH option that the huge memory model be used, allowing arrays or common blocks to exceed 64K; and the /DMICRO option instructs the compiler to use the conditional compilation blocks defined for the Microsoft compiler. These conditional blocks of code implement the PC-specific features of the model including writing the date and time fields on each page of the printed output file and writing an update to the screen on the status of processing. The *.FOR parameter tells the compiler to compile all files in the default directory ending with an extension of *.FOR. This assumes that all of the source code modules and the include files are in a single directory, or that the compiler has been setup to search for the include files in the appropriate directory. This command line for the compiler makes full use of the compiler's optimization routines to speed up the code. To disable optimization, the /Od option would be added.

The source modules for the ISCST model are as follows:

```
ISCST3.FOR  -  Main program, error handling and other utilities
PCCODE.FOR  -  PC-specific code for command line, date and time
SETUP.FOR   -  Main SETUP subroutines and initialization module
INPSUM.FOR  -  Subroutines to summarize the input data
COSET.FOR   -  Subroutines to process CO pathway inputs
SOSET.FOR   -  Subroutines to process SO pathway inputs
RESET.FOR   -  Subroutines to process RE pathway inputs
MESET.FOR   -  Subroutines to process ME pathway inputs
TGSET.FOR   -  Subroutines to process TG pathway inputs
OUSET.FOR   -  Subroutines to process OU pathway inputs
```

METEXT.FOR	-	Extracts and checks the meteorological data
CALC1.FOR	-	Main calculation subroutines, including source-type specific
CALC2.FOR	-	Secondary group of calculation subroutines for hourly values
CALC3.FOR	-	Group of subroutines to process and sort averages
CALC4.FOR	-	Group of subroutines to output results as calculated (e.g. DAYTABLE and POSTFILE results)
PRISE.FOR	-	Plume rise subroutines
SIGMAS.FOR	-	Dispersion parameter subroutines
PITAREA.FOR	-	Open pit and area source subroutines
OUTPUT.FOR	-	Model output subroutines
DEPFLUX.FOR	-	Group of subroutines to perform dry deposition calculations
MAIN1.INC	-	First INCLUDE file, used throughout model
MAIN2.INC	-	Second INCLUDE file, used for MODNAM variable only
MAIN3.INC	-	Third INCLUDE file, contains only results arrays
DEPVAR.INC	-	INCLUDE file for common variables used with the DEPFLUX block of subroutines

Once the source files have been compiled successfully, and object (.OBJ) files have been generated for each source file, the model is ready to be linked and an executable file created. The Microsoft executable file on the SCRAM BBS was linked using a memory overlay manager so that only certain portions of the code are resident in memory at any given time. This allows for a more efficient use of available memory by the model, and therefore allows for larger runs to be performed than would be possible without using overlays. This is accomplished with the following command line for the linker provided with the Microsoft compiler:

```
LINK /E /SE:256 ISCST3+PCCODE+SETUP+(INPSUM)+(COSET)+(SOSET)+(RESET)+(MESET)+(TGSET)+(OUSET)+(METEXT+
             CALC1+CALC2+CALC3+PRISE+SIGMAS+CALC4+DEPFLUX+PITAREA)+(OUTPUT)
```

The /E option instructs the linker to produce a packed executable file that occupies less disk space. The /SE:256 option increases the number of segments allowed to 256. The ISCST3, PCCODE and SETUP modules are always memory resident, and any module or group

of modules within parentheses are overlayed into the same area of memory only when needed. Linking without the overlay manager will increase the minimum load size for the executable file by about 200K for the ISCST model. Since most of the overlay swapping occurs during the setup processing, which is only a very small fraction of the execution time for normal sized applications, the use of overlays does not significantly effect the execution time of the model. The load size of the model can be reduced somewhat by placing the SETUP and CALC4 modules in separate overlays. Placing SETUP in an overlay will only effect performance (execution speed) for the setup processing stage, and will only be significant for relatively long input runstream files (e.g. with a large number of sources or with many discrete receptors). If the application does not make use of the SAVEFILE, DAYTABLE, MAXIFILE and/or POSTFILE keyword options (where results are output as their are calculated), then moving the CALC4 module to a separate overlay will not effect performance at all, since it is only called if one of those options is used. An example of the LINK command to minimize the load size of the model is as follows:

```
LINK /E /SE:256 ISCST3+PCCODE+(SETUP)+(INPSUM)+(COSET)+(SOSET)+(RESET)+(MESET)+(TGSET)+(OUSET)+(METEXT+
              CALC1+CALC2+CALC3+PRISE+SIGMAS+DEPFLUX+PITAREA)+(CALC4)+(OUTPUT)
```

This overlay structure will reduce the load size by about 24K for the ISCST model.

4.2.2 Modifying PARAMETER Statements for Unusual Modeling Needs

As discussed in Section 2.3, the ISC models make use of a static storage allocation design, where the model results are stored in explicitly dimensioned data arrays, and the array limits are controlled by PARAMETER statements in the Fortran computer code. These array limits also correspond to the limits on the number of sources, receptors, source groups and averaging periods that the model can accept for a given run. Depending

on the amount of memory available on the particular computer system being used, and the needs for a particular modeling application, the storage limits can easily be changed by modifying the PARAMETER statements and recompiling the model.

The limits on the number of receptors, sources, source groups, averaging periods, and events (for ISCEV model) are initially set as follows for the three models for the DOS and extended memory (EM) versions on the PC:

PARAMETER Name	Limit Controlled	ISCST	ISCEV	ISCLT
NREC	Number of Receptors	500 (DOS) 1200 (EM)	-	500 (DOS) 1200 (EM)
NSRC	Number of Sources	100 (DOS) 300 (EM)	100 (DOS) 500 (EM)	50 (DOS) 300 (EM)
NGRP	Number of Source Groups	2 (DOS) 4 (EM)	25 (DOS) 50 (EM)	3 (DOS) 5 (EM)
NAVE	Number of Short Term Averages	2 (DOS) 4 (EM)	4 (DOS) 4 (EM)	-
NEVE	Number of Events	-	2500 (DOS) 5000 (EM)	-

Fortran PARAMETER statements are also used to specify the array limits for the number of output types (CONC, DEPOS, DDEP, and/or WDEP) available with the ISCST model (NTYP, initially set to 2 for the DOS version and 4 for the EM version), the number of high short term values by receptor to store for the ISCST model (NVAL, initially set to 2 for the DOS version and 6 for the EM version), the number of overall maximum values to store (NMAX, initially set to 50 for ISCST and to 10 for Long Term), and the number of

x-coordinates and y-coordinates that may be included in the optional terrain grid file (MXTX and MXTY, initially set to 101 for the DOS version of Short Term, 201 for the DOS version of Long Term, and 601 for the EM version of both models).

In addition to the parameters mentioned above, parameters are used to specify the number of gridded receptor networks in a particular run (NNET), and the number of x-coordinate (or distance) and y-coordinate (or direction) values (IXM and IYM) for each receptor network. Initially, the models allow up to 5 receptor networks (of any type), and up to 50 x-coordinates (or distances) and up to 50 y-coordinates (or directions). The source arrays also include limits on the number of variable emission rate factors per source (NQF, initially set to 24 for the DOS version of Short Term and 96 for the EM version of Short Term, and to 36 for the DOS version of Long Term and 144 for the EM version of Long Term), the number of sectors for direction-specific building dimensions (NSEC, initially set to 36 for Short Term and 16 for Long Term), and the number of settling and removal categories (NPDMAX, initially set to 10 for the DOS version of Short Term and 20 for the EM version of Short Term and both versions of Long Term).

To modify the array limits for the model, the user must first edit the appropriate PARAMETER values in the MAIN1.INC file for that model. Once the array limits have been customized to a particular application's needs, then the entire model must be recompiled and linked (see Section 4.2.1 above). Because the high value arrays in the ISCST model are 5-dimensional arrays (NREC,NVAL,NGRP,NAVE,NTYP) and there are three arrays with these dimensions (the sorted high values, the data period for each value, and the calm and missing value flag for each value), the model's storage requirements are particularly sensitive to increasing the number of source groups or the number of high values to store at each receptor location. For example, the amount of storage space

required to store these three arrays with the initial PARAMETER values for the DOS version is about 72K. To increase the number of source groups from 2 to 4 would double the storage requirement, adding at least another 72K to the load size of the model.

The user should first determine the types of applications for which they most typically use the models, and then modify the appropriate PARAMETER values accordingly. If someone never (or very rarely) uses variable emission rate factors, then modifying the NQF parameter could free up some memory. Changing NQF from 24 to 1 will free up about 9K for a model using 100 sources. The user may also wish to reduce the NPDMAX parameter if particulate categories are rarely used.

Often, when a larger number of source groups has been used with the ISCST model, it has been for the purpose of performing source contribution (or source culpability) analyses. Since the ISCEV (EVENT) model provides this type of information without having to specify a separate source group for each source, the need for large numbers of source groups in the ISCST model should be lessened. If the storage limits available on the 640K PC environment are too restrictive for particular applications, then the user should examine the possibility of using a different hardware environment or a different operating system where the 640K barrier will not be limiting. Such systems are available for PCs with 80386 and 80486 processors. The extended memory (EM) versions of the models provided on the SCRAM BBS require an 80386 or 80486 processor with at least 8 MB of RAM (7 MB of available extended memory) for the Short Term model and at least 4 MB of RAM (3 MB of available extended memory) for the Long Term model. The setup and application of the models on the DEC VAX minicomputer and the IBM 3090 mainframe computer are also described in the next section of this User's Guide, and in more detail in Volume III of the ISC User's Guide.

4.3 PORTING THE MODELS TO OTHER HARDWARE ENVIRONMENTS

The ISC models are designed and coded to allow them to run on most operating environments, including DOS, UNICOS, UNIX, SunOS, VAX/VMS, and TSO/MVS. The ISC models use ANSI Standard FORTRAN 77 with the exception of two widely supported language extensions, namely the INCLUDE statement and the DO WHILE ... END DO loop construct. Although the users do not need to make major changes, they may experience some minor differences from machine to machine on the exact syntax of the INCLUDE statement. These common language extensions may not be supported on older versions of some compilers as well. The following sections address portability of the models to various systems in more detail.

4.3.1 Non-DOS PCs

The only requirement for porting the models to non-DOS PC environments is the availability of a Fortran compiler capable of operating in and compiling for the non-DOS operating system. The extended memory (EM) versions of the models available on the SCRAM BBS were compiled using the Lahey F77L-EM/32 Fortran Compiler, which uses the Ergo Computing OS/386 operating system to access extended memory in 32-bit protected mode. The EM executable files are bound with the Ergo OS/386 operating system and a load module to allow the models to be run on DOS machines.

One significant advantage to installing and running the models in 32-bit protected mode on PCs is the ability to address a much larger memory storage area. This allows for the data storage limits controlled by the Fortran PARAMETER statements to be set much higher than is possible for the DOS versions. By using the 32-bit instruction set,

the protected mode versions also tend to run about 20 to 30 percent faster than the DOS versions. More information about compiling the models with the Lahey F77L-EM/32 compiler is provided in Appendix D.

4.3.2 DEC VAX

4.3.2.1 Compiler/System Dependent Preprocessing.

The ISC codes as provided on the SCRAM BBS are compatible with VAX-11 FORTRAN Version 2 and above, except that the PC-specific features contained in PCCODE.FOR must be replaced with equivalent system-specific functions for the VAX (which may be called VAXCODE.FOR), or commented out. These features include writing the date and time on each page of the printed output file and writing an update to the screen on the status of processing.

4.3.2.2 Creating An Executable ISCST.

Although the users can specify any way they want to group and store the code and data files, the easiest way is to copy all the source codes modules, INCLUDE files and meteorology data into a subdirectory. The user can then write a .COM file to compile, link and create an executable.

The files needed to make the ISCST executable are the following:

MAIN1.INC, MAIN2.INC, MAIN3.INC, DEPVAR.INC, ISCST3.FOR, (VAXCODE.FOR), SETUP.FOR, COSET.FOR, SOSET.FOR, RESET.FOR, MESET.FOR, TGSET.FOR, OUSET.FOR, INPSUM.FOR,

METEXT.FOR, CALC1.FOR, CALC2.FOR, PRISE.FOR, SIGMAS.FOR, CALC3.FOR, CALC4.FOR, DEPFLUX.FOR, PITAREA.FOR, OUTPUT.FOR

The following is a sample command file named MAKEISC.COM:

```
$SET DEF [USERNAME.ISCST3]
$ FOR ISCST3.FOR
$ FOR VAXCODE.FOR
$ FOR SETUP.FOR
$ FOR COSET.FOR
$ FOR SOSET.FOR
$ FOR RESET.FOR
$ FOR MESET.FOR
$ FOR TGSET.FOR
$ FOR OUSET.FOR
$ FOR INPSUM.FOR
$ FOR METEXT.FOR
$ FOR CALC1.FOR
$ FOR CALC2.FOR
$ FOR PRISE.FOR
$ FOR SIGMAS.FOR
$ FOR CALC3.FOR
$ FOR CALC4.FOR
$ FOR DEPFLUX.FOR
$ FOR PITAREA.FOR
$ FOR OUTPUT.FOR
$LINK ISCST3,VAXCODE,SETUP,COSET,SOSET,RESET,MESET,TGSET,OUTSET,-
INPSUM,METEXT,CALC1,CALC2,PRISE,SIGMAS,CALC3,CALC4,DEPFLUX,PITAREA,OUTPUT
$ EXIT
```

To make the executable file, the users should run the MAKEISC.COM file by typing @makeisc after the command line prompt and pressing ENTER.

4.3.2.3 Running ISCST.

The VAX/VMS operating system is somewhat different from the DOS and UNIX operating environments. The users are not able to direct system I/O on the command line prompt. Instead, the users need to generate a .COM file first, and then run the .COM file online or submit the .COM file to a system batch queue.

Here is an example of the .COM runfile named RUNISC.COM:

```
$SET DEF [USERNAME.ISCST3]
$DEFINE/USER_MODE SYS$INPUT TEST-ST.INP
$DEFINE/USER_MODE SYS$OUTPUT TEST-ST.OUT
$RUN ISCST3
$EXIT
```

The users can either type in @runisc ENTER to run the model online or SUBMIT runisc on the command line prompt to submit a batch job.

4.3.3 IBM 3090

4.3.3.1 Compiler/System Dependent Preprocessing.

The ISC codes as provided on the SCRAM BBS are compatible with the IBM VS FORTRAN (Version 2), except that the PC-specific features contained in PCCODE.FOR must be replaced with equivalent system-specific functions for the IBM (which may be called IBMCODE.FOR), or commented out. These features include writing the date and time on each page of the printed output file and writing an update to the screen on the status

of processing. The syntax for the INCLUDE statement is different on the IBM VS FORTRAN, and the user will have to replace the statements such as:

```
INCLUDE 'MAIN1.INC'
```

with a corresponding statement such as:

```
INCLUDE (MAIN1)
```

throughout the ISC source code. This can easily be accomplished with the editor, and there are three INCLUDE files used in most of the models. For the ISCST model, the INCLUDE file names are MAIN1.INC, MAIN2.INC, and MAIN3.INC. The deposition routines in DEPFLUX.FOR use one INCLUDE file, named DEPVAR.INC.

4.3.3.2 Creating An Executable ISCST.

The ISCST model can be compiled and linked in one step under VS FORTRAN by executing the appropriate procedure (e.g., VSF2CG to compile and load) in the JCL for the compile job. It is easiest to concatenate all of the source (*.FOR) files into a single partitioned data set member, and identify that file name with a DD statement in the JCL. Special procedures may be needed to access the INCLUDE files, where each INCLUDE file should be a member in a partitioned data set.

4.3.3.3 Running ISCST.

When running the ISCST model under IBM/MVS, special attention is needed to defining and controlling the file I/O. The input runstream file is read from the default input unit, Fortran unit number 5, and the output print file is written to the default output unit, Fortran unit number 6. The input meteorological data file is read from Fortran unit 19. Other system files include the temporary error/message file (unit 10) and the temporary event file for ISCST (unit 18). These files, as well as any user-specified optional output files, must be defined with DD statements in the JCL.

4.3.4 Various UNIX machines (CRAY, SUN, DEC VAX, AT&T)

4.3.4.1 Compiler/System Dependent Preprocessing.

The ISC codes as provided on the SCRAM BBS are compatible with any ANSI Standard FORTRAN 77 Compiler operating under UNICOS, UNIX, and SUN OS, except that the PC-specific features contained in PCCODE.FOR must be replaced with equivalent system-specific functions for UNIX (which may be called UNIXCODE.FOR), or commented out. These features include writing the date and time on each page of the printed output file and writing an update to the screen on the status of processing.

4.3.4.2 Creating An Executable ISCST.

Although the users can specify any way they want to group and store the code and data files, the easiest way is to copy all the source codes modules, INCLUDE files and meteorology data into a subdirectory. The users should make sure that every source file

has suffix .f and the file name should be a lower case ASCII character string, because the UNICOS, UNIX, and SUN OS is case-sensitive. Also, for the same reason, all of the .INC file should be in UPPER CASE. The user can then write a make file to compile, link and create an executable.

The files needed to make the ISCST executable are the following:

MAIN1.INC, MAIN2.INC, MAIN3.INC, DEPVAR.INC, iscst3.f, (unixcode.f), setup.f, coset.f, soset.f, reset.f, meset.f, tgset.f, ouset.f, inpsum.f, metext.f, calc1.f, calc2.f, prise.f, sigmas.f, calc3.f, calc4.f, depflux.f, pitarea.f, output.f

Compiling ISCST is relatively easy under UNIX operating environment due to the similarity between DOS and UNIX. For a DEC VAX workstation running Utrix 4.3, the command:

```
f77 -o iscst3 *.f
```

will generate an ISCST executable. For a CRAY running UNICOS 5.1, the following commands will generate an ISCST executable under UNICOS:

```
cft77 iscst3.f
cft77 unixcode.f
cft77 setup.f
cft77 coset.f
cft77 soset.f
cft77 reset.f
cft77 meset.f
cft77 tgset.f
cft77 ouset.f
cft77 inpsum.f
cft77 metext.f
cft77 calc1.f
cft77 calc2.f
cft77 prise.f
cft77 sigmas.f
cft77 calc3.f
cft77 calc4.f
cft77 depflux.f
cft77 pitarea.f
cft77 output.f
segldr -o iscst3 *.o
```

The command for compiling ISCST under the SUN OS environment is similar to the one for VAX Ultrix 4.3.

4.3.4.3 Running ISCST.

Before running ISCST, the users need to check the meteorology data file and make sure the file name matches the one in the input file. File names in UNIX are case sensitive, so the characters in the file name need to match the ones in the input file. Then the user can type:

```
iscst3 <inputfile >outputfile
```

to run the executable.

4.3.5 Advanced Topics.

For more detailed information about porting and installing the ISC models to other computer environments, refer to Volume III of the ISC User's Guide. Volume III provides a more detailed description of the design and structure of the computer code, including module calling trees, data dictionary, and a description of the model loop structures. Volume III also includes instructions for compiling the ISC models with compilers that do not support the INCLUDE and DO WHILE ... ENDDO Fortran language extensions.

5.0 REFERENCES

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APPENDIX A. ALPHABETICAL KEYWORD REFERENCE

This appendix provides an alphabetical listing of all of the keywords used by the ISC models. Each keyword is identified as to the pathway for which it applies, the keyword type (either mandatory or optional, and either repeatable or non-repeatable), and with a brief description of the function of the keyword. For a more complete description of the keywords, including a list of associated parameters, refer to the Detailed Keyword Reference in Section 3 or the Functional Keyword/Parameter Reference in Appendix B.

Keyword	Path	Type	Keyword Description
ANEMHGHT	ME	M - N	Height of anemometer above stack base
AVERTIME	CO	M - N	Averaging time(s) to process (up to NAVE short term plus PERIOD or ANNUAL averages)
AVEMIXHT	ME	M - R	Average mixing height for each wind speed, stability category and season (Applies Only to Long Term)
AVEROUGH	ME	O - R	Roughness length (m) for each season (Applies Only to Long Term)
AVESPEED	ME	O - N	Average (median) wind speed for each speed category in the STAR summary (Applies Only to Long Term)
AVETEMPS	ME	M - R	Average ambient temperature for each stability category and season (Applies Only to Long Term)
BOUNDARY	RE	O - R	Defines discrete polar receptor locations corresponding to minimum plant boundary distances for each 10 degree sector
BOUNDELV	RE	O - R	Defines terrain elevations for discrete receptors specified with BOUNDARY keyword
BUILDHGT	SO	O - R	Building height values for each wind sector
BUILDWID	SO	O - R	Building width values for each wind sector
CONCUNIT	SO	O - N	Optional conversion factors for emission input units and concentration output units
DAYRANGE	ME	O - R	Specifies days or ranges of days to process (default is to process all data read in), applies only to ISCST processing
DAYTABLE	OU	O - N	Option to provide summaries for each averaging period for each day processed. (Applies to ISCST Only)
DCAYCOEF	CO	O - N	Optional decay coefficient for exponential decay

Type: M - Mandatory N - Non-repeatable
O - Optional R - Repeatable

Keyword	Path	Type	Keyword Description
DEPOUNIT	CO	O - N	Optional conversion factors for emission input units and deposition output units
DISCCART	RE	O - R	Defines the discretely placed receptor locations referenced to a Cartesian system
DISCPOLR	RE	O - R	Defines the discretely placed receptor locations referenced to a polar system
DTHETADZ	ME	O - R	Input optional vertical potential temperature gradients
ELEVUNIT	CO SO RE TG	O - N O - N O - N O - N	Defines input units for receptor elevations (RE or CO path), source elevations (SO path) or terrain grid elevations (TG path) (defaults to meters)
EMISFACT	SO	O - R	Optional input for variable emission rate factors
EMISUNIT	SO	O - N	Optional conversion factors for emission units, and concentration or deposition output units
ERRORFIL	CO	O - N	Option to generate detailed error listing file
EVENTFIL	CO	O - N	Specifies whether to generate an input file for EVENT model (Applies only to ISCST)
EVENTOUT	OU	M - N	Specifies the level of output information provided by the EVENT model
EVENTPER	EV	M - R	Describes data and averaging period for an event
EVENTLOC	EV	M - R	Describes receptor location for an event
FINISHED	ALL	M - N	Identifies the end of inputs for a particular pathway
FLAGPOLE	CO	O - N	Specifies whether to accept receptor heights above local terrain (m) for use with flagpole receptors, and

NOTE: See ELEVUNIT footnote on p. B-5.

Keyword	Path	Type	Keyword Description
GAS-SCAV	SO	O - R	Optional input of precipitation scavenging coefficients for gaseous pollutants
GRIDCART	RE	O - R	Defines a Cartesian grid receptor network
GRIDPOLR	RE	O - R	Defines a polar receptor network
HALFLIFE	CO	O - N	Optional half life used for exponential decay
HOUREMIS	SO	O - R	Option for specifying hourly emission rates in a separate file
INITFILE	CO	O - N	Option to initialize model from file of intermediate results generated by SAVEFILE option
INPUTFIL	ME TG	M - N M - N	Describes input meteorological data file (ME path) and terrain grid file (TG path)
LOCATION	SO TG	M - R M - N	Identifies coordinates for particular source (SO path) or for the terrain grid location (TG path)
LOWBOUND	SO	O - R	Switch to use non-DFAULT option for "lower bound" wake calculations, controlled by sector
MASSFRAX	SO	O - R	Optional input of mass fraction for each particle size category
MAXIFILE	OU	O - R	Option to list events exceeding a threshold value to file (if CO EVENTFIL option is used, these events are included in the input file generated for the EVENT model)
MAXTABLE	OU	O - R	Option to summarize the overall maximum values
MODELOPT	CO	M - N	Job control and dispersion options
MULTYEAR	CO	O - N	Specifies that run is part of a multi-year run, e.g., for PM-10 H6H in five years

PARTDENS	SO	O - R	Optional input of particle density for each size category
PARTDIAM	SO	O - R	Optional input of particle diameter for each size category

Keyword	Path	Type	Keyword Description
PARTSLIQ	SO	O - R	Optional input of scavenging coefficients of particulate emissions for liquid precipitation
PARTSICE	SO	O - R	Optional input of scavenging coefficients of particulate emissions for frozen precipitation
PLOTFILE	OU	O - R	Option to write certain results to a storage file suitable for input to plotting routines
POLLUTID	CO	M - N	Identifies pollutant being modeled
POSTFILE	OU	O - R	Option to write results to a mass storage file for postprocessing
RECTABLE	OU	O - R	Option to output value(s) by receptor
RUNORNOT	CO	M - N	Identifies whether to run model or process setup information only
SAVEFILE	CO	O - N	Option to store intermediate results for later restart of the model after user or system interrupt (ST Only)
SRCGROUP	SO	M - R	Identification of source groups
SRCPARAM	SO	M - R	Identifies source parameters for a particular source

STARDATA	ME	O - N	Identifies which STAR summaries are included in meteorological data file
STARTEND	ME	O - N	Specifies start and end dates to be read from input meteorological data file (default is to read entire file), applies only to ISCST processing
STARTING	ALL	M - N	Identifies the start of inputs for a particular pathway
SURFDATA	ME	M - N	Surface meteorological station
TERRHGTS	CO	O - N	Specifies whether to assume flat terrain (default) or to allow use of receptors on elevated terrain
TITLEONE	CO	M - N	First line of title for output
TITLETWO	CO	O - N	Optional second line of output title

Keyword	Path	Type	Keyword Description
TOXXFILE	OU	O - R	Creates output file formatted for use with TOXX model component of TOXST or the RISK model component of TOXLT
UAIRDATA	ME	M - N	Uper air meteorological station
WDROTATE	ME	O - N	Wind direction rotation adjustment
WINDCATS	ME	O - N	Upper bound of wind speed categories
WINDPROF	ME	O - R	Input optional wind profile exponents

APPENDIX B. FUNCTIONAL KEYWORD/PARAMETER REFERENCE

This appendix provides a functional reference for the keywords and parameters used by the input runstream files for the ISC models. The keywords are organized by functional pathway, and within each pathway the order of the keywords is based on the function of the keyword within the models. The pathways used by the models are as follows, in the order in which they appear in the runstream file and in the tables that follow:

CO - for specifying overall job **CO**ntrol options;
SO - for specifying **SO**urce information;
RE - for specifying **RE**ceptor information (ISCST and ISCLT models only);
ME - for specifying **ME**teorology information and options;
TG - for specifying **T**errain **G**rid information and options (optional);
EV - for specifying **EV**ent information (ISCEV model only); and
OU - for specifying **OU**tput options.

