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&G Idaho, Inc.

pared for
Nuclear Regulatory Commission

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INTEGRATED RELIABILITY AND RISK ANALYSIS SYSTEM (IRRAS) VERSION 4.0

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Integrated Reliability and Risk Analysis System (IRRAS) Version 4.0

Reference Manual

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ABSTRACT

The Integrated Reliability and Risk Analysis System (IRRAS) is a state-of-the-art, microcomputer-based probabilistic risk assessment (PRA) model development and analysis tool to address key nuclear plant safety issues. IRRAS is an integrated software tool that gives the user the ability to create and analyze fault trees and accident sequences using a microcomputer. This program provides functions that range from graphical fault tree construction to cut set generation and quantification.

Version 1.0 of the IRRAS program was released in February of 1987. Since that time, many user comments and enhancements have been incorporated into the program providing a much more powerful and user-friendly system. This version has been designated IRRAS 4.0 and is the subject of this Reference Manual. Version 4.0 of IRRAS provides the same capabilities as Version 1.0 and adds a relational data base facility for managing the data, improved functionality, and improved algorithm performance.

Fin No. L1429 -- SARA, IRRAS, and MAR-D Maintenance and User Support

Previous Reports in the Series

K.D. Russell et al., *Integrated Reliability and Risk Analysis System (IRRAS) Version 2.5 Reference Manual*, NUREG/CR-5300, EGG-2613, March 1991.

K.D. Russell, M.B. Sattison, D.M. Rasmuson, *Integrated Reliability and Risk Analysis System (IRRAS) - Version 2.0 User's Guide*, NUREG/CR-5111, EGG-2535, manuscript completed March 1989, published June 1990

K.D. Russell, D.M. Snider, M.B. Sattison, H.D. Stewart, S.D. Matthews, K.L. Wagner, *Integrated Reliability and Risk Analysis System (IRRAS) User's Guide - Version 1.0 (DRAFT)*, NUREG/CR-4844, EGG-2495, June 1987

CONTENTS

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 data base structure, to create, analyze, and quantify the data, and to display results and perform sensitivity analysis. The programs included in this suite are as follows; Models And Results Database (MAR-D) software, Integrated Reliability and Risk Analysis System (IRRAS) software, Systems Analysis and Risk Assessment (SARA) software, and Fault tree, Event tree, and P&ID (FEP) graphical editor software. Each of these programs perform 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. The MAR-D program also provides the facilities for loading and unloading of PRA data from the relational database structure used to store the data to an ASCII format 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 the 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 in draft form and will be finalized.

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 technical 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 in draft form and will be finalized.

ACKNOWLEDGMENTS

The IRRAS project would not have enjoyed the success it has without the efforts of some other key contributors. These individuals provided a major contribution to the development and success of the IRRAS system.

- Howard D. Stewart - for his support in designing the overall IRRAS concepts and for his software support in implementing these concepts.

- Dale M. Snider and Kurt L. Wagner - for their contribution to the graphical concepts and software development in IRRAS 1.0.

- Scott D. Matthews and Cory Atwood for their support on the uncertainty analysis.

Appreciation is also expressed to all the various organizations and individuals who provided valuable comments and reviews of the preliminary versions of IRRAS.

INTEGRATED RELIABILITY AND RISK ANALYSIS SYSTEM (IRRAS) VERSION 4.0 VOLUME 1 - REFERENCE MANUAL

EXECUTIVE SUMMARY

The Integrated Reliability and Risk Analysis System (IRRAS) is being developed at the Idaho National Engineering Laboratory (INEL) as the U.S. Nuclear Regulatory Commission's (NRC's) state-of-the-art microcomputer-based probabilistic risk assessment (PRA) model development and analysis tool to address key nuclear plant safety issues.

IRRAS is an integrated PRA software tool that gives the user the ability to create and analyze fault trees and accident sequences using a microcomputer. This program provides functions that range from graphical fault tree and event tree construction to cut set generation and quantification.

The INEL's role in the IRRAS program is that of software developer and interface to the user community, including training and technology transfer. Version 1.0 of the IRRAS program was released in February of 1987 to prove the concept of performing this kind of analysis on microcomputers. That version contained many of the basic features needed for fault tree analysis and was well received by the PRA community. Since the release of Version 1.0, many user comments and enhancements have been incorporated into the program, providing a much more powerful and user-friendly system. This version has been designated IRRAS 4.0. Previous versions of IRRAS include versions 2.0 and 2.5.

IRRAS has all the capabilities and functions required to create, modify, reduce, and analyze fault tree models used in the analysis of complex systems and processes. IRRAS uses advanced graphic and analytical techniques to achieve the greatest possible realization of the potential of the microcomputer. Version 4.0 of IRRAS provides all of the same capabilities as Version 1.0 and adds a relational data base facility for managing the data, improved functionality, and improved algorithm performance.

1. INTRODUCTION

The Integrated Reliability and Risk Analysis System (IRRAS) software development project was started as a result of a recognized need for microcomputer-based software to aid the probabilistic risk assessment (PRA) analyst. The initial scope of the project was to provide a software package that could demonstrate the feasibility of using the microcomputer as a workstation for performing PRA analyses. This package did not necessarily need to perform all of the functions required; however, it did need to provide certain essential functions such as fault tree construction, failure data input, cut set generation, and cut set quantification. The result of this software development project was IRRAS 1.0. That version of the software was released in February of 1987 and contained only the essential concepts mentioned above.

IRRAS 1.0 was an immediate success and clearly demonstrated not only the tremendous need but also the feasibility of performing this work on a microcomputer. As a result of this success, IRRAS 2.0 development was begun. This package was designed to be a comprehensive PRA analysis package and included all the functions necessary for a PRA analyst to perform his or her work. The areas that were not treated in version 1.0 were addressed, and a complete, integrated package was developed. Because IRRAS version 2.0 was a complete rewrite from version 1.0, a thorough test plan was necessary. The major features of IRRAS 2.0 along with an Alpha test were completed in early March of 1988. Following the Alpha test, approximately 15 sites were selected from among the sites currently using IRRAS 1.0. and were sent a Beta test version of IRRAS 2.0. In May of 1988, the Beta test was completed and work began on fixing any bugs found. In addition, any desired new features that could reasonably be incorporated into version 2.0 were included. IRRAS 2.0 was released in June 1990 and work began on the development of IRRAS 2.5.

IRRAS version 2.5 was an integrated PRA software tool that gave the user the ability to create and analyze fault trees and event trees using a personal computer (PC). This program provided functions for fault tree and event tree construction and analysis. The fault tree functions ranged from graphical fault tree construction to fault tree cut set generation and quantification. The event tree functions included graphical event tree construction, the linking of fault trees, defining accident sequences, generating accident sequence cut sets, and quantifying them.

IRRAS version 4.0 contains many significant enhancements over previous versions. This version provides much more powerful cut set generation algorithms. These algorithms are more than a thousand times faster than previous versions of IRRAS. Problems that took hours to solve can now be solved in seconds using IRRAS 4.0. Other enhancements provided in this version include the ability to use the system fault tree logic to solve accident sequences and the addition of flag sets to automatically prune the sequence logic. Many of the operations in IRRAS have also been streamlined and simplified to provide an even more powerful tool for the PRA analyst. This version has undergone a rigorous testing program to ensure reliability and useability. Overall, IRRAS 4.0 continues to provide more powerful tools for the PRA analyst.

The objective of the IRRAS development is to provide the U.S. Nuclear Regulatory Commission (NRC) with a PC-based tool that can be used by NRC staff to evaluate incidents in a timely manner. IRRAS 1.0 was released in February 1987. Since that time, it has been distributed to over 400 users in the United States. These users include NRC staff, national laboratories, contractors, vendors, utilities, architectural engineering firms, consultants, universities, other government agencies, and their contractors. IRRAS is being used as an analysis tool in the resolution of generic issues, inspection activities, and other NRC programs.

At the center of the PRA is the fault tree model. This model, along with component reliability data, provides the basis for risk analysis in most PRA methods. Prior to the development of IRRAS, an analyst would generate models using an alphanumeric text editor. The information would be input in a format compatible with the analysis software, such as SETS, used to process the information. When changes to the model were needed, the analyst would go back to the text file and modify the card images to reflect the changes in the logic model. The analyst would then resubmit them to generate the new cut sets. This process is prone to errors and difficult for the analyst to visualize. IRRAS helps eliminate this problem.

IRRAS automates the model creation, manipulation, modification, and quantification processes. Designed for the IBM-PC and compatibles, IRRAS is readily accessible and portable. Taking advantage of new state-of-the-art algorithms, IRRAS is quite fast and powerful.

IRRAS simplifies the analysis process and automates the construction of input to the analysis software. The analyst can graphically construct and modify fault trees. IRRAS gives the users better visualization of the fault tree and simplifies the construction and maintenance. The program supports all of the basic constructs involved in fault tree construction, including NOT gates. Once the fault tree is constructed, the program automatically generates the alphanumeric input for the analysis software. The component reliability information is then easily input into the IRRAS data base using specially designed menus and screens.

After constructing the system fault tree models, the analyst processes these models with an integrated fault tree analysis package. This package includes the capability to read a fault tree and failure rate data associated with the basic events. The program then generates the minimal cut sets of the fault tree and quantifies the fault tree top event probability using the minimal cut set upper bound. Importance measures for both cut sets and basic events are calculated. The results are documented in various reports generated by the program. The user may select truncation of cut sets by size and/or probability and specify the gate where reduction is to begin. The user may perform some cut set level analysis by using a cut set editor to modify the cut sets, save the new cut sets, and recalculate the minimal cut set upper bound and the new importance measures.

The analyst defines accident sequences in terms of the systems. IRRAS 4.0 has the ability to link fault trees according to the accident sequence logic to create core damage sequence cut sets. These accident sequence cut sets are then quantified to determine the accident sequence frequency. Importance measures are also calculated.

Many features of mainframe codes have been incorporated into IRRAS 4.0. Improved fault tree reduction techniques, such as identification of independent subtrees and coalescing gates, help to speed up the analysis and make it possible to process larger logic models. Error-checking routines have been added to ensure that the input can be processed when it is time to analyze the fault trees.

In IRRAS 4.0, the graphical fault tree logic can be directly generated from alphanumeric input. This allows the user to read mainframe code input files, such as SETS, and generate the fault tree graphics. The logic models are then easily modified for re-analysis.

IRRAS 4.0 includes fault tree, event tree and cut set editors to improve the analysis capabilities without requiring complete regeneration and reduction of the fault trees. Basic event or initiating event frequencies are easily changed. Cut sets are easily modified with the cut set editor to add recovery actions, or cut sets may be deleted if desired. These changes can be saved in the data base and quantified as desired.

The sections that follow provide the user with the detailed information needed to become familiar with IRRAS 4.0. Sections 3 through 11 present a step-by-step approach to using the basic capabilities of IRRAS. Appendix A provides the specifics of hardware requirements and installation. Appendix B contains data interchange formats.

NOTE: It should be noted that this document assumes the reader is familiar with PRA methods and terminology. This manual does not instruct the reader in PRA methodology, but merely serves as a reference manual for the IRRAS user.

2. GETTING TO KNOW IRRAS 4.0

The purpose of this section is to give you, the user, an overview of what IRRAS 4.0 can do. We begin with brief discussions of the IRRAS 4.0 modules. (Each module roughly corresponds to a major function or feature.) Next, we explain a little about the IRRAS 4.0 data base so you can begin to learn how IRRAS 4.0 works. Then, we give some pointers on how to best get around inside the program with some special keys. Finally, we provide some insight as to how IRRAS 4.0 works, the usual order of operating IRRAS, and things you must do to prevent unpredictable results.

2.1 IRRAS 4.0 Modules

We have structured IRRAS 4.0 so that the various functions are contained in individual modules or program units. Each module is activated by the use of a command from a menu on the screen. The main modules are SELECT Family, GENERATE Event Data, BUILD Fault Trees, FAULT Tree Analysis, CREATE Event Trees, ANALYZE Sequences, MODIFY Data Base, REPORT on Data Base, and UTILITY Options. Each module is described below.

The *SELECT Family* module is used to select the family data set you wish to work with and provides the capability of copying raw (MAR-D) data files or IRRAS data base files into a specific family.

The *GENERATE Event Data* module is used to create a working copy of user event data for use in analysis. This data can then be modified using change sets or used to update the base case data.

The *BUILD Fault Trees* module is used to build and edit fault tree models and output them to several hard copy hardware devices. Fault trees can be drawn using the keyboard or a mouse. If you use the keyboard, you'll soon see the advantages of getting a mouse. We have used pop-up menu technology in this module to make tree drawing as simple as possible.

The *FAULT Tree Analysis* module is used to quantify the fault tree. Here you determine the minimal cut sets, calculate the probability of failure of the top event of the fault tree, calculate the importance measures of the basic events and the cut sets, and perform uncertainty analysis on the top event failure probability. Sensitivity analysis can be done by changing the failure probability of basic events and requantifying.

The *CREATE Event Trees* module is used to build, edit, and link event trees in a fashion similar to the way the fault trees are constructed in IRRAS 4.0. This greatly simplifies and automates the event tree construction and analysis process.

The *ANALYZE Sequences* module is a powerful sequence analyzer. This module generates the cut sets for an accident sequence by combining the cut sets or fault trees for the top events that make up the sequence. Comparisons are made between the cut set lists for successful and failed fault trees to eliminate impossible failure combinations (similar to the delete term option in SETS). Once the sequence cut sets have been generated, you can quantify the sequence, calculate importance measures, and perform uncertainty analysis. The results can be displayed on the screen, sent to a printer, or written to a file for later use.

The *MODIFY Data Base* module provides access to the IRRAS 4.0 relational data base that is created, in part, from use of the other modules. Figure 1 shows the structure of this data base. All information is grouped into families. A family can be a facility, a group of systems, or any other logical group for which fault trees or sequences are desired. You define the families and assign descriptions in this module. Fault trees are assigned to families in the BUILD Fault Trees module. Sequences are created and assigned descriptions in the MODIFY Data Base module. Basic events are automatically extracted from the fault trees assigned to the family, but you must assign reliability data and descriptions in the MODIFY Data Base module. Additions, deletions, and modifications to the data base can be made here. Section 2.2 provides more detailed information on the data base.

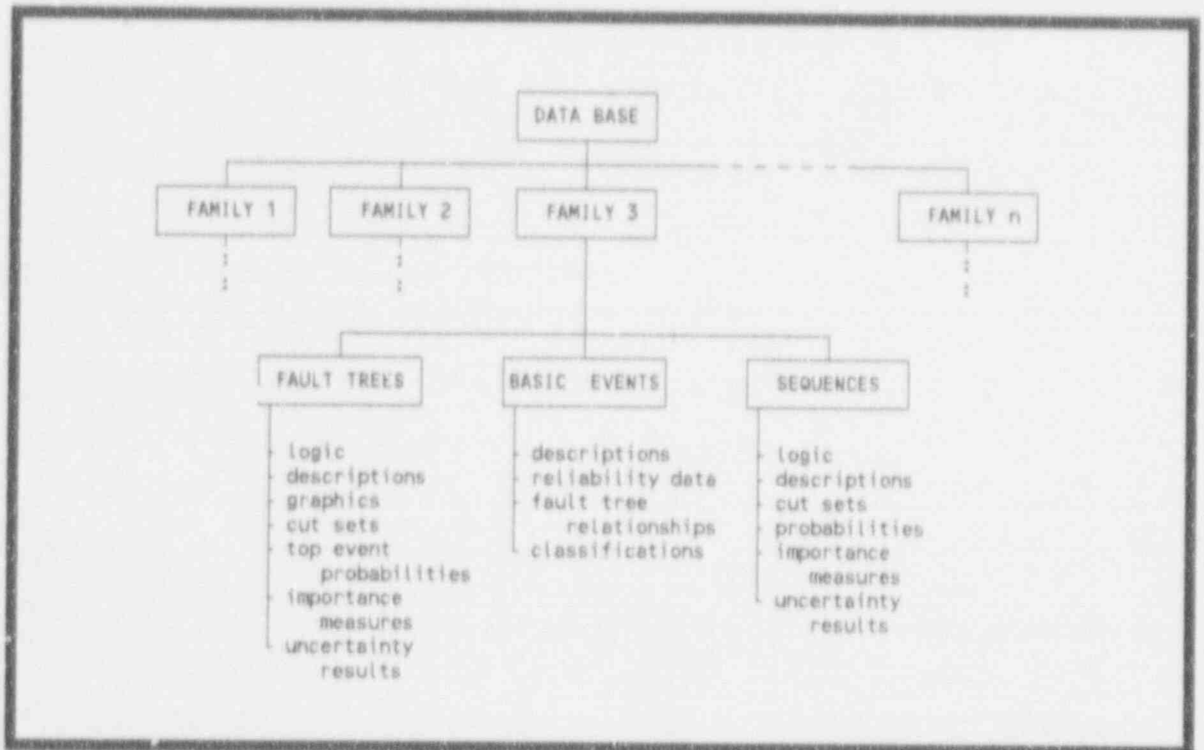


Figure 1. IRRAS 2.6 data base structure.

The *REPORT on Data Base* module lets you see what is in the IRRAS 4.0 data base. Reports are available on families, basic events, attributes, systems, event trees, sequences, end states, and user information.

The last module, *UTILITY Options*, performs program and computer-related tasks such as setting new machine constants after a hardware configuration change or interfacing with SETS or the PRA data base. The Utility option consists of five functions: Define Constants, Load MAR-D Data Files, Extract MAR-D Data Files, Version 1.0/4.0 Interface, and Recover Data Base. The first option, Define Constants, is used to indicate system hardware configuration, set uncertainty and cut set defaults, and set event tree and fault tree graphics defaults. The second option, Load MAR-D data Files, allows you to load raw files into IRRAS. Extract MAR-D Data Files allows you to output the IRRAS data base records into files that conform to MAR-D data format. The Version 1.0/4.0 Interface allows you to convert data base files using IRRAS Version 1.0 software to IRRAS Version 4.0, or from Version 4.0 to Version 1.0.

Finally, the Recover Data Base option allows you to rebuild the index files to each relation in the data base.

2.2 IRRAS 4.0 Data Base Concepts

Before you can use IRRAS 4.0 effectively, you need a good understanding of the IRRAS 4.0 data base structure and concepts. The data base provides an effective way to manage the inputs and outputs of the various modules.

The IRRAS 4.0 data base is divided into *families*. A family is the first thing that must be created when using IRRAS 4.0. As delivered, IRRAS 4.0 provides an initial family called DEMO. (Once you are comfortable with IRRAS 4.0, you may want to clear this family from the data base.) A *family* is any logical grouping of fault trees and sequences with their associated basic events, cut sets, reliability data, and descriptions. Access to any portion of the data base is obtained through the appropriate family.

A fault tree is automatically assigned to the current family selected when the BUILD Fault Trees module is exited. The basic events used by the fault tree are checked against the events already assigned to the family. Only new basic events are added to the family list. Thus, for a given family there is only one list that contains all the basic events for all the fault trees in the family. This ensures that the reliability data used for a basic event in one tree are identical to those used for the same event in another tree in the family.

The family relation maintains data common to all fault trees in the family, including

- family name and description,
- basic event names and attributes,
- event-to-fault tree association,
- event-to-sequence association,
- fault tree change status information, and
- sequence change status information.

NOTE: Change status is a flag set by the system indicating one of the following:

'c'	=	flags the system or sequence as having cut sets that must be recalculated
'q'	=	flags the system or sequence as having cut sets that must be requantified
'u'	=	flags the system or sequence as needing uncertainty distributions recalculated.

These are discussed in detail in Section 6.

The fault tree relation maintains data for the following fault tree attributes:

- fault tree name and description,
- fault tree logic,
- graphic representation,
- minimal cut sets,
- top event probability,
- importance measures, and
- uncertainty analysis results.

Similarly, the relation defined for an accident sequence includes:

- name and description,
- logic (combination of successful and failed systems),
- minimal cut sets,
- sequence probability,
- importance measures, and
- uncertainty analysis results.

The event tree relation includes:

- event tree name and description,
- graphic representation, and
- initiating event.

A relation is also maintained to track event changes relating to event class and event probability.

Unrelated to trees and/or families is the user/system data.

The relations are permanent relations used to maintain the IRRAS 4.0 data base. For each relation, three files exist:

- *.DAT,
- *.IDX, and
- *.BLK.

The *.DAT file contains the actual data and information about which data constitutes a "key." The *.IDX file contains indices into the data for keyed fields. Finally, the *.BLK file contains variable length data (such as cut sets) that are accessible through pointers contained in the *.DAT file.

2.3 Using IRRAS for the First Time

The installation procedure for loading IRRAS 4.0 into your computer is found in Appendix A. The loading process creates three new directories, if they do not already exist. These 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. These directories take approximately 6000K of memory on the hard disk when first loaded. Of course, storage requirements go up as you use the program and generate more data.

IRRAS 4.0 uses approximately 550K of internal memory when executed, therefore, resident programs such as Sidekick must be unloaded before using IRRAS 4.0 on a 640K machine.

The following procedure assumes your system is running DOS 3.3 or newer. If your DOS version is older than 3.3, you must upgrade to use IRRAS 4.0.

To start IRRAS 4.0, simply change directories to PRADATA.B1 (CD\PRADATA.B1), type IRRAS, and press <Enter>. (The < > designates pressing the indicated key.) This will execute IRRAS 4.0 with the keyboard as the graphics input device unless you have a mouse and have loaded your mouse driver. If so, then you may use either input device interchangeably.

On the very first entry into IRRAS 4.0 after installation, the IRRAS Constants screen will appear (see Figure 2). With this screen, you tell the program the configuration of your hardware and the default values desired for various functions within the program. This screen, once completed, will not appear on subsequent entries into IRRAS. If you desire to change a default or your hardware configuration has changed, this screen can be called up from the UTILITY Options menu (see Section 11).

When this form is filled out properly, press <Enter> to place the information in the data base. Another defaults/constants screen will appear. This screen, shown in Figure 3, establishes the defaults for the fault tree graphics. Once this is filled in properly, press <Enter>, and a third and final screen (Figure 4) will appear with defaults for the event tree editor. Fill this screen in as required and press <Enter>.

```
                    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)          1
 (0-IBM, 1-PARADISE, 2-ATI, 3-TECMAR, 4-TSENG, 5-VIDEO7,  PLASMA) 0
 Printer type (0-Other, 1-Epson, 2-HP Laser)                  2
 Printer [illegible] BM character font? (Y/N)                 N
 [illegible] port (0-None, 1-Com1, 2-Com2, 3-Com3)            0
 [illegible] alternate basic Event Names ? (Y=alternate N=primary)  N
 [illegible] Measurement Type ? (R=ratios, I=intervals, U=uncert) R
 Verify [illegible] 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)          Y     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 2. IRRAS Constants form for example.

```
                    C o n s t a n t s

        ------ Fault Tree Graphics Information ------
   ----------------Name----------------
   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        N      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 3. IRRAS Event tree graphics information.

```
                      Constants

   ─────── 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 . . . . . . . . . . . . . . . . . . . . . 1.00
   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 4. Event tree graphics information.

2.4 Getting Around Inside IRRAS 4.0

Option selection from any menu with a vertical list of options can be done in several ways. The up and down arrow keys can be used to move a highlight through the options. When the highlight is on the desired option, press <Enter> to select the option. The <Space bar> will also move the highlight through the options. Another method of selecting an option is to type in the first or second letter of the option and press <Enter>. On menus that have horizontal lists of options, the highlighted letter of the option must be typed in the option field followed with <Enter>.

Certain portions of the program have help screens to aid the user. These help screens are accessed by pressing the <F1> key. The <Esc> key is used to cancel or abort a function.

Pressing <Alt> H displays the Key Function help screen. This screen is shown in Figure 5. This screen identifies the functions of some special keys for use on fill-in-the-blank type forms used in IRRAS 4.0.

```
                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-           B&W / color---Ctl/B
insert---Ins        delete--------Del
```

Figure 5. 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 cause each screen to be appended to the bottom of the SCREEN.CPY file.

2.5 Invoking IRRAS

As mentioned earlier, to invoke IRRAS type **IRRAS** at the C:\PRADATA.B1 prompt. When you invoke this option, the main menu will be displayed (see Figure 6). Each menu option is discussed in the following sections (Sections 3 through 11).

2.6 Hot Keys

Hot keys allow you to directly transfer to any main menu option from any IRRAS module. To view the help screen for the hot key options, press <F1> from the main menu. Figure 7 will be displayed. This is a help screen only, and does not have to appear in order for the hot keys to be active. From most screens in IRRAS, you simply press the <Alt> key combination that corresponds to the desired main menu option. You will be immediately transferred into the corresponding module.

2.7 Menu Options Naming Conventions

Throughout IRRAS, a consistent naming convention is used on all menus. On each menu (like the Create Event tree menus), some options appear in all upper-case letters, while for other options only the first letter is uppercase. When an option appears in all upper-case letters, an associated pop-up menu will be displayed listing the suboptions available when the option is invoked. If the option is not all uppercase, then no pop-up menu is associated and therefore no suboptions are available with the option.

```
Integrated Reliability and Risk Analysis System
  --/--/--    LEARN2                --/--/--

              EXIT      IRRAS 2.6

              SELECT    Family
              GENERATE  Event Data

              BUILD     Fault Trees
              FAULT     Tree Analysis

              CREATE    Event Trees
              ANALYZE   Sequences

              MODIFY    Data Base
              REPORT    on Data Base

              UTILITY   Options

         Option EXIT       Selected
```

Figure 6. IRRAS 2.6 main menu.

```
                              Hot Keys

Hot keys allow you to go directly to a main menu option without re-
turning to the main menu to make the selection.

