Models and Results Database (MAR–D), Version 4.0

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ABSTRACT

The Nuclear Regulatory Commission's Office of Nuclear Regulatory Research (NRC-RES) is presently funding the development of the Models and Results Database (MAR-D) at the Idaho National Engineering Laboratory. MAR-D's primary function is to create a data repository for NUREG-1150 and other permanent data by providing input, conversion, and output capabilities for data used by IRRAS, SARA, SETS, and FRANTIC personal computer (PC) codes.

As probabilistic risk assessments and individual plant examinations are submitted to the NRC for review, MAR-D can be used to convert the models and results from the study for use with IRRAS and SARA. Then, these data can be easily accessed by future studies and will be in a form that will enhance the analysis process.

This reference manual provides an overview of the functions available within MAR-D and step-by-step operating instructions.

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EXECUTIVE SUMMARY

For several years, the U. S. Nuclear Regulatory Commission (NRC) has been using the Integrated Reliability and Risk Analysis System (IRRAS) and the System Analysis and Risk Assessment (SARA) tools to analyze and evaluate generic issues, multiplant actions, and other probabilistic risk assessment (PRA) related problems. These personal computer (PC)-based software tools have proven quite valuable, being both readily accessible and cost effective.

During the development of these tools, the large PRAs sponsored by the NRC were using mainframe computer tools such as the Set Equation Transformation System (SETS) and the Top Event Matrices Analysis Code (TEMAC). While these codes are powerful, they are also expensive to use for multiple sensitivity studies and follow-on analyses, and they are not as readily available to the many users who would like to employ PRA information and techniques in their projects. Therefore, to better utilize current PRA material and exploit the advantages of the PC tools, the NRC initiated a project to develop the Models and Results Database (MAR-D) to manage the transfer and storage of PRA data from the mainframe and PC codes. Having logic models, failure rate data, minimal cut sets and other PRA-related data available in a convenient form allows various analysts to perform studies on the same plants starting with the same baseline PRA information.

MAR-D's primary function is to create a data repository for NUREG-1150 and other permanent data by providing input, conversion, and output capabilities for data used by IRRAS, SARA, SETS, and FRANTIC software. Some of the elements of MAR-D are in SARA and IRRAS and the prime purpose of the MAR-D code is for loading PRAs into a database for use by SARA and IRRAS.

MAR-D provides facilities to load, store, and extract all of the information associated with an IRRAS PRA. This information includes the following: event trees (logic and graphics), sequences (logic and cut sets), fault trees (graphics, logic, and cut sets) and basic event failure rates and descriptions, plant damage states, basic event attributes, failure modes, system descriptions, component descriptions, location descriptions, class attributes, and family information.

As PRAs and individual plant examinations (IPEs) are submitted to the NRC for review, MAR-D can be used to convert the models and results from the study for use with IRRAS and SARA. Then, these data can be easily accessed by future studies and will be in a form that will enhance the analysis process.

This reference manual provides an overview of the functions available within MAR-D and step-by-step instructions for operating the system.

FOREWORD

The U. S. Nuclear Regulatory Commission has developed a powerful suite of computer programs for the performance of probabilistic risk assessments (PRAs). This suite of programs allows an analyst to perform many of the functions necessary to create, quantify, and evaluate the risk associated with a facility or process being analyzed. These programs include software to define the database structure, to create, analyze, and quantify the data, and to display results and perform sensitivity analyses. The programs included in this suite are as follows: Models And Results Database (MAR-D) software, Integrated Reliability and Risk Analysis System (IRRAS) software, System Analysis and Risk Assessment (SARA) software, and Fault tree, Event tree, and P&ID (FEP) graphical editor software. Each of these programs performs a specific function in taking a PRA from the conceptual state all the way to publication.

MAR-D is a program that is used primarily for PRA data loading. This program defines a common relational database structure that is used by the entire suite of programs. This structure allows all of the software to access and manipulate data created by other software in the system without performing a lengthy conversion. Hence, data created by IRRAS is immediately available to SARA for sensitivity analysis. MAR-D also provides the facilities for loading and unloading of PRA data from the relational database structure used to store the data. A simple ASCII data format is used for interchange with other PRA software not included in NRC's suite of programs. This feature allows for compatibility with previously developed software systems and allows for maximum data interchange. Elements of this software are included with both IRRAS and SARA to allow these programs to load and unload data in MAR-D format. Normally, the entire MAR-D software is used only by those performing a data loading function and is not required by the end user. Documentation for MAR-D, Version 4.0 is available as NUREG/CR-5301.

IRRAS is a program developed for the purpose of performing those functions necessary to create and analyze a complete PRA. This program includes functions to allow the user to create event trees and fault trees, to define accident sequences and basic event failure data, to solve system and accident sequence fault trees, to quantify cut sets, and to perform uncertainty analysis on the results. Also included in this program are features to allow the analyst to generate reports and displays that can be used to document the results of an analysis. Since this software is a very detailed technical tool, the user of this program should be familiar with PRA concepts and the methods used to perform these analyses. Although IRRAS has been designed to be user friendly and makes the process of performing a PRA easier, the complexity of this type of analysis requires a user with a more detailed understanding of PRA concepts than is required by other tools in this suite. The IRRAS 4.0 reference manual is available as NUREG/CR-5813, Volume 1. The IRRAS 4.0 tutorial, Volume 2, is in preparation.

SARA is a program that allows the user to review the results of a PRA and to perform limited sensitivity analysis on these results. It is limited primarily to the extent that changes in the plant model can be accommodated by using the cut set editor. If other than simple changes are being simulated, then IRRAS should be used so that new cut sets can be accurately generated. This tool is intended to be used by a less technically-oriented user and does not require the level of understanding of PRA concepts required by IRRAS. With this program a user can review the information generated by a PRA analyst and compare the results to those generated by making limited modifications to the data in the PRA. Also included in this program is the ability to graphical display the information stored in the MAR-D database. This information includes event trees, fault trees, P&IDs and uncertainty distributions. The user of this program can gain a better understanding of the results of a PRA without getting into the details of the construction and analysis work behind the PRA. The SARA reference manual and tutorial are available as NUREG/CR-5303, Volumes 1 and 2, respectively.

FEP is a program developed to provide a common access to the suite of graphical tools developed for performing risk assessment. These tools include the graphical event tree, fault tree, and P&ID editors. The event tree and fault tree editors are available through IRRAS; however, the P&ID editor is only accessible through FEP. The event tree editor allows the analyst to construct and modify graphical event trees. The fault tree editor allows the user to construct and modify graphical fault trees. The P&ID editor allows the user to construct and modify plant drawings. These drawings can then be used to document the modeling used in a PRA. These editors are an integral part of a PRA. With the FEP tool, the user need not be concerned with the complexity of the IRRAS program if the need is only to generate one of these graphical displays. Documentation for FEP, Version 4.0 is available as NUREG/CR-5866.

ACKNOWLEDGMENTS

Models and Results
Database (MAR-D)
Version 4.0: Reference Manual

1. INTRODUCTION

The Models and Results Database (MAR-D) was developed by the Idaho National Engineering Laboratory (INEL) under contract to the U. S. Nuclear Regulatory Commission (USNRC). It is a user-friendly database system designed to serve as a data repository for probabilistic risk assessment (PRA) data and to provide load and output routines to format data for PRA tools. [Currently these include the Integrated Reliability and Risk Analysis System (IRRAS), the System Analysis and Risk Assessment (SARA) system, and the Set Equation Transformation System (SETS).] This reference manual documents the functions and operation of the software.

As the user, it is your responsibility to ensure the integrity of the database. To this end, you are able to

- Load data files containing family, basic event, system, event tree, end state, and sequence data;

- Manually modify the descriptive information of the loaded files;

- Produce a listing of data in the database;

- Output data from the database to a file in the format of one of the PRA data tools (IRRAS, SARA, SETS, and FRANTIC*).

1.1 Database Concepts

The MAR-D is divided into families. A family is any logical grouping of fault trees, event trees, and sequences and their associated basic events, cut sets, reliability data, and descriptions. Typically,

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a. FRANTIC ABC is a PC interactive, user-friendly, and much-enhanced version of the mainframe FRANTIC III version. It evaluates the time-dependent and average unavailability for any general system. Nonrepairable, monitored, and periodically tested components can be treated in the model calculations. A unique feature of FRANTIC is the very detailed time-dependent modeling or periodic and aperiodic testing. This includes the effects of test downtimes, test overrides, detection inefficiencies, test-caused failures, and component wearout. FRANTIC also includes an extensive sensitivity analysis capability for addressing the effects of testing and maintenance procedures. The program provides full-screen editing of all input data and displays the results as tables and graphs. Data may be entered manually or loaded from previously saved PC files. The cut sets can be imported directly from an IRRAS file or from the MAR-D database. A complete user's manual is available, but documentation is also available directly from on-line help screens.

for nuclear power plant analysis, the family is a given plant or unit. The term "family" is used rather than "plant" to allow the grouping of data for a single study on a plant and, as with IRRAS, to increase the community of users for the database system. Data for each family are put into separate DOS subdirectories.

1.1.1 Data Organization

Figure 1 shows the structure of the hierarchical, relational database used to store each family's data. The nodes of the tree represent the following relations:

1. Basic events for all cut sets in the family,

2. Event attribute descriptive information,

3. Systems (Fault trees),

4. Event trees,

5. End states (Plant Damage States).

6. Sequences,

7. Graphical information,

8. Gates,

9. Histograms, and

10. Changes to event data.
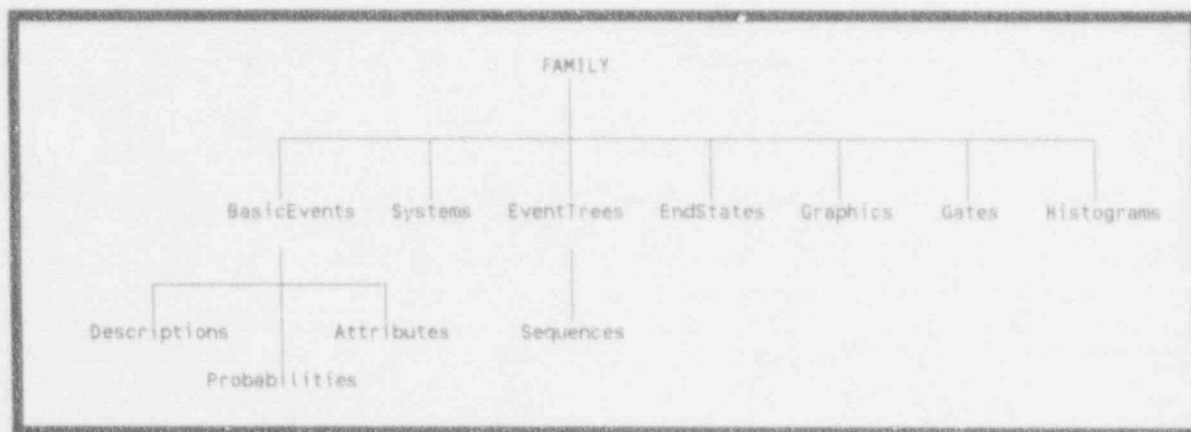
Figure 1. Hierarchical database structure.

In general, each relation contains name, description, identification number, and textual information fields, and then any fields specific to that relation. To store the relation data, four files may exist:

- schema.DFL,

- relationName.DAT,

- relationName.IDX, and

- relationName.BLK.

These files are created automatically both in the data loading process and during program execution. The schema.DFL file contains the information necessary to allow the software to read the data files. It is a "road map" of the data and should always accompany the data when transferred. The *.DAT file must exist; it contains the actual data and information about the key of the relation. The *.IDX file contains indices to the data of keyed fields. Finally, the *.BLK file contains variable length data (such as cut sets, logic, and graphics) referenced by pointers in the *.DAT file.

Data across families are independent (i.e., class attributes, failure modes, component types, and system types are re-identified for each family rather than using a single list by which all families must abide). Access to any portion of the database is obtained by selecting the appropriate family (Section 3.2).

1.1.2 Data Files

Files containing information to be loaded into the database must be standard ASCII files with formats and extensions as specified in Appendix A. The files are first copied (Section 3.4) into a family and the family is selected (Section 3.2). Files can then be loaded and the data manipulated using the options described in Section 4.

1.2 Capabilities

The MAR-D has been structured so that each operation is contained in an individual program module. Each module is activated by selecting an option on the main menu (Figure 2). The main modules are:

SELECT Family (Section 3)--copy files and isolate a family for further operations;

LOAD Data Files (Section 4)--store files in the database;

EXTRACT Data Files (Section 5)--extract data from the database and convert to the desired format;

MODIFY Database (Section 6)--create families and make changes to loaded information;

REPORTS (Section 7)--report on the contents of the current family; and

UTILITY (Section 8)--change system constants and reformat (rebuild) relations.
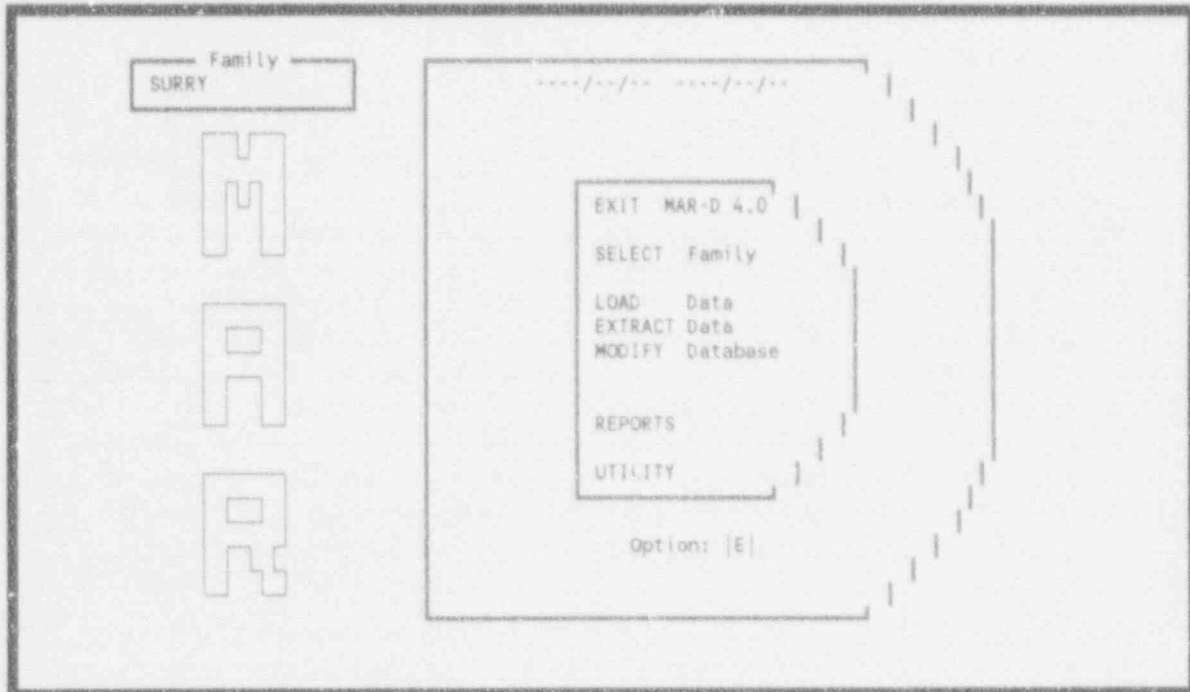
Figure 2. MAR-D main menu.

2. GETTING STARTED

2.1 Installation

The MAR-D software will run on an IBM-PC, -XT, -AT, or PS-2 compatible personal computer with Disk Operating System (DOS) Version 3.3 or later. The computer must have at least 640K of memory, and a large capacity disk drive. The software must be placed on a large capacity disk drive to have room for the data files, although only one family may be used at a time. A color monitor greatly aids in the presentation of the menus; thus, an EGA or VGA is needed. Finally, there must be a CONFIG.SYS file in the root directory that contains the following:

        FILES = 30
        BUFFERS = 15
        DEVICE = ANSI.SYS

The device driver ANSI.SYS must also be copied from the DOS directory to the root directory if it is not already there.

The MAR-D software requires the following files, which are included on the distribution disks:

        ADDFILE.BAT   -   Concatenates broken up distribution files;
        INSTALL.BAT   -   Installs MAR-D program from floppy;
        INSTALLM.EXE   -   Creates directory for MAR-D program;
        MAR-D.001   -   Archived MAR-D program.

The batch file INSTALL.BAT is used to load MAR-D software and data from the distribution floppy disk onto your hard drive. The loading process creates three new directories, if they do not already exist. These directories are \PRADATA.B1, \PRATOOLS.B1, and \HALO88. The PRATOOLS.B1 directory contains the program, the PRADATA.B1\DEMO directory contains sample data, and the HALO88 directory contains the graphics package.

Insert the MAR-D distribution disk into the floppy disk drive. At the prompt, type the underlined information:

                        c:\ > m:INSTALL d: < Enter >

where m: is a floppy disk drive containing the first MAR-D distribution disk and d: is a fixed disk drive where the software is to be installed. Insert any subsequent floppy disks as directed.

To start MAR-D, simply change directories to PRADATA.B1 (CD\PRADATA.B1), type MARD, and press < Enter >. Read the disclaimer (Figure 3) and modify the constants screens (Figure 4-Figure 6) as required (see Section 8.2 for information on the constants screens). The main menu (Figure 2) should appear. Then, you must add a family using the MODIFY Database Family Add option (Section 6.2.2). When complete, exit back to the main menu. Next, copy the files to be loaded into the database (into that family) using the Copy option (Section 3.4), and SELECT the family just added using the Select option (Section 3.2). Selecting a family automatically returns you to the main menu. Load the copied files into the database using the LOAD Data option (Section 4).
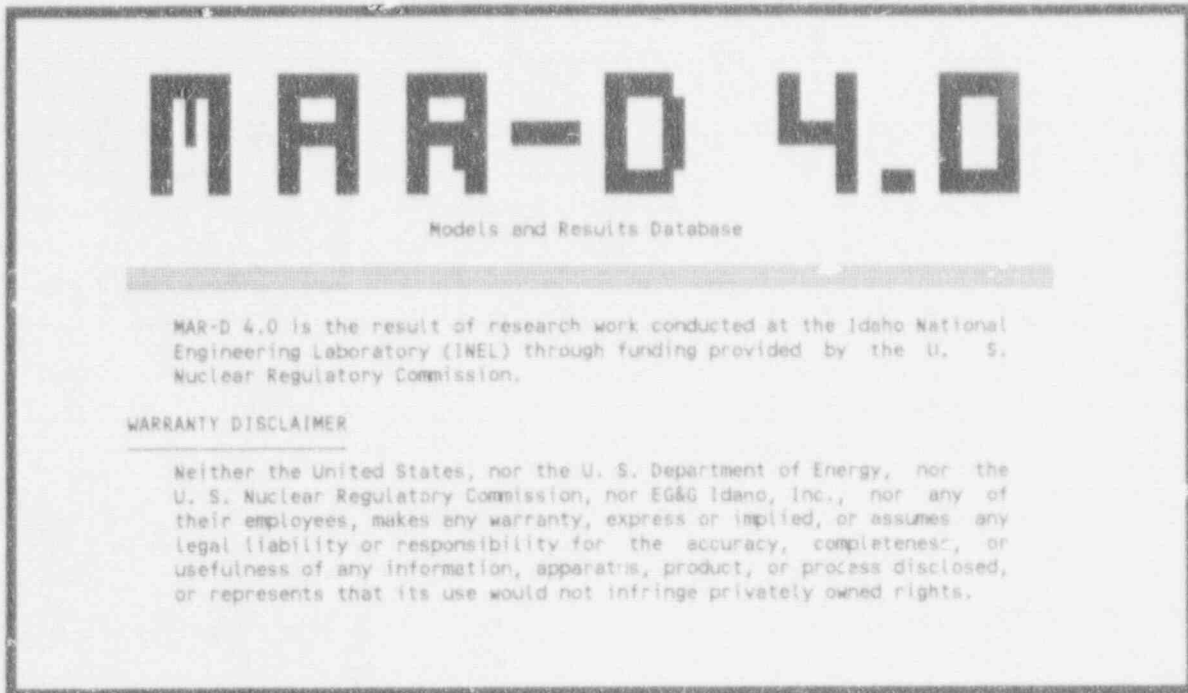
Figure 3. MAR-D copyright form.
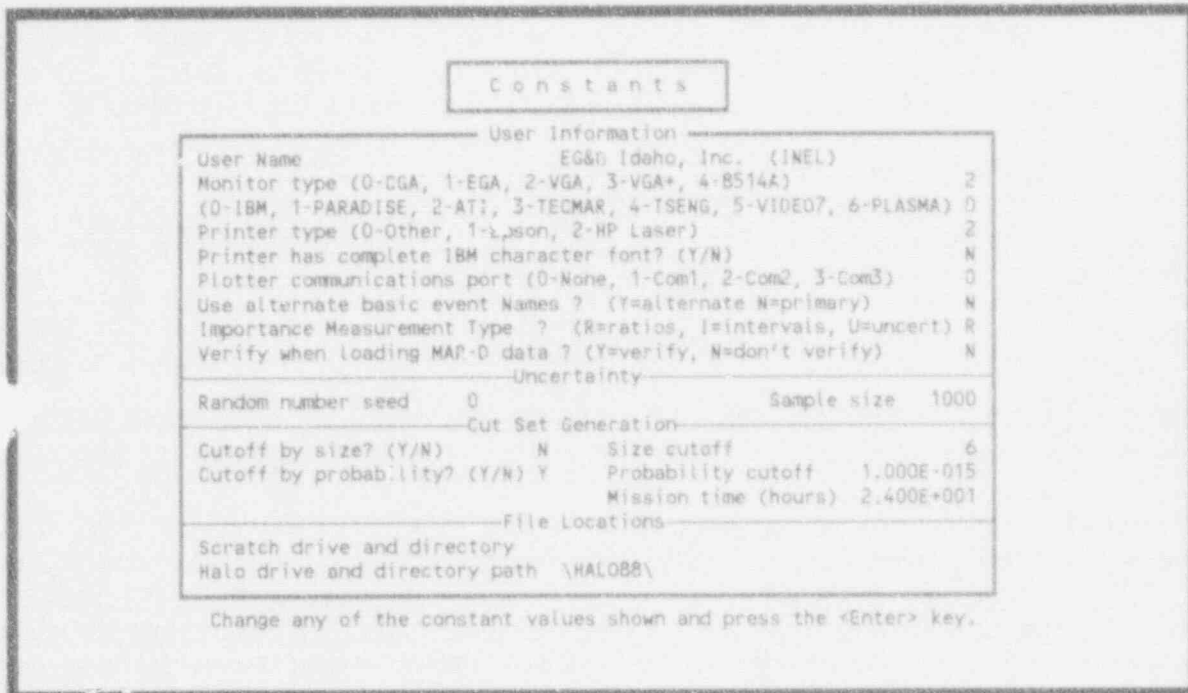
Figure 4. Set constants--screen 1.
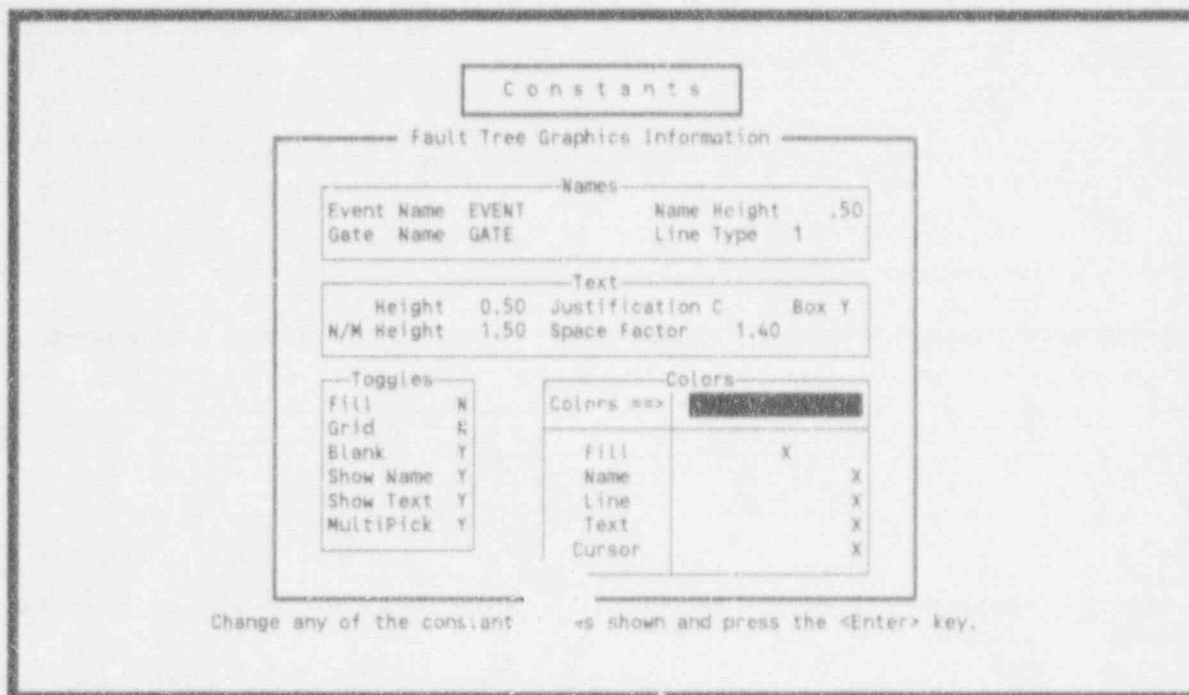
Figure 5. Set constants--screen 2.
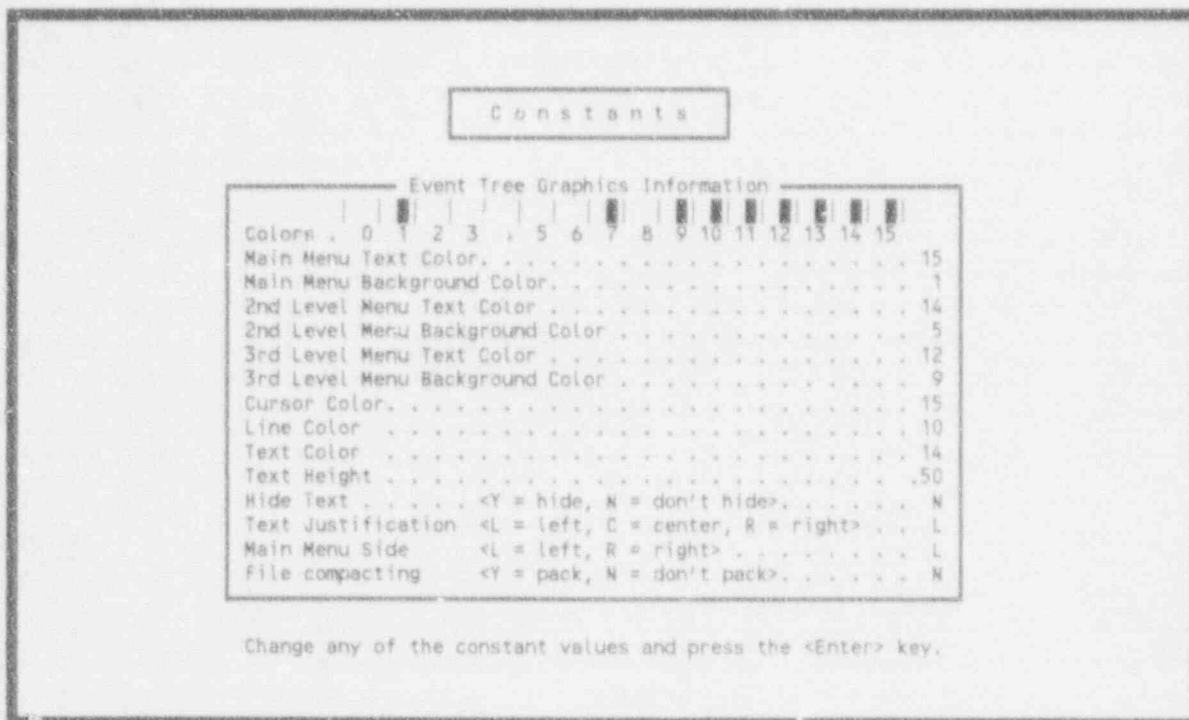
Figure 6. Set constants--screen 3.

The copied files now reside in the database. The data can be modified, deleted, output in another file format, or output in report or summary form.

2.2 Menu Operation

Figure 7 shows the Key Functions help screen, accessed by pressing < Alt/H >. This screen identifies the functions of some special keys used in MAR-D.

```
                          Key Function Help
              exit·········Enter        restore field--Ctl/R
              home········Home          clear form·····Ctl/Home
              get help····F1            clear field····Ctl/End
              end help····F10           copy screen····Ctl/K
              autohelp····Alt/A         B&W / color····Ctl/B
              ins mode····Ins           delete·········Del
```
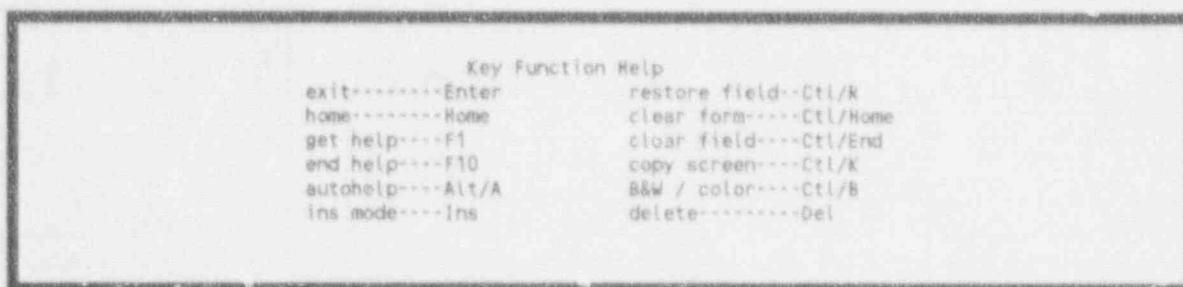
Figure 7. Key functions help screen.

The carriage return < CR > or < Enter > key sends a completed screen to the program for execution. The arrow keys and < Tab > key move the cursor around the fields on a screen. The < Home > key moves the cursor to the home field on the screen. The < Ins > key inserts characters in the text in a field. The < F10 > key terminates a help screen. < Ctrl > R restores a field to its original setting. < Ctrl > < Home > clears all entries in all fields on the screen. < Ctrl > < End > clears the selected field. < Ctrl > B switches the display between black and white and color. < Ctrl > K copies the screen into a file on the disk named SCREEN.CPY. Multiple uses of < Ctrl > K will append each screen to the bottom of the SCREEN.CPY file.

On menus with vertical lists of options, use the up and down arrow keys to position the highlighted area, or type the green letter(s), and press < Enter >. On menus with horizontal lists of options, type the green letter of the option in the option field, fill in the remainder of the screen, and press < Enter >. On screens where fields (other than the option box) are display-only (i.e., you cannot change the information), the right arrow will work as an < Enter > and the left arrow will work as an < Esc >.

2.3 Invoking MAR-D

To begin using the MAR-D type

c:\PRADATA.B1 > mard < Enter >

A copyright form will appear (Figure 8) and pause for a couple of seconds. If the MAR-D is being run for the first time, a series of three forms (Figures 4-6) is displayed allowing you to set various constants, select colors, identify your hardware, etc. These constants can be changed whenever desired using the Utility Constants option (Section 8.2).
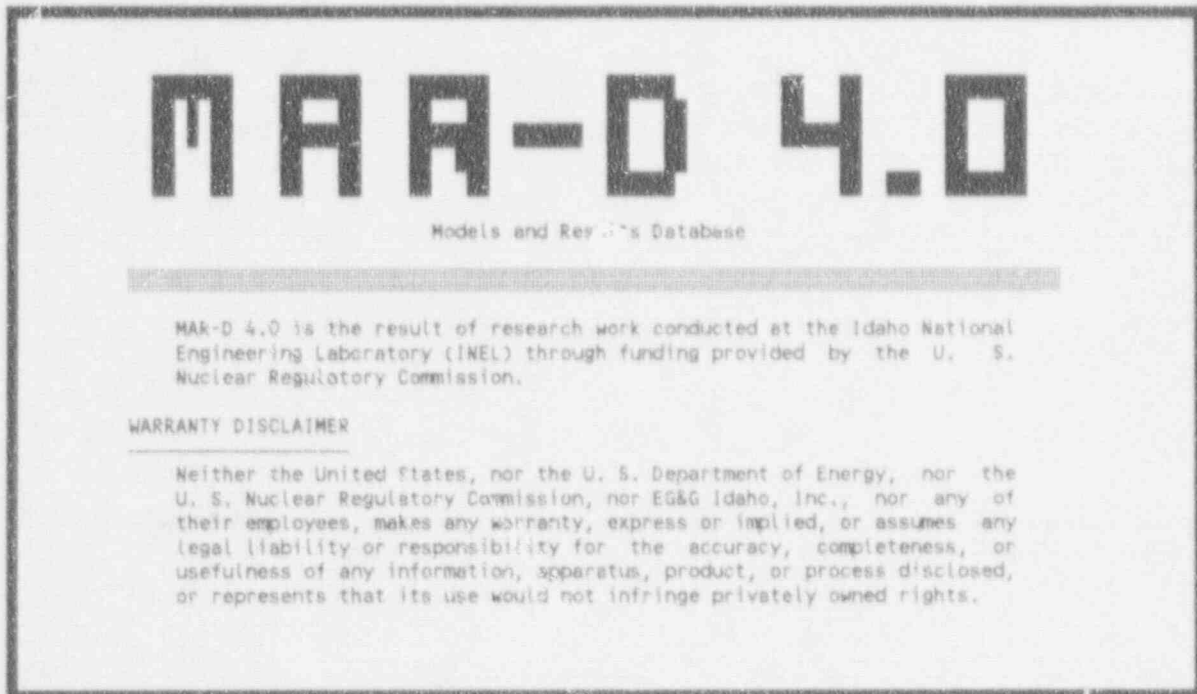
Figure 8. MAR-D copyright form.