The pathways and keywords are presented in the same order as in the Detailed Keyword Reference in Section 3, and in the Quick Reference at the end of the manual.

Two types of tables are provided for each pathway. The first table lists all of the keywords for that pathway, identifies each keyword as to its type (either mandatory or optional and either repeatable or non-repeatable), and provides a brief description of the function of the keyword. The second type of table, which takes up more than one page for most pathways, presents the parameters for each keyword, in the order in which they should appear in the runstream file where order is important, and describes each parameter in detail. Also indicated for certain keywords or parameter descriptions are cases where the inputs apply on to a certain model, either ISCST, ISCEV, or ISCLT.

The following convention is used for identifying the different types of input parameters. Parameters corresponding to secondary keywords which should be input "as is" are listed on the tables with all capital letters and are underlined. Other parameter names are given with an initial capital letter and are not input "as is." In all cases, the parameter names are intended to be descriptive of the input variable being represented, and they often correspond to the Fortran variable names used in the model code. Parentheses around a parameter indicate that the parameter is optional for that keyword. The default that is taken when an optional parameter is left blank is explained in the discussion for that parameter.

TABLE B-1

DESCRIPTION OF CONTROL PATHWAY KEYWORDS

CO Keywords	Type	Keyword Description
STARTING	M - N	Identifies the start of CONTROL pathway inputs
TITLEONE	M - N	First line of title for output
TITLETWO	O - N	Optional second line of title for output
MODELOPT	M - N	Job control and dispersion options
AVERTIME	M - N	Averaging time(s) to process
POLLUTID	M - N	Identifies type of pollutant being modeled
HALFLIFE	O - N[1]	Optional half life used for exponential decay
DCAYCOEF	O - N[1]	Optional decay coefficient
TERRHGTS	O - N	Specifies whether to assume flat terrain (default) or to allow use of receptors on elevated terrain
ELEVUNIT[2]	O - N	Defines input units for receptor elevations (defaults to meters)
FLAGPOLE	O - N	Specifies whether to accept receptor heights above local terrain (m) for use with flagpole receptors, and allows for a default flagpole height to be specified
RUNORNOT	M - N	Identifies whether to run model or process setup information only
EVENTFIL[3]	O - N	Specifies whether to generate an input file for EVENT model (Applies to ISCST Only)
SAVEFILE[4]	O - N	Option to store intermediate results for later restart of the model after user or system interrupt (Applies to ISCST Only)
INITFILE[4]	O - N	Option to initialize model from file of intermediate results generated by SAVEFILE option (Applies to ISCST Only)
MULTYEAR[4]	O - N	Option to process multiple years of meteorological data (one year per run) and accumulate high short term values across years (Applies to ISCST Only)
ERRORFIL	O - N	Option to generate detailed error listing file (error file is mandatory for CO RUNORNOT NOT case)
FINISHED	M - N	Identifies the end of CONTROL pathway inputs

Type: M - Mandatory N - Non-Repeatable
O - Optional R - Repeatable

1) Either HALFLIFE or DCAYCOEF may be specified. If both cards appear a warning

message will be issued and the first value entered will be used in calculations. Default assumes a half life of 4 hours for SO_2 modeled in urban mode.

2) The CO ELEVUNIT card is obsolescent with this version of the ISC models. The new RE ELEVUNIT card should be used instead to specify elevation units for receptors.

3) The EVENTFIL keyword controls whether or not to generate an input file for the ISCEV (EVENT) model. The primary difference between ISCST and ISCEV processing is in the treatment of source group contributions. The ISCST model treats the source groups independently, whereas the ISCEV model determines individual source contributions to particular events, such as the design concentrations determined from ISCST, or user-specified events. By specifying the EVENTFIL keyword, an input runstream file will be generated that can be used directly with the ISCEV model. The events included in the generated ISCEV model input file are defined by the RECTABLE and MAXIFILE keywords on the OU pathway, and are placed in the EVent pathway. If more than one output type (CONC, DEPOS, DDEP, and/or WDEP) is selected for the ISCST model, only events associated with the first output type, in the order stated above, are included in the EVENT model input file.

4) The SAVEFILE and INITFILE keywords work together to implement the model's re-start capabilities. Since the MULTYEAR option utilizes the re-start features in a special way to accumulate high short term values from year to year, it cannot be used together with the SAVEFILE or INITFILE keyword in the same model run.

TABLE B-2

DESCRIPTION OF CONTROL PATHWAY KEYWORDS AND PARAMETERS

Keyword	Parameters	
TITLEONE	Title1	
where:	Title1	First line of title for output, character string of up to 68 characters
TITLETWO	Title2	
where:	Title2	Optional second line of title for output, character string of up to 68 characters
MODELOPT	DFAULT CONC DRYDPLT WETDPLT RURAL GRDRIS NOSTD NOBID NOCALM MSGPRO NOSMPL (ST) DEPOS or DDEP URBAN or and/or NOCMPL WDEP DFAULT CONC DRYDPLT RURAL GRDRIS NOSTD NOBID (LT) DEPOS or DDEP	

where:	DFAULT	Specifies use of regulatory default options (final rise, stack tip downwash, BID, calms processing, "upper bound" wake calcs, default exponents and DTDZ), overrides presence of GRDRIS, NOSTD, NOBID, NOCALM, and MSGPRO keywords
	CONC	Specifies calculation of concentration values
	DEPOS	Specifies calculation of total deposition flux (both dry and wet) for Short Term, and dry deposition flux for Long Term
	DDEP	Specifies calculation of dry deposition flux only
	WDEP	Specifies calculation of wet deposition flux only (ST only)
	DRYDPLT	Specifies inclusion of plume depletion due to dry removal
	WETDPLT	Specified inclusion of plume depletion due to wet removal (ST only)
	RURAL	Specifies use of rural dispersion
	URBAN	Specifies use of urban dispersion
	GRDRIS	Option to use gradual plume rise
	NOSTD	Option to use no stack-tip downwash
	NOBID	Option to use no buoyancy-induced dispersion
	NOCALM	Option to bypass calms processing routine (ST only)
	MSGPRO	Option to use missing data processing routines (ST only)
	NOSMPL	Option to suppress simple terrain calculations, i.e., use COMPLEX1 algorithms only (ST only)
	NOCMPL	Option to suppress complex terrain calculations, i.e., use ISCST algorithms only (ST only)
AVERTIME	Time1 Time2 Time3 Time4 MONTH PERIOD or ANNUAL	(ISCST and ISCEV only)
where:	TimeN	Nth optional averaging time (1, 2, 3, 4, 6, 8, 12, 24-hr; number of periods limited by NAVE parameter)
	MONTH	Option to calculate MONTHly averages (counts toward NAVE limit)
	PERIOD	Option to calculate averages for the entire data PERIOD
	ANNUAL	Option to calculate ANNUAL averages for the entire data

TABLE B-2 (CONT.)

DESCRIPTION OF CONTROL PATHWAY KEYWORDS AND PARAMETERS

AVERTIME	JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC (ISCLT model) WINTER SPRING SUMMER FALL or QUART1 QUART2 QUART3 QUART4 MONTH SEASON QUARTR ANNUAL PERIOD	
where:	JAN	Option to calculate JANuary averages from STAR data
	FEB	Option to calculate FEBruary averages from STAR data
	DEC	Option to calculate DECember averages from STAR data
	WINTER	Option to calculate WINTER averages from STAR data
	SPRING	Option to calculate SPRING averages from STAR data
	SUMMER	Option to calculate SUMMER averages from STAR data
	FALL	Option to calculate FALL averages from STAR data
	QUART1	Option to calculate QUART1 averages from STAR data
	QUART2	Option to calculate QUART2 averages from STAR data
	QUART3	Option to calculate QUART3 averages from STAR data
	QUART4	Option to calculate QUART4 averages from STAR data
	MONTH	Option to calculate averages for all twelve MONTHs
	SEASON	Option to calculate averages for all four SEASONs
	QUARTR	Option to calculate averages for all four QUARTeRs
	ANNUAL	Option to calculate annual values from an ANNUAL STAR summary
	PERIOD	Option to calculate averages for the entire data PERIOD
POLLUTID	Pollut	
where:	Pollut	Identifies type of pollutant being modeled. Any name of up to eight characters may be used, e.g., SO2, NOX, CO, PM10, TSP or OTHER. Selection of SO2 with the URBAN DFAULT options forces use of a half life of 4 hours for exponential decay. Use of PM10, PM-10 or OTHER allows for the use of the MULTYEAR option.
HALFLIFE	Haflif	
where:	Haflif	Half life used for exponential decay (s)
DCAYCOEF	Decay	
where:	Decay	Decay coefficient for exponential decay (s^{-1}) = 0.693/HAFLIF

TERRHGTS	FLAT or ELEV	
where:	FLAT	Specifies that flat terrain will be assumed for all calculations (default)
	ELEV	Specifies that receptors may be located on elevated terrain (chopped off at release height) Note that if ELEVated receptors are allowed, then receptor heights must be input on the RE pathway, or they will be assumed to be 0.0.
ELEVUNIT	METERS or FEET	
where:	METERS	Specifies input units for terrain (receptor) elevations of meters
	FEET	Specifies input units for terrain (receptor) elevations of feet Note: This keyword applies to receptor elevations only.
FLAGPOLE	(Flagdf)	
where:	Flagdf	Default value for height of (flagpole) receptors above local ground level, a default value of 0.0 m is used if this optional parameter is omitted

Note: The CO ELEVUNIT card is obsolescent with this version of the ISC models. The new RE ELEVUNIT card should be used instead to specify elevation units for receptors. If the CO ELEVUNIT card is present, it will be processed as it was in the previous version of the ISC models, but it cannot be used when an ELEVUNIT card is present on either the SO, RE or TG pathways.

TABLE B-2 (CONT.)

DESCRIPTION OF CONTROL PATHWAY KEYWORDS AND PARAMETERS

RUNORNOT	RUN or NOT	
where:	RUN	Indicates to run full model calculations
	NOT	Indicates to process setup data and report errors, but to not run full model calculations
EVENTFIL	(Evfile) (Evopt)	
where:	Evfile	Identifies the filename to be used to generate a file for input to EVENT model (Default=EVENTFIL.INP)
	Evopt	Optional parameter to specify the level of output detail selected for the EVENT model: either SOCONT or DETAIL (default is DETAIL if this parameter is omitted)
SAVEFILE	(Savfil) (Dayinc) (Savfl2)	
where:	Savfil	Specifies name of disk file to be used for storing intermediate results (default = SAVE.FIL) file is overwritten after each dump)
	Dayinc	Number of days between dumps (optional: default is 1)
	Savfl2	Optional second disk filename to be used on alternate dumps - eliminates risk of system crash during the dump. If blank, file is overwritten each time.
INITFILE	(Inifil)	
where:	Inifil	Specifies name of disk file of intermediate results to be used for initializing run (default = SAVE.FIL)
MULTYEAR	Savfil (Inifil)	
where:	Savfil	Specifies name of disk file to be used for storing results at end of the year
	Inifil	Optional name of disk file used for initializing the results arrays from previous year(s). The Inifil parameter is not used for the first year in the multi-year run.

ERRORFIL	(Errfil) (DEBUG)	
where:	Errfil	Specifies name of detailed error listing file (default = ERRORS.LST)
	DEBUG	Option to provide detailed output for debugging purposes, e.g., plume heights, sigmas, etc. Generates Very Large Files -- Use with CAUTION!!!

TABLE B-3

DESCRIPTION OF SOURCE PATHWAY KEYWORDS

SO Keywords	Type	Keyword Description
STARTING	M - N	Identifies the start of SOURCE pathway inputs
ELEVUNIT	O - N	Defines input units for source elevations (defaults to meters), must be first keyword after SO STARTING if used.
LOCATION	M - R	Identifies coordinates for particular source
SRCPARAM	M - R	Identifies source parameters for a particular source
BUILDHGT	O - R	Building height values for each wind sector
BUILDWID	O - R	Building width values for each wind sector
LOWBOUND	O - R	Switch to use non-DFAULT option for "lower bound" wake calculations, controlled by sector
EMISFACT	O - R	Optional input for variable emission rate factors
EMISUNIT	O - N	Optional conversion factors for emissions, concentrations, and depositions
CONCUNIT	O - N	Optional conversion factors for emissions and concentrations
DEPOUNIT	O - N	Optional conversion factors for emissions and depositions
PARTDIAM	O - R	Input variables for optional input of particle size (microns)
MASSFRAX	O - R	Optional input of mass fraction for each particle size category
PARTDENS	O - R	Optional input of particle density (g/cm^3) for each size category
PARTSLIQ	O - R	Optional input of scavenging coefficient $(s\text{-}mm/hr)^{-1}$ of particulates for liquid precipitation
PARTSICE	O - R	Optional input of scavenging coefficient $(s\text{-}mm/hr)^{-1}$ of particulates for frozen precipitation
GAS-SCAV	O - R	Optional input of scavenging coefficient $(s\text{-}mm/hr)^{-1}$ of gases for liquid or frozen precipitation
HOUREMIS	O - R	Option for specifying hourly emission rates in a separate file
SRCGROUP[1]	M - R	Identification of source groups
FINISHED	M - N	Identifies the end of SOURCE pathway inputs

1) Source groups are treated independently for ISCST. The ISCEV (EVENT) model provides the contribution from each source to the group total for each specified event.

TABLE B-4

DESCRIPTION OF SOURCE PATHWAY KEYWORDS AND PARAMETERS

Keyword	Parameters	
ELEVUNIT	METERS or FEET	
where:	METERS	Specifies input units for source elevations of meters
	FEET	Specifies input units for source elevations of feet Note: This keyword applies to source elevations only.
LOCATION	Srcid Srctyp Xs Ys (Zs)	
where:	Srcid	Source identification code (alphanumeric string of up to eight characters)
	Srctyp	Source type: POINT, VOLUME, AREA, OPENPIT
	Xs	x-coord of source location, corner for AREA and OPENPIT (in m)
	Ys	y-coord of source location, corner for AREA and OPENPIT (in m)
	Zs	Optional z-coord of source location (elevation above mean sea level, defaults to 0.0 if omitted)
SRCPARAM	Srcid Ptemis Stkhgt Stktmp Stkvel Stkdia	
	Vlemis Relhgt Syinit Szinit	
	Aremis Relhgt Xinit (Yinit) (Angle) (Szinit)	
	Pitemis Relhgt Xinit Yinit Pitvol (Angle)	

where:	Srcid	Source identification code
	__Emis	Source emission rate: in g/s for Ptemis or Vlemis, g/(sm^2) for Aremis or Pitemis for concentration or deposition
	___Hgt	Source physical release height above ground (center of height for VOLUME, height above base of pit for OPENPIT)
	Stktmp	Stack gas exit temperature (K)
	Stkvel	Stack gas exit velocity (m/s)
	Stkdia	Stack inside diameter (m)
	Syinit	Initial lateral dimension of VOLUME source (m)
	Szinit	Initial vertical dimension of VOLUME or AREA source (m) (optional parameter for AREA sources, assumed to be 0.0 if omitted)
	Xinit	Length of side of AREA or OPENPIT source in X-direction (m)
	Yinit	Length of side of AREA or OPENPIT source in Y-direction (m) (optional for AREA sources, assumed to be equal to Xinit if omitted)
	Angle	Orientation angle of AREA or OPENPIT source relative to North (degrees), measured positive clockwise, rotated around the source location, (Xs,Ys) (optional parameter, assumed to be 0.0 if omitted)
	Pitvol	Volume of open pit (m^3)
BUILDHGT	Srcid (or Srcrng) Dsbh(i), i=1,36 (16 for LT)	
where:	Srcid	Source identification code
	Srcrng	Range of sources (inclusive) for which building dimensions apply, entered as two alphanumeric strings separated by a '-'
	Dsbh	Array of direction-specific building heights (m) beginning with 10 degree flow vector and incrementing by 10 degrees clockwise
BUILDWID	Srcid (or Srcrng) Dsbw(i), i=1,36 (16 for LT)	
where:	Srcid	Source identification code
	Srcrng	Range of sources (inclusive) for which building dimensions apply
	Dsbw	Array of direction-specific building widths (m) beginning with 10 degree flow vector and incrementing by 10 degrees clockwise

TABLE B-4 (CONT.)

DESCRIPTION OF SOURCE PATHWAY KEYWORDS AND PARAMETERS

LOWBOUND	Srcid (or Srcrng) Idswak(i), i=1,36 (16 for LT)	
where:	Srcid	Source identification code
	Srcrng	Range of sources (inclusive) for which LOWBOUND option applies
	Idswak	Array of direction-specific wake option switches beginning with 10 degree flow vector and incrementing by 10 degrees clockwise (0=upper bound, 1=lower bound)
EMISFACT	Srcid (or Srcrng) Qflag Qfact(i), i=1,n	
where:	Srcid	Source identification code
	Srcrng	Range of sources (inclusive) for which emission rate factors apply
	Qflag	Variable emission rate flag: Short Term Model: SEASON for seasonal; MONTH for monthly; HROFDY for hour-of-day; STAR for speed-by-stability; SEASHR for season-by-hour Long Term Model: SEASON for seasonal; MONTH for monthly; SSTAB for season-by-stability; SSPEED for season-by-speed; STAR for speed-by-stability; SSTAR for season-by-speed-and-stability
	Qfact	Array of scalar emission rate factors, for: SEASON, n=4; MONTH, n=12; HROFDY, n=24; STAR, n=36; SSTAB, n=24; SSPEED, n=24; SEASHR, n=96; SSTAR, n=144

EMISUNIT	Emifac Emilbl Conlbl or Deplbl	
where:	Emifac	Emission rate factor used to adjust units of output (default value is 1.0 E06 for CONC for grams to micrograms; and 3600. for DEPOS, DDEP or WDEP for grams/sec to grams/hour; Note that ISCLT emission rates are automatically adjusted for the number of hours in the STAR period for deposition calculations)
	Emilbl	Label to use for emission units (default is grams/sec)
	Conlbl	Label to use for concentrations (default is micrograms/m^3)
	Deblbl	Label to use for deposition (default is grams/m^2)
CONCUNIT	Emifac Emilbl Conlbl	(Applies to ISCST Only)
where:	Emifac	Emission rate factor used to adjust units of output for concentration (default value is 1.0 E06)
	Emilbl	Label to use for emission units (default is grams/sec)
	Conlbl	Label to use for concentrations (default is micrograms/m^3)
DEPOUNIT	Emifac Emilbl Deplbl	(Applies to ISCST Only)
where:	Emifac	Emission rate factor used to adjust units of output for deposition (default value is 3600.)
	Emilbl	Label to use for emission units (default is grams/sec)
	Deblbl	Label to use for deposition (default is grams/m^2)

TABLE B-4 (CONT.)

DESCRIPTION OF SOURCE PATHWAY KEYWORDS AND PARAMETERS

PARTDIAM	Srcid (or Srcrng) Pdiam(i), i=1,Npd	
where:	Srcid	Source identification code
	Srcrng	Range of sources (inclusive) for which size categories apply
	Pdiam	Array of particle diameters (microns)
MASSFRAX	Srcid (or Srcrng) Phi(i), i=1,Npd	
where:	Srcid	Source identification code
	Srcrng	Range of sources (inclusive) for which mass fractions apply
	Phi	Array of mass fractions for each particle size category
PARTDENS	Srcid (or Srcrng) Pdens(i), i=1,Npd	
where:	Srcid	Source identification code
	Srcrng	Range of sources (inclusive) for which particle densities apply
	Pdens	Array of particle densities (g/cm^3) for each size category
PARTSLIQ	Srcid (or Srcrng) Scavcoef(i), i=1,Npd	
where:	Srcid	Source identification code
	Srcrng	Range of sources (inclusive) for which scavenging coefficients apply
	Scavcoef	Scavenging coefficient $(s\text{-}mm/hr)^{-1}$ for liquid precipitation for each size category
PARTSICE	Srcid (or Srcrng) Scavcoef(i), i=1,Npd	
where:	Srcid	Source identification code
	Srcrng	Range of sources (inclusive) for which scavenging coefficients apply
	Scavcoef	Scavenging coefficient $(s\text{-}mm/hr)^{-1}$ for frozen precipitation for each size category
GAS-SCAV	Srcid (or Srcrng) LIQ or ICE Scavcoef	

where:	Srcid Srcrng LIQ ICE Scavcoef	Source identification code Range of sources (inclusive) for which scavenging coefficent applies Specifies that inputs are for liquid precipitation Specifies that inputs are for frozen precipitation Scavenging coefficient $(s\text{-}mm/hr)^{-1}$ for liquid or frozen precipitation for each size category
HOUREMIS	Emifil Srcid's Srcrng's	
where:	Emifil Srcid's Srcrng's	Specifies name of the hourly emission rate file Discrete source IDs that are included in the hourly emission file Source ID ranges that are included in the hourly emission file
SRCGROUP	Grpid Srcid's Srcrng's	
where:	Grpid Srcid's Srcrng's	Group ID (Grpid = ALL specifies group including all sources), number of source groups limited by NGRP parameter in the computer code Discrete source IDs to be included in group Source ID ranges to be included in group Note: Card may be repeated with same Grpid if more space is needed to specify sources

TABLE B-5

DESCRIPTION OF RECEPTOR PATHWAY KEYWORDS

(APPLIES TO ISCST AND ISCLT)

RE Keywords	Type	Keyword Description
STARTING	M - N	Identifies the start of RECEPTOR pathway inputs
ELEVUNIT	O - N	Defines input units for receptor elevations (defaults to meters), must be first keyword after RE STARTING if used.
GRIDCART	O - R[1]	Defines a Cartesian grid receptor network
GRIDPOLR	O - R[1]	Defines a polar receptor network
DISCCART	O - R[1]	Defines the discretely placed receptor locations referenced to a Cartesian system
DISCPOLR	O - R[1]	Defines the discretely placed receptor locations referenced to a polar system
BOUNDARY	O - R[1]	Defines discrete polar receptor locations corresponding to minimum plant boundary distances for each 10 degree sector
BOUNDELV	O - R	Defines terrain elevations for discrete receptors specified with BOUNDARY keyword
FINISHED	M - N	Identifies the end of RECEPTOR pathway inputs

1) At least one of the following must be present: GRIDCART, GRIDPOLR, DISCCART, DISCPOLR, or BOUNDARY. Multiple receptor networks can be specified in a single run, including both Cartesian and polar, up to an overall maximum controlled by the NREC parameter.

TABLE B-6

DESCRIPTION OF RECEPTOR PATHWAY KEYWORDS AND PARAMETERS

(APPLIES TO ISCST AND ISCLT)

Keyword	Parameters	
ELEVUNIT	METERS or FEET	
where:	METERS	Specifies input units for receptor elevations of meters
	FEET	Specifies input units for receptor elevations of feet Note: This keyword applies to receptor elevations only.
GRIDCART	Netid STA XYINC Xinit Xnum Xdelta Yinit Ynum Ydelta or XPNTS Gridx1 Gridx2 Gridx3 .... GridxN, and YPNTS Gridy1 Gridy2 Gridy3 .... GridyN ELEV Row Zelev1 Zelev2 Zelev3 ... ZelevN FLAG Row Zflag1 Zflag2 Zflag3 ... ZflagN END	

where:	Netid	Receptor network identification code (up to eight alphanumeric characters)
	STA	Indicates STArt of GRIDCART subpathway, repeat for each new Netid
	XYINC	Keyword identifying grid network generated from x and y increments
	Xinit	Starting x-axis grid location in meters
	Xnum	Number of x-axis receptors
	Xdelta	Spacing in meters between x-axis receptors
	Yinit	Starting y-axis grid location in meters
	Ynum	Number of y-axis receptors
	Ydelta	Spacing in meters between y-axis receptors
	XPNTS	Keyword identifying grid network defined by a series of x and y coordinates
	Gridx1	Value of first x-coordinate for Cartesian grid
	GridxN	Value of 'nth' x-coordinate for Cartesian grid
	YPNTS	Keyword identifying grid network defined by a series of x and y coordinates
	Gridy1	Value of first y-coordinate for Cartesian grid
	GridyN	Value of 'nth' y-coordinate for Cartesian grid
	ELEV	Keyword to specify that receptor elevations follow
	Row	Indicates which row (y-coordinate fixed) is being input
	Zelev	An array of receptor terrain elevations for a particular Row
	FLAG	Keyword to specify that flagpole receptor heights follow
	Row	Indicates which row (y-coordinate fixed) is being input
	Zflag	An array of receptor heights above local terrain elevation for a particular Row (flagpole receptors)
	END	Indicates END of GRIDCART subpathway, repeat for each new Netid

TABLE B-6 (CONT.)

DESCRIPTION OF RECEPTOR PATHWAY KEYWORDS AND PARAMETERS

(APPLIES TO ISCST AND ISCLT)

GRIDPOLR	Netid STA ORIG Xinit Yinit, or ORIG Srcid DIST Ring1 Ring2 Ring3 ... RingN DDIR Dir1 Dir2 Dir3 ... DirN, or GDIR Dirnum Dirini Dirinc ELEV Dir Zelev1 Zelev2 Zelev3 ... ZelevN FLAG Dir Zflag1 Zflag2 Zflag3 ... ZflagN END

where:	Netid	Receptor network identification code (up to eight alphanumeric characters)
	STA	Indicates STArt of GRIDPOLR subpathway, repeat for each new Netid
	ORIG	Optional keyword to specify the origin of the polar network (assumed to be at x=0, y=0 if omitted)
	Xinit	x-coordinate for origin of polar network
	Yinit	y-coordinate for origin of polar network
	Srcid	Source ID of source used as origin of polar network
	DIST	Keyword to specify distances for the polar network
	Ring1	Distance to the first ring of polar coordinates
	RingN	Distance to the 'nth' ring of polar coordinates
	DDIR	Keyword to specify discrete direction radials for the polar network
	Dir1	First direction radial in degrees (1 to 360)
	DirN	The 'nth' direction radial in degrees (1 to 360)
	GDIR	Keyword to specify generated direction radials for the polar network
	Dirnum	Number of directions used to define the polar system
	Dirini	Starting direction of the polar system
	Dirinc	Increment (in degrees) for defining directions
	ELEV	Keyword to specify that receptor elevations follow
	Dir	Indicates which direction is being input
	Zelev	An array of receptor terrain elevations for a particular direction radial
	FLAG	Keyword to specify that flagpole receptor heights follow
	Dir	Indicates which direction is being input
	Zflag	An array of receptor heights above local terrain elevation for a particular direction (flagpole receptors)
	END	Indicates END of GRIDPOLR subpathway, repeat for each new Netid

TABLE B-6 (CONT.)