<Alt/E> -- Exit IRRAS 2.6            <Alt/G> -- Generate Event Data
<Alt/A> -- Analyze Sequences         <Alt/M> -- Modify Data Base
<Alt/B> -- Build Fault Trees         <Alt/R> -- Report on Data Base
<Alt/C> -- Create Event Trees        <Alt/S> -- Select Family
<Alt/F> -- Fault Tree Analysis       <Alt/U> -- Utility options
                    Press <Enter> to return
```

Figure 7. Help screen for hot keys

2.8 Other Things You Should Know

IRRAS 4.0 uses a relational data base to store and retrieve information. Certain information records are automatically added to the data base depending on the functions performed by the user. IRRAS contains nine relations or tables of information. Each relation stores specific PRA information. The first relation is the "Family" relation. This relation contains general information about the PRA. Normally, a user will need to create a family relation for each PRA they are performing. All the information in a family is stored together in a subdirectory. The family relation also contains cross reference information for each basic event, system, sequence, and event tree in the family. The cross reference information is automatically updated each time one of these pieces of data is modified. When IRRAS is initially installed, only one family exists. This family is the "DEMO" family. The first thing the user will need to do is create a new family where the results of the PRA can be stored.

Once the "Family" is created, the user is ready to add information to the data base. Typically the next step would be to use the Event Tree editor to generate the event trees for the Family. When the user creates event trees using this editor, IRRAS automatically adds certain information to the data base. When the event tree is saved, an entry is created in the Graphics relation that contains the graphical information associated with the event tree. If the event tree contains an initiating event as the first top event in the tree, then an entry is also created in the Event Tree relation containing the name of the event tree, the initiating event for the event tree, and other descriptive data. The entry in the Event Tree relation is only created if the user has specified an initiating event. The reason for this is that if you have specified an initiating event, IRRAS assumes that you will be solving this event tree. If one is not specified, then IRRAS assumes that you will be only transferring to this event tree. Next, IRRAS creates an entry in the "System" relation for each top event defined in the event tree. By default, IRRAS assumes that each top event is represented by a system with the same name. At the time the system entry is created, IRRAS also creates a basic event with the same name as the system. This event is used when the system logic is not expanded during fault tree analysis or when the logic has not yet been developed.

The next step in the PRA analysis is to create the fault trees. If the graphical fault tree editor is used to create the fault trees, then IRRAS creates an entry in the Graphics relation for each fault tree created. An entry is not automatically created in the System relation for each fault tree. IRRAS only creates an entry in the System relation if it knows that the user will be solving this fault tree; otherwise, it assumes that it is only a subtree. If the user has not created any event trees with a top event having the same name as a fault tree, and the fault tree is to be solved, then the user must manually add the system name to the data base, using the Modify Data Base option.

IRRAS requires that certain conventions be used for naming fault trees. If a fault tree is to be used as a top event in an event tree, or referenced in a sequence, then the name of the fault tree and the name of the top gate in the fault tree must be the same as the name of the top event in the event tree and system name in the System relation. A good procedure to follow is to always name the top gate of a fault tree the same name as the fault tree.

IRRAS also adds all the basic event references in the fault tree to the Basic Event relation. If a description is provided for a Basic Event, then this description is also added to the data base. All other information for the basic event is left unchanged or defaulted. IRRAS also creates an entry in the Gate relation for each gate defined in the fault tree. The gate type and description is also stored in the data base. Finally, IRRAS creates an entry in the Basic Event relation and the Graphics relation for each transfer gate defined in the fault tree. This is done to allow the user to specify whether a transfer gate is to be expanded or whether the basic event representing the transfer gate is to be used.

Once the fault trees are defined, the user will need to enter the failure data for each basic event in the data base. This can be done with either the Modify Database option or with the Generate Failure Data and Base Case update options. If the Modify Database option is used to change the default failure data, then the user must be sure to use the Generate Failure Data option to generate the current failure data to be used in the remainder of the analysis. Any time changes are made to the basic event failure data, the user MUST use the Generate option before the changes can be used. If it appears that changes made to basic event failure data are not being used properly by IRRAS, the user should check to ensure that the proper data were generated.

The Sequence relation contains information about the sequences for an Event Tree. The user normally generates the sequence entries using the Link Event Tree option. When the user selects this option, IRRAS generates a sequence entry for each valid sequence in the event tree. Any sequences that may have been generated previously for an event tree are automatically removed from the data base. Each sequence contains an endstate name that is created in the Endstate relation, if it does not already exist. Changing the name of an endstate in a sequence only changes the name for that specific sequence and does not change the information in the Endstate relation or the Event Tree for that sequence. When a sequence is solved, the cut sets generated are stored in the sequence relation.

The other relations in the IRRAS data base are the Gate relation and the UserInfo relation. The Gate relation stores the name, type, and description of each gate contained in the fault trees for this data base. This information can be edited. However, the changes are only reflected in the graphical fault trees if the user performs an alpha to graphics conversion on the fault trees that use the gates.

The Userinfo relation contains basic operating constants for IRRAS. The user may change these constants to reflect the desired defaults to be used. One of the pieces of information stored in the Userinfo relation is a scratch drive and directory. IRRAS uses this information to locate scratch files during fault tree and sequence solutions. If the user has additional extended memory, a virtual disk drive may be created and the scratch path set to that drive. Doing this will improve the performance of IRRAS by a factor of from 2 to 5 times depending upon the problem being solved.

As the user adds information to the IRRAS data base, a cross reference map is maintained for each basic event, system, fault tree, and event tree in the data base. This map is automatically updated each time one of the specified pieces of information is added or changed. When the user decides to delete a piece of information from the data base, IRRAS checks these cross reference maps to ensure the piece of information being deleted is not used anywhere in the data base. If it is used, IRRAS will not allow the information to be deleted until those records referencing it are changed or deleted. For instance, if a basic event is to be deleted, the user must ensure that the event is not used by a fault tree logic, system cut sets (base or current), event tree logic, sequence logic, or sequence cut sets (base or current). In the Modify Data Base module, IRRAS will display a "-" character in front of any event which it determines is not used by anything in the data base. When deleting fault tree or event tree subtrees that are not used, the user will not find them in the System or Event Tree relation lists. Since they are subtrees, they are only found in the Graphics relation. To delete them, the user must use the Modify Data Base module and select the Graphics relation to be edited.

The information stored in the IRRAS data base is buffered in and out of memory during processing. When the information is modified, IRRAS may not write the information out to the hard disk immediately. If the user does not exit IRRAS normally by using the "EXIT" option from the main menu, then the information that was changed may be lost. The user should always exit IRRAS before turning off or rebooting the computer. If a power failure or abnormal program abort occurs, the user should enter IRRAS, select the Utilities menu, and from that menu select the Rebuild option. The user should then rebuild everything in the data base before continuing to use the program on this data. Failure to do this may cause unpredictable results. If a data base is generating results that the user cannot explain, the data base family in question should be rebuilt and the results checked again. If the results still cannot be explained, then a bug may be causing the error and should be reported immediately.

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 IRRAS data base 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. IRRAS retains the last family you selected when you exited the program so when you enter IRRAS again the last family selected is the current family. The Select Family screen (Figure 8) lists all families in the IRRAS data base. 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 IRRAS 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.

Figure 8. Select family menu.

3.1 Exit

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

3.2 Select

This option is used to select the family data files that will be accessed during subsequent IRRAS 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 IRRAS 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 9), 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.

```
                    Version Conflict

 ─────────────────────── 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 9. Version conflict warning message.

3.3 Family Copy

This option provides the means of copying data base files between families. 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 data base 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. 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 10), 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> (For example, 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 Data Base option. After you have added the family, you may return to the Select Family option and copy your data base into the new family.

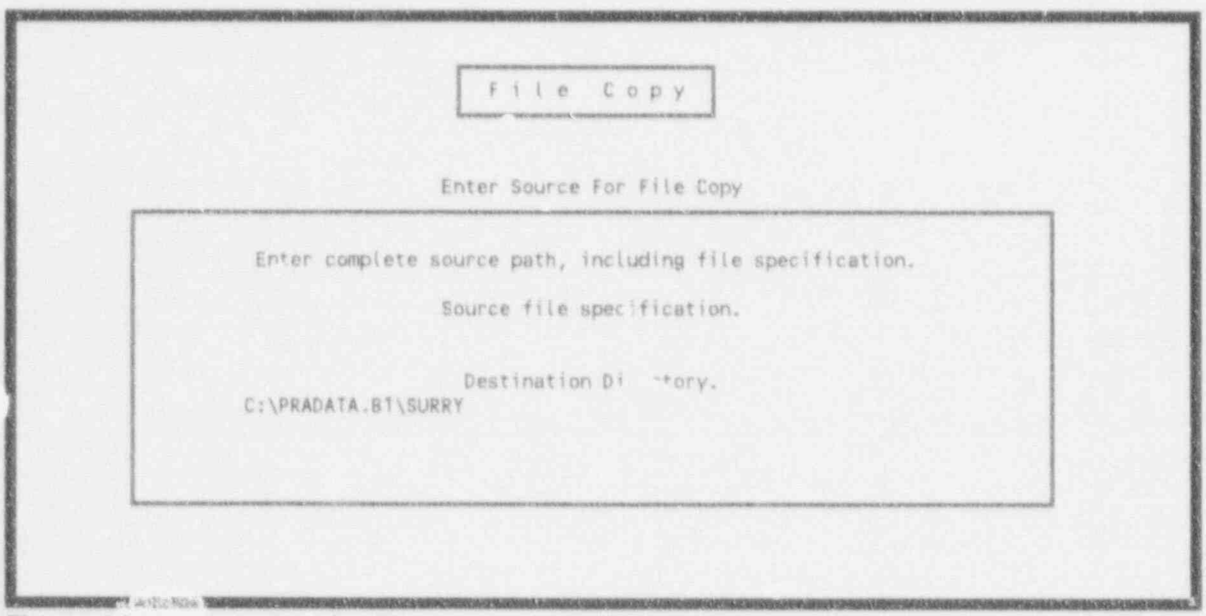


Figure 10. Enter source for file copy.

4. GENERATE EVENT DATA

The Generate Event Data module is used to create a working copy of user event data for use in analysis. This data can then be modified using change sets or used to update the base case data. This option allows you to add, modify, and delete change sets. Change sets contain information about the probability/class changes that are to be applied to basic events during system or sequence analysis. Within a change set you may modify selected event probabilities, and reset those event probabilities to the base case values. In addition, you may perform a base case update that takes all current basic event data and makes it the new base case data. The original base case data are overwritten in this process. You may also add, modify, or delete user-defined histograms.

The event data can be manipulated to examine the changes in the probabilities of plant accidents and accident sequence failures based on basic events. Events can be added, modified, and deleted. The probability of events occurring can be recalculated. You may generate change sets to be applied to the basic events for later propagation through the sequence cut sets. You may update the base case that will replace the present base case data with current data.

From the Generate Event Data option, the following operations may be performed: add, modify, or delete change sets; create and reset individual event probability changes; add a class probability change to a group of events; add, modify, or delete user-defined histograms; update the base case event data with the current case event data; generate new current case event data using the temporary modifications made to the marked change sets; and create reports that reflect the event modifications that currently exist within the data base.

Highlight Generate Event Data on the main menu or type a <G> to select this option and press <Enter>. The Change Sets screen shown in Figure 11 will be displayed. A change set is a set of sensitivity data modifications to be applied to the basic events. Change sets modify the current case basic event data. A change set consists of probability and/or class changes for a group of basic events. As shown in Figure 11, ten options are available. Each of these options is discussed in the following paragraphs.

4.1 Exit

Type an <E> in the option field and press <Enter>, or press the <Esc> key to return to the IRRAS main menu.

4.2 Add

The Add function is used to add a change set name and description to the data base. You supply a name (up to 16 characters) and a description (up to 60 characters). The current date is supplied by the system, however, you may change it if you wish, by typing over the default date.

```
 Family
SURRY                      C h a n g e   S e t s

Option |A|  Exit  /  Add  /  Modify  /  Delete  /  Probability  /  Class
            Histograms / Generate Changes / Report Changes / Base Case Update

# ---- N a m e ------------- D e s c r i p t i o n --------
  AAA
  OEP
  P&ID

        <Esc>          <F1>          <F2>            <F3>
        Exit           Help      Mark/Unmark      Clear All
                                    Change
```

Figure 11. Change sets menu.

To invoke the add function, type an <A> in the option field and press <Enter>. The Add Change Set screen shown in Figure 12 will be displayed. This screen is displayed with the <A> (Add) option as the default entry in the option field. After entering the change set name (required) and description (optional) and pressing <Enter>, the message **New change record added** is displayed at the bottom of the screen and you are returned to the previous screen (Figure 13), where the newly added change set will be included. If the name you entered already exists, the message **Duplicate change record name - not added** is displayed at the bottom of the screen.

```
                     A d d   C h a n g e   S e t

                        Option |A|  Exit / Add

   Name         HP-1                               Date   1991/07/19
   Description
```

Figure 12. Add a change set.

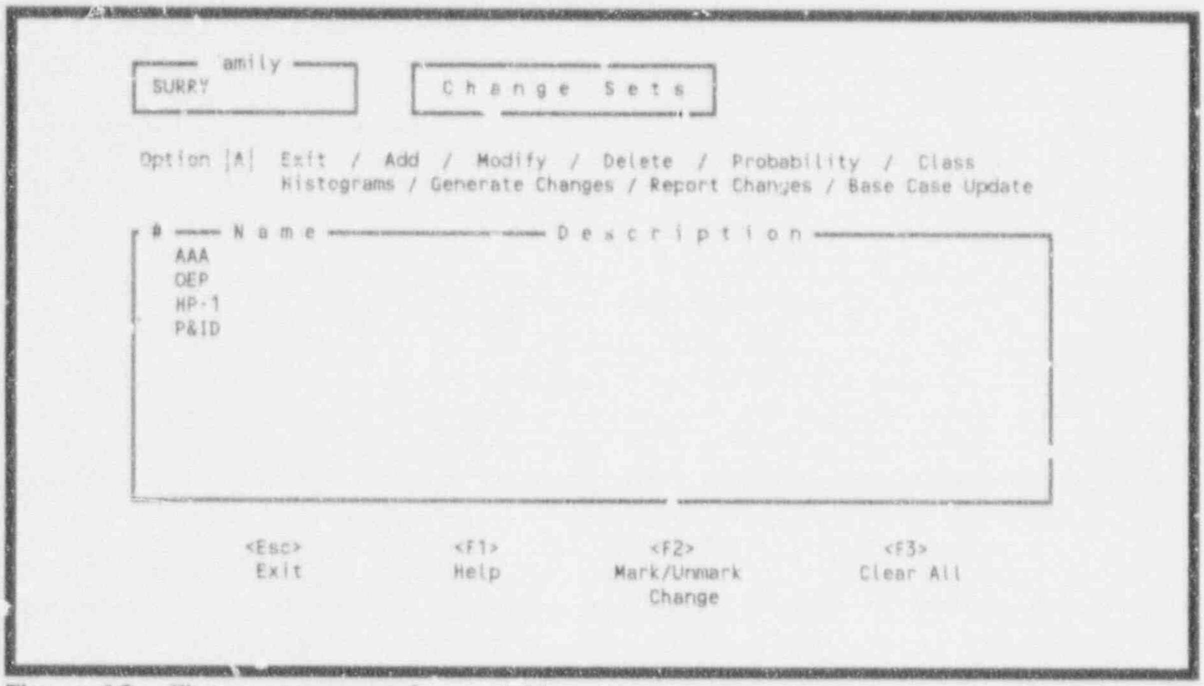


Figure 13. Change set screen after an Add.

To exit the Add Change Set screen without entering a new change set, press <Esc> or move the cursor to the option field by pressing <Home>, type an <E> (for Exit), and press <Enter>.

4.3 Modify

This option allows you to modify the name, description, and/or date for an existing change set. To invoke this function, type an <M> in the option field, highlight the change set you want to modify, and press <Enter>. The Modify Change Set screen (shown in Figure 14) appears. If you did not highlight the change set to modify before pressing <Enter>, the message **Record must be highlighted first** appears.

Edit the name, description, and/or date and press <Enter> to execute the change. Use the <Tab> key to move the cursor from field to field. A confirmation message, **Record modified**, is displayed. To return to the Change Sets screen without modifying the change set, press <Esc> or move the cursor to the option field by pressing <Home>, typing an <E>, and pressing <Enter>.

4.4 Delete

This function is used to remove a change set from the data base. To invoke this function, type a <D> in the option field, highlight the change set you want to delete, and press <Enter>. The Delete Change Set screen (see Figure 15) is displayed with an "E" (Exit) in the option field. To delete the change set, type a <D> and press <Enter>. You will be returned to the Change Sets screen, and the message **Change record deleted** is displayed.

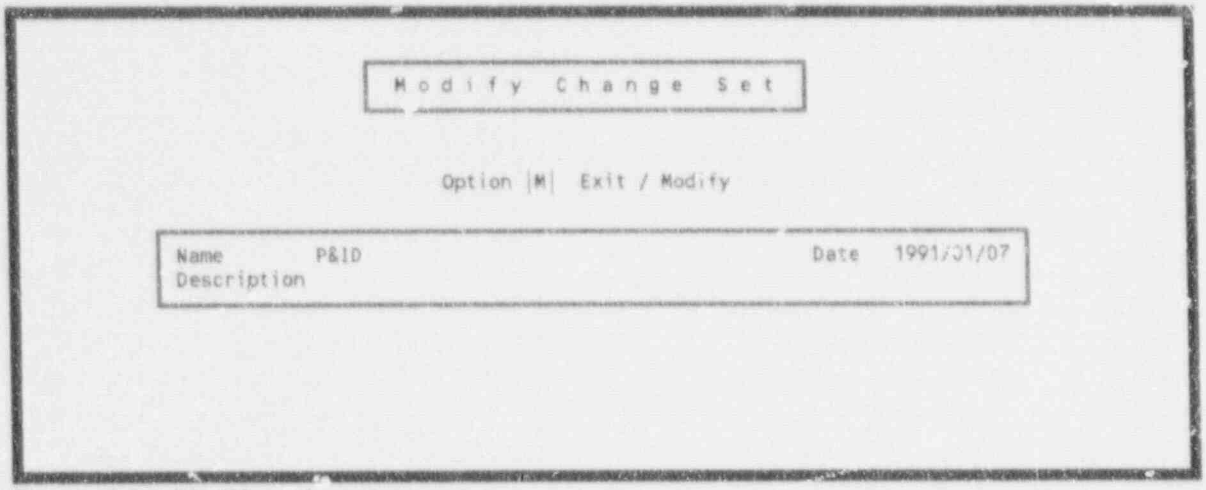


Figure 14. Modify a change set.

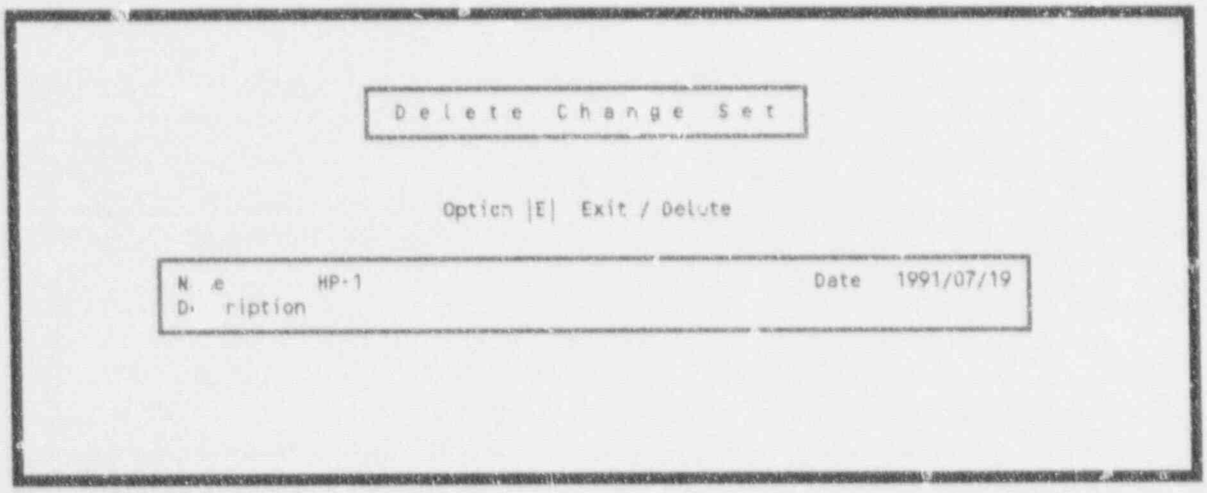


Figure 15. Delete a change set.

If you did not indicate the change set you wanted to delete before pressing <Enter>, the message **Record must be highlighted first** appears.

4.5 Probability

This function allows you the flexibility to experiment with setting different basic event failure and uncertainty data. These data values may be set for a single event or for a specified group of events. The function also provides a reset option to set data values back to the base case values. To invoke the Probability function, type a <P> in the option field, highlight a change set, and press <Enter>. If you press <Enter> without highlighting a change set, the message **A line must be highlighted** will be displayed. If you receive this message, highlight an event and press <Enter>. The Select Event screen (see Figure 16) appears with <P> (Probability) as the default option. The change set name is shown in the upper right corner in the Change Set box. Three options are available: Exit, Probability, and Reset probability to base.

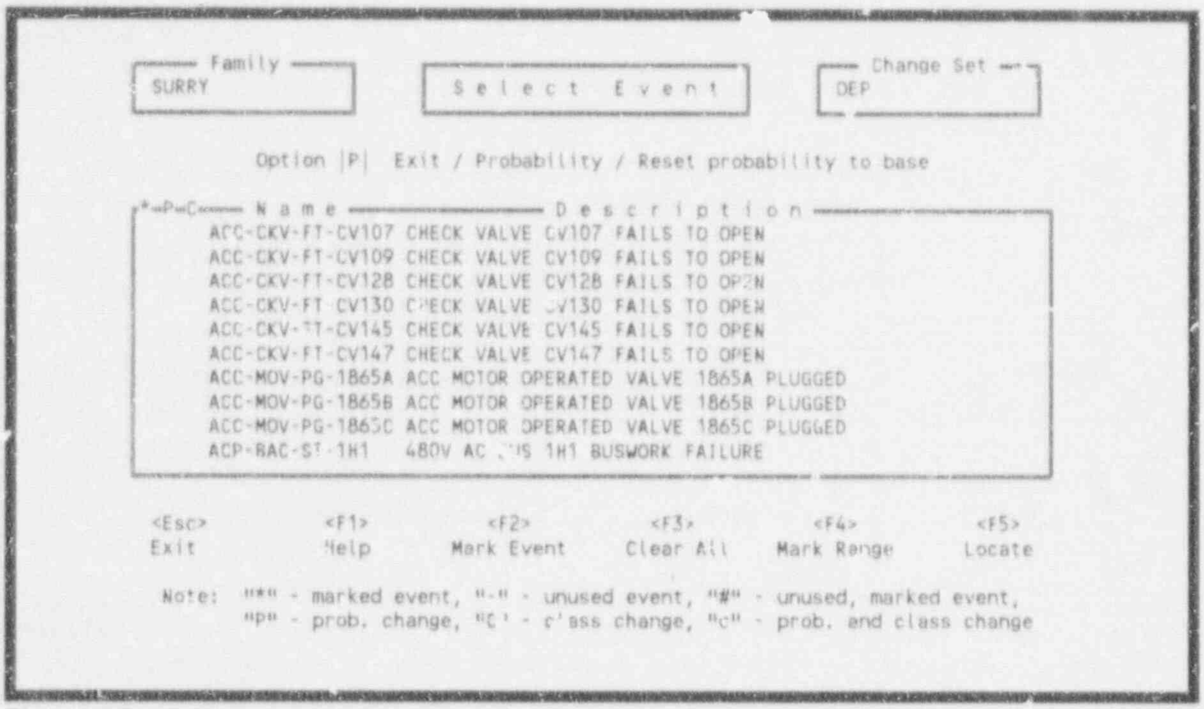


Figure 16. Select an event for probability change.

4.5.1 Exit

This option terminates the probability function and returns you to the Change Set screen (Figure 11). To invoke this option, type an <E> in the option field and press <Enter>, or press the <Esc> key.

4.5.2 Probability

This function allows you to modify the current uncertainty and failure data values. This current data can then be applied to the specified events for use during event tree analysis. The changes applied to basic event data may be for a single event or a group of marked events.

To invoke this function, type a <P> in the option field, highlight an event or mark a group of events (using the <F2> and/or <F4> function keys) and press <Enter> (see Figure 17). If only a single event has been selected, then the Event Probability Changes screen (for a single event) will be displayed (Figure 18). The display is divided into four data areas: Event Attributes, Uncertainty Data, Failure Data, Process Flag. The Event Attributes data display is for information only; no changes may be made to the data fields in this display. The Uncertainty Data/Failure Data areas display both the base case and current data values. You may change only the current data values. The Process Flag area is a one-character field that specifies if certain processes should take special note of the selected event. One of the following upper-case values can be input: 'S' (sensitivity analysis), 'X' (do not expand transfers), 'Y' (never expand transfers), and 'I' (always expand transfers).

```
   Family                       Select Event                 Change Set
   SURRY                                                      OEP

          Option |P|  Exit / Probability / Reset probability to base

*-P-C-- 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

  <Esc>       <F1>        <F2>         <F3>         <F4>         <F5>
  Exit        Help      Mark Event   Clear All   Mark Range     Locate

  Note:  "*" - marked event, "-" - unused event, "#" - unused, marked event,
         "p" - prob  change, "C" - class change, "c" - prob. and class change
```

Figure 17. Events marked for modification.

```
              E v e n t   P r o b a b i l i t y   C h a n g e s

---------------------------- Event Attributes ----------------------------
        Names         Comp Id    Sys    Train   Type   F/Mode   Location   Init?
<F>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

Base -- Uncertainty Data -- Current | Base ---- Failure Data --- Current
L <------- Dist. Type -------->     | 1 <------- Calc. Type -------->

 3.000E+000 <-- Value --> ------E---- | 1.000E-004 <--- Prob ---> ------E----
31   <----- Corr. Class ----->        | +0.000E+000 <-- Lambda --> ------E----
----------- Process Flag ------------ | +0.000E+000 <--- Tau ----> ------E----
   <------------ Flag ------------->  | +0.000E+000 <- Mission --> ------E----

          Note : Leave Current values blank if no changes are desired.
```

Figure 18. Changes to an event probability.