After the copyright screen and/or constants screens are displayed, the MAR-D Main Menu (Figure 9) appears. The name of the last selected family will appear as the current family name in the box at the top left corner.

Each option listed on the MAR-D main menu is discussed in the following sections.
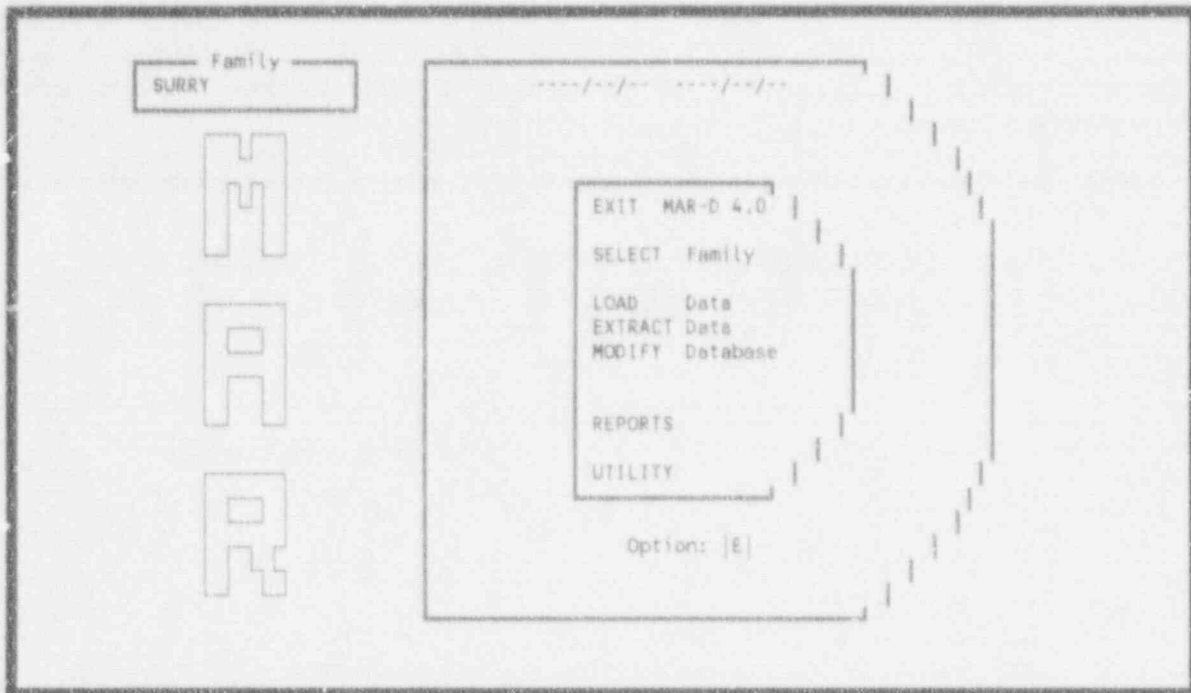
Figure 9. MAR-D main menu.

3. SELECT FAMILY

This option allows you to select the family data set you wish to work with and provides the capability of copying raw (MAR-D) data files or database files into a specific family. A family is a group of models, such as those for a single plant, unit, or facility. When the family is successfully selected, the name is shown in the upper left corner of the screen.

The current directory is the current family unless you select another family. MAR-D retains the last family you selected when you exited the program so when you enter MAR-D again the last family selected is the current family. The Select Family screen (Figure 10) lists all families in MAR-D. The select family function provides four options: Exit, Select, Family Copy, and Copy. In addition, three function keys are available:

<Esc>	Exits the Select Family module and returns you to the MAR-D main menu.
<F1>	Displays on-line help messages.
<F5>	Allows you to locate a specified family. When you press <F5> a blank line will appear on the screen. Enter all or part of the family name you wish to locate and press <Enter>. This feature will place the highlight on the located name. If the requested name is not found, then the next name in alphabetical order will be highlighted. This feature is especially useful when there are several screens of families to display.


```
    ┌─── Family ───┐        ┌──────────────────────────┐
    │ SURRY        │        │  S e l e c t   F a m i l y │
    └──────────────┘        └──────────────────────────┘

              Option [S]  Exit / Select / Family Copy / Copy

    ┌─ Family Name ── Directory ──────────────── Description ─────────┐
    │ PRADATA        PRADATA                                          │
    │ SURRY          SURRY          SURRY UNIT 1                      │
    │                                                                │
    │                                                                │
    │                                                                │
    │                                                                │
    └────────────────────────────────────────────────────────────────┘

              <Esc>           <F1>            <F5>
              Exit            Help            Locate
```
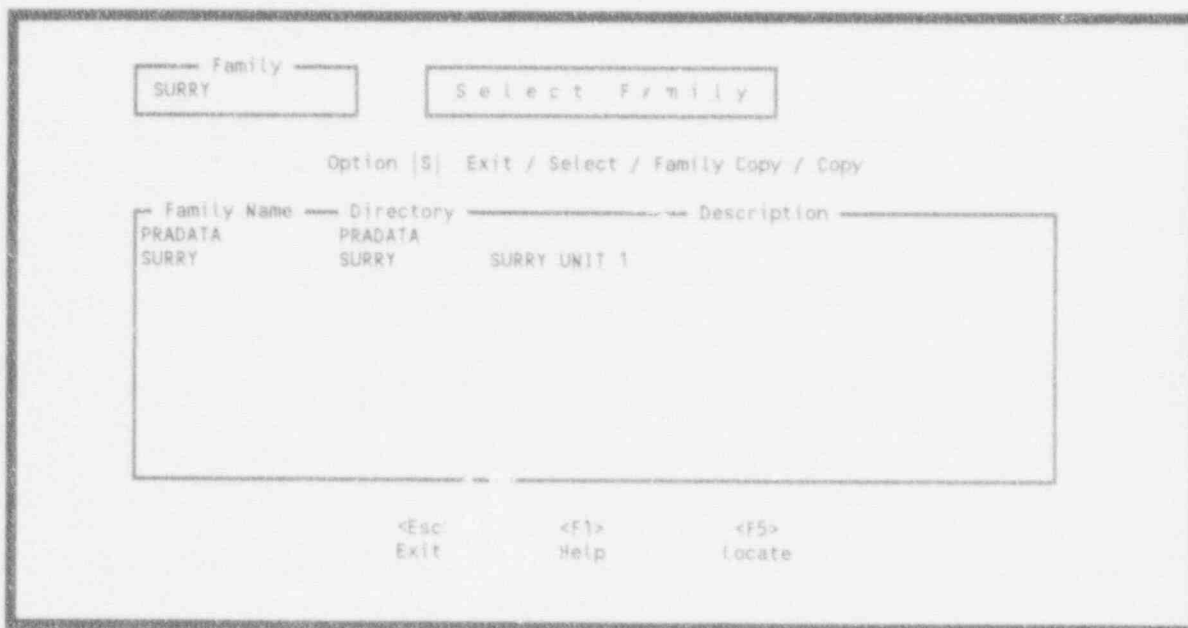
Figure 10. Select family menu.

3.1 Exit

Typing <E> in the option field and pressing <Enter>, or pressing <Esc> will return you to the MAR-D main menu.

3.2 Select

This option is used to select the family data files that will be accessed during subsequent MAR-D functions. To invoke the option, type <S> in the option field, highlight a family, and press <Enter>. If a family is not highlighted, the message **Position the cursor over the family to select** will be displayed. When a family is highlighted and selected, you will be returned to the MAR-D main menu where the selected family name will appear at the top of the menu. For later functions, the selected family name will appear in the box in the upper left corner of the screen. If for any reason the family cannot be selected, the message **Unable to select desired family** appears, the previously selected family will be retained, and you will be given another chance to select a family. If the highlighted family's data version does not match the current software version, the version update screen appears (Figure 11), and you will be asked if you want to rebuild the data. To select the family, the data must be rebuilt, so enter a <Y> to rebuild, and then select the desired family. If you type <N>, that family's data will not be rebuilt, that family will not be selected, the former selected family will be retained, and the message **Unable to select desired family** appears.


```
┌─────────────────────────────────────────────────────────────┐
│                  ┌─────────────────────────┐                 │
│                  │   V e r s i o n   C o n f l i c t   │     │
│                  └─────────────────────────┘                 │
│                                                               │
│         ┌──────────── W A R N I N G ────────────┐            │
│         │ Some of the data base files were created with a     │
│         │ different version of the software. All conflicting  │
│         │ files will be rebuilt and reorganized to            │
│         │ match the current version. Data for this family     │
│         │ cannot be accessed or modified until the files are  │
│         │ rebuilt.                                            │
│         │        Do you wish to continue? [N] (Y,N)           │
│         └─────────────────────────────────────┘              │
└─────────────────────────────────────────────────────────────┘
```
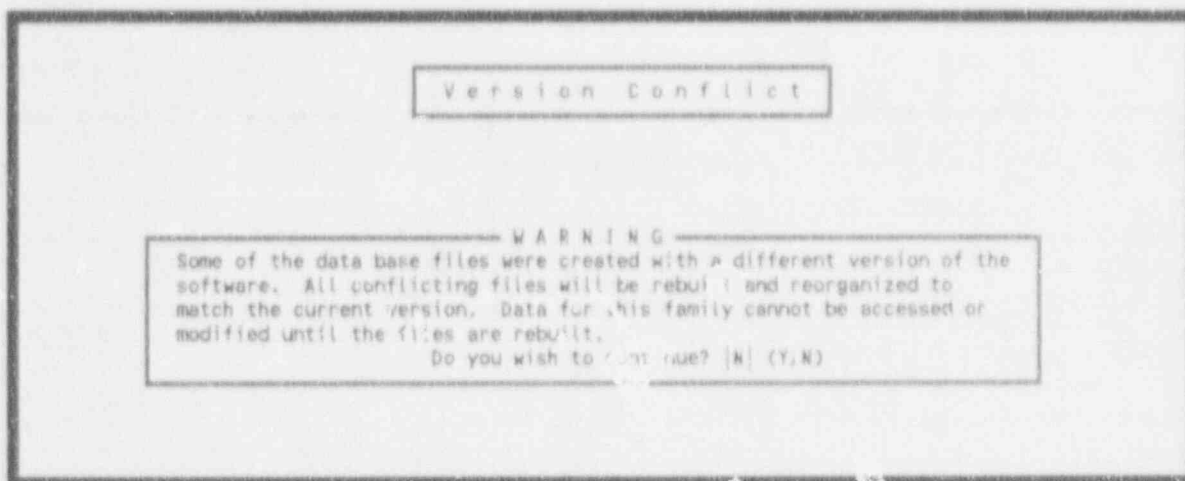
Figure 11. Version conflict warning message.

3.3 Family Copy

This option provides the means of copying database files between families. If a family contains data that the user needs, this option allows them to copy all the data into a new family. Then the user can modify any of the data in the new family while keeping the original family data preserved. The family you are copying to should be empty. This option will overwrite all existing files. To invoke this

option, type <F> in the option field, highlight a family, and press <Enter>. If no family has been highlighted, the message **Position the cursor over the family to copy from** appears at the bottom of the screen. If this message appears, highlight a family and press <Enter>. The message **Position the cursor over the family to copy to** will then appear. Again, highlight a family and press <Enter>. All family database files will be copied from the first family highlighted to the second family highlighted. When the files are copied, the message **Family successfully copied** appears.

3.4 Copy

This option provides the means of copying any file (raw data and/or a MAR-D file) into any family. If the user has a need for data that was generated using another application, this option provides the mechanism to copy such data into a family. To invoke this option, type <C> in the option field, highlight the family to copy to, and press <Enter>. If no family is highlighted, the message **Position the cursor over the family to copy to** is displayed at the bottom of the screen. If this message appears, highlight a family and press <Enter>. A new screen, File Copy (shown in Figure 12), requesting the path and file name of the source data being copied into the selected family is displayed. Specify the entire path of the data to be copied and press <Enter> (e.g., A:*.* or D:\RAWDATA\DEMO*.*). A confirmation message **File(s) successfully copied** is displayed when the files have been copied.

Entering an invalid path, a nonexistent file name, or pressing <Enter> without specifying a path results in the data not being located, and displays an error message **Unable to locate requested file(s)**. To return to the Select Family screen without copying a file, press <Esc>. The message **Copy attempt terminated at users's request** appears and the Select Family screen is redisplayed.

If you want to copy to a family that does not yet exist, you must first add the family. To add a family, see the Modify Database option. After you have added the family, you may return to the Select Family option and copy your database into the new family.

```
┌─────────────────────────────────────────────────────────┐
│              ┌─────────────────────────┐                 │
│              │      F i l e   C o p y   │                 │
│              └─────────────────────────┘                 │
│                                                          │
│              Enter Source for File Copy                  │
│        ─────────────────────    ──────────────────       │
│       ┌──────────────────────────────────────────┐       │
│       │  Enter complete source path, including file specification. │
│       │                                           │       │
│       │         Source file specification.        │       │
│       │                                           │       │
│       │                                           │       │
│       │            Destination Directory.         │       │
│       │  C:\PRADATA.B1\CURRY                       │       │
│       │                                           │       │
│       └──────────────────────────────────────────┘       │
│                                                          │
└─────────────────────────────────────────────────────────┘
```

Figure 12. Enter source for file copy.

4. LOAD DATA

Before loading any data, a family must be created through the MODIFY Database Family option (Section 6.2.2). Copy (Section 3.4) the files you wish to load into that family. Select (Section 3.2) that family and verify that the family name displayed in the top left corner of each menu is where the data should be loaded. If it is not correct, use the SELECT Family option again to choose the desired family.

Upon entering the LOAD module, Figure 13 will be displayed. As you cursor down through the data tools, autohelp menus will appear to the right listing the types of data that can be loaded (Figure 14). The right arrow or < Enter > will take you to this second menu (Figure 15). Again, as you cursor down through the data types, menus will appear listing the specifics of what can be loaded (Figure 16). After choosing the data to load (Figure 17), the form in Figure 18 will appear listing the files that contain that data and have the proper extension.

Figure 13. LOAD data tools.
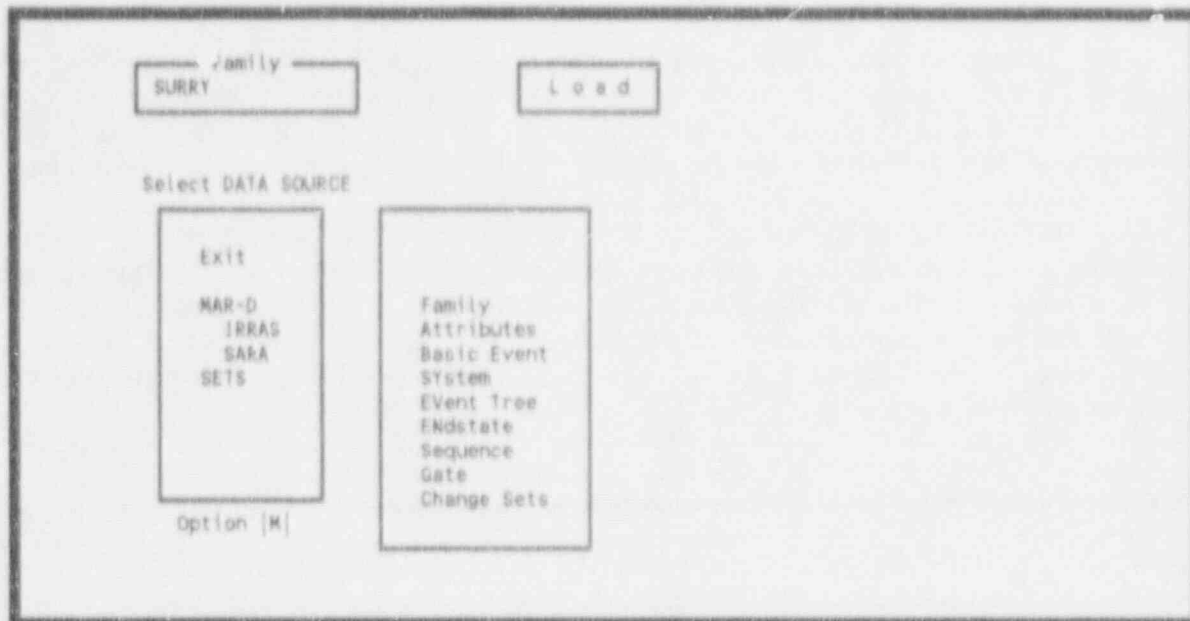
Figure 14. LOAD data tools and a data types help screen.
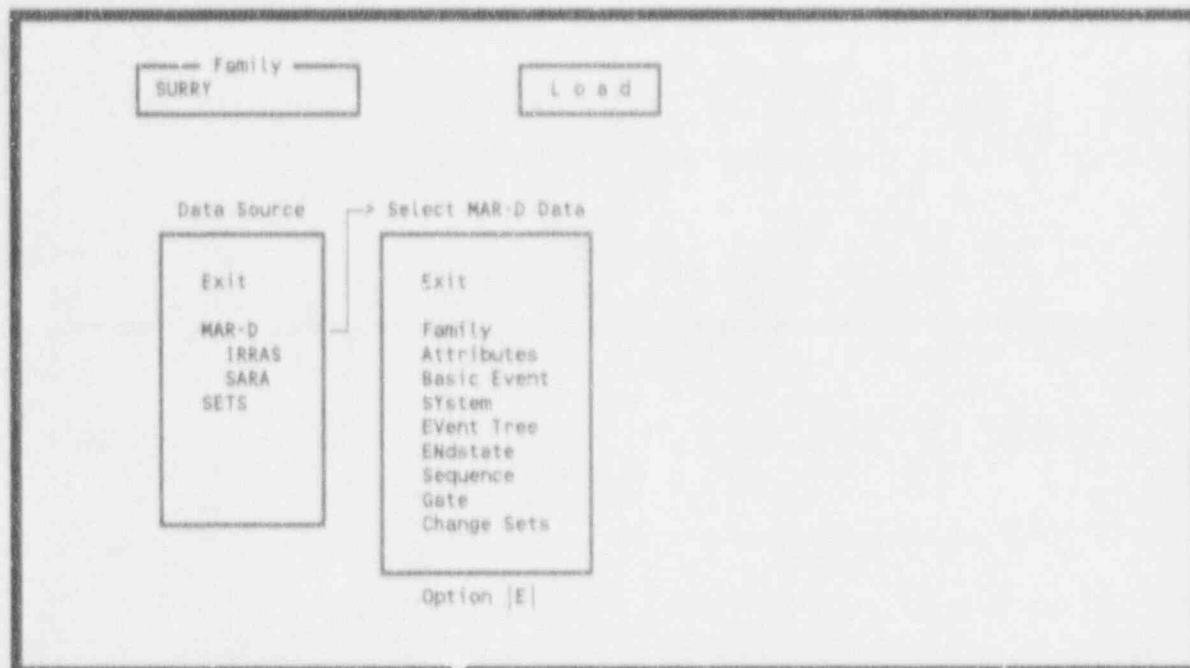
Figure 15. LOAD data types.
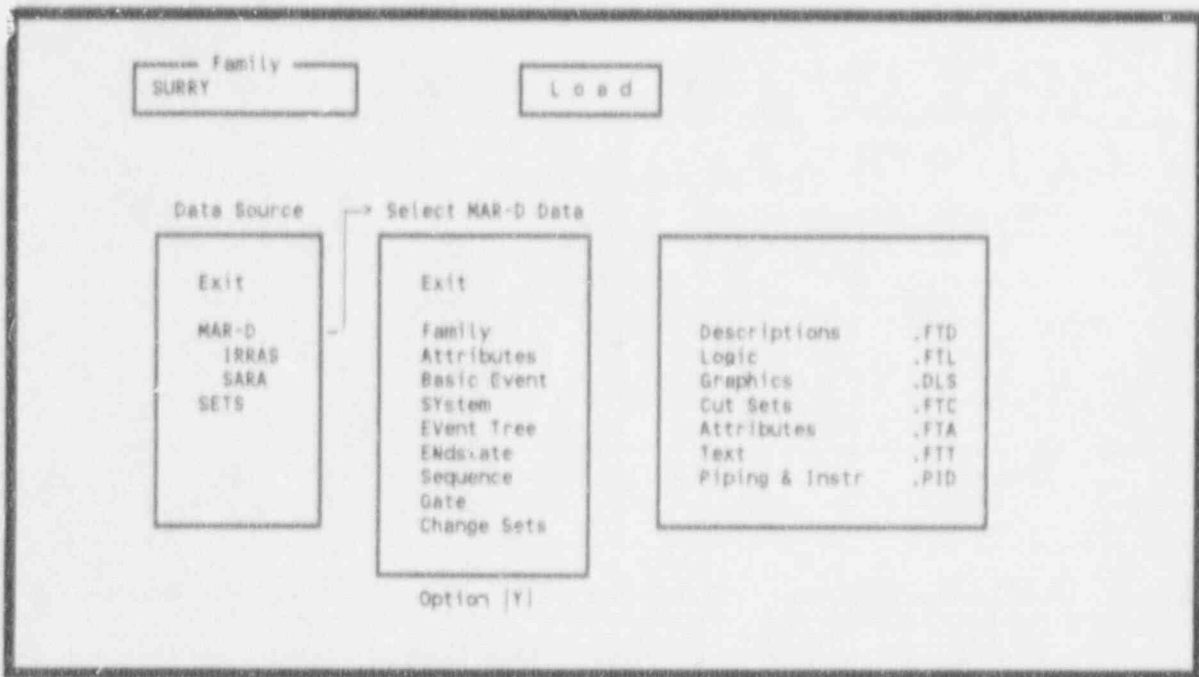
Figure 16. LOAD data types and a specific data help form.
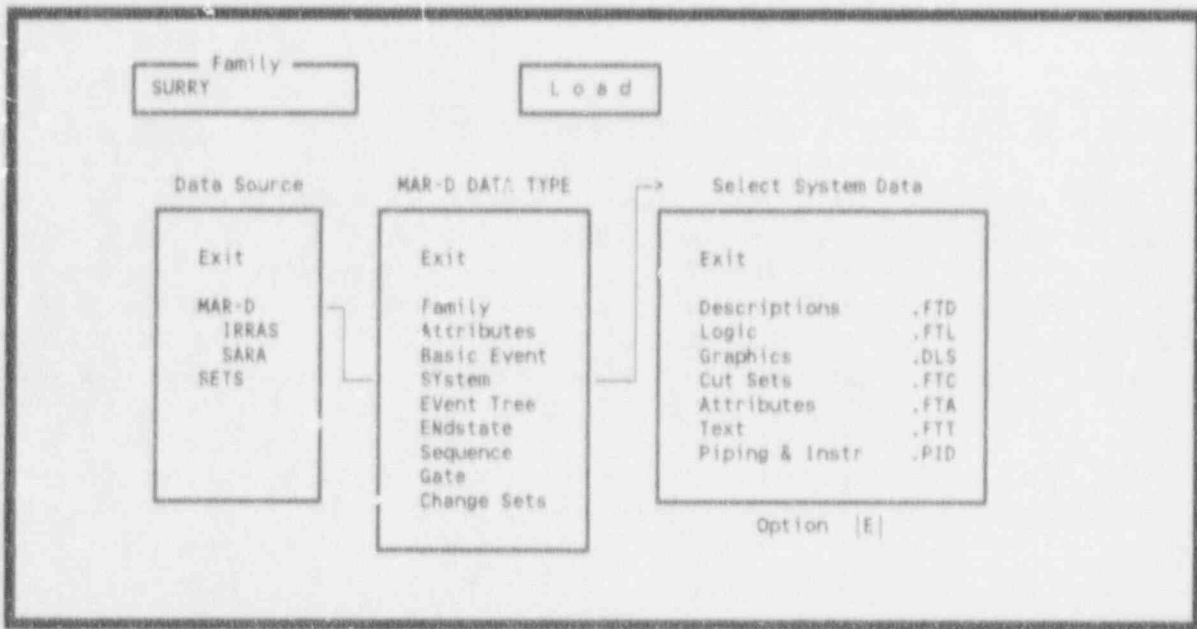
Figure 17. LOAD data type data.

```
 ┌─────── Family ───────┐        ┌──────────────┐      MAR-D to Data Base
 │ SURRY                │        │   L o a d    │      Fault Tree Graphics
 └──────────────────────┘        └──────────────┘

                    Option |L| Exit / Load file(s)

   ┌──────────┬──────────┬──────────┬──────────┬──────────┬──────────┐
   │ 4KV1H    │ 4KV1J    │ ACC      │ ACC4     │ ACC5     │ ACC6     │
   │ AFW-1    │ AFW-2    │ AFW-3    │ AFW1     │ AFW13    │ AFW13A   │
   │ AFW13B   │ AFW14    │ AFW14A   │ AFW14B   │ AFW15    │ AFW15A   │
   │ AFW15B   │ AFW16A   │ AFW17    │ AFW17A   │ AFW17B   │ AFW18    │
   │ AFW18A   │ AFW2     │ AFW21    │ AFW21A   │ AFW22    │ AFW22A   │
   │ AFW3     │ AFW5     │ AFW6     │ C        │ CPC1     │ CPC2     │
   │ CPC3     │ CPC4     │ CPCA     │ CPCB     │ CPCC     │ CS       │
   │ CSS1     │ CSS2     │ CV       │ D1       │ D2       │ D3       │
   │ D4       │ D5       │ D6       │ E1A      │ E1B      │ E1J      │
   │ E2111    │ E31111   │ E411V    │ E4801H   │ E4801J   │ EH1      │
   │ EH2      │ EJ1      │ EJ2      │ ESTB1H   │ ESTB1J   │ F1       │
   └──────────┴──────────┴──────────┴──────────┴──────────┴──────────┘
```

Figure 18. List of files to be loaded.

Each of the subsections below contains additional information on loading various types of data. In general, new data loaded into the database overwrites old data of the same name. After loading data, generate either a Summary Report or a Detailed Data Report to verify the data.

4.1 Load Verification

Consistency checking for names contained in multiple files can be done by setting "Verify when loading MAR-D data?" to "Y" using the Utility Constants option (Section 8.2). Data files that have no prerequisite loaded files (*.CTD, *.FTD, *.BED, etc.) are assumed to be correct and are loaded directly into the database without any field checking taking place. Data files having prerequisite loaded files contain dependent fields referenced in those data files (e.g., the *.BEI file contains event names also contained in the *.BED file). See Table 1 for a listing of files and their prerequisite files and dependent fields.

If a dependent field does not exist in the database at load time, that field will be displayed in a confirmation/add menu. Thus, if an event name contained in a *.BEI file does not match any event name previously loaded by the *.BED file, the new name will be displayed with the option to add the event name or simply abort the load process (Figure 19). Note that the dependent field name cannot be edited at this point. If the name is not correct then exit, fix the mistake, and reload.

However, if you suspect your data files have multiple cross-reference errors, load the files and allow the load procedure to find the errors for you. As an error is displayed to the screen, write down the line number and file name and continue with the load. When the load is finished, make the necessary corrections to the data files, delete the database files for that family (i.e., the *.DAT, *.IDX, and *.BLK files), and restart the load procedure.

Figure 19. Editing screen for adding a basic event.

Table 1. File extensions and their prerequisite files and dependent fields.

Group	File	Prereq. files	Dependent fields
Family:	.FAD	....	....
	.FAT	....	....
	.FTT	....	....

NOTE: consistency checking for family names is active for all files.

Group	File	Prereq. files	Dependent fields
Attributes:	.CAD	....	....
	.CTD	....	....
	.FMD	....	....
	.LCD	....	....
	.STD	....	....

Group	File	Prereq. files	Dependent fields
BasicEvents:	.BED	....	....
	.BEI	.BED	Event Name
	.BEA	.BED	Event Name
		.CAD	Class Attr
		.CTD	Comp Type
		.FMD	Fail Mode
		.LCD	Location
		.STD	System Type

Group	File	Prereq. files	Dependent fields
Systems:	.FTD	....	....
	.DLS	....	....
	.FTL	.BED	Event Name
		.GTD	Gate Name
	.FTC	.FTD	System Name
		.BED	Event Name
	.FTA	.FTD	System Name
	.FTT	.FTD	System Name

NOTE: .DLS and .FTL files are put into graphic relation instead of system relation. No cross relational cross checking available for graphics name.

Group	File	Prereq. files	Dependent fields
EventTrees:	.ETD	....	....
	.ETA	.ETD	Event Tree Name
		.BEI	Init Event
	.ETG	.ETD	Event Tree Name
	.ETL	.ETD	Event Tree Name
		.BEI	Init Event: unless Top
		.FTD	System Name for TOPS
	.ETT	.ETD	Event Tree Name

NOTE: .ETG is currently loaded as text. .ETL should look exactly like .ETG file.

Group	File	Prereq. files	Dependent fields
EndStates:	.ESD	....	....
	.ESI	????	????
	.EST	.ESD	End State Name

Group	File	Prereq. files	Dependent fields
Sequences:	.SQD	.ETD	Event Tree Name
	.SQC	.ETD	Event Tree Name
		.SQD	Sequence Name
		.BED	Event Name
	.SQA	.ETD	Event Tree Name
		.SQD	Sequence Name
		.ESD	End State Name
	.SQT	.ETD	Event Tree Name
		.SQD	Sequence Name

Table 1. (continued)

```
Group        File    Prereq. files  Dependent fields
=======================================================================
Gates :      .GTD    ....           ....
             .GTA    .GTD           Gate Name
.......................................................................
Change Sets: .CSD    ....           ....
             .CSI    .CSD           Change Set Name
                     .BED           Event Name
```

Each data type is discussed in the following paragraphs.

4.1.1 Family

Family descriptions, attributes, and text can be loaded into the database. This information is currently stored in only the MAR-D format (see Appendix A). Note that each file contains data for only one family, and that a change in the data file family name will not change the database family name.

4.1.2 Attributes

Basic event attributes descriptions (locations, failure modes, class attributes, system types and component types) can be loaded using the MAR-D attributes option. The file format is described in Appendix A.

4.1.3 Basic Event

Event descriptions, failure rates, and attributes can be loaded into the database. The alternate name of the event defaults to the value of the primary name if an alternate name is not specified. The file formats are described in Appendix A.

For SETS failure rate data, the probability value is stored and the calculation type is set to 1.

4.1.4 SYstem

System descriptions, graphics, logic, cut sets, attributes, text and piping and instrumentation diagrams (P&IDs) can be loaded into the database. System cut sets and attributes data can be loaded into either the base case (permanent) or alternate (temporary) field areas. MAR-D applications will normally use the base case load option because only permanent data should be loaded into the database. Analysis software such as IRRAS or SARA will use alternate fields for comparisons of changed value results. The file formats are described in Appendix A.

Any basic event found within the system logic or cut sets will be added to the Event relation.

4.1.5 EVent Tree

Event tree descriptions, graphics, logic, attributes, rules, and text can be loaded into the database. The file format is described in Appendix A.

4.1.6 ENdstate

End state names, descriptions, and text can be loaded into the database. Formats for end state information have not yet been determined.

4.1.7 Sequence

Sequence cut sets for MAR-D (IRRAS, SARA), and SETS file formats can be loaded. In the MAR-D format, sequence descriptions, cut sets, attributes, text, and logic can be loaded as well. With cut sets and attributes, data can be loaded into either the base case or alternate field areas (Figure 22). The file formats are described in Appendix A.

Before loading a SETS-format sequence, a menu for selecting and adding event trees is displayed (Figures 20 and 21), as an event tree must exist before a sequence can be loaded. This is not necessary for MAR-D format sequences since the event tree names are contained within the format.