DESCRIPTION OF RECEPTOR PATHWAY KEYWORDS AND PARAMETERS

(APPLIES TO ISCST AND ISCLT)

DISCCART	Xcoord Ycoord (Zelev) (Zflag)	
where:	Xcoord	x-coordinate for discrete receptor location
	Ycoord	y-coordinate for discrete receptor location
	Zelev	Elevation above sea level for discrete receptor location (optional), used only for ELEV terrain
	Zflag	Receptor height (flagpole) above local terrain (optional), used only with FLAGPOLE keyword
DISCPOLR	Srcid Dist Direct (Zelev) (Zflag)	
where:	Srcid	Specifies source identification for which discrete polar receptor locations apply (used to define the origin for the discrete polar receptor)
	Dist	Downwind distance to receptor location
	Direct	Direction to receptor location, in degrees clockwise from North
	Zelev	Elevation above sea level for receptor location (optional), used only for ELEV terrain
	Zflag	Receptor height (flagpole) above local terrain (optional), used only with FLAGPOLE keyword
BOUNDARY	Srcid Dist(i), i=1,36	
where:	Srcid	Specifies source identification for which boundary distances apply
	Dist	Array of 36 values corresponding to minimum plant boundary distances for every 10-degree sector, beginning with the 10 degree flow vector Note: Discrete receptor coordinates are generated with an origin referenced to the location of the source identified with Srcid
BOUNDELV	Srcid Zelev(i), i=1,36	

where:	Srcid	Specifies source identification for which boundary distances apply
	Zelev	Array of 36 values corresponding to terrain elevation for plant boundary distances for 10-degree sectors, beginning with the 10 degree flow vector

TABLE B-7

DESCRIPTION OF METEOROLOGY PATHWAY KEYWORDS

ME Keywords	Type	Keyword Description
STARTING	M - N	Identifies the start of METEOROLOGY pathway inputs
INPUTFIL	M - N	Describes input meteorological data file
ANEMHGHT	M - N	Input height of anemometer above stack base
SURFDATA	M - N	Describes surface meteorological station
UAIRDATA	M - N	Describes upper air meteorological station
STARTEND	O - N	Specifies start and end dates to be read from input meteorological data file (default is to read entire file). (Applies to ISCST Only)
DAYRANGE	O - R	Specifies days or ranges of days to process (default is to process all data read in). (Applies to ISCST Only)
WDROTATE	O - N	May be used to correct for alignment problems of wind direction measurements, or to convert wind direction from to flow vector
WINDPROF	O - R	Input optional wind profile exponents
DTHETADZ	O - R	Input optional vertical potential temperature gradients
WINDCATS	O - N	Input upper bounds of wind speed categories, five values input - sixth category is assumed to have no upper bound. (Applies to Short Term Only)
AVESPEED	O - N	Average (median) wind speed for each speed category in the STAR summary. (Applies to ISCLT Only)
AVETEMPS	M - R	Average ambient temperatures for each stability category and season. (Applies to ISCLT Only)
AVEMIXHT	M - R	Average mixing heights for each wind speed, stability category and season. (Applies to ISCLT Only)
AVEROUGH	O - R	Roughness length for each season (Applies to ISCLT Only)
FINISHED	M - N	Identifies the end of METEOROLOGY pathway inputs

TABLE B-8

DESCRIPTION OF METEOROLOGY PATHWAY KEYWORDS AND PARAMETERS

Keyword	Parameters	
INPUTFIL	Metfil (Format)	
where:	Metfil	Specify filename for meteorological input file
	Format	Specify format for input file: options are to provide FORTRAN read format for ASCII file, (YR,MN,DY,HR,AFV (or WD),WS,TA,KST,ZIRUR,ZIURB); use default ASCII format (4I2,2F9.4,F6.1,I2,2F7.1) if blank; use free format if FREE; use default ASCII format with hourly WINDPROF and DTHETADZ if CARD ; or use unformatted PCRAMMET file if UNFORM
ANEMHGHT	Zref (Zrunit)	
where:	Zref	Reference (anemometer) height above ground for wind speed measurement; also assumed to be height above stack base
	Zrunit	Units of Zref: METERS or FEET (default is METERS)
SURFDATA	Stanum Year (Name) (Xcoord Ycoord)	
where:	Stanum	Station number, e.g. 5-digit WBAN number for NWS surface station
	Year	Year of data being processed (four digits)
	Name	Station name (optional)
	Xcoord	x-coordinate of station location (m) (optional)
	Ycoord	y-coordinate of station location (m) (optional)
UAIRDATA	Stanum Year (Name) (Xcoord Ycoord)	
where:	Stanum	Station number, e.g. 5-digit WBAN number for NWS upper air station
	Year	Year of data being processed (four digits)
	Name	Station name (optional)
	Xcoord	x-coordinate of station location (m) (optional)
	Ycoord	y-coordinate of station location (m) (optional)

STARTEND	Strtyr Strtmn Strtdy (Strthr) Endyr Endmn Enddy (Endhr) (Applies to ISCST Only)	
where:	Strtyr	Year of first record to be read
	Strtmn	Month of first record to be read
	Strtdy	Day of first record to be read
	Strthr	Hour of first record to be read (optional)
	Endyr	Year of last record to be read
	Endmn	Month of last record to be read
	Enddy	Day of last record to be read
	Endhr	Hour of last record to be read (optional) Note: File read begins with hour 1 of the start date and ends with hour 24 of the end date if Stahr and Endhr are omitted.

TABLE B-8 (CONT.)

DESCRIPTION OF METEOROLOGY PATHWAY KEYWORDS AND PARAMETERS

DAYRANGE	Range1 Range2 Range3 ... RangeN (Applies to ISCST Only)	
where:	Range1	First range of days to process, either as individual day (XXX) or as range (XXX-YYY); days may be input as Julian dates (XXX) or as month and day (XX/YY)
	RangeN	The 'nth' range of days to process
STARDATA	JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC (ISCLT Model) WINTER SPRING SUMMER FALL or QUART1 QUART2 QUART3 QUART4 MONTH SEASON QUARTR ANNUAL	
where:	JAN	Option to calculate JANuary averages from STAR data
	FEB	Option to calculate FEBruary averages from STAR data
	DEC	Option to calculate DECember averages from STAR data
	WINTER	Option to calculate WINTER averages from STAR data
	SPRING	Option to calculate SPRING averages from STAR data
	SUMMER	Option to calculate SUMMER averages from STAR data
	FALL	Option to calculate FALL averages from STAR data
	QUART1	Option to calculate QUART1 averages from STAR data
	QUART2	Option to calculate QUART2 averages from STAR data
	QUART3	Option to calculate QUART3 averages from STAR data
	QUART4	Option to calculate QUART4 averages from STAR data
	MONTH	Option to calculate averages for all twelve MONTHs
	SEASON	Option to calculate averages for all four SEASONs
	QUARTR	Option to calculate averages for all four QUARTeRs
	ANNUAL	Option to calculate annual values from an ANNUAL STAR summary
	PERIOD	Option to calculate averages for the entire data PERIOD
WDROTATE	Rotang	
where:	Rotang	Specifies angle (in degrees) to rotate wind direction measurements to correct for alignment problems; value of Rotang is subtracted from WD measurements, i.e., rotation is counterclockwise; may also be used to adjust input of wind direction from values to flow vector values by setting Rotang = 180

WINDPROF	Stab Prof1 Prof2 Prof3 Prof4 Prof5 Prof6	
where:	Stab	Specifies stability category (A through F) for the following six values by wind speed class
	Prof1	Wind speed profile exponent for first speed class
	Prof2	Wind speed profile exponent for second speed class
	Prof3	Wind speed profile exponent for third speed class
	Prof4	Wind speed profile exponent for fourth speed class
	Prof5	Wind speed profile exponent for fifth speed class
	Prof6	Wind speed profile exponent for sixth speed class
		Note: Card is repeated for each stability class
DTHETADZ	Stab Dtdz1 Dtdz2 Dtdz3 Dtdz4 Dtdz5 Dtdz6	
where:	Stab	Specifies stability category (A through F) for the following six values by wind speed class
	Dtdz1	Vertical temperature gradient for first speed class
	Dtdz2	Vertical temperature gradient for second speed class
	Dtdz3	Vertical temperature gradient for third speed class
	Dtdz4	Vertical temperature gradient for fourth speed class
	Dtdz5	Vertical temperature gradient for fifth speed class
	Dtdz6	Vertical temperature gradient for sixth speed class
		Note: Card is repeated for each stability class

TABLE B-8 (CONT.)

DESCRIPTION OF METEOROLOGY PATHWAY KEYWORDS AND PARAMETERS

WINDCATS	Ws1 Ws2 Ws3 Ws4 Ws5 (Applies to Short Term Only)	
where:	Ws1	Upper bound of first wind speed category (m/s)
	Ws2	Upper bound of second wind speed category (m/s)
	Ws3	Upper bound of third wind speed category (m/s)
	Ws4	Upper bound of fourth wind speed category (m/s)
	Ws5	Upper bound of fifth wind speed category (m/s) (sixth category is assumed to have no upper bound)
AVESPEED	Ws1 Ws2 Ws3 Ws4 Ws5 Ws6 (Applies to ISCLT Only)	
where:	Ws1	Median speed of first wind speed category (m/s)
	Ws2	Median speed of second wind speed category (m/s)
	Ws3	Median speed of third wind speed category (m/s)
	Ws4	Median speed of fourth wind speed category (m/s)
	Ws5	Median speed of fifth wind speed category (m/s)
	Ws6	Median speed of sixth wind speed category (m/s)
AVETEMPS	Aveper Ta1 Ta2 Ta3 Ta4 Ta5 Ta6 (Applies to ISCLT Only)	
where:	Aveper	Specifies averaging period (see AVERTIME keyword) for the following temperatures (K)
	Ta1	Average temperature of stability category A
	Ta2	Average temperature of stability category B
	Ta3	Average temperature of stability category C
	Ta4	Average temperature of stability category D
	Ta5	Average temperature of stability category E
	Ta6	Average temperature of stability category F Note: Card is repeated for each averaging period
AVEMIXHT	Aveper Stab Mixht1 Mixht2 Mixht3 Mixht4 Mixht5 Mixht6 (Applies to ISCLT Only)	

where:	Aveper	Specifies averaging period (see AVERTIME keyword) for the following mixing heights (m)
	Stab	Specifies stability category (A through F) for the following six values by wind speed class
	Mixht1	Average mixing height for first speed class
	Mixht2	Average mixing height for second speed class
	Mixht3	Average mixing height for third speed class
	Mixht4	Average mixing height for fourth speed class
	Mixht5	Average mixing height for fifth speed class
	Mixht6	Average mixing height for sixth speed class
		Note: Card is repeated for each stability class and for each averaging period
AVEROUGH	Aveper Z0	(Applies to ISCLT Only)
where:	Aveper	Specifies averaging period (AVERTIME keyword) for the roughness length (m)
	Z0	Roughness Length
		Note: Card is repeated for each averaging period

TABLE B-9

DESCRIPTION OF TERRAIN GRID PATHWAY KEYWORDS

TG Keywords	Type	Keyword Description
STARTING	M - N	Identifies the start of TERRAIN GRID pathway inputs
INPUTFIL	M - N	Describes input terrain grid data file
LOCATION	M - N	Specifies the origin of the terrain grid
ELEVUNIT	O - N	Defines input units for terrain grid elevations (defaults to meters)
FINISHED	M - N	Identifies the end of TERRAIN GRID pathway inputs

Note: The Terrain Grid (TG) pathway is optional. The TG pathway is only used for calculating dry depletion in elevated or complex terrain. If it is omitted, then the terrain profile is linearly interpolated along the plume path from source to receptor for dry depletion calculations.

TABLE B-10

DESCRIPTION OF TERRAIN GRID PATHWAY KEYWORDS AND PARAMETERS

INPUTFIL	Tgfile	
where:	Tgfile	Specifies filename for the terrain grid data file
LOCATION	Xorig Yorig (Units)	
where:	Xorig Yorig Units	UTM X-coordinate of origin for the source and receptor locations UTM Y-coordinate of origin for the source and receptor locations Units for Xorig and Yorig (FEET, KM, or METERS - default is in METERS)
ELEVUNIT	METERS or FEET	
where:	METERS FEET	Specifies input units for terrain grid elevations of meters Specifies input units for terrain grid elevations of feet Note: This keyword applies to terrain grid elevations only.

TABLE B-11

DESCRIPTION OF EVENT PATHWAY KEYWORDS

(APPLIES TO ISCEV MODEL ONLY)

EV Keywords	Type	Keyword Description
STARTING	M - N	Identifies the start of EVENT pathway inputs
EVENTPER	M - R	Describes data and averaging period for an event
EVENTLOC	M - R	Describes receptor location for an event
FINISHED	M - N	Identifies the end of EVENT pathway inputs

TABLE B-12

DESCRIPTION OF EVENT PATHWAY KEYWORDS AND PARAMETERS

(APPLIES TO ISCEV MODEL ONLY)

Keyword	Parameters	
EVENTPER	Evname Aveper Grpid Date	
where:	Name	Specify name of event to be processed (e.g. H2H24ALL), (up to eight alphanumeric characters)
	Grpid	Specify source group ID for event
	Aveper	Specify averaging period for event
	Date	Specify data period for event (ending YYMMDDHH for averaging period)
EVENTLOC	Evname XR= Xr YR= Yr (Zelev) (Zflag) or RNG= Rng DIR= Dir (Zelev) (Zflag)	
where:	Evname	Specify name of event to be processed (e.g. H2H24ALL), (up to eight alphanumeric characters)
	XR=	X-coordinate for event (discrete Cartesian receptor)
	YR=	Y-coordinate for event (discrete Cartesian receptor)
	RNG=	Distance range for event (discrete polar receptor)
	DIR=	Radial direction for event (discrete polar receptor)
	Zelev	Terrain elevation for event (optional)
	Zflag	Receptor height above ground for event (optional)

Note: EVENT locations can be input as either discrete Cartesian receptors (XR=, YR=) or as discrete polar receptors (RNG=, DIR=). Events that are specified in the file generated by the ISCST model (CO EVENTFIL card) are always given as discrete Cartesian coordinates. Discrete polar receptors are assumed to be relative to an origin of (0,0).

TABLE B-13

DESCRIPTION OF OUTPUT PATHWAY KEYWORDS

OU Keywords	Type	Keyword Description
STARTING	M - N	Identifies the start of OUTPUT pathway inputs
RECTABLE	O - R	Option to specify value(s) by receptor for output
MAXTABLE	O - R	Option to summarize the overall maximum values
DAYTABLE	O - N	Option to print summaries for each averaging period for each day processed. (Applies to ISCST Only)
MAXIFILE	O - R	Option to list events exceeding a threshold value to file (if CO EVENTFIL option is used, these events are included in the input file generated for the EVENT model). (Applies to ISCST Only)
POSTFILE[1]	O - R	Option to write results to a mass storage file for postprocessing. (Applies to ISCST Only)
PLOTFILE[1]	O - R	Option to write certain results to a storage file suitable for input to plotting routines
TOXXFILE	O - R	Option to write results to a storage file suitable for input to the TOXX model component of TOXST or the RISK model component of TOXLT
EVENTOUT[2]	M - N	Specifies the level of output information provided by the EVENT model. (Applies to ISCEV Only)
FINISHED	M - N	Identifies the end of OUTPUT pathway inputs

1) POSTFILE is used to output concurrent concentration values for particular source groups and averaging times across the receptor network, suitable for postprocessing, such as might be done for implementing the intermediate terrain policy. PLOTFILE is used to output specific design values, such as second high concentrations, across the receptor network, suitable for plotting concentration contours.

2) EVENTOUT is the only keyword on the OU pathway for the Short Term EVENT model.

TABLE B-14

DESCRIPTION OF OUTPUT PATHWAY KEYWORDS AND PARAMETERS

Keyword	Parameters	
RECTABLE	Aveper FIRST SECOND . . . SIXTH (Short Term Model) or Aveper 1ST 2ND . . . 6TH (Short Term Model) INDSRC and/or SRCGRP (Long Term Model)	
where:	Aveper	Averaging period to summarize with high values (keyword ALLAVE specifies all averaging periods)
	FIRST	Select summaries of FIRST highest values by receptor
	SECOND	Select summaries of SECOND highest values by receptor
	SIXTH	Select summaries of SIXTH highest values by receptor
	1ST	Select summaries of 1ST highest values by receptor
	2ND	Select summaries of 2ND highest values by receptor
	6TH	Select summaries of 6TH highest values by receptor Note: If two keywords are input separated by a dash (e.g. FIRST-THIRD), then summaries of all high values in that range are provided. The number of high values allowed is controlled by the NVAL parameter in the computer code (initially set at 3). Also, if the CO EVENTFIL keyword is exercised, then the events generated by the RECTABLE keyword are included in the input file for EVENT model.
	INDSRC	Specifies that summaries of individual source values for each receptor point will be provided
	SRCGRP	Specifies that summaries of source group values for each receptor point will be provided Note: Either INDSRC or SRCGRP or both may be specified

MAXTABLE	Aveper Maxnum (Short Term Model) Maxnum INDSRC and/or SRCGRP and/or SOCONT (Long Term Model)	
where:	Aveper	Averaging period to summarize with maximum values (keyword ALLAVE specifies all averaging periods)
	Maxnum	Specifies number of overall maximum values to summarize (number of maximum values permitted is limited by the NMAX parameter in the computer code, initially set at 50 for Short Term and 10 for Long Term)
	INDSRC	Specifies that summaries of maximum values for individual sources will be provided (independent of source group maxima)
	SRCGRP	Specifies that summaries of maximum values by source group will be provided
	SOCONT	Specifies that summaries of individual source contributions for locations of maximum source group values will be provided Note: Any combination of Long Term parameters is acceptable

TABLE B-14 (CONT.)

DESCRIPTION OF OUTPUT PATHWAY KEYWORDS AND PARAMETERS

DAYTABLE	Avper1 Avper2 Avper3 . . . (Applies to ISCST Only)	
where:	Avper1	Averaging period to summarize with values by receptor for each day of data processed (keyword ALLAVE for first parameter specifies all averaging periods)
MAXIFILE	Aveper Grpid Thresh Filnam (Funit) (Applies to ISCST Only)	
where:	Aveper	Specifies averaging period for list of values equal to or exceeding a threshold value
	Grpid	Specifies source group to be output to file
	Thresh	Threshold value (e.g. NAAQS) for list of exceedances
	Filnam	Name of disk file to store maximum values
	Funit	Optional parameter to specify the file unit Note: If the CO EVENTFIL keyword is exercised, then the events generated by the MAXIFILE keyword are included in the input file for the EVENT model.
POSTFILE	Aveper Grpid Format Filnam (Funit) (Applies to ISCST Only)	
where:	Aveper	Specifies averaging period to be output to file, e.g., 24 for 24-hr averages, PERIOD for period averages
	Grpid	Specifies source group to be output to file
	Format	Specifies format of file, either UNFORM for unformatted files or PLOT for formatted files for plotting
	Filnam	Specifies filename for output file
	Funit	Optional parameter to specify the file unit

PLOTFILE	Aveper Grpid Hivalu Filnam (Funit) (ISCST short term values) Aveper Grpid Filnam (Funit) (ISCLT model and ISCST PERIOD averages)	
where:	Aveper	Specifies averaging period to be output to file, e.g., 24 for 24-hr averages, PERIOD for period averages, WINTER for winter averages, etc.
	Grpid	Specifies source group to be output to file
	Hivalu	Specifies high value summary (e.g. FIRST, SECOND, 1ST, 2ND, etc.) to be output to file (must be selected on a RECTABLE card)
	Filnam	Specifies filename for output file
	Funit	Optional parameter to specify the file unit
TOXXFILE	Aveper Cutoff Filnam (Funit) (ISCST short term values) Aveper Grpid Filnam (Funit) (ISCLT model)	
where:	Aveper	Specifies averaging period to be output to file, e.g., 1 for 1-hr averages, PERIOD for period averages (LT only), WINTER for winter averages, etc.
	Cutoff	Specifies cutoff (threshold) value in g/m^3 for outputting results for ISCST model
	Grpid	Specifies source group to be output to file (LT only)
	Filnam	Specifies filename for output file
	Funit	Optional parameter to specify the file unit
EVENTOUT	SOCONT or DETAIL (Applies to ISCEV Only)	
where:	SOCONT	Specifies the option to provide source contribution information only in the event output
	DETAIL	Specifies the option to include hourly concentrations for each source and hourly meteorological data in the event output

APPENDIX C. UTILITY PROGRAMS

C.1 CONVERTING INPUT RUNSTREAM FILES - STOLDNEW

The STOLDNEW.EXE program is a file conversion utility that may be used to convert original ISCST model (EPA, 1987a) input files to the proper format for the ISCST2 model (EPA, 1992). With the exception of the source inputs for the dry deposition algorithm, the ISCST2 model inputs generated by STOLDNEW will be compatible with the ISCST3 model.

To run the file conversion utility, type STOLDNEW at the DOS prompt. The program will prompt the user for the name of the original ISCST input file being converted and for the name of the new file to be generated in the ISCST2 format. The program will also generate a file called SUMMARY.OLD that contains a summary of model inputs in the same format as would appear at the beginning of an original ISCST model run.

Even though the STOLDNEW utility should convert most ISCST input files without any difficulty, users are strongly encouraged to check the results of STOLDNEW carefully before using the input file with the ISCST3 model. The purpose of this is primarily to check for rounding of the inputs in the conversion process. Some inputs that may vary over a considerable range, such as the emission rate, are converted using an Fortran G format with a full seven significant digits. However, most inputs are converted using a Fortran F format specifier that uses a fixed number of decimal places. Some rounding is possible on some of these fixed format inputs, depending on how many decimal places were used for inputting the data in the original format.

The STOLDNEW utility program will prompt the user to input additional filenames where appropriate. Specifically, the program prompts for the name of the meteorological data file (including a DOS path if desired), which is inserted into the appropriate field on the ME INPUTFIL keyword. If the option for using unformatted preprocessed data was specified for the original ISCST input, then the meteorology data filename should be the name of the file containing the preprocessed data. If the "card image" meteorological data option was specified for the original ISCST model input, then the hourly "card image" meteorological data are included as part of the original runstream option file. In this case, the STOLDNEW program prompts for the name of the file that it uses for writing out the card image data in the ASCII format used by the ISCST3 model. The format field on the ME INPUTFIL card will include the default ASCII format used by the ISCST3 model (which would have the same effect as leaving the field blank), unless the card image data includes hourly wind profile exponents or hourly vertical potential temperature gradients. In the latter case, STOLDNEW will insert the CARD keyword for the meteorological data format on the ME INPUTFIL card.

Another case where the STOLDNEW program will prompt for a filename is when the option for generating a separate file of concurrent concentration values is selected in the original runstream file (ISW(5)=1). In this case, the program will request the name to use for the concentration file, and will insert that name in the appropriate field for the OU POSTFILE keyword inputs. A separate POSTFILE card will be generated for each combination of averaging period and source group, with all of the concentration results being written to a single file on file unit 20. This will result in a concentration file that is nearly identical to the file generated by the original ISCST model.

It should be noted that the ISCST3 model does not support the use of hourly decay coefficients, which were allowed for the original ISCST model when "card image" meteorological data were used. If hourly decay coefficients are detected in the original ISCST runstream file, then STOLDNEW will write a warning message to the screen and within the new runstream file indicating that the hourly values of decay coefficients will be ignored. The only other option available in the original ISCST model that is not available with ISCST3 is the option to list the meteorological data for each day processed as part of the main printed output file. In lieu of this option, a separate utility program, called METLIST, is available with the ISC2 package that produces a listing of meteorological data for the period of interest. The METLIST program is described in more detail in Section C.3.

C.2 CONVERTING UNFORMATTED PCRAMMET FILES TO ASCII FORMATTED FILES - BINTOASC

The BINTOASC.EXE program is a utility program that converts unformatted (binary) meteorological data files generated by the PCRAMMET or MPRM preprocessor programs to the default ASCII format used by the ISCST3 Model. The ASCII data file consists of sequential hourly records.

To run this program, type BINTOASC at the DOS prompt. The program will prompt for the name of the unformatted data input file and the name of the ASCII formatted output file. The BINTOASC program will convert unformatted data files generated by a Microsoft-compiled version of PCRAMMET, as well as files generated by versions of PCRAMMET or MPRM compiled with either the Lahey or the Ryan-McFarland FORTRAN compilers. The program will write a message to the screen indicating which of the three types of files has been identified. If the program encounters an error reading the data file,

then a message will be written to the screen indicating which compilers are supported. The program may also have encountered a read error due to the use of "short integers" (INTEGER*2) in the storing of some of the data in the unformatted file. The program assumes that all integer variables occupy four bytes of storage.

Once the type of unformatted file has been determined the program will prompt the user as follows:

Do You Want to Convert the Entire Data File? (Y or N)

If the user responds with either a 'Y' or a 'y', then the program will convert the entire data file (up to 366 days for a leap year). If the user responds with either an 'N' or an 'n', then the program will prompt the user as follows:

Enter the Start Date and End Date (e.g. 1,365):

The user can select a single day or a range of (Julian) days within the year to convert to the ASCII file.

If the BINTOASC program encounters a calm hour in the unformatted data file, which is identified by a wind speed of 1.0 m/s and a flow vector equal to the flow vector for the previous hour, then it writes out a wind speed of 0.0 for that hour, which is interpreted by the ISC2 Short Term models as a calm hour. The flow vector variable written to the ASCII file corresponds to the randomized flow vector in the unformatted data file. The structure of the PCRAMMET-generated unformatted data file and the default ASCII file are described in detail in Appendix F.

C.3 LISTING HOURLY METEOROLOGICAL DATA - METLIST

The METLIST.EXE program is a utility program that creates a listing file of meteorological data for a specified day or range of days, which can be sent to a printer. The program lists one day of data per page, with appropriate column headers for the meteorological variables. The original version of the ISCST model included an option to print the hourly meteorological data within the main output file. This option has not been included in the ISCST3 model. The user can use the METLIST program instead to create a listing for the data period of interest, and refer to that listing as needed to examine the meteorological data. Since the ISCST3 model also uses ASCII sequential hourly files (see Sections 3.5.1 and C.1), the meteorological data file can be examined directly through an editor or listing program, or the ASCII file itself can be printed. Therefore, the need for an option to list meteorological data within the program has been reduced. Also, the ISCEV2 model contains the option to list the hourly meteorological data for specific events that are of interest to the user.