When the Process Flag field is blank, the transfer associated with this event is expanded for failure references. For success references, the transfer is also expanded; however, the cut sets generated are removed from the failure cut sets using cut set matching. An "X" tells IRRAS that the basic event is to be used for failure references, but success references are to be treated the same as if the flag was blank. A "Y" indicates that a transfer is to be replaced with its basic event for failed references and the complement of the event is to be used for success references. An "I" causes IRRAS to treat the transfer as independent. Logic below this transfer is expanded for failure references, and for success references the complement of the logic is used.

If a group of events were marked (see Figure 17) using the <F2> and <F4> function keys, and the cursor was in the option field, then upon pressing <Enter> the Events Probability Changes screen (for a group of events) will be displayed (see Figure 19). This display is divided into three areas: Uncertainty Data, Failure Data, and Process Flag. As before, both the base case and current data values are shown. You may only change the current values. The changes entered on this screen will be applied to all marked events.

```
                    E v e n t   P r o b a b i l i t y   C h a n g e s

      ------ Uncertainty Data ----------------- ------ Failure Data ----------
      Distribution Type ---------->         Calculation Type ---------->

      Value -------------> ------E----      Probability -------> ------E----
      Correlation Class -------->           Lambda ------------> ------E----
      ---------- Process Flag ----------    Tau ---------------> ------E----
      Flag ---------------------------->    Mission Time ------> ------E----

                            Enter change values required.

           Note : All marked event change probabilities will be affected.
                  Press <Esc> to return without changing.
```

Figure 19. Event change screen for marked events.

The probability changes made are reflected on the Select Event display by showing a "P" to the left of the affected events. Probability changes have a higher priority than class changes. When both are applied to an event, the probability change will be used during fault tree/sequence analysis. This is indicated by flagging the affected events with a "P" and "c" as shown in Figure 20.

On the Event Probability Changes display, help screens are supplied for all data entry fields. Pressing <F1> when the cursor is in any data entry field will cause a help screen to be displayed. Most of the help forms contain a data entry field at the bottom of the display. This field may be used to enter the desired data value, which will then be transferred into the proper data field upon exiting the help screen. Highlighting an item in the help form list will set the correct value in the data entry field.

```
   ┌── Family ──┐       ┌───────────────────┐        ┌── Change Set ──┐
   │ SURRY      │       │ S e l e c t  E v e n t │     │ OEP            │
   └────────────┘       └───────────────────┘        └────────────────┘

            Option [P]  Exit / Probability / Reset probability to base

  *─P─C─── N a m e ────────────── D e s c r i p t i o n ──────────────
  * P c ACC-CKV-FT-CV107 CHECK VALVE CV107 FAILS TO OPEN
        ACC-CKV-FT-CV109 CHECK VALVE CV109 FAILS TO OPEN
  * P c ACC-CKV-FT-CV128 CHECK VALVE CV128 FAILS TO OPEN
        ACC-CKV-FT-CV130 CHECK VALVE CV130 FAILS TO OPEN
      C ACC-CKV-FT-CV145 CHECK VALVE CV145 FAILS TO OPEN
  * P c ACC-CKV-FT-CV147 CHECK VALVE CV147 FAILS TO OPEN
        ACC-MOV-PG-1865A ACC MOTOR OPERATED VALVE 1865A PLUGGED
  * P c ACC-MOV-PG-1865B ACC MOTOR OPERATED VALVE 1865B PLUGGED
  * P c ACC-MOV-PG-1865C ACC MOTOR OPERATED VALVE 1865C PLUGGED
  * P c ACP-B4C-ST-1H1   480V AC BUS 1H1 BUSWORK FAILURE

   <Esc>        <F1>        <F2>          <F3>        <F4>         <F5>
   Exit         Help     Mark Event    Clear All   Mark Range    Locate

    Note:  "*" - marked event, "-" - unused event, "#" - unused, marked event,
           "P" - prob. change, "C" - class change, "c" - prob. and class change
```

Figure 20. Event probability and class changes flagged.

Currently, there are seven predefined distribution types available. The predefined distribution types are normal, lognormal, beta, gamma, chi-squared, exponential, and uniform. In addition to these predefined distribution types, user-defined histograms may be used. The default distribution type is the lognormal. Figure 21 shows the help form associated with the distribution type field on the Event Probability Changes screen. From this help screen, help forms associated with each of the seven predefined distribution types are available. To view these distribution help forms, press the <F1> key while the cursor is positioned on the desired distribution type.

Correlation classes are used to account for data dependencies among like events in the data base. Correlation classes consist of four character upper case values. A blank correlation class indicates that there are no data dependencies. When running the uncertainty analyses, the same sample value will be used for all basic events with the same correlation class.

In the Failure Data box the calculation type is a numerical reference to the calculation method to be used. There are 13 calculation types numbered 1 through 9, T, F, I, and S. When the cursor is positioned in the Calculation Type field, press <F1> for an explanation of these calculations. The help screen is shown in Figure 22.

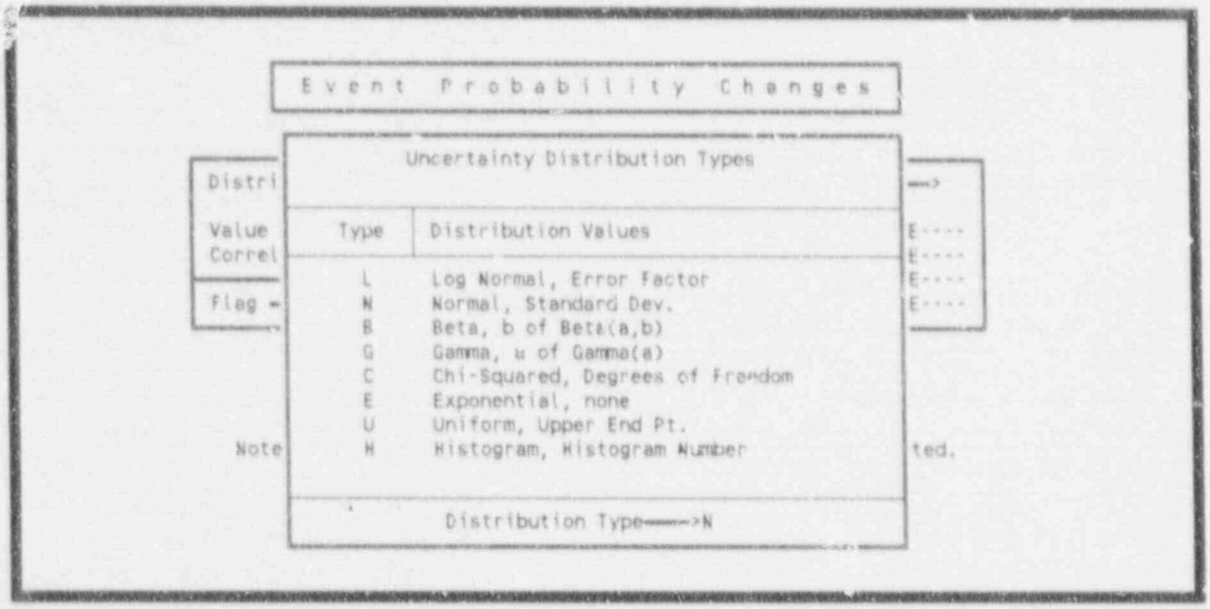


Figure 21. Uncertainty distribution types (probability change).

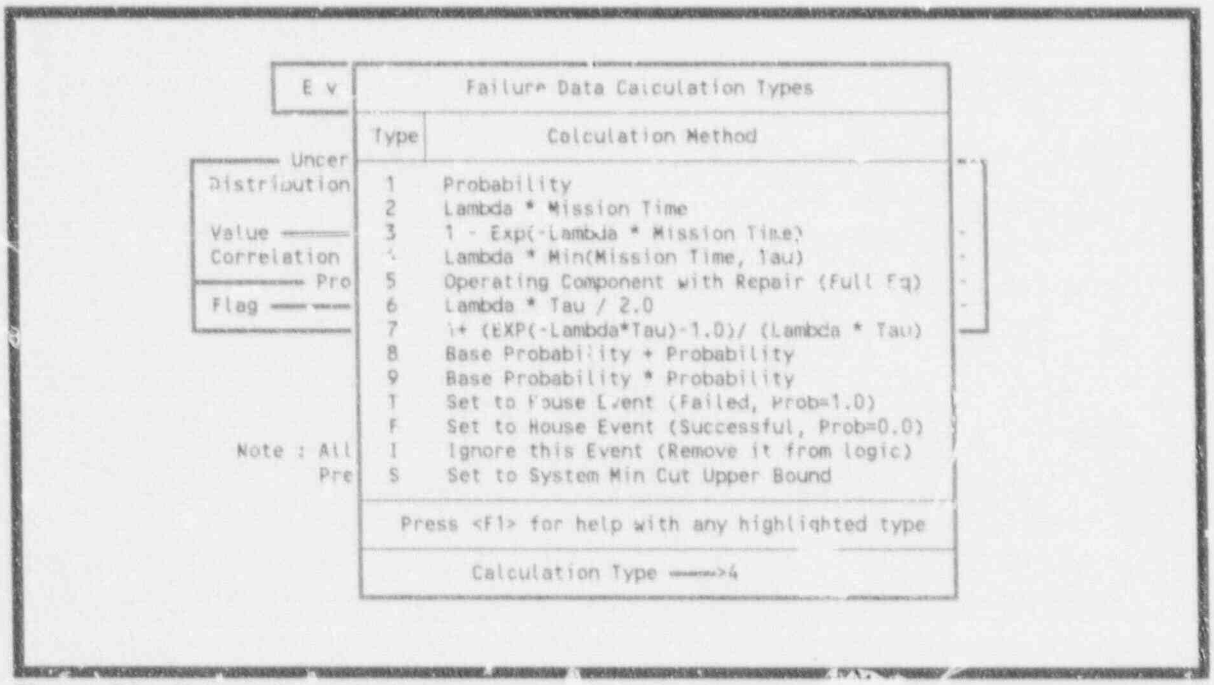


Figure 22. Failure data calculation types (probability changes).

The following symbols are used in the equations for calculating failure probability

- P = failure probability of the basic event,
- p = failure probability,
- bp = base case failure probability,
- L = failure rate per hour, input as lambda,
- t_m = mission time expressed in hours, input as a default, and
- T = average time to repair expressed in hours, input as tau.

An equation for each calculation type follows:

Calculation Type 1 P = p.

Calculation Type 2 P = L * t_m.

Calculation Type 3 P = 1 - Exp (-L * t_m).

Calculation Type 4 P = L * Min (t_m, T).

Calculation Type 5 P = ([L * T] / [1 + {L * T}]) * (1 - EXP [-(L + 1 / T) * t_m]).

Calculation Type 6 P = L * (T/2).

Calculation Type 7 P = 1 + (EXP[-L * T] - 1) / (L * T).

Calculation Type 8 P = bp + p.

Calculation Type 9 P = bp * p.

Calculation Type T P = 1.0 (House event - failed).

Calculation Type F P = 0.0 (house event - successful).

Calculation Type I P = 0.0 (ignore event).

Calculation Type S P = 0.0 (find a system with the same name and use its current mincut upperbound as the probability)

4.5.3 Reset Probability to Base

This option allows you to reset the probability changes (not class changes) for a selected event back to the base case values. You may reset probability changes for a single event, a group of events, or all events.

To reset the probability change for a single event, type an <R> (Reset probabilities) in the option field, highlight the desired event name and then press <Enter>. The message **"Reset HIGHLIGHTED probability change? (Y/N)"** is displayed at the bottom of the screen. To reset the probability back to the base case value enter <Y> for yes. To terminate the reset operation enter

<N> for no.

To reset the probability changes for a group of events, mark the desired events using the F2 and/or F4 keys, type an <R> in the option field and press <Enter>. The message **"Reset ALL marked probability changes? (Y/N)"** is displayed at the bottom of the screen. Press <Y> to complete the reset operation, or <N> to terminate the reset operation.

To reset all event probabilities to the base case values, clear all existing marks with the F3 key, type an <R> in the option field and press <Enter>. The message **"Reset ALL probability changes? (Y/N)"** is displayed at the bottom of the screen. Press <Y> to perform the reset operation, or <N> to terminate the reset operation.

4.6 Class

This option allows you to change event data parameters for a specified grouping of events. To invoke this option, enter a <C> in the option field, highlight the desired change set, and press <Enter>. If you do not highlight a change set before pressing <Enter>, the message **An event change must be highlighted** will be displayed at the bottom of the screen. The screen display for this option is shown in Figure 23. All data fields in the four data areas are data entry fields. The event class is defined by entering data in the Event Attributes data fields. The more of these fields that are filled in the finer the class definition becomes.

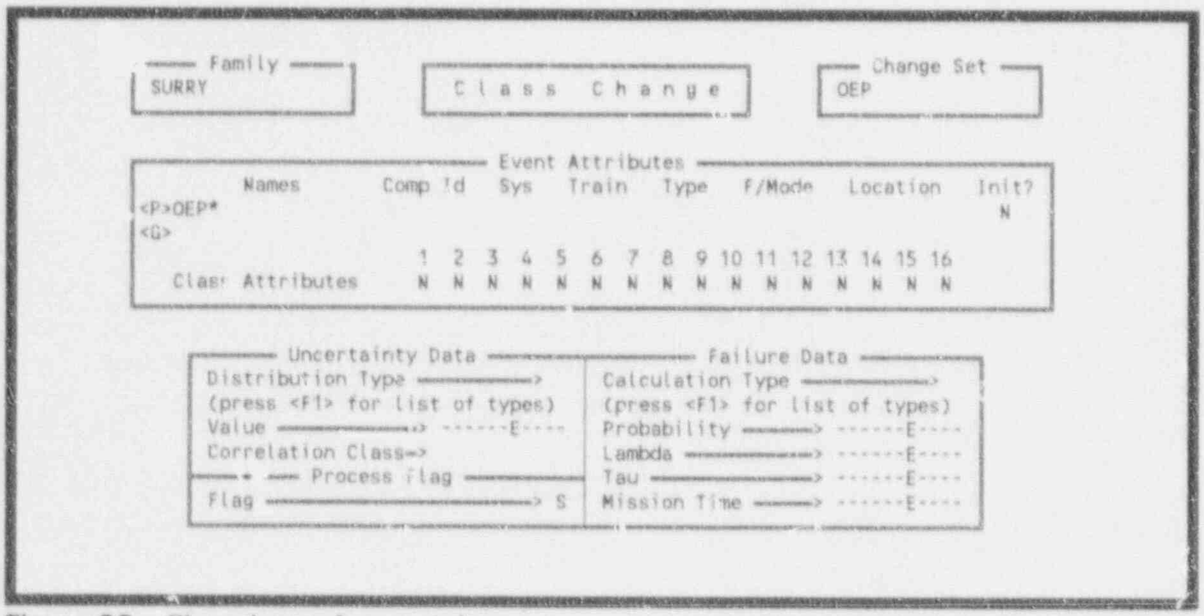


Figure 23. Class change for event data.

The class changes that you request are reflected on the Select Event display by showing a "C" to the left of the affected events (Figure 24). Probability changes have a higher priority than class changes. When both are applied to an event, the probability change will be used during event tree analysis. This is indicated by flagging the affected events with .. "P" and "c" as shown in Figure 24.

```
 ---- Family ----          ---------------------          ---- Change Set ----
| SURRY          |        | S e l e c t   E v e n t |    | OEP                |

          Option |P|  Exit / Probability / Reset probability to base

*=P=C--- N a m e ------------ D e s c r i p t i o n --------------------
  P c ACC-CKV-FT-CV107 CHECK VALVE CV107 FAILS TO OPEN
  P c ACC-CKV-FT-CV109 CHECK VALVE CV109 FAILS TO OPEN
  P c ACC-CKV-FT-CV128 CHECK VALVE CV128 FAILS TO OPEN
  P c ACC-CKV-FT-CV130 CHECK VALVE CV130 FAILS TO OPEN
  P c ACC-CKV-FT-CV145 CHECK VALVE CV145 FAILS TO OPEN
    C 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

<Esc>        <F1>       <F2>          <F3>         <F4>          <F5>
Exit         Help       Mark Event    Clear All    Mark Range    Locate

 Note:  "*" - marked event, "-" - unused event, "#" - unused, marked event,
        "P" - prob. change, "C" - class change, "c" - prob. and class change
```

Figure 24. Class and probability changes applied to select events.

On the Class Change display, help screens are supplied for all data entry fields. Pressing < F1 > when the cursor is in any data entry field will cause a help screen to be displayed. Figure 25 and Figure 26 show the help screens for Distribution Type and Calculation Type, respectively. Most of the help forms in this situation contain a data entry field at the bottom of the display. This field may be used to enter the desired data value, which will then be transferred into the proper data field upon exiting the help screen. Highlighting an item in the help form list will set the correct value in the data entry field.

4.7 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 uncertainty distribution for a variable that can not be expressed with one of the predefined distribution types. The Edit Histograms screen (Figure 27) displays the names of all currently existing histograms. A unique number is associated with each histogram and is listed on the Edit Histograms screen to the left of the histogram name. The format type is also provided. There are two format types: percentage format and range format. If the histogram was entered in a percent format, a "P" will be displayed in the type field. If the histogram was entered in a range format, an "R" will appear in the type field. To activate this option, type an < H > (Histograms) in the option field of the Change Sets screen and press < Enter >. Figure 27 will be displayed.

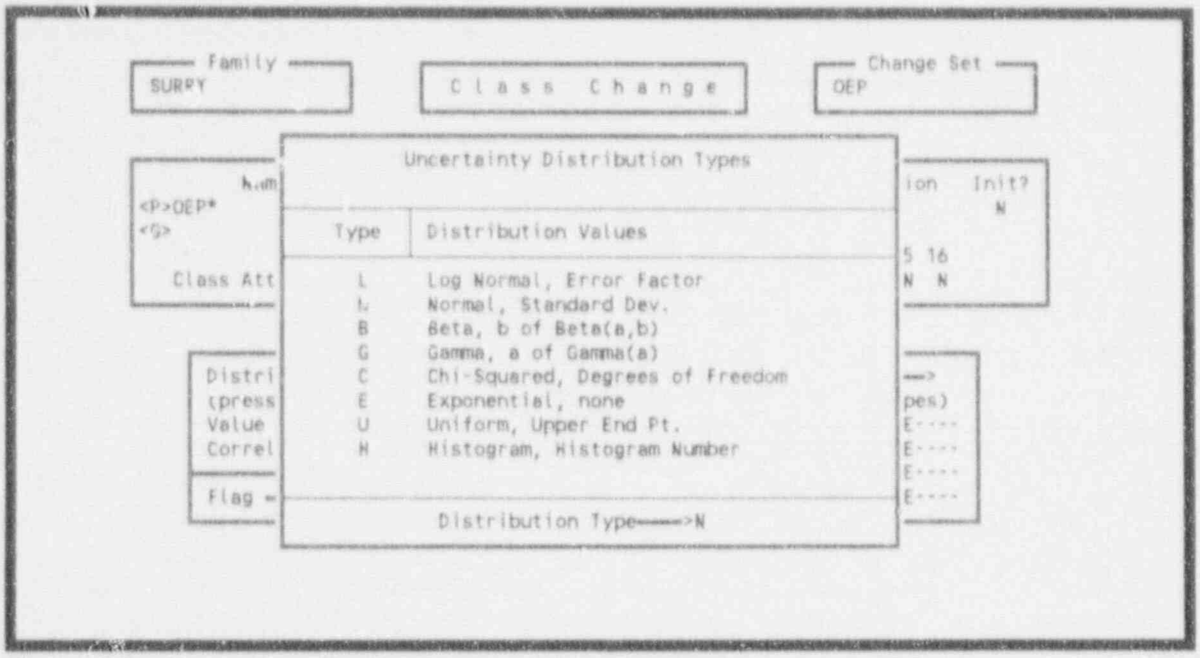


Figure 25. Uncertainty distribution types (class changes).

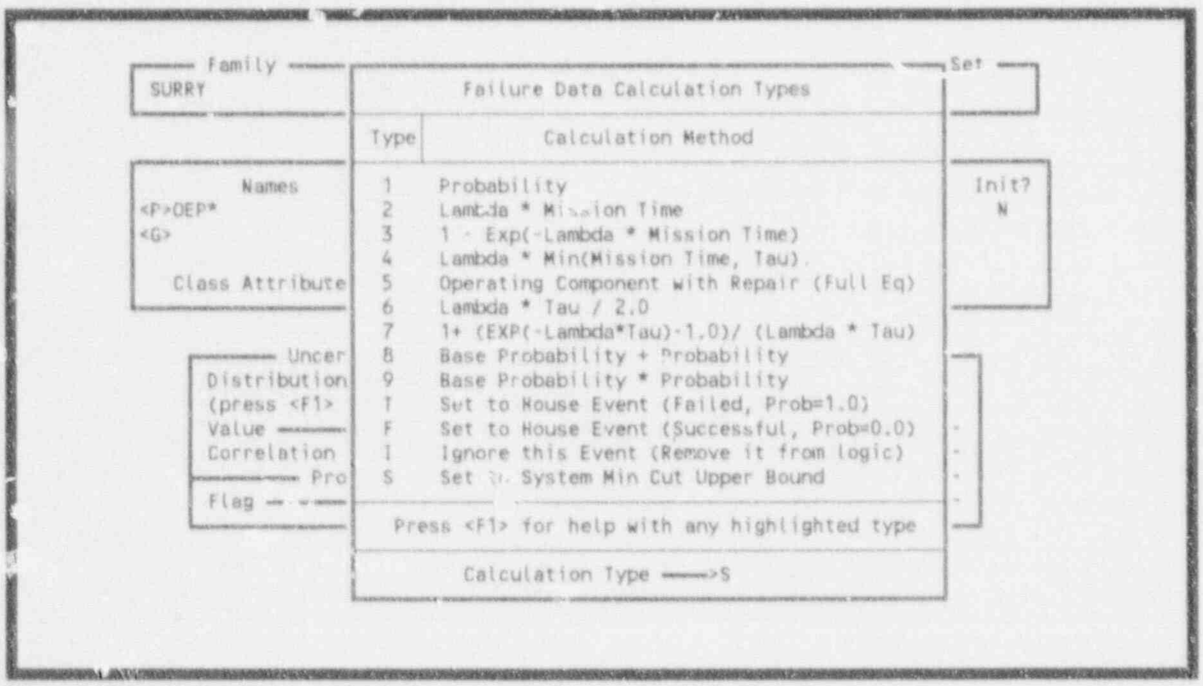


Figure 26. Failure data calculation types (class changes).

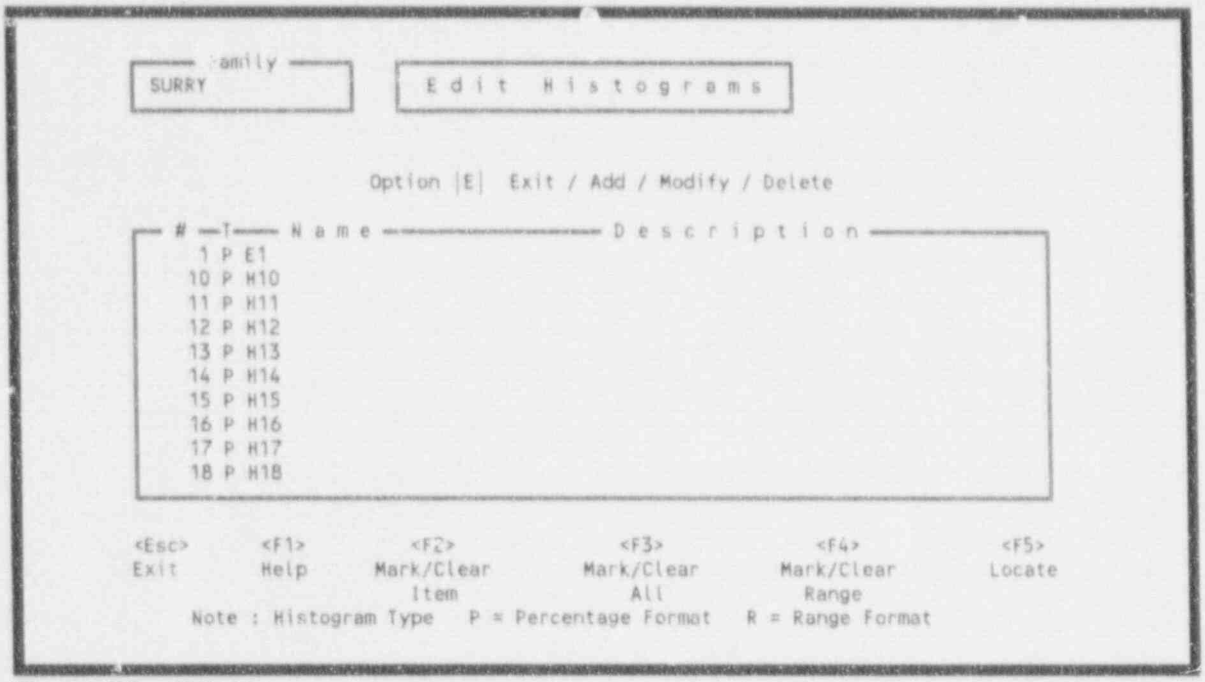


Figure 27. Edit histograms menu.