The event tree initiating event must have been entered into the database prior to loading sequence cut sets and, therefore, does not need to be included; any found will be removed from the cut set data. The event tree initiating event will be included in each cut set term for SETS *.DNF format output.

```
┌─ Family ─┐                    ┌──────────┐
│ DEMO     │                    │  L o a d │
└──────────┘                    └──────────┘

              Option |S|  Exit / Select / Add

 ─ Event Tree ───────────────── Description ──────────
 LOSP          Loss of offsite power event tree




                 Select an Event tree to load Sequences.

         <Esc>              <F1>              <F5>
         Exit               Help              Locate
```
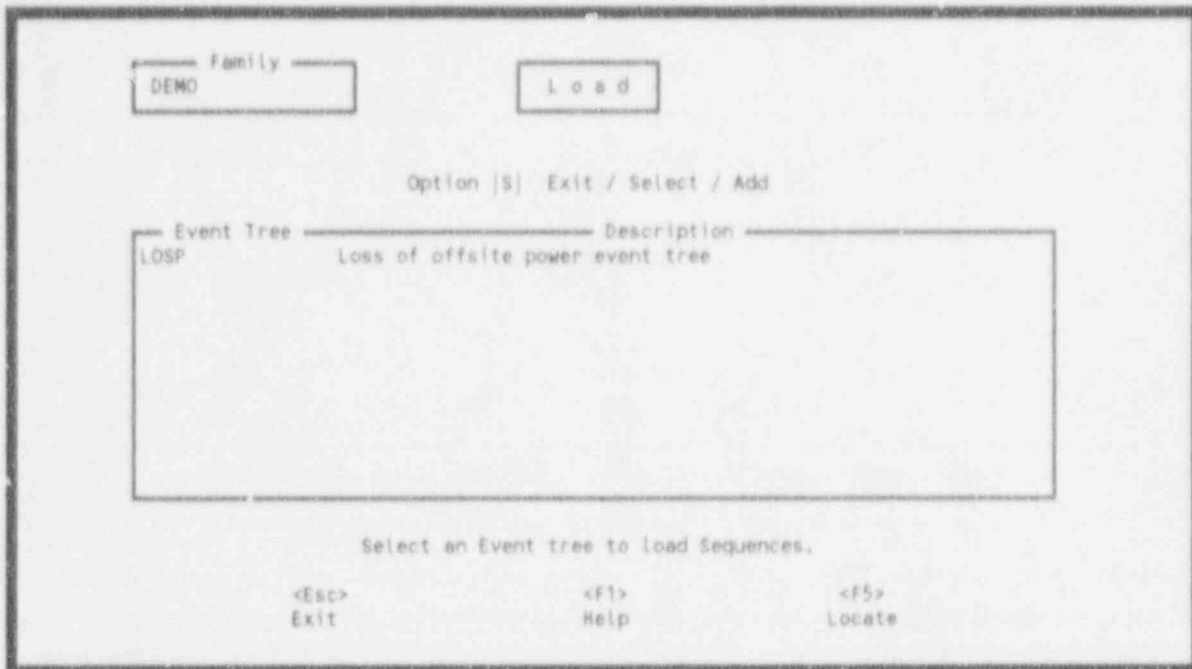
Figure 20. Listing of event trees for loading sequences.

```
                  ┌────────────────────────┐
                  │  A d d   E v e n t  T r e e │
                  └────────────────────────┘

                     Option |A|  Exit / Add

  ┌──────────────────────────────────────────────┐
  │ Name                                          │
  │ Description                                    │
  │ Initiating event name                          │
  └──────────────────────────────────────────────┘
```
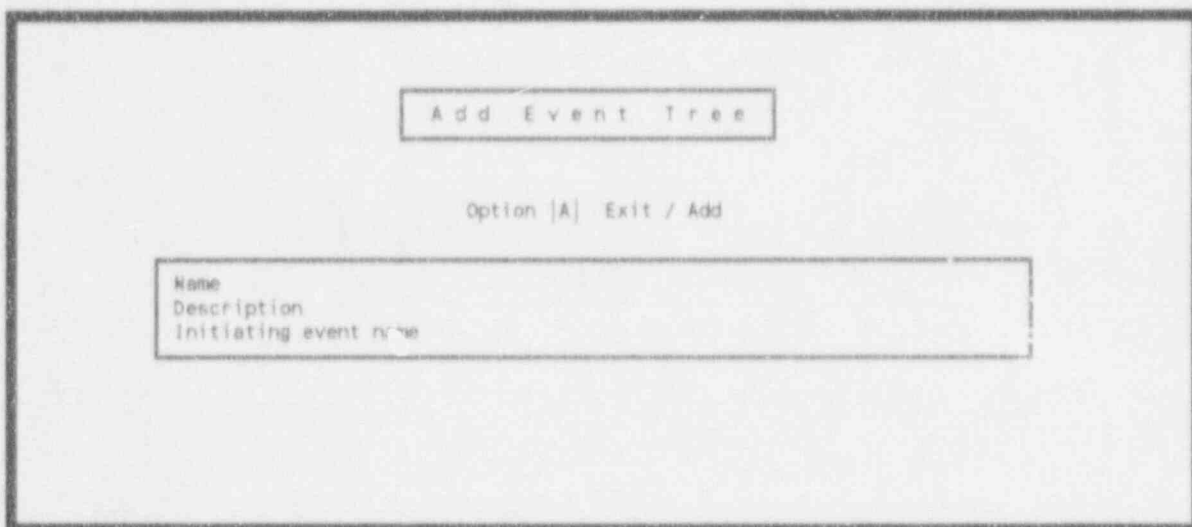
Figure 21. Add an event tree for loading sequences.

Load Data

```
┌────────────────────────────────────────────────────────────────────────────┐
│                                                                            │
│      ──── Family ────                      ┌──────────┐                     │
│      │ SURRY        │                      │  L o a d │    MAR-D to Data Base │
│      └──────────────┘                      └──────────┘    Sequence Cut Sets │
│                                                                            │
│                       Option: |B|  Exit / Base Case / Alternate             │
│                                                                            │
│      ┌─────────┬─────────┬─────────┬─────────┬─────────┬─────────┐          │
│      │ A       │ A-D5    │ ATWS1   │ ATWS2   │ S1      │ S2      │          │
│      │ S3      │ T1      │ T1S1    │ T1SB    │ T2      │ T5A     │          │
│      │ T5B     │ T7      │ V       │         │         │         │          │
│      │         │         │         │         │         │         │          │
│      │         │         │         │         │         │         │          │
│      │         │         │         │         │         │         │          │
│      │         │         │         │         │         │         │          │
│      │         │         │         │         │         │         │          │
│      │         │         │         │         │         │         │          │
│      └─────────┴─────────┴─────────┴─────────┴─────────┴─────────┘          │
│                                                                            │
└────────────────────────────────────────────────────────────────────────────┘
```

Figure 22. Event tree sequences to be loaded.

4.1.8 Gate

Gate names, descriptions, and types can be loaded into the database for use in graphics conversion. The file format is described in Appendix A.

4.1.9 Change Sets

All change set information used in the GENERATE change set option in IRRAS 4.0 can be loaded via this file. The file format is described in Appendix A.

5. EXTRACT DATA

Data can be output in MAR-D (IRRAS, SARA), SETS, or FRANTIC format using the EXTRACT Data option. The extracted file is created in the current family subdirectory. The default output file name for description, information, and attribute data consists of the first eight characters of the family name plus the appropriate extension. For MAR-D cut set, logic, graphic, and textual information, if all files are selected for extraction, the file name will be the family name with the extension. Otherwise, the file name will be the first six characters of the name plus a 2-character ID number.

NOTE: **If a file with this name already exists it will be overwritten.**

The EXTRACT menus are almost identical to the LOAD menus with the exception of the first menu (Figure 23). A data tool type is selected, then a data type (Figure 24), and finally the specific data to be output (Figure 25). In outputting some data, a fourth menu appears (Figures 26 or 27). Read the note at the bottom of the screen as well as the appropriate section on extracting that data type.

Figure 23. Extract data tool selection.
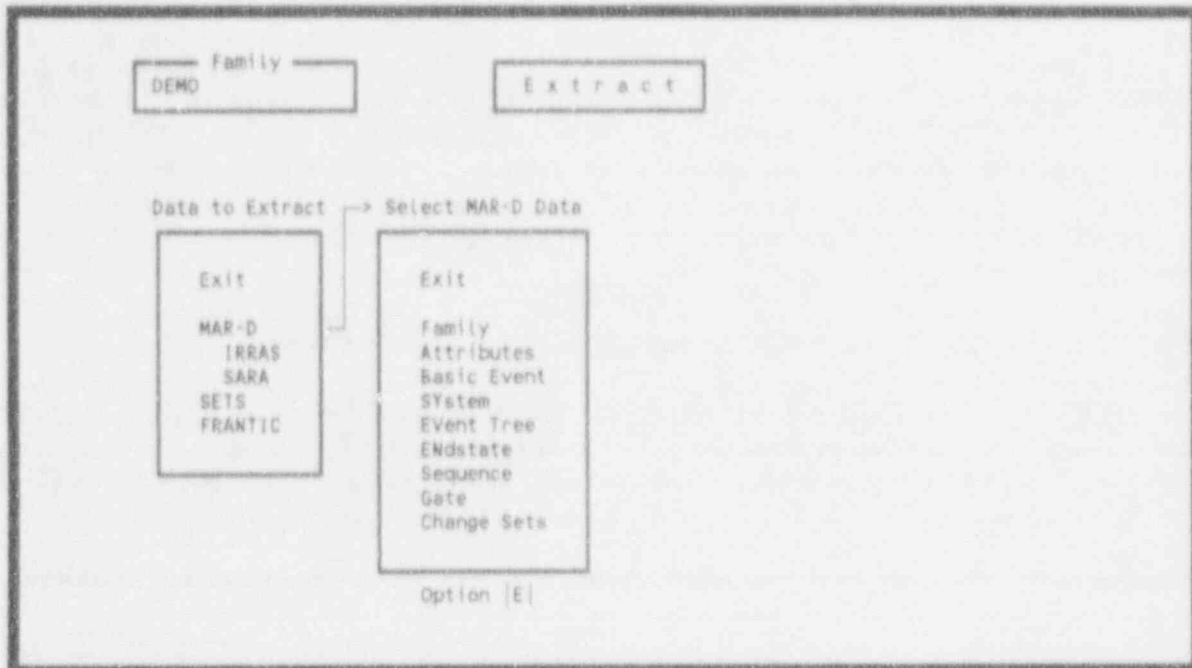
Figure 24. Data types that can be extracted.
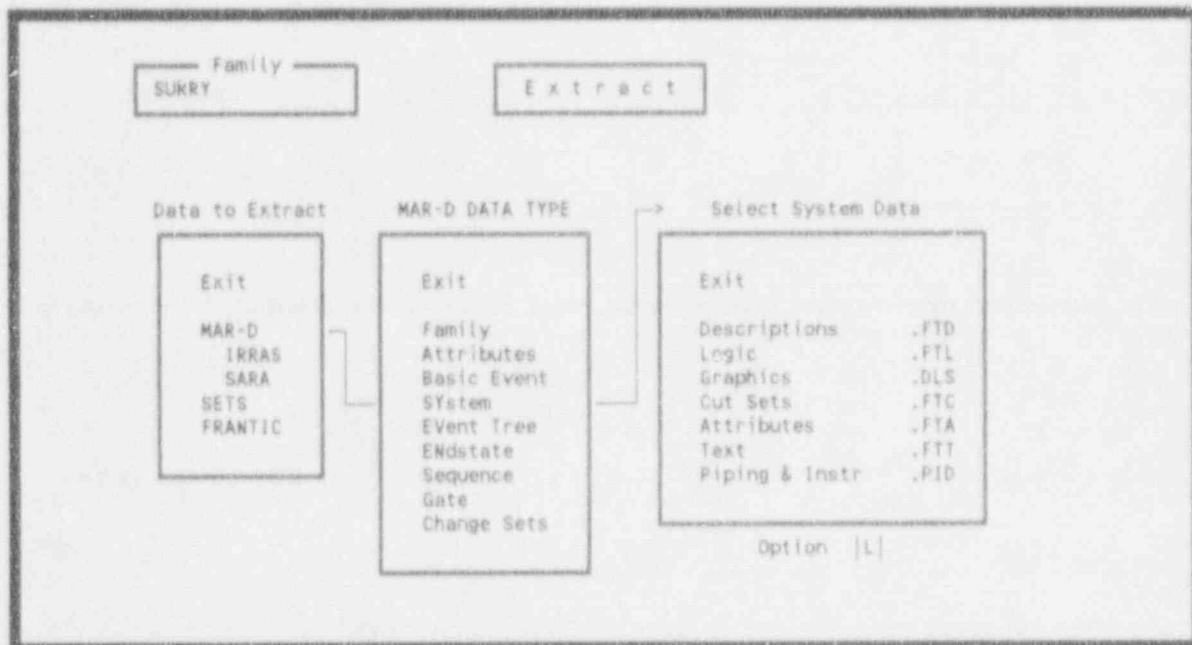
Figure 25. Selection of the data file type to extract.

```
┌─────────────────────────────────────────────────────────────────────────────┐
│                                                                               │
│   ┌── Family ───┐          ┌─────────────────┐                                │
│   │ DEMO        │          │  E x t r a c t  │    Data Base to MAR-D          │
│   └─────────────┘          └─────────────────┘    Fault Tree Logic            │
│                                                                               │
│                                                                               │
│                    Option |X|  Exit / eXpanded / Logic                        │
│                                                                               │
│   ┌── Fault Tree = Data ───────────────── Description ──────────────────┐     │
│   │ CCS          L Containment Cooling System fault tree                 │     │
│   │ ECS          L Emergency Cooling System fault tree                   │     │
│   │ LOSP         L Loss of Offsite Power Initiating Event fault tree     │     │
│   │                                                                      │     │
│   │                                                                      │     │
│   │                                                                      │     │
│   │                                                                      │     │
│   │                                                                      │     │
│   │                                                                      │     │
│   └──────────────────────────────────────────────────────────────────┘     │
│                                                                               │
│                                                                               │
│            <Esc>                <F1>                <F5>                       │
│            Exit                 Help                Locate                     │
│                                                                               │
└─────────────────────────────────────────────────────────────────────────────┘
```

Figure 26. Extract fault tree logic.

```
┌─────────────────────────────────────────────────────────────────────────────┐
│                                                                               │
│   ┌── Family ───┐          ┌─────────────────┐                                │
│   │ DEMO        │          │  E x t r a c t  │    Data Base to MAR-D          │
│   └─────────────┘          └─────────────────┘    Fault Tree Cutsets          │
│                                                                               │
│                                                                               │
│                    Option |B|  Exit / Base ase / Alternate                    │
│                                                                               │
│   ┌── Fault Tree = Data ───────────────── Description ──────────────────┐     │
│   │ CCS          C Containment Cooling System fault tree                 │     │
│   │ ECS          C Emergency Cooling System fault tree                   │     │
│   │                                                                      │     │
│   │                                                                      │     │
│   │                                                                      │     │
│   │                                                                      │     │
│   │                                                                      │     │
│   │                                                                      │     │
│   │                                                                      │     │
│   └──────────────────────────────────────────────────────────────────┘     │
│                                                                               │
│                                                                               │
│            <Esc>                <F1>                <F5>                       │
│            Exit                 Help                Locate                     │
│                                                                               │
└─────────────────────────────────────────────────────────────────────────────┘
```

Figure 27. Extract sequence cut sets.

5.1 Family

Family descriptions, attributes, and text can be output from the database. Note that each file will contain information for the selected family.

5.2 Attributes

Event attributes (locations, failure modes, class attributes, system types, and component types) can be output from the database. Event attributes will be output for the entire family.

5.3 Basic Event

Event descriptions, failure rates, and attributes can be output for all the events in a family. If alternate basic event names are used, the constant is set to "Y", and the alternate name will be used instead of the primary name for descriptions and failure rates. Primary names will be output.

5.4 SYstem

Descriptions and attributes can be output for all the systems in a family. System logic, graphics, and cut sets are selected from an output menu. If all logic or graphics are selected, a single file will be created for each of the names; for all cut sets and text, the family name will be used, with systems separated by ^EOS (see Appendix A).

5.5 EVent Tree

Descriptions and attributes can be output for all the event trees in a family. Event tree logic graphics, attributes, rules, and text are selected from an output menu.

5.6 ENdstate

End state descriptions can be output for the whole family. Text is selected from an output menu.

5.7 Sequence

Sequence descriptions and attributes can be output for an entire family. Sequence cut sets, logic, and text must first have an event tree selected (Figure 28), then that event tree's sequences are displayed (Figure 29) and can be output. If all event trees are selected, the sequences for each event t, will be output to a file with that event tree's name. If a single event tree is selected, the output seque. e menu containing all of the sequences associated with that event tree will be displayed (Figure 29). If all of the

sequences are selected, those sequences will be output to a single file with the event tree's name. If a single sequence is selected, it is output to a file with that sequence's name.

```
┌──────────────────────────────────────────────────────────────────────────┐
│                                                                            │
│   ┌──── Family ────┐              ┌─────────────┐                          │
│   │ DEMO           │              │ E x t r a c t│   Data Base to MAR-D    │
│   └────────────────┘              └─────────────┘   Sequence Cutsets       │
│                                                                            │
│                   Option |B|  Exit / Base Case / Alternate                 │
│   ┌─ Event Tree ──────────────────────────── Description ──────────────┐   │
│   │ LOSP          Loss of offsite power event tree                     │   │
│   │                                                                    │   │
│   │                                                                    │   │
│   │                                                                    │   │
│   │                                                                    │   │
│   │                                                                    │   │
│   │                                                                    │   │
│   └────────────────────────────────────────────────────────────────────┘  │
│                                                                            │
│          <Esc>                    <F1>                    <F5>             │
│          Exit                     Help                    Locate           │
│                                                                            │
└──────────────────────────────────────────────────────────────────────────┘
```

Figure 28. Extracted sequence cut sets.

5.8 Gate

Gate names, descriptions, and types be output for an entire family.

5.9 Change Sets

All change set information used in the GENERATE option in IRRAS 4.0 can be output for an entire family.

```
┌─══ Family ═══─┐                  ┌─────────────────┐
│ DEMO          │                  │  E x t r a c t  │   Data Base to MAR-D
└───────────────┘                  └─────────────────┘   Sequence Cutsets


┌─══ Event Tree ══─┐      Option |X|  Exit / eXtract
│ LOSP             │
├─ Sequence ══ Data ══════════════════ Description ═══════════════════════┐
│ 1-LOSP-ECS-CCS     Loss of Offsite Power with success of ECS, no core damage │
│ 2-LOSP-ECS-CCS   C Loss of Offsite Power, failed ECS, success. CCS, core dama │
│ 3-LOSP-ECS-CCS   C LOSP, failed ECS & CCS, core damage & containment failure  │
│                                                                              │
│                                                                              │
│                                                                              │
│                                                                              │
└──────────────────────────────────────────────────────────────────────────────┘


         <Esc>                  <F1>                   <F5>
         Exit                   Help                   Locate
```

Figure 29. OUTPUT Sequences of an Event.

6. MODIFY DATABASE

This option allows you to modify the base or original family data files for a family, event trees, systems, end states, basic events, attributes, gates, graphics, and histograms. To invoke this option, type <M> in the option field or highlight Modify Database and press <Enter>. Figure 30 will be displayed.
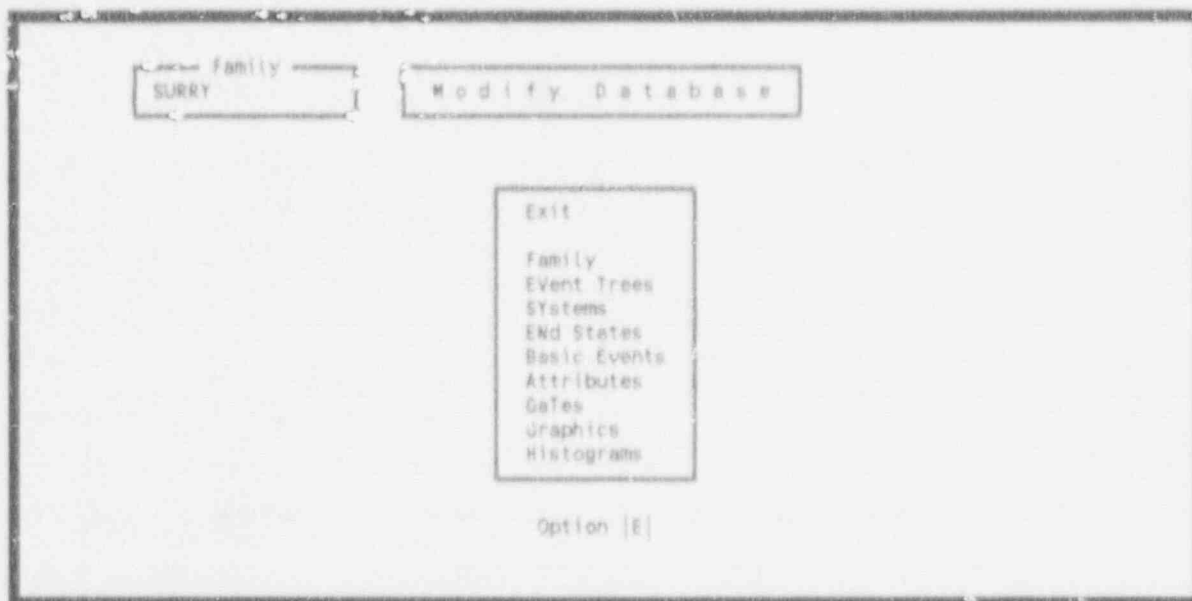
Figure 30. Modify data base main menu.

In general, each of the options shown in Figure 30 use the same modification functions: Exit, Add, Modify, Delete, and Locate. Some of the options have additional functions such as: Text and Sequences.

The following function keys are available throughout the Modify Database option:

<Esc>	Exits the current option and returns you to the Modify Database screen.
<F1>	Displays associated help messages.
<F2>	Mark/Clear tags items for use in the selected option.
<F3>	Clear All Marked events removes the marks (*) from the listed items. If no items are marked, this option will mark all of the items.
<F4>	Mark/Clear range of items quickly tags large numbers of items for processing.

<F5>   Locate an item. This option will display a blank field in the center of the screen, and a message **Please enter name to locate** will appear. The user should enter the name to be located and then press <Enter>. This feature will place the highlight on the located name. If the required name is not found, then the next name in alphabetical order will be highlighted

6.1 Exit

This option returns you to the MAR-D main menu. To invoke this option, type <E> in the option field and press <Enter>, or press the <Esc> key.

6.2 Family

This option allows you to add, modify, and delete a family or modify the associated text. To invoke this option, type <F> in the option field or highlight Family and press <Enter>. Figure 31 will be displayed.

```
┌───────────────────────────────────────────────────────────────────────┐
│                                                                         │
│   ─── Family ───                    ┌──────────────────────┐            │
│   SURRY                             │   E d i t   f a m i l y │          │
│                                     └──────────────────────┘            │
│                                                                         │
│              Option |E|  Exit / Add / Modify / Delete / Text            │
│                                                                         │
│    ┌ Family Name ── Directory ───────────────── Description ──────────┐ │
│    │ BROWN1         BROWN1                                            │ │
│    │ DEMO           DEMO        Demonstration sample family           │ │
│    │ LEARN          LEARN       Sample family of data for the SARA 4.0 Tutorial │ │
│    │ LEARN          LEARN2      Sample family of data for the SARA 4.0 Tutorial │ │
│    │ PRADATA.B1     PRADATA.B1                                        │ │
│    │ SURRY          SURRY       SURRY UNIT 1   RELEASE DATE 04-11-91   │ │
│    │                                                                  │ │
│    │                                                                  │ │
│    └──────────────────────────────────────────────────────────────────┘ │
│                                                                         │
│              <Esc>          <F1>           <F5>                          │
│              Exit           Help           Locate                       │
│                                                                         │
└───────────────────────────────────────────────────────────────────────┘
```

Figure 31. Family editing menu.

6.2.1 Exit

This option returns you to the Modify Database screen. To invoke this option, type <E> in the option field and press <Enter>, or press the <Esc> key.

6.2.2 Add

This option allows you to add a family to the database. To invoke this option type < A > in the option field and press < Enter >. The Add Family screen (shown in Figure 32) will be displayed. The only required information to be entered on this screen is the family name. The options at this point are Exit, Add, and Passwords.

```
                          ┌─────────────────────┐
                          │  A d d   F a m i l y │
                          └─────────────────────┘


                     Option |A|  Exit / Add / Passwords

   ┌──────────────────────────────────────────────────────────────────┐
   │  Name         Location        Company   Type   Design   Vendor    │
   │                                                                    │
   │                    Description                         Tree Type   │
   │                                                                    │
   │      Operational date   Qualification date    Mission time        │
   │      ----/--/--          ----/--/--            ------E----         │
   └──────────────────────────────────────────────────────────────────┘
```

Figure 32. Editing screen for adding a family.

6.2.2.1 Exit. This option returns you to the Edit Family screen. To invoke this option, type < E > in the option field and press < Enter >, or press the < Esc > key.

6.2.2.2 Add. This option performs the actual addition of the family to the database. To invoke this option, type < A > in the option field, enter a family name and any of the other information you wish, and press < Enter >. At completion of the Add you are returned to the Edit Family screen, where the addition of the new family will be reflected.

6.2.2.3 Passwords. This option not yet available.

6.2.3 Modify

This option allows you to modify the family data record. To invoke this option type < M > in the option field, highlight the family you wish to edit, and press < Enter >. The Modify Family screen is shown in Figure 33. The options at this point are Exit, Modify, and Passwords.

6.2.3.1 Exit. This option returns you to the Edit Family screen. To invoke this option, type < E > in the option field and press < Enter >, or press the < Esc > key.

```
                        ┌─────────────────────────┐
                        │   M o d i f y   F a m i l y  │
                        └─────────────────────────┘


                        Option |M| Exit / Modify / Passwords

        ┌──────────────────────────────────────────────────────────────┐
        │     Name           Location        Company   Type   Design   Vendor │
        │  SURRY          WILLIAMSBURG VA    VEPCO      PWR    3 LOOP    W      │
        │                                                                      │
        │                     Description                            Tree Type │
        │  SURRY UNIT 1    RELEASE DATE 04-11-91                                │
        │                                                                      │
        │            Operational date   Qualification date   Mission time      │
        │               1972/12/22         ----/--/--         2.400E+001       │
        │                                                                      │
        │               Data Version Date     Data Update Date                 │
        │                 ----/--/--            ----/--/--                      │
        └──────────────────────────────────────────────────────────────┘
```

Figure 33. Editing screen for modifying a family.

6.2.3.2 Modify. This option applies the actual modification of the family data to the database. To invoke this option, type <M> in the option field, modify any of the data fields on the screen and press <Enter>. On completion of the Modify you are returned to the Edit Family screen.

6.2.3.3 Passwords. This option not yet available.

6.2.4 Delete

> NOTE: A family that contains sub-families cannot be deleted. The deletion process must proceed up from the lowest to the highest sub-family.

This option allows you to delete family data records from the database. To invoke this option, type <D> in the option field and press <Enter>. The Delete Family screen is shown in Figure 34. The options at this point are Exit and Delete.

6.2.4.1 Exit. This option returns you to the Edit Family screen. To invoke this option, type <E> in the option field and press <Enter>, or press the <Esc> key.

6.2.4.2 Delete. This option verifies the delete family request. To invoke this option, type <D> in the option field and press <Enter>. A warning screen is superimposed over the Delete Family screen allowing you to cancel the deletion process (Figure 35). Enter a <Y> to delete the family or an <N> to terminate the deletion process. If you respond with a <Y>, the message **Deletion completed** will be displayed at the bottom of the screen.

```
┌──────────────────────────────────────────────────────────────┐
│                    ┌─────────────────────┐                    │
│                    │   D e l e t e   F a m i l y   │          │
│                    └─────────────────────┘                    │
│                                                               │
│                     Option |D|  Exit / Delete                 │
│                                                               │
│  ┌─────────────────────────────────────────────────────────┐ │
│  │    Name          Location      Company  Type  Design  Vendor│ │
│  │ LEARN                                                    │ │
│  │                  Description                    Tree Type│ │
│  │ Sample family of data for the SARA 4.0 Tutorial Manual.  │ │
│  │                                                          │ │
│  │     Operational date  Qualification date  Mission time   │ │
│  │       ----/--/--         ----/--/--        2.400E+001    │ │
│  └─────────────────────────────────────────────────────────┘ │
└──────────────────────────────────────────────────────────────┘
```

Figure 34. Editing screen for deleting a family.

```
┌──────────────────────────────────────────────────────────────┐
│                    ┌─────────────────────┐                    │
│                    │   D e l e t e   F a m i l y   │          │
│                    └─────────────────────┘                    │
│                                                               │
│                     Option |D|  Exit / Delete                 │
│                                                               │
│  ┌─────────────────────────────────────────────────────────┐ │
│  │    Name          Location      Company  Type  Design  Vendor│ │
│  │ LEARN                                                    │ │
│  │                  Description                    Tree Type│ │
│  │ Sample family o┌──────────────────────────────┐          │ │
│  │                │         W A R N I N G        │n time    │ │
│  │     Opera      │ This family directory and all of its │E+001 │ │
│  │       --       │ files will be deleted!!       │          │ │
│  │                │ Do you wish to proceed? N Y/N │          │ │
│  │                └──────────────────────────────┘          │ │
│  └─────────────────────────────────────────────────────────┘ │
└──────────────────────────────────────────────────────────────┘
```

Figure 35. Warning screen for a family delete.

6.2.5 Text

This option allows you to view and edit any descriptive text associated with a specific family. To invoke this option, type < T > in the option field, highlight a family, and press < Enter >.

The initial display for this option displays the first 13 lines of the text block. The following keys allow you to display additional lines of text:

PgDn	-	Presents the next 13 lines of text.
PgUp	-	Presents the previous 13 lines of text.
Ctrl-PgDn	-	Presents the last 13 lines of text.
Ctrl-PgUp	-	Presents the first 13 lines of text.

The editing keys are

Ctrl-Z	-	Exits the text editing feature and saves the text information as it currently exists.
ESC	-	Exits without saving changes.
Alt-A	-	Adds a line after the line at the current cursor position.
Alt-B	-	Adds a line before the line at the current cursor position.
Alt-H	-	Displays editing keys help screen.
Alt-D	-	Deletes a line at the current cursor position.
Alt-R	-	Restores the previous deleted text.
Del	-	Deletes a character at current cursor position.
Ins	-	Inserts a character at current cursor position.
Ctrl-End	-	Deletes all characters from the current cursor position to the end of the cursor line.

The arrow keys are used to move the cursor within the block of text.

The editor does not line wrap, therefore, you must use < Alt-A > to establish each new line of text. If you wish to save your text changes, press < Ctrl-Z >. After you have pressed < Ctrl-Z > you are returned to the Edit Family screen with the message **Text record modified** displayed at the bottom of the screen. If you pressed < Esc >, you will be returned to the family selection screen with the message **Text record not modified** displayed at the bottom of the screen.

6.3 EVent Trees

This option allows you to modify event tree data records. To invoke this option, type < V > in the option field or highlight EVent Trees and press < Enter >. The Edit Event Trees screen listing all of the event trees belonging to the current family will be displayed (Figure 36). The modification options are: Exit, Add, Modify, Delete, Text, Sequences, Base Case Update, and Clear Alternate Case.

```
┌──────────────────────────────────────────────────────────────────────────┐
│    ┌──── Family ────┐                                                       │
│    │ SLRRY          │         ┌─────────────────────────────────┐          │
│    └────────────────┘         │   E d i t   E v e n t   T r e e s │        │
│                               └─────────────────────────────────┘          │
│                                                                            │
│        Option |E|  Exit / Add / Modify / Delete / Text / Sequences         │
│                    Base Case Update / Clear Alternate Case                  │
│    ┌──── N a m e ───────────────────── D e s c r i p t i o n ──────┐       │
│    │ BA            BRIDGE TREE, LARGE LOCA                          │       │
│    │ BS1           BRIDGE TREE, MEDIUM LOCA                         │       │
│    │ BS2           BRIDGE TREE, SMALL LOCA                          │       │
│    │ BS3           BRIDGE TREE, VERY SMALL LOCA                     │       │
│    │ BT1S          BRIDGE TREE, STATION BLACKOUT AT UNIT 1          │       │
│    │ BT1SB         BRIDGE TREE, STATION BLACKOUT AT BOTH UNITS      │       │
│    │ BT2           BRIDGE TREE, LOSS OF MAIN FEEDWATER              │       │
│    │ BT7           BRIDGE TREE, STEAM GENERATOR TUBE RUPTURE        │       │
│    │ FA            LARGE LOCA EVENT TREE                            │       │
│    │ FS1           MEDIUM LOCA EVENT TREE                           │       │
│    └───────────────────────────────────────────────────────────────┘       │
│                                                                            │
│   <Esc>      <F1>        <F2>          <F3>          <F4>        <F5>        │
│   Exit       Help     Mark/Clear    Mark/Clear    Mark/Clear   Locate       │
│                         Item           All          Range                   │
└──────────────────────────────────────────────────────────────────────────┘
```

Figure 36. Selection screen for event tree editing.

6.3.1 Exit

This option returns you to the Modify Database main menu. To invoke this option, type <E> in the option field and press <Enter>, or press the <Esc> key.

6.3.2 Add

This option allows you to add an event tree to the database. In IRRAS 4.0, when the user creates event trees using the graphical event tree editor or loads a graphical event tree from another database, an event tree record is automatically added to the database. The user need only use this option if the graphical event tree format is not used. To invoke this option, type <A> in the option field and press <Enter>. The Add Event Tree screen will be displayed (Figure 37). The options at this point are Exit and Add.

6.3.2.1 Exit. This option returns you to the Edit Event Trees screen. To invoke this option, type <E> in the option field and press <Enter>, or press the <Esc> key.

6.3.2.2 Add. This option performs the actual add of a new event tree record. To invoke this option, type <A> in the option field, fill in the requested data fields, and press <Enter>. The required information for an event tree add is the name and initiating event.

When you position the cursor in the Initiating Event Name field, a window will appear listing all initiating events for the current family. Press <F1> to position the cursor in the window. Use the

```
┌─────────────────────────────────────────────────────────────────────────┐
│  ┌─── Family ───┐     ┌─────────────────────────────────────┐            │
│  │ SURRY        │     │  A d d   E v e n t   T r e e        │            │
│  └──────────────┘     └─────────────────────────────────────┘            │
│                                                                           │
│                          Option [A]  Exit / Add                           │
│                                                                           │
│  ┌──────────────────────────────────────────────────────────┐            │
│  │ Name                                                      │            │
│  │ Description                                                │            │
│  │ Initiating Event Name                                     │            │
│  └──────────────────────────────────────────────────────────┘            │
│                                                                           │
└─────────────────────────────────────────────────────────────────────────┘
```

Figure 37. Editing screen for adding an event tree.

arrow, tab, or space bar keys to scroll through the list of events. When the desired event is highlighted, press < Enter >. The selected event will be placed in the corresponding field. Upon pressing < Enter >, the message **Record added** will be displayed at the bottom of the screen.

6.3.3 Modify

This option allows you to modify an event tree record. To invoke this option, type < M > in the option field, highlight an event tree name, and press < Enter >. The Modify Event Tree screen is shown in Figure 38. The options at this point are Exit and Modify.

```
┌─────────────────────────────────────────────────────────────────────────┐
│   ┌─── Family ───┐      ┌─────────────────────────────────────┐          │
│   │ SURRY        │      │  M o d i f y   E v e n t   T r e e  │          │
│   └──────────────┘      └─────────────────────────────────────┘          │
│                                                                           │
│                           Option [M]  Exit / Modify                       │
│                                                                           │
│   ┌──────────────────────────────────────────────────────────┐           │
│   │ Name          ATWS1                                       │           │
│   │ Description CORE DAMAGE TREE, ANTICIPATED TRANSIENT WITHOUT SCRAM │    │
│   │ Initiating Event Name 1E-1                                │           │
│   └──────────────────────────────────────────────────────────┘           │
│                                                                           │
└─────────────────────────────────────────────────────────────────────────┘
```

Figure 38. Editing screen for modifying an event tree.

6.3.3.1 Exit. This option returns you to the Edit Event Trees screen. To invoke this option, type < E > in the option field and press < Enter >, or press the < Esc > key.

6.3.3.2 Modify. This option performs the actual modification of the event tree record. To invoke this option, type < M > in the option field, modify any of the data fields on the Modify Event

Trees screen, and press <Enter>.