To use this program, type METLIST from the command line prompt. The program will prompt the user for the following information:

Enter Meteorology File Name: (Enter the name of the file containing the meteorological data)

Options for File Formats are:

ASCII
UNFORM
FREE
CARD
Fortran format specifier

Enter File Format: (Select the format of the meteorological file by entering one of the four keywords above or by entering a Fortran format specifier, e.g. (4I2,2F9.4,F6.1,I2,2F7.1))

Enter Output File Name: (Enter the name of the file to which the meteorological data listing will be stored)

Enter Day Range: (Enter the Julian start day and Julian end day, e.g. 1,10)

The ASCII data format option for the METLIST program corresponds with the default ASCII format used by the ISCST3 and ISCEV3 models. The Fortran specifier for this format is '(4I2,2F9.4,F6.1,I2,2F7.1)'. The other format options are described in Section 3.5.1.1. The METLIST program was compiled using the Microsoft FORTRAN Compiler, and therefore only supports unformatted data files generated by Microsoft versions of PCRAMMET or MPRM. To use unformatted data files generated by either the Lahey or the Ryan-McFarland compiler, the user should first convert the unformatted data file to the default ASCII format using the BINTOASC utility program (described in Section C.2), and then use the METLIST program and select the ASCII format option.

APPENDIX D. BATCH FILE DESCRIPTIONS FOR COMPILING THE MODELS ON A PC

D.1 MICROSOFT/DOS VERSIONS

The ISC models were developed on an IBM-compatible PC using the Microsoft Optimizing FORTRAN Compiler (Version 5.1). The models are provided on the Support Center for Regulatory Air Models (SCRAM) Bulletin Board System (BBS) as executable files designed to run on DOS PCs. These DOS versions were compiled with the Microsoft emulator library option that allows the models to utilize a math coprocessor if available, but also run in the absence of one. The batch file provided for compiling the ISCST model with the Microsoft compiler (FLMSISCS.BAT) includes the following commands:

```
FL /c /FPi /AH ISCST3.FOR
FL /c /FPi /AH /DMICRO PCCODE.FOR
FL /c /FPi /AH SETUP.FOR
FL /c /FPi /AH COSET.FOR
FL /c /FPi /AH SOSET.FOR
FL /c /FPi /AH RESET.FOR
FL /c /FPi /AH MESET.FOR
FL /c /FPi /AH TGSET.FOR
FL /c /FPi /AH OUSET.FOR
FL /c /FPi /AH INPSUM.FOR
FL /c /FPi /AH METEXT.FOR
FL /c /FPi /AH CALC1.FOR
FL /c /FPi /AH CALC2.FOR
FL /c /FPi /AH DEPFLUX.FOR
FL /c /FPi /AH PRISE.FOR
FL /c /FPi /AH SIGMAS.FOR
FL /c /FPi /AH CALC3.FOR
FL /c /FPi /AH CALC4.FOR
FL /c /FPi /AH PITAREA.FOR
FL /c /FPi /AH OUTPUT.FOR
```

```
LINK @FLMSISCS.LRF
```

where /c instructs the compiler to compile without linking; the /FPi option instructs the compiler to use in-line instructions for floating point operations and link with an emulator library (uses 80x87 coprocessor if present); and the /AH option that the huge memory model be used, allowing arrays or common blocks to exceed 64K. The /DMICRO option for the PCCODE.FOR source file instructs the compiler to use the conditional compilation blocks defined for the Microsoft compiler. These enable the PC-specific features, such as writing the date and time on each page of the output file and writing an update to the screen on the status of processing. Each of the source files (*.FOR) for the ISCST model are listed separately in this batch file, which assumes that all of the source code modules and the include files are in a single directory, or that the compiler has been setup to search for the include files in the appropriate directory. The command line options for the compiler make full use of the compiler's optimization routines to speed up the code. To disable optimization, the /Od option would be added. Disabling optimization will increase the model's execution time by about 10 percent, and will also increase the size of the code.

Once the source files have been compiled successfully, and object (.OBJ) files have been generated for each source file, the model is ready to be linked and an executable file created. The executable file on the SCRAM BBS was linked using a memory overlay manager so that only certain portions of the code are resident in memory at any given time. This allows for a more efficient use of available memory by the model, and therefore allows for larger runs to be performed than would be possible without using overlays. This is accomplished with the following command line for the linker provided with the Microsoft compiler, which is included in the link response file, FLMSISCS.LRF:

```
/E /SE:256 ISCST3+PCCODE+SETUP+(COSET)+(SOSET)+(RESET)+(MESET)+(TGSET)+(OUSET)+(INPSUM)+(METEXT+
          CALC1+CALC2+CALC3+PRISE+SIGMAS+CALC4+DEPFLUX+PITAREA)+(OUTPUT)
```

The /E option instructs the linker to produce a packed executable file that occupies less disk space. The /SE:256 option increases the number of segments allowed to 256. With this memory overlay structure, the ISCST3, PCCODE and SETUP modules are always memory resident, and any module or group of modules within parentheses are overlayed into the same area of memory only when needed. Linking without the overlay manager will increase the minimum load size for the executable file by about 200K for the ISCST model.

Similar batch files are available for compiling and linking the ISCLT and ISCEV models. The batch file for the ISCLT model, FLMSISCL.BAT, includes the following commands:

```
FL /c /FPi /AH ISCLT3.FOR
FL /c /FPi /AH /DMICRO PCCODELT.FOR
FL /c /FPi /AH SETUPLT.FOR
FL /c /FPi /AH COSETLT.FOR
FL /c /FPi /AH SOSETLT.FOR
FL /c /FPi /AH RESETLT.FOR
FL /c /FPi /AH MESETLT.FOR
FL /c /FPi /AH TGSETLT.FOR
FL /c /FPi /AH OUSETLT.FOR
FL /c /FPi /AH INPSUMLT.FOR
FL /c /FPi /AH METEXTLT.FOR
FL /c /FPi /AH CALC1LT.FOR
FL /c /FPi /AH CALC2LT.FOR
FL /c /FPi /AH CALC3LT.FOR
FL /c /FPi /AH PRISELT.FOR
FL /c /FPi /AH SIGMASLT.FOR
FL /c /FPi /AH PITAREAL.FOR
FL /c /FPi /AH DEPFLUX.FOR
FL /c /FPi /AH OUTPUTLT.FOR
```

```
LINK @FLMSISCL.LRF
```

The only difference between this and the file for the ISCST model is the source file names. This file invokes the following command line from the FLMSISCL.LRF link response file:

```
/E /SE:256 ISCLT3+PCCODELT+SETUPLT+(COSETLT)+(SOSETLT)+(RESETLT)+(MESETLT)+(TGSETLT)+(OUSETLT)+
          (INPSUMLT)+(METEXTLT+CALC1LT+CALC2LT+CALC3LT+PRISELT+SIGMASLT+PITAREAL+DEPFLUX)+(OUTPUTLT)
```

The batch file for the ISCEV model, FLMSISCE.BAT, includes the following commands:

```
FL /c /FPi /AH EVISCST3.FOR
FL /c /FPi /AH /DMICRO EVPCCODE.FOR
FL /c /FPi /AH EVSETUP.FOR
FL /c /FPi /AH EVCOSET.FOR
FL /c /FPi /AH EVSOSET.FOR
FL /c /FPi /AH EVMESET.FOR
FL /c /FPi /AH EVTGSET.FOR
FL /c /FPi /AH EVEVSET.FOR
FL /c /FPi /AH EVOUSET.FOR
FL /c /FPi /AH EVINPSUM.FOR
FL /c /FPi /AH EVMETEXT.FOR
FL /c /FPi /AH EVCALC1.FOR
FL /c /FPi /AH EVCALC2.FOR
FL /c /FPi /AH EVPRISE.FOR
FL /c /FPi /AH EVSIGMAS.FOR
FL /c /FPi /AH EVPITARE.FOR
FL /c /FPi /AH DEPFLUX.FOR
FL /c /FPi /AH EVOUTPUT.FOR
LINK @FLMSISCE.LRF
```

which invokes the following command from the ISCEV.LRF link response file:

```
/E /SE:256 EVISCST3+EVPCCODE+EVSETUP+(EVCOSET)+(EVSOSET)+(EVMESET)+(EVTGSET)+(EVEVSET)+(EVOUSET)+
          (EVINPSUM)+(EVMETEXT+EVCALC1+EVCALC2+EVPRISE+EVSIGMAS)+(EVOUTPUT)
```

D.2 LAHEY/EXTENDED MEMORY VERSIONS

While the ISC models were developed on an IBM-compatible PC using the Microsoft Optimizing FORTRAN Compiler (Version 5.1), the models have also been compiled using the Lahey F77L-EM/32 Fortran Compiler (Version 5.2) to generate PC-executable files capable of utilizing extended memory on 80386 and 80486 PCs with at least 8 MB of RAM for the Short Term model and at least 4 MB of RAM for the Long Term model. The extended memory (EM) versions of the models are also provided on the SCRAM BBS. The batch file provided for compiling the ISCST model (ISCST3EM.EXE) with the Lahey compiler (F77LISCS.BAT) includes the following commands:

```
F77L3 ISCST3.FOR /NO /NW
F77L3 PCCODE.FOR /NO /NW /D1LAHEY
F77L3 SETUP.FOR  /NO /NW
F77L3 COSET.FOR  /NO /NW
F77L3 SOSET.FOR  /NO /NW
F77L3 RESET.FOR  /NO /NW
F77L3 MESET.FOR  /NO /NW
F77L3 TGSET.FOR  /NO /NW
F77L3 OUSET.FOR  /NO /NW
F77L3 INPSUM.FOR /NO /NW
F77L3 METEXT.FOR /NO /NW
F77L3 CALC1.FOR  /NO /NW
F77L3 CALC2.FOR  /NO /NW
F77L3 PRISE.FOR  /NO /NW
F77L3 SIGMAS.FOR /NO /NW
F77L3 CALC3.FOR  /NO /NW
F77L3 CALC4.FOR  /NO /NW
F77L3 DEPFLUX.FOR /NO /NW
F77L3 PITAREA.FOR /NO /NW
F77L3 OUTPUT.FOR /NO /NW
386link @F77LISCS.LRF
cfig386 ISCST3EM.EXE -nosignon
```

where /NO option instructs the compiler not to list the compiler options to the screen, the /NW option suppresses a certain level of warning messages, and the /D1LAHEY option

for the PCCODE.FOR source file instructs the compiler to use the conditional compilation blocks defined for the Lahey compiler. These conditional blocks of code enable the PC-specific features, such as writing the date and time on each page of the output file and writing an update to the screen on the status of processing. Each of the source files (*.FOR) for the ISCST model are listed separately in this batch file, which assumes that all of the source code modules and the include files are in a single directory, or that the compiler has been setup to search for the include files in the appropriate directory. The '386link @F77LISCS.LRF' links the model using the F77LISCS.LRF link response file, which includes the following command:

```
ISCST3,PCCODE,SETUP,COSET,SOSET,RESET,MESET,TGSET,OUSET,INPSUM,METEXT,CALC1,CALC2,
CALC3,CALC4,PRISE,SIGMAS,DEPFLUX,PITAREA,OUTPUT -STUB RUNB -EXE ISCST3EM.EXE - PACK
```

There are no memory overlays used for the Lahey versions, since they make use of extended memory.

Similar batch files are available for the ISCLT (F77LISCL.BAT) and the ISCEV (F77LISCE.BAT) models, except for the specification of the appropriate source file names provided in the previous section. The executable filenames for these models are ISCLT3EM.EXE and ISCEVEM.EXE.

APPENDIX E. EXPLANATION OF ERROR MESSAGE CODES

E.1 INTRODUCTION

One of the significant operational improvements of the ISC models is an improved error handling procedure. The input runstream is checked to identify parameters that are missing or potentially in error, and the input source and meteorological data are checked and flagged for possible erroneous values.

The ISC models use a "defensive programming" approach to eliminate as much as possible of the user's work in debugging the input runstream file. Also, a great deal of effort has been made to eliminate the possibility of run time errors, such as "divide by zero," and to point out questionable input data. Error messages are reported to the user in two ways. A summary of messages is provided in the main output result file, and the user can also request a detailed message listing file.

Message Summary: Whether the user selects a detailed error listing file or not, the ISC models output a summary of messages within the output result file. This message table gives the number of messages of each type, together with a detailed list of all the fatal errors and warning messages. During setup processing, if no errors or warnings are generated, then the model simply reports to the user that "SETUP Finishes Successfully."

Detailed Message Listing File: The ISC models provide the option of saving a detailed list of all messages generated by the model in a separate output file. The user can select this option by specifying the keyword "ERRORFIL" followed by a filename

inside the COntrol pathway. For example, the following statements will save all the error messages to an ASCII text file named "errormsg.out":

```
CO STARTING
   ERRORFIL  errormsg.out
CO FINISHED
```

E.2 THE OUTPUT MESSAGE SUMMARY

There are two message summaries provided in the standard output file of the ISC models. The first one is located after the echo of input runstream file images and before the input data summary. This summary will take one of two forms, depending on whether any fatal error or non-fatal warning messages were generated, and also depending on whether the option to RUN or NOT to run was selected on the CO RUNORNOT card. If there are no errors or warnings generated during the setup processing, and the RUN option was selected, then the model simply reports that "SETUP Finishes Successfully." If any fatal errors or warning messages were generated during the setup processing, or if the option NOT to run was selected, then a more detailed summary is provided. This summary provides a message count for each type of message, and a detailed listing of each fatal error and warning message generated. The second message summary table is located at the very end of the standard output result file, and it sums up the messages generated by the complete model run - both setup processing and run-time processing.

An example of a setup processing message summary is shown in Figure E-1.

```
*** Message Summary For The ISC3 Model Setup ***

 --------- Summary of Total Messages ---------

A Total of           0 Fatal Error Message(s)
A Total of           0 Warning Message(s)
A Total of           0 Information Message(s)


   ******** FATAL ERROR MESSAGES ********
                ***  NONE  ***

   ********   WARNING MESSAGES   ********
                ***  NONE  ***

   **********************************
   *** SETUP Finishes Successfully ***
   **********************************
```

FIGURE E-1. EXAMPLE OF AN ISC MESSAGE SUMMARY

E.3 DESCRIPTION OF THE DETAILED MESSAGE LAYOUT

Three types of messages can be produced by the models during the processing of input runstream images and during model calculations. These are described briefly below:

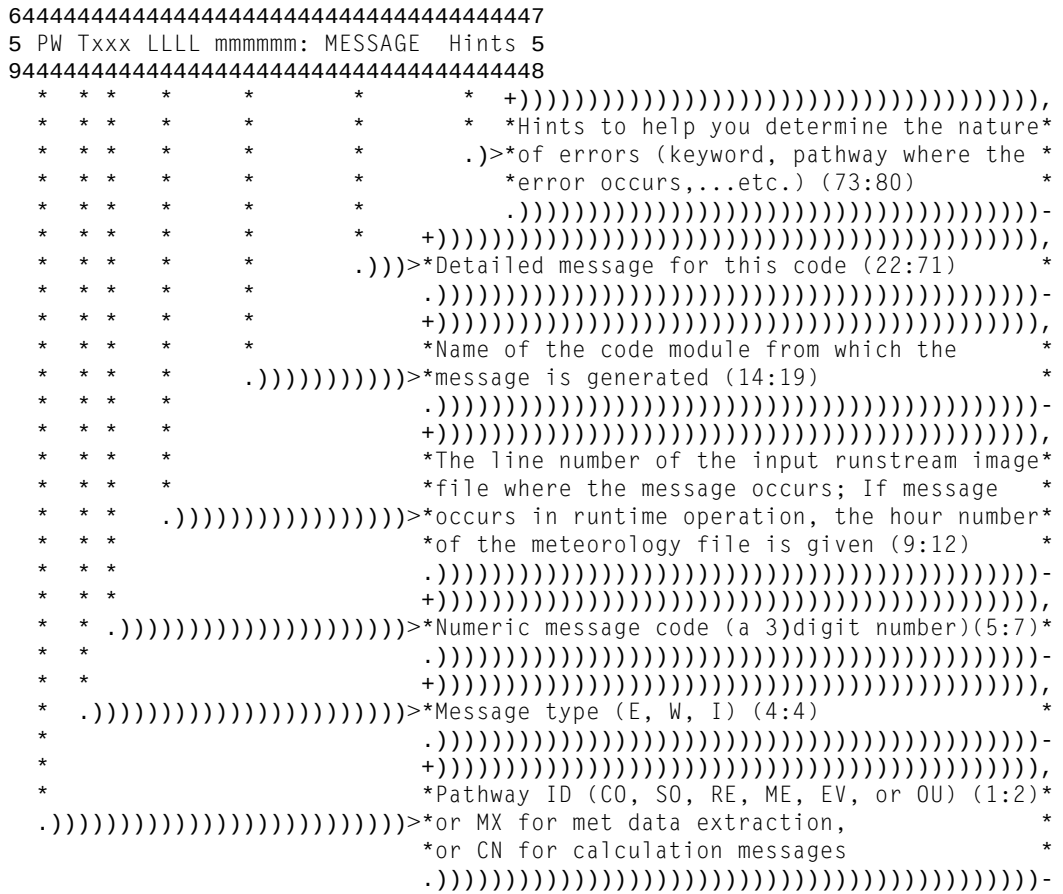
- Errors that will halt any further processing, except to identify additional error conditions (type E);
- Warnings that do not halt processing but indicate possible errors or suspect conditions (type W); and
- Informational messages that may be of interest to the user but have no direct bearing on the validity of the results (type I).

The messages have a consistent structure which contains the pathway ID, indicating which pathway the messages are generated from; the message type followed by a three-digit message number; the line number of the input runstream image file for setup messages (or the meteorology hour number for runtime messages); the name of the module (e.g. the subroutine name) from which the message is generated; a detailed message corresponding to the message code; and an 8-character simple hint to help the user spot the possible source of the problem.

The following is an example of a detailed message generated from the CO pathway:

```
CO E100    8 EXPATH: Invalid Pathway Specified. The Troubled Pathway is FF
```

The message syntax is explained in more detail below (values in parentheses give the column numbers within the message line for each element):



The three message types are identified with the letters E (for errors), W (for warnings), and I (for informational messages). The 3-digit message codes are grouped into general categories corresponding to the different stages of the processing. Theses categories are:

100 - 199 Input Runstream Image Structure Processing
200 - 299 Parameter Setup Processing
300 - 399 Data and Quality Assurance Processing
400 - 499 Run Time Message Processing
500 - 599 Input/Output Message Processing

A detailed description of each of the message codes currently used in the models is provided in the next section.

E.4 DETAILED DESCRIPTION OF THE ERROR/MESSAGE CODES

INPUT RUNSTREAM IMAGE STRUCTURE PROCESSING, 100-199

This type of message indicates problems with the basic syntax and/or structure of the input runstream image. Typical messages include errors like "Missing mandatory keyword", "Illegal Keyword", ..., etc. If a fatal error of this kind is detected in a runstream image, a fatal error message is written to the message file and any attempt to process data is prohibited, although the remainder of the runstream file is examined for other possible errors. If a warning occurs, data may still be processed, although the inputs should be checked carefully to be sure that the condition causing the warning does not indicate an error.

100 Invalid Pathway Specified. The pathway ID should be a 2 character string. It should be one of the following: CO for control pathway, SO for source pathway, RE for receptor pathway (or EV for event pathway for ISCEV model), ME for meteorology data setting pathway, and OU for output format pathway. Its position is normally confined to columns 1 and 2 (1:2) of the input runstream file. However, the model

does allow for a shift of the entire input runstream file of up to 3 columns. If the inputs are shifted, then all input records must be shifted by the same amount. The invalid pathway is repeated at the end of the message.

105 Invalid Keyword Specified. The keyword ID should be an 8-character string. Its position is normally confined to columns 4 to 11 (4:11) of the input runstream file. However, the model does allow for a shift of the entire input runstream file of up to 3 columns. If the inputs are shifted, then all input records must be shifted by the same amount. There should be a space between keyword ID and any other data fields. For a list of valid keywords, refer to Appendix A or Appendix B. The invalid keyword is repeated at the end of the message.

110 Keyword is Not Valid for This Pathway. The input keyword is a valid 8-character string, but it is not valid for the particular pathway. Refer to Appendix A, Appendix B or Section 3 for the correct usage of the keyword. The invalid keyword is repeated at the end of the message.

115 Starting and Finishing Statements do not match. Only One STARTING and one FINISHED statement,respectively, is allowed at the very beginning and the very end of each pathway block. Check the position and frequency to make sure the input runstream file meets the format requirement. The pathway during which the error occurs is included at the end of the message.

120 Pathway is Out of Sequence. The pathways are not input in the correct order. The correct order is CO, SO, RE, ME, and OU for the ISCST and ISCLT models, and CO, SO, ME, EV, and OU for the ISCEV model. The offending pathway is given as a hint.

125 Missing FINISHED Statement - Runstream file is incomplete. One or more FINISHED statements are missing. A 5-digit status variable is given as a hint. Each digit corresponds to a pathway in the appropriate order, and is a '1' if the pathway is complete and a '0' if the FINISHED is missing. For example, a status of '10111' indicates that the SO pathway was missing a FINISHED statement. Normally such an error will generate additional messages as well.

130 Missing Mandatory Keyword. To run the model, certain mandatory keywords must present in the input runstream file. For a list of mandatory keywords, see Appendix A or Appendix B. For more detailed information on keyword setup, see the description of message code 105. The missing keyword is included with the message.

135 Duplicate Non-repeatable Keyword Encountered. More than one instance of a non-repeatable keyword is encountered. For a list of non-repeatable keywords, see Appendix A or Appendix B. The repeated keyword is included with the message.

140 Invalid Order of Keyword. A keyword has been placed out of the acceptable order. The order for most keywords is not critical, but the relative order of a few keywords is important for the proper interpretation of the input data. The keyword reference in Section 3 identifies any requirements for the order of keywords. The keyword that was out of order is included with the message.

143 Conflicting Options: UNFORM with Dry or Wet Deposition. The dry and wet deposition algorithms of the Short Term model require additional meteorological variables that are not included in the unformatted data file generated by the PCRAMMET or MPRM meteorological processors. The user must use PCRAMMET or MPRM to generate an ASCII meteorological data file with the necessary variables.

144 Conflicting Options: NOSMPL with FLAT Terrain. The NOSMPL option specifies that only the COMPLEX1 algorithms will be used, whereas the FLAT option specifies that flat terrain will be used (i.e., all receptor elevations are at stack base elevation). Since the COMPLEX1 algorithms apply only to receptor elevations that are above the release height, these two options are in conflict.

145 Conflicting Options: MULTYEAR and Re-Start Option. The multiple year option for processing PM-10 values makes use of the re-start routines in the model with some slight changes to handle the period averages from year to year. As a result, the MULTYEAR keyword cannot be specified with either the SAVEFILE or INITFILE keywords.

150 Conflicting Options: MULTYEAR for Wrong Pollutant. The multiple year option is provided specifically for the processing of PM-10 values to obtain the "high-sixth-high in five years" design value. Its treatment of the high short term values for multiple year periods is not consistent with existing air quality standards for other pollutants. To use the MULTYEAR option, the user must specify a pollutant type (on the CO POLLUTID card) of PM-10, PM10, or OTHER.

151 CO ELEVUNIT card is obsolescent: use RE ELEVUNIT card. With the release of the ISC3 models, the CO ELEVUNIT card has been designated as obsolescent - it will still be processed as before by the model, but the user is encouraged to use the

new RE ELEVUNIT card instead. The RE ELEVUNIT card has the same effect as the original CO ELEVUNIT card.

152 ELEVUNIT card must be first for this pathway. The ELEVUNIT card must be the first non-commented card after STARTING when used on the SO or RE pathway. This requirement is made in order to simplify reviewing runstream files to determine the elevation units used for sources and receptors.

153 Cannot use CO ELEVUNIT card with ELEVUNIT card for the SO, RE or TG pathway. With the release of the ISC3 models, the CO ELEVUNIT card has been designated as obsolescent - it will still be processed as before by the model if it is the only CO ELEVUNIT card encountered in the runstream. This is to allow for compatibility of the model with old input files. However, if any of the new ELEVUNIT cards (on the SO, RE or TG pathways) are used, then the CO ELEVUNIT card must be removed.

155 Conflicting Decay Keyword. The ISC models allow for the user to specify the rate of exponential decay either in terms of the half-life (HALFLIFE keyword) or the decay coefficient (DCAYCOEF keyword). If both keywords are specified, then only the first one will be used, and inputs for the second one will be ignored.

157 EMISUNIT keyword used with more than one output type. If both concentration and deposition are being output for the ISCST model, then the EMISUNIT keyword cannot be used. To specify emission or output units, the CONCUNIT and/or DEPOUNIT keyword should be used.

158 EMISUNIT keyword used with CONCUNIT or DEPOUNIT keyword. The EMISUNIT keyword may be used if a single output type (CONC, DEPOS, DDEP or WDEP) is being generated, whereas the CONCUNIT or DEPOUNIT keywords must be used if more than one output type is generated.

160 Duplicate ORIG Secondary Keyword for GRIDPOLR. Only one origin card may be specified for each grid of polar receptors. The network ID for the effected grid is included with the message.

170 Invalid Secondary Key for Receptor GRID. The network ID for the effected grid is included with this message. Refer to Appendix B for the correct syntax of secondary keywords.

175 Missing Secondary Keyword END for Receptor Grid. The END secondary keyword is required for each grid of receptors input by the user (keywords GRIDCART and GRIDPOLR). It signals the end of inputs and triggers the processing of data for that particular network.

180 Conflicting Secondary Keyword for Receptor Grid. Two incompatible secondary keywords have been input for the same grid of receptors, e.g. GDIR and DDIR for the keyword GRIDPOLR, where GDIR specifies to generate directions with uniform spacing, and DDIR specifies that discrete, non-uniform directions are being specified.

185 Missing Receptor Keywords. No Receptors Specified. Since none of the RE pathway keywords are mandatory, a separate error check is made to determine if any of the RE keywords are specified. At least one of the following keywords must be present: GRIDCART, GRIDPOLR, DISCCART, DISCPOLR, or BOUNDARY.

190 No Keywords for OU Pathway and No PERIOD or ANNUAL Averages. All of the OU pathway keywords are optional, and in fact the model will run if no keywords are specified on the OU pathway as long as PERIOD or ANNUAL averages are being calculated. However, if there are no OU keywords and no PERIOD or ANNUAL averages, then there will be no output generated by the model, and this fatal error message will be generated.

195 Incompatible Option Used With SAVEFILE or INITFILE. Either a non-fatal message to warn the user that DAYTABLE results will be overwritten if the model run is re-started, or a fatal error message generated if the TOXXFILE option is selected with either the SAVEFILE or INITFILE options.