4.7.1 Exit

To return to the Change Sets screen, type an <E> (Exit) in the option field and press <Enter>, or press the <Esc> key.

4.7.2 Add Histograms

This option allows you to create a user-defined distribution type. To add a new histogram to the data base, type an <A> (Add) in the option field and press <Enter>. At this point, Figure 28 is displayed and you are given the choice of adding the histogram data in either a percentage format or in a range format.

If you wish to add a percentage histogram to the data base, enter a <P> (Percentage) in the option field. Entering a <P> in the option field will cause a Percentage Format Histogram screen to appear. On 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 29 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 30). 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.

1

IMAGE EVALUATION TEST TARGET (MT-3)

150mm

6"

1

IMAGE EVALUATION
TEST TARGET (MT-3)

150mm

6"

```
 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 28. Select percentage or range format for the histogram.

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

                   Option |A|  Exit / Add       Percent Sum     97.00
                                                Percent Left     3.00
                        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   ------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 29 Adding a percentage histogram.

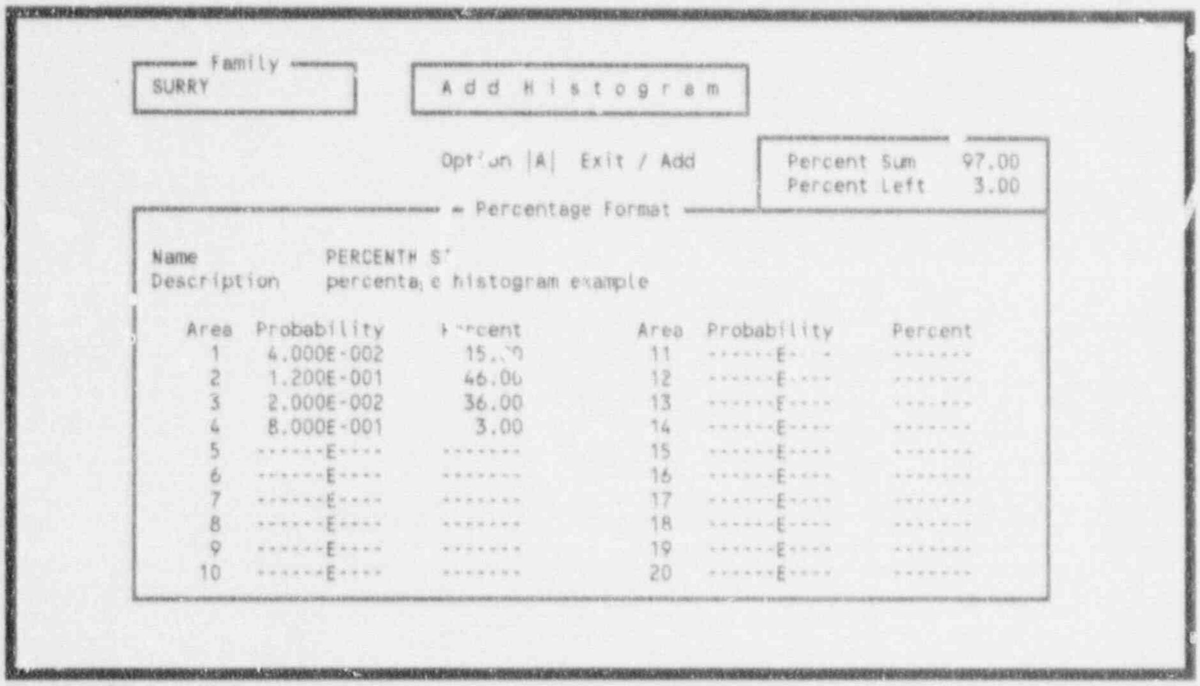


Figure 30. Add the remaining percent to create a valid histogram.

Another way to input a histogram is to use the range format. To add a range histogram to the data base, enter an <R> (Range) in the option field of the Add Histograms screen. This will bring up a Range Format Histogram screen (Figure 31). On this screen, type in a name and a 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 31 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 70.0 (Bin 2), the height for the sub-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).

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. However, if you wish to exit the Add process without saving the new histogram, enter an <E> in the option field and press <Enter>, or press the <Esc> key.

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

                         Option |A|  Exit / Add

                         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 31. Add a range histogram.

4.7.3 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. Remember, the percentages must total 100% before it will be accepted as a valid percentage histogram. Figure 32 demonstrates the screen for modifying histograms in percentage format.

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 bin's starting points, ending points, or probabilities. Figure 33 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>. 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.

```
Family
SURRY                     M o d i f y   H i s t o g r a m

                 Option |M|  Exit / Modify    Percent Sum    100.00
                                              Percent Left      .00
                      Percentage Format

Name            HISTPERCENTTEST
Description     this is an example of a percentage histogram

  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 32. Modify a percentage histogram.

```
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 33. Modify a range histogram.

4.7.4 Delete Histograms

To delete an existing histogram from the data base, 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>. To exit the Delete Histograms screen without deleting the histogram, press the <Esc> key or enter an <E> (Exit) in the option field and press <Enter>. Figure 34 and Figure 35 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    ?.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 34. 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 35. Delete a range histogram.

4.8 Generate Changes

This option applies the event data modifications specified by the selected change sets to the basic event data file. This option must be executed prior to any data analysis if you wish the change set modifications to be reflected in the analysis results. The Generate Changes option creates new current event data, which is used when a user wishes to run an uncertainty analysis on a selected sequence.

To activate this function, type <G> (Generate Changes) in the option field, use the function key <F2> to mark the change sets to be used during the generation process, and then press <Enter>. Upon pressing <Enter>, the default mission time and propagate event failure flag are displayed at the bottom of the screen (Figure 36). If you do not wish to change the mission time, press <Enter>. **New event data has been generated with changes** is displayed when the changes are successfully generated. If no changes were made, the message **New event data has been generated (no changes)** is displayed at the bottom of the Change Sets screen.

If the propagate event failure flag is set to 'Y' and if an event is failed (i.e., set to house event "T"), then any event with the same "system" and train attribute is set to "T" also. Any event with the same group name is also set to "T." This is a repetitive process. That is, if an event is set to house event "T" because it matches the system and train, any event in the same group will be set to house event "T."

This option transfers the temporary values for the basic events marked with either a probability change or a class change in the marked change set to the current event data values. If an event in the change set has both a class change and a probability change associated with it, the probability change

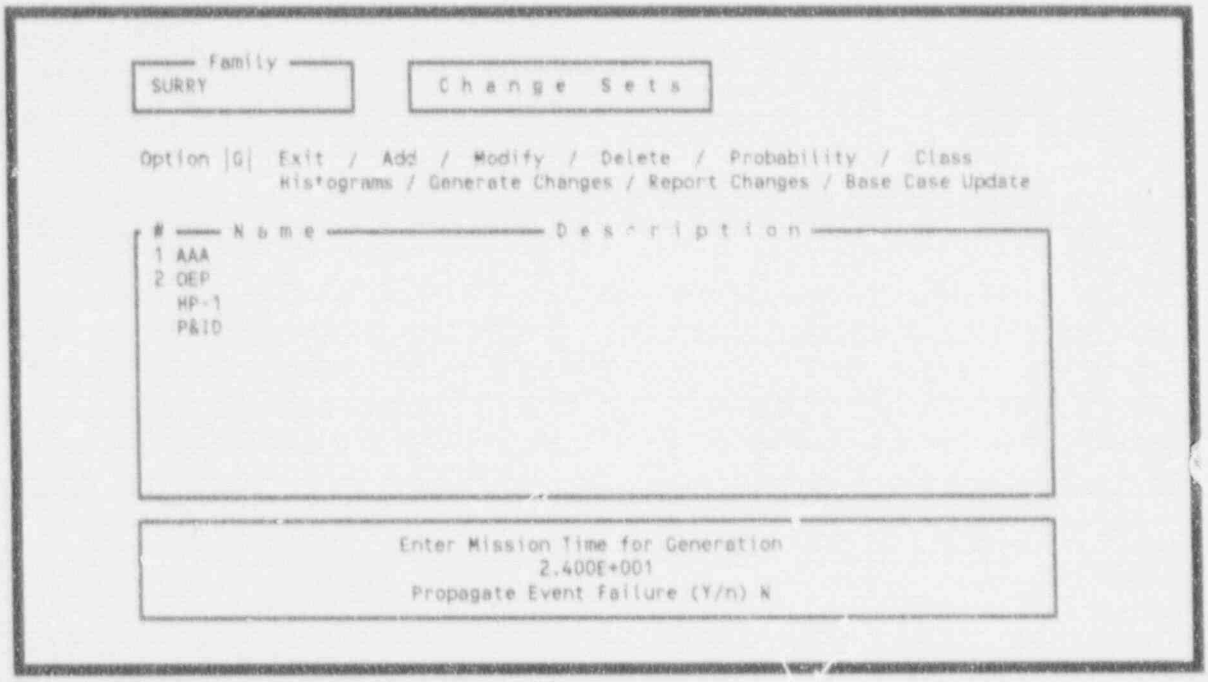


Figure 36. Set mission time for generate changes.

takes precedence over the class change when generating new current case event data values. If the event does not have an associated probability change or class change, then the current case event data values will be set equal to the base case data for that event.

If you select the Generate Changes option without marking any of the change sets, then the current case data will be initialized to the base case data.

If more than one change set is marked when you enter the Generate Changes option then the probability and class changes in the change sets marked with the highest number will take precedence over any changes from lower numbered change sets.

For example, three change sets (CS) are marked and Event A has both a probability change and a class change associated with it in CS 2. Event B has a probability change in CS 1, and a class change in CS 3. Event C has only a class change in CS 1. Event D has no probability changes or class changes associated with it in any of the three marked change sets. The outcome of the Generate Changes option on these three marked change sets would be as follows:

> The current case data for event A would be set to the temporary values associated with the probability change in CS 2. (Probability changes take precedence over class changes when they occur for the same event within the same change set.)
>
> The current case data for event B would be set equal to the temporary values associated with the class change in CS 3. (The probability or class change in higher numbered change sets take precedence over changes in lower numbered change sets.)
>
> The current case data for event C would be set to the temporary values associated with the class

change in CS 1.

The current case data for event D would be set to the base case values for event D. (There were no probability changes or class changes made to event D in any of the marked change sets.)

4.9 Report Changes

This option allows you to create reports that reflect the event modifications that currently exist within the data base. There are three report types: Unaffected Events, Affected Events, and All Events (see Figure 37). Each of the report types may be sorted by event name, ascending probability, or change sets. In addition, a report may be routed to the console, an attached printer, or a disk file. When a report is routed to the printer or a disk file, the data will be echoed on the console.

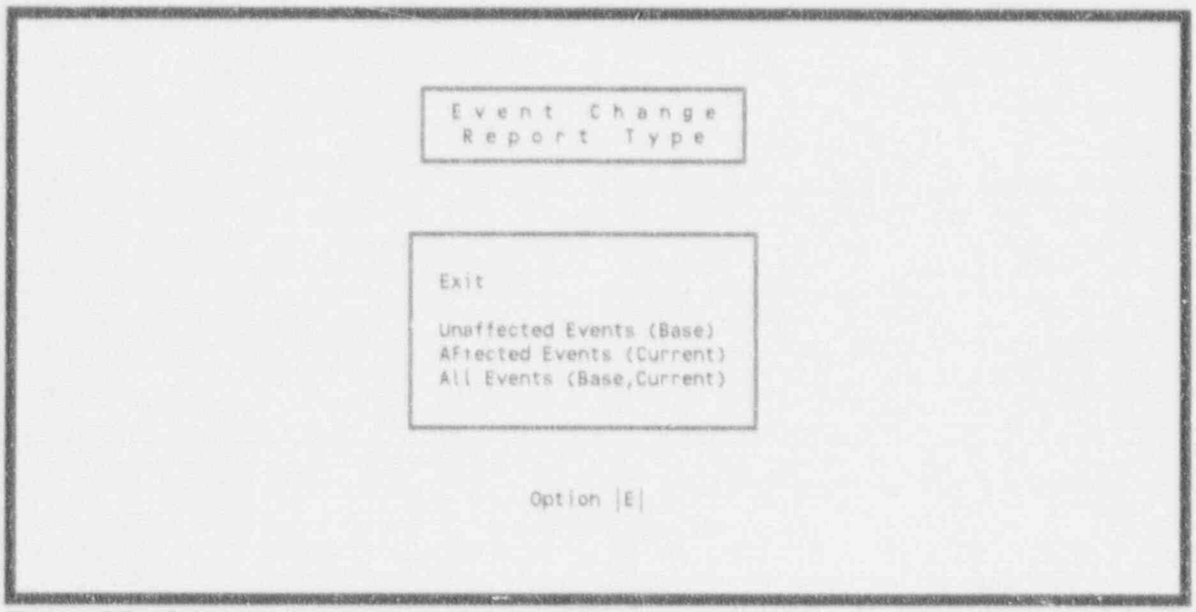


Figure 37. Selecting the event report type.

4.9.1 Exit

This option returns you to the Change Sets screen. To invoke the option, type <E> in the option field and press <Enter>, or press <Esc>.

4.9.2 Unaffected Events (Base)

This option allows you to generate a report of the events that are not affected by any of the change sets that currently exist in the data base. To invoke this option, type <U> in the option field and press <Enter>. The sort selection menu will be displayed, allowing you to sort the data by event name, ascending probability, or change set (see Figure 38).

```
Sort By :

Event Name
Ascending Probabilities
Change Sets


              Option |E|
```

Figure 38. Selecting the sorting order for event reports.

After the sorting method has been selected, you are asked to specify the routing of the report (Figure 39).

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

                 ------------ Report Title ------------------
                 Events Not Affected By Change Sets

                       -------- Output File Name --------
                       CON

 NOTE:  File Name =  "CON"  - Output report to the screen.
                     "PRN"  - Output report to the printer.
                     "   "  - No report is produced.
                     <ESC>  - No report is produced.
                     other  - Valid DOS file name.  Examples are:
                              A:LISTING, C:\REPORT\REP1, and RESULTS.
```

Figure 39. Unaffected events (base) report routing.

4.9.3 AFfected Events (Current)

This option allows you to generate a report of the events that are affected by the change sets that currently exist in the data base. To invoke the option, type <F> in the option field and press <Enter>. The sort selection menu will be presented allowing you to sort the data by event name, ascending probability, or change set (Figure 38).

After the sorting method has been selected, you are asked to specify the routing of the report (see Figure 39).

4.9.4 All Events (Base, Current)

This option allows you to generate a report of all of the events in the data base. The report will indicate the events affected by a change set. To invoke the option, type <A> in the option field and press <Enter>. The sort selection menu will be presented allowing you to sort the data by event name, ascending probability, or change set (Figure 38).

After the sorting method has been selected, you are asked to specify the routing of the report (see Figure 39).

4.10 Base Case Update

This option allows you to overwrite the base case data values stored in the data base with the current (temporary) data values for each basic event. After executing this option, the original base case data are no longer available.

To invoke this option, type <B> (Base Case Update) in the option field, mark the desired change set(s) and press <Enter>. A confirmation screen (Figure 40) will appear to ensure you wish to update the base case values with the temporary data values from the marked change set(s). To terminate the process type an <N> in the option field and press <Enter>. To initiate the update process, type a <Y> in the option field and press <Enter>. Upon pressing <Enter>, the default mission time is displayed at the bottom of the screen (Figure 41). If you do not wish to change the mission time press <Enter>.

WARNING: When you respond with a <Y> on the warning screen, you will overwrite the base case.

In order to run a base case update at least one change set must be marked. This option transfers the temporary values for the basic events marked with either a probability change or a class change in a change set to the base case values. The existing base case values will be lost. Any event in the change set that does not have either a class change or a probability change associated with it will maintain its existing base case data. Upon completion of the base case update, the message **Base case events have been updated with changed values** will appear at the bottom of the screen.

If an event in a marked change set has both a class change and a probability change associated with it, the probability change takes precedence and will be used to update the base case values.

If more than one change set has been marked and is being used in the base case update, then the probability and class changes in the highest numbered change set take precedence over changes from lower numbered change sets. For example, if Event A has a probability change associated with it in Change Set 1, and a class change associated with it in Change Set 2, then the class change from Change Set 2 would override the probability change from Change Set 1.

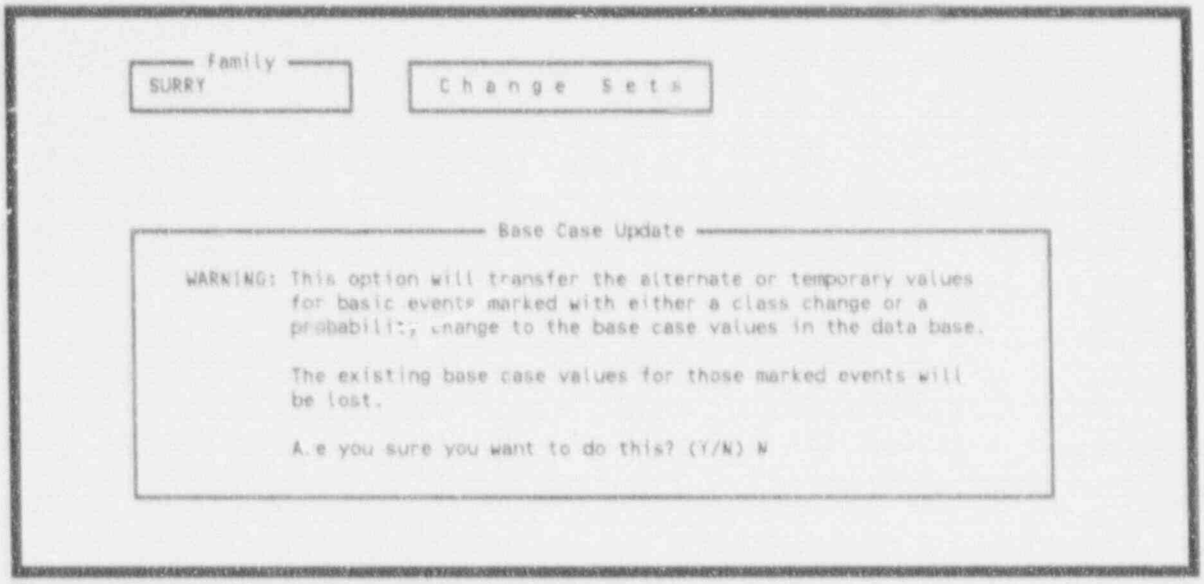


Figure 40. Confirm the base case update request.

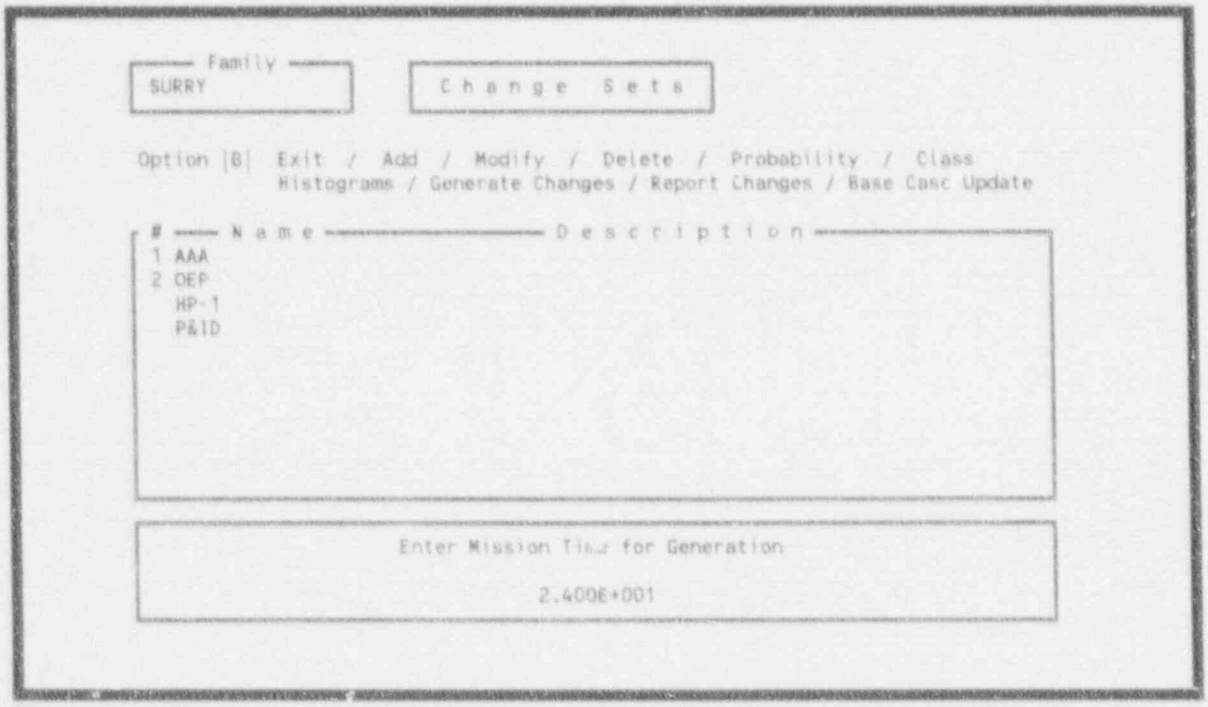


Figure 41. Set mission time for base case update.

5. BUILD FAULT TREES

This option allows you to graphically build and edit fault tree models and output them to several hard copy hardware devices. The defaults for the hardware devices are set in the constants screen (Figure 2). When this option is selected, Figure 42 is displayed.

```
 Family                          I R R A S
 SURRY                   Fault Tree Graphics System

                         Exit

                         Build Graphic Trees

                         Plot Trees
                         Load Graphic Trees
                         Alpha to Graphics
                         Graphical Pager

                         eXtract Fault Trees
                         Define Plotter Pens

                              Option |E|
```

Figure 42. Build fault trees menu.

As shown, the following options are available:

Exit	-	Returns you to the IRRAS Main Menu.
Build Graphic Trees	-	Allows you to construct the actual fault tree diagram.
Plot Trees	-	Allows you to plot an HP graphics file.
Load Graphic Trees	-	Allows you to load a .DLS (graphics) file.
Alpha to Graphics	-	Allows you to convert the alphanumeric logic for a system or subsystem to a graphical format.
Graphical Pager	-	Allows you to break-up a diagram into multiple pages.
eXtract Fault Trees	-	Allows you to extract fault trees, clear extracted fault trees, and display extracted fault trees.
Define Plotter Pens	-	Allows you to assign colors to your plotter pens.

Each of these options is discussed in the following paragraphs.

5.1 Build Graphic Trees

This option allows you to construct the actual fault tree diagram. You may start building from scratch or from an existing file to generate or modify logic. When this option is selected, Figure 43 will be displayed. The editing commands are shown in the left column, while the rest of the screen is the drawing surface. The editing commands shown in upper-case letters have additional pop-up menus associated with them. The cursor is used to position pop-up menus, draw lines, place drawing symbols, and select menu options.

To invoke any of the editing commands (using a mouse), position the cursor over the desired editing command on the active menu. The active menu is the last menu you pulled up or moved. When the editing command box is highlighted (a white line outlines the box), press the left mouse button. The command is now invoked. Each editing command is described in the following paragraphs.

5.1.1 EXIT

This option terminates the editing session and returns you to the previous screen. To invoke this option, position the cursor over the EXIT box and press the left mouse button or <Enter>.

5.1.2 Move

The move command, which is represented by ←→, allows you to position the editing command menu anywhere on the screen. When you invoke this command, a white line surrounds the entire editing menu. Drag the cursor to position the outline at the new location and press the left mouse button or <Enter>. The menu will be displayed at the new location.

5.1.3 SHOW

This command clears the screen and re-displays the currently defined diagram.