To modify the initiating event field, position the cursor in the Initiating Event Name field to display a window listing all initiating events for the current family. Press <F1> to position the cursor in the window. Use the arrow, tab, or space bar keys to scroll through the list of events. When the desired event is highlighted, press <Enter>. The selected event will be placed in the corresponding field. Upon pressing <Enter>, the message **Record modified** will be displayed at the bottom of the screen.

6.3.4 Delete

This option allows you to delete an event tree record and associated sequence records from the database. To invoke this option, type <D> in the option field, highlight an event tree, and press <Enter>. The delete event tree record is shown in Figure 39. The options at this point are Exit and Delete.

Figure 39. Editing screen for deleting an event tree

6.3.4.1 Exit. This option returns you to the Edit Event Trees screen. To invoke this option, type <E> in the option field and press <Enter>, or press the <Esc> key.

6.3.4.2 Delete. This option performs the actual deletion of the event tree record. To invoke this option, type <D> in the option field and press <Enter>. A warning screen will appear, allowing you to cancel the deletion at this point (Figure 40). If you respond Y (yes), all sequence records associated with the event tree will be deleted from the database. You will be returned to the Edit Event Trees screen with the message **Record deleted** displayed.
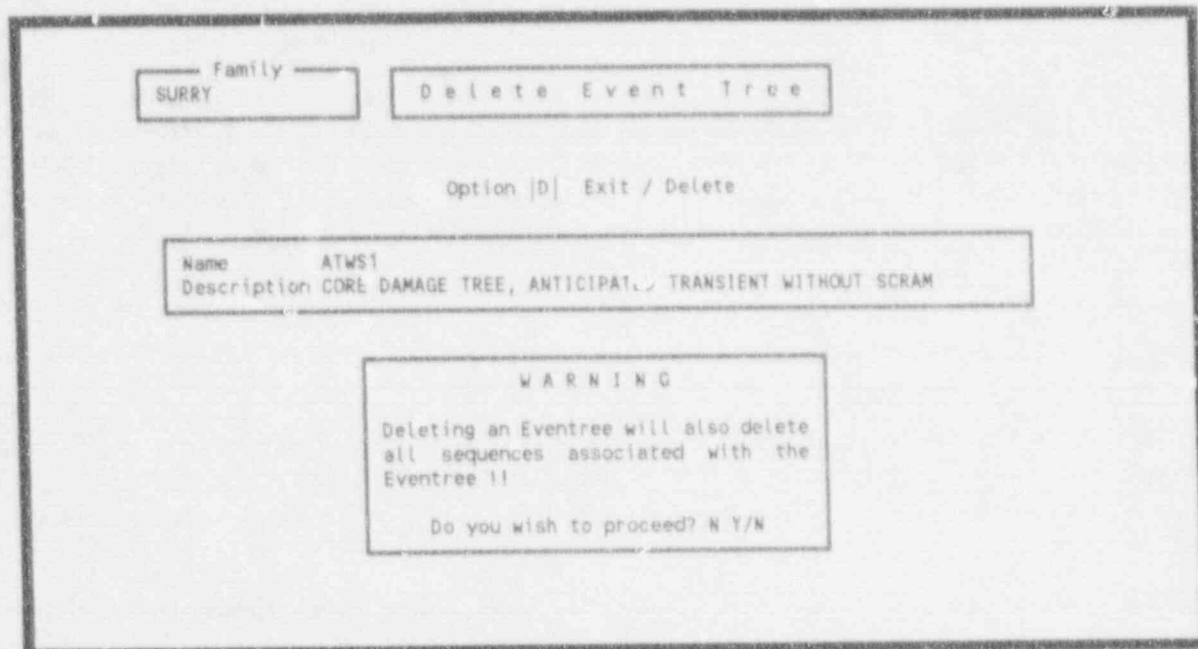
Figure 40. Warning screen for an event tree deletion.

6.3.5 Text

This option allows you to view and edit any descriptive text associated with a specific event tree. This option operates the same as the Text option discussed in the Family section. Refer to Section 6.2.5.

6.3.6 Sequences

This option allows you to modify the sequences associated with an event tree. To invoke this option, type <S> in the option field, highlight an event tree name, and press <Enter>. If an event tree was not highlighted before pressing <Enter>, the message **An event tree must be highlighted first** will be displayed. After highlighting an event tree and pressing <Enter>, the Edit Sequences screen shown in Figure 41 will be displayed. The editing options for sequences are: Exit, Add, Modify, Delete, Text, Base Case Update, and Clear Alternate Case.

6.3.6.1 Exit. This option returns you to the Edit Event Trees screen. To invoke this option, type <E> in the option field and press <Enter>, or press the <Esc> key.

6.3.6.2 Add. This option allows you to add a sequence record to the database. To invoke this option, type <A> in the option field and press <Enter>. The Add Sequence screen is shown in Figure 42. The options at this point are Exit and Add.

```
  ┌─── Family ───┐          ┌──────────────────────┐          ┌── Event Tree ──┐
  │ SURRY        │          │  E d i t   S e q u e n c e s │    │ FT1SB          │
  └──────────────┘          └──────────────────────┘          └────────────────┘

              Option |E|  Exit / Add / Modify / Delete / Text
                          Base Case Update / Clear Alternate Case

  ┌── N a m e ──────────────────── D e s c r i p t i o n ──────────────┐
  │ TK-R-2          ATWS - UNFAVORABLE MODERATOR TEMPERATURE COEFFICIENT │
  │                                                                      │
  │                                                                      │
  │                                                                      │
  │                                                                      │
  │                                                                      │
  └──────────────────────────────────────────────────────────────────┘

  <Esc>      <F1>        <F2>            <F3>            <F4>         <F5>
  Exit       Help        Mark/Clear      Mark/Clear      Mark/Clear   Locate
                         Item            All             Range
```

Figure 41. Sequence selection screen for editing.


```
  ┌─── Family ───┐          ┌──────────────────────┐          ┌── Event Tree ──┐
  │ SURRY        │          │  A d d   S e q u e n c e │        │ FT1SB          │
  └──────────────┘          └──────────────────────┘          └────────────────┘

                        Option |A|  Exit / Add

  ┌──────────────────────────────────────────────────────────────────┐
  │ Name                                                               │
  │ Description                                                        │
  │ End State                                                          │
  │ Flag Set Name                                                      │
  └──────────────────────────────────────────────────────────────────┘
```

Figure 42. Editing screen for adding a sequence.

6.3.6.2.1 Exit—This option returns you to the Edit Sequences screen. To invoke this option, type <E> in the option field and press <Enter>, or press the <Esc> key.

6.3.6.2.2 Add—This option performs the actual add of a new sequence record. To invoke this option, type <A> in the option field, fill in the requested data fields, and press <Enter>. The only required information for a sequence add is the name.

When you position the cursor in the End State Field, a window will appear listing all end states for the current family. Press <F1> to position the cursor in the window. Use the arrow, tab, or space bar keys to scroll through the list of end states. When the desired end state is highlighted, press <Enter>. The selected end state will be placed in the corresponding field.

The Flag Set Name is the name of a change set containing flags to be used when generating cut sets for this sequence. MAR-D uses this default flag set name to modify or prune the fault tree logic for this sequence before it is solved (see Analyze Sequences). Enter a flag set name or leave blank and press <Enter>. Upon pressing <Enter>, the message **Record added** will be displayed at the bottom of the screen.

6.3.6.3 Modify. This option allows you to modify a sequence record. To invoke this option, type <M> in the option field, highlight a sequence name, and press <Enter>. The Modify Sequence screen is shown in Figure 43. The options at this point are Exit and Modify.


```
           ┌─── Family ───┐     ┌─────────────────────────┐     ┌─ Event Tree ─┐
           │ SURRY        │     │  M o d i f y  S e q u e n c e │     │ FT1SB        │
           └──────────────┘     └─────────────────────────┘     └──────────────┘


                            Option |M|  Exit / Modify


           ┌─────────────────────────────────────────────────────────────┐
           │ Name          TK-R-Z                                         │
           │ Description   ATWS - UNFAVORABLE MODERATOR TEMPERATURE COEFFICIENT │
           │ End State     3A /YYXN                                       │
           │ Flag Set Name                                               │
           └─────────────────────────────────────────────────────────────┘
```

Figure 43. Editing screen for modifying a sequence.

6.3.6.3.1 Exit—This option returns you to the Edit Sequences screen. To invoke this option, type <E> in the option field and press <Enter>, or press the <Esc> key.

6.3.6.3.2 Modify—This option performs the actual modification of the sequence record. To invoke this option, type <M> in the option field, modify any of the data fields on the Modify Sequence screen, and press <Enter>. You will be returned to the Edit Sequences screen with the message **Record Modified** displayed at the bottom of the screen.

6.3.6.4 Delete. This option allows you to delete a sequence record. To invoke this option, type <D> in the option field, highlight a sequence name, and press <Enter>. The Delete Sequence screen is shown in Figure 44. Two options are available: Exit and Delete.

```
┌─── Family ───┐   ┌──────────────────────────┐   ┌── Event Tree ──┐
│ SURRY        │   │  D e l e t e   S e q u e n c e │   │ FT1SB          │
└──────────────┘   └──────────────────────────┘   └────────────────┘


                      Option |E|  Exit / Delete


  ┌────────────────────────────────────────────────────────────────┐
  │ Name        TK-R-Z                                              │
  │ Description ATWS - UNFAVORABLE MODERATOR TEMPERATURE COEFFICIENT │
  └────────────────────────────────────────────────────────────────┘
```

Figure 44. Editing screen for deleting a sequence.

6.3.6.4.1 Exit—This option returns you to the Edit Sequences screen. To invoke this option, type < E > in the option field and press < Enter >, or press the < Esc > key.

6.3.6.4.2 Delete—This option performs the actual deletion of the sequence record. To invoke this option, type < D > in the option field and press < Enter >. The message **Record deleted.** will be displayed at the bottom of the screen.

6.3.6.5 Text. This option allows you to view and edit any descriptive text associated with a specific sequence. This option operates the same as the Text option discussed in the Family section. Refer to Section 6.2.5.

6.3.6.6 Base Case Update. This option allows you to overwrite all base case (original) data with the current case data. The base case cut sets will be set to the alternate case cut sets; the base case uncertainty data will be set to the current case uncertainty data; and the base case quantile values will be set equal to the quantile values for the current case. The base case minimum cut set upper bound will be initialized to the current case minimum cut set upper bound. **WARNING: The original base case data will be lost if this option is executed!**

The base case update may be performed on a single sequence, a group of sequences, or on all of the sequences in the current family. To activate this option for a single sequence, type a < B > (Base Case Update) in the option field, highlight the desired sequence, and press < Enter >. To perform a base case update on a group of sequences, mark the desired sequences using the F2, F3, or F4 keys, type a < B > in the option field and press < Enter >. To perform this option on all sequences in the current family, type a < B > in the option field and press < Enter >. A message **Process all records? (Y/N)** will appear at the bottom of the screen. Type a < Y > to continue the base case update for all of the sequences, or type an < N > to discontinue the update for all sequences.

A warning screen (Figure 45) will then be displayed asking for a (Y/N) confirmation prior to performing the update. To terminate the update, type an < N > in the option field or press the < Esc > key. To initiate the base case update, type a < Y > in the option field. This will cause the current case data to overwrite the base case data. Upon completion of this process, a message **Base case update complete** will be displayed at the bottom of the screen.

```
┌─────────────────────────────────────────────────────────────────────────────┐
│                                                                               │
│     ┌─── Family ───┐        ┌─────────────────────────┐   ┌─── Event Tree ──┐ │
│     │ SURRY        │        │ E d i t   S e q u e n c e s │   │ FT1SB         │ │
│     └──────────────┘        └─────────────────────────┘   └───────────────┘   │
│                                                                               │
│              Option |B|  Exit / Add / Modify / Delete / Text                  │
│                          Base Case Update / Clear Alternate Case              │
│                                                                               │
│          ┌──────────────────── Base Case Update ─────────────────────┐        │
│          │                                                           │        │
│          │  WARNING: This option will transfer the alternate or temporary  values │
│          │           stored in the data base to the base case.  The old base case │
│          │           will be lost.                                   │        │
│          │                                                           │        │
│          │                                                           │        │
│          │                                                           │        │
│          │  Are you sure you want to do this? (Y/N) N                │        │
│          │                                                           │        │
│          └───────────────────────────────────────────────────────────┘        │
│                                                                               │
└─────────────────────────────────────────────────────────────────────────────┘
```
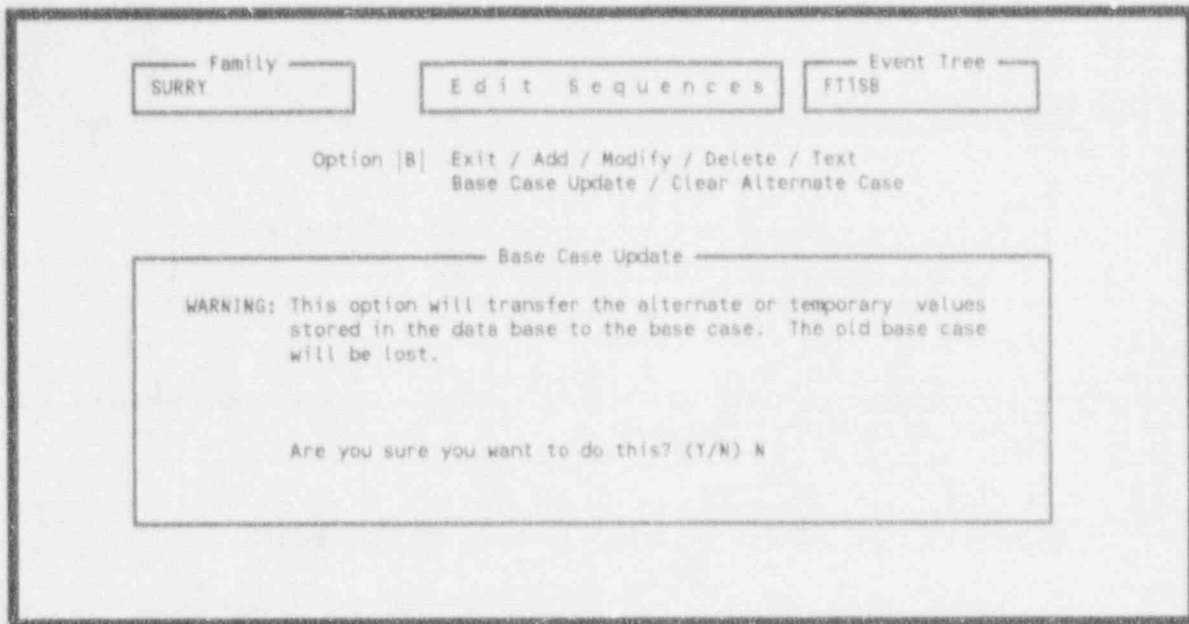
Figure 45. Base case update for sequences.

6.3.6.7 Clear Alternate Case. This option clears all alternate case information for the specified sequence(s). To invoke this option, type a <C> in the option field, highlight the desired sequence and press <Enter>. A warning will be displayed (see Figure 46). To continue enter a <Y> and press <Enter>; otherwise enter an <N> and press <Enter> to terminate the process.

```
┌─────────────────────────────────────────────────────────────────────────────┐
│                                                                               │
│     ┌─── Family ───┐        ┌─────────────────────────┐   ┌─── Event Tree ──┐ │
│     │ SURRY        │        │ E d i t   S e q u e n c e s │   │ FT1SB         │ │
│     └──────────────┘        └─────────────────────────┘   └───────────────┘   │
│                                                                               │
│              Option |C|  Exit / Add / Modify / Delete / Text                  │
│                          Base Case Update / Clear Alternate Case              │
│                                                                               │
│          ┌─────────────────── Clear Alternate Case ──────────────────┐        │
│          │                                                           │        │
│          │  WARNING: This option will clear the alternate or temporary values │
│          │           stored in the data base.                       │        │
│          │                                                           │        │
│          │                                                           │        │
│          │                                                           │        │
│          │  Are you sure you want to do this? (Y/N) N                │        │
│          │                                                           │        │
│          └───────────────────────────────────────────────────────────┘        │
│                                                                               │
└─────────────────────────────────────────────────────────────────────────────┘
```
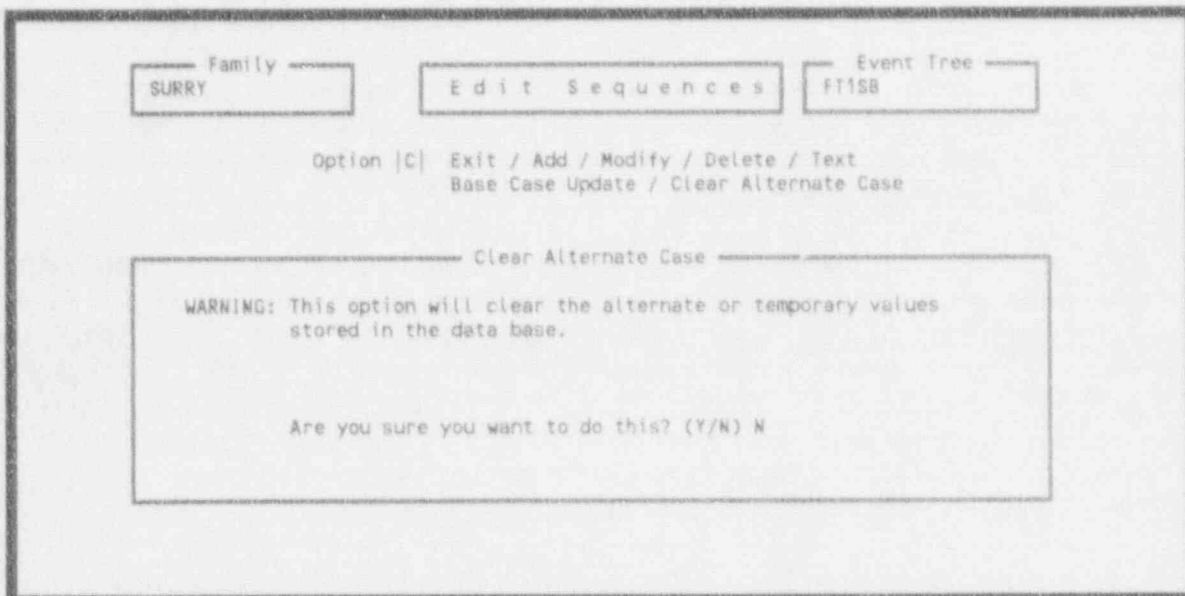
Figure 46. Clear alternate case for selected sequence(s).

6.3.7 Base Case Update

This option operates the same as described in Section 6.3.6.6, except all sequences for the specified event tree are updated.

6.3.8 Clear Alternate Case

This option operates the same as described in Section 6.3.6.7, except the alternate case information for all sequences for the specified event tree is cleared (see Figure 47).

```
┌───── Family ─────┐        ┌──────────────────────────────────┐
│ SURRY            │        │  E d i t   E v e n t   T r e e s │
└──────────────────┘        └──────────────────────────────────┘

        Option |C|  Exit / Add / Modify / Delete / Text / Sequences
                    Base Case Update / Clear Alternate Case

        ┌──────────────────── Clear Alternate Case ────────────────────┐
        │                                                              │
        │  WARNING: This option will clear the alternate or temporary values │
        │           stored in the data base for all the sequences associated │
        │           with the highlighted/marked event tree.            │
        │                                                              │
        │                                                              │
        │           Are you sure you want to do this? (Y/N) N          │
        │                                                              │
        └──────────────────────────────────────────────────────────────┘
```

Figure 47. Clear alternate case for event trees.

6.4 SYstems

This option allows you to modify system data records. To invoke this option, type < Y > in the option field or highlight SYstems and press < Enter >. The Edit Systems screen lists all of the systems contained in the current family (Figure 48). The modification options are: Exit, Add, Modify, Delete, Text, Base Case Update, and Clear Alternate Case.

6.4.1 Exit

This option returns you to the Modify Database menu. To invoke this option, type < E > in the option field and press < Enter >, or press the < Esc > key.

```
┌──────────────────────────────────────────────────────────────────────────────┐
│                                                                                │
│    ┌─── Family ───┐         ┌──────────────────────────┐                       │
│    │ SURRY        │         │   E d i t   S y s t e m s │                       │
│    └──────────────┘         └──────────────────────────┘                       │
│                                                                                │
│              Option |E|  Exit / Add / Modify / Delete / Text                   │
│                          Base Case Update / Clear Alternate Case               │
│                                                                                │
│    ┌─── N a m e ──────────────────── D e s c r i p t i o n ──────────────┐     │
│    │ C           CONTAINMENT SPRAY                                        │     │
│    │ CS          CONTAINMENT SYSTEMS                                      │     │
│    │ CV          CORE VULNERABLE TO CD                                    │     │
│    │ D1          HIGH PRESSURE INJECTION - AUTOMATIC                      │     │
│    │ D2          HIGH PRESSURE INJECTION - MANUAL                         │     │
│    │ D3          HIGH PRESSURE INJECTION - RCP SEALS                      │     │
│    │ D4          HIGH PRESSURE INJECTION - EMERGENCY BORATION             │     │
│    │ D5          ACCUMULATORS                                             │     │
│    │ D6          LOW PRESSURE INJECTION                                   │     │
│    │ F1          INSIDE SPRAY RECIRCULATION                               │     │
│    └─────────────────────────────────────────────────────────────────────┘     │
│                                                                                │
│   <Esc>       <F1>        <F2>          <F3>          <F4>          <F5>        │
│   Exit        Help      Mark/Clear    Mark/Clear    Mark/Clear     Locate       │
│                           Item           All          Range                     │
│                                                                                │
└──────────────────────────────────────────────────────────────────────────────┘
```

Figure 48. Selection screen for system editing.

4.2 Add

This option allows you to add a system record to the current family. To invoke this option, type <A> in the option field and press <Enter>. The Add System screen is shown in Figure 49. The options at this point are Exit and Add.

```
┌──────────────────────────────────────────────────────────────────────────────┐
│                                                                                │
│      ┌─── Family ───┐         ┌──────────────────────┐                         │
│      │ SURRY        │         │  A d d   S y s t e m  │                         │
│      └──────────────┘         └──────────────────────┘                         │
│                                                                                │
│                       Option |A|  Exit / Add                                   │
│                                                                                │
│   ┌──────────────────────────────────────────────────────────────┐            │
│   │ Name                                                          │            │
│   │ Description                                                    │            │
│   │ System Code        MinCut Upperbound ------E----               │            │
│   └──────────────────────────────────────────────────────────────┘            │
│                                                                                │
└──────────────────────────────────────────────────────────────────────────────┘
```

Figure 49. Editing screen for adding a system.

6.4.2.1 Exit. This option returns you to the Edit Systems screen. To invoke this option, type <E> in the option field and press <Enter>, or press the <Esc> key.

6.4.2.2 Add. This option performs the actual add of a new system record. To invoke this option, type <A> in the option field, fill in the requested data fields, and press <Enter>. The only required information for a system add is the name. When complete, you will be returned to the Edit Systems screen with the message **Record Added** displayed.

6.4.3 Modify

This option allows you to modify a system record. To invoke this option, type <M> in the option field, highlight a system name, and press <Enter>. The Modify System screen is shown in Figure 50. The options at this point are Exit and Modify.


```
┌─── Family ───┐        ┌──────────────────────────┐
│ SURRY        │        │  M o d i f y   S y s t e m │
└──────────────┘        └──────────────────────────┘


                    Option |M|  Exit / Modify


        ┌─────────────────────────────────────────────────────┐
        │ Name         CV                                      │
        │ Description CORE VULNERABLE TO CD                     │
        │ System Code        Mincut Upperbound  2.000E-002     │
        └─────────────────────────────────────────────────────┘
```

Figure 50. Editing screen for modifying a system.

6.4.3.1 Exit. This option returns you to the Edit Systems screen. To invoke this option, type <E> in the option field and press <Enter,> or press the <Esc> key.

6.4.3.2 Modify. This option performs the actual modification of the system record. To invoke this option, type <M> in the option field, modify any of the data fields on the Modify System screen, and press <Enter>. When completed, you will be returned to the Edit Systems screen with the message **Record modified** displayed.

6.4.4 Delete

This option allows you to delete a system record from the database. To invoke this option, type <D> in the option field, highlight a system and press <Enter>. The Delete System screen is shown in Figure 51. The options at this point are Exit and Delete.

```
┌──────────────────────────────────────────────────────────────────────┐
│                                                                        │
│     ┌─── Family ───┐      ┌──────────────────────────────┐             │
│     │ SURRY        │      │  D e l e t e   S y s t e m   │             │
│     └──────────────┘      └──────────────────────────────┘             │
│                                                                        │
│                          Option [E]  Exit / Delete                     │
│                                                                        │
│     ┌────────────────────────────────────────────────────────┐        │
│     │ Name         CV                                         │        │
│     │ Description CORE VULNERABLE TO CD                       │        │
│     └────────────────────────────────────────────────────────┘        │
│                                                                        │
└──────────────────────────────────────────────────────────────────────┘
```

Figure 51. Editing screen for deleting a system.

6.4.4.1 Exit. This option returns you to the Edit Systems screen. To invoke this option, type <E> in the option field and press <Enter>, or press the <Esc> key.

6.4.4.2 Delete. This option performs the actual deletion of the system record. To invoke this option, type <D> in the option field and press <Enter>. When complete, you will be returned to the Edit Systems screen with the message **Record deleted** displayed.

6.4.5 Text

This option allows you to view and edit any descriptive text associated with a specific system. This option operates the same as the Text option discussed in the Family section. Refer to Section 6.2.5.

6.4.6 Base Case Update

This option operates the same as described for sequences in Section 6.3.6.6. Here, the update is performed on an entire system(s).

6.4.7 Clear Alternate Case

This option operates the same as described for sequences in Section 6.3.6.7. Here, the clearing is performed on an entire system(s).

6.5 ENd States

This option allows you to modify the end state data records. To invoke this option, type <N> in the option field or highlight ENd States and press <Enter>. The Edit End State screen, which lists all of the end states belonging to the current family, is shown in Figure 52. The modification options are: Exit, Add, Modify, Delete, Text, Base Case Update, and Clear Current Case.

```
┌─── Family ───┐        ┌────────────────────────────────────┐
│ SURRY        │        │  E d i t   E n d   S t a t e       │
└──────────────┘        └────────────────────────────────────┘

          Option |E|  Exit / Add / Modify / Delete / Text
                      Base Case Update / Clear Current Case

   ─── N a m e ─────────────────────── D e s c r i p t i o n ───
   AINY-YYN        LARGE LOCA - LPR FAILURE, CHR FAILS, RCP SEAL CLNG FAILS
   AISY-YYN        LARGE LOCA - LPI FAILS, CHR FAILS, RCP SEAL CLNG FAILS
   AIYY-YYN        LARGE LOCA - LPR FAILURE, RCP SEAL COOLING FAILS
   ALNY-YYY        LARGE LOCA - HPI FAILURE, CHR FAILS
   ALSY-YYY        LARGE LOCA - HPI FAILURE, CHR FAILS
   ALYY-YYY        LARGE LOCA - HPI FAILURE
   ANNY-NYN        LARGE LOCA - ECCS FAILS, CHR FAILS, RWST FAILS, RCP
   ANNY-NYY        LARGE LOCA - ECCS FAILS, CHR FAILS, RWST FAILS
   ANNY-YYN        LARGE LOCA - ECCS FAILS, CHR FAILS, RCP SEAL COOLING FAILS
   ANSY-YYN        LARGE LOCA - ECCS FAILURE, CHR FAILS, RCP SEAL CLNG FAILS

<Esc>     <F1>        <F2>          <F3>          <F4>          <F5>
Exit      Help      Mark/Clear    Mark/Clear    Mark/Clear    Locate
                       Item          All          Range
```

Figure 52. Selection screen for end state editing.

6.5.1 Exit

This option returns you to the Modify Database menu. To invoke this option, type <E> in the option field and press <Enter>, or press the <Esc> key.

6.5.2 Add

This option allows you to add an end state record to the current family. To invoke this option, type <A> in the option field and press <Enter>. The Add End State screen is shown in Figure 53. The options at this point are Exit and Add.

6.5.2.1 Exit. This option returns you to the Edit End State screen. To invoke this option, type <E> in the option field and press <Enter>, or press the <Esc> key.

Figure 53. Editing screen for adding an end state.

6.5.2.2 Add. This option performs the actual add of a new end state record. To invoke this option, type <A> in the option field, fill in the requested data fields, and press <Enter>. The only required information for an end state add is the name. When complete, you will be returned to the Edit End State screen with the message **Record added** displayed.

6.5.3 Modify

This option allows you to modify an end state record. To invoke this option, type <M> in the option field, highlight an end state name, and press <Enter>. The Modify End State screen is shown in Figure 54. The options at this point are Exit and Modify.

Figure 54. Editing screen for modifying an end state.

6.5.3.1 Exit. This option returns you to the Edit End State screen. To invoke this option, type <E> in the option field and press <Enter>, or press the <Esc> key.

6.5.3.2 Modify. This option performs the actual modification of the end state record. To invoke this option, type <M> in the option field, modify any of the data fields on the Modify End State

screen, and press <Enter>. When complete, you will be returned to the Edit End State screen with the message **Record modified** displayed at the bottom of the screen.

6.5.4 Delete

This option allows you to delete an end state record from the database. To invoke this option, type <D> in the option field, highlight an end state and press <Enter>. The Delete End State screen is shown in Figure 55. The options at this point are Exit and Delete.

```
  ┌──── Family ────┐   ┌───────────────────────────────┐
  │ SURRY          │   │  D e l e t e   E n d   S t a t e  │
  └────────────────┘   └───────────────────────────────┘


                        Option |E|  Exit / Delete

  ┌──────────────────────────────────────────────────────────────┐
  │ Name        1IYYYYN                                           │
  │ Description MEDIUM LOCA - LPR FAILURE - RCP SEAL COOLING FAILS │
  └──────────────────────────────────────────────────────────────┘
```

Figure 55. Editing screen for deleting an end state.

6.5.4.1 Exit. This option returns you to the Edit End State screen. To invoke this option, type <E> in the option field and press <Enter>, or press the <Esc> key.

6.5.4.2 Delete. This option performs the actual deletion of the end state record. To invoke this option, type <D> in the option field and press <Enter>. When complete, you will be returned to the Edit End State screen with the message **Record deleted** displayed at the bottom of the screen.

6.5.5 Text

This option allows you to view and edit any descriptive text associated with a specific end state. This option operates the same as the Text option discussed in the Family section. Refer to Section 6.2.5.

6.5.6 Base Case Update

This operates the same as described for sequences in Section 6.3.6.6.

6.5.7 Clear Current Case

This option clears all current case information from the specified end state(s). This option works similar to that described for sequences in Section 6.3.6.7.

6.6 Basic Events

This option allows you to modify the basic event data records. To invoke this option, type <B> in the option field or highlight Basic Events and press <Enter>. The Edit Events screen, listing all of the basic events belonging to the current family, is displayed (Figure 56). The modification options are: Exit, Add, Modify, Delete, and Remove Unused Events.

```
┌─── Family ───┐        ┌──────────────────────┐
│ SURRY        │        │  E d i t   E v e n t s │
└──────────────┘        └──────────────────────┘


        Option |E|  Exit / Add / Modify / Delete / Remove Unused Events

   ┌─── N a m e ──────────────────── D e s c r i p t i o n ─────────────┐
   │ ACC-CKV-FT-CV107   CHECK VALVE CV107 FAILS TO OPEN                  │
   │ ACC-CKV-FT-CV109   CHECK VALVE CV109 FAILS TO OPEN                  │
   │ ACC-CKV-FT-CV128   CHECK VALVE CV128 FAILS TO OPEN                  │
   │ ACC-CKV-FT-CV130   CHECK VALVE CV130 FAILS TO OPEN                  │
   │ ACC-CKV-FT-CV145   CHECK VALVE CV145 FAILS TO OPEN                  │
   │ ACC-CKV-FT-Cv147   CHECK VALVE CV147 FAILS TO OPEN                  │
   │ ACC-MOV-PG-1865A   ACC MOTOR OPERATED VALVE 1865A PLUGGED           │
   │ ACC-MOV-PG-1865B   ACC MOTOR OPERATED VALVE 1865B PLUGGED           │
   │ ACC-MOV-PG-1865C   ACC MOTOR OPERATED VALVE 1865C PLUGGED           │
   │ ACP-BAC-ST-1H1     480V AC BUS 1H1 BUSWORK FAILURE                  │
   └────────────────────────────────────────────────────────────────────┘

           NOTE:  A '-' in the mark column indicates an unused event.
  <Esc>    <F1>       <F2>           <F3>          <F4>          <F5>
  Exit     Help       Mark/Clear     Mark/Clear    Mark/Clear    Locate
                      Item           All           Range
```

Figure 56. Selection screen for basic event editing.

6.6.1 Exit

This option returns you to the Modify Database menu. To invoke this option, type <E> in the option field and press <Enter>, or press the <Esc> key.

6.6.2 Add

This option allows you to add a basic event record to the current family. To invoke this option, type <A> in the option field and press <Enter>. The Add Event screen is shown in Figure 57. The options at this point are Exit and Add.

6.6.2.1 Exit. This option returns you to the Edit Events screen. To invoke this option, type <E> in the option field and press <Enter>, or press the <Esc> key.

6.6.2.2 Add. This option performs the actual add of a new basic event record. To invoke this option, type <A> in the option field, fill in the requested data fields, and press <Enter>. The only required information for a basic event add is the name. When complete, you will be returned to the Edit

Figure 57. Editing screen for adding a basic event.

Event screen with the message **Record Added** displayed at the bottom of the screen.

6.6.3 Modify

This option allows you to modify a basic event record. To invoke this option, type < M > in the option field, highlight a basic event name, and press < Enter >. The Modify Basic Event screen is shown in Figure 58. The options at this point are Exit and Modify.