PARAMETER SETUP PROCESSING, 200-299

This type of message indicates problems with processing of the parameter fields for the runstream images. Some messages are specific to certain keywords, while others indicate general problems, such as an invalid numeric data field. If a fatal error of this kind is detected in a runstream image, a fatal error message is written to the message file and any attempt to process data is prohibited, although the remainder of the runstream file is examined for other possible errors. If a warning occurs, data

may still be processed, although the inputs should be checked carefully to be sure that the condition causing the warning does not indicate an error.

200 Missing Parameter(s). No options were selected for the indicated keyword. Check Appendix B for the list of parameters for the keyword in question.

201 Not Enough Parameters Specified For The Keyword. Check if there are any missing parameters following the indicated keyword. See Appendix B for the required keyword parameters.

202 Too Many Parameters Specified For The Keyword. Refer to Appendix B or Section 3 for the list of acceptable parameters.

203 Invalid Parameter Specified. The inputs for a particular parameter are not valid for some reason. Refer to Appendix B or Section 3. The invalid parameter is included with the message.

204 Option Parameters Conflict. Forced by Default to: Some parameters under the indicated keyword conflict with the other model parameters setting. Refer to Appendix B or Section 3 for the correct parameter usage. The default setting is specified with the message.

205 No Option Parameter Setting. Forced by Default to: No setting was specified for a particular parameter. Refer to Appendix B or Section 3 for the correct parameter usage. The default setting is specified with the message.

206 Regulatory DFAULT Specified With Non-default Option. The DFAULT option on the CO MODELOPT card always overrides the specified non-default option, and a warning message is generated.

207 No Parameters Specified. Default Values Used For. The keyword for which no parameters are specified is included with the message. Refer to Appendix B or Section 3 for a discussion of the default condition.

208 Illegal Numerical Field Encountered. The model may have encountered a non-numerical character for a numerical input, or the numerical value may exceed

the limit on the size of the exponent, which could potentially cause an underflow or an overflow error.

209 Negative Value Appears For A Non-negative Variable. The effected variable name is provided with the message.

210 Number of Short Term Averages Exceeds Maximum. The user has specified more short term averages on the CO AVERTIME card than the model array limits allow. This array limit is controlled by the NAVE PARAMETER specified in the MAIN1.INC file. The value of NAVE is provided with the message.

211 Duplicate Parameter(s) Specified for Keyword. A duplicate parameter or set of parameters has been specified for the indicated keyword. For example, if more than one POSTFILE keyword is included for the same averaging period and source group, then this error message will be generated.

212 END Encountered Without (X,Y) Points Properly Set. This error occurs during setting up the grid of receptors for a Cartesian Network. This message may occur for example if X-coordinate points have been specified without any Y-coordinate points for a particular network ID.

213 ELEV Inputs Inconsistent With Option: Input Ignored. This happens when the user inputs elevated terrain heights for receptors when the TERRHGTS option is FLAT. The input terrain heights are ignored and the model proceeds with FLAT terrain modeling.

214 ELEV Inputs Inconsistent With Option: Defaults Used. This happens when the user does not input elevated terrain heights for receptors when the TERRHGTS option is ELEV. The model assumes that the missing terrain heights are at 0.0 meters for those receptors and proceeds with ELEV terrain modeling.

215 FLAG Inputs Inconsistent With Option: Input Ignored. This happens when the user inputs receptor heights above ground for flagpole receptors when the FLAGPOLE keyword option has not been specified. The input flagpole heights are ignored in the model calculations.

216 FLAG Inputs Inconsistent With Option: Defaults Used. This happens when the user does not input receptor heights above ground for flagpole receptors when the

FLAGPOLE keyword option has been specified. The model assumes that the missing flagpole heights are equal to the default value specified on the CO FLAGPOLE card. If no default height is specified on the FLAGPOLE card, then a default of 0.0 meters is assumed.

217 More Than One Delimiter In A Field. For example, 12//34 is an illegal input data item for the DAYRANGE card, and STACK1--STACK-20 is an illegal specification for a range of sources.

218 Number of (X,Y) Points Not Match With Number Of ELEV Or FLAG. Check the number of elevated terrain heights or flagpole receptor heights for the gridded network associated with the indicated line number in the runstream file.

219 Number Of Receptors Specified Exceeds Maximum. The user has specified more receptors on the RE pathway than the model array limits allow. This array limit is controlled by the NREC PARAMETER specified in the MAIN1.INC file. The value of NREC is provided with the message.

220 Missing Origin (Use Default = 0,0) In GRIDPOLR. This is a non-fatal warning message to indicate that the ORIG secondary keyword has not been specified for a particular grid of polar receptors. The model will assume a default origin of (X=0, Y=0).

221 Missing Distance Setting In Polar Network. No distances have been provided (secondary keyword DIST) for the specified grid of polar receptors.

222 Missing Degree Or Distance Setting In Polar Network. Missing a secondary keyword for the specified grid of polar receptors.

223 Missing Distance or Degree Field. No data fields have been specified for the indicated secondary keyword.

224 Number of Receptor Networks Exceeds Maximum. The user has specified more receptor networks of gridded receptors on the RE pathway than the model array limits allow. This array limit is controlled by the NNET PARAMETER specified in the MAIN1.INC file. The value of NNET is provided with the message.

225 Number of X-Coords Specified Exceeds Maximum. The user has specified more X-coordinate values for a particular grid of receptors than the model array limits allow. This array limit is controlled by the IXM PARAMETER specified in the MAIN1.INC file. The value of IXM is provided with the message.

226 Number of Y-Coords Specified Exceeds Maximum. The user has specified more Y-coordinate values for a particular grid of receptors than the model array limits allow. This array limit is controlled by the IYM PARAMETER specified in the MAIN1.INC file. The value of IYM is provided with the message.

227 No Receptors Were Defined on the RE Pathway. Either through lack of inputs or through errors on the inputs, no receptors have been defined.

228 Default(s) Used for Missing Parameters on Keyword. Either an elevated terrain height or a flagpole receptor height or both are missing for a discrete receptor location. Default value(s) will be used for the missing parameter(s).

229 Too Many Parameters - Inputs Ignored on Keyword. Either an elevated terrain height or a flagpole receptor height or both are provided when the corresponding option has not been specified. The unneeded inputs are ignored.

230 Not Enough Numerical Values Specified. For example, less than 36 distance fields may have been specified for a particular group of BOUNDARY receptors.

231 Too Many Numerical Values Specified. For example, more than 36 distance fields may have been specified for a particular group of BOUNDARY receptors.

232 Number Of Specified Sources Exceeds Maximum. The user has specified more sources than the model array limits allow. This array limit is controlled by the NSRC PARAMETER specified in the MAIN1.INC file. The value of NSRC is provided with the message.

233 Building Dimensions Specified for a Non-POINT Source. Building dimensions can only be specified for a POINT source, since the VOLUME, AREA and OPENPIT source algorithms do not include building downwash.

234 Too Many Sectors Input. For example, the user may have input too many building heights or widths for a particular source.

235 Number of Source Groups Specified Exceeds Maximum. The user has specified more source groups than the model array limits allow. This array limit is controlled by the NGRP PARAMETER specified in the MAIN1.INC file. The value of NGRP is provided with the message.

236 Not Enough BUILDHGTs Specified for a Source ID. There should be 36 building heights for Short Term and 16 for Long Term.

237 Not Enough BUILDWIDs Specified for a Source ID. There should be 36 building widths for Short Term and 16 for Long Term.

238 Not Enough LOWBOUNDs Specified for a Source ID. There should be 36 lower bound flags specified for Short Term and 16 for Long Term.

239 Not Enough QFACTs Specified for a Source ID. The number of variable emission rate factors specified for a particular source is less than the model expects based on the variable emission rate flag. Check the EMISFACT keyword on the SO pathway in Appendix B of Section 3 for the appropriate number.

240 Inconsistent Number of Particle Size Categories for a particular source. The number of parameters must be the same for the PARTDIAM, MASSFRAX and PARTDENS keywords for a particular source.

242 No Particle Size Categories Specified for Source ID. There were no settling/removal categories specified for the indicated source. When modeling for total deposition, the user must include the PARTDIAM, MASSFRAX and PARTDENS keywords for each source.

243 No Scavenging Coefficients Specified for Source ID. There were no scavenging coefficients specified for the indicated source. When modeling for total deposition, wet deposition, or wet depletion, the user must include the PARTSLIQ and PARTSICE keywords for particulate sources or the GAS-SCAV keyword for gaseous sources.

244 Too Many Settling and Removal Parameters specified for a particular source. The limit is controlled by the NPDMAX PARAMETER in the computer code, set initially to 20.

245 Number of Particle Size Categories Exceeds Maximum. The user has specified more settling/removal categories than the model array limits allow. This array limit is controlled by the NPDMAX PARAMETER specified in the MAIN1.INC file. The value of NPDMAX is provided with the message.

248 No Sources Were Defined on the SO Pathway. There must be at least one LOCATION card and one SRCPARAM card to define at least one source on the SO pathway. Either no cards were input or there were errors on the inputs.

250 Duplicate XPNT/DIST or YPNT/DIR Specified for GRID. One of the grid inputs, either an X-coordinate, Y-coordinate, polar distance range or polar direction, has been specified more than once for the same grid of receptors. This generates a non-fatal warning message.

252 Duplicate Receptor Network ID Specified. A network ID for a grid of receptors (GRIDCART or GRIDPOLR keyword) has been used for more that one network.

255 Boundary Receptor Distances Not Defined Yet. The user has input the BOUNDELV keyword for a particular source before any BOUNDARY keyword has been specified for that source.

260 Number of Emission Factors Exceeds Maximum. The user has selected an option for variable emission rate factors that exceeds the array storage limit for emission rate factors. The array limit is controlled by the NQF PARAMETER specified in the MAIN1.INC file. The value of NQF is provided with the message.

270 Number of High Values Specified Exceeds Maximum. The user has selected a high short term value on the OU RECTABLE card that exceeds the array storage limit for high values by receptor. The array limit is controlled by the NVAL PARAMETER specified in the MAIN1.INC file. The value of NVAL is provided with the message.

280 Number of Maximum Values Specified Exceeds Maximum. The user has selected a value for the number of overall maximum values on the OU MAXTABLE card that exceeds the array storage limit for overall maximum values. The array limit is controlled by the NMAX PARAMETER specified in the MAIN1.INC file. The value of NMAX is provided with the message.

285 Number of Output Types Specified Exceeds Maximum (for Short Term only). The user has specified more than the maximum number of output types allowed (CONC, DEPOS, DDEP, and/or WDEP). The number of output types is controlled by the NTYP PARAMETER specified in the MAIN1.INC file. The value of NTYP is provided with the message.

290 Number of Events Specified Exceeds Maximum. The user has specified more events than the ISCEV model array limits allow. The array limit is controlled by the NEVE PARAMETER specified in the EVMAIN1.INC file. The value of NEVE is provided with the message.

SETUP DATA AND QUALITY ASSURANCE PROCESSING, 300-399

This type of message indicates problems with the actual values of the parameter data on the input runstream image. The basic structure and syntax of the input card is correct, but
one or more of the inputs is invalid or suspicious. These messages include quality assurance checks on various model inputs. Typical messages will tell the consistency of parameters and data for the setup and run of the model. If a fatal error of this kind is detected in a runstream image, a fatal error message is written to the message file and any attempt to process data is prohibited. If a warning occurs, data may or may not be processed, depending on the processing requirements specified within the run stream input data.

300 Specified Source ID Has Not Been Defined Yet. The message indicates that the user attempts to use a source ID on a keyword before defining this source ID on a SO LOCATION card. It could indicate an error in specifying the source ID, an omission of a LOCATION card, or an error in the order of inputs.

310 Attempt to Define Duplicate LOCATION Card for Source. There can be only one LOCATION card for each source ID specified. The source ID is included with the message.

315 Attempt to Define Duplicate SRCPARAM Card for Source. There can be only one SRCPARAM card for each source ID specified. The source ID is included with the message.

320 Source Parameter May Be Out-of-Range for Parameter. The value of one of the source parameters may be either too large or too small. The name of the parameter is provided with the message. Use the line number provided to locate the card in question.

322 Release Height Exceeds the Effective Depth for an OPENPIT Source. The release height for an OPENPIT source is measured from the base (bottom) of the pit. If the release height exceeds the effective depth of the pit, calculated from the lateral dimensions and volume of the pit, a fatal error message is generated.

323 No Particle Categories Specified for an OPENPIT Source. Since the OPENPIT algorithm is applicable for particulate emissions, particle category data must be specified for open pit sources using the PARTDIAM, MASSFRAX, and PARTDENS keywords. This fatal error message will be generated if no particle information is specified for an open pit source.

325 Negative Exit Velocity (Set=1.0E-5) for Source ID. The exit velocity for the specified source ID was input as a negative value. Since the model currently cannot handle sources with downward momentum, the exit velocity is set to a very small value (1.0E-5 m/s) and modeling proceeds. This non-fatal message is generated to warn the user that the input may be in error.

330 Mass Fraction Parameters Do Not Sum to 1. (within +/- 2 percent) for a particular source.

332 Mass Fraction Parameter Out-of-Range for a particular source. Must be between 0.0 and 1.0, inclusive.

334 Particle Density Out-of-Range for a particular source. Must be greater than 0.0.

340 Possible Error in the Anemometer Height. The value of the anemometer height may be either too large or too small

350 Julian Day Out Of Range. This error occurs if the Julian Day selected is less than zero or greater than 366. Check ME setup to ensure the Julian Day selection.

355 Specified Averaging Period Not Being Calculated. This is a non-fatal warning message for the ISCLT model generated when average temperatures or mixing heights are specified for a STAR averaging period that was not specified on the CO AVERTIME card. The inputs will be ignored, and processing will continue.

360 2-digit Year Specified. Valid for the range 1901-2099. Four-digit years are valid for the entire range of Gregorian dates, but two digit years are accepted.

362 Averaging Time Conflict: PERIOD with ANNUAL Data. The PERIOD average is not compatible with the specification of an ANNUAL STAR summary on the CO AVERTIME card or the ME STARDATA card.

364 Averaging Time Conflict: PERIOD with MONTH and SEASON or QUARTR. The PERIOD average is not compatible with the presence of monthly STAR summaries and seasonal or quarterly summaries in the same data file.

366 Possible Averaging Time Conflict: PERIOD Average Only. The CO AVERTIME card has specified the PERIOD average only. There could be a conflict unless the ME STARDATA card is used to specify the STAR summaries in the data file.

368 Averaging Time Conflict: PERIOD Average with No STARDATA. The ISCLT model cannot process the PERIOD average unless the STAR summaries in the data file are identified, either through the CO AVERTIME card or the ME STARDATA card.

369 Averaging Time Conflict: Both SEASON and QUARTR. The ISCLT model cannot process both seasonal and quarterly STAR summaries in the same model run, since they occupy the same areas in the data storage.

370 Invalid Date: 2/29 In a Non-leap Year. The year has been identified as a leap year, and a date of 2/29 (February 29) has been specified on the DAYRANGE card. Check the year and/or the date specification.

380 This Input Variable is Out-of-Range. The indicated value may be too large or too small. Use the line number to locate the card in question, and check the variable for a possible error.

385 Averaging period does not equal 1-hour averages for the TOXXFILE option for the ISCST model. The ISCST model will generate TOXXFILE outputs for other averaging periods, but the TOXX model component of TOXST currently supports only the 1-hour averages. This is a non-fatal warning message.

390 Invalid Averaging Period Specified for the Event. An invalid averaging period has been specified for the event name indicated for the ISCEV model. This may be an averaging period that was not selected on the CO AVERTIME card, or it may be an averaging period of greater than 24 hours, which cannot be handled by ISCEV.

391 Aspect ratio (length/width) of an area source is greater than 10. The new area source algorithm in the ISC3 model allows for specifying area sources as elongated rectangles, however, if the aspect ratio exceeds 10 a warning message will be printed out. The user should subdivide the area so that each subarea has an aspect ratio of less than 10.

392 Aspect ratio (length/width) of an open pit source is greater than 10. The new open pit algorithm in the ISC3 model allows for specifying open pit sources as elongated rectangles, however, if the aspect ratio exceeds 10 a warning message will be printed out. Due to the way open pit sources are treated by the model, an open pit source should not be subdivided. The user should therefore use extra caution when interpreting results of the open pit algorithm for sources that exceed an aspect ration of 10.

393 Terrain grid value differs by more than 50 percent from the source elevation for the specified source. The ISC model will compare source elevations to an interpolated elevation from a terrain grid file (from the TG pathway) if one is used. A warning message is generated if the elevations differ by more than 50 percent. Several warning messages could indicate an error in specifying the elevation units for either source elevations or terrain elevations. Elevation units are in meters by default, but may be specified as feet by using the ELEVUNIT keyword.

394 Terrain grid value differs by more than 50 percent from the receptor elevation for the specified receptor. The ISC model will compare source elevations to an interpolated elevation from a terrain grid file (from the TG pathway) if one is used. A warning message is generated if the elevations differ by more than 50 percent. Several warning messages could indicate an error in specifying the

elevation units for either receptor elevations or terrain elevations. Elevation units are in meters by default, but may be specified as feet by using the ELEVUNIT keyword.

395 Monthly QFACT Specified With No Monthly Averages. The monthly variable emission rate option for the ISCLT model can only be used with monthly STAR summaries.

398 STAR Data Not Available for the Specified Average. The STAR summaries identified on the ME STARDATA card do not include one of the averaging periods selected on the CO AVERTIME card for the ISCLT model.

RUNTIME MESSAGE PROCESSING, 400-499

This type of message is generated during the model run. Setup processing has been completed successfully, and the message is generated during the performance of model calculations. Typical messages will tell the information and error during the model run. If a fatal error of this kind is detected during model execution, a fatal error message is written to the message file and any further processing of the data is prohibited. The rest of the meteorological data file will be read and quality assurance checked to identify additional errors. If a warning occurs, data may or may not be processed, depending on the processing requirements specified within the run stream input data.

400 No Convergence Reached in SUB. CUBIC. The CUBIC module is used to solve a cubic equation for the Schulman-Scire BLP plume rise and for the vertical virtual distance for URBAN mode. The routine uses Newton's method, which is an iterative approach to determining the solution to the cubic equation. This message is generated if the routine does not converge within 24 iterations. The message is provided for informational purposes and processing will continue. The date of occurrence is provided with the message.

410 Flow Vector Out-of-Range. The flow vector must be between 0 and 360 degrees, inclusive. The date of occurrence is provided with the message (in the form of year, month, day, hour as YYMMDDHH)

420 Wind Speed Out-of-Range. The wind speed value may be either too large or too small. An error is generated if the speed is less than 0.0, and a warning is generated if the speed is greater than 30.0 m/s. The date of occurrence is provided with the message (in the form of year, month, day, hour as YYMMDDHH).

430 Ambient Temperature Data Out-of-Range. The ambient temperature value may be either too large or too small. A warning is generated if the temperature is less than 250.0 K or greater than 320 K. The date of occurrence is provided with the message (in the form of year, month, day, hour as YYMMDDHH).

435 Surface Roughness Length Out-of-Range. The surface roughness value may be too small or missing. A warning is generated if the surface roughness length is less than 1.0E-05 meters. The value is set to 1.0E-05 to avoid possible division by zero. The date of occurrence is provided with the message (in the form of year, month, day, hour as YYMMDDHH).

440 Calm Hour Identified in Meteorology Data File. This message is generated if a calm hour is identified, and provides the date of occurrence (in the form of year, month, day, hour as YYMMDDHH). The message will be generated whether or not the calms processing option is used.

450 Error in Meteorology File - Record Out of Sequence. There is an error in the sequence of the hourly meteorological data file. The message also provides the date of occurrence (in the form of year, month, day, hour as YYMMDDHH).

455 Date/Time Mismatch on Hourly Emission File. There is mismatch in the date/time field between the meteorological data file and the hourly emission file. The message also provides the date of the occurrence from the surface/scalar file (in the form of year, month, day, hour as YYMMDDHH).

460 Missing Hour Identified in Meteorology Data File. At least one of the meteorological variables is missing or invalid for the hour specified (in the form of year, month, day, hour as YYMMDDHH). If the missing data processing option is not used, then this message will be generated and any further calculations with

the data will be aborted. The model will continue to read through the meteorological data file and check the data.

470 Mixing Height Value is Less Than or Equal to 0.0. This is an informational message that may indicate an error in the meteorological data file. Since the plume will always be above a mixing of 0.0 or less, no calculations are performed for the hour specified (in the form of year, month, day, hour as YYMMDDHH).

480 Sum of STAR Frequencies Does Not Total to 1.0. The ISCLT model accepts STAR data files with either normalized frequencies or with a frequency count. For normalized frequencies, the sum of the STAR frequencies should total 1.0. If the sum is less than 0.98 or greater than 1.02, this non-fatal warning message is generated. The actual sum of the frequencies for each STAR summary is included in the printed output file at the end of the listing for the STAR frequency input. The frequency array is not automatically normalized to 1.0 as was done by the original ISCLT model.

INPUT/OUTPUT MESSAGE PROCESSING, 500-599

This type of message is generated during the model input and output. Typical messages will tell the type of I/O operation (e.g., opening, reading or writing to a file), and the type of file. If a fatal error of this kind is detected in a runstream image, a fatal error message is written to the message file and any attempt to process data is prohibited. If a warning occurs, data may or may not be processed, depending on the processing requirements specified within the run stream input data.

500 Fatal Error Occurs During Opening of the Data File. The file specified can not be opened properly. This may be the runstream file itself, the meteorological data file, or one of the special purpose output files. This may happen when the file called is not in the specified path, or an illegal filename is specified. If no errors are found in the filename specification, then this message may also indicate that there is not enough memory available to run the program, since opening a file causes a buffer to be opened which takes up additional memory in RAM. For the

special purpose output files, the hint field includes character string identifying the type of file and the file unit number, e.g., 'PLTFL312'.

510 Fatal Error Occurs During Reading of the File. File is missing, incorrect file type, or illegal data field encountered. Check the indicated file for possible problems. If the file is identified as 'DEP-MET', then the problem may be that the additional surface variables needed for the new deposition algorithms are missing. As with error number 500, this message may also indicate that there is not enough memory available to run the program if no other source of the problem can be identified.

520 Fatal Error Occurs During Writing to the File. Similar to message 510, except that it occurs during a write operation.

530 Error Occurs Reading Met Station or Year: File Says. This error occurs only with the ST models. The surface and upper air station numbers and years specified on the ME pathway do not agree with the values on the first record of the meteorological data file. The value from the file is printed out to help resolve the problem.

540 No RECTABLE/MAXTABLE/DAYTABLE for Averaging Period. No printed output options selected for a particular averaging period. This is a non-fatal warning condition for the ISCST model.

550 File Unit/Name Conflict for the Output Option. This error indicates that a problem exists with the filename and file unit specification for one of the special purpose output files. The associated keyword is provided as a hint. The same filename may have been used for more than one file unit, or vice versa.

560 User Specified File Unit < 20 for OU Keyword. A file unit of less than 20 has been specified for the indicated special purpose output files. This is a fatal error condition. File units of less than 20 are reserved for system files. Specify a unit number in the range of 20 to 100.

565 Possible conflict With Dynamically Allocated FUNIT. A file unit specified for the indicated special purpose output files is in the range > 100, and may therefore conflict with file units dynamically allocated for special purpose files by the model. This is typically a non-fatal warning condition.

570 Problem Reading Temporary Event File for Event. The ISCST model stores high value events in a temporary file that is used to create the input file for the ISCEV model, if requested, and also to store the high values for the summary tables at the end of the printed output file. A problem has been encountered reading this file, possibly because the concentration or deposition value was too large and overflowed the fixed format field of F14.5.

575 End-of-File Reached Trying to Read STAR Data. The ISCLT model has encountered an end-of-file for the STAR meteorological data trying the read the indicated averaging period. Check the data file for the correct number of STAR summaries or modify the CO AVERTIME and/or ME STARDATA cards.

580 End-of-File Reached Trying to Read a Data File. The ISCST model has encountered an end-of-file trying the read the indicated file. This may appear when trying to "re-start" a model run with the CO INITFILE card if there is an error with the initialization file. Check the data file for the correct filename.

APPENDIX F. DESCRIPTION OF FILE FORMATS

F.1 ASCII METEOROLOGICAL DATA

The ISCST and ISCEV models are designed to accept a wide range of ASCII meteorological data file formats. The use of ASCII files for meteorological data has two distinct advantages over the use of unformatted data files, such as are generated by the PCRAMMET and MPRM preprocessors (see the next section). The first advantage is the portability of the data files to different compilers and computer systems used for running the models. The second advantage is that the data file can be examined easily to determine its contents, and listed to the computer screen or to a printer for later reference. The user may specify the use of the default ASCII format by leaving the formet field blank on the ME INPUTFIL card. The user may also specify FREE-formatted reads for the meteorological data, may specify the Fortran read format explicitly, or may select the CARD option, which allows for the input of hourly wind profile exponents and vertical potential temperature gradients.

The first record of the meteorological data input file contains the station number and year for both the surface station and the upper air (mixing height) station. For the formatted ASCII files, these four integer variables are read using a free-format READ, i.e., the variables must be separated by either a comma or by one or more blank spaces. The order of these variables is as follows:

Surface Station Number, e.g., WBAN Number for NWS data
Year for Surface Data (2 or 4 digits)
Upper Air Station Number (for Mixing Height Data)
Year for Upper Air Data (2 or 4 digits)

The model checks these variables against the values input by the user on the ME SURFDATA and ME UAIRDATA cards (see Section 3.5.3).

The rest of the records in the file include the sequential meteorological data. The order of the meteorological variables for the formatted ASCII files and the default ASCII format are as follows:

Variable	Fortran Format	Columns
Year (last 2 digits)	I2	1-2
Month	I2	3-4
Day	I2	5-6
Hour	I2	7-8
Flow Vector (deg.)	F9.4	9-17
Wind Speed (m/s)	F9.4	18-26
Ambient Temperature (K)	F6.1	27-32
Stability Class (A=1, B=2, ... F=6)	I2	33-34
Rural Mixing Height (m)	F7.1	35-41
Urban Mixing Height (m)	F7.1	42-48
Wind Profile Exponent (CARD only)	F8.4	49-56
Vertical Potential Temperature Gradient (K/m) (CARD only)	F8.4	57-65
Friction velocity (m/s) (Dry Deposition Only)	F9.4	49-57 (66-74 for CARD)
Monin-Obukhov Length (m) (Dry Deposition Only)	F10.1	58-67 (75-84 for CARD)

Surface Roughness Length (m) (Dry Deposition Only)	F8.4	68-75 (85-92 for CARD)
Precipitation Code (00-45) (Wet Deposition Only)	I4	76-79 (93-96 for CARD)
Precipitation Rate (mm/hr) (Wet Deposition Only)	F7.2	80-86 (97-103 for CARD)

Calm hours are identified in the ASCII meteorological data files by a wind speed of 0.0 m/s. For unformatted PCRAMMET files that are converted to the ASCII format by BINTOASC (see Section C.2), the conversion program checks for calm hours based on the PCRAMMET convention of a wind speed equal to 1.0 m/s and a flow vector equal to the flow vector for the previous hour, and sets the wind speed to 0.0 in the ASCII file.