5.1.4 BILD

This command allows you to generate drawing symbols. When you invoke this command, an additional pop-up menu is displayed (Figure 44). This submenu contains all the constructs needed to create fault tree models. These constructs are

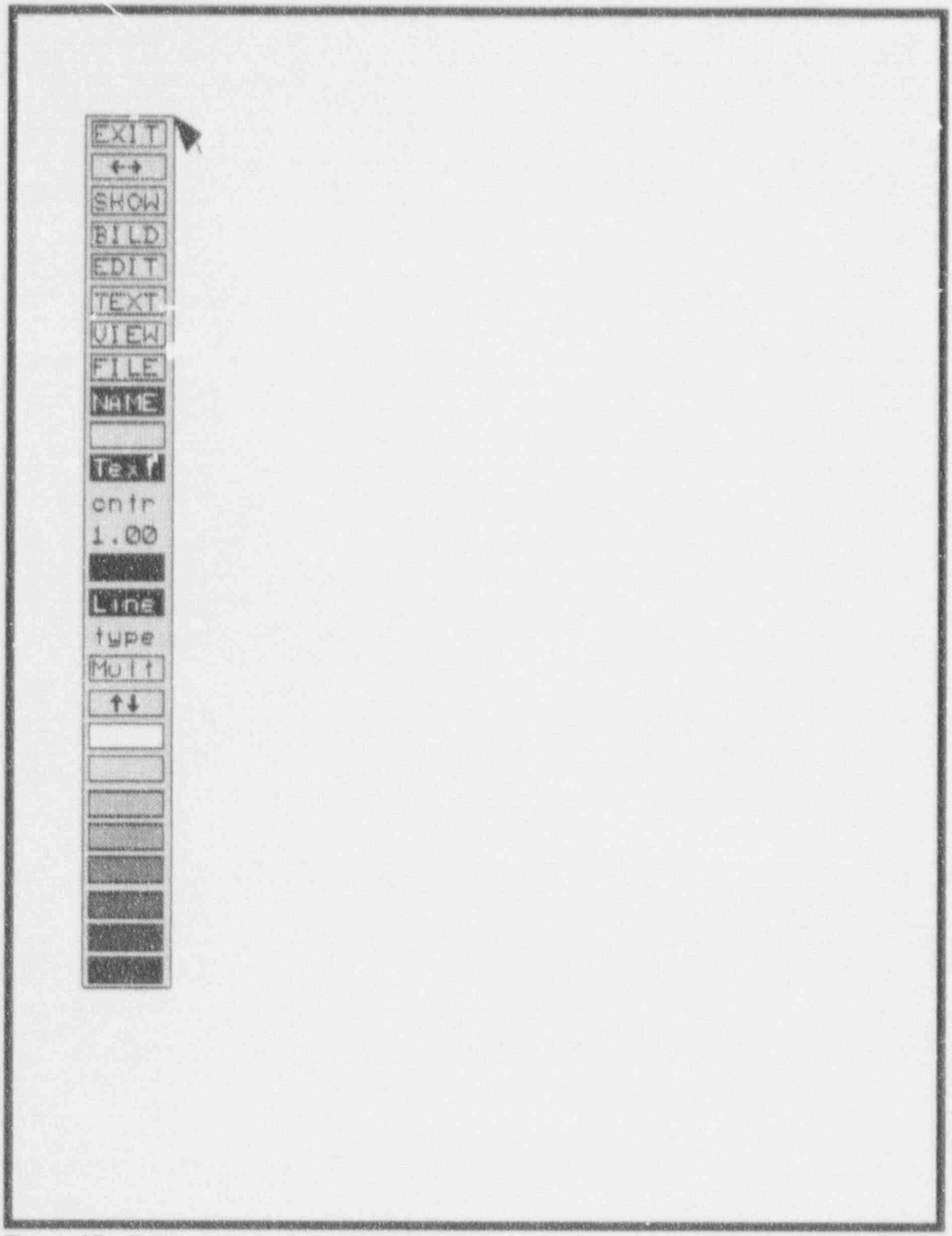


Figure 43. Editing commands for the BILD option.

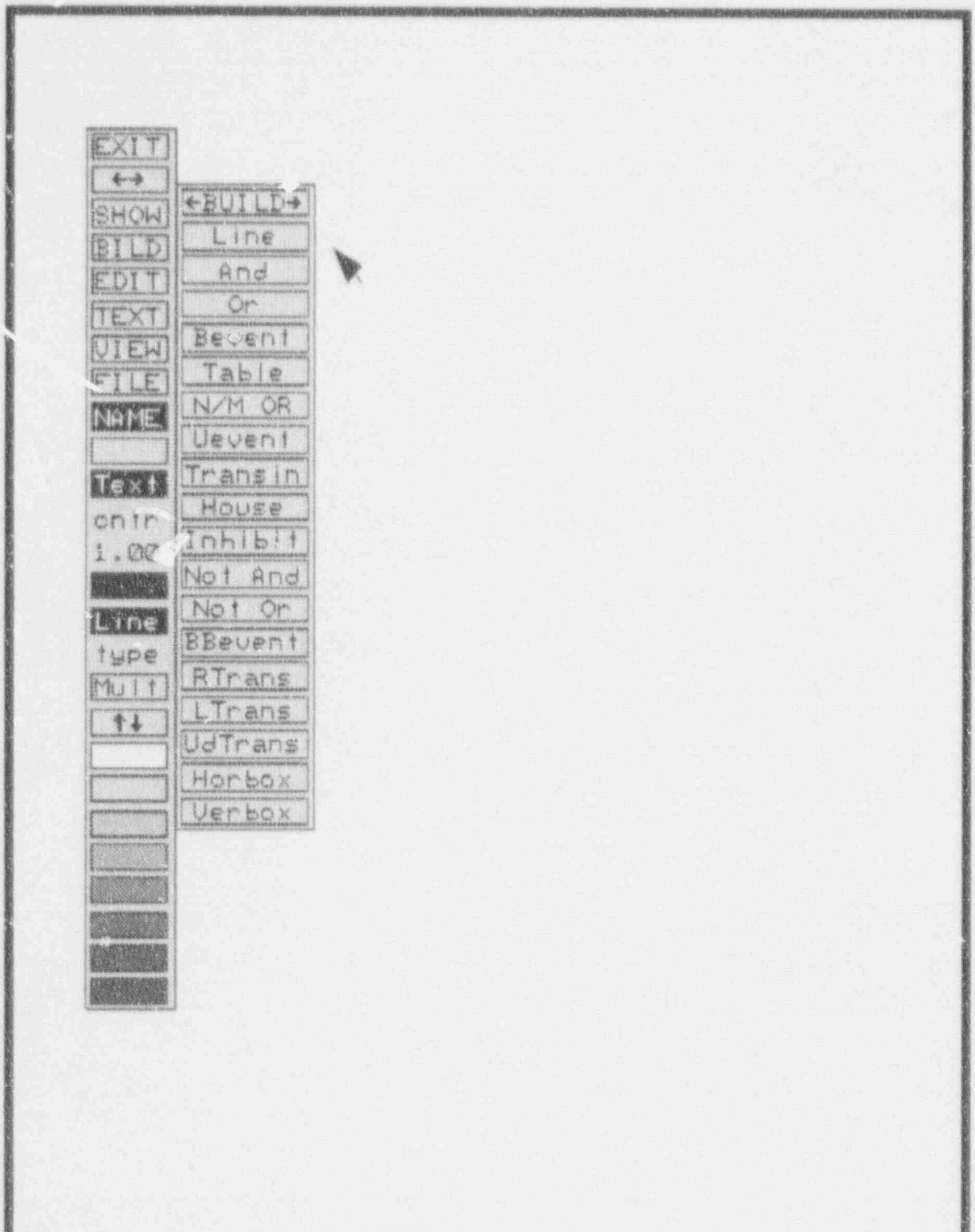


Figure 44. BILD pop-up menu options.

←BUILD→

Allows you to move the BUILD pop-up menu to a new location on the screen. When you invoke this command, a white outline box appears. Drag the cursor to position the outline to the desired location and press the left mouse button or <Enter>. The BUILD pop-up menu will be re-displayed at the new location.

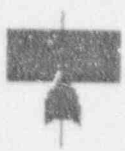
Line

Allows you to draw lines. When you invoke this option, you will be prompted with **Enter points for line**. The cursor will change from an arrow to a cross hair. Position the cross hair at the point where you want the line to begin, press the left mouse button or <Enter>. The cross hair will now change into a small dot. Drag the cursor in the direction you want the line to follow. When satisfied with the length and direction of the line, press the left mouse button or <Enter>. If the multipick option is turned on (see Section 5.1.16), the prompt **Enter points for next line** will appear. You may draw another line or press the right mouse button to terminate line mode. When you terminate line mode, the cross hair will return. Press the right mouse button to return to the normal cursor mode (arrow).

And

Generates the "And" symbol. Move the symbol to the desired screen location and press the left mouse button or the <Enter> key. If the multipick option is turned on (see Section 5.1.16), another And symbol will appear automatically. You can position this symbol to the desired location or press the right mouse button to terminate And symbol generation.

Or

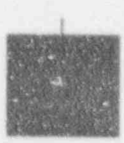


Generates the "Or" symbol. Move the symbol to the desired screen location and press the left mouse button or the <Enter> key. If the multipick option is turned on (see Section 5.1.16), another Or symbol will appear automatically. You can position this symbol to the desired location or press the right mouse button to terminate Or symbol generation.

Bevent

Generates the "Bevent" symbol. Move the symbol to the desired screen location and press the left mouse button or the <Enter> key. If the multipick option is turned on (see Section 5.1.16), another Bevent symbol will appear automatically. You can position this symbol to the desired location or press the right mouse button to terminate Bevent symbol generation.

Table

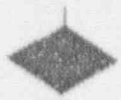


Generates the "Table" symbol. Move the symbol to the desired screen location and press the left mouse button or the <Enter> key. If the multipick option is turned on (see Section 5.1.16), another Table symbol will appear automatically. You can position this symbol to the desired location or press the right mouse button to terminate Table symbol generation.

N/M OR

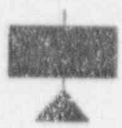
Generates the "N/M OR" symbol. Move the symbol to the desired screen location and press the left mouse button or the <Enter> key. The prompt **Enter N (out of) M values** will appear at the bottom of the screen. Enter the required values (e.g. 2 5) and press <Enter>. If the multipick option is turned on (see Section 5.1.16), another N/M OR symbol will appear automatically. You can position this symbol to the desired location or press the right mouse button to terminate N/M OR symbol generation.

Uevent



Generates the "Uevent" symbol. Move the symbol to the desired screen location and press the left mouse button or the <Enter> key. If the multipick option is turned on (see Section 5.1.16), another Uevent symbol will appear automatically. You can position this symbol to the desired location or press the right mouse button to terminate Uevent symbol generation.

Transin

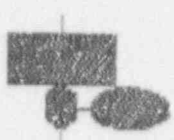


Generates the "Transin" symbol. Move the symbol to the desired screen location and press the left mouse button or the <Enter> key. If the multipick option is turned on (see Section 5.1.16), another Transin symbol will appear automatically. You can position this symbol to the desired location or press the right mouse button to terminate Transin symbol generation.

House

Generates the "House" symbol. Move the symbol to the desired screen location and press the left mouse button or the <Enter> key. If the multipick option is turned on (see Section 5.1.16), another House symbol will appear automatically. You can position this symbol to the desired location or press the right mouse button to terminate House symbol generation.

Inhibit

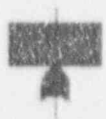


Generates the "Inhibit" symbol. Move the symbol to the desired screen location and press the left mouse button or the <Enter> key. If the multipick option is turned on (see Section 5.1.16), another Inhibit symbol will appear automatically. You can position this symbol to the desired location or press the right mouse button to terminate Inhibit symbol generation.

Not And

Generates the "Not And" symbol. Move the symbol to the desired screen location and press the left mouse button or the <Enter> key. If the multipick option is turned on (see Section 5.1.16), another Not And symbol will appear automatically. You can position this symbol to the desired location or press the right mouse button to terminate Not And symbol generation.

Not Or



Generates the "Not Or" symbol. Move the symbol to the desired screen location and press the left mouse button or the <Enter> key. If the multipick option is turned on (see Section 5.1.16), another Not Or symbol will appear automatically. You can position this symbol to the desired location or press the right mouse button to terminate Not Or symbol generation.

BBevent

Generates the "BBevent" symbol. Move the symbol to the desired screen location and press the left mouse button or the <Enter> key. If the multipick option is turned on (see Section 5.1.16), another BBevent symbol will appear automatically. You can position this symbol to the desired location or press the right mouse button to terminate BBevent symbol generation.

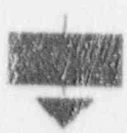
RTrans

Generates the "RTrans" symbol. Move the symbol to the desired screen location and press the left mouse button or the <Enter> key. If the multipick option is turned on (see Section 5.1.16), another RTrans symbol will appear automatically. You can position this symbol to the desired location or press the right mouse button to terminate RTrans symbol generation.

LTrans

Generates the "LTrans" symbol. Move the symbol to the desired screen location and press the left mouse button or the <Enter> key. If the multipick option is turned on (see Section 5.1.16), another LTrans symbol will appear automatically. You can position this symbol to the desired location or press the right mouse button to terminate LTrans symbol generation.

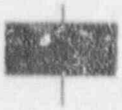
UdTrans



Generates the "UdTrans" symbol. Move the symbol to the desired screen location and press the left mouse button or the <Enter> key. If the multipick option is turned on (see Section 5.1.16), another UdTrans symbol will appear automatically. You can position this symbol to the desired location or press the right mouse button to terminate UdTrans symbol generation.

Horbox

Generates the "Horbox" symbol. Move the symbol to the desired screen location and press the left mouse button or the <Enter> key. If the multipick option is turned on (see Section 5.1.16), another Horbox symbol will appear automatically. You can position this symbol to the desired location or press the right mouse button to terminate Horbox symbol generation.

Verbox  Generates the "Verbox" symbol. Move the symbol to the desired screen location and press the left mouse button or the <Enter> key. If the multipick option is turned on (see Section 5.1.16), another Verbox symbol will appear automatically. You can position this symbol to the desired location or press the right mouse button to terminate Verbox symbol generation.

5.1.5 EDIT

This option allows you to modify fault tree diagrams. In addition to modifying the actual diagram, you may use this option to load existing diagrams and modify various attributes of the drawing. When you invoke the EDIT option, a pop-up menu (Figure 45) will be displayed. The first box, ←EDIT→, is used to position the pop-up menu to a new location on the screen. The remaining editing options are described in the following paragraphs.

5.1.5.1 ATTRIBUTES. This option allows you to specify the actual attributes of the symbols and text used in the fault tree diagram. Attributes include text size, line type, fill, font size, etc. Changing the attributes does not affect the global (default) values. Only the specific objects selected while in the given mode (e.g., Fill Col, Line Col, etc.) will be affected. When you invoke this option an additional pop-up menu is displayed as shown in Figure 46. The following attributes may be modified:

Fill Col

This attribute allows you to change the color for the drawing symbols. When you pick this option, the message **Pick a new color from the color bar** will be displayed at the bottom of the screen. To select a color, position the cursor over the desired color and press the left mouse button. (**NOTE:** The ↑↓ (color) option is active at this time. This option will display the additional color selections available.) Next, you will be prompted to **Pick shapes to be modified**. The cursor will change to a cross hair. Box the shapes to be changed by marking opposite corners. To box the symbols, position the cursor on the symbols to change and press the left mouse button. The cross hair is replaced with a small white dot. Drag the cursor over the shapes to be changed. An outline box appears. When the box surrounds the desired shapes completely, press the left mouse button. The box will disappear and the selected symbols will change to the new color. If no shapes change color, then the selected box was not large enough to include any shapes. If the multipick option is turned on (see Section 5.1.16), you will be prompted to **Pick next shapes to be modified**. At this point you may select more shapes or press the right mouse button to terminate this process.

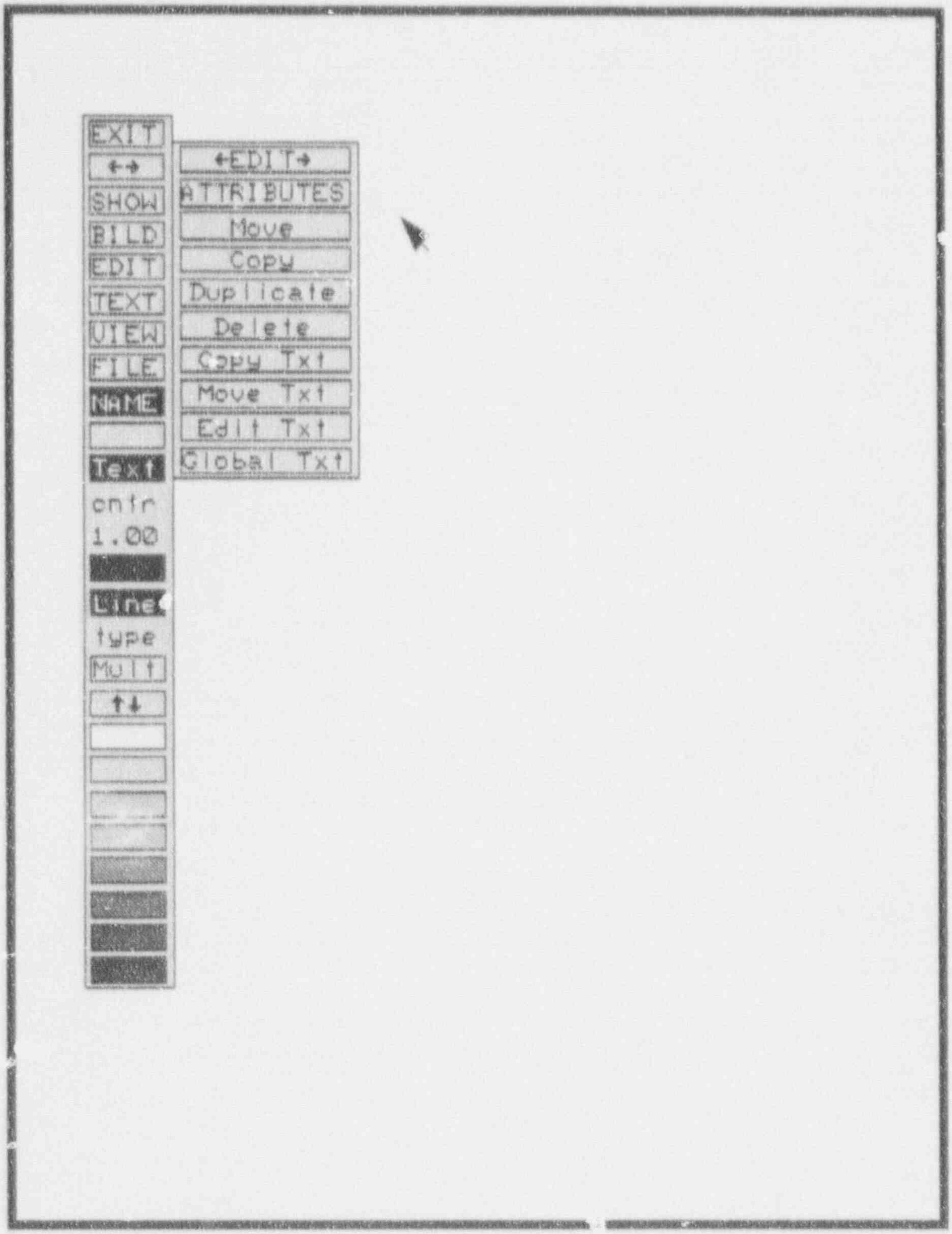


Figure 45. Edit pop-up menu.

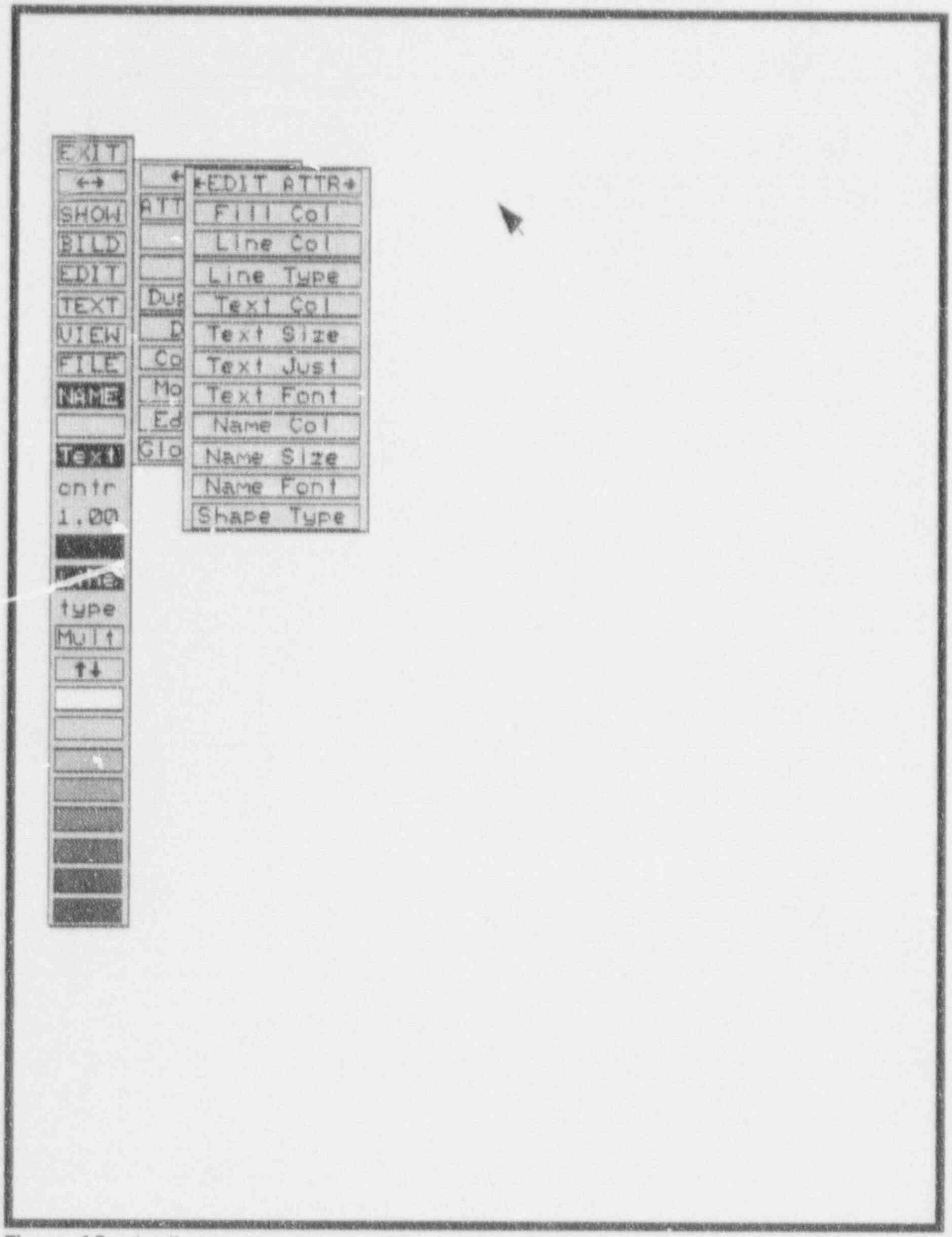


Figure 46. Attributes pop-up menu.

Line Col - This attribute allows you to change the color of the lines in the current diagram. Again, you will be prompted to **Pick a new color from the color bar**. To select a color, position the cursor over the desired color box and press the left mouse button. (**NOTE**: The ↑↓ (color) option is active at this time. This option will display the additional color selections available.) Next, you will be prompted to **Pick the line(s) to be modified**. The cursor will change from an arrow to a cross hair. Box the lines to be changed by marking opposite corners. To box the lines, position the cursor on the lines whose color you wish to change and press the left mouse button. The cross hair is replaced by a small white dot. Drag the cursor through the lines to be modified. A box appears surrounding the chosen lines. When the box completely surrounds the chosen lines, press the left mouse button. The box will disappear and the selected line(s) will change to the new color. If the multipick option is turned on (see Section 5.1.16), you will be prompted to **Pick next line(s) to be modified**. At this point, you may choose additional lines to change, or press the right mouse button to terminate the process.

Line Type - This attribute allows you to select the line type. When you select this option, a small window appears displaying the three available line types (solid, broken, or dotted line). You will be prompted to **Pick line type**. The cursor will change to a cross hair. Position the cross hair over the desired line type, and press the left mouse button. Next, you will be prompted to **Pick line(s) to be modified**. Box the lines to be changed by marking the opposite corners of the region. Choose the lines to be modified by positioning the cursor over the lines to be modified and pressing the left mouse button. Again, the cursor changes to a small dot. Drag the cursor over the lines to be modified. An outline box will appear. When the box completely surrounds the lines to be modified, press the left mouse button. The box will disappear and the selected lines will change to the new line type. If the multipick option is turned on (see Section 5.1.16), you will be prompted to **Pick next line(s) to be modified**. At this point, you may select more lines or press the right mouse button to terminate the process. Upon termination, the normal cursor will return.

Text Col This attribute option allows you to change the color of the text in your fault tree diagram. When you invoke this option, you will be prompted to **Pick a new color from the color bar**. Position the cursor over the desired color and press the left mouse button. (**NOTE:** The ↑↓ (color) option is active at this time. This option will display the additional color selections available.) Next, you will be prompted to **Pick text to be modified**. The cursor will change from an arrow to a cross hair. Box the text to be changed by marking the opposite corners of the text area. To box the area, position the cursor over the text to be changed and press the left mouse button. A small dot will appear. Drag the cursor over the text until the outline box surrounds all the desired text. Press the left mouse button. All selected text will change to the new color. If the multipick option is turned on (see Section 5.1.16), you will be prompted to **Pick next text to be modified**. At this point you can select more text or press the right mouse button to terminate the process. The color change will only affect the selected text.

Text Size - This attribute option allows you to specify the height of the text in your diagram. When you invoke this option, you will be prompted to **Enter text size**. Text sizes are indicated by a number between 0.01 and 66.00, with 66 being the full 66 lines from the top to the bottom of the screen. This roughly corresponds to the 66 lines on a full sheet of regular paper. For the purpose of writing text in gate blocks, a text size of about 0.5 is appropriate. The size looks too small on the screen, but it is a good size for sending to a laserjet printer. Larger text sizes will be necessary for printers with lower resolution. Next, you will be prompted to **Pick text to be modified**. Position the cursor on the text to be resized and press the left mouse button. A small dot will appear. Drag the cursor over the text to be resized. When the outline box completely surrounds the text to be modified, press the left mouse button. The box will disappear and the selected text will be displayed in the new text size. If the multipick option is turned on (see Section 5.1.16), you will be prompted to **Pick next text to be modified**. At this point you can select more text, or press the right mouse button to terminate the process. This new text size will only affect the selected text.

Text Just - This attribute allows you to justify selected portions of the text in your diagram. When you invoke this option, you will be prompted to **Pick text to be modified**. Position the cross hair over the text to be justified and press the left mouse button. A small dot will appear. Drag the cursor over the text to be justified. When the outline box completely surrounds the desired text, press the left mouse button. The outline box will disappear and the selected text will be justified (see Section 5.1.11 for a complete discussion on setting the justification). If the multipick option is turned on (see Section 5.1.16), you will be prompted to **Pick next text to be modified**. At this point you may select additional text to be justified or press the right mouse button to terminate the process. Only the selected text will be justified. The remaining text will be unchanged.