6.6.3.1 Exit. This option returns you to the Edit Events screen. To invoke this option, type < E > in the option field and press < Enter >, or press the < Esc > key.

6.6.3.2 Modify. This option performs the actual modification of the basic event record. To invoke this option, type < M > in the option field, modify any of the data fields on the Modify Event screen, and press < Enter >. When complete, you will be returned to the Edit Events screen with the message **Record Modified** displayed at the bottom of the screen.

6.6.4 Delete

This option allows you to delete a basic event record from the current family. To invoke this option, type < D > in the option field, highlight a basic event and press < Enter >. The Delete Event screen is shown in Figure 59. The options at this point are Exit and Delete.

```
┌──────────────────────────────────────────────────────────────────────────┐
│                                                                            │
│    ┌── Family ──┐              ┌──────────────────────────┐                │
│    │ SURRY      │              │  M o d i f y   E v e n t │                │
│    └────────────┘              └──────────────────────────┘                │
│                                                                            │
│                          Option |M|  Exit / Modify                         │
│                                                                            │
│    ┌──────────────────── Event Attributes ──────────────────────────┐      │
│    │      Names        Comp Id   Sys   Train  Type  F/Mode Location Init? │ │
│    │ <P>ACC-CKV-FT-CV109  CV109   ACC          CKV     FT             N  │  │
│    │ <A>ACC-CKV-FT-CV109                                                │  │
│    │ <G>ACCCKVCV109        1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16       │  │
│    │ Class Attributes      N N N N N N N N N N  N  N  N  N  N  N        │  │
│    │                                                                   │  │
│    │ Description   CHECK VALVE CV109 FAILS TO OPEN                      │  │
│    └───────────────────────────────────────────────────────────────────┘  │
│          ┌──── Uncertainty Data ─────┐  ┌──── Failure Data ──────┐          │
│          │ Distribution Type ───> L  │  │ Calculation Type ──> 1 │          │
│          │ (press <F1> for list of types) (press <F1> for list of types)    │
│          │ Value ──────> 3.000E+000  │  │ Probability ──> 1.000E-004 │       │
│          │ Correlation Class ──> 31  │  │ Lambda ──> +0.000E+000  │          │
│          │ ──── Process Flag ────     │  │ Tau ──> +0.000E+000    │          │
│          │ Flag ──────>              │  │ Mission Time ──> +0.000E+000 │     │
│          └───────────────────────────┘  └────────────────────────┘          │
└──────────────────────────────────────────────────────────────────────────┘
```

Figure 58. Editing screen for modifying a basic event.

```
┌──────────────────────────────────────────────────────────────────────────┐
│                                                                            │
│    ┌── Family ──┐              ┌──────────────────────────┐                │
│    │ SURRY      │              │  D e l e t e   E v e n t │                │
│    └────────────┘              └──────────────────────────┘                │
│                                                                            │
│                          Option |E|  Exit / Delete                         │
│                                                                            │
│    ┌──────────────────── Event Attributes ──────────────────────────┐      │
│    │      Names        Comp Id   Sys   Train  Type  F/Mode Location Init? │ │
│    │ <P>ACC-CKV-FT-CV128           ACC          CKV     FT             Y  │  │
│    │ <A>ACC-CKV-FT-CV128                                                │  │
│    │ <G>ACCCKV             1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16       │  │
│    │   Class Attributes    N N N N N N N N N N  N  N  N  N  N  N        │  │
│    │   Description  CHECK VALVE CV128 FAILS TO OPEN                     │  │
│    └───────────────────────────────────────────────────────────────────┘  │
└──────────────────────────────────────────────────────────────────────────┘
```

Figure 59. Editing screen for deleting a basic event.

6.6.4.1 Exit. This option returns you to the Edit Events screen. To invoke this option, type <E> in the option field and press <Enter>, or press the <Esc> key.

6.6.4.2 Delete. This option performs the actual deletion of the basic event record. To invoke this option, type <D> in the option field and press <Enter>. When complete, you will be returned to the Edit Events screen with the message **Record deleted** displayed at the bottom of the screen.

6.6.5 Remove Unused Event

This option looks at all references to an event in the current family and deletes any events that are not referenced by anything. When you invoke this option, a warning screen will be displayed telling you that all records that are marked as unused will be deleted. At this prompt, enter a <Y> to continue the deletion process, or enter an <N> to terminate without deleting the unused events (Figure 60).
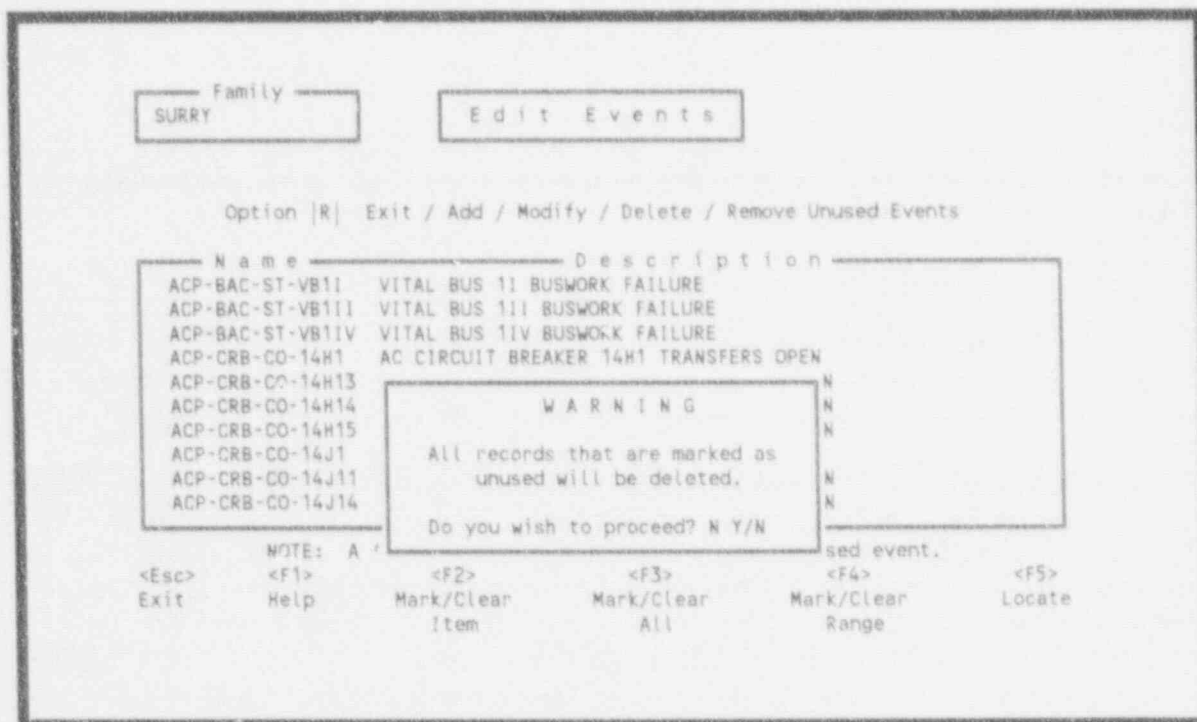
Figure 60. Remove unused events prompt.

6.7 Attributes

This option allows you to edit the six attributes in the current family (Figure 61): System, Location, Failure Mode, Class Attribute, Basic Event Type, and Trains. The options available within each of these attributes are: Exit, Add, Modify, and Delete.
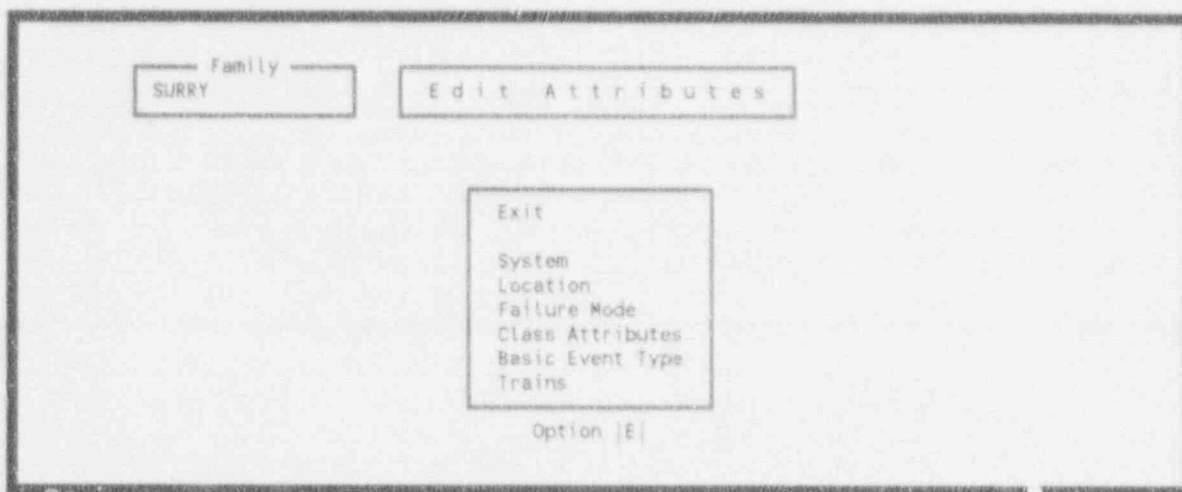
Figure 61. Attribute selection for editing.

The Edit Attributes screen shown in Figure 61 and succeeding screens (Figure 62 - Figure 65) are consistent throughout the attributes option for each of the six categories. Because this option operates the same for all six attribute categories, a generic write-up is presented.

To invoke this option, type < A > in the option field or highlight Attributes and press < Enter >. This will display a list of attribute categories (see Figure 61). Highlighting a category or typing a category's highlighted letter and pressing < Enter > displays the list of attributes available under the selected category. For each attribute category, the following options are available: Exit, Add, Modify, and Delete.

6.7.1 Exit

This option returns you to the Modify Database menu. To invoke this option, type < E > in the option field and press < Enter >, or press the < Esc > key.

```
  +-- Family --+        +-------------------------+        +--- Type ----+
  | SURRY      |        |  E d i t   A t t r i b u t e s |  | ATTRIBUTE NAME |
  +------------+        +-------------------------+        +-------------+

                    Option |E|  Exit / Add / Modify / Delete
        +-- N a m e -----------------+--- D e s c r i p t i o n ----+
        |                                                           |
        |  The NAME column will contain the list of systems, failure modes, etc. |
        |  available for the current family.                        |
        |                                                           |
        |  The DESCRIPTION column will contain the corresponding description for |
        |  each attribute displayed.                                |
        |                                                           |
        |                                                           |
        +-----------------------------------------------------------+

  <Esc>      <F1>        <F2>            <F3>            <F4>          <F5>
  Exit       Help        Mark/Clear      Mark/Clear      Mark/Clear    Locate
                         Item            All             Range
```

Figure 62. Selection screen for attribute editing.

```
  +-- Family --+        +-------------------------+        +--- Type ----+
  | SURRY      |        |  A d d   A t t r i b u t e |    | ATTRIBUTE NAME |
  +------------+        +-------------------------+        +-------------+

                       Option |A|  Exit / Add

  +-----------------------------------------------------------+
  | Attribute Name                                            |
  | Description                                               |
  +-----------------------------------------------------------+
```

Figure 63. Editing screen for adding an attribute.

Figure 64. Editing screen for modifying an attribute.

Figure 65. Editing screen for deleting an attribute.

6.7.2 Add

The add option allows you to add a new attribute record to the current family. To invoke this option, type <A> in the option field and press <Enter>. The Add Attribute screen is shown in Figure 63. The options at this point are Exit and Add.

6.7.2.1 Exit. This option returns you to the Edit Attributes screen. To invoke this option, type <E> in the option field and press <Enter>, or press the <Esc> key.

6.7.2.2 Add. This option performs the actual add of a new attribute record. To invoke this option, type <A> in the option field, fill in the requested data fields, and press <Enter>. The only required information for an attribute add is the name. When complete, you will be returned to the Edit Attributes screen with the message **Record added** displayed at the bottom of the screen.

6.7.3 Modify

This option allows you to modify an attribute record. To invoke this option, type <M> in the option field, highlight an attribute name, and press <Enter>. The Modify Attribute screen is shown in Figure 64. The options at this point are Exit and Modify.

6.7.3.1 Exit. This option returns you to the Edit Attributes screen. To invoke this option, type <E> in the option field and press <Enter>, or press the <Esc> key.

6.7.3.2 Modify. This option performs the actual modification of the attribute record. To invoke this option, type <M> in the option field, modify any of the data fields on the Modify Attribute screen, and press <Enter>. When complete, you will be returned to the Edit Attributes screen with the message **Record modified** displayed at the bottom of the screen.

6.7.4 Delete

This option allows you to delete an attribute record from the current family. To invoke this option, type <D> in the option field, highlight an attribute and press <Enter>. The Delete Attribute screen is shown in Figure 65. The options at this point are Exit and Delete.

6.7.4.1 Exit. This option returns you to the Edit Attributes screen. To invoke this option, type <E> in the option field and press <Enter>, or press the <Esc> key.

6.7.4.2 Delete. This option performs the actual deletion of the attribute record. To invoke this option, type <D> in the option field and press <Enter>. When complete, you will be returned to the Edit Attributes screen with the message **Record deleted** displayed at the bottom of the screen.

6.8 GaTes

This option allows you to modify gate records. To invoke this option, type <T> in the option field or highlight GaTes and press <Enter>. The Edit Gates screen, listing all of the gates belonging to the current family, is displayed (Figure 66). The modification options are: Exit, Add, Modify, and Delete.

6.8.1 Exit

This option returns you to the Modify Database menu. To invoke this option, type <E> in the option field and press <Enter>, or press the <Esc> key.

6.8.2 Add

This option allows you to add a gate record to the current family. To invoke this option, type
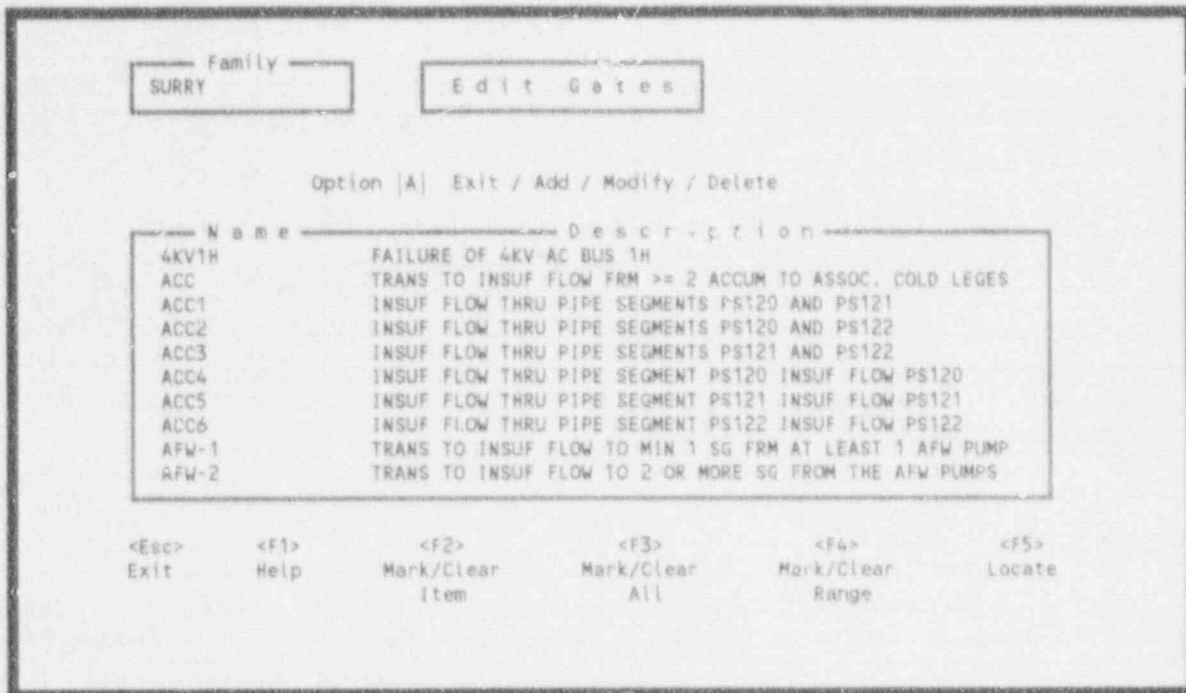
Figure 66. Selection screen for gate editing.

<A> in the option field and press <Enter>. The Add Gate screen is shown in Figure 67. The options at this point are Exit and Add.

6.8.2.1 Exit. This option returns you to the Edit Gates screen. To invoke this option, type <E> in the option field and press <Enter>, or press the <Esc> key.

6.8.2.2 Add. This option performs the actual add of a new gate record. To invoke this option, type <A> in the option field, fill in the requested data fields, and press <Enter>. The only required information for a gate add is the name and type fields. When complete, you will be returned to the Edit Gates screen with the message **Record Added** displayed at the bottom of the screen

6.8.3 Modify

This option allows you to modify a gate record. To invoke this option, type <M> in the option field, highlight a gate name, and press <Enter>. The Modify Gate screen is shown in Figure 68. The options at this point are Exit and Modify.

6.8.3.1 Exit. This option returns you to the Edit Gates screen. To invoke this option, type <E> in the option field and press <Enter>, or press the <Esc> key.

```
┌────────────────────────────────────────────────────────────────┐
│                                                                │
│   ── Family ──         ┌───────────────────┐                   │
│   SURRY                │  A d d   G a t e   │                   │
│                        └───────────────────┘                   │
│                                                                │
│                  Option |A|  Exit / Add                        │
│                                                                │
│   ┌──────────────────────────────────────────────────────┐    │
│   │ Name                                                  │    │
│   │ Description                                           │    │
│   │ Type                                                  │    │
│   └──────────────────────────────────────────────────────┘    │
│                                                                │
│                                                                │
│                                                                │
│                                                                │
└────────────────────────────────────────────────────────────────┘
```

Figure 67. Editing screen for adding a gate.

```
┌────────────────────────────────────────────────────────────────┐
│                                                                │
│     ── Family ──          ┌───────────────────────┐            │
│     SURRY                 │  M o d i f y   G a t e │            │
│                           └───────────────────────┘            │
│                                                                │
│                   Option |M|  Exit / Modify                    │
│                                                                │
│     ┌────────────────────────────────────────────────────┐    │
│     │ Name          GATE1                                 │    │
│     │ Description                                         │    │
│     │ Type          OR                                    │    │
│     └────────────────────────────────────────────────────┘    │
│                                                                │
│                                                                │
│                                                                │
└────────────────────────────────────────────────────────────────┘
```

Figure 68. Editing screen for modifying a gate.

6.8.3.2 Modify. This option performs the actual modification of the gate record. To in...
this option, type <M> in the option field, modify any of the data fields on the Modify Gate screen, and
press <Enter>. When complete, you will be returned to the Edit Gates screen with the message **Record
Modified** displayed at the bottom of the screen.

6.8.4 Delete

This option allows you to delete a gate record from the current family. To invoke this option,
type <D> in the option field, highlight the gate to be deleted, and press <Enter>. The Delete Gate
screen is shown in Figure 69. The options at this point are Exit and Delete.


```
          ─── Family ───            ┌──────────────────────────┐
          SURRY                     │   D e l e t e    G a t e │
                                    └──────────────────────────┘


                           Option |E| Exit / Delete

          ┌─────────────────────────────────────────────────────┐
          │ Name        123GATE                                  │
          │ Description                                          │
          └─────────────────────────────────────────────────────┘
```

Figure 69. Editing screen for deleting a gate.

6.8.4.1 Exit. This option returns you to the Edit Gates screen. To invoke this option, type
<E> in the option field and press <Enter>, or press the <Esc> key.

6.8.4.2 Delete. This option performs the actual deletion of the gate record. To invoke this
option, type a <D> in the option field and press <Enter>. When complete, you will be returned to
the Edit Gates screen with the message **Record deleted** displayed at the bottom of the screen.

6.9 Graphics

This option allows you to edit three categories of graphics data records (Figure 70). They are:
Fault Tree Graphics, Event Tree Graphics, and P&ID Graphics. The options available within each of
these categories are: Exit, Add, Modify, and Delete.

The Edit Graphics screen shown in Figure 71 and succeeding screens Figure 72 through
Figure 74 are consistent throughout the graphics option for each of the three categories.

```
┌─────────────────────────────────────────────────────────────────────┐
│                                                                       │
│      ┌──── Family ────┐      ┌──────────────────────────┐             │
│      │ SURRY          │      │  E d i t   G r a p h i c s │            │
│      └────────────────┘      └──────────────────────────┘             │
│                                                                       │
│                      ┌────────────────────────┐                       │
│                      │  Exit                  │                       │
│                      │                        │                       │
│                      │  Fault Tree Graphics   │                       │
│                      │                        │                       │
│                      │  EVent Tree Graphics   │                       │
│                      │                        │                       │
│                      │  P&ID Graphics         │                       │
│                      └────────────────────────┘                       │
│                                                                       │
│                          Option |E|                                   │
│                                                                       │
└─────────────────────────────────────────────────────────────────────┘
```
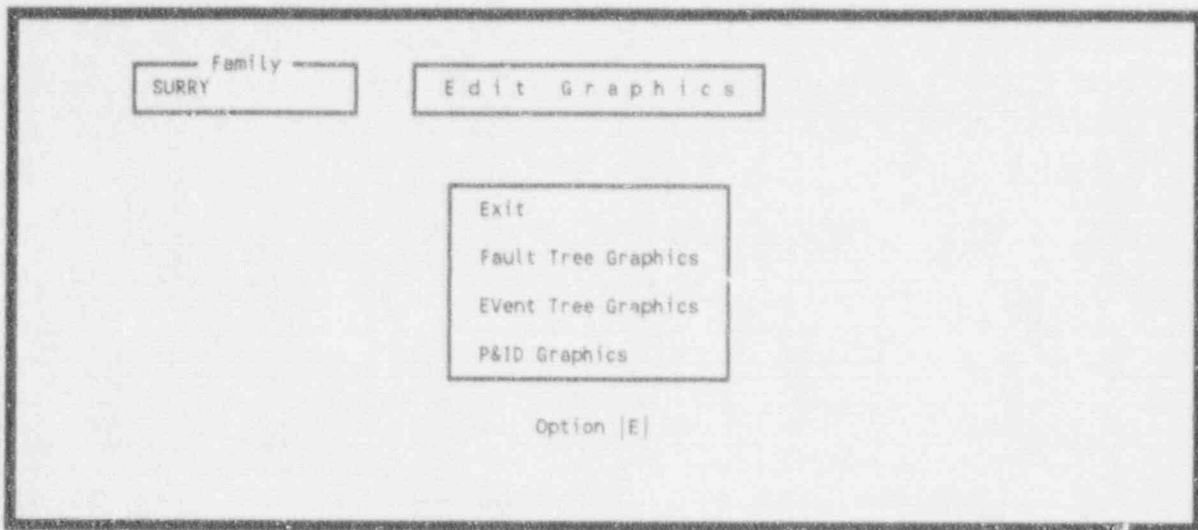
Figure 70. Selection of graphics type for editing.

To invoke this option, type < G > in the option field or highlight Graphics and press < Enter >. This will display a list of graphics categories. Highlighting a category or typing a category's highlighted letter and pressing < Enter > displays the list of graphics records available under the selected category.

6.9.1 Exit

This option returns you to the Edit Graphics main menu. To invoke this option, type < E > in the option field and press < Enter >, or press the < Esc > key.

```
┌──────────────────────────────────────────────────────────────────────┐
│                                                                        │
│   ┌── Family ──┐        ┌──────────────────────────────┐               │
│   │ SURRY      │        │   E d i t   G r a p h i c s  │               │
│   └────────────┘        └──────────────────────────────┘               │
│                                                                        │
│                                                                        │
│              Option |E|  Exit / Add / Modify / Delete                  │
│                                                                        │
│     ┌── N a m e ─────────────── D e s c r i p t i o n ──────────┐      │
│     │ 4KV1H      FAILURE OF 4KV AC BUS 1H              (FT 4KV1H)│      │
│     │ 4KV1J      FAILURE OF 4KV AC BUS 1J              (FT 4KV1J)│      │
│     │ ACC4       INSUFFICIENT FLOW THRU PIPE SEGMENT PS120 (GATE ACC1/FT D5│
│     │ ACC5       INSUFFICIENT FLOW THRU PIPE SEGMENT PS121 (GATE ACC3/FT D5│
│     │ ACC6       INSUFFICIENT FLOW THRU PIPE SEGMENT PS122 (GATE ACC3/FT D5│
│     │ AFW1       INSUFF FLOW THRU PIPE SEG. PS93 TO SG A (GATE L2-2/FT L2) │
│     │ AFW13      INSUFFICIENT FLOW THRU PIPE SEGMENT PS83 (GATE AFW4/FT L) │
│     │ AFW13A     INSUFFICIENT FLOW THRU P PE SEGMENT PS83 (GATE AFW7/FT AFW│
│     │ AFW13B     INSUFFICIENT FLOW THRU PIPE SEGMENT PS83 (GATE AFW9/FT L3)│
│     │ AFW14      INSUFFICIENT FLOW THRU PIPE SEGMENT PS84 (GATE AFW8/FT L) │
│     └──────────────────────────────────────────────────────────┘      │
│                                                                        │
│   <Esc>      <F1>         <F2>           <F3>          <F4>       <F5>  │
│   Exit       Help      Mark/Clear     Mark/Clear    Mark/Clear  Locate │
│                           Item            All          Range           │
│                                                                        │
└──────────────────────────────────────────────────────────────────────┘
```

Figure 71. Selection of graphics picture for editing.

```
┌──────────────────────────────────────────────────────────────────────┐
│                                                                        │
│   ┌── Family ──┐        ┌──────────────────────────────────┐           │
│   │ SURRY      │        │  A d d  G r a p h i c  P i c t u r e│         │
│   └────────────┘        └──────────────────────────────────┘           │
│                                                                        │
│                      Option |A|  Exit / Add                            │
│                                                                        │
│     ┌────────────────────────────────────────────────────────┐        │
│     │ Name                                                    │        │
│     │ Description                                             │        │
│     └────────────────────────────────────────────────────────┘        │
│                                                                        │
└──────────────────────────────────────────────────────────────────────┘
```

Figure 72. Editing screen for adding a graphics picture.

Figure 73. Editing screen for modifying a graphics picture.

Figure 74. Editing screen for deleting a graphics picture.

6.9.2 Fault Tree Graphics

This option allows you to modify the Fault Tree Graphics records. To invoke this option, type < F > in the option field or highlight Fault Tree Graphics and press < Enter >. The screen shown in Figure 71, listing the fault tree graphics (pictures), will be displayed. The option available are Exit, Add, Modify, and Delete.

6.9.2.1 Exit. This option returns you to the Edit Graphics main menu. To invoke this option, type < E > in the option field and press < Enter >, or press the < Esc > key.

6.9.2.2 Add. This option allows you to add a graphics picture record to the database. To invoke this option, type < A > in the option field and press < Enter >. The Add Graphics Picture screen is shown in Figure 72. The options at this point are Exit and Add.

6.9.2.2.1 Exit—This option returns you to the Edit Graphics screen. To invoke this option, type < E > in the option field and press < Enter >, or press the < Esc > key.

6.9.2.2.2 Add—This option performs the actual add of a new graphics picture record. To invoke this option, type < A > in the option field, fill in the requested data fields, and press < Enter >. The only required information for a graphics picture add is the name. When complete, you are returned to the Edit Graphics screen with the message **Record added** displayed at the bottom of the screen.

6.9.2.3 Modify. This option allows you to modify a graphics picture record. To invoke this option, type < M > in the option field, highlight a graphics picture name, and press < Enter >. The Modify Graphics Picture screen is shown in Figure 73. The options at this point are Exit and Modify.

6.9.2.3.1 Exit—This option returns you to the Edit Graphics screen. To invoke this option, type < E > in the option field and press < Enter >, or press the < Esc > key.

6.9.2.3.2 Modify—This option performs the actual modification of the graphics picture record. To invoke this option, type < M > in the option field, modify any of the data fields on the Modify Graphics Picture screen, and press < Enter >. When complete, you will be returned to the Edit Graphics screen with the message **Record modified** displayed at the bottom of the screen.

6.9.2.4 Delete. This option allows you to delete a graphics picture from the database. To invoke this option, type < D > in the option field, highlight a graphics picture and press < Enter >. The Delete Graphics Picture screen is shown in Figure 74. The options at this point are Exit and Delete.

6.9.2.4.1 Exit—This option returns you to the Edit Graphics screen. To invoke this option, type < E > in the option field and press < Enter >, or press the < Esc > key.

6.9.2.4.2 Delete—This option performs the actual deletion of the graphics picture record. To invoke this option, type < D > in the option field and press < Enter >. When complete, you will be returned to the Edit graphics screen with the message **Record deleted** displayed at the bottom of the screen.

6.9.3 Event Tree Graphics

This option allows you to modify the Event Tree Graphics records. To invoke this option, type <V> in the option field or highlight Event Tree Graphics and press <Enter>. The screen shown in Figure 71, listing the event tree graphics pictures, will be displayed. The option available are Exit, Add, Modify, and Delete.

6.9.3.1 Exit. This option returns you to the Edit Graphics menu. To invoke this option, type <E> in the option field and press <Enter>, or press the <Esc> key.

6.9.3.2 Add. This option allows you to add a graphics picture record to the database. To invoke this option, type <A> in the option field and press <Enter>. The Add Graphic Picture screen is shown in Figure 72. The options at this point are Exit and Add.

6.9.3.2.1 Exit—This option returns you to the Edit Graphics screen. To invoke this option, type <E> in the option field and press <Enter>, or press the <Esc> key.

6.9.3.2.2 Add—This option performs the actual add of a new graphics picture record. To invoke this option, type <A> in the option field, fill in the requested data fields, and press <Enter>. The only required information for a graphics add is the name. When complete, you will be returned to the Edit Graphics screen with the message **Record added** displayed at the bottom of the screen.

6.9.3.3 Modify. This option allows you to modify a graphics picture record. To invoke this option, type <M> in the option field, highlight a graphics picture name, and press <Enter>. The Modify Graphic Picture screen is shown in Figure 73. The options at this point are Exit and Modify.

6.9.3.3.1 Exit—This option returns you to the Edit Graphics screen. To invoke this option, type <E> in the option field and press <Enter>, or press the <Esc> key.

6.9.3.3.2 Modify—This option performs the actual modification of the graphics picture record. To invoke this option, type <M> in the option field, modify any of the data fields on the Modify Graphic Picture screen, and press <Enter>. When complete, you will be returned to the Edit Graphics screen with the message **Record modified** displayed at the bottom of the screen.

6.9.3.4 Delete. This option allows you to delete a graphics picture from the database. To invoke this option, type <D> in the option field, highlight a graphics picture and press <Enter>. The Delete Graphic Picture screen is shown in Figure 74. The options at this point are Exit and Delete.

6.9.3.4.1 Exit—This option returns you to the Edit Graphics screen. To invoke this option, type <E> in the option field and press <Enter>, or press the <Esc> key.

6.9.3.4.2 Delete—This option performs the actual deletion of the graphics picture record. To invoke this option, type <D> in the option field and press <Enter>. When co᠁ you will be returned to the Edit Graphics screen with the message **Record deleted** displayed at ᠁m of the screen.

6.9.4 P&ID Graphics

This option allows you to modify the P&ID Graphics records. To invoke this option, type < P > in the option field or highlight P&ID Graphics and press < Enter >. The screen shown in Figure 71, listing the P&ID graphics pictures, will be displayed. The option available are Exit, Add, Modify, and Delete.

6.9.4.1 Exit. This option returns you to the Edit Graphics main menu. To invoke this option, type < E > in the option field and press < Enter >, or press the < Esc > key.

6.9.4.2 Add. This option allows you to add a graphics picture record to the database. To invoke this option, type < A > in the option field and press < Enter >. The Add Graphic Picture screen is shown in Figure 72. The options at this point are Exit and Add.

6.9.4.2.1 Exit—This option returns you to the Edit Graphics screen. To invoke this option, type < E > in the option field and press < Enter >, or press the < Esc > key.

6.9.4.2.2 Add—This option performs the actual add of a new graphics picture record. To invoke this option, type < A > in the option field, fill in the requested data fields, and press < Enter >. The only required information for a graphic add is the name. When complete, you will be returned to the Edit Graphics screen with the message **Record added** displayed at the bottom of the screen.

6.9.4.3 Modify. This option allows you to modify a graphics picture record. To invoke this option, type < M > in the option field, highlight a graphics picture name, and press < Enter >. The Modify Graphic Picture screen is shown in Figure 73. The options at this point are Exit and Modify.

6.9.4.3.1 Exit—This option returns you to the Edit Graphics screen. To invoke this option, type < E > in the option field and press < Enter >, or press the < Esc > key.

6.9.4.3.2 Modify—This option performs the actual modification of the graphics picture record. To invoke this option, type < M > in the option field, modify any of the data fields or the Modify Graphic Picture screen, and press < Enter >. When complete, you will be returned to the Edit Graphics screen with the message **Record modified** displayed at the bottom of the screen.

6.9.4.4 Delete. This option allows you to delete a graphics picture from the database. To invoke this option, type < D > in the option field, highlight a graphics picture and press < Enter >. The Delete Graphic Picture screen is shown in Figure 74. The options at this point are Exit and Delete.

6.9.4.4.1 Exit—This option returns you to the Edit Graphics screen. To invoke this option, type < E > in the option field and press < Enter >, or press the < Esc > key.

6.9.4.4.2 Delete—This option performs the actual deletion of the graphics picture record. To invoke this option, type < D > in the option field and press < Enter >. When complete, you will be returned to the Edit Graphics screen with the message **Record deleted** displayed at the bottom of the screen.

6.10 Histograms

This option allows you to create, modify, and delete user-defined histograms. This is a useful option for allowing you to input your own distribution for a variable that can r᾿ be expressed with one of the predefined distribution types. The Edit Histograms screen (Figure 75) displays the names of all the currently existing histograms with their associated format type. As shown, four options are available: Exit, Add, Modify, and Delete.