F.2 PCRAMMET METEOROLOGICAL DATA

The PCRAMMET preprocessor generates an unformatted file of meteorological data from National Weather Service observations suitable for use by several dispersion models, including the ISCST model. The file contains two types of records, the first is a header record and the second is the meteorological data. The second contains the data for one 24-hour period (midnight to midnight) and is repeated until all data are listed. The data are written unformatted to the file. This type of file may also be generated by the MPRM processor designed for processing on-site meteorological data.

The format of the header record is:

```
READ(u) ID1,IYEAR1,ID2,IYEAR2
        5   5      5   5
        5   5      5   94 Last 2 digits of beginning year of mixing
        5   5      5      height data.
        5   5      5
        5   5      94 5-digit station identification of mixing
        5   5         height data.
        5   5
        5   94 Last 2 digits of beginning year of hourly
        5      surface data.
        5
        94 5-digit station identification of hourly
           surface data.
```

The format of the meteorological records are:

```
READ(u) IYEAR,MONTH,IDAY,PGSTAB,SPEED,TEMP,FLWVEC,RANFLW,MIXHGT
          5     5     5    5      5     5    5      5      5
          5     5     5    5      5     5    5      5      94 Array of mixing
          5     5     5    5      5     5    5      5         heights (m)
          5     5     5    5      5     5    5      5
          5     5     5    5      5     5    5      94 Array of randomized
          5     5     5    5      5     5    5         flow vectors (to
          5     5     5    5      5     5    5         nearest degree)
          5     5     5    5      5     5    5
          5     5     5    5      5     5    94 Array of flow vectors (to
          5     5     5    5      5     5       nearest 10 degrees)
          5     5     5    5      5     5
          5     5     5    5      5     94 Array of temperatures (degrees
          5     5     5    5      5        Kelvin)
          5     5     5    5      5
          5     5     5    5      94 Array of wind speeds (m/s)
          5     5     5    5
          5     5     5    94 Array of Pasquill stability categories
          5     5     5
          5     5     94 Day of month (1-31)
          5     5
          5     94 Month of year (1-12)
          5
          94 Last 2 digits of year
```

The DIMENSION statements used to define the arrays are:

```
DIMENSION IKST(24), AWS(24), ATA(24), AFV(24), AFVR(24), AZI(2,24)
```

The first index in the AZI (mixing height) array controls which of the two mixing height values is referenced. AZI(1,i) refers to the rural mixing height values, where i equals from 1 to 24 and refers to hour of day in local standard time. AZI(2,i) refers to the urban mixing height values.

The following preset values are used to indicate missing data:

IKST	0
AWS	-9
ATA	-99
AFV	-99
AFVR	-99
AZI	-999

F.3 STAR SUMMARY JOINT FREQUENCY DISTRIBUTIONS

For the ISC Long Term dispersion model, the input file describing the meteorological conditions is a joint frequency distribution. These frequency distributions are called STAR summaries for STability ARray. The frequency distribution is constructed using 16 wind direction sectors, with the first 22.5 sector centered on winds from the North (increasing clockwise), six wind speed classes and six stability classes. The wind speed classes are 0-3, 3-6, 6-10, 10-16, 16-21 and >21 kts. The

Pasquill stability categories for the ISCLT dispersion model are grouped into classes as,

Class	Pasquill category	Remarks
1	A	Very unstable conditions
2	B	Moderately unstable conditions
3	C	Slightly unstable conditions
4	D	Neutral conditions
5	E	Slightly stable conditions
6	F	Very stable conditions

A separate STAR summary may be used for each averaging period, such as a month or a season, or for the entire annual data period.

The format of the meteorological file is:

```
LOOP ON I=1,6
LOOP ON K=1,16

READ(u,f)  FREQ( (I,J,K),J=1,6 )
           5      5   5  5
           5      5   5  94 Index associated with wind speed class
           5      5   5
           5      5   94 Index associated with wind direction sector
           5      5
           5      94 Index associated with stability class
           5
           94 Frequency of occurrence (decimal), of stability class I, with
              wind speed class J, for wind from wind sector K
```

FORMAT(6F10.0)

Hence the meteorological file consists of 96 records for each STAR summary, the first 16 are for stability class 1, the next 16 are for stability class 2, and so forth.

F.4 THRESHOLD VIOLATION FILES (MAXIFILE OPTION)

The OU MAXIFILE card for the ISCST model allows the user the option to generate a file or files of threshold violations for specific source group and averaging period combintations. The file consists of several header records, each identified with an asterisk (*) in column one. The header information includes the model name and version number, the first line of the title information for the run, the list of modeling option keywords applicable to the results, the averaging period and source group included in the file, and the threshold value. Any value equal to or exceeding the threshold value will be included in the file. The header also includes the format used for writing the data records, and column headers for the variables included in the file. The variables provided on each data record include the averaging period, the source group ID, the date (YYMMDDHH) for the end of averaging period, the X and Y coordinates of the receptor location, the receptor terrain elevation and flagpole receptor height, and the

concentration or deposition value that violated the threshold. The following example from a threshold file identifies the contents of the MAXIFILE:

```
* ISCST3 (95250): A Simple Example Problem for the ISCST Model
* MODELING OPTIONS USED:
*  CONC                        RURAL  FLAT          DFAULT
*         MAXI-FILE FOR  3-HR VALUES >= A THRESHOLD OF    30.00
*         FOR SOURCE GROUP: ALL
*         FORMAT: (1X,I3,1X,A8,1X,I8,2(1X,F13.5),2(1X,F7.2),1X,F13.5)
*AVE   GRP     DATE           X             Y        ELEV    FLAG   AVERAGE CONC
*___ ________ ________  _____________  _____________  ______  ______  _____________
   3 ALL      64010206      76.60445      64.27876    0.00    0.00      30.24433
   3 ALL      64010218      76.60445      64.27876    0.00    0.00      42.91793
   3 ALL      64010424      76.60445      64.27876    0.00    0.00      34.63943
   3 ALL      64010506      76.60445      64.27876    0.00    0.00      38.86485
   3 ALL      64010506     153.20889     128.55753    0.00    0.00      33.00018
   3 ALL      64010512      86.60254      50.00000    0.00    0.00      36.78835
   3 ALL      64010515      86.60254      50.00000    0.00    0.00      33.48914
   3 ALL      64010518      76.60445      64.27876    0.00    0.00      44.44987
   3 ALL      64010521     128.55753     153.20889    0.00    0.00      34.85760
   3 ALL      64010524       0.00000     100.00000    0.00    0.00      58.49796
   3 ALL      64010524      -0.00001     200.00000    0.00    0.00      38.87197
```

F.5 POSTPROCESSOR FILES (POSTFILE OPTION)

The OU POSTFILE card for the ISCST model allows the user the option of creating output files of concurrent concentration or deposition values suitable for postprocessing. The model offers two options for the type of file generated - one is an unformatted file similar to the concentration file generated by the previous version of ISCST, and the other is a formatted file of X, Y, CONC (or DEPO) values suitable for inputting to plotting programs.

The unformatted POSTFILE option generates a separate unformatted data record of concurrent values for each averaging period and source group specified. The averaging period and source group combinations may be written to separate files, or combined into a single file. Each record begins with the date variable for the end of the averaging period (an integer variable of the form YYMMDDHH), the averaging period (e.g., an interger value of 3 for 3-hour averages), and the source group ID (eight characters). Following these three header variables, the record includes the concentration or deposition values for each receptor location, in the order in which the receptors are defined on the RE pathway. If more than one output type (CONC, DEPOS, DDEP, and/or WDEP) is calculated, then all of the output values for a particular averaging period and source group are included on a single record, in the order listed here. The results are output to the unformatted file or files as they are calculated by the model.

The formatted plot file option for the POSTFILE keyword includes several lines of header information, each identified with an asterisk (*) in column one. The header information includes the model name and version number, the first line of the title information for the run, the list of modeling option keywords applicable to the results, the averaging period and source group included in the file, and the number of receptors included. The header also includes the format used for writing the data records, and column headers for the variables included in the file. The variables provided on each data record include the X and Y coordinates of the receptor location, the concentration or deposition value for that location, the receptor terrain elevation, the averaging period, the source group ID, and either the date variable for the end of the averaging period (in the form of YYMMDDHH) for short term averages or the number of hours in the period for PERIOD averages. The last column provides the eight-character receptor network ID for receptors that are defined as part of a gridded network. For discrete

receptors, the network ID field includes the character string ' NA '. When more than one output type is selected among the list of CONC, DEPOS, DDEP, and/or WDEP, the PLOT formatted post-processing output file will include all of the output types selected, in the order listed here. The results for each output type will be printed in separate columns, one record per receptor. The following example from a formatted postprocessor file for PERIOD averages identifies the contents of the POSTFILE:

```
* ISCST3 (95250): A Simple Example Problem for the ISCST Model
* MODELING OPTIONS USED:
*  CONC                        RURAL  FLAT          DFAULT
*         POST/PLOT FILE OF PERIOD VALUES FOR SOURCE GROUP: ALL
*         FOR A TOTAL OF   180 RECEPTORS.
*         FORMAT: (3(1X,F13.5),1X,F8.2,2X,A6,2X,A8,2X,I8,2X,A8)
*        X             Y      AVERAGE CONC   ZELEV     AVE     GRP      NUM HRS   NET ID
*  ___________   ___________   ___________   ______  ______  ________  ________  ________
      17.36482      98.48077       0.09078     0.00  PERIOD  ALL            240  POL1
      34.72964     196.96155       0.04353     0.00  PERIOD  ALL            240  POL1
      52.09445     295.44232       0.02323     0.00  PERIOD  ALL            240  POL1
      86.82409     492.40387       0.00646     0.00  PERIOD  ALL            240  POL1
     173.64818     984.80774       0.00389     0.00  PERIOD  ALL            240  POL1
      34.20201      93.96926       0.00053     0.00  PERIOD  ALL            240  POL1
      68.40403     187.93852       0.22839     0.00  PERIOD  ALL            240  POL1
     102.60604     281.90778       0.14398     0.00  PERIOD  ALL            240  POL1
     171.01007     469.84631       0.06481     0.00  PERIOD  ALL            240  POL1
```

F.6 HIGH VALUE RESULTS FOR PLOTTING (PLOTFILE OPTION)

The OU PLOTFILE card for the ISCST model allows the user the option of creating output files of highest concentration or deposition values suitable for importing into graphics software to generate contour plots. The formatted plot files generated by the PLOTFILE include several lines of header information, each identified with an asterisk

(*) in column one. The header information includes the model name and version number, the first line of the title information for the run, the list of modeling option keywords applicable to the results, the averaging period and source group included in the file, the high value (e.g. 2ND highest) included for plotting, and the number of receptors included. The header also includes the format used for writing the data records, and column headers for the variables included in the file. The variables provided on each data record include the X and Y coordinates of the receptor location, the concentration or deposition value for that location, the receptor terrain elevation, the averaging period, the source group ID, and either the high value included for short term averages or the number of hours in the period for PERIOD averages. The last column provides the eight-character receptor network ID for receptors that are defined as part of a gridded network. For discrete receptors, the network ID field includes the character string ' NA '. When more than one output type is selected among the list of CONC, DEPOS, DDEP, and/or WDEP, the PLOTFILE output file will include all of the output types selected, in the order listed here. The results for each output type will be printed in separate columns, one record per receptor. The following example from a

formatted postprocessor file for high second highest 24-hour averages identifies the contents of the PLOTFILE:

```
* ISCST3 (95250): A Simple Example Problem for the ISCST Model
* MODELING OPTIONS USED:
*  CONC                        RURAL  FLAT          DFAULT
*         PLOT FILE OF  HIGH 2ND  HIGH 24-HR VALUES FOR SOURCE GROUP: ALL
*         FOR A TOTAL OF   180 RECEPTORS.
*         FORMAT: (3(1X,F13.5),1X,F8.2,3X,A5,2X,A8,2X,A4,6X,A8)
*        X             Y      AVERAGE CONC   ZELEV     AVE     GRP       HIVAL    NET ID
*  ____________  ____________  ____________  ______  ______  ________  ________  ________
      17.36482      98.48077       0.00038    0.00   24-HR  ALL       2ND       POL1
      34.72964     196.96155       0.00759    0.00   24-HR  ALL       2ND       POL1
      52.09445     295.44232       0.00223    0.00   24-HR  ALL       2ND       POL1
      86.82409     492.40387       0.00058    0.00   24-HR  ALL       2ND       POL1
     173.64818     984.80774       0.00012    0.00   24-HR  ALL       2ND       POL1
      34.20201      93.96926       0.00032    0.00   24-HR  ALL       2ND       POL1
      68.40403     187.93852       0.73597    0.00   24-HR  ALL       2ND       POL1
     102.60604     281.90778       0.46271    0.00   24-HR  ALL       2ND       POL1
     171.01007     469.84631       0.22714    0.00   24-HR  ALL       2ND       POL1
```

The PERIOD and ANNUAL average PLOTFILE uses the same format for the data records as the PERIOD and ANNUAL average formatted POSTFILE shown in the previous section.

F.7 TOXX MODEL INPUT FILES (TOXXFILE OPTION)

The OU TOXXFILE card for the ISCST model allows the user the option to generate an unformatted file or files of threshold violations for a specific averaging period for use with the TOXX model component of TOXST. The file consists of three header records, including the first line of the title information for the run, the number of source groups, receptors and averaging periods, information on the type of receptor network,

and the threshold cutoff value. Following the header records are pairs of records identifying the specific averaging period, source group and receptor location and corresponding concentration value for the values exceeding the user-specified threshold. If any source group exceeds the threshold for a given averaging period and receptor location, then the concentrations for all source groups are output for that period and receptor. The structure of the unformatted file for the ISCST model TOXXFILE option is described below:

Record #	Description
1	Title (80 characters)
2	IYEAR, NUMGRP, NUMREC, NUMPER, ITAB, NXTOX, NYTOX, IDUM1, IDUM2, IDUM3
3	CUTOFF, RDUM1, ..., RDUM9

where:
- TITLE = First line of title (80 characters)
- IYEAR = Year of simulation
- NUMGRP = No. of source groups
- NUMREC = Total no. of receptors
- NUMPER = No. of averaging periods (e.g., number of hours in the year)
- ITAB = 1 for polar grid; 2 for Cartesian grid; 0 for discrete receptors or mixed grids
- NXTOX = No. of x-cooordinates (or distances) in receptor network
- NYTOX = No. of y-coordinates (or directions) in receptor network
- IDUM1, IDUM2, IDUM3 = dummy integer variables, arbitrarily set equal to zero
- CUTOFF = User-specified threshold for outputting results (g/m^3)
- RDUM1, ..., RDUM9 = Dummy real variables (nine) arbitrarily set equal to zero

Following the header records, the file consists of pairs of records including an ID variable identifying the data period, source group number and receptor number, and the corresponding concentration values. The number of values included in each record is

controlled by the NPAIR PARAMETER, which is initially set at 100 in the MAIN1.INC file. The identification variable is determined as follows:

IDCONC = IPER*100000 + IGRP*1000 + IREC

where: IPER = the hour number for the year corresponding to the concentration value
IGRP = the source group number (the order in which the group was defined on the SO pathway)
IREC = the receptor number (the order in which the receptor was defined on the RE pathway)

The TOXXFILE option for the ISCLT model works somewhat differently from the ISCST model option described above. The format of the TOXXFILE output file for ISCLT is the same format as used for the PLOTFILE option in ISCLT, except for some slight differences in some of the header records, and the fact that the TOXXFILE output file includes the results for each source in the specified source group. The following is an example of an ISCLT TOXXFILE output:

```
 * ISCLT3 (95250):  TEST RUN FOR NEW ISCLT MODEL - BASED ON SCRAM BBS TEST CASE
 * MODELING OPTIONS USED:
 *  CONC   RURAL   ELEV   FLGPOL DFAULT
 *        TOXXFILE OF WINTER VALUES FOR SOURCE GROUP: ALL
 *        FOR A TOTAL OF  36 RECEPTORS.
 *        ITAB =  1;  NXTOX =   9;  NYTOX =   4
 *        FORMAT: (4(1X,F13.5),1X,F14.6,1X,F8.2,2X,A6,2X,A8)
 *          X             Y            CONC       ZELEV    AVE     SOURCE
 * ___________ _____________ _____________ ___________ ______ _______
    125.00000      -.00001       .000000      1.52  WINTER  1
    250.00000      -.00001       .002418      3.05  WINTER  1
    400.00000      -.00002      1.680273      7.62  WINTER  1
    800.00000      -.00003     11.524000     10.36  WINTER  1
   2000.00000      -.00009      8.915471     10.67  WINTER  1
   4000.00000      -.00017      5.361694     10.97  WINTER  1
   8000.00000      -.00035      3.010265     15.24  WINTER  1
  16000.00000      -.00070      1.210022     30.48  WINTER  1
  20000.00000      -.00087       .918835     30.48  WINTER  1
       .00000   -125.00000       .000001      1.52  WINTER  1
       .00001   -250.00000       .004480      3.05  WINTER  1
       .00001   -400.00000      1.500647      7.62  WINTER  1
       .00002   -800.00000     10.346320     10.36  WINTER  1
       .00005  -2000.00000      9.384181     10.67  WINTER  1
       .00010  -4000.00000      6.173569     10.97  WINTER  1
       .00019  -8000.00000      3.782269     15.24  WINTER  1
       .00039 -16000.00000      1.583979     30.48  WINTER  1
       .00049 -20000.00000      1.202485     30.48  WINTER  1
```

The ITAB, NXTOX, and NYTOX variables included in the header records for the ISCLT TOXXFILE output are the same as defined above for the ISCST model option.

APPENDIX G. QUICK REFERENCE FOR ISCST AND ISCLT MODELS

CO Keywords	Type	Parameters	Sec.
TITLEONE	M-N	Title1	3.2.1
TITLETWO	O-N	Title2	3.2.1
MODELOPT	M-N	DFAULT CONC DRYDPLT WETDPLT RURAL GRDRIS NOSTD NOBID NOCALM MSGPRO NOSMPL (ST) DEPOS or or DDEP URBAN NOCMPL and/or WDEP DFAULT CONC DRYDPLT RURAL GRDRIS NOSTD NOBID (LT) DEPOS or or URBAN DDEP	3.2.2
AVERTIME	M-N	1 2 3 4 6 8 12 24 MONTH PERIOD (ST Model) or ANNUAL JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC (LT Model) WINTER SPRING SUMMER FALL or QUART1 QUART2 QUART3 QUART4 MONTH SEASON QUARTR ANNUAL PERIOD	3.2.3
POLLUTID	M-N	Pollut	3.2.4
HALFLIFE	O-N	Haflif	3.2.5
DCAYCOEF	O-N	Decay	3.2.5
TERRHGTS	O-N	FLAT or ELEV	3.2.6
ELEVUNIT	O-N	METERS or FEET	3.2.6
FLAGPOLE	O-N	(Flagdf)	3.2.7
RUNORNOT	M-N	RUN or NOT	3.2.8
EVENTFIL	O-N	(Evfile) (Evopt) (ST model only)	3.2.9
SAVEFILE	O-N	(Savfil) (Dayinc) (Savfl2) (ST model only)	3.2.10
INITFILE	O-N	(Inifil) (ST model only)	3.2.10

MULTYEAR	O-N	Savfil (Inifil) (ST model only)	3.2.11
ERRORFIL	O-N	(Errfil) (DEBUG)	3.2.12

Type: M - Mandatory N - Non-repeatable
O - Optional R - Repeatable

SO Keywords	Type	Parameters	Section
ELEVUNIT	O-N	METERS or FEET	3.3
LOCATION	M-R	Srcid Srctyp Xs Ys (Zs) (Srctyp = POINT, VOLUME, AREA, or OPENPIT)	3.3.1
SRCPARAM	M-R	Srcid Ptemis Stkhgt Stktmp Stkvel Stkdia (POINT Source) Vlemis Relhgt Syinit Szinit (VOLUME Source) Aremis Relhgt Xinit (Yinit) (Angle) (Szinit) (AREA Source) Opemis Relhgt Xinit Yinit Pitvol (Angle) (OPENPIT Source)	3.3.2
BUILDHGT	O-R	Srcid (or Srcrng) Dsbh(i),i=1,Nsec	3.3.3
BUILDWID	O-R	Srcid (or Srcrng) Dsbw(i),i=1,Nsec	3.3.3
LOWBOUND	O-R	Srcid (or Srcrng) Idswak(i),i=1,Nsec	3.3.3
EMISFACT	O-R	Srcid (or Srcrng) Qflag Qfact(i),i=1,Nqf	3.3.4
EMISUNIT	O-N	Emifac Emilbl Conlbl (or Deplbl)	3.3.5
CONCUNIT	O-N	Emifac Emilbl Conlbl	3.3.5
DEPOUNIT	O-N	Emifac Emilbl Deplbl	3.3.5
PARTDIAM	O-R	Srcid (or Srcrng) Pdiam(i),i=1,Npd	3.3.6
MASSFRAX	O-R	Srcid (or Srcrng) Phi(i),i=1,Npd	3.3.6
PARTDENS	O-R	Srcid (or Srcrng) Pdens(i),i=1,Npd	3.3.6
PARTSLIQ	O-R	Srcid (or Srcrng) Scavcoef(i),i=1,Npd (ST model only)	3.3.7
PARTSICE	O-R	Srcid (or Srcrng) Scavcoef(i),i=1,Npd (ST model only)	3.3.7
GAS-SCAV	O-R	Srcid (or Srcrng) LIQ or ICE Scavcoef (ST model only)	3.3.7
HOUREMIS	O-R	Emifil Srcid's Srcrng's	3.3.8
SRCGROUP	M-R	Grpid Srcid's Srcrng's	3.3.9

RE Keywords	Type	Parameters	Section
ELEVUNIT	O-N	METERS or FEET	3.4

GRIDCART	O-R	Netid STA XYINC Xinit Xnum Xdelta Yinit Ynum Ydelta or XPNTS Gridx1 Gridx2 Gridx3 ... GridxN, and YPNTS Gridy1 Gridy2 Gridy3 ... GridyN ELEV Row Zelev1 Zelev2 Zelev3 ... ZelevN FLAG Row Zflag1 Zflag2 Zflag3 ... ZflagN END	3.4.1
GRIDPOLR	O-R	Netid STA ORIG Xinit Yinit, or ORIG Srcid DIST Ring1 Ring2 Ring3 ... RingN DDIR Dir1 Dir2 Dir3 ... DirN or GDIR Dirnum Dirini Dirinc ELEV Rad Zelev1 Zelev2 Zelev3 ... ZelevN FLAG Rad Zflag1 Zflag2 Zflag3 ... ZflagN END	3.4.1
DISCCART	O-R	Xcoord Ycoord (Zelev) (Zflag)	3.4.3
DISCPOLR	O-R	Srcid Range Direct (Zelev) (Zflag)	3.4.3
BOUNDARY	O-R	Srcid Dist(I),I=1,36	3.4.4
BOUNDELV	O-R	Srcid Zelev(I),I=1,36	3.4.4

Note: While all RE keywords are optional, at least one receptor must be defined for each run.

ME Keywords	Type	Parameters	Section
INPUTFIL	M-N	Metfil (Format)	3.5.1
ANEMHGHT	M-N	Zref (Zrunit)	3.5.2
SURFDATA	M-N	Stanum Year (Name) (Xcoord Ycoord)	3.5.3
UAIRDATA	M-N	Stanum Year (Name) (Xcoord Ycoord)	3.5.3
STARTEND	O-N	Strtyr Strtmn Strtdy (Strthr) Endyr Endmn Enddy (Endhr) (ST only)	3.5.5
DAYRANGE	O-R	Range1 Range2 Range3 ... RangeN (ST model only)	3.5.5
STARDATA	O-N	JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC (LT model only) WINTER SPRING SUMMER FALL or QUART1 QUART2 QUART3 QUART4 MONTH SEASON QUARTR ANNUAL PERIOD	3.5.4
WDROTATE	O-N	Rotang	3.5.6
WINDPROF	O-R	Stab Prof1 Prof2 Prof3 Prof4 Prof5 Prof6	3.5.8
DTHETADZ	O-R	Stab Dtdz1 Dtdz2 Dtdz3 Dtdz4 Dtdz5 Dtdz6	3.5.9
WINDCATS	O-N	Ws1 Ws2 Ws3 Ws4 Ws5	3.5.7
AVESPEED	O-N	Ws1 Ws2 Ws3 Ws4 Ws5 Ws6 (LT model only)	3.5.10
AVETEMPS	M-R	Aveper Ta1 Ta2 Ta3 Ta4 Ta5 Ta6 (LT model only)	3.5.11
AVEMIXHT	M-R	Aveper Stab Mixht1 Mixht2 Mixht3 Mixht4 Mixht5 Mixht6 (LT model only)	3.5.12
AVEROUGH	O-R	Aveper Z0 (LT model only)	3.5.13

TG Keywords	Type	Parameters	Section
INPUTFIL	M-N	Tgfile	3.6
LOCATION	M-N	Xorig Yorig (Units)	3.6
ELEVUNIT	O-N	METERS or FEET	3.6

OU Keywords	Type	Parameters	Section
RECTABLE	O-R	Aveper FIRST SECOND ... SIXTH or 1ST 2ND ... 6TH (ST Model) INDSRC and/or SRCGRP (LT Model)	3.8.1 3.8.3
MAXTABLE	O-R	Aveper Maxnum (ST Model) Maxnum INDSRC and/or SRCGRP and/or SOCONT (LT Model)	3.8.1 3.8.3
DAYTABLE	O-N	Avper1 Avper2 Avper3 Avper4 (ST model only)	3.8.1
MAXIFILE	O-R	Aveper Grpid Thresh Filnam (Funit) (ST model only)	3.8.1
PLOTFILE	O-R	Aveper Grpid Hivalu Filnam (Funit) (ST model) Aveper Grpid Filnam (Funit) (LT model & ST period ave)	3.8.1 3.8.3
POSTFILE	O-R	Aveper Grpid Format Filnam (Funit) (ST model only)	3.8.1
TOXXFILE	O-R	Aveper Cutoff Filnam (Funit) (ST model) Aveper Grpid Filnam (Funit) (LT model)	3.8.1 3.8.3

APPENDIX H. QUICK REFERENCE FOR ISCEV (EVENT) MODEL
(USED FOR SHORT TERM EVENT/SOURCE CONTRIBUTION ANALYSES)

CO Keywords	Type	Parameters	Sec.
TITLEONE	M-N	Title1	3.2.1
TITLETWO	O-N	Title2	3.2.1
MODELOPT	M-N	DFAULT CONC DEPOS DDEP and/or WDEP DRYDPLT WETDPLT RURAL or URBAN GRDRIS NOSTD NOBID NOCALM MSGPRO NOSMPL or NOCMPL	3.2.2
AVERTIME	M-N	1 2 3 4 6 8 12 24 MONTH PERIOD or ANNUAL	3.2.3
POLLUTID	M-N	Pollut	3.2.4
HALFLIFE	O-N	Haflif	3.2.5
DCAYCOEF	O-N	Decay	3.2.5
TERRHGTS	O-N	FLAT or ELEV	3.2.6
FLAGPOLE	O-N	(Flagdf)	3.2.7
RUNORNOT	M-N	RUN or NOT	3.2.8
ERRORFIL	O-N	(Errfil) (DEBUG)	3.2.12

Note: MONTH, PERIOD, and ANNUAL averages are ignored by the EVENT model, which can only handle short term averages of up to 24 hours. Also, only the first output type, in the order of CONC, DEPOS, DDEP and WDEP, is used.