Text Font - This attribute option allows you to select the font type for selected text. When you select this option an additional pop-up menu will be displayed (Figure 47). Select the desired font type by positioning the cursor over the font and pressing the left mouse button. You must select a font (or cancel) in order to continue. Next, you will be prompted to **Pick text to be modified**. Position the cursor over the text to be changed and press the left mouse button. A small dot will appear. Drag the cursor over the text to be modified. When the box completely surrounds the text to be modified, press the left mouse button. The selected text will be displayed in the new font size. If the multipick option is turned on (see Section 5.1.16), you will be prompted to **Pick next text to be modified**. At this point you may select more text, or press the right mouse button to terminate the process. Only the selected text will carry the new font type. The remaining text (unselected) will remain unchanged.

Name Col - This attribute option allows you to change the color of the default or given name of the symbol/shape. When you select this option, you will be prompted to **Pick a new color from the color bar**. Position the cursor over the desired color and press the left mouse button. (**NOTE:** The ↑↓ (color) option is active at this time. This option will display the additional color selections available.) Next, you will be asked to **Pick shapes to be modified**. Position the cross hair over the shapes to be changed and press the left mouse button. A small dot will appear. Drag the cursor over the shapes to be modified. You must be sure to place the box completely around the shape and not just the name. When the box surrounds the desired shapes, press the left mouse button. The selected symbol name(s) will change to the new color. If the multipick option is turned on (see Section 5.1.16), you will be prompted to **Pick next shapes to be modified**. At this point you may select additional shapes or press the right mouse button to terminate the process.

Name Size - This attribute option allows you to specify the height of the shape name in your diagram. When you invoke this option, you will be prompted to **Enter text size**. Text sizes are indicated by a number between 0.01 and 66.00, with 66 being the full 66 lines from the top to the bottom of the screen. This roughly corresponds to the 66 lines on a full sheet of regular paper. For the purpose of writing text in gate blocks, a text size of about 0.5 is appropriate. The size looks too small on the screen, but it is a good size for sending to a laserjet printer. Larger text sizes will be necessary for printers with lower resolution. Next, you will be prompted to **Pick shapes to be modified**. Position the cursor on the shape to be modified and press the left mouse button. A small dot will appear. Drag the cursor over the text to be changed. When the box surrounds the shapes to be modified, press the left mouse button. If the multipick option is turned on (see Section 5.1.16), you will be prompted to **Pick next shapes to be modified**. At this point you can select more

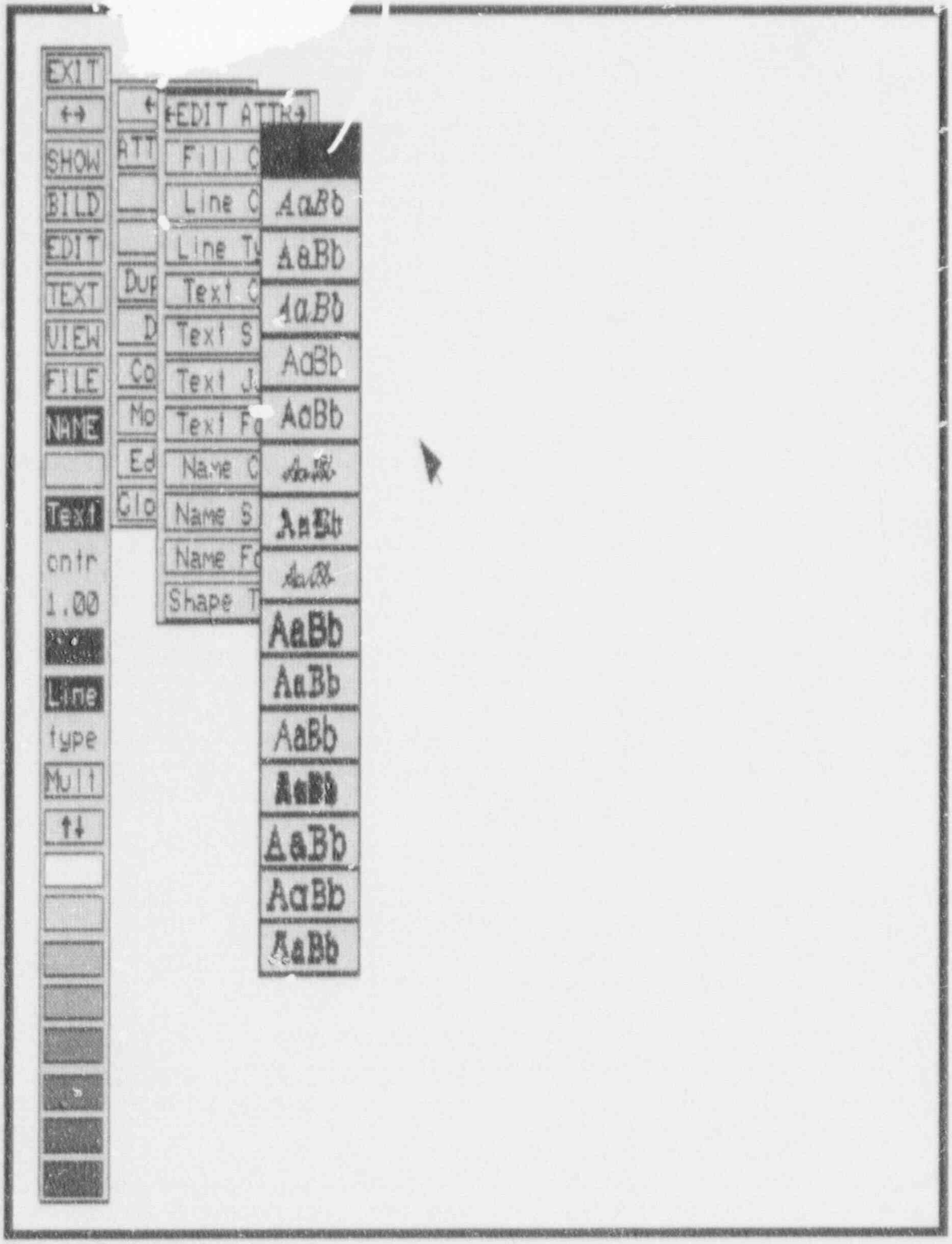


Figure 47. Font selection screen.

shapes, or press the right mouse button to terminate the process. This new text size will only affect the selected shapes.

Name Font — This attribute option allows you to select the font type the shape name will have in your diagram. When you select this option an additional pop-up menu will be displayed (Figure 47). Select the desired font type by positioning the cursor over the font and pressing the left mouse button. Next, you will be prompted to **Pick shapes to be modified**. Position the cursor over the shapes to be changed and press the left mouse button. A small dot will appear. Drag the cursor over the text to be modified. When the box surrounds the shapes to be modified, press the left mouse button. If the multipick option is turned on (see Section 5.1.16), you will be prompted to **Pick next shapes to be modified**. At this point you may select more shapes, or press the right mouse button to terminate the process. Only the selected shapes will carry the new font type. The remaining shapes (unselected) will be unchanged.

Shape Type — This attribute allows you to change an existing symbol in the current diagram to another symbol. When you select this option an additional pop-up menu will be displayed showing a menu similar to the build pop-up menu shown in Figure 44. You will be prompted to **Select the new shape type, or <cancel> to quit**. On this menu, you must select the desired shape. This is the symbol with which you are replacing the existing symbol. Highlight the desired symbol and press the left mouse button on the <Enter> key. You will be prompted with **Select shapes to be changed to new type**. Position the cursor over the shape to be changed to the new shape and press the left mouse button or the <Enter> key. A small dot appears. Drag the cursor over the shape(s) to be changed. When the box completely surrounds the desired shape(s), press the left mouse button. The box will disappear and the symbols will be changed to the new symbols. If the multipick option is turned on (see Section 5.1.16), you will be prompted to **Select next shape(s) to be changed or <cancel> to reselect type**. At this point you may select more shapes to change, or press the right mouse button to select a new replacement symbol.

5.1.5.2 Move. This editing option allows you to move a portion of the diagram to a new location. When you invoke this option, you will be prompted to **Box region to be moved - press CANCEL to quit.** Position the cross hair over the region to be moved and press the left mouse button. A small dot will appear. Drag the cursor over the region until the box completely surrounds the region to be moved, and press the left mouse button. Next, you will be prompted to **Pick reference point - press CANCEL to reselect.** The reference point is used to give you some indication of the position of the object being moved relative to the box. Position the cross hair at the location where you want the selected region to be moved. Next, you will be prompted to **Position Box at new location - press CANCEL to reselect.** Use the cursor to move the box to the exact position where you want the box to appear. When you are satisfied with the new position press the right mouse button. The selected region will be moved to this new location. If the multipick option is turned on (see Section 5.1.16), you will be returned to the **Position box at new location ...** prompt. At this point you may select a new location to move the selected symbols or press the right mouse button to return to the "box region" prompt. At this point you may select another region to move or press the right mouse button to terminate the process.

5.1.5.3 Copy. This editing option allows you to copy a portion of the diagram and move it to a new location. This option does not create an exact copy, but rather copies the structure of the objects. When you invoke this option, you will be prompted to **Box region to be copied - press CANCEL to quit.** To box the region to be copied, mark the opposite corners of the region. Position the cross hair on the region to be copied and press the left mouse button. A small dot will appear. Drag the cursor over the region to be copied until the box completely surrounds the region. Press the left mouse button. You will be prompted to **Pick reference point - press CANCEL to reselect.** Position the cursor at the location you want the region to be copied to and press the left mouse button. The selected region will be copied and displayed at the chosen location. If the multipick option is turned on (see Section 5.1.16), you will be returned to the **Position Box at new location -press CANCEL to reselect** prompt. At this point you can copy the selected region to another location on the diagram, or press the right mouse button to terminate the process. If the process is terminated, you will be returned to the "box region" prompt. You may select another region to copy or press the right mouse button to terminate the process.

5.1.5.4 Duplicate. This editing option allows you to duplicate a portion of the fault tree diagram. This option makes an **exact** copy. Duplicate replicates the structure, logic, and even the names used. When you invoke this option, you will be prompted to **Box region to be duplicated -press CANCEL to quit**. To box the region to be duplicated, mark the opposite corners of the region. Position the cross hair at the area to be duplicated and press the left mouse button. A small dot appears. Drag the cursor over the area to be duplicated until the outline box completely surrounds the desired area. When complete, press the left mouse button. The box will disappear and you will be prompted to **Pick reference point - press CANCEL to reselect.** Position the cursor at the desired point and press the left mouse button. An outline box the size of the selected area will appear. You will be prompted to **Position Box at new location - press CANCEL to reselect.** Position the cursor at the desired location and press the left mouse button. The selected area will be duplicated (an exact copy) and displayed at the new location. If the multipick option is turned on (see Section 5.1.16), another outline box will appear and you will be prompted to **Position Box at new location - press CANCEL to reselect.** At this point, you can duplicate the region again, or press the right mouse button to terminate the process. You will be returned to the **Box region to be duplicated** prompt. You may select another region to be duplicated or press the right mouse button to cancel the process.

5.1.5.5 Delete. This editing option allows you to delete any portion of the displayed fault tree diagram. When you invoke this option, you will be prompted to **Pick region to be deleted**. Position the cursor at the place you want to delete and press the left mouse button. A small dot will appear. Drag the cursor over the area to be deleted until the outline box completely surrounds the area. Press the left mouse button. Next, you will be prompted **Delete region? Left = delete, Right = cancel**. If the boxed area is the area you want to delete, press the left mouse button. If it is not the desired region, press the right mouse button. If the multipick option is turned on (see Section 5.1.16), you will be prompted to **Pick next region to be deleted**. At this point you may select another region to delete, or press the right mouse button to terminate the process.

5.1.5.6 Copy Txt. This option allows you to copy text from one area of the diagram to another. When you invoke this option, you will be prompted to **Pick text to be copied - press CANCEL to quit.**

Position the cross hair on the text to be copied. A small dot will appear. Drag the cursor over the text until the outline box completely surrounds the entire text. Press the left mouse button. Next, you will be prompted to **Pick reference point - press CANCEL to reselect.** The reference point is used to give you some indication of the position of the object being moved relative to the box. Position the cursor at the desired point and press the left mouse button. You will be prompted to **Position Box at new location - press CANCEL to reselect.** The selected text will now be displayed at the new location. (The text still remains at its original location). If the multipick option is turned on (see Section 5.1.16), you will be prompted to **Position Box at new location**. At this point you may copy the text to yet another location or press the right mouse button to terminate the process. You will be returned to the **Pick text to be copied - press CANCEL to quit** prompt. You may select another piece of text to copy or press the right mouse button to terminate the copy process.

5.1.5.7 Move Txt. This editing option allows you to move text from one area of the diagram to another. When you invoke this option, you will be prompted to **Pick text to be moved - press CANCEL to quit.** To mark the text to be moved, box the opposite corners of the text region. Position the cross hair at the start of the text to be moved, and press the left mouse button. A small dot will appear. Drag the cursor over the text to be moved until the outline box completely surrounds the desired text. Press the left mouse button. Next, you will be prompted to **Pick reference point - press CANCEL to reselect**. The reference point is used to give you some indication of the position of the object being moved relative to the box. Position the cursor at the desired location and press the left mouse button. You will be prompted to **Position Box at new location - press CANCEL to reselect.** Move the cursor until the box is positioned at the point where you want to move the text. Press the left mouse button again. The text will be moved to the new location. If the multipick option is turned on (see Section 5.1.16), the box will appear again and you will be prompted to **Position Box at new location - press CANCEL to reselect.** At this point you can move the same text to yet another location or press the right mouse button to terminate the process. If you choose to terminate, you will be returned to the **Pick text to be moved** prompt. You may choose more text to move or press the right mouse button to cancel the move text option. **NOTE:** When you move text, the selected text will be removed from its original position.

5.1.5.8 Edit Txt. This editing option allows you to edit text. When you invoke this option, you will be prompted to **Box text to be edited**. To box the text to be edited, mark the opposite corners of the text region. Position the cursor at the text to be modified and press the left mouse button. A small dot will appear. Drag the cursor over the text to be modified until the outline box surrounds all the desired text. Press the left mouse button. A large window will appear displaying the selected text in a readable format. The text is displayed one line at a time. To edit the text, simply type over the existing text. You may use the <Ins> and <Del> keys to add and delete characters as necessary. In addition, you may use the backspace and end keys. Backspace moves all characters from the right of the cursor to the left one space. The End key positions the cursor at the end of the current line. When complete, press <ESC> and the next line of text will appear. When complete you will be prompted to **Box text to be edited** (if the multipick option is turned on -see Section 5.1. [illegible] At this point you can select additional text to modify or press the right mouse button to terminate [illegible] cess.

5.1.5.9 Global Txt. This editing option allows you to replace a specified word or group of words with a new word(s) at each and every occurrence in the fault tree diagram. When you invoke this option, you will be prompted to **Enter search string:**. Enter the word or phrase to be replaced (up to 42 characters are allowed for one search) and press <Enter>. Next, you will be prompted to **Enter**

replacement string:. Enter the replacement word or phrase (again, up to 42 characters are allowed) and press <Enter>. Every occurrence will be replaced. When complete, the normal cursor (arrow) will return. **NOTE:** All occurrences of the strings will be replaced. For example, if you have a string in a text area you wish to change and that string also happens to be part of a NAME, both instances will be replaced with the new string.

5.1.6 TEXT

The TEXT command allows you to create titles, labels, descriptions, and names for your fault tree diagram. When you invoke this option, Figure 48 will be displayed. Each of the text submenu options is described in the following paragraphs.

The first option shown, ←TEXT→, is used to move the options menu to a new location. Position the cursor on the ←TEXT→ box and press the left mouse button. An outline box will appear. Position the box to the desired location and press the left mouse button. To remove the text suboptions menu, position the cursor anywhere in the text suboptions column and press the right mouse button.

The remaining TEXT suboptions are discussed in the following paragraphs.

5.1.6.1 Write Text. This text suboption allows you to add text anywhere on the fault tree diagram. When you invoke this option, you will be prompted to **Pick location for text**. Position the cursor where you want to write text and press the left mouse button. A window will appear. This window can hold up to 10 lines of text. Type in the new text as you want it to appear on the diagram. When finished, press <Esc>. When you return to the diagram, the newly added text will be included. If the multipick option is turned on (see Section 5.1.16), you will be prompted to **Pick next location for text.** At this point, you can choose another location to add text, or press the right mouse button to terminate the process.

5.1.6.2 Edit Text. This text suboption allows you to edit any of the text appearing on the diagram. When you invoke this option, you will be prompted to **Box text to be edited.** Position the cross hair at the beginning of the text you wish to modify and press the left mouse button. A small dot will appear. Drag your cursor over the text until the outline surrounds the text you wish to modify. When the text is surrounded, press the left mouse button. A window will appear displaying the first line of the selected text. To modify the text, simply type over the existing text. Use the <Ins> and <Del> keys to add and delete characters as necessary. In addition, you may use the Backspace and End keys. Backspace moves all characters from the right of the cursor to the left one space. The End key positions the cursor at the end of the current line. When complete, press <Esc>. If the multipick option is turned on (see Section 5.1.16), you will be returned to the **Box text to be edited.** prompt. At this point, you may box more text to edit or press the right mouse button to terminate the process.

5.1.6.3 FONT. This text suboption allows you to change the FONT type of the text. When you invoke this option, Figure 49 will be displayed. To select a font, position the cursor on the desired font and press the left mouse button. The font is now selected. New text will now appear in the new font style. This option updates the global font default. **NOTE:** The currently selected font is shown in a different color.

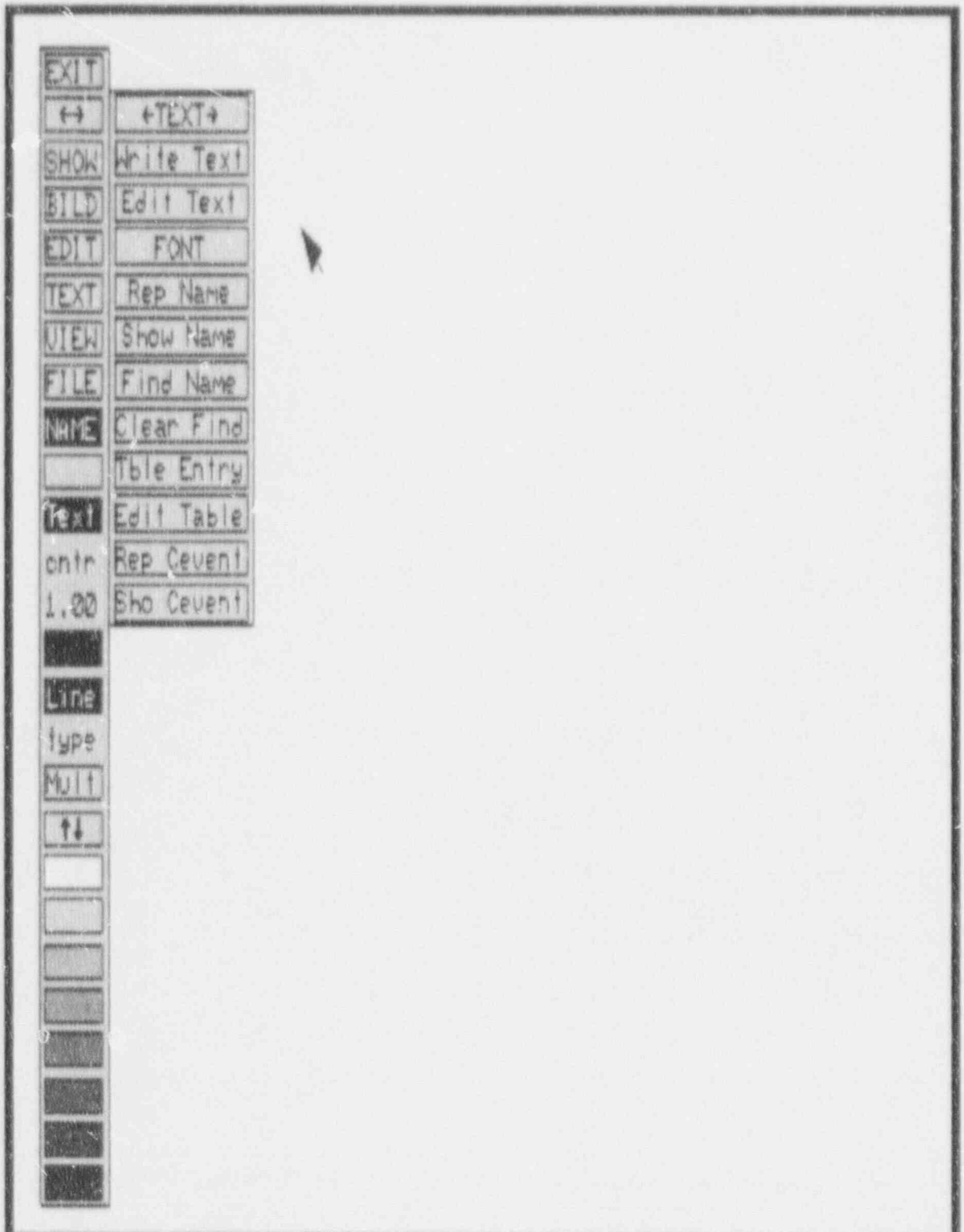


Figure 48. TEXT main menu.

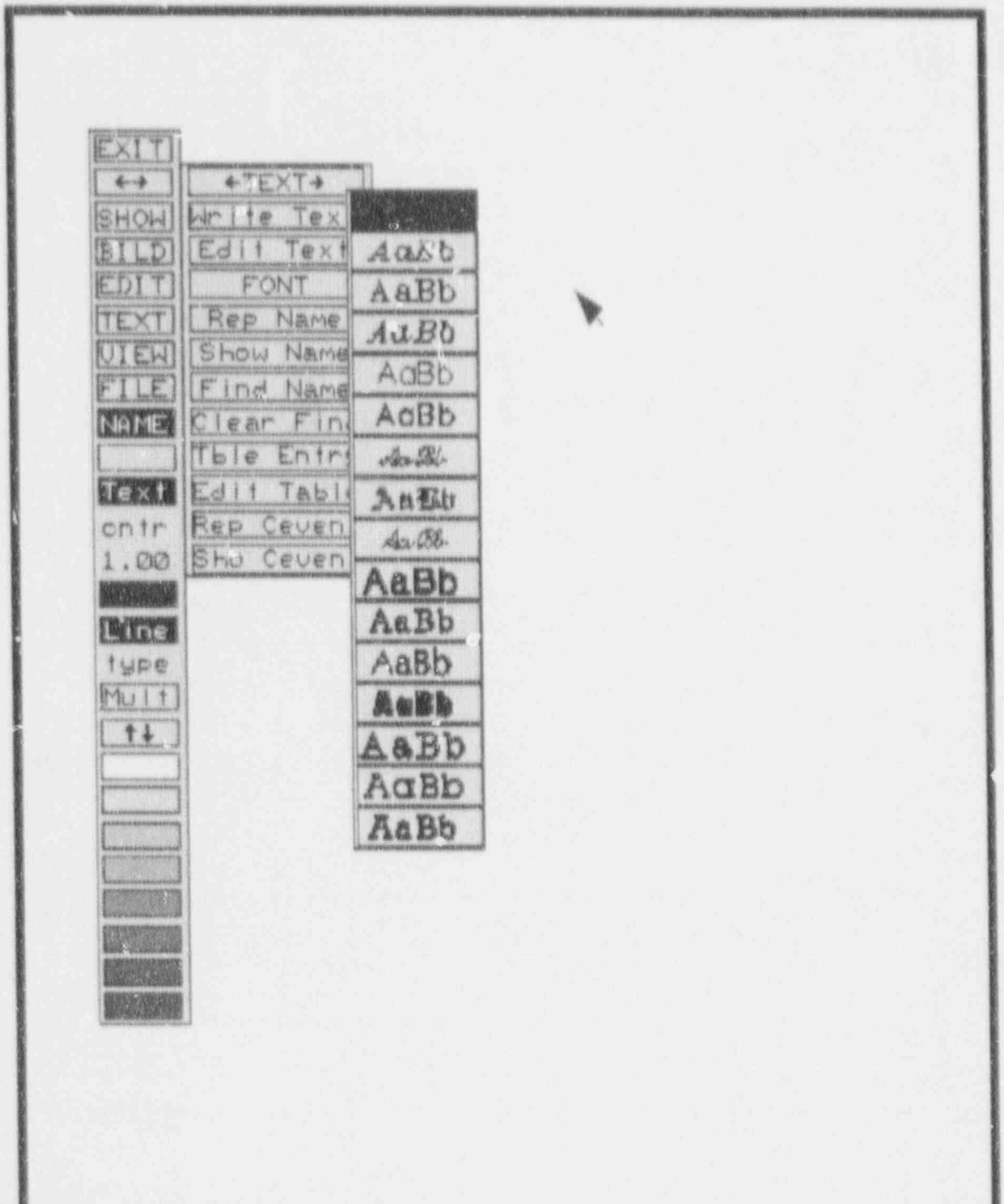


Figure 49. FONT selection menu.

5.1.6.4 Rep Name. This text suboption allows you to name or replace a name. When you invoke this option you will be prompted to **Pick shape to be named.** Position the cursor on the shape to be named and press the left mouse button. The prompt **Enter new name or CR for = >** will be displayed. Enter a new label and press <Enter>. The shape(s) will be renamed. If the multipick option is turned on (see Section 5.1.16), you will be returned to the **Pick next shape to be named** prompt. At this point you may choose another shape to label or press the right mouse button to terminate the process.