To activate this option type an <H> (Histograms) in the option field or highlight Histograms and press <Enter>. Figure 75 will be displayed.

```
 ══ Family ══
 SURRY                        E d i t   H i s t o g r a m s


                      Option |E|  Exit / Add / Modify / Delete

 ── # ──T── N a m e ════════════════════ D e s c r i p t i o n ──
     1 P E1
    10 P H10
    11 P H11
    12 P H12
    13 P H13
    14 P H14
    15 P H15
    16 P H16
    17 P H17
    18 P H18



 <Esc>      <F1>       <F2>            <F3>            <F4>           <F5>
 Exit       Help     Mark/Clear      Mark/Clear      Mark/Clear     Locate
                       Item             All            Range
           Note : Histogram Type   P = Percentage Format   R = Range Format
```

Figure 75. Edit histograms menu.

6.10.1 Exit

This option returns you to the Modify Database screen. To invoke this option, type an <E> (Exit) in the option field and press <Enter>, or press the <Esc> key.

6.10.2 Add Histograms

This option allows you to create a user-defined distribution type. To add a new histogram to the database, type an <A> (Add) in the option field and press <Enter>. At this point, Figure 76 is displayed and you are given the choice of adding the histogram data in either a percentage format or

range format.


```
┌─────────────────────────────────────────────────────────────────────────────┐
│  ┌── Family ──┐        ┌─────────────────────────────┐                        │
│  │ SURRY      │        │   E d i t   H i s t o g r a m s │                    │
│  └────────────┘        └─────────────────────────────┘                        │
│                                                                               │
│              Option │ │  Percentage Format / Range Format                     │
│   ┌─ # ──T── N a m e ──────────────── D e s c r i p t i o n ──────┐           │
│   │    1 P  E1                                                     │           │
│   │   10 P  H10                                                    │           │
│   │   11 P  H11                                                    │           │
│   │   12 P  H12                                                    │           │
│   │   13 P  H13                                                    │           │
│   │   14 P  H14                                                    │           │
│   │   15 P  H15                                                    │           │
│   │   16 P  H16                                                    │           │
│   │   17 P  H17                                                    │           │
│   │   18 P  H18                                                    │           │
│   └────────────────────────────────────────────────────────────┘           │
│                                                                               │
│  <Esc>     <F1>      <F2>           <F3>            <F4>          <F5>          │
│  Exit      Help      Mark/Clear     Mark/Clear      Mark/Clear    Locate       │
│                      Item           All             Range                      │
│         Note : Histogram Type   P = Percentage Format   R = Range Format       │
└─────────────────────────────────────────────────────────────────────────────┘
```

Figure 76. Select percentage or range format for the histogram.

If you wish to add a percentage histogram to the database, enter a <P> (Percentage) in the option field. Entering a <P> in the option field will cause a Percentage Format Histogram screen to appear. From this screen you should type in a name and a description for the new histogram. Enter the percentages for the histogram along with the corresponding probabilities. Figure 77 demonstrates how to enter a percentage histogram, given that 15% of the data points have a probability of 0.04, 46% of the data points have a probability of 0.12, 36% of the data points have a probability of 0.02, and the remaining 3% of the data points have a probability of 0.8. The sum of the percentages entered must total 100%, in order for the histogram to be accepted as a valid percentage histogram (Figure 78). In the upper right-hand area of the screen is a box that shows the current sum of the percentages that have been input and the remaining percentage needed to reach the 100% total.

Another way to input a histogram is to use the range format. To add a range histogram to the database, enter an <R> (Range) in the option field of the Add Histogram screen. This action will bring up a Range Format Histogram screen (Figure 79). On this screen, type in a name and description for the range histogram. Then, enter the starting probability point, the ending probability point, and the height associated with the first bin of the histogram. Next, for each successive bin of the histogram, an ending probability point and a height should be entered. There is a maximum of 20 bins allowed for each range histogram. Figure 79 is an example of inputting a range histogram whose data points lie on the closed interval of 0.0 and 1.0. The height associated with the data points on the sub-interval of 0.0 to 0.2 is 10.0 (Bin 1), the height for the sub-interval of 0.2 to 0.6 is 7.0 (Bin 2), the height for the sub-

```
       ── Family ──                ┌─────────────────────────┐
      │ SURRY          │           │ A d d   H i s t o g r a m │
       ────────────────            └─────────────────────────┘

                          Option |A|  Exit / Add        ┌─────────────────────────┐
                                                         │ Percent Sum   97.00    │
                              ── Percentage Format ──    │ Percent Left   3.00    │
                                                         └─────────────────────────┘
      Name           PERCENTHIST
      Description    percentage histogram example

        Area  Probability     Percent      Area  Probability     Percent
          1   4.000E-002       15.00         11   ------E----     -------
          2   1.200E-001       46.00         12   ------E----     -------
          3   2.000E-002       36.00         13   ------E----     -------
          4   ------E----      -------       14   ------E----     -------
          5   ------E----      -------       15   ------E----     -------
          6   ------E----      -------       16   ------E----     -------
          7   ------E----      -------       17   ------E----     -------
          8   ------E----      -------       18   ------E----     -------
          9   ------E----      -------       19   ------E----     -------
         10   ------E----      -------       20   ------E----     -------
```
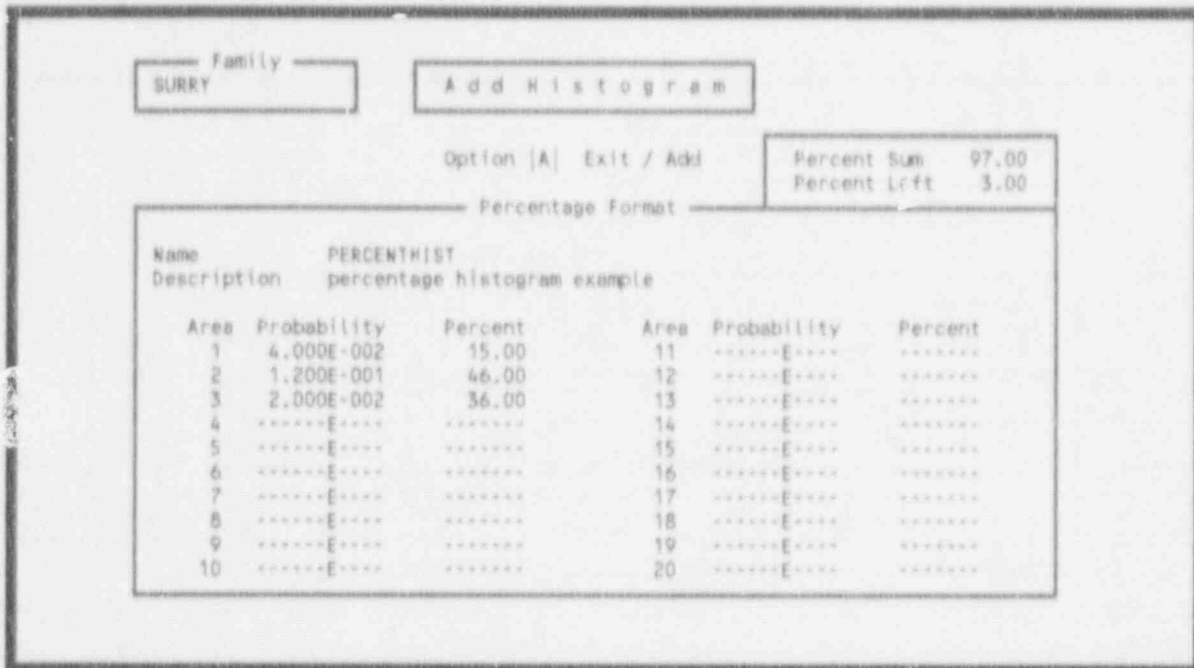
Figure 77. Adding a percentage histogram.

```
       ── Family ──                ┌─────────────────────────┐
      │ SURRY          │           │ A d d   H i s t o g r a m │
       ────────────────            └─────────────────────────┘

                          Option |A|  Exit / Add        ┌─────────────────────────┐
                                                         │ Percent Sum   100.00   │
                              ── Percentage Format ──    │ Percent Left     .00   │
                                                         └─────────────────────────┘
      Name           PERCENTHIST
      Description    percentage histogram example

        Area  Probability     Percent      Area  Probability     Percent
          1   4.000E-002       15.00         11   ------E----     -------
          2   1.200E-001       46.00         12   ------E----     -------
          3   2.000E-002       36.00         13   ------E----     -------
          4   8.000E-001        3.00         14   ------E----     -------
          5   ------E----      -------       15   ------E----     -------
          6   ------E----      -------       16   ------E----     -------
          7   ------E----      -------       17   ------E----     -------
          8   ------E----      -------       18   ------E----     -------
          9   ------E----      -------       19   ------E----     -------
         10   ------E----      -------       20   ------E----     -------
```
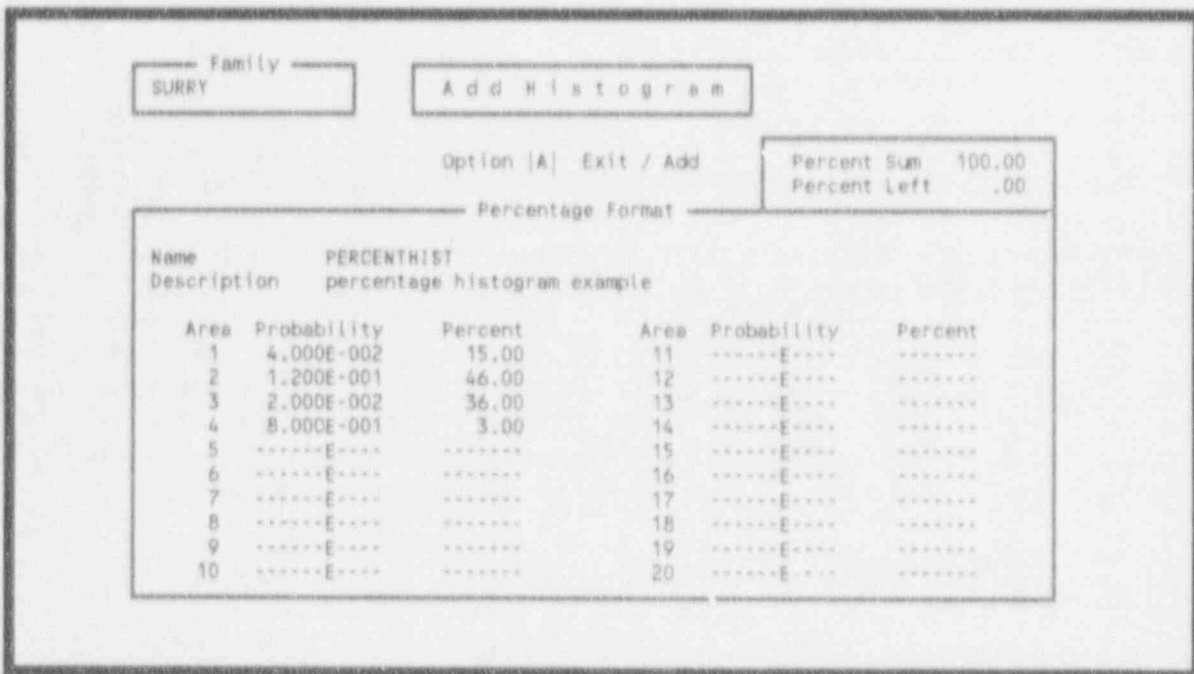
Figure 78. Add the remaining percent to create a valid histogram.

interval of 0.6 to 0.₈ is 20.0 (Bin 3), and the height for the last sub-interval of 0.8 to 1.0 is 5.0 (Bin 4).
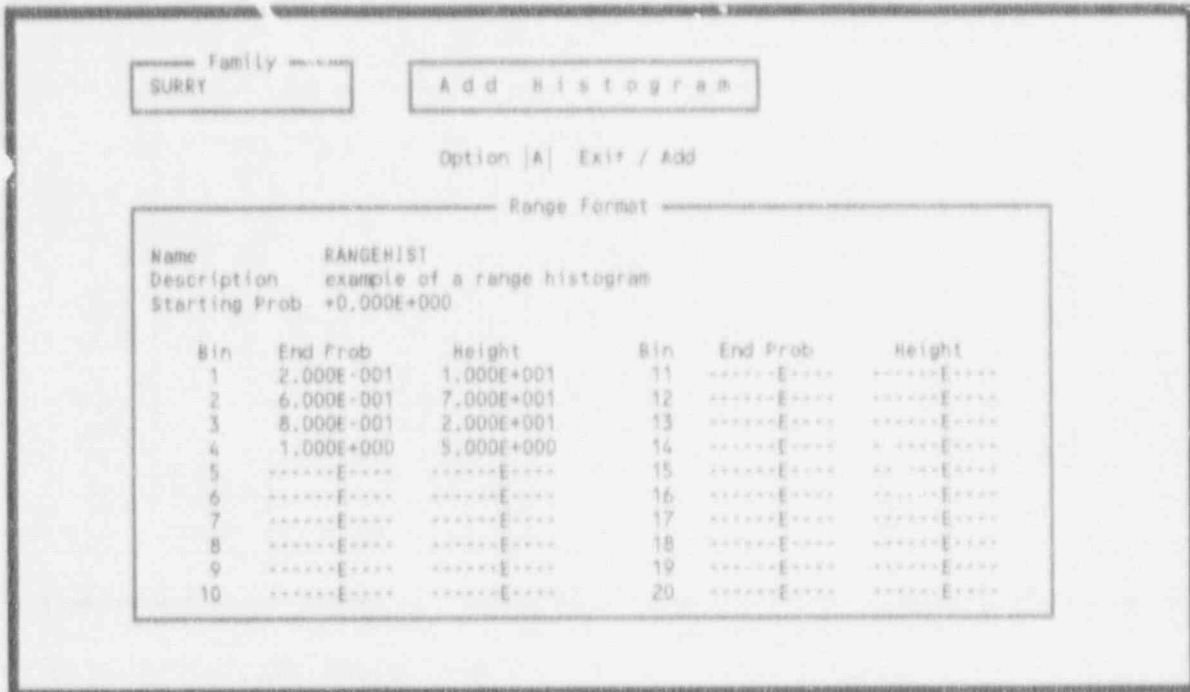
Figure 79. Add a range histogram.

The code calculates the midpoint of each bin, finds the area of each bin, and normalizes each area so the sum of the areas equals 1.0. The midpoint is the probability for each bin and the normalized area corresponds to the percent in the Percent Histogram format. The basic event mean probability should correspond to the mean of the histogram.

Once you have typed in the histogram data, enter an <A> in the option field and press <Enter> to save the newly created histogram. When complete, you will be returned to the Edit Histograms screen with the message **Record Added** displayed at the bottom of the screen. However, if you wish to exit the Add process without saving the new histogram, enter an <E> in the option field or press the <Esc> key.

6.10.3 Modify Histograms

To modify a currently existing histogram, type an <M> (Modify) in the option field of the Edit Histograms screen, highlight the desired histogram, and press <Enter>.

If you selected to modify a percentage histogram, then the histogram data will be displayed in percentage format. You may make modifications to the histogram's name, description, or any of the probabilities or percentages. The percentages must still total 100% before it will be accepted as a valid

percentage histogram. Figure 80 demonstrates the screen for modifying histograms in percentage format.

Figure 80. Modify a percentage histogram.

If you selected to modify a range histogram, then the histogram data will be displayed in range format. You may change the histogram's name, description, and any of the bins' starting points, ending points or probabilities. Figure 81 demonstrates the screen for modifying histograms in range format.

If you wish to save the modifications made to the selected histogram, type an <M> (Modify) in the option field of the Modify Histograms screen and press <Enter>. When complete, you will be returned to the Edit Histograms screen with the message **Record modified** displayed at the bottom of the screen. If you wish to exit this screen without modifying the histogram, enter an <E> in the option field and press <Enter>, or press the <Esc> key.

6.10.4 Delete Histograms

To delete an existing histogram from the database, type a <D> (Delete) in the option field of the Edit Histograms screen, highlight the histogram to be deleted, and press <Enter>.

This action will result in displaying the selected histogram in the appropriate format on the Delete Histograms screen. To delete the histogram, type a <D> (Delete) in the option field and press <Enter>. When complete, you will be returned to the Edit Histograms screen with the message **Record Deleted** displayed at the bottom of the screen. To exit the Delete Histograms screen without deleting the

```
┌─────────────────────────────────────────────────────────────────────┐
│                                                                       │
│    ┌── Family ──────┐        ┌─────────────────────────────┐          │
│    │ SURRY          │        │   M o d i f y   H i s t o g r a m │      │
│    └────────────────┘        └─────────────────────────────┘          │
│                                                                       │
│                      Option |M|  Exit / Modify                        │
│                                                                       │
│    ┌──────────────────────── Range Format ─────────────────────┐      │
│    │                                                            │      │
│    │ Name         RANGEHIST                                     │      │
│    │ Description   example of a range histogram                 │      │
│    │ Starting Prob  +0.000E+000                                 │      │
│    │                                                            │      │
│    │   Bin   End Prob      Height      Bin   End Prob    Height │      │
│    │    1    2.000E-001   1.000E+001   11   ......E....  ......E.... │  │
│    │    2    6.000E-001   7.000E+001   12   ......E....  ......E.... │  │
│    │    3    8.000E-001   2.000E+001   13   ......E....  ......E.... │  │
│    │    4    1.000E+000   5.000E+000   14   ......E....  ......E.... │  │
│    │    5    ......E....  ......E....   15   ......E....  ......E.... │  │
│    │    6    ......E....  ......E....   16   ......E....  ......E.... │  │
│    │    7    ......E....  ......E....   17   ......E....  ......E.... │  │
│    │    8    ......E....  ......E....   18   ......E....  ......E.... │  │
│    │    9    ......E....  ......E....   19   ......E....  ......E.... │  │
│    │   10    ......E....  ......E....   20   ......E....  ......E.... │  │
│    └────────────────────────────────────────────────────────────┘    │
│                                                                       │
└─────────────────────────────────────────────────────────────────────┘
```
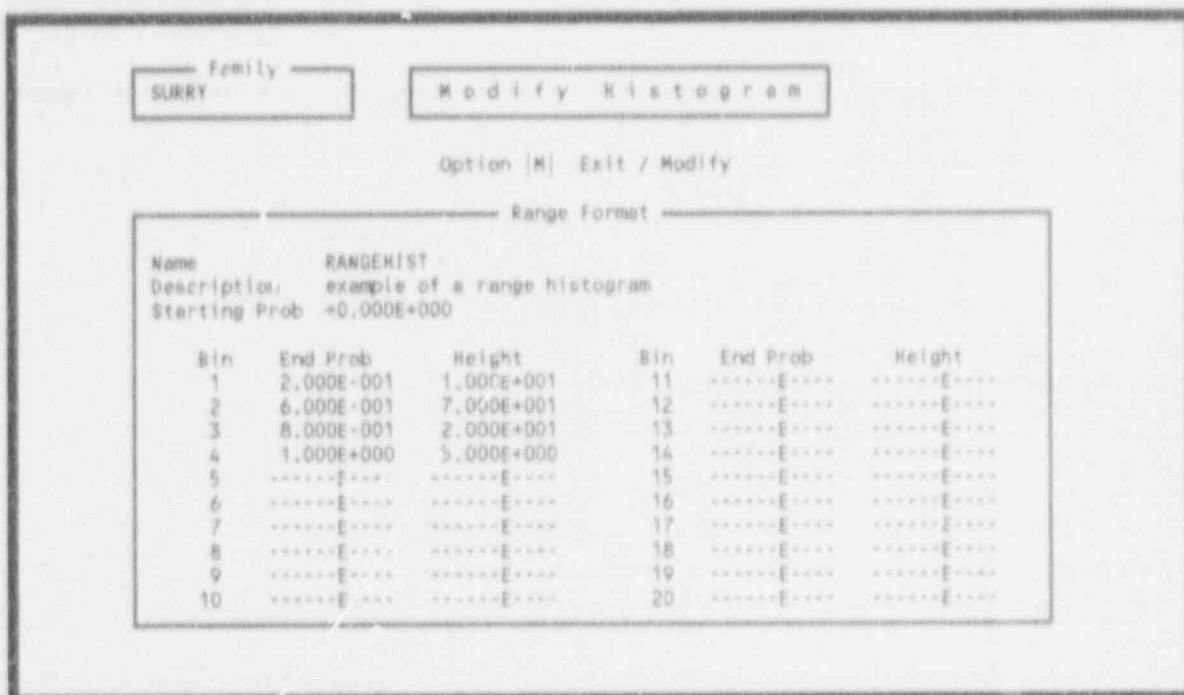
Figure 81. Modify a range histogram.

histogram being displayed, press the <Esc> key or enter an <E> (Exit) in the option field and press <Enter>. Figure 82 and Figure 83 show examples of the Delete Histograms screen for percentage histograms and range histograms, respectively.

```
 ===== Family =====                 ┌─────────────────────────────┐
 SURRY                              │  D e l e t e   H i s t o g r a m  │
                                    └─────────────────────────────┘

                          Option |E|  Exit / Delete

 ══════════════════════════════ Percentage Format ══════════════════════════

 Name          PERCENTHIST
 Description   percentage histogram example

    Area  Probability      Percent        Area  Probability      Percent
     1    4.000E-002        15.00          11    ······E····      ·······
     2    1.200E-001        46.00          12    ······E····      ·······
     3    2.000E-002        36.00          13    ······E····      ·······
     4    8.000E-001         3.00          14    ······E····      ·······
     5    ······E····      ·······         15    ······E····      ·······
     6    ······E····      ·······         16    ······E····      ·······
     7    ······E····      ·······         17    ······E····      ·······
     8    ······E····      ·······         18    ······E····      ·······
     9    ······E····      ·······         19    ······E····      ·······
    10    ······E····      ·······         20    ······E····      ·······
```

Figure 82. Delete a percentage histogram.

```
 ===== Family =====                 ┌─────────────────────────────┐
 SURRY                              │  D e l e t e   H i s t o g r a m  │
                                    └─────────────────────────────┘

                          Option |E|  Exit / Delete

 ════════════════════════════════ Range Format ════════════════════════════

 Name          RANGEHIST
 Description   example of a range histogram
 Starting Prob  +0.000E+000

    Bin   End Prob         Height         Bin   End Prob         Height
     1    2.000E-001       1.000E+001      11   ······E····      ······E····
     2    6.000E-001       7.000E+001      12   ······E····      ······E····
     3    8.000E-001       2.000E+001      13   ······E····      ······E····
     4    1.000E+000       5.000E+000      14   ······E····      ······E····
     5    ······E····      ······E····      15   ······E····      ······E····
     6    ······E····      ······E····      16   ······E····      ······E····
     7    ······E····      ······E····      17   ······E····      ······E····
     8    ······E····      ······E····      18   ······E····      ······E····
     9    ······E····      ······E····      19   ······E····      ······E····
    10    ······E····      ······E····      20   ······E····      ······E····
```

Figure 83. Delete a range histogram.

7. REPORTS

Two types of reports are available: the Summary Report and the Detailed Data Report. After choosing the type of report (Figure 84) and the material to be reported (Figure 85 and Figure 86), the output device must be designated (Figure 87 and Figure 88).

Figure 84. Types of reports.

Figure 85. Type of summary.

```
+-------------------------------------------------------------------+
|  +----- Family -----+        +-------------------+                 |
|  | DEMO             |        |  R e p o r t      |                 |
|  +------------------+        +-------------------+                 |
|                                                                   |
|      Report Type                Data selection                    |
|  +------------------+       +-------------------+                  |
|  |                  |       |                   |                  |
|  |   Exit           |       |   Exit            |                  |
|  |                  |       |                   |                  |
|  |   Summary        |       |   All             |                  |
|  |   Detail         |       |   Basic Events    |                  |
|  |                  |       |   SYstem          |                  |
|  |                  |       |   ENd States      |                  |
|  +------------------+       +-------------------+                  |
|      Option: |D|                 Data: |E|                         |
+-------------------------------------------------------------------+
```

Figure 86. Material to report for Detailed Data Report.

```
+-------------------------------------------------------------------+
|  +----- Family -----+        +-------------------+                 |
|  | DEMO             |        |  R e p o r t      |                 |
|  +------------------+        +-------------------+                 |
|                                                                   |
|    Report Type           Data selection        Output selection   |
|  +---------------+     +---------------+     +---------------+     |
|  |               |     |               |     |               |     |
|  |  Exit         |     |  Exit         |     |  EXIT         |     |
|  |               |     |               |     |               |     |
|  |  Summary      |     |  Summary      |     |  CONSOLE      |     |
|  |  Detail       |     |  Counts       |     |  PRINTER      |     |
|  |               |     |               |     |  FILE         |     |
|  +---------------+     +---------------+     +---------------+     |
|    Option: |S|           Data: |S|            To: |CONSOLE|        |
+-------------------------------------------------------------------+
```

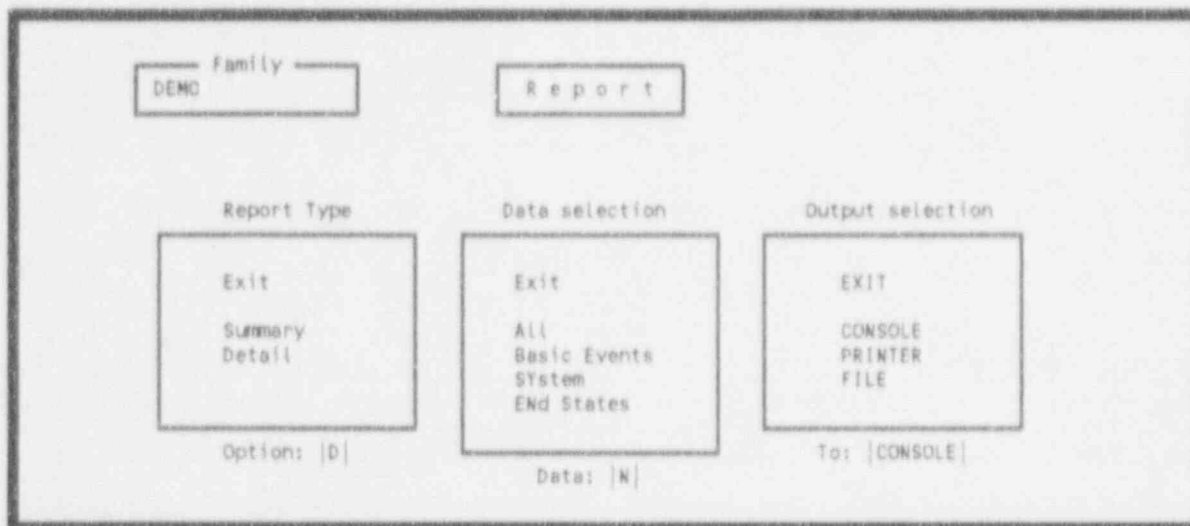**Figure 87.** Output destination--Summary Report.

Figure 38. Output destination—detailed report.

7.1 Summary Report

The Summary option lists the data available for a selected family. It contains the name and description of all data and whether or not the associated cut sets, logic, and graphics data are available. A report on the data of a family is created by selecting a family and generating a report. If the output device is FILE, the report is written to DATA.RPT in the current family. If a new report is written to this file, the old report is overwritten.

The Count option provides a simple count of the number of records in each data type currently in the database.

7.2 Detailed Data Report

The Detailed Data Report displays the details of the family data stored in the database. It can be produced for a single data type (Basic Events, SYstem, or ENd States option), or for all of the data in the current family (All option). The All option reports all data for all of the data types. If the output device is FILE, the report is written to DATA.RPT in the current family. If a new report is written to this file, the old report is overwritten.

8. UTILITY

The UTILITY module allows you to perform routine functions that are required by MAR-D such as defining constants and recovering the database. When you invoke this option, Figure 89 will be displayed. As shown, three options are available: Exit, Constants, and Recover Database.
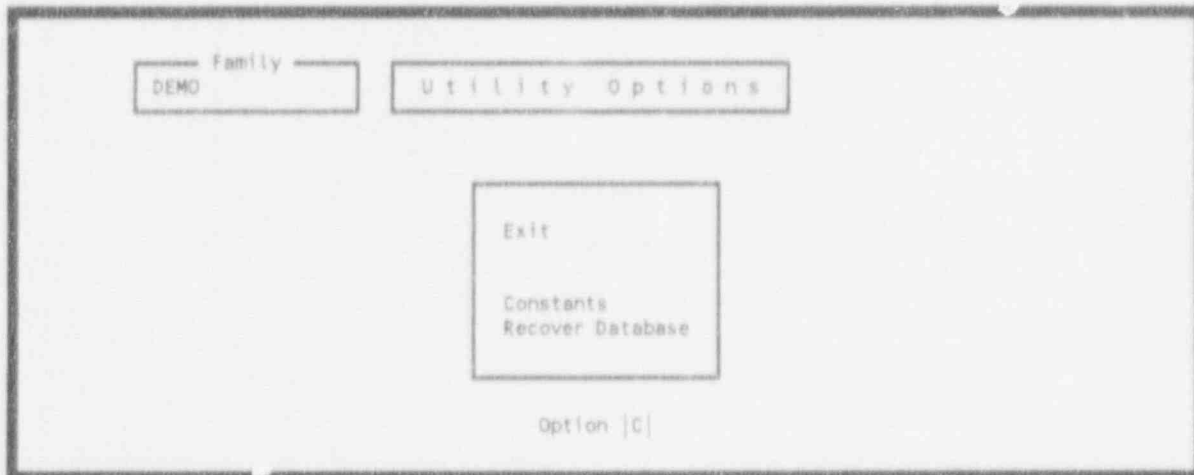

Figure 89. UTILITY options menu.

8.1 Exit

Type <E> in the command line, or highlight Exit, and press <Enter>, or press the <Esc> key to return to the MAR-D main menu.

8.2 Constants

The Constants <C> option allows you to define what hardware the system uses as well as defining uncertainty settings, cut set constants, and default values for the graphics editor. After choosing this option, the User Information Constants screen shown in Figure 90 is displayed. Table 2 provides a brief description of each of the fields in Figure 90.

```
                        ┌─────────────────────┐
                        │    C o n s t a n t s │
                        └─────────────────────┘
        ═══════════════════ User Information ═══════════════════
     User Name                        EG&G Idaho, Inc.  (INEL)
     Monitor type (0-CGA, 1-EGA, 2-VGA, 3-VGA+, 4-8514A)              2
     (0-IBM, 1-PARADISE, 2-ATI, 3-TECMAR, 4-TSENG, 5-VIDEO7, 6-PLASMA) 0
     Printer type (0-Other, 1-Epson, 2-HP Laser)                     2
     Printer has complete IBM character font? (Y/N)                  N
     Plotter communications port (0-None, 1-Com1, 2-Com2, 3-Com3)    0
     Use alternate basic event names ?  (Y=alternate N=primary)     N
     Importance Measurement Type ?  (R=ratios, I=intervals, U=uncert) R
     Verify when loading MAR-D data ? (Y=verify, N=don't verify)     N
        ───────────────────── Uncertainty ─────────────────────
     Random number seed      0                     Sample size    1000
        ─────────────────── Cut Set Generation ────────────────
     Cutoff by size? (Y/N)        N    Size cutoff                    6
     Cutoff by probability? (Y/N) Y    Probability cutoff    1.000E-015
                                       Mission time (hours)  2.400E+001
        ───────────────────── File Locations ──────────────────
     Scratch drive and directory
     Halo drive and directory path  \HALO88\
```

Change any of the constant values shown and press the <Enter> key.

Figure 90. User information constants screen.

Table 2. User Information field descriptions for constants option

FIELD	DESCRIPTION
User Name	36 character user identification (optional) field
Monitor type	0 - Enhanced graphics monitor. 1 - DEFAULT - Standard color graphics monitor 2 - Video graphics monitor (2640 x 480) 3 - Video graphics monitor plus (800 x 600) 4 - 8514A
Card type	0 - IBM 1 - Paradise 2 - ATI 3 - TECMAR 4 - TSENG 5 - VIDEO-7 6 - PLASMA
Printer type	0 - Other 1 - Epson 2 - HP Laser (DEFAULT)
Printer has complete IBM character font?	Y - Yes. N - No (DEFAULT)
Plotter communications port	0 - No Plotter connected to port (DEFAULT). 1 - Plotter connected to Com1 port. 2 - Plotter connected to Com2 port. 3 - Plotter connected to Com3 port.
Use alternate basic event names?	Y - Alternate name will be used. N - Primary name will be used (DEFAULT).
Importance Measurement Type	R - Ratios (DEFAULT) I - Intervals U - Uncertainty
Verify when loading MAR-D data?	Y - File dependency will be checked. N - No file cross checking will done. (DEFAULT)
Random number seed for uncertainty calculations	5 digit numeric field indicating the first random number in the seed to be used in the Monte Carlo calculation. 0 (DEFAULT) indicates that the random number will be the current value of the real clock.
Sample size	6 digit numeric field indicating the default number of Monte Carlo samples to be run in the uncertainty analyses. Sample size may range from 1 to 999999 (DEFAULT = 1,000).