SO Keywords	Type	Parameters	Section
ELEVUNIT	O-N	METERS or FEET	3.3
LOCATION	M-R	Srcid Srctyp Xs Ys (Zs) (Srctyp = POINT, VOLUME, AREA, or OPENPIT)	3.3.1
SRCPARAM	M-R	Srcid Ptemis Stkhgt Stktmp Stkvel Stkdia (POINT Source) Vlemis Relhgt Syinit Szinit (VOLUME Source) Aremis Relhgt Xinit (Yinit) (Angle) (Szinit) (AREA Source) Opemis Relhgt Xinit Yinit Pitvol (Angle) (OPENPIT Source)	3.3.2

BUILDHGT	O-R	Srcid (or Srcrng) Dsbh(i),i=1,Nsec	3.3.3
BUILDWID	O-R	Srcid (or Srcrng) Dsbw(i),i=1,Nsec	3.3.3
LOWBOUND	O-R	Srcid (or Srcrng) Idswak(i),i=1,Nsec	3.3.3
EMISFACT	O-R	Srcid (or Srcrng) Qflag Qfact(i),i=1,Nqf	3.3.4
EMISUNIT	O-N	Emifac Emilbl Conlbl (or Deplbl)	3.3.5
CONCUNIT	O-N	Emifac Emilbl Conlbl	3.3.5
DEPOUNIT	O-N	Emifac Emilbl Deplbl	3.3.5
PARTDIAM	O-R	Srcid (or Srcrng) Pdiam(i),i=1,Npd	3.3.6
MASSFRAX	O-R	Srcid (or Srcrng) Phi(i),i=1,Npd	3.3.6
PARTDENS	O-R	Srcid (or Srcrng) Pdens(i),i=1,Npd	3.3.6
PARTSLIQ	O-R	Srcid (or Srcrng) Scavcoef(i),i=1,Npd (ST model only)	3.3.7
PARTSICE	O-R	Srcid (or Srcrng) Scavcoef(i),i=1,Npd (ST model only)	3.3.7
GAS-SCAV	O-R	Srcid (or Srcrng) LIQ or ICE Scavcoef (ST model only)	3.3.7
HOUREMIS	O-R	Emifil Srcid's Srcrng's	3.3.8
SRCGROUP	M-R	Grpid Srcid's Srcrng's	3.3.9

Type: M - Mandatory N - Non-repeatable
O - Optional R - Repeatable

ME Keywords	Type	Parameters	Section
INPUTFIL	M-N	Metfil (Format)	3.5.1
ANEMHGHT	M-N	Zref (Zrunit)	3.5.2
SURFDATA	M-N	Stanum Year (Name) (Xcoord Ycoord)	3.5.3
UAIRDATA	M-N	Stanum Year (Name) (Xcoord Ycoord)	3.5.3
WDROTATE	O-N	Rotang	3.5.6
WINDCATS	O-N	Ws1 Ws2 Ws3 Ws4 Ws5	3.5.7
WINDPROF	O-R	Stab Prof1 Prof2 Prof3 Prof4 Prof5 Prof6	3.5.8
DTHETADZ	O-R	Stab Dtdz1 Dtdz2 Dtdz3 Dtdz4 Dtdz5 Dtdz6	3.5.9

TG Keywords	Type	Parameters	Section
INPUTFIL	M-N	Tgfile	3.6
LOCATION	M-N	Xorig Yorig (Units)	3.6
ELEVUNIT	O-N	METERS or FEET	3.6

EV Keywords	Type	Parameters	Section
EVENTPER	M-R	Evname Aveper Grpid Date	3.7.1
EVENTLOC	M-R	Evname XR= Xr YR= Yr (Zelev) (Zflag) or RNG= Rng DIR= Dir (Zelev) (Zflag)	3.7.2

OU Keywords	Type	Parameters	Section
EVENTOUT	M-N	SOCONT or DETAIL	3.8.2

Note: RE Pathway is not used for the ISCEV (EVENT) model. Receptor locations for specific events are identified on the EVent Pathway in combination with particular data periods.

GLOSSARY

ASCII -- American Standard Code for Information Interchange, a standard set of codes used by computers and communication devices. Sometimes used to refer to files containing only such standard codes, without any application-specific codes such as might be present in a document file from a word processor program.

CD-144 Format -- Card Deck-144 data format available from NCDC for National Weather Service surface observations commonly used for dispersion models. Each record represents an 80-column "card image".

CO -- **CO**ntrol, the 2-character pathway ID for input runstream images used to specify overall job control options.

CO Pathway -- Collective term for the group of input runstream images used to specify the overall job control options, including titles, dispersion options, terrain options, etc.

Directory -- A logical subdivision of a disk used to organize files stored on a disk.

Dispersion Model -- A group of related mathematical algorithms used to estimate (model) the dispersion of pollutants in the atmosphere due to transport by the mean (average) wind and small scale turbulence.

DOS -- Disk Operating System. Software that manages applications software and provides an interface between applications and the system hardware components, such as the disk drive, terminal, and keyboard.

EBCDIC -- Extended Binary Coded Decimal Interchange Code, the collating sequence used on IBM mainframe computers.

Echo of inputs -- By default, the ISC models will echo the input runstream images, character by character, into the main printed output file. This serves as a record of the inputs as originally entered by the user, without any rounding of the numerical values. The echoing can be suppressed with the NO ECHO option.

EOF -- End-of-File.

EPA -- U. S. Environmental Protection Agency.

Error message -- A message written by the model to the error/message file whenever an error is encountered that will inhibit data processing.

Error/Message File -- A file used for storage of messages written by the model.

EV -- **EV**ent, the 2-character pathway ID for input runstream images used to specify event inputs for the Short Term EVENT model.

EV Pathway -- Collective term for the group of input runstream images used to specify the event periods and location for the Short Term EVENT model.

EVENT Model -- A new ISC Short Term model (ISCEV) developed with Version 2 of ISCST, specifically designed to provide source contribution (culpability) information for specific events of interest, e.g., design values or threshold violations.

Extended Memory -- Additional memory on 80386 and 80486 PCs that allows programs to address memory beyond the 640 KB limit of DOS. Special software is required to utilize this extra memory.

Fatal Error -- Any error which inhibits further processing of data by the model. Model continues to read input images to check for errors during setup, and will continue to read input meteorological data during calculation phase.

Flow Vector -- The direction towards which the wind is blowing.

GMT -- Greenwich Mean Time, the time at the 0° meridian.

Informational Message -- Any message written to the error/message file that may be of interest to the user, but which have no direct bearing on the validity of the results, and do not affect processing.

Input Image -- User supplied input, read through the default input device, controlling the model options and data input. A single card or record from the input runstream file. Each input image consists of a pathway ID (may be blank indicating a continuation of the previous pathway), a keyword (may also be blank for continuation of a keyword), and possibly one or more parameter fields.

Input Runstream File -- The basic input file to the ISC models controlling the modeling options, source data, receptor locations, meteorological data file specifications, and output options. Consists of a series of input images grouped into functional pathways.

ISCEV -- Industrial Source Complex - Short Term EVENT Dispersion Model.

ISCST -- Industrial Source Complex - Short Term Dispersion Model.

ISCLT -- Industrial Source Complex - Long Term Dispersion Model.

JCL -- Job Control Language, an IBM mainframe's operating system control language for batch jobs.

Joint Frequency Distribution -- The joint frequency of wind direction sector, wind speed class and stability category (see also STAR).

Julian Day -- The number of the day in the year, i.e., Julian Day = 1 for January 1 and 365 (or 366 for leap years) for December 31.

KB -- Kilobyte, 1000 bytes, a unit of storage on a disk

Keyword -- The 8-character codes that follow immediately after the pathway ID in the input run stream data.

LST -- Local Standard Time.

Math Co-processor -- A computer chip used to speed up floating point arithmetic in a personal computer.

MB -- Megabyte, one million bytes, a unit of storage on a disk

ME -- **ME**teorology, the 2-character pathway ID for input runstream images used to specify meteorological data options

ME Pathway -- Collective term for the group of input runstream images used to specify the input meteorological data file and other meteorological variables, including the period to process from the meteorological file for the ISCST model.

Meteorological Data File -- Any file containing meteorological data, whether it be mixing heights, surface observations or on-site data.

Missing Value -- Alphanumeric character(s) that represent breaks in the temporal or spatial record of an atmospheric variable.

Mixing Height -- The depth through which atmospheric pollutants are typically mixed by dispersive processes.

MPRM -- Meteorological Processor for Regulatory Models, a program designed for the purpose of processing on-site meteorological data to prepare them for input to the regulatory models, such as ISC. Produces a file comparable to the PCRAMMET pre-processor output, and also capable of producing STAR summaries.

NCDC -- National Climatic Data Center, the federal agency responsible for distribution of the National Weather Service upper air, mixing height and surface observation data.

NO ECHO -- Option to suppress echoing of the runstream input images to the main printed output file.

NWS -- National Weather Service.

On-site Data -- Data collected from a meteorological measurement program operated in the vicinity of the site to be modeled in the dispersion analysis.

OU -- **OU**tput, the 2-character pathway ID for input runstream images used to specify output options.

OU Pathway -- Collective term for the group of input runstream images used to specify the output options for a particular run.

Overlay -- One or more subprograms that reside on disk and are loaded into memory only when needed.

Pasquill Stability Categories -- A classification of the dispersive capacity of the atmosphere, originally defined using surface wind speed, solar insolation (daytime) and cloudiness (nighttime). They have since been reinterpreted using various other meteorological variables.

Pathway -- One of the six major functional divisions in the input runstream file for the ISC models. These are **CO**ntrol, **SO**urce, **RE**ceptor, **ME**teorology, **EV**ent, and **OU**tput (see these entries in this section for a description).

PC -- Personal Computer, a wide ranging class of computers designed for personal use, typically small enough to fit on a desktop.

PCRAMMET -- Meteorological processor program used for regulatory applications capable of processing twice-daily mixing heights (TD-9689 format) and hourly surface weather observations (CD-144 format) for use in dispersion models such as ISCST, CRSTER, MPTER and RAM.

Quality Assessment -- Judgment of the quality of the data.

Quality Assessment Check -- Determining if the reported value of a variable is reasonable (see also Range Check).

Quality Assessment Message -- Message written to the error/message file when a data value is determined to be suspect.

Quality Assessment Violation -- Occurrences when data values are determined to be suspect (see also Range Check Violation).

RAM -- Random Access Memory on a personal computer.

Range Check -- Determining if a variable falls within predefined upper and lower bounds.

Range Check Violation -- Determination that the value of a variable is outside range defined by upper and lower bound values (see also Quality Assessment Violation).

RE -- **RE**ceptor, the 2-character pathway ID for input runstream images used to specify receptor locations.

RE Pathway -- Collective term for the group of input runstream images used to specify the receptor locations for a particular run.

Regulatory Applications -- Dispersion modeling involving regulatory decision-making as described in the Guideline on Air Quality Models (Revised), (EPA, 1987b).

Regulatory Model -- A dispersion model that has been approved for use by the regulatory offices of the EPA, specifically one that is included in Appendix A of the Guideline on Air Quality Models (Revised), (EPA, 1987b), such as the ISC model.

Runstream File -- Collectively, all input images required to process input options and input data for the ISC models.

SCRAM BBS -- Support Center for Regulatory Air Models - Bulletin Board System, an electronic bulletin board system used by EPA for disseminating air quality dispersion models, modeling guidance, and related information.

Secondary Keyword -- A descriptive alphabetical keyword used as a parameter for one of the main runstream keywords to specify a particular option.

SO -- **SO**urce, the 2-character pathway ID for input runstream images used to specify input source parameters and source groups.

SO Pathway -- Collective term for the group of input runstream images used to specify the source input parameters and source group information.

STAR -- STability ARray, a joint frequency distribution summary of stability category, wind speed and wind direction. The STAR data are used as input for the ISC Long Term dispersion model.

Station Identification -- An integer or character string used to uniquely identify a station or site as provided in the upper air (TD-5600 and TD-6201), mixing height (TD-9689), and surface weather (CD-144 and TD-3280) data formats available from NCDC. There are no standard station numbers for on-site data or card image/screening data, and the user may include any integer string

Subdirectory -- A directory below the root, or highest level, directory or another subdirectory, used for organization of files on a storage medium such as a PC hard disk.

Surface Weather Observations -- A collection of atmospheric data on the state of the atmosphere as observed from the earth's surface. In the U.S. the National Weather Service collect these data on a regular basis at selected locations.

Surface Roughness Length -- Height at which the wind speed extrapolated from a near-surface wind speed profile becomes zero.

Syntax -- The order, structure and arrangement of the inputs that make of the input runstream file, specifically, the rules governing the placement of the various input elements including pathway IDs, keywords, and parameters.

TD-1440 Format -- A format available from NCDC for summarizing NWS surface observations in an 80-column format; the CD-144 format is a subset of this format. This format has been superseded by the TD-3280 format.

TD-3280 Format -- The current format available from NCDC for summarizing NWS surface weather observations in an elemental structure, i.e., observations of a single atmospheric variable are grouped together for a designated period of time.

TD-5600 Format -- A format available from NCDC for reporting NWS upper air sounding data. This format has been superseded by the TD-6201 format.

TD-6201 Format -- The current format available from NCDC for reporting NWS upper air data. The file structure is essentially the same as the TD-5600 format except that there is more quality assurance information.

TD-9689 Format -- The format available from NCDC for mixing heights estimated from morning upper air temperature and pressure data and hourly surface observations of temperature.

UNAMAP -- User's Network for Applied Modeling of Air Pollution, a collection of dispersion models and closely related support utilities, used for disseminating models prior to the SCRAM BBS.

Unformatted File -- A file written without the use of a FORTRAN FORMAT statement, sometimes referred to as a binary file.

Upper Air Data (or soundings) -- Meteorological data obtained from balloon- borne instrumentation that provides information on pressure, temperature, humidity, and wind away from the surface of the earth.

Vertical Potential Temperature Gradient -- The change of potential temperature with height, used in modeling the plume rise through a stable layer, and indicates the strength of

the stable temperature inversion. A positive value means that potential temperature increases with height above ground and indicates a stable atmosphere.

Warning Message -- A message written by the model to the error/message file whenever a problem arises that may reflect an erroneous condition, but does not inhibit further processing.

Wind Profile Exponent -- The value of the exponent used to specify the profile of wind speed with height according to the power law (see Section 1.1.3 of Volume II).

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ADDENDUM

USER'S GUIDE FOR THE INDUSTRIAL SOURCE COMPLEX (ISC3) DISPERSION MODELS

VOLUME I - USER INSTRUCTIONS

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Air Quality Planning and Standards
Emissions, Monitoring, and Analysis Division
Research Triangle Park, North Carolina 27711

February 2002

ACKNOWLEDGMENTS

The Addendum to the User's Guide for the ISC3 Models has been prepared by Roger W. Brode of Pacific Environmental Services, Inc., Research Triangle Park, North Carolina, under subcontract to EC/R, Inc., Chapel Hill, North Carolina. This effort has been funded by the Environmental Protection Agency under Contract No. 68D98006, with Dennis G. Atkinson as Work Assignment Manager.

USER INSTRUCTIONS FOR THE
REVISED ISCST3 MODEL (DATED 02035)

This document provides user instructions for recent enhancements of the ISCST3 model, including the most recent version dated 02035 (February 4, 2002). The enhancements described in this Addendum include changes to the processing of multi-year averages for post-1997 PM_{10} NAAQS analyses, enhancements to the model which were formerly available in draft form as ISCST390 (dated 97365), enhancements to the model for air toxics applications, and an option to specify variable emission rate factors that vary by season, hour-of-day, and day-of-week. The enhancements from the draft ISCST390 model include a conversion to Fortran 90 in order to make use of allocatable arrays for data storage, incorporation of the EVENT processing from the ISCEV3 model, an INCLUDED keyword option for the source, receptor and event pathways, and two new options for specifying area sources. The use of allocatable arrays provides much more flexibility for the end user of the ISCST3 model. The enhancements for air toxics applications include the Sampled Chronological Input Model (SCIM) option, optimizations for the area source and dry depletion algorithms, inclusion of the gas dry deposition algorithms based on the draft GDISCDFT model (dated 96248), and the option to output results by season and hour-of-day (SEASONHR). User instructions for these enhancements are provided below.

ENHANCEMENTS INTRODUCED WITH ISCST3 (DATED 98348)

Post-1997 PM_{10} Processing

A new NAAQS for modeling PM_{10} was promulgated in July 1997. This guidance utilizes the expected second high value of the 24-hour NAAQS replaced by a 3-year average of the 99th percentile value of the frequency distribution and a 3-year average of the annual mean. Since the Guideline on Air Quality Modeling precludes the use of a 3-year data set, a policy was established that uses unbiased estimates of the 3-year averages, utilizing all meteorological data (both single and multiple years of data) available. An unbiased estimate of the 99th percentile is the fourth highest concentration, if one year of meteorological data are input to the model, or the multi-year average of the fourth highest concentrations, if more than one year of meteorological data are input to the model. Similarly, an unbiased estimate of the 3-year average annual mean is simply the annual mean, if only one year of meteorological data are input to the model, or the multi-year average annual mean if multiple years of meteorological data are used. Analogously to the original NAAQS situation, the entire area is in compliance when the highest fourth high (or highest average fourth high) and the highest annual mean (or the highest average annual mean) are less than or equal to the NAAQS.

The revised ISCST3 model will process the 24-hour and annual averages for PM_{10} according to the new NAAQS if the pollutant ID specified on the CO POLLUTID card is

PM10 or PM-10, and the CO MULTYEAR card is not present. In this case, the model will compute an average of the fourth highest concentrations at each receptor across the number of years of meteorological data being processed. For a single year of data, the model will report the fourth highest concentration at each receptor. For a five year period of data, the model will report the average of the five fourth-highest values at each receptor. Also, for multiple year data files, the annual average will first be calculated for each individual year of data, and the average of these across the number of years will be calculated. This processing of the annual average across multiple years may give slightly different results than the PERIOD average across the same time period, due to differences in the number of calms from year to year. In order to accommodate this difference, the new PM_{10} NAAQS makes use of the ANNUAL average keyword for specifying the long-term average.

Users should be aware of the following restrictions which are applied to the new PM_{10} NAAQS processing.

1. The averaging periods are limited to the 24-hour and ANNUAL averages. Use of the PERIOD average or a short-term average other than 24-hour will result in a fatal error message being generated.

2. Only the FOURTH (or 4TH) highest value may be requested on the RECTABLE card for 24-hour averages. Specifying another high value on the RECTABLE card will result in a fatal error message being generated.

3. The model will only process complete years of meteorological data, although there is no restriction on the start date for the data. If less than one complete year of data is processed, a fatal error message will be generated. If additional meteorological data remains after the end of the last complete year of data, the remaining data will be ignored, and a non-fatal warning message will be generated specifying the number of hours ignored.

4. The MULTYEAR card cannot be used with the new PM_{10} NAAQS. Multiple year analyses should be accomplished by including the multiple years of meteorology in a single data file.

5. Since the 24-hour average design values for post-1997 PM_{10} analyses may consist of averages over a multi-year period, they are incompatible with the EVENT processor. If the MAXIFILE option is used to output 24-hour average threshold violations, these may be used with the EVENT processor. Therefore, if the EVENTFIL option is used without the MAXIFILE option for post-1997 PM_{10} analyses, a non-fatal warning message will be generated, and the EVENTFIL option will be ignored.

The revised ISCST3 model may still be used to perform PM_{10} analyses according to the pre-1997 NAAQS. This may be accomplished as before by use of the

MULTYEAR card on the CO pathway, except that the syntax for this keyword has been changed slightly. The syntax and type are now as follows:

Syntax:	CO MULTYEAR H6H Savfil (Inifil)
Type:	Optional, Non-repeatable

where H6H is a new secondary keyword that identifies this as a pre-1997 analysis, the Savfil parameter specifies the filename for saving the results arrays at the end of each year of processing, and the Inifil parameter specifies the filename to use for initializing the results arrays at the beginning of the current year. The Inifil parameter is optional, and should be left blank for the first year in the multi-year series of runs. Other than the additional secondary keyword of H6H, the MULTYEAR card works the same as in previous versions of ISCST3. A non-fatal warning message will be generated if the MULTYEAR card is used for pre-1997 NAAQS analyses.

Memory Allocation

The revised ISCST3 model will allocate data storage as needed based on the number of sources, receptors, source groups, and other input requirements, up to the maximum amount of memory available on the computer being used. The minimum system requirements for this version of the model are a 386 or higher processor with a math coprocessor and at least 2 MB of extended memory.

The revised ISCST3 model uses allocatable arrays to allocate data storage at model runtime rather than at compile time, as done by the previous version of ISCST3. The ISCST3 model preprocesses the model runstream input file to determine the data storage requirements for a particular model run, and then allocates the input data arrays before processing the setup data. Once the setup processing is completed, the model allocates storage for the result arrays. When allocating data storage, the ISCST3 model traps for errors, e.g., not enough memory available to allocate. If the allocation is unsuccessful, then an error message is generated by the model and further processing is prevented. If the CO RUNORNOT NOT option is selected, the model will still go through all array allocations so that the user can determine if sufficient memory is available to complete the run. Also, an estimate of the total amount of memory needed for a particular run is printed out as part of the first page of printed output.

The parameters that are established at model runtime are as follows:

NSRC = Number of Sources
NREC = Number of Receptors
NGRP = Number of Source Groups
NAVE = Number of Short Term Averaging Periods
NVAL = Number of High Values by Receptor (RECTABLE Keyword)
NTYP = Number of Output Types (CONC, DEPOS, DDEP and WDEP)

NMAX	= Number of Overall Maximum Values (MAXTABLE Keyword)
NQF	= Number of Variable Emission Rate Factors Per Source
NPDMAX	= Number of Particle Diameter Categories Per Source
IXM	= Number of X-coord (Distance) Values Per Receptor Network
IYM	= Number of Y-coord (Direction) Values Per Receptor Network
NNET	= Number of Cartesian and/or Polar Receptor Networks
NEVE	= Number of Events for EVENT processing

In the case of NPDMAX, if no particle information is present in the input runstream, then NPDMAX is set to 1, otherwise it is set to 20. Other parameters are set to the actual numbers required for a particular model run.

A change has also been made that affects the length of filenames that may be specified in the ISCST3 model input file. A new PARAMETER called ILEN_FLD has been added to MODULE MAIN1 in MODULES.FOR, which is initially assigned a value of 80. This PARAMETER is now used to specify the maximum length of individual fields on the input runstream image, and also to declare the length of all filename and format variables. This includes the input and output filenames specified on the command line.

EVENT Processing

The revised ISCST3 model incorporates the EVENT processing from the ISCEV3 model. Currently, ISCST3 can be run in either the original ISCST3 mode or in the ISCEV3 mode for a particular model run. The input requirements of each mode are the same as for the original ISCST3 and ISCEV3 models, respectively. In other words, ISCST3 will accept input files that have been setup for either ISCST3 or ISCEV3.

INCLUDED Option

The INCLUDED keyword option allows for the user to incorporate source, receptor, and/or event data from a separate file into an ISCST3 model runstream file. Multiple INCLUDED cards may be placed anywhere within the source, receptor and/or event pathway, after the STARTING card and before the FINISHED card (i.e., the STARTING and FINISHED cards cannot be included in the external file). The data in the included file will be processed as though it were part of the runstream file. The syntax and type of the INCLUDED keyword are summarized below:

Syntax:	`SO INCLUDED Incfil`
	`RE INCLUDED Incfil`
	`EV INCLUDED Incfil`

Type:	`Optional, Repeatable`

where the Incfil parameter is a character field of up to 80 characters (controlled by the ILEN_FLD PARAMETER in MAIN1) that identifies the filename for the included file.

The contents of the included file must be valid runstream images for the applicable pathway. If an error is generated during processing of the included file, the error message will report the line number of the included file. If more than one INCLUDED file is specified for a particular pathway, the user will first need to determine which file the error occurred in.

AREAPOLY and AREACIRC Source Type Options

The ISCST3 model includes two new options for specifying area sources. These are identified by the AREAPOLY and AREACIRC source types on the SO LOCATION keyword. The syntax, type and order of the LOCATION keyword are summarized below:

Syntax:	SO LOCATION Srcid Srctyp Xs Ys (Zs)
Type:	Mandatory, Repeatable
Order:	Must be first card for each source input

where the Srcid parameter is the alphanumeric source ID defined by the user (up to eight characters), Srctyp is the source type, which is identified by one of the secondary keywords - POINT, VOLUME, AREA, AREAPOLY, or AREACIRC - and Xs, Ys, and Zs are the x, y, and z coordinates of the source location in meters. All three of the area source types use the same numerical integration algorithm for estimating impacts from area sources, and are merely different options for specifying the shape of the area source. The AREA source keyword may be used to specify a rectangular-shaped area source with arbitrary orientation; the AREAPOLY source keyword may be used to specify an area source as an irregularly-shaped polygon of up to 20 sides; and the AREACIRC source keyword may be used to specify a circular-shaped area source (modeled as an equal-area polygon of up to 20 sides). Note that the source elevation, Zs, is an optional parameter. The x (east-west) and y (north-south) coordinates are for the center of the source for POINT, VOLUME, and AREACIRC sources, and are for one of the vertices of the source for AREA and AREAPOLY sources. The source coordinates may be input as Universal Transverse Mercator (UTM) coordinates, or may be referenced to a user-defined origin.