5.1.6.5 Show Name. This text suboption allows you to display (in readable characters) a shape name. When you invoke this option, you will be prompted to **Pick the shape**. Position the cross hair on the desired shape and press the left mouse button. The name for the selected shape will be displayed at the bottom of the screen. If the multipick option is turned on (see Section 5.1.16), the cross hair returns and you may select another shape or press the right mouse button to terminate the process.

5.1.6.6 Find Name. This text suboption allows you to locate a specific shape name on your diagram. When you invoke this option, you will be prompted with **Enter name >**. Enter the shape name you wish to locate and press <Enter>. A broken dotted line will outline the shape containing the specified label. This outline will appear until you invoke the Clear Find option.

5.1.6.7 Clear Find. To invoke this option, position the cursor over the Clear Find menu option, and press the left mouse button. All highlight outlines will be cleared from the screen.

5.1.6.8 Tble Entry. This option allows you to add entries to an existing table. When you invoke this option, you will be prompted to **Pick Table**. Position the cross hair over the table to be modified and press the left mouse button. You will be prompted to **Enter name (terminate with CR) >**. Enter the new table entry and press <Enter>. If the multipick option is turned on, you will be prompted with **Next name (terminate with CR) >**. At this point you may enter another table entry or press the <Enter> key to terminate the process. Upon pressing <Enter> you will be returned to the **Pick Next Table** prompt. At this point, you may mark another table symbol for entry or press the right mouse button to terminate the process.

5.1.6.9 Edit Table. This option allows you to edit individual table entries. When you invoke this option, you will be prompted to **Pick gate, event, or tab**. Position the cross hair on the desired gate, event, or table and press the left mouse button. A window will appear displaying the names. You are prompted to **Pick the name to modify,-use "@" in 1st col to delete.** Position the cursor over the name to modify and press the left mouse button. You will be prompted to enter a new name. Enter the name and press <Enter>. To cancel or terminate this process, press the right mouse button.

5.1.6.10 Rep Cevent. This option allows you to rename or change the name (label) given to the event part of an inhibit gate. When you select this option you will be prompted to **Pick INHIBIT gate**.

5.1.6.11 Sho Cevent. This option allows you to view the Cevent name associated with the inhibit gate. When you invoke this option, you will be prompted to **Pick the INHIBIT gate**.

5.1.7 VIEW

This option allows you to change the position and size of the displayed diagram. You may move the drawing up, down, right, left, zoom in, zoom out, or restore the drawing to its original size and/or position. You may also use a toggling method to display/not display names and text, and display a grid. When you select this option, Figure 50 will be displayed.

The first box, ←VIEW→, is used to move the VIEW menu to a new location on the screen. To invoke this option, position the cursor on the ←VIEW→ box and press the left mouse button. An outline box will appear. Move the outline to the desired location on the screen and press the left mouse button. In addition, you can remove the VIEW option box by positioning the cursor on any command in the VIEW menu and pressing the right mouse button or pressing the <Esc> key. The VIEW submenu consists of the following options:

- Page ↑: Invoking this option allows you to shift the figure up one page (previous page). To invoke this option, position the cursor in the Page ↑ box and press the left mouse button or <Enter>. The diagram's previous page will be displayed and the message **View changed** will appear at the bottom of the screen. This message will remain on the screen until the view option is terminated.

- Page ↓: Invoking this option allows you to shift the figure down one page (next page). To invoke this option, position the cursor in the Page ↓ box and press the left mouse button or <Enter>. The diagram's next page will be displayed and the message **View changed** will appear at the bottom of the screen. This message will remain on the screen until the view option is terminated.

- Page ←: Invoking this option allows you to shift the figure to the left one page (one screen). To invoke this option, position the cursor in the Page ← box and press the left mouse button or <Enter>. The diagram will shift to the left one screen at a time and the message **View changed** will appear at the bottom of the screen. This message will remain on the screen until the view option is terminated.

- Page →: Invoking this option allows you to shift the figure to the right one page (one screen). To invoke this option, position the cursor in the Page → box and press the left mouse button or <Enter>. The diagram will shift to the right one screen at a time and the message **View changed** will appear at the bottom of the screen. This message will remain on the screen until the view option is terminated.

- Scroll: Invoking this option allows you to move the diagram to another location on the screen. To invoke this option, position the cursor in the Scroll box and press the left mouse button. A white outline box appears, with a cross hair placed in the center of the outline. Position the cursor at the desired location and press the left mouse button. The cross hair serves as a reference point for placing the drawing. The reference point (+) is used to give you some indication of the position of the object being moved relative to the screen.

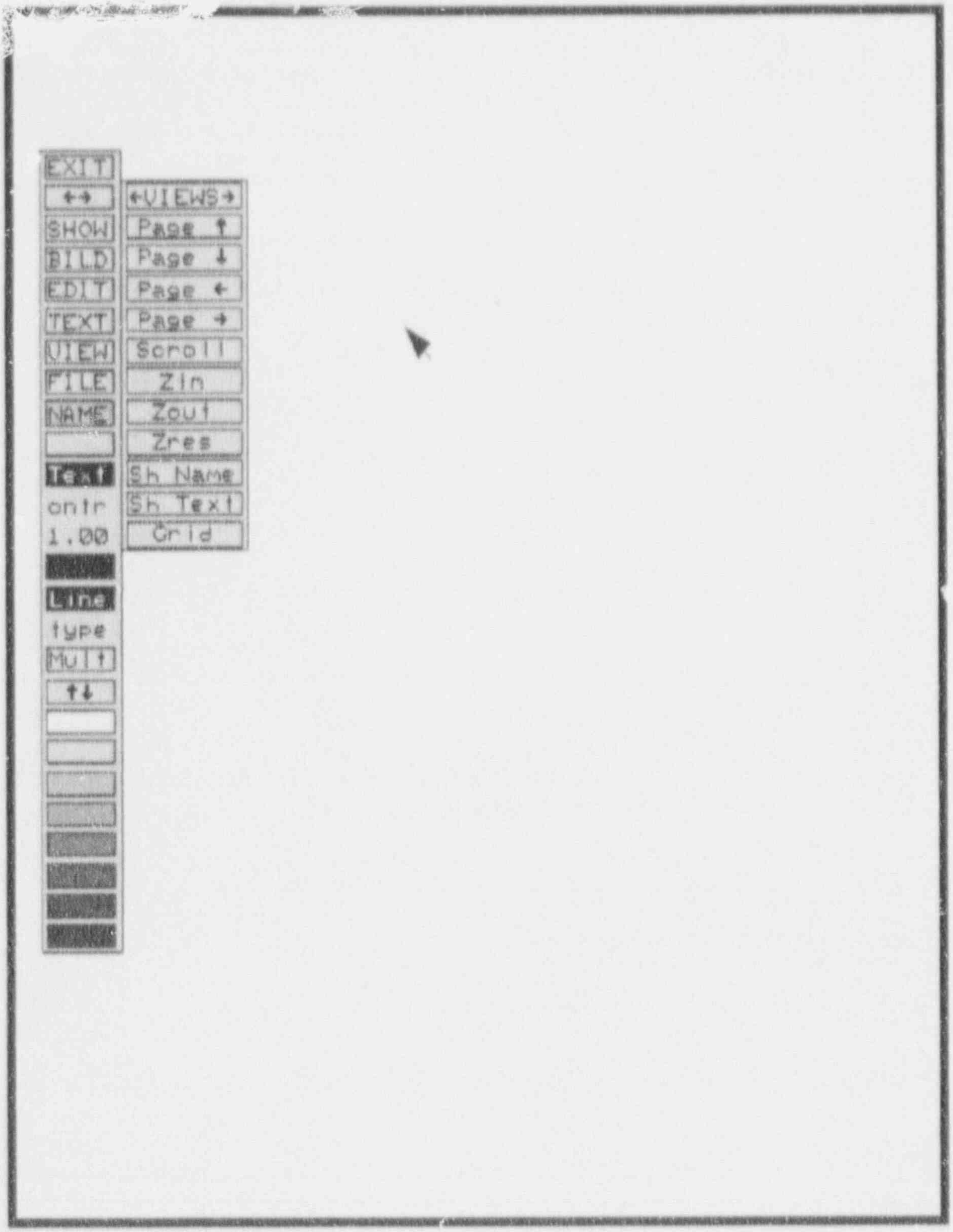


Figure 50. VIEW main menu.

- Zoom in: Invoking this option allows you to fill the screen with a small portion of the original display (magnifies the selected portion of the screen). To invoke this option, position the cursor in the Zin (zoom in) box and press the left mouse button or <Enter>. The message **Pick two corners of box** will be displayed. Move the cursor to the start of the portion of the diagram to be enlarged and press the left mouse button. A small dot appears. Drag the cursor across the desired area until it is completely surrounded by the outline box. Press the left mouse button. The portion of the original display enclosed by the box will now fill the entire screen. The display can be restored to its original size by invoking the Zres (zoom restore) option.

- Zoom out: Invoking this option allows you to shrink the displayed diagram by approximately 50%. To invoke this option, position the cursor in the Zout (zoom out) box and press the left mouse button or <Enter>. The entire display will be reduced. To restore the display to its original size, invoke the Zres option.

- Zoom Restore: This option restores any display created by Zin (zoom in), page up, page down, page left, page right, or Zout (zoom out) to the original display size or to the last saved file. To invoke this option, position the cursor in the Zres box and press the left mouse button or <Enter>.

- Sh Name: This option allows you to toggle the setting to display or not display names. Sh Name displays all the names in your diagram. No Name does not display any of the names in your diagram.

- Sh Text: This option allows you to toggle the text setting from Sh Text to No Text. Sh Text displays all defined text. No Text does not display the text.

- GRID: This option displays a grid behind your diagram to allow you to line up symbols and text. This is a toggle switch. To turn the grid on position the cursor in the GRID option box and press the left mouse button or <Enter>. To turn the grid off, repeat the same steps.

5.1.8 FILE

This option allows you to perform various file maintenance utilities including loading, saving, merging files, and printing hard copies of your diagrams. When you invoke this option, Figure 51 will be displayed. Each FILE option is discussed in the following paragraphs.

The first box, ←FILE→, is used to move the FILE menu to a new location on the screen. To invoke this option, position the cursor on the ←FILE→ box and press the left mouse button. An outline box will appear. Move the outline to the new location on the screen and press the left mouse button. The menu will be placed at the new location. In addition, you can remove the FILE menu box by positioning the cursor on any command in the FILE menu and pressing the right mouse button or pressing the <Esc> key.

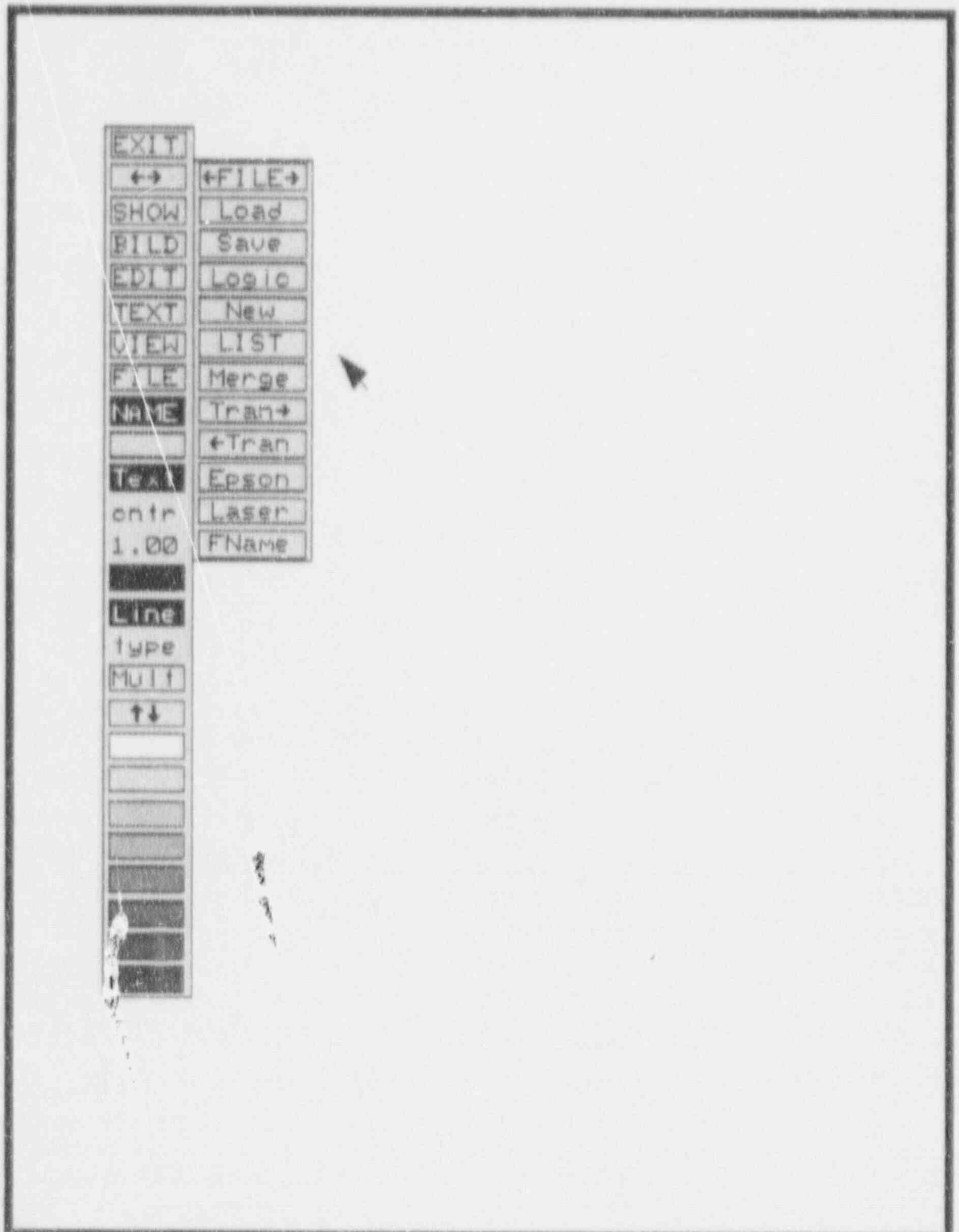


Figure 51. FILE main menu.

5.1.8.1 Load. This FILE suboption allows you to load any Fault Tree File (graphics) with the extension ".DLS" onto the screen. When you invoke this option, you will be prompted to **Enter file name >**. Enter the name of the file you wish to load and press <Enter>. The diagram will appear on the screen. If you do not remember your file name, use the LIST suboption to display all existing files in the current directory.

5.1.8.2 Save. This FILE suboption allows you to save all changes made to the diagram. When you invoke this option you will be prompted to **Enter file name or CR for File ...>**. The default file name will consist of the currently displayed diagram and an extension of .DLS. Enter a new file name if desired, or press <Enter> to save the diagram under the default name. If the default file name already exists (i.e., you have saved your diagram previously), the message **File already exists. Do you wish to replace? Y/N>** will be displayed. If you wish to write the changes over the existing file, type a Y and press <Enter>; otherwise, enter an N.

5.1.8.3 Logic. This FILE suboption allows you to save the logic of the diagram. When you invoke this option, you are prompted to **Enter file name or CR for file XXX >**, where XXX is the file name of the currently displayed diagram. Enter the new file name and press <Enter>. When complete, the message **Logic saved** will be displayed at the bottom of the screen.

5.1.8.4 New. This FILE suboption allows you to essentially cancel your current editing session. All changes made since the last save will not be applied. When you invoke this option, the screen will be cleared and you will be returned to Figure 43.

5.1.8.5 LIST. This FILE suboption displays the list of files currently residing in the default directory. When you invoke this option, a pop-up menu will be displayed showing all the files contained in the current directory. You will be prompted to **Pick the file to load**. Position the cursor over the file to load and press the left mouse button or <Enter>. The file will be loaded and displayed on the screen.

5.1.8.6 Merge. This FILE suboption allows you to merge the contents of two files into a single file. When you invoke this option, a pop-up menu will be displayed showing all the files contained in the current directory. You will be prompted to **Pick the file to load**. Position the cursor over the file to merge into the currently displayed diagram and press the left mouse button or <Enter>. Next, you will be prompted to **Pick location for the top center of merged file**. Position the cross hair at the desired location and press the left mouse button or <Enter>. The screen will be cleared and then reshown with the merged files displayed.

5.1.8.7 Tran→. This FILE suboption allows you to view the drawing defined in the file given in the transfer name.

5.1.8.8 ←Tran. This FILE suboption allows you to view the drawing that define(s) the transfer logic. Transfers allow you to create fault trees consisting of many pages.

5.1.8.9 Epson. This option formats the diagram for an Epson printer and sends it to the local Epson printer.

5.1.8.10 Laser. This option formats the diagrams for a laser printer and sends it to the local laser printer to be printed.

5.1.8.11 FName. This option displays the current file name of the diagram being displayed. When you invoke this option, the file name will be displayed at the bottom of the screen.

5.1.9 NAME

This option allows you to change the defaults for the name symbols. When you invoke this option, Figure 52 will be displayed. Each option is described below.

- Name Col: This option allows you to change the color of the name. When you invoke this option, you will be prompted to **Pick a new color from the color bar**. Position the cursor on the desired color and press the left mouse button. (**NOTE:** The ↑↓ (color) option is active at this time. This option will display the additional color selections available.) The NAME box will change to the new default color.

- Name Size: This option allows you to change the text size of the name. When you invoke this option, you will be prompted to **Enter text size >**. As mentioned earlier, text sizes are indicated by a number between 0.01 and 66.00, with 66 being the full 66 lines from the top to the bottom of the screen. This roughly corresponds to the 66 lines on a full sheet of regular paper. Enter the desired text size and press <Enter>.

- Dflt Gate: This option allows you to assign a default name to the gate. When you invoke this option you will be prompted to **Enter gate default name >**. Enter the name (up to 11 characters are allowed) and press <Enter>.

- Dflt Event: This option allows you to assign a default name for an event. When you invoke this option you will be prompted to **Enter event default name >**. Enter the desired name (up to 11 characters are allowed) and press <Enter>.

5.1.10 Text

This option allows you to set a default color for the text in your diagram. To invoke this option position the cursor over the Text box and press the left mouse button. You will be prompted to **Pick a new color from the color bar**. Position the cursor on the desired color box and press the left mouse button. (**NOTE:** The ↑↓ (color) option is active at this time. This option will display the additional color selections available.) All text will now be displayed in this color. If the diagram already exists, only the new text will be displayed in the new color. You must return to the ATTRIBUTES option to change the existing text color (if desired).

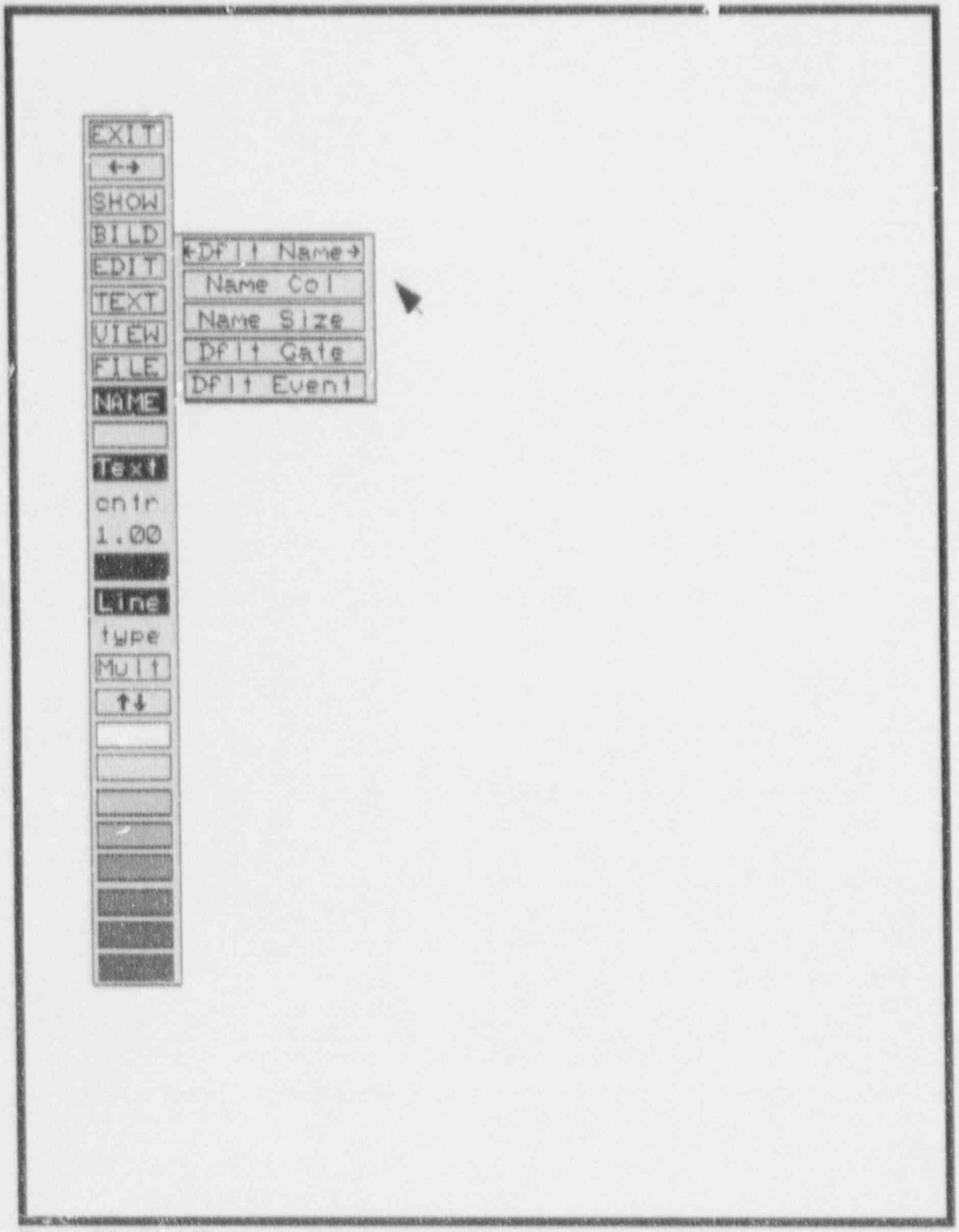


Figure 52. NAME menu options.

5.1.11 cntr/left/right

This option allows you to set the justification for your diagrams. Justification is where the text will be placed offset from the placement point. This works as a toggle switch. To change justification, position the cursor over the cntr (default) box and press the left mouse button or the <Enter> key. You will see the box change from cntr to rght (right). Press the left mouse button or <Enter> key again, and the box will change from rght to left.

Left justification means the text will be anchored at the left bottom corner, or the text will flow to the right of where it was placed. Center justification means the text will be centered about the placement point. Right justification means the text will be placed to the left of the placement point. Set the toggle for the desired justification.

5.1.12 Text Size (0.50)

This option allows you to set a default text size for your diagrams. The default value is .5. Text size ranges from .001 to 9.0. For the purpose of writing text in gate blocks, a text size of about 0.5 is appropriate. The size looks too small on the screen, but it is a good size for sending to a laser printer. **REMEMBER**, here you are setting the default text size. You may always change the text size for special text by invoking the ATTRIBUTES option, under the EDIT command.

5.1.13 Fill

This option allows you to select a color for the drawing symbols. When you invoke this option you will be prompted to **Pick a new color from the color bar**. Position the cursor over the desired color and press the left mouse button. (**NOTE:** The ↑↓ (color) option is active at this time. This option will display the additional colors available.) The Fill box will change to the newly selected color. All drawing symbols created in your new diagram will be displayed in this selected color. If you modify an existing drawing, the symbol colors won't change. To change the color of existing symbols you must invoke the ATTRIBUTES suboption from the EDIT option.

5.1.14 Line

This option allows you to select a color for the lines that connect the text and symbols in the diagram. When you invoke this option you will be prompted to **Pick a new color from the color bar**. Position the cursor over the desired color and press the left mouse button. (**NOTE:** The ↑↓ (color) option is active at this time. This option will display the additional color selections available.) The Line box will change to the selected color. All lines generated in your new diagram will be this selected color. Again, if you are modifying an existing drawing the lines won't change to this color. To change existing lines to the new color you must invoke the ATTRIBUTES suboption for the EDIT option.

5.1.15 type

This option allows you to set a default line type for your diagrams. When you invoke this option, a small window appears displaying the three line types (solid, broken, and dotted). To select a line type, position the cross hair over the desired line type and press the left mouse button. All lines drawn in your new diagram will be of this type. If you have an existing drawing that you are modifying, remember - the existing lines do not change. To change existing lines you must access the ATTRIBUTES suboption under the EDIT option.

5.1.16 Mult

This option allows you to toggle between multiple pick and single pick. The multipick option allows you to continue with a given process until terminated. For example, when creating an "AND" gate, the symbol will reappear after each placement until you cancel the process by pressing the right mouse button. If sing[illegible] (sngl) is turned on, the user must return to the menu and select "AND" again after each placeme[illegible]

5.1.17 Scroll Color Bar (↑ ↓)

This option allows you to scroll the color bar to display the additional color selections available. Position the cursor on the color bar scroll box (up and down arrow, and press the left mouse button or <Enter> key. The next series of available colors will be displayed.

5.2 Plot Trees

This option allows you to plot graphics. When you invoke this option, Figure 53 will be displayed. All available plot files are displayed. The following options are available:

Exit	-	Returns you to Figure 42.
Plotter	-	Sends the specified file to the plotter.
Hpgl File	-	Generates an HPGL formatted file.
Raster File	-	Rasterizes a selected fault tree diagram for printing (highest quality - 300 dpi).
Low Resolution Raster	-	Rasterizes a selected fault tree for printing (lower quality - 150 dpi).