Table 2. (continued)

FIELD	DESCRIPTION
Cutoff by size?	Y - Do not generate fault tree or sequence cut sets containing more basic events than indicated in the Size cutoff field (DEFAULT). N - Generate all cut sets for the fault tree or sequence that meet the probability cutoff criteria (if in effect).
Size cutoff	The default maximum number of basic events allowed in cut set generation when size cutoff is in effect. DEFAULT = 6
Cutoff by probability?	Y - Do not generate fault tree or sequence cut sets that have a probability less than the cutoff indicated in the probability cutoff field (DEFAULT) N - Generate all cut sets that meet the size cutoff criteria (if in effect) regardless of the cut set probability.
Probability cutoff	The default minimum cut set probability allowed in cut set generation when probability cutoff is in effect. (DEFAULT = 000E-015)
Mission time (hours)	The default mission time to be used in the calculation of basic event probabilities (when appropriate). DEFAULT = 2.400E+001
Scratch drive and directory	36 character field indicating the drive and path to the scratch directory where files will be stored (DEFAULT set to blanks)
Halo drive and directory path	36 character field indicating the drive and path to the Halo graphics that MAR-D 4.0 should use (\HALO88\)

After setting the User Information constants, press < Enter >. The next screen displays the Fault Tree Graphics Constants (Figure 91). Table 3 provides a brief description of each of the fields in Figure 91.

```
                        ┌─────────────────────────────┐
                        │   C o n s t a n t s          │
                        └─────────────────────────────┘
         ┌──────────── Fault Tree Graphics Information ────────────┐
         │                                                         │
         │    ┌───────────────── Names ─────────────────┐          │
         │    │ Event Name  EVENT        Name Height  .50 │         │
         │    │ Gate Name   GATE         Line Type    1   │         │
         │    └───────────────────────────────────────────┘        │
         │                                                         │
         │    ┌──────────────── Text ───────────────────┐          │
         │    │    Height   1.00  Justification C   Box Y │         │
         │    │ N/M Height  1.50  Space Factor  1.40      │         │
         │    └───────────────────────────────────────────┘        │
         │                                                         │
         │    ┌─ Toggles ─┐    ┌────────── Colors ──────────┐       │
         │    │ Fill    Y │    │ Colors ==> [           ]   │       │
         │    │ Grid    N │    │                            │       │
         │    │ Blank   Y │    │    Fill          X         │       │
         │    │ Show Name Y│   │    Name              X     │       │
         │    │ Show Text Y│   │    Line              X     │       │
         │    │ MultiPick Y│   │    Text              X     │       │
         │    └───────────┘    │    Cursor            X     │       │
         │                     └────────────────────────────┘       │
         └─────────────────────────────────────────────────────────┘
         Change any of the constant values shown and press the <Enter> key.
```

Figure 91. Fault tree graphics information.

Utility

Table 3. Fault tree graphics information field descriptions

FIELD	DESCRIPTION
Event Name	10-character field for the fault tree basic event default name. The default name is followed by a sequential number for each separate event, e.g., EVENT1, EVENT2, etc. (DEFAULT = EVENT)
Gate Name	10-character field for the fault tree gate default name. The default name is followed by a sequential number for each separate event, e.g., GATE1, GATE2, etc. (DEFAULT = GATE)
Name Height	The height of the event and gate names. This is a number between 0.01 and 66.00, where 66.00 represents the full 66 lines from the top of the screen to the bottom. (DEFAULT = 0.50)
Line Type	1 - Solid line (DEFAULT) 2 - Dashed line. 3 - Dotted line.
Text Height	The height of the text to be written. This is a number between 0.01 and 66.00 (see Name Height). DEFAULT = .50
N/M Height	The height of the numbers on an N/M OR gate showing the N and M values. This is a number between 0.01 and 66.00. (DEFAULT = 1.50)
Justification	Text justification. L - Left justified. C - Centered (DEFAULT). R - Right justified.
Space Factor	The spacing between lines of text written consecutively. This is a number between 1.00 and 10.00. A value of 1.00 will cause the top of the following line of text to touch the bottom of the preceding line. (DEFAULT = 1.40)

Table 3. (continued).

FIELD	DESCRIPTION
Fill	Yes/No toggle turning the fill on/off for plotting. DEFAULT = No
Grid	Yes/No toggle turning a reference grid on/off. DEFAULT = No
Blank	Y - The immediate area surrounding a gate or event name will be blanked out. (DEFAULT) N - The gate and event names will be written over any lines drawn in the areas for the names.
Show Name	Yes/No toggle turning on/off the display of event and gate names when the SHOW command is used. DEFAULT = Yes
Show Text	Yes/No toggle turning on/off the display of descriptive text when the SHOW command is used. DEFAULT = Yes.
MultiPick	When building trees, multipick will generate multiple gates for each pick of a gate type. DEFAULT = Yes.
Fill Color	An X under the desired color selects the default color for filling in shapes. DEFAULT color = blue.
Name Color	An X under the desired color selects the default color for displaying names. DEFAULT color = white.
Line Color	An X under the desired color selects the default color for drawing lines. DEFAULT color = white.
Text Color	An X under the desired color selects the default color for writing text. DEFAULT color = white.
Cursor Color	An X under the desired color selects the default color for the cursor. DEFAULT color = white

After setting the Fault Tree graphics information constants press <Enter>. The next screen displays Event Tree graphics information (Figure 92). Make any changes needed and press <Enter>. Table 4 provides a brief description of each of the fields in Figure 92.

```
                        ┌─────────────────────────┐
                        │      C o n s t a n t s   │
                        └─────────────────────────┘

        ══════════════ Event Tree Graphics Information ══════════════
                   │ │ ▌ │ │ │ │ ▌ │ ▌ ▌ ▌ ▌ │ ▌ │
        Colors .   0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
        Main Menu Text Color. . . . . . . . . . . . . . . . 15
        Main Menu Background Color. . . . . . . . . . . . .  1
        2nd Level Menu Text Color . . . . . . . . . . . . . 14
        2nd Level Menu Background Color . . . . . . . . . .  5
        3rd Level Menu Text Color . . . . . . . . . . . . . 12
        3rd Level Menu Background Color . . . . . . . . . .  9
        Cursor Color. . . . . . . . . . . . . . . . . . . . 15
        Line Color  . . . . . . . . . . . . . . . . . . . . 10
        Text Color  . . . . . . . . . . . . . . . . . . . . 14
        Text Height . . . . . . . . . . . . . . . . . . . . .50
        Hide Text . . . . . . <Y = hide, N = don't hide>. . . N
        Text Justification  <L = left, C = center, R = right> . . L
        Main Menu Side      <L = left, R = right> . . . . . . . L
        File compacting     <Y = pack, N = don't pack>. . . . . N


        Change any of the constant values and press the <Enter> key.
```

Figure 92. Event tree graphics information.

Table 4. Event tree graphics information field descriptions

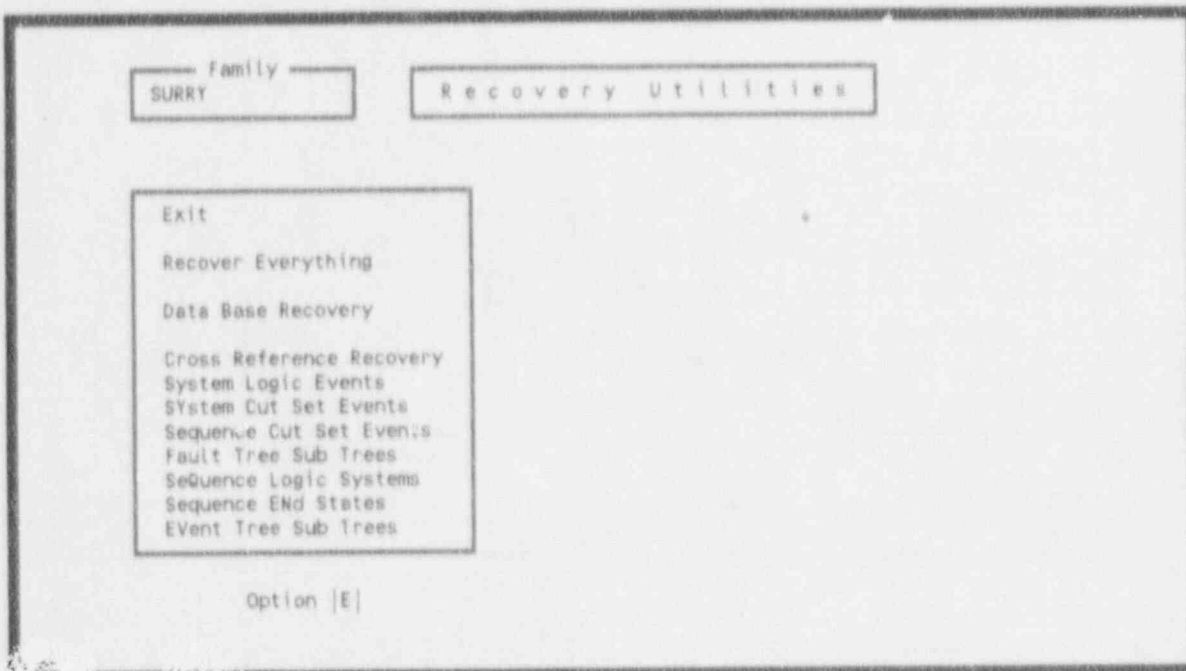| FIELD	DESCRIPTION
Colors	Colors that can be used in event tree graphics and their associated reference numbers.
Main Menu Text Color	Color of main menu's text. DEFAULT = 15 (white).
Main Menu Background Color	Background color upon which text is written. DEFAULT = 1 (blue).
2nd Level Menu Text Color	Color of text in second level menus. DEFAULT = 14 (yellow).
2nd Level Menu Background Color	Background color of second level menus upon which text is written. DEFAULT = 5 (purple).
3rd Level Menu Text Color	Color of text in third level menus. (DEFAULT = 12 (cyan).
3rd Level Menu Background Color	Background color of third level menus upon which text is written. DEFAULT = 9 (light blue).
Cursor Color	Default color of cursor. DEFAULT = 15 (white).
Line Color	Default color of lines. DEFAULT = 15 (white).
Text Color	Default color of text. DEFAULT = 14 (yellow).
Text Height	Default text height. DEFAULT = 1.00.
Hide Text	Y/N Hide text when displaying tree. DEFAULT = N.
Text Justification	L = Left (DEFAULT) C = Center R = Right.
Main Menu Side	L/R - Side of screen to place main menu. (DEFAULT = left).
File Compacting	Y/N - Compact file when leaving editor. DEFAULT = No.

8.3 Recover Database

NOTE: Before recovering the database, it is suggested that you backup the *.DFL files and corresponding data files (*.IDX , *.DAT, and *.BLK) in the directory of the family to be rebuilt.

The Recover Database < R > option allows you to restructure the database and re-index the data. Some indications that a database rebuild is necessary include:

1.   Data elements such as events/systems have been deleted and seem to reappear
2.   During cut set generation or update, the min cut upper bound seems surprisingly high
3.   Cross Reference reports show/don't show events being used properly
4.   Events/systems that don't appear to be referenced cannot be deleted, and
5.   After a software version update.

You may rebuild the database anytime because the rebuild process compacts the data and generally helps the software run faster. The screen shown in Figure 93 appears when this option is selected. As shown, several different recovery methods are available. Each method is discussed in the following paragraphs.


```
          ═══ Family ═══            ┌─────────────────────────────────────┐
          ┌──────────────┐          │   R e c o v e r y   U t i l i t i e s │
          │ SURRY        │          └─────────────────────────────────────┘
          └──────────────┘

          ┌─────────────────────────────────┐
          │  Exit                           │                    .
          │                                 │
          │  Recover Everything             │
          │                                 │
          │  Data Base Recovery             │
          │                                 │
          │  Cross Reference Recovery       │
          │  System Logic Events            │
          │  SYstem Cut Set Events          │
          │  Sequence Cut Set Events        │
          │  Fault Tree Sub Trees           │
          │  SeQuence Logic Systems         │
          │  Sequence ENd States            │
          │  EVent Tree Sub Trees           │
          └─────────────────────────────────┘

               Option |E|
```

93. Recover data base selection screen.

8.3.1 Recover Everything

This option performs all the recovery methods shown on the screen. This option will recover all key indexes and then recover the cross references. This option will take several minutes to complete.

If your database has not been damaged, this option will restructure and optimize your database.

To invoke this option, highlight Recover Everything or enter an <R> in the option field and press <Enter> When you invoke this option, a warning screen will be displayed (see Figure 94). At the prompt, enter .. <Y> and press <Enter> to continue with the recovery, or enter an <N> and press <Enter> to terminate the process.
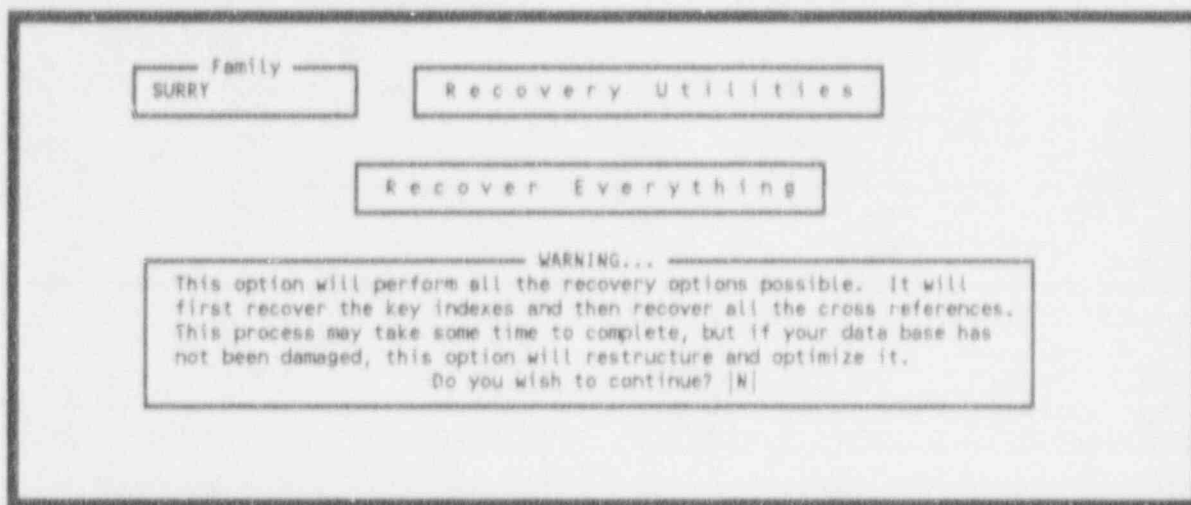

Figure 94. Recover everything warning screen.

8.3.2 Data Base Recovery

This option rebuilds all the files contained in your database. If you think your database has been damaged, use this option to recover all data files. If your database has not been damaged, this option will restructure and optimize your database.

To invoke this option, enter a <D> in the option field or highlight Data Base Recovery and press <Enter>. When you invoke this option, a warning screen will be displayed (see Figure 95). At the prompt, enter a <Y> and press <Enter> to continue with the recovery, or enter an <N> and press <Enter> to terminate the process.

8.3.3 System Logic Events

This option rebuilds the system logic events cross reference list. Each system's logic record is read and each event used is tracked. If no logic exists for a system, the list is cleared, and a message will be displayed on the screen, and the recovery process will continue. If an event is referenced, but not used, it will be added.

To invoke this option, enter an <L> in the option field or highlight System Logic Events and press <Enter>. When you invoke this option, a warning screen will be displayed (see Figure 96).
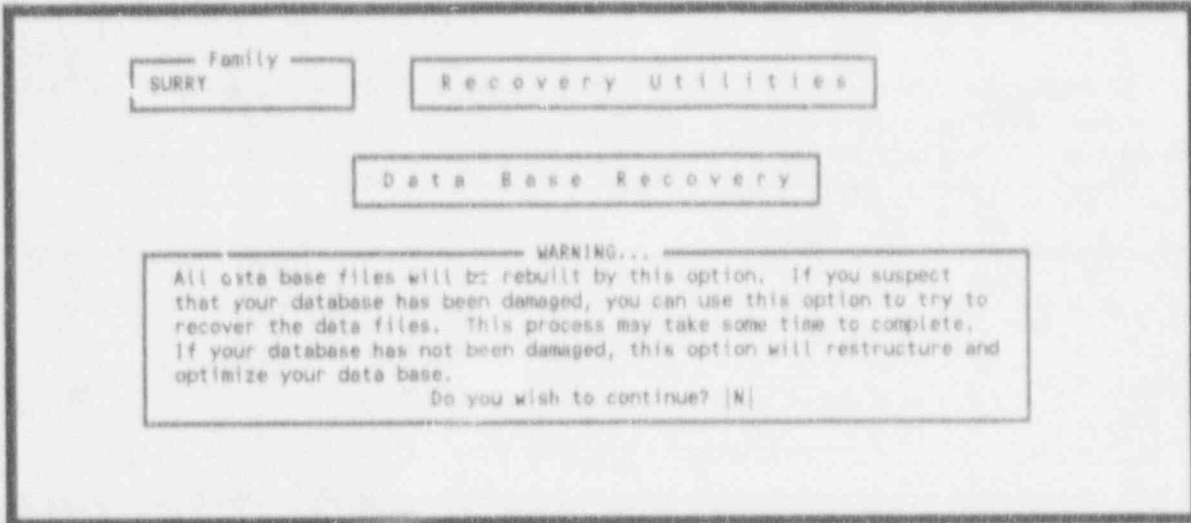
Figure 95. Data base recovery warning screen.

At the prompt, enter a < Y > and press < Enter > to continue with the recovery, or enter an < N > and press < Enter > to terminate the process.
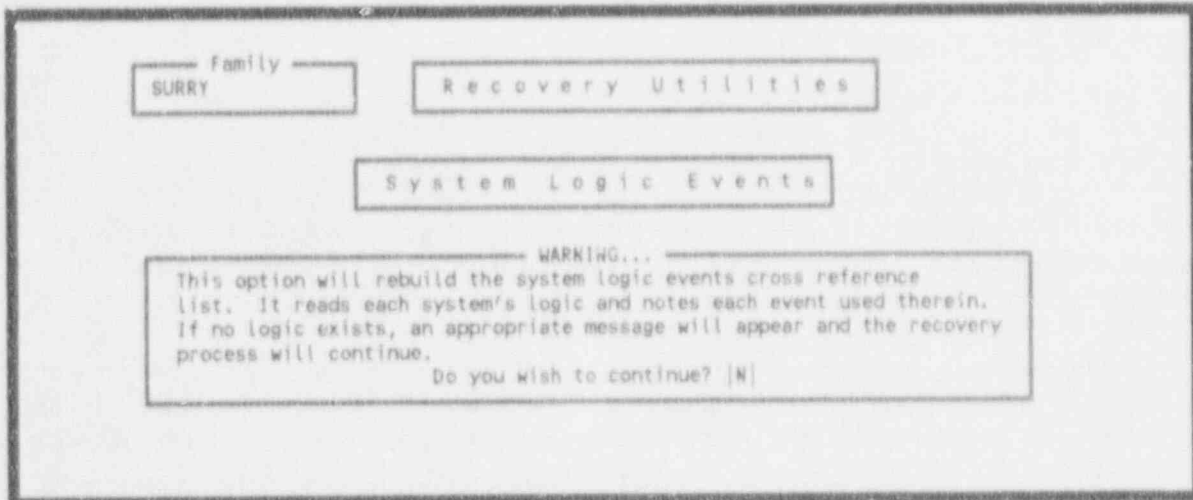

Figure 96. System logic events warning screen.

8.3.4 SYstem Cut Set Events

This option rebuilds the system cut set events cross reference list. Each system's base and current cut sets are read. The program tracks each event used. If no cut sets exist for a system, a message will be displayed on the screen and the recovery process will continue. If an event is referenced but not used, it will be added.

To invoke this option, enter a < Y > in the option field or highlight SYstem Cut Sets Events and press < Enter >. When you invoke this option, a warning screen will be displayed (see Figure 97). At the prompt, enter a < Y > and press < Enter > to continue with the recovery, or enter an < N > and press < Enter > to terminate the process.
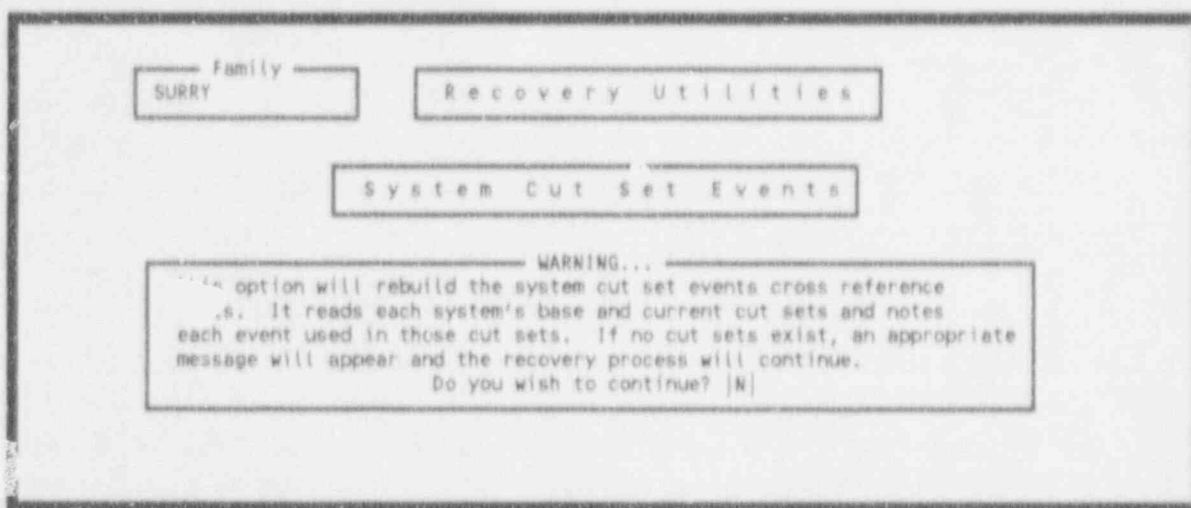

Figure 97. System cut set events warning screen.

8.3.5 Sequence Cut Set Events

This option rebuilds the sequence cut set events cross reference list. Each sequence's base and current cut sets are read. The program tracks each event used. If no cut sets exist for a sequence, a message will be displayed on the screen and the recovery process will continue. If an event is referenced but not used, it will be added.

To invoke this option, enter an <S> in the option field or highlight Sequence Cut Sets Events and press <Enter>. When you invoke this option, a warning screen will be displayed (see Figure 98). At the prompt, enter a <Y> and press <Enter> to continue with the recovery, or enter an <N> and press <Enter> to terminate the process.
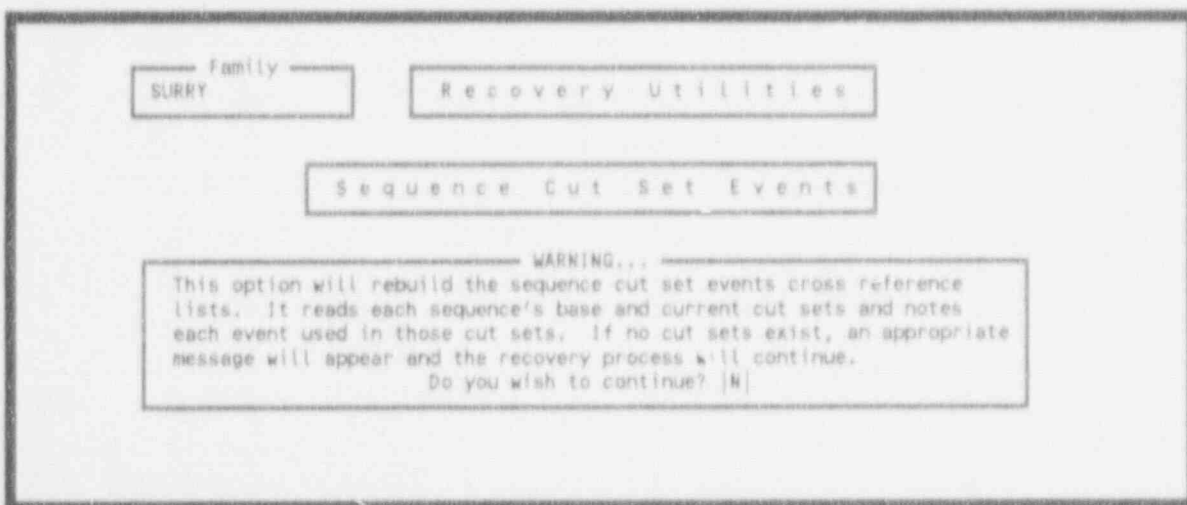
```
┌─── Family ───┐      ┌──────────────────────────────────┐
│ SURRY        │      │  R e c o v e r y   U t i l i t i e s │
└──────────────┘      └──────────────────────────────────┘

            ┌──────────────────────────────────────┐
            │ S e q u e n c e   C u t   S e t   E v e n t s │
            └──────────────────────────────────────┘

       ┌──────────────── WARNING... ──────────────────┐
       │ This option will rebuild the sequence cut set events cross reference │
       │ lists. It reads each sequence's base and current cut sets and notes  │
       │ each event used in those cut sets. If no cut sets exist, an appropriate │
       │ message will appear and the recovery process will continue.          │
       │              Do you wish to continue? |N|                            │
       └────────────────────────────────────────────┘
```

Figure 98. Sequence cut set events warning screen.

8.3.6 Fault Tree Sub Trees

This option rebuilds the fault tree subtree cross reference list. Each fault tree graphic relation's logic is read. The program notes any transfer in that logic. If a subtree is referenced, but does not exist in the database, that subtree will be added to the database.

To invoke this option, enter an < F > in the option field or highlight Fault Tree Sub Trees and press < Enter >. When you invoke this option, a warning screen will be displayed (see Figure 99). At the prompt, enter a < Y > and press < Enter > to continue with the recovery, or enter an < N > and press < Enter > to terminate the process.

```
┌─── Family ───┐          ┌──────────────────────────────────┐
│ SURRY        │          │  R e c o v e r y   U t i l i t i e s │
└──────────────┘          └──────────────────────────────────┘

              ┌──────────────────────────────────────┐
              │  F a u l t   T r e e   S u b   T r e e s │
              └──────────────────────────────────────┘

          ┌──────────────── WARNING... ────────────────┐
          │ This option will rebuild the fault tree sub tree cross reference lists. │
          │ It does this by reading each fault tree graphic relation's logic and │
          │ noting any transfers in that logic. If a sub tree is referenced, but │
          │ does not exist, that sub tree will be added to the data base. │
          │           Do you wish to continue? |N| │
          └────────────────────────────────────────────┘
```
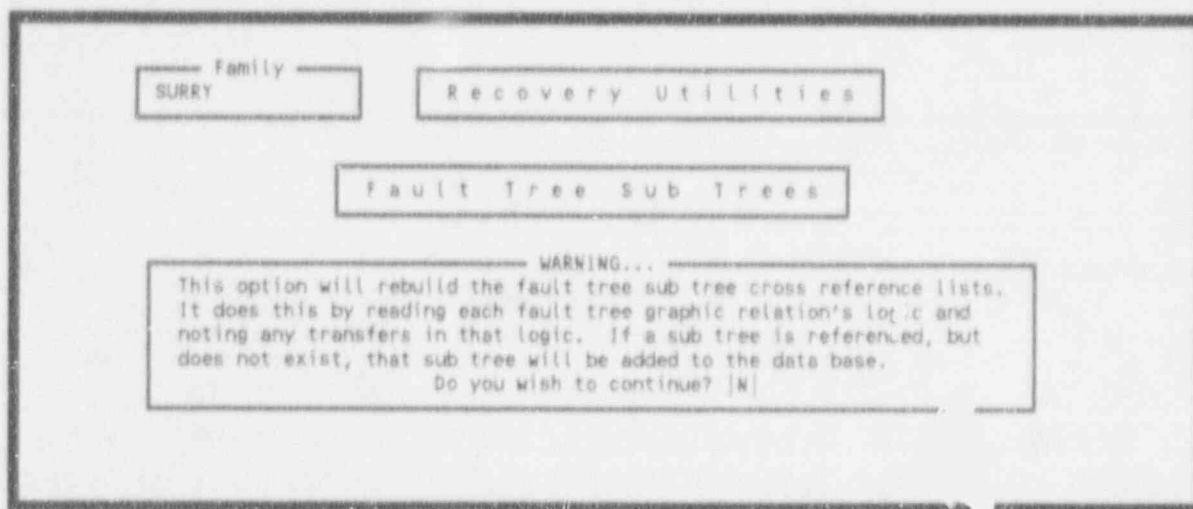
Figure 99. Fault tree subtrees.

8.3.7 SeQuence Logic Systems

This option rebuilds the sequence logic systems cross reference list. Each sequence's logic is read and each system used is noted. If no logic exists a message will be displayed and the recovery process will continue.

To invoke this option, enter a < Q > in the option field or highlight SeQuence Logic Systems and press < Enter >. When you invoke this option, a warning screen will be displayed (see Figure 100). At the prompt, enter a < Y > and press < Enter > to continue with the recovery, or enter an < N > and press < Enter > to terminate the process.
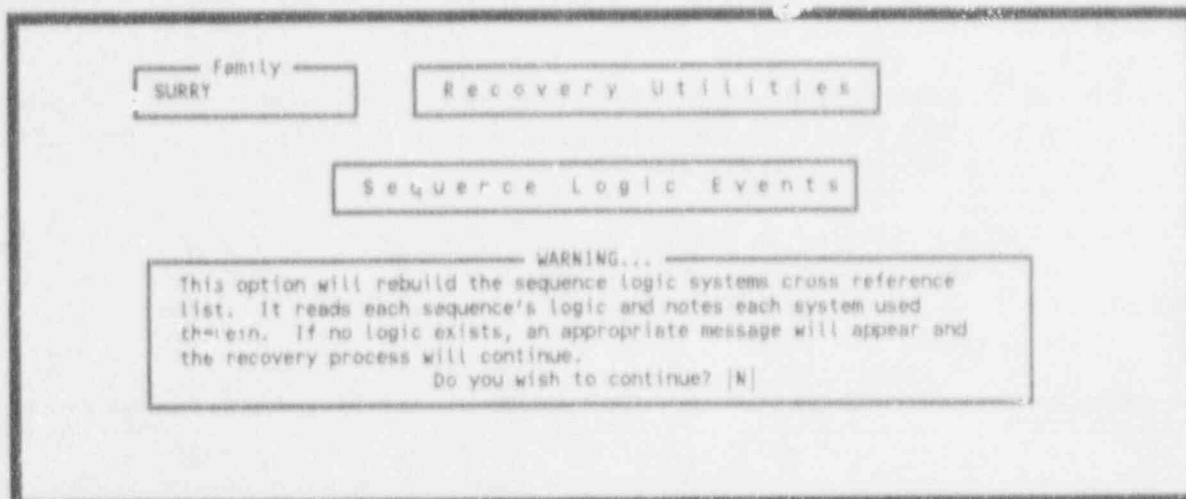
Figure 100. Sequence logic systems warning screen.

8.3.8 Sequence ENd States

This option actually checks that the end states for each sequence are contained in the end state relation. Each sequence is read and each end state is noted. If a referenced end state does not exists, it will be added to the end state relation and the recovery process will continue.

To invoke this option, enter a <Q> in the option field or highlight Sequence ENd States and press <Enter>. When you invoke this option, a warning screen will be displayed (see Figure 101). At the prompt, enter a <Y> and press <Enter> to continue with the recovery, or enter an <N> and press <Enter> to terminate the process.
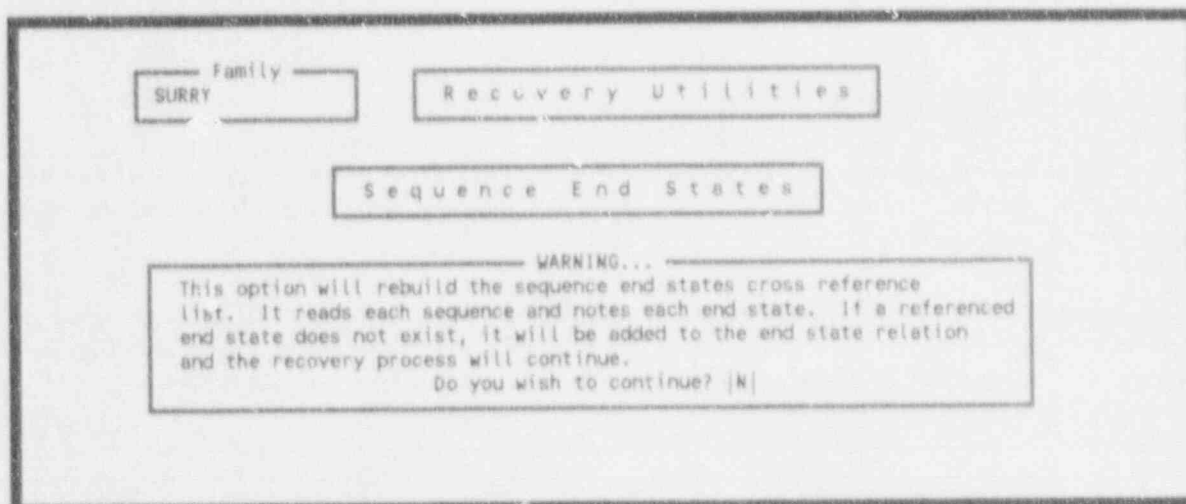

Figure 101. Sequence end states warning screen.

8.3.9 EVent Tree Sub Trees

This option rebuilds the event tree subtree cross reference list. Each event tree graphic relation's logic is read. The program notes any transfer in that logic. If a subtree is referenced, but does not exists in the database, that subtree will be added to the database.