The main source parameters for the AREAPOLY and AREACIRC source types are input on the SRCPARAM card, which is a mandatory keyword for each source being modeled. These inputs are described below

AREAPOLY Source Type

The AREAPOLY source type may be used to specify an area source as an arbitrarily-shaped polygon of between 3 and 20 sides (the number of sides allowed may be increased by modifying the NVMAX and NVMAX2 parameters in MODULES.FOR). This source type option provides the user with considerable flexibility for specifying the shape of an area source. The syntax, type and order for the SRCPARAM card for AREAPOLY sources are summarized below:

Syntax:	SO SRCPARAM Srcid Aremis Relhgt Nverts (Szinit)
Type:	Mandatory, Repeatable
Order:	Must follow the LOCATION card for each source input

where the Srcid parameter is the same source ID that was entered on the LOCATION card for a particular source, and the other parameters are as follows:

Aremis - area emission rate in g/(s-m^2),

Relhgt - release height above ground in meters,

Nverts - number of vertices (or sides) of the area source polygon,

Szinit - initial vertical dimension of the area source plume in meters (optional).

As with AREA sources, the emission rate for the source is an emission rate per unit area, which is different from the point and volume source emission rates, which are total emission rates (g/s) for the source. The number of vertices (or sides) used to define the area source polygon may vary between 3 and 20. The locations of the vertices are specified by use of the AREAVERT keyword, which applies only to AREAPOLY sources. The syntax, type and order for the AREAVERT keyword used for AREAPOLY sources are summarized below:

Syntax:	SO AREAVERT Srcid Xv(1) Yv(1) Xv(2) Yv(2) ... Xv(I) Yv(I)
Type:	Mandatory for AREAPOLY sources, Repeatable
Order:	Must follow the LOCATION and SRCPARAM card for each source input

where the Xv(I) and Yv(I) are the x-coordinate and y-coordinate values of the vertices of the area source polygon. There must by Nverts pairs of coordinates for the area source, where Nverts is the number of vertices specified for that source on the SRCPARAM card. The first vertex, Xv(1) and Yv(1), must also match the coordinates given for the source location on the LOCATION card, Xs and Ys. The remaining vertices may be defined in either a clockwise or counter-clockwise order from the point used for defining the source location.

AREACIRC Source Type

The AREACIRC source type may be used to specify an area source as a circular shape. The model will automatically generate a regular polygon of up to 20 sides to approximate the circular area source. The polygon will have the same area as that specified for the circle. The syntax, type and order for the SRCPARAM card for AREACIRC sources are summarized below:

Syntax:	SO SRCPARAM Srcid Aremis Relhgt Radius (Nverts) (Szinit)
Type:	Mandatory, Repeatable
Order:	Must follow the LOCATION card for each source input

where the Srcid parameter is the same source ID that was entered on the LOCATION card for a particular source, and the other parameters are as follows:

Aremis - area emission rate in g/(s-m^2),

Relhgt - release height above ground in meters,

Radius - radius of the circular area in meters,

Nverts - number of vertices (or sides) of the area source polygon (optional, 20 sides will be used if omitted),

Szinit - initial vertical dimension of the area source plume in meters (optional).

As with AREA sources, the emission rate for the source is an emission rate per unit area, which is different from the point and volume source emission rates, which are total emission rates (g/s) for the source.

ENHANCEMENTS INTRODUCED WITH ISCST3 (DATED 99155)

TOXICS Option

The revised ISCST3 model includes enhancements for air toxics applications. These enhancements include the Sampled Chronological Input Model (SCIM) option, optimizations for the area source and dry depletion algorithms, inclusion of the gas dry deposition algorithms based on the draft GDISCDFT model (dated 96248), and the option to output results by season and hour-of-day (SEASONHR). In order to utilize these enhancements, the user must include the TOXICS keyword on the CO MODELOPT card. Since the TOXICS option is a non-regulatory default option, the DFAULT keyword should not be included on the MODELOPT card. If the DFAULT keyword is present on the MODELOPT card, the DFAULT option will override the TOXICS option if it is present, and any other enhancements dependent on the TOXICS option. The enhancements associated with the TOXICS option are described below.

Sampled Chronological Input Model (SCIM) Option

If the non-default TOXICS option is specified, the user may also use the SCIM option to reduce model runtime. The SCIM option can only be used with the ANNUAL average option, and is primarily applicable to multi-year model simulations. The

approach used by the SCIM option is to sample the meteorological data at a user-specified regular interval to approximate the long-term (i.e., ANNUAL) average impacts. Since wet deposition does not occur at regular intervals, the user can also specify a separate wet sampling interval to reduce the uncertainty introduced by sampling for wet deposition. The DEPOS option is ignored when SCIM is selected because, depending upon whether or not the user selected the separate wet hour sampling, the dry deposition and wet deposition rates can be based on different sets of sampled hours. Therefore, the annualized deposition rates for the two types of deposition are calculated separately. For this reason, the user is advised to calculate dry and wet deposition rates separately (using DDEP and WDEP, respectively) and add the two to obtain the total deposition rate when the SCIM option is used. Studies have shown that the uncertainty in modeled results introduced by use of the SCIM option is generally lower for area sources than for point sources.

When only the regular sampling is selected, all hourly impacts (concentration, dry deposition flux and the wet deposition flux) are calculated in the normal fashion for each sampled hour. The annual average concentration is then simply calculated by dividing the cumulative concentration for the sampled hours by the number of hours sampled (arithmetic average), and the annual dry and the wet deposition fluxes are calculated by scaling the respective cumulative fluxes for the sampled hours by the ratio of the total hours to the sampled hours. The following illustrates the calculation of the ANNUAL impacts when only the regular sampling is selected:

$$C = \Sigma C_s / N_s$$
$$D = \Sigma D_s (N_t / N_s)$$
$$W = \Sigma W_s (N_t / N_s)$$

where:
C, D, W = Calculated conc, dry flux and wet flux, respectively
$\Sigma C_s, \Sigma D_s, \Sigma W_s$ = Cumulative impacts for the sampled hours
N_s = Number of sampled hours
N_t = Total number of hours in the data period

When the wet hour sampling is also selected along with regular sampling, the impacts are calculated slightly differently. The concentrations and the dry deposition fluxes are based on the weighted contributions from the regular samples, modeled as dry hours, and the wet hour samples. The regular samples consist of all the hours based on regular sampling interval, but the effects of precipitation are ignored so that their contribution represents only dry conditions, while the contribution from the wet hour samples represents only wet conditions. The wet deposition fluxes are only based on the wet hour samples. The following illustrates the calculation of the ANNUAL impacts when both the regular sampling as well as the wet hour sampling are selected:

$$C = \frac{\Sigma C_d (N_{td}/N_{sd}) + \Sigma C_w (N_{tw}/N_{sw})}{N_t}$$

$$D = \Sigma D_d (N_{td}/N_{sd}) + \Sigma D_w (N_{tw}/N_{sw})$$

$$W = \Sigma W_w (N_{tw}/N_{sw})$$

where:
C, D, W = Calculated conc, dry flux and wet flux, respectively
$\Sigma C_d, \Sigma D_d$ = Cumulative impacts for regular (dry) sampled hours
$\Sigma C_w, \Sigma D_w, \Sigma W_w$ = Cumulative impacts for sampled wet hours
N_{sd} = Number of regular sampled hours, modeled as dry
N_{sw} = Number of sampled wet hours
N_{td} = Total number of dry hours in the data period
N_{tw} = Total number of wet hours in the data period
N_t = Total number of hours in the data period (N_{td} + N_{tw})

To use the SCIM option, the user must include the SCIM and TOXICS keywords on the CO MODELOPT card, and also specify the SCIM sampling parameters on the ME SCIMBYHR card. The SCIM parameters on the SCIMBYHR card specify the starting hour and sampling interval for the regular or dry sample, and also for the wet sample if used. The syntax and type of the SCIMBYHR keyword are summarized below:

Syntax:	ME SCIMBYHR NRegStart NRegInt NWetStart NWetInt (Filnam)
Type:	Optional, Non-repeatable

where the NRegStart and NRegInt parameters specify the first hour to be sampled and the sampling interval when performing the regular sampling, respectively, and NWetStart and NWetInt parameters specify the first wet hour to sample and the wet hour sampling interval, respectively. Optionally, the user can create an output file by specifying the Filnam parameter containing the meteorological data for the sampled hours (in the same format used in the summary of the first 24 hours of data included in the main output file).

Although the ME SCIMBYHR is an optional card, it is required when using the SCIM option. NRegStart is required to have a value from 1 through 24, i.e., the first sampled hour must be on the first day in the meteorological data file. There are no restrictions for NRegInt; however, NRegInt would generally be greater than 1. For example, NRegInt could be based on the formula (24n+1), where "n" is the number of days to skip between samples, in order to ensure a regular diurnal cycle to the sampled hours (e.g., 25 or 49). NWetStart must be no greater than NWetInt. An input of 0 (zero) for NWetInt indicates that the user has not selected the wet hour sampling.

Optimized Area Source and Dry Depletion Algorithms

When the TOXICS option is specified, the area source and dry depletion integration routines are optimized to reduce model runtime. This is accomplished by incorporation of a 2-point Gaussian Quadrature routine for numerical integration for some situations instead of the Romberg numerical integration utilized in the regulatory default mode. In addition, for area sources with dry depletion, another optimization option is available to reduce model runtime by specifying the AREADPLT keyword on the CO MODELOPT card. When the AREADPLT option is specified the model will apply a single "effective" depletion factor to the undepleted area source integral, rather than applying the numerical integration for depletion within the area source integral. If AREADPLT is selected, the DRYDPLT option for non-area sources is automatically selected.

Gas Dry Deposition Algorithm

The revised ISCST3 model has the option to model the effects of dry deposition for gaseous pollutants. In order to utilize this algorithm, the non-default TOXICS option must be specified on the CO MODELOPT card. There are three new keywords on the CO pathway and one new keyword on the SO pathway that are used for specifying inputs for the gas dry deposition algorithm. The user has the option of specifying the deposition velocity to be used with the CO GASDEPVD card, or allowing the model to calculate the deposition velocities. If the user does not specify the deposition velocity with the GASDEPVD keyword, then the state of vegetation must be specified with the CO VEGSTATE card, and the source parameters for gas deposition must be specified with the SO GASDEPOS card. The user also has the option to override certain default reference parameters through use of the CO GASDEPRF card. The inputs for these keywords are described below. The use of the gas dry deposition algorithm in ISCST3 also requires additional meteorological parameters, which can be provided by the MPRM meteorological preprocessor. The formats for the meteorological data input file for gas dry deposition applications is also described below.

Specifying the State of Vegetation

An optional keyword is available on the Control pathway to allow the user to specify the state of vegetation for use with the gaseous dry deposition algorithm of the ISCST3 model. Three options are available on this keyword, one for active and unstressed vegetation, one for active and stressed vegetation, and another for inactive vegetation.

The syntax and type of the VEGSTATE keyword are summarized below:

Syntax:	CO VEGSTATE UNSTRESSED or STRESSED or INACTIVE
Type:	Optional, Non-repeatable

where the secondary keyword options describe the three options for the state of vegetation. The state of vegetation is used in the model, along with ambient temperature and incoming short-wave radiation, to determine the resistance to transport through the

stomatal pores. For unirrigated vegetation, the user should select the appropriate option for vegetation state based on existing soil moisture conditions. For irrigated vegetation, the user should assume that the vegetation is active and unstressed.

Option for Overriding Default Reference Parameters for Gas Dry Deposition

An optional keyword is available on the Control pathway to allow the user to override the default reference parameters of cuticle resistance, ground resistance, and pollutant reactivity for use with the gas dry deposition algorithm.

The syntax and type of the GASDEPRF keyword are summarized below:

Syntax:	`CO GASDEPRF Rcutr Rgr Reactr (Refpoll)`
Type:	`Optional, Non-repeatable`

where the parameter Rcutr is the reference value for cuticle resistance, Rgr is the reference value for ground resistance, Reactr is the reference value for pollutant reactivity, and Refpoll is the optional name of the reference pollutant. If the GASDEPRF keyword is omitted, then the following default reference values for SO_2 are used by the model: Rcutr = 30 s/cm; Rgr = 10 s/cm; and Reactr = 8.

Option for Specifying the Deposition Velocity for Gas Dry Deposition

An optional keyword is available on the Control pathway to allow the user to specify the deposition velocity for use with the gaseous dry deposition algorithm of the ISCST3 model. A single deposition velocity can be input for a given model run, and is used for all sources of gaseous pollutants. Selection of this option will by-pass the algorithm for computing deposition velocities for gaseous pollutants, and should only be used when sufficient data to run the algorithm are not available. Results of the ISCST3 model based on a user-specified deposition velocity should be used with extra caution.

The syntax and type of the GASDEPVD keyword are summarized below:

Syntax:	`CO GASDEPVD Uservd`
Type:	`Optional, Non-repeatable`

where the parameter Uservd is the gaseous dry deposition velocity (m/s). A non-fatal warning message is generated by the model if a value of Uservd greater than 0.05 m/s (5 cm/s) is input by the user. When the GASDEPVD keyword is used, the VEGSTATE and GASDEPRF keywords for the CO pathway, and the GASDEPOS keyword for the SO pathway, are no longer applicable and cannot be used in the same model run.

Specifying Source Parameters for Gas Dry Deposition

The input of source parameters for gas dry deposition is controlled by the GASDEPOS keyword on the SO pathway. The gas dry deposition variables may be input for a single source, or may be applied to a range of sources.

The syntax, type, and order for the GASDEPOS keyword are summarized below:

Syntax:	SO GASDEPOS Srcid (or Srcrng) Diff Alphas Reac Rsubm Henry
Type:	Optional, Repeatable
Order:	Must follow the LOCATION card for each source input

where the Srcid or Srcrng identify the source or sources for which the inputs apply, the parameter Diff is the molecular diffusivity for the pollutant being modeled (cm^2/s), Alphas is the solubility enhancement factor (α_*) for the pollutant, Reac is the pollutant reactivity parameter, Rsubm is the mesophyll resistance term (r_m) for the pollutant (s/cm), and Henry is the Henry's Law coefficient for the parameter. Values of these physical parameters for several common pollutants may be found in chemical engineering handbooks and various publications, such as the Air/Superfund National Technical Guidance Study Series (EPA, 1993). The Alphas and Henry parameters are only used when applying the algorithm over a water surface. If no water surfaces are present in a particular application, then dummy (non-zero) values may be input for Alphas and Henry. The model converts the input units for Diff to m^2/s and Rsubm to s/m before being used in the computations.

Meteorological Formats for Gas Dry Deposition

Since the deposition algorithms require additional meteorological variables, the exact format of ASCII meteorological data will depend on whether the dry and/or wet deposition algorithms are being used. If the deposition algorithms are being used, then the unformatted data file cannot be used. The order of the meteorological variables for the formatted ASCII files and the default ASCII format are as follows when the CARD option is used:

ASCII Meteorological Formats With the CARD Option		
Variable	Fortran Format	Columns
Year (last 2 digits)	I2	1-2
Month	I2	3-4
Day	I2	5-6
Hour	I2	7-8
Flow Vector (deg.)	F9.4	9-17
Wind Speed (m/s)	F9.4	18-26
Ambient Temperature (K)	F6.1	27-32
Stability Class (A=1, B=2, ... F=6)	I2	33-34
Rural Mixing Height (m)	F7.1	35-41
Urban Mixing Height (m)	F7.1	42-48
Wind Profile Exponent (CARD only)	F8.4	49-56
Vertical Potential Temperature Gradient (K/m) (CARD only)	F8.4	57-65
Friction Velocity (m/s) (Dry or Wet Deposition Only)	F9.4	66-74
Monin-Obukhov Length (m) (Dry or Wet Deposition Only)	F10.1	75-84
Surface Roughness Length (m) (Dry or Wet Deposition Only)	F8.4	85-92
Incoming Short-wave Radiation (W/m^2) (Gas Dry Deposition Only)	F8.1	93-100
Leaf Area Index (Gas Dry Deposition Only)	F8.3	101-108
Precipitation Code (00-45) (Wet Deposition Only)	I4	109-112 (93-96 without Gas Dry Deposition)
Precipitation Rate (mm/hr) (Wet Deposition Only)	F7.2	113-119 (97-103 without Gas Dry Deposition)

The order and default format of the meteorological variables for the formatted ASCII files without the CARD option are as follows:

ASCII Meteorological Formats Without the CARD Option		
Variable	Fortran Format	Columns
Year (last 2 digits)	I2	1-2
Month	I2	3-4
Day	I2	5-6
Hour	I2	7-8
Flow Vector (deg.)	F9.4	9-17
Wind Speed (m/s)	F9.4	18-26
Ambient Temperature (K)	F6.1	27-32
Stability Class (A=1, B=2, ... F=6)	I2	33-34
Rural Mixing Height (m)	F7.1	35-41
Urban Mixing Height (m)	F7.1	42-48
Friction Velocity (m/s) (Dry or Wet Deposition Only)	F9.4	49-57
Monin-Obukhov Length (m) (Dry or Wet Deposition Only)	F10.1	58-67
Surface Roughness Length (m) (Dry or Wet Deposition Only)	F8.4	68-75
Incoming Short-wave Radiation (W/m^2) (Gas Dry Deposition Only)	F8.1	76-83
Leaf Area Index (Gas Dry Deposition Only)	F8.3	84-91
Precipitation Code (00-45) (Wet Deposition Only)	I4	92-95 (76-79 without Gas Dry Deposition)
Precipitation Rate (mm/hr) (Wet Deposition Only)	F7.2	96-102 (80-86 without Gas Dry Deposition)

Season by Hour-of-Day Output Option (SEASONHR)

When the non-default TOXICS option is specified, the user may request an output file containing the average results (CONC, DEPOS, DDEP and/or WDEP) by season and hour-of-day. To select this option, the user must include the SEASONHR keyword on the OU pathway. The syntax, type, and order for the SEASONHR keyword are summarized below:

Syntax:	`OU SEASONHR  GroupID  FileName  (FileUnit)`
Type:	`Optional, Repeatable`

where the GroupID parameter specifies the source group to be output, FileName specifies the name of the output file, and the optional FileUnit parameter specifies an optional file unit and must be greater than 20. If FileUnit is left blank, then the model will dynamically assign a file unit based on the formula 302+IGRP*10, where IGRP is the group index number. A sample from a SEASONHR output file is shown below:

```
* ISCST3 (99155):  Example of SEASONHR Output File Option
* MODELING OPTIONS USED:
*  CONC                 WDEP   RURAL  FLAT          TOXICS                                          WETDPL
*         FILE OF SEASON/HOUR VALUES FOR SOURCE GROUP: ALL
*         FOR A TOTAL OF   216 RECEPTORS.
*         FORMAT: (4(1X,F13.5),1X,F8.2,2X,A8,2X,I4,2X,I4,2X,I4,2X,A8)
*        X             Y      AVERAGE CONC      WET DEPO   ZELEV     GRP     NHRS  SEAS  HOUR  NET ID
*  ___________   ___________   ___________   ___________   ______  ________  ____  ____  ____  ________
      8.68241      49.24039       0.00000       0.00603     0.00  ALL         87     1     1  POL1
     17.36482      98.48077       0.00000       0.00177     0.00  ALL         87     1     1  POL1
     86.82409     492.40387       0.18098       0.00008     0.00  ALL         87     1     1  POL1
    173.64818     984.80774       2.52520       0.00001     0.00  ALL         87     1     1  POL1
    868.24091    4924.03857       2.07470       0.00000     0.00  ALL         87     1     1  POL1
   1736.48181    9848.07715       0.93252       0.00000     0.00  ALL         87     1     1  POL1
     17.10101      46.98463       0.00000       0.00002     0.00  ALL         87     1     1  POL1
     34.20201      93.96926       0.00000       0.00000     0.00  ALL         87     1     1  POL1
    171.01007     469.84631       0.15772       0.00000     0.00  ALL         87     1     1  POL1
    342.02014     939.69263       2.48554       0.00000     0.00  ALL         87     1     1  POL1
   1710.10071    4698.46289       6.09119       0.00000     0.00  ALL         87     1     1  POL1
   3420.20142    9396.92578       4.49830       0.00000     0.00  ALL         87     1     1  POL1
     25.00000      43.30127       0.00000       0.00017     0.00  ALL         87     1     1  POL1
     50.00000      86.60254       0.00000       0.00001     0.00  ALL         87     1     1  POL1
    250.00000     433.01270       0.10114       0.00000     0.00  ALL         87     1     1  POL1
    500.00000     866.02539       2.12970       0.00000     0.00  ALL         87     1     1  POL1
   2500.00000    4330.12695       2.79993       0.00000     0.00  ALL         87     1     1  POL1
   5000.00000    8660.25391       1.97200       0.00000     0.00  ALL         87     1     1  POL1
```

The NHRS column in the output file contains the number of non-calm and non-missing hours used to calculate the season-by-hour-of-day averages. The SEAS column is the season index, and is 1 for winter, 2 for spring, 3 for summer and 4 for fall. The records loop through hour-of-day first, and then through the seasons.

ENHANCEMENTS INTRODUCED WITH ISCST3 (DATED 00101)

Removal of UNFORM Option for Meteorological Data

The unformatted meteorological data option (ME INPUTFIL UNFORM) is no longer supported by the ISCST3 model. Unnecessary code has been removed, and proper error handling has been implemented. Users with unformatted meteorological data should first convert the data to an ASCII format using the BINTOASC utility program available on the SCRAM website. The unformatted data file option has been removed for several reasons, including the fact that unformatted files are not portable across different computer systems and compilers, and that unformatted files cannot be used with the deposition algorithms in ISCST3.

Season by Hour-of-Day and Day-of-Week Emission Factors

The variable emission rate factor option controlled by the EMISFACT keyword on the SO pathway has been modified to include an option to specify variable emission rate factors that vary by season, hour-of-day, and day-of-week. The day-of-week variability allows for different emission factors to be specified for Weekdays (Monday-Friday), Saturdays, and Sundays.

The syntax, type and order of the EMISFACT keyword are summarized below:

Syntax:	`SO EMISFACT  Srcid (or Srcrng)  Qflag  Qfact(i),i=1,n`
Type:	`Optional, Repeatable`
Order:	`Must follow the LOCATION card for each source input`

where the Srcid parameter is the same source ID that was entered on the LOCATION card for a particular source. The user also has the option of using the Srcrng parameter for specifying a range of sources for which the emission rate factors apply, instead of identifying a single source. This is accomplished by two source ID character strings separated by a dash, e.g., STACK1-STACK10.

The parameter Qflag is the variable emission rate flag, and is one of the following secondary keywords:

SEASON emission rates vary seasonally (n=4),

MONTH emission rates vary monthly (n=12),

HROFDY emission rates vary by hour-of-day (n=24),

STAR emission rates vary by speed and stability category (n=36),

SEASHR emission rates vary by season and hour-of-day (n=96), and

SHRDOW emission rates vary by season, hour-of-day, and day-of-week [M-F, Sat., Sun.] (n=288)

The Qfact array is the array of factors, where the number of factors is shown above for each Qflag option. The EMISFACT card may be repeated as many times as necessary to input all of the factors, and repeat values may be used for the numerical inputs. An example of each of these options is presented below, with column headers to indicate the order in which values are to be input.

```
**                            WINTER  SPRING  SUMMER  FALL
SO EMISFACT STACK1 SEASON     0.50    0.50    1.00    0.75

**                            JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
SO EMISFACT STACK1 MONTH      0.1 0.2 0.3 0.4 0.5 0.5 0.5 0.6 0.7 1.0 1.0 1.0

**                             1   2   3   4   5   6   7   8   9  10  11  12
SO EMISFACT STACK1 HROFDY     0.0 0.0 0.0 0.0 0.0 0.5 1.0 1.0 1.0 1.0 1.0 1.0

**                            13  14  15  16  17  18  19  20  21  22  23  24
SO EMISFACT STACK1 HROFDY     1.0 1.0 1.0 1.0 1.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0


** or, equivalently:          1-5    6    7-17   18   19-24
SO EMISFACT STACK1 HROFDY     5*0.0  0.5  11*1.0  0.5  6*0.0

**              Stab. Cat.:   A      B      C      D      E      F  (6 WS Cat.)
SO EMISFACT STACK1 STAR       6*0.5  6*0.6  6*0.7  6*0.8  6*0.9  6*1.0

SO EMISFACT STACK1 SEASHR     enter 24 hourly scalars for each of the four
                              seasons (winter, spring, summer, fall), e.g.,

**                              Winter    Spring    Summer     Fall
SO EMISFACT STACK1 SEASHR       24*0.50   24*0.50   24*1.00   24*0.75

SO EMISFACT STACK1 SHRDOW     enter 24 hourly scalars for each of the four
                              seasons (winter, spring, summer, fall), first
                              for Weekdays (Monday-Friday), then for Saturdays,
                              and finally for Sundays, e.g.,

** Weekdays:                   Winter    Spring    Summer     Fall
SO EMISFACT STACK1 SHRDOW       24.1.0    24*0.8    24*0.6    24*0.8
** Saturdays:
SO EMISFACT STACK1 SHRDOW       24*0.5    24*0.4    24*0.3    24*0.4
** Sundays:
SO EMISFACT STACK1 SHRDOW       24*0.25   24*0.2    24*0.15   24*0.2
```

ENHANCEMENTS INTRODUCED WITH ISCST3 (DATED 02035)

HE>ZI Option for Receptors Below Stack Base

A non-default option called HE>ZI has been added to the CO MODELOPT keyword to address a potential problem that may occur for cases when the receptor elevation is below the stack base elevation. In these cases the mixing height (ZI), which is terrain-following, may drop below the plume centerline height (HE), which is horizontal, resulting in anomalously large concentrations due to the actual plume approaching the centerline of one of the image plumes in the Vertical Term. When the HE>ZI option is specified on the CO MODELOPT card, the model limits the plume centerline height (HE) to be less than or equal to the mixing height (ZI) when calculating the Vertical Term. The model

also generates informational messages that identify when this adjustment has been made. Since HE>ZI is a non-default option, it will be overridden if the DFAULT option is specified.

References

Environmental Protection Agency, 1993: Air/Superfund National Technical Guidance Study Series, Models for Estimating Air Emission Rates from Superfund Remedial Actions. EPA-451/R-93-001, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina 27711.