To invoke this option, enter a <V> in ,the option field or highlight EVent Tree Sub Trees and press <Enter>. When you invoke this option, a warning screen will be displayed (see Figure 102). At the prompt, enter a <Y> and press <Enter> to continue with the recovery, or enter an <N> and press <Enter> to terminate the process.

```
╔═══════════════════════════════════════════════════════════════════╗
║  ═══ Family ═══         ┌─────────────────────────────────┐       ║
║  SURRY                  │   R e c o v e r y   U t i l i , e s │    ║
║                         └─────────────────────────────────┘       ║
║                                                                    ║
║              ┌──────────────────────────────────────┐             ║
║              │  E v e n t   T r e e   S u b   T r e e s │          ║
║              └──────────────────────────────────────┘             ║
║                                                                    ║
║         ══════════════ WARNING... ══════════════                  ║
║         This option will rebuild the event tree sub tree cross reference lists. ║
║         It does this by reading each event tree graphic relation's logic and   ║
║         noting any transfers in that logic.  If a sub tree is referenced, but   ║
║         does not exist, that sub tree will be added to the data base.           ║
║                   Do you wish to continue? |N|                    ║
╚═══════════════════════════════════════════════════════════════════╝
```
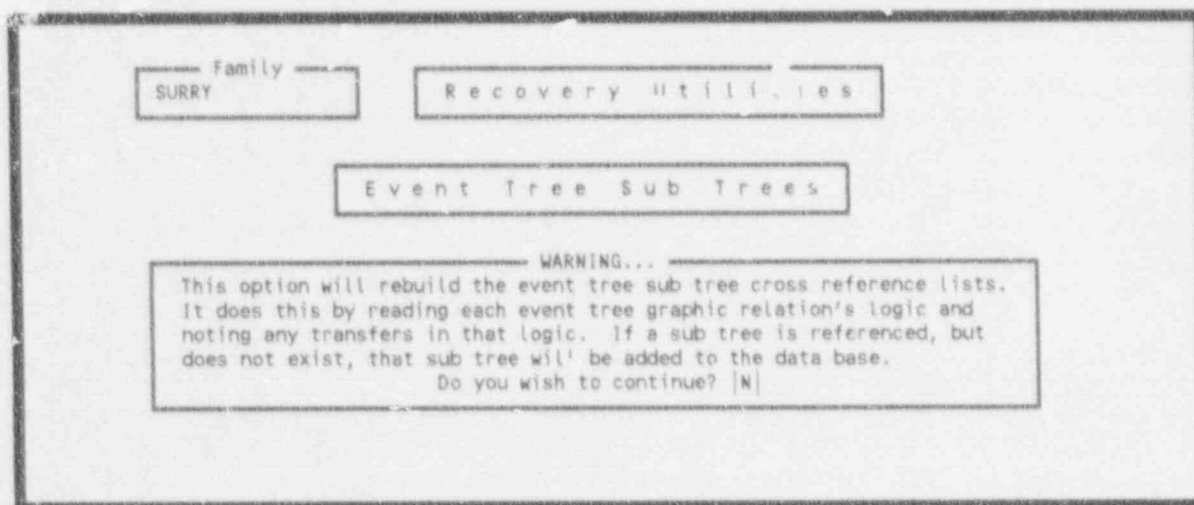
Figure 102. Event tree subtrees warning screen.

9. BIBLIOGRAPHY

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K.D. Russell et al., *System Analysis and Risk Assessment (SARA) System Version 4.0 Reference Manual, Vol. 1*, NUREG/CR-5303, EGG-2628, February 1992.

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APPENDIX A

DATA INTERCHANGE FORMATS

APPENDIX A

DATA INTERCHANGE FORMATS

Data files created by IRRAS, SARA, and SETS can be loaded into MAR-D and IRRAS, SARA, SETS, and FRANTIC files can be output.

Sections A.1 and A.2 contain the format of each of the files used by MAR-D. Examples are provided in most cases. The IRRAS, SARA, and SETS manuals contain additional information on file formats and data common among the tools. (See the Bibliography Section for the titles of the manuals.)

MAR-D

PRA Models and Results Data Base
Data Interchange Formats. April 14, 1992

A.1 MAR-D (IRRAS, SARA)

A.1.1 General Format Rules

1. All name references (family names, event names, etc.) must be upper case alphanumeric. All lower case characters will be converted to upper case. Any alpha fields that are longer than the format specified will be truncated. No spaces are allowed in the middle of names.

2. Descriptions can have both upper-case and lower-case characters. No character checking will be done. No commas are allowed in the description.

3. Commas are used as field delimiters in most formats, and can be used as placeholders for unknown fields. Any number of leading and trailing field spaces can be inserted. Exceptions to this format are detailed as needed.

4. Text rules:
    1. File is standard ASCII text, single spaced, upper and lower case.
    2. First line of paragraph is indented 5 spaces, with a blank line between paragraphs.
    3. ^EOS signals the End of Section so that multiple names in the same family can be collected in one file.

These rules apply to all files unless specifically stated otherwise.

Data Formats

A.1.2 Family (Plant) Information

A.1.2.1 Family Names and Descriptions.

File Name:

    xxxxxx.FAD

File Format:

    name,description

where

name	- 16 character	Family name (first 8 characters must be unique).
description	- 60 character	Family description

A.1.2.2 Family Attribute File.

File Name:

    xxxxxx.FAA

File Format:

    name,mission,newSum,co,loc,type,design,vendor,AE,OpDate,QualDate

where

name	- 16 character	Family name
mission	- Floating point	Default mission time in hours
newSum	- Floating point	New sequence frequency sum
co	- 10 character	Company name
loc	- 16 character	Location name
type	- 3 character	Facility type
design	- 10 character	Facility design
vendor	- 5 character	Vendor name
AE	- 10 character	Architectural Engineer
OpDate	- (yyyy/mm/dd)	Operational date
QualDate	- (yyyy/mm/dd)	Qualification date

A.1.2.3 Family Textual Information.

File Name:

    xxxxxx.FAT

File Format:

    family =

    -- text --

where

family	- 16 character	Family name

A.1.3 Basic Event Information

A.1.3.1 Basic Event Names and Descriptions.

File Name:

    xxxxxx.BED

File Format:

    family =

    name,description

    . . . , ...

where

family	- 16 character	Family name
name	- 16 character	Event name
description	- 60 character	Alphanumeric description

A.1.3.2 Basic Event Rate Information.

The basic event failure rates are stored in the Event relation. This information can also be entered through the modify option.

File Name:

    xxxxxx.BEI

File Format:

    family =

    name, calc, udC, udT, udV, prob, lambda, tau, mission, init

    . . . , . . . , . . . , . . . , . . . , . . . , . . . , . . . , . . . , . . .

where

family	- 16 character	Family name
name	- 16 character	Basic event name
calc	- 1 character	Calculation type

        1 - Probability

        2 - Lambda * Mission Time

        3 - 1 - Exp(-Lambda * Mission Time)

        4 - Lambda * Min(Mission Time, Tau)

        5 - Operating component with full repair

        6 - Lambda * Tau / 2.0

        7 - 1+(EXP(-Lambda*Tau)-1.0)/(Lambda*Tau)

        8 - Base Probability * Probability

        9 - Base Probability * Probability

        T - Set to House Event (Failed, Prob=1.0)

        F - Set to House Event (Successful,Prob=0.0)

      udC - 4 characters   Uncertainty correlation class

        Events in same class are 100% correlated.

udT	- 1 character	Uncertainty distribution type
	L	- Log normal, error factor
	N	- Normal, standard deviation
	B	- Beta, b of Beta(a,b)
	G	- Gamma, a Gamma(a)
	E	- Exponential, none
	U	- Uniform, Upper end pt.

udV	-	Floating point Uncertainty distribution value
prob	-	Floating point Probability value
lambda	-	Floating point Basic event failure rate per hr.
tau	-	Floating point Time to repair in hours
mission	-	Floating point Mission time
init	-	Boolean Initiating event flag (Y/N)

General Rules:

   1. The name field is mandatory.

A.1.3.3 Basic Event Attribute Codes.

Basic event attributes are entered through MODIFY--Basic Event and stored in Event.

File Name:

   xxxxxx.BEA

File Format:

   family =

   name,Aname,type,sys,fail,loc,compID,Gname,train,att1,...,att16

where

family	- 16 character	Family name
name	- 16 character	Event name
Aname	- 16 character	Alternate event name
type	- 3 character	Event component type
sys	- 3 character	Event component system
fail	- 2 character	Failure mode
loc	- 3 character	Component location
compID	- 7 character	Component ID
Gname	- 16 character	Event group identifier
train	- 1 character	Train identifier
att1..att16	- Class attribute flags--16 values of Y or N (yes or no) indicate whether the attribute described in the class attribute file is applicable.	

General Rules:

   1. The name field is mandatory.

A.1.4 Event Attribute Descriptions

A.1.4.1 Failure Mode Descriptions.

File Name:
    xxxxxx.FMD
File Format:
    family =
    fail,description

    ..., ...

where
family	- 16 character	Family name
fail	- 2 character	Failure mode identifier
description	- 60 character	Failure mode description

A.1.4.2 Component Type Descriptions.

File Name:
    xxxxxx.CTD
File Format:
    family =
    comp, description

    ..., ...

where
family	- 16 character	Family name
comp	- 3 character	Component type identifier
description	- 60 character	Component type description

A.1.4.3 System Type Descriptions.

File Name:
    xxxxxx.STD
File Format:
    family =
    sys,description

    ..., ...

where
family	- 16 character	Family name
sys	- 3 character	Component system identifier
description	- 60 character	System description

A.1.4.4 Location Descriptions.

File Name:

    xxxxxx.LCD

File Format:

    family =

    loc,description

    . . . , . . .

where

family	- 16 character	Family name
loc	- 3 character	Component location identifier
description	- 60 character	Component location description

A.1.4.5 Class Attribute Descriptions.

File Name:

    xxxxxx.CAD

File Format:

    family =

    Attr#,description

    . . . , . . .

where

family	- 16 character	Family name
Attr#	- Integer 1..16	Attribute number
description	- 60 character	Attribute description

A.1.5 Fault Tree Information

A.1.5.1 Fault Tree Names and Descriptions.

File Name:

    xxxxxx.FTD

File Format:

    family =

    name,description[,s]

    . . . , . . .

where

family	- 16 character	Family name
name	- 16 character	Fault tree name
description	- 60 character	Fault tree description
s	- 1 character	If included indicates fault tree is a subsystem

A.1.5.2 Fault Tree Graphics.

Fault tree graphics are stored in the block data file of the Graphics relation. The MAR-D file (.DLS) is a display list sequence for the graphics in a binary format. It is loaded and output as-is with no conversion performed.

File Name:

    xxxxxx.DLS

File Format:

    IRRAS 2.5/4.0 Fault Tree Graphics file (DLS format)

A.1.5.3 Fault Tree Logic.

Fault tree logic is stored in the block data file of the Graphics relation.

File Name:

    xxxxxx.FTL

File Format:

    family, fault tree =

    * gatename1,description

    gatename1 gatetype input1 input2 . . . inputn

    . . .   .

    * gatenamen,description

    gatenamen gatetype input1 input2 . . . inputn

    . . .

where

family	- 16 character	Family name
fault tree	- 16 character	Fault tree name
gatename	- 16 character	Gate name

Data Formats

<pre>
          gatetype   - 4 character   Gate type
                AND   = logical AND
                OR   = logical OR
                TBL   = table of events
                TRAN   = transfer
                                followed by a 16-character fault tree name
                NAND   = logical NOT AND
                NOR   = logic NOT OR
                N/M   = N out of M logic gate
                CONT   = continuation of inputs to the previous gate
          input   - 16 character   inputs to the gate
                                               (event or gate names)
          description   - 60 character   gate name descriptions
                                               included as comment
</pre>

General Rules:
1. A gate definition cannot exceed 255 characters.
2. A line beginning with an asterisk ("*") is a comment.
3. For each gate name a comment should be included giving the gate description.

A.1.5.4 Fault Tree Cut Sets.

The fault tree cut sets are stored in the System relation in the block data file.

File Name:
    xxxxx.FTC
File Format:
    family, fault tree =
    eventname * eventname +
    eventname * eventname * eventname *
    eventname +
    eventname * eventname.
    ^EOS
    family, fault tree2 =
where

family	- 16 character	Family name
fault tree	- 16 character	Fault tree name
eventname	- 16 character	Event names in the cut set

General Rules:
1. An asterisk ("*") separates cut set events. Spaces are ignored.
2. A plus sign ("+") separates cut sets.
3. A period (".") denotes the end of a sequence.
4. A slash ("/") precedes complemented events.
5. Event names are a maximum of 16 characters including the "/".
6. A line beginning with an asterisk ("*") is a comment.

A.1.5.5 Fault Tree Attributes.

File Name:

    xxxxx.FTA

File Format:

    family =

    name,level,mission,mincut,proCut,sample,seed,sizCut,sys,cuts,

          events,value1,...,value9

    ..., ..., ..., ..., ..., ..., ..., ..., ..., ...

where

family	- 16 character	Family name
name	- 16 character	Fault tree name
level	- Integer 2	0 = top level tree
mission	- Floating point	Mission time
mincut	- Floating point	Mincut upper bound
proCut	- Floating point	Probability cut off value
sample	- Integer 4	Sample size
seed	- Integer 8	Random number seed
sizecut	- Integer 2	Size cut off value
sys	- 3 character	System identifier
cuts	- Integer 5	Base number of cut sets
events	- Integer 5	Base number of events
value	- Floating point	Base uncertainty values

A.1.5.6 Fault Tree Textual Information.

File Name:

    xxxxxx.FTT

File Format:

    family, fault tree =

        -- text --

    ^EOS

    family, fault tree2 =

    . . .

where

family	- 16 character	Family name
fault tree	- 16 character	Fault tree name

A.1.6 Event Tree Information

A.1.6.1 Event Tree Names and Descriptions.

File Name:

    xxxxxx.ETD

File Format:

    family =

    name,description[,s]

    . . . , . . .

where

family	- 16 character	Family name
name	- 16 character	Event tree name
description	- 60 character	Event tree description
s	- 1 character	If included indicates fault tree is a system

A.1.6.2 Event Tree Attributes.

File Name:

    xxxxxx.ETA

File Format:

    family =

    name,init

    . . . , . . .

where

family	- 16 character	Family name
name	- 16 character	Event tree name
init	- 16 character	Initiating event name

A.1.6.3 Event Tree Graphics.

The IRRAS Event Tree Graphics file (*.ETG) is a display list sequence for the graphics. Its format and contents are the same as the Event Tree Logic File.

File Name:

    xxxxxx.ETG

File Format:

    See file format for the Event Tree Logic

SAMPLE GRAPHICAL EVENT TREE

ABCDE	BCDEF	CDEFG	DEFGH	EFGHI

```
ABCDE        BCDEF       CDEFG       DEFGH       EFGHI
                                                  +5 ————————
                                       +4 ————————
                          3 ———————              -5 ————————
            +2 ————————
                                       -4 ————— 5 ————————
  +1 ————————
                          +3 ————— 4 ————————— 5 ————————
                                                  +5 ————————
                                       +4 ————————
            -2 ————————               -5 ————————
                          -3 ————————
                                       -4 ————— 5 ————————
                          3 ————— 4 ————— 5 ————————
            +2 ————————   +3 ———————  +4 ————— 5 ————————
  -1 ————————                          -4 ————— 5Transfer
                                       -4 ————— 5 ————————
            -2 ————————               -4 ————— 5 ————————
                          -3 ————— 4 ————— 5 ————————
```
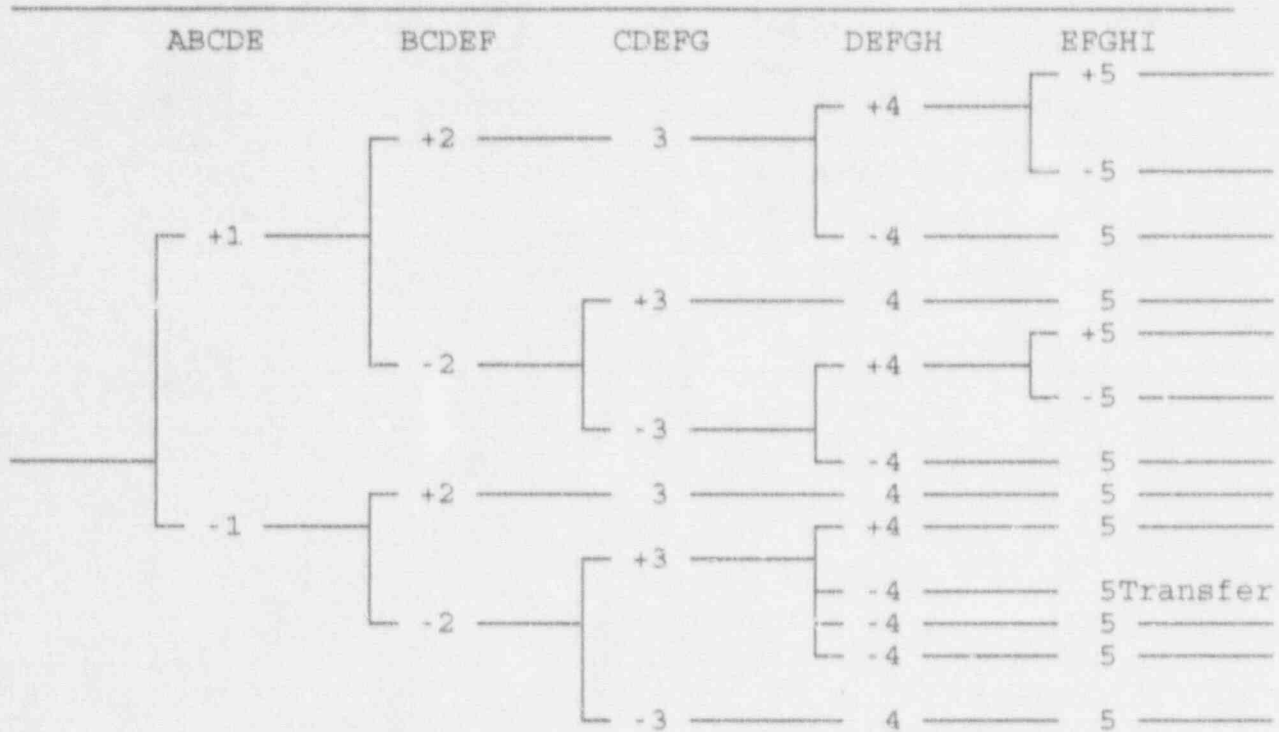
A.1.6.4 Event Tree Logic.

File Name:

    xxxxxx.ETL

File Format:

    family, event tree, init event [,T] =
    ^TOPS
    * 1 | 2 | 3 | 4 | 5 | this is a comment
    ABCDE BCDEF CDEFG DEFGH EFGHI
    ^LOGIC

```
+1      +2       3      +4      +5
                                -5

                        -4       5
         -2      +3       4       5
                 -3      +4      +5
                                -5

                        -4       5
-1      +2        3       4       5
         -2      +3      +4       5
                        -4       5
                        -4       5
                        -4       5
                 -3       4       5
```

Data Formats

```
^SEQUENCES
Y/N, header#1,        Y/N, header#2,         Y/N, header#3,        Y/N,header#4
Y/N, sequence#1,      Y/N, end state#1,      Y/N, xdata1#1,        Y/N,xdata2#1
Y/N, sequence#2,      Y/N, end state#2,      Y/N, xdata1#2,        Y/N,xdata2#2
Y/N, sequence#3,      Y/N, end state#3,      Y/N, xdata1#3,        Y/N,xdata2#3
Y/N, sequence#4,      Y/N, end state#4,      Y/N, xdata1#4,        Y/N,xdata2#4
Y/N, sequence#5,      Y/N, end state#5,      Y/N, xdata1#5,        Y/N,xdata2#5
Y/N, sequence#6,      Y/N, end state#6,      Y/N, xdata1#6,        Y/N,xdata2#6
Y/N, sequence#7,      Y/N, end state#7,      Y/N, xdata1#7,        Y/N,xdata2#7
Y/N, sequence#8,      Y/N, end state#8,      Y/N, xdata1#8,        Y/N,xdata2#8
Y/N, sequence#9,      Y/N, tran file#9,      Y/N, xdata1#9,        Y/N,xdata2#9, T
Y/N, sequence#10,     Y/N, end state#10,     Y/N, xdata1#10,       Y/N,xdata2#10
Y/N, sequence#11,     Y/N, end state#11,     Y/N, xdata1#11,       Y/N,xdata2#11
Y/N, sequence#12,     Y/N, end state#12,     Y/N, xdata1#12,       Y/N,xdata2#12
Y/N, sequence#13,     Y/N, end state#13,     Y/N, xdata1#13,       Y/N,xdata2#13


^TEXT
SIZE s
JUST j
COLOR j
XY xvalue,yvalue
 "60 character line of text"
XY xvalue, yvalue
 "60 character line of text"
 "60 character line of text"


^PARMS
START yvalue
WINDOW x1,y1,x2,y2
HEADER x1,x2,x3,x4
^EOS
family, event tree2 =
(additional event trees)
```

where

family	- 16 character	Family name
event tree	- 16 character	Event tree name
init event	- 16 character	Initiating Event
[,T]	- 1 character	Optional flag indicating init event name is a Top event system
TOPS	- 16 character	Top event/system names
Y/N	- Boolean	End state text displayed?
header	- 16 character	Sequence header
sequence	- 16 character	Sequence name
endstate	- 16 character	End state name
tran file	- 16 character	Name of transfer file
xdata1	- 16 character	Information (optional)
xdata2	- 16 character	Information (optional)

General Rules:
1. A line beginning with an asterisk ("*") is a comment.
2. Literal "^TOPS", "^LOGIC", "^SEQUENCES" labels must be present.
3. Logic is built according to the position of the top event in the definition.
   Plus sign (" + ")---the specified top event succeeded.
   Minus sign ("-")---the specified top event failed.
   Blank (" ")---the response of the indicated top event did not matter.
4. Header, Sequence name, End State name, Xdata1, Xdata fields associated with each sequence. "Y/N" indicates whether the specified field is visible. A "T" at the end indicates the sequence transfers to another tree.
5. User text is input following the ^TEXT command. Parameters include the size, justification, color, and location of the text block.
6. The ^PARMS command allows input of program control parameters.

A.1.6.5 Event Tree Rules.

File Name:
    xxxxxxxx.ETR
File Format:
    family, event tree =
    IF top1 top2 top3
    THEN top4 = sys1,
        top5 = sys2.
    IF top3 top4 top5 THEN top3 = sys4.

       . . .

    ^EOS
    family, event tree2
where:

family	- 16 character	Family name
event tree	- 16 character	Event tree name
tops	- 16 character	Top event/system names

A.1.6.6 Event Tree Textual Information.

File Name:
    xxxxxx.ETT
File Format:
    family, event tree =
        -- text --
    ^EOS
    family, event tree2 =
        -- text --
where

family	- 16 character	Family name
event tree	- 16 character	Event tree name

A.1.7 End State Information

Each sequence can be tied to a single plant damage state. The end state probabilities are currently entered by the user. The name and description data are loaded with the SARA *.PDS file.

A.1.7.1 End State Names and Descriptions.

File Name:
    xxxxxx.ESD
File Format:
    family =
    name,description

    . . . , . . .

where

family	- 16 character	Family name
name	- 16 character	End state name
description	- 60 character	End state description

A.1.7.2 End State Information.

File Name:
    xxxxxx.ESI
File Format:
    family =

        ******************** will be defined later **************

A.1.7.3 End State Textual Information.

File Name:
    xxxxxx.EST
File Format:
    family, end state =
        -- text --
    ^EOS
    family, end state2 =
where

| family | - 16 character | Family name |
| end state | - 16 character | End State name |

A.1.8 Sequence Information

A.1.8.1 Sequence Names and Descriptions.

File Name:
    xxxxxx.SQD
File Format:
    family,event. . . =
    name,description

    . . . , . . .
    ^EOS
where

family	- 16 character	Family name
eventree	- 16 character	Event tree name
name	- 16 character	Sequence name
description	- 60 character	Sequence description

A.1.8.2 Sequence Cut Sets.

The sequence cut sets are the minimal cut sets for sequence logic as derived from the fault tree logic. The cut sets are stored in the block data file of the Sequence relation.

The MAR-D sequence cut sets (.SQC) are in a format similar to that of the fault tree cut sets described in Section 5.1.5.

File Name:
    xxxxxx.SQC
File Format:
    family, event tree, sequence =
    eventname * eventname +
    eventname * eventname * eventname *
    eventname +
    eventname * eventname.
    ^EOS
    family, event tree2, sequence2 =
where

family	- 16 character	Family name
event tree	- 16 character	Event tree name
sequence	- 16 character	Sequence name
eventname	- 16 character	Event names in the cut set

Data Formats

General Rules:
1. An asterisk ("*") separates events in a cut set. Spaces are ignored.
2. A plus sign ("+") separates cut sets.
3. A period (".") denotes the end of the sequence.
4. A slash ("/") precedes complemented events.
5. Event names have a maximum of 16 characters including the "/" character for complemented events.
6. A line beginning with an asterisk ("*") is a comment.

A.1.8.3 Sequence Attributes.

File Name:

    xxxxxx.SQA

File Format:

    family, event tree =

    name,endstate,mincut,mission,procut,sample,seed,size,cuts,

        events,value1, . . . ,value9,default flags, used flags

    . . . , . . . , . . . , . . . , . . . , . . . , . . . , . . .

    ^EOS

    family, event tree2 =

where

family	- 16 character	Family name
event tree	- 16 character	Event tree name
name	- 16 character	Sequence name
endstate	- 16 character	End State name
mincut	- Floating point	Mincut upper bound
mission	- Floating point	Mission time in hours
procut	- Floating point	Probability cut off value
sample	- Integer 4	Sample size
seed	- Integer 8	Random number seed
size	- Integer 2	Size cut off value
cuts	- Integer 5	Base number of cut sets
events	- Integer 5	Base number of events
value	- Floating point	Base uncertainty values
value1	- 5th percentile	
value2	- Median	
value3	- Mean	
value4	- 95th percentile	
value5	- Minimum sample	
value6	- Maximum sample	
value7	- Standard deviation	
value8	- Skewness	
value9	- Kurtosis	
Default flags	- Default flag set for this sequence	
Used flags	- Flag set used to generate these cut sets	

A.1.8.4 Sequence Logic.

File Name:
>xxxxxxxx.SQL

File Format:
>family, event tree, sequence=
>sys1 sys2 /sys3 sys4

>. . .

>^EOS
>family, event tree2, sequence2=

where

family	- 16 character	Family name
event tree	- 16 character	Event tree name
sequence	- 16 character	Sequence name
sys	- 16 character	System name

General Rules:
>1. Complemented systems are prefixed with "/".

A.1.8.5 Sequence Textual Information.

File Name:
>xxxxxx.SQT

File Format:
>family, event tree, sequence=
>>--- text ---
>^EOS
>family, event tree2, sequence2=
>>--- text ---

where

family	- 16 character	Family name
sequence	- 16 character	Sequence name
event tree	- 16 character	Event tree name

A.1.9 Piping and Instrumentation Diagrams

A.1.9.1 P&ID.

The piping and instrumentation diagrams is a graphics file in binary format. It will be loaded and output as-is: no conversion will be performed.

File Name:
>xxxxxx.PID

File Format:
>(P&ID Editor format)

A.1.10 Gate

A.1.10.1 Gate Description.

File Name:
   xxxxxx.GTD

File Format:
   family=
   name,description

where

family	- 16 character	Family name
name	- 16 character	Gate name
description	- 60 character	Gate description

A.1.10.2 Gate Attributes.

File Name:
   xxxxxx.GTA

File Format
   family=
   name,attribute

where

family	- 16 character	Family name
name	- 16 character	Gate name
attribute	- 4 characters	Gate type

A.1.1' Change Sets

A.1.11.1 Change Set Description.

File Name:
   xxxxxx.CSD
File Format:
   family=
   name,description
   ....

where

family	- 16 character	Family name
name	- 16 character	Change set name
description	- 60 character	Change set description

A.1.11.2 Change Set Information.

File Name:
xxxxxx.CSI

File Format:
family,change=
^PROBABILITY
eventname,calc.udT,prob,lambda,tau,udV,udC,mission,init
^CLASS
eventname,group,compType,compId,system,location,failMode,train,init,att1,..att16
calcType,udT,prob,lambda,tau,udV,udC,mission,init
^EOS
family,change2=

where

change	- 16 character	change set name
eventname	- 16 characters	name mask
group	- 16 characters	event group mask
compType	- 7 characters	component type mask
compId	- 3 characters	component ID mask
system	- 3 characters	system mask
location	- 3 characters	location mask
failMode	- 2 characters	failure mode mask
train	- 2 characters	train mask
init	- 1 character	initiating event (Y/N)
att1..att16	- Class attribute flats--16 values of Y or N (yes or no) indicate whether the attribute described in the class attribute file is applicable.	

calc	- 1 character	Calculation type

1 - Probability
2 - Lambda * Mission Time
3 - 1 - Exp(-Lambda * Mission Time)
4 - Lambda * Min(Mission Time, Tau)
5 - Operating component with full repair
6 - Lambda * Tau / 2.0
7 - 1 + (EXP(-Lambda*Tau)-1.0)/(Lambda*Tau)
8 - Base Probability * Probability
9 - Base Probability * Probability
T - Set to House Event (Failed, Prob=1.0)
F - Set to House Event (Successful, Prob=0.0)

Data Formats

udT	-	1 character	Uncertainty distribution type
		L -	Log normal, error factor
		N -	Normal, standard deviation
		B -	Beta, b of Beta(a,b)
		G -	Gamma, a Gamma(a)
		E -	Exponential, none
		U -	Uniform, Upper end pt.
prob	-	Floating point Probability value	
lambda	-	Floating point Basic event failure rate per hr.	
tau	-	Floating point Time to repair in hours	
udV	-	Floating point Uncertainty distribution value	
udC	-	4 characters	Uncertainty correlation class
		Events in same class are 100% correlated.	
mission	-	Floating point Mission time	
init	-	Boolean (T/F) Initiating event	

A.2 SETS

A.2.1 Sequences

A.2.1.1 Sequence Cut Sets.

File Name:
xxxxxx.DNF.

The format of the SETS output cut sets file (.DNF) is dependent upon the command issued within SETS. The factored form is

$$A * (B + C)$$

The disjunctive normal form is

$$A * B + A * C.$$

ONLY the disjunctive normal form is accepted by the MAR-D at this time.

File Format:
sequence-name =
eventName * eventName +
eventName * eventName.
where

. . . . .

General Rules:
1. An asterisk ("*") separates event names. Spaces are ignored.
2. A plus sign ("+") separates cut sets.
3. A period (".") denotes the end of a sequence.
4. An asterisk ("*") in the first column denotes a comment.

A.2.2 Fault Trees

A.2.2.1 Fault Tree Logic.

File Name:
xxxxxx.SET.
File Format:
FAULT TREE$ fault-tree-name.
COMMENT$ descriptive material *
gate-type $ gate-name. IN$ input-1, input-2, . . . , input-n.
                                    OUT$ output-1, output-2, . . . , output-n.
event-type $event-name.   OUT$ output-1, . . . , output-n.

Data Formats

where

fault-tree-name	- The name of the fault tree.
gate-type	- The type of gate being defined.

<div style="margin-left: 4em">

AG = AND gate

OG = OR gate

EOR = Exclusive OR gate (converted to SG)

EAG = Exclusive AND gate (converted to SG)

SG = Special Gate

</div>

gate-name	- The name of the gate being defined (16 characters) input-n
	- The names of the gates or primary events that are the immediate inputs to the gate being defined (16 characters)
output-n	- The names of the gates that are the immediate outputs of the gate or primary event being defined (16 characters).
event-type	- The type of primary event being defined.

<div style="margin-left: 4em">

BE = Basic Event

CE = Conditional Event

UE = Undeveloped Event

DE = Developed Event

EE = External Event

</div>

COMMENT$	- Defines a comment. Must follow a "." delimiter.

A.2.2.2 Fault Tree Cut Sets.

The fault tree cut sets are stored in the System relation in the block data file. The format of the cut set file (.DNF) is given above.

A.2.3 Basic Events

A.2.3.1 Basic Event Failure Rates.

File Name:

xxxxxxx.VBK.

File Format:

VALUE BLOCK$ value-block-name

prob $ name-list$

prob $ name-list$

where

prob	- point value probability estimate
name-list	- list of event names separated by commas

A.2.3.2   Basic Event Descriptions

File Name:

      xxxxxxxx.DES

FileFormat:

      event-name $ event-description $

where

event-name	- Name of basic event
event-description	- Basic event description (60 character maximum)

A.2.4 Output Reports

Output reports can be converted to other formats or loaded by the user. They are not stored intact in the database. The cut sets are stripped from the listing file (.LIS) and stored in the Sequence relation. A variable occurrence table is written to file "sequence-name.VOT" in the family directory.

File Name:

      xxxxxx.LIS.

File Format:

    . . . Header information

      EXECUTE

      LDBLK (sequence name, sequence name, . . .)

    . . .

      COMTRMVAL (sequence name)

      -- blank line --

      /OMEGA means empty cut set

      -- 12 blank lines --

      Variable Occurrence Table--Output as is

      -- 5 lines to cut set table --

      41 character leader + 1 space + basic event name

      THE MAXIMUM TERM--ends the cut sets

    . . .

General Rules:

    1. A plus sign (" + ") followed by a blank line separates cut sets.

    2. Cut set terms can be continued on separate lines.

    3. An asterisk ("*"), plus sign (" + "), or blank (" ") separates basic event names.

    4. A period (".") denotes the last cut set.

BIBLIOGRAPHIC DATA SHEET

(See instructions on the reverse)

2. TITLE AND SUBTITLE

Models and Results Database (MAR-D), Version 4.0: Reference Manual

5. AUTHOR(S)

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8. PERFORMING ORGANIZATION — NAME AND ADDRESS *(If NRC, provide Division, Office or Region, U.S. Nuclear Regulatory Commission, and mailing address; if contractor, provide name and mailing address.)*

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9. SPONSORING ORGANIZATION — NAME AND ADDRESS *(If NRC, type "Same as above"; if contractor, provide NRC Division, Office or Region, U.S. Nuclear Regulatory Commission, and mailing address.)*

Division of Safety Issue Resolution
Office of Nuclear Regulatory Research
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10. SUPPLEMENTARY NOTES

11. ABSTRACT *(200 words or less)*

The Nuclear Regulatory Commission's Office of Nuclear Regulatory Research (NRC-RES) is presently funding the development of the Models and Results Database (MAR-D) at the Idaho National Engineering Laboratory. MAR-D's primary function is to create a data repository for NUREG-1150 and other permanent data by providing input, conversion, and output capabilities for data used by IRRAS, SARA, SETS, and FRANTIC personal computer (PC) codes.

As probabilistic risk assessments and individual plant examinations are submitted to the NRC for review, MAR-D can be used to convert the models and results from the study for use with IRRAS and SARA. Then, these data can be easily accessed by future studies and will be in a form that will enhance the analysis process.

This reference manual provides an overview of the functions available within the MAR-D and step-by-step operating instructions.

12. KEY WORDS/DESCRIPTORS *(List words or phrases that will assist researchers in locating the report.)*

Models and Results Database (MAR-D)
probabilistic risk assessments (PRA)
data loading

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WASHINGTON, D.C. 20555

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