In addition, the following function keys are available for the remaining options presented in this section:

<Esc>	-	Returns you to the previous screen.
<F1>	-	Displays on-line help messages.
<F2>	-	Marks a file for further processing. When you mark a file, an asterisk will appear in front of the file name.

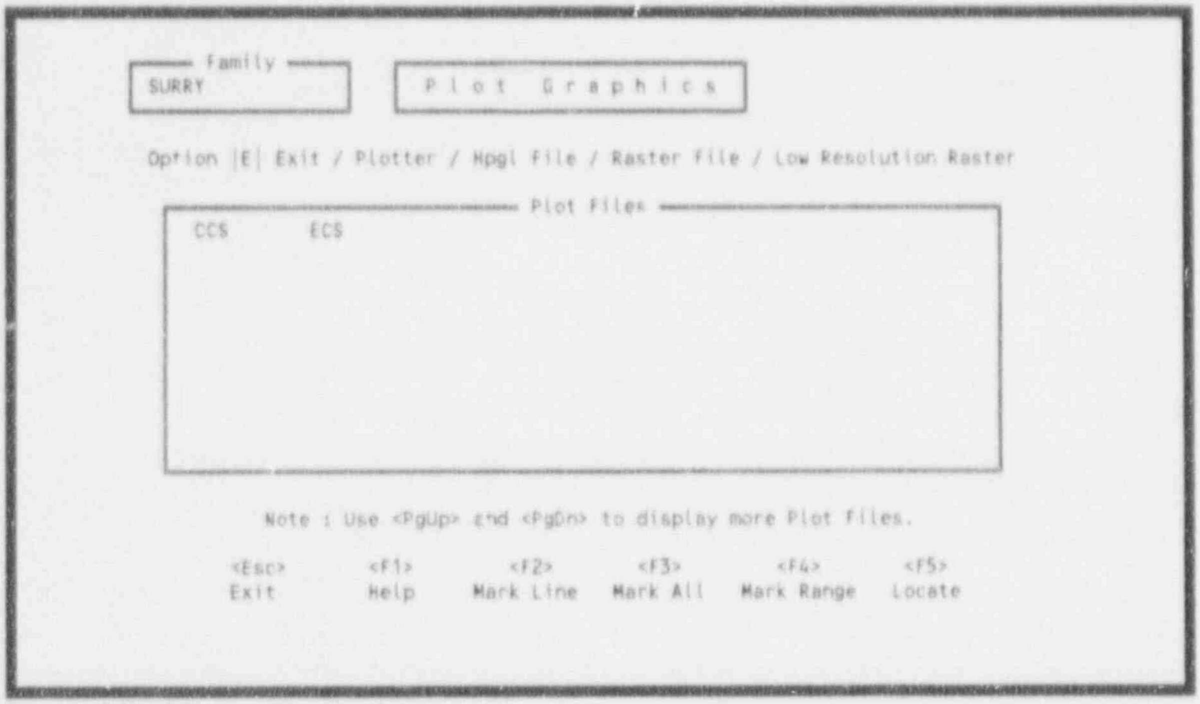


Figure 53. HP plot files display screen.

<F3>	-	Marks all the displayed files for further processing.
<F4>	-	Allows you to mark a range of files for further processing.
<F5>	-	Allows you to locate a specific file for further processing. When you invoke this function, Figure 54 will be displayed. Enter the file name to locate and press <Enter>. The specified file will be highlighted. If the file name does not exist, then the next name in alphabetical order will be highlighted.

5.2.1 Plotter

This option takes the .DLS files generated in the HP Plotter option in the graphics editor (Build) and sends it to the HP Pen Plotter (7475). If a plotter is not defined, you will receive the message **Plotter not attached**.

5.2.2 Hpgl Files

This option creates .HPG files. An .HPG file may be printed using the batch program PLOTHPG. Once the *.HPG file is created, exit IRRAS and return to the PRADATA.B1\XXXXXX subdirectory. At this point, you must type the following command:

..\PLOTHPG *.HPG

where

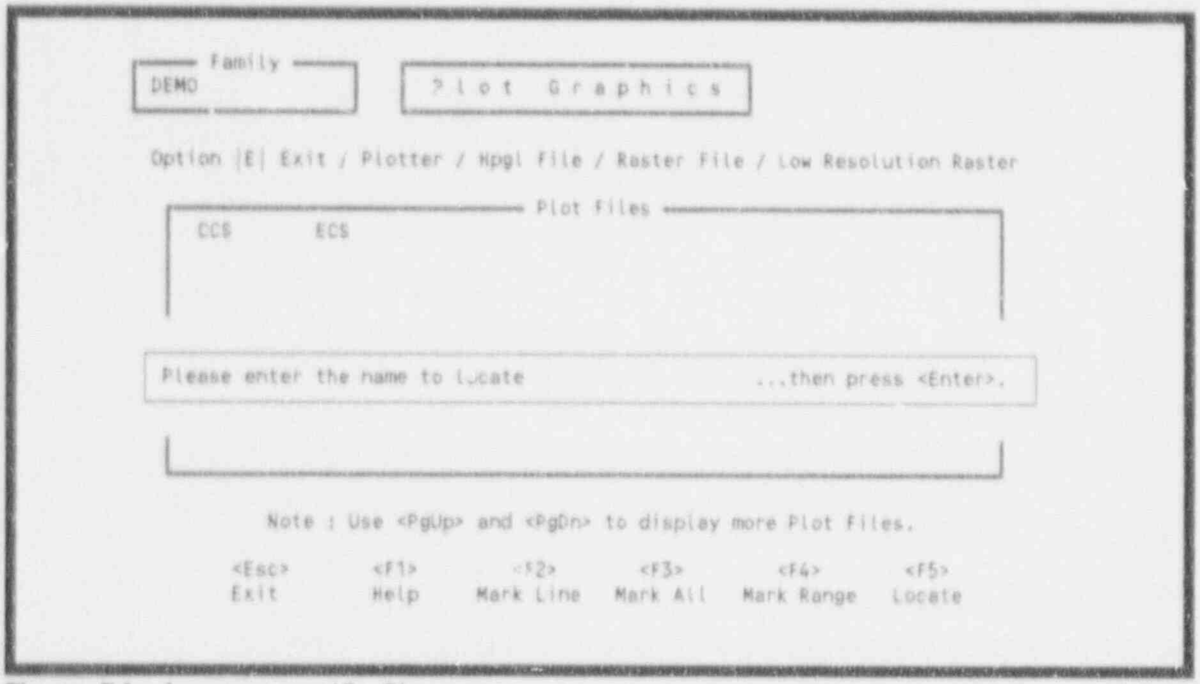


Figure 54. Locate a specific file prompt.

* = wild card specification used to spool all .HPG files contained in the specified directory. If you do not wish to print all *.HPG files, you may specify an individual file.

NOTE: PLOTHPG will only work on an HP LaserJet III or IIIP.

5.2.3 Raster File

This option allows you to rasterize fault tree diagrams for printing. Obtaining a "laser printed" output of a fault tree diagram is done in two steps. First, you must select the drawings to rasterize. Once the drawings have been rasterized, you must exit the program and return to the PRADATA.B1\XXXXXX subdirectory. At this point, you use the PLOTRAS batch program to send the files to the laser printer. The command to invoke this batch program is:

..\PLOTRAS *.RAS.

(See 5.2.2 for where list definition).

NOTE: PLOTRAS will work on any laser printer.

This option rasterizes the selected fault tree to 300 dots per inch (dpi). This option provides you with the highest quality of output available. To invoke this option, enter an <R> in the option field, highlight or mark the file(s) to rasterize, and press <Enter>. A percent complete message will be displayed so you can track the progress of the rasterizing. When complete, a message will be displayed notifying you that the raster image has been created.

5.2.4 Low Resolution Raster

This option rasterizes the selected fault tree to 150 dpi. To invoke this option, enter an <L> in the option field, highlight the file(s) to be rasterized, and press <Enter>. A message will be displayed telling you that the rasterizing is being performed. A percent complete will also be displayed so you can track the progress of the rasterizing. When complete, a message will be displayed notifying you that the raster image has been created.

5.3 Load Graphic Trees

This option allows you to load graphic files. When you invoke this option, Figure 55 will be displayed. As shown, two options are available: Exit and Load.

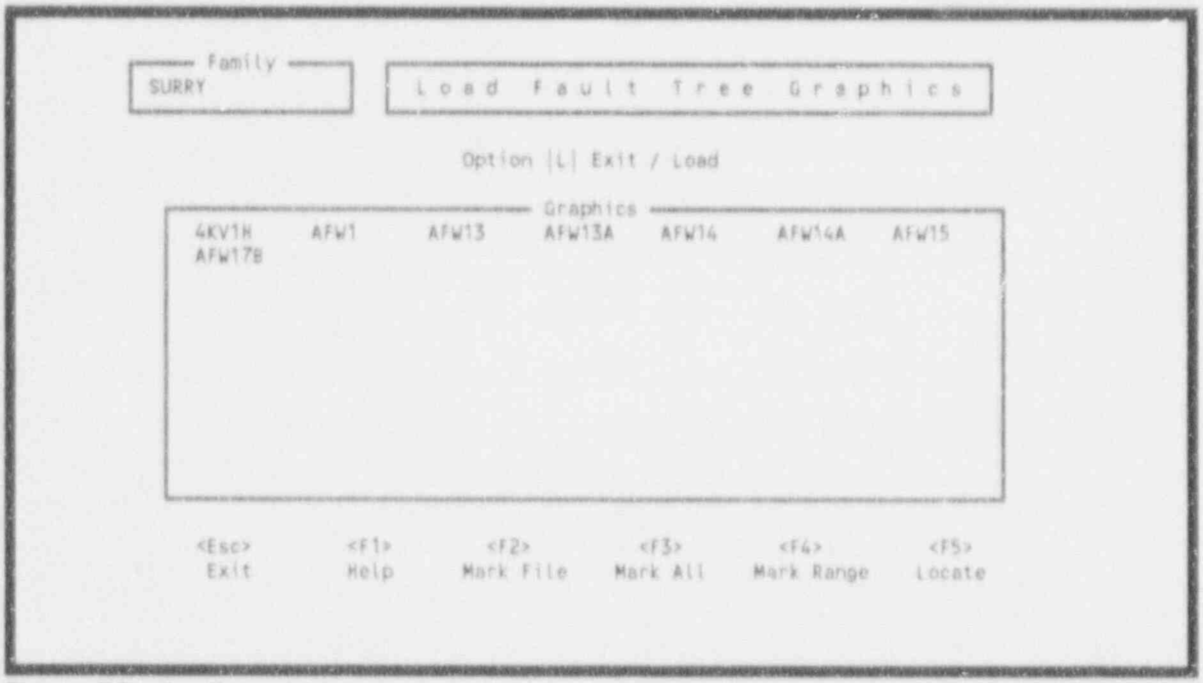


Figure 55. Load graphics tree screen.

5.3.1 Exit

This option returns you to the previous screen (Figure 42). To invoke this option, enter an <E> in the option field and press <Enter>, or press the <Esc> key.

5.3.2 Load

This option allows you to load graphics into the system. A conversion of the selected file will be performed. To invoke this option, enter an <L> in the option field, highlight the file or mark the files to be loaded using the function keys, and press <Enter>. A message will be displayed telling you that the selected file(s) is being converted.

5.4 Alpha to Graphics

This option allows you to convert the alphanumeric logic for a system or subsystem to a graphical format. Use this option when you define the fault tree logic with an ASCII file or use the logic editor to change the logic for a fault tree. The graphics and logic information for a fault tree are two separate entities, therefore, a conversion must be made if any changes are made to the alphanumeric logic. However, if changes are made to the graphics representation, the changes are automatically reflected in the alphanumeric logic. When you invoke this option, Figure 56 will be displayed. As shown, two options are available: Exit and Convert.

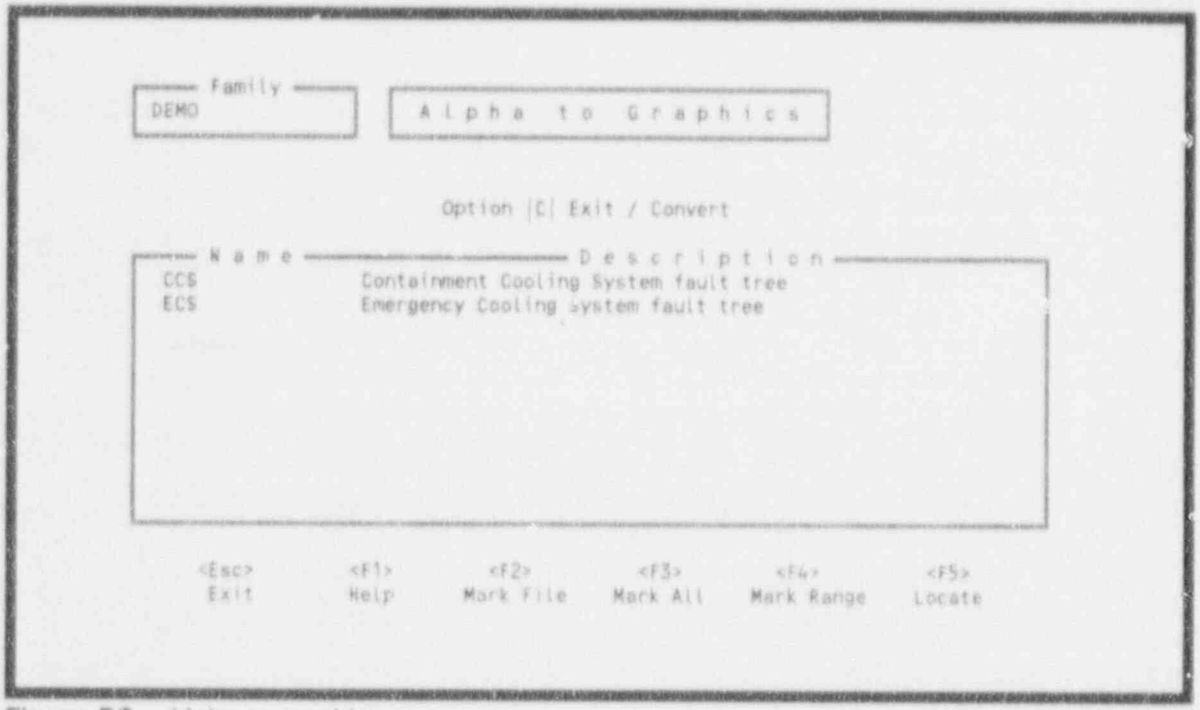


Figure 56. Alpha to graphics screen.

5.4.1 Exit

This option returns you to the previous screen (Figure 42). To invoke this option, enter an <E> in the option field and press <Enter>, or press the <Esc> key.

5.4.2 Convert

This option allows you to convert an alpha file(s) to a graphical format. To invoke this option, enter a <C> in the option field, highlight the file (using the arrow key) or mark the files (using the function keys) you wish to convert. A small window will appear at the top of the screen (as shown in Figure 57). Two prompts are displayed asking you whether you want to use tables and/or boxed events in the newly created graphic file. Enter a Y or N. Press <Enter> when complete. A message will appear notifying you that the graphics image has been created.

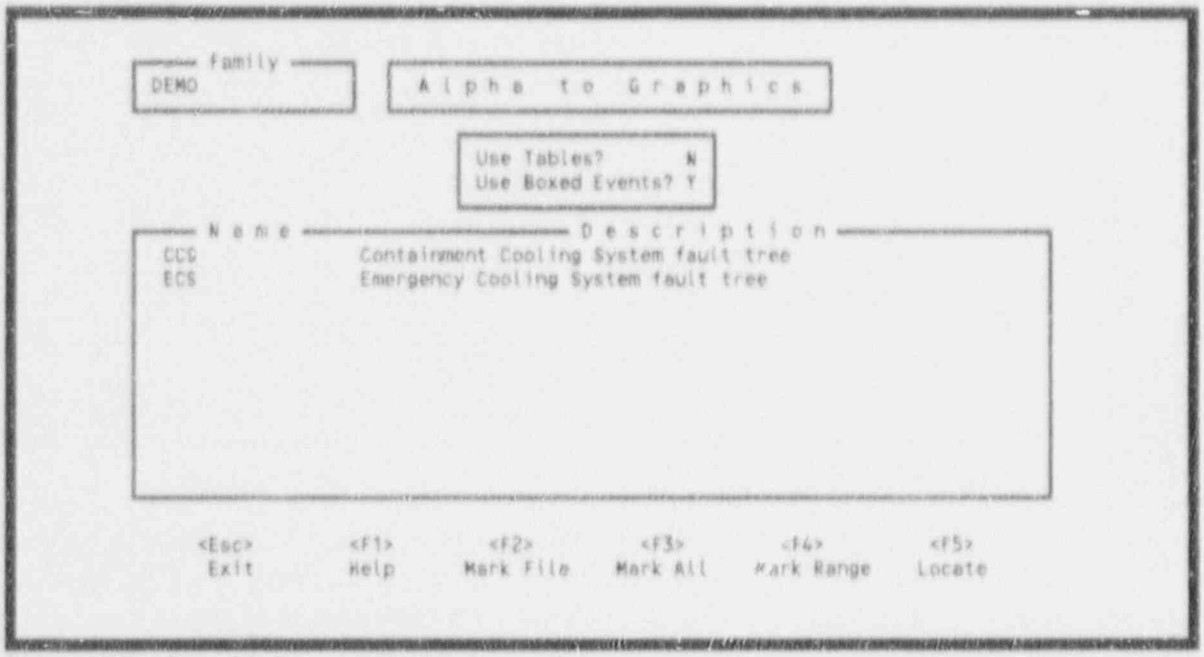


Figure 57. Set table/box toggle for conversion.

5.5 Graphical Pager

This option allows you to break up larger drawings into many pages or smaller drawings. When you invoke this option, Figure 58 is displayed. Each menu option is discussed in the following paragraphs.

5.5.1 Exit

This option returns you to the previous screen (Figure 42). To invoke this option, enter an <E> in the option field and press <Enter> or press the <Esc> key.

5.5.2 Page

This option invokes the paging options. To invoke this option, enter a <P> in the option field, highlight the file to page, and press <Enter>. Figure 59 will be displayed. As shown, seven options are available. Each option is discussed in the following paragraphs.

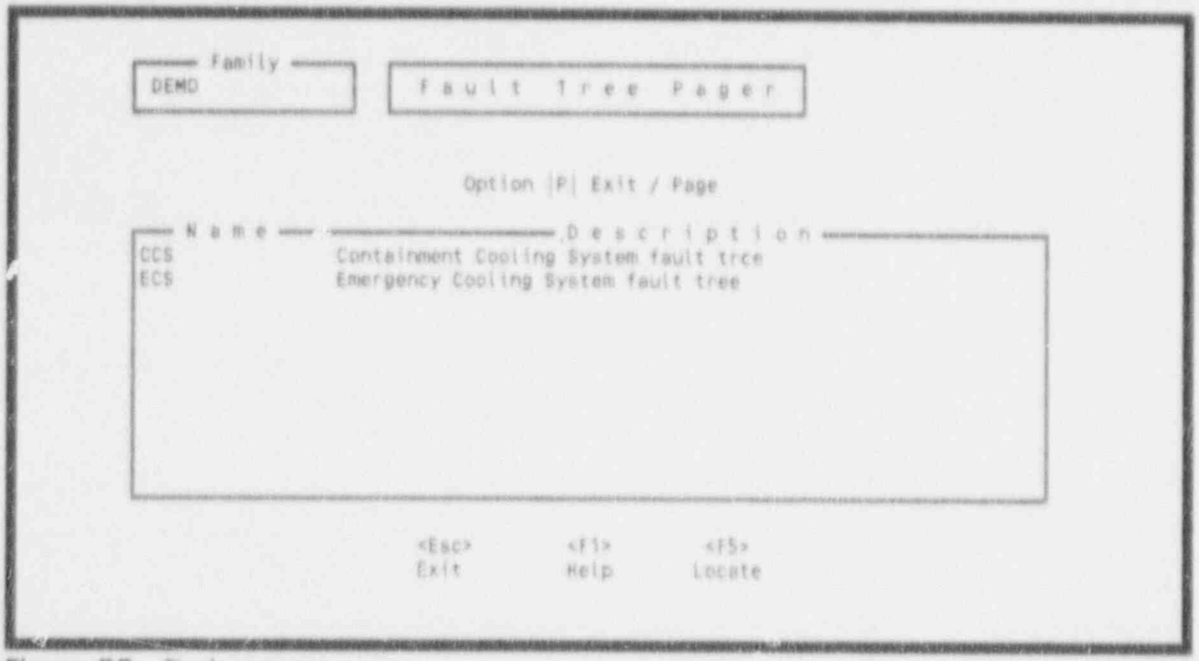


Figure 58. Fault tree pager menu.

5.5.2.1 ←PAGE→. This option allows you to move the menu to another location on the screen. To invoke this option, position the cursor on the ←PAGE→ box and press the left mouse button. An outline box will appear. Move the box to the desired location and press the [illegible] mouse button again. The pop-up menu will be displayed at the new location.

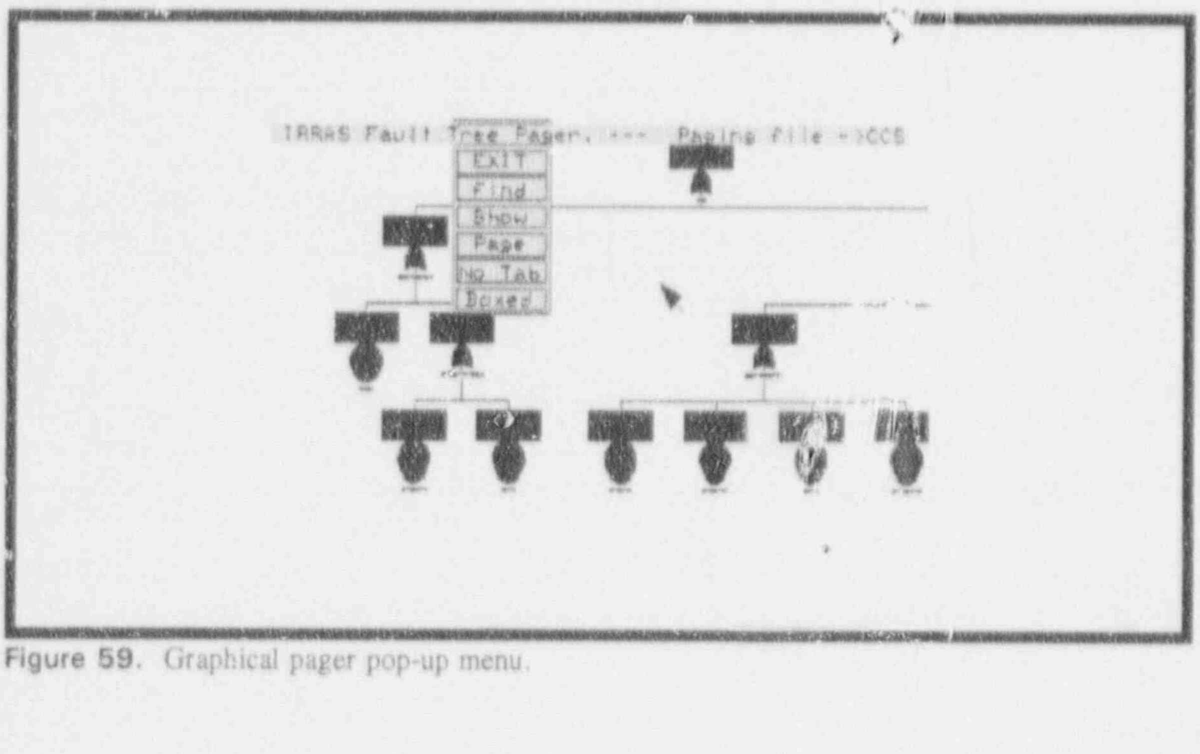


Figure 59. Graphical pager pop-up menu.

5.5.2.2 Exit. This option returns you to the previous screen (Figure 58). To invoke this option, enter an <E> in the option field and press <Enter>, or press the <Esc> key.

5.5.2.3 Find. This option allows you to locate a specific event or label on the diagram. When you invoke this option, you will be prompted to **Enter name >**. Enter the name you wish to locate and press <Enter>. The symbol containing the entered name will be highlighted with a broken dotted line. The dotted line will remain until you invoke another option.

5.5.2.4 Show. This option allows you to display the labels in a readable format. When you invoke this option, you will be prompted to **Pick a shape**. Position the cross hair on the desired shape and press the left mouse button. The event or label will be displayed at the bottom of the screen. At this point you may position the cross hair on another symbol or shape or press the right mouse button to terminate the process.

5.5.2.5 Page. This option allows you to insert or transfer a page break in your diagram. When you invoke this option you will be prompted to **Select a Gate for the desired page break**. Position the cross hair at the appropriate gate and press the left mouse button. The page break will be created. At this point you may create another page or press the right mouse button to terminate the process.

5.5.2.6 Table/No Tab. This option toggles generation of "tables" rather than "basic events." To toggle, position the cursor on the Table box and press the left mouse button. The menu will be redisplayed and the Table box will now read No Tab (basic events).

5.5.2.7 Boxed/No Box. This option toggles generation of "boxed basic events" rather than "basic events." To toggle, position the cursor on the Boxed option and press the left mouse button. The menu will be redisplayed and the Boxed option will now read No Box (basic events).

5.6 eXtract Fault Trees

This option allows you to extract fault trees from the data base. When you create a fault tree diagram and save it, the .DLS file is saved in the data base as well as in a temporary .DLS file. When you delete the temporary .DLS file, the file still exists in the data base. This option allows you to extract the .DLS file from the data base. When you invoke this option, Figure 60 will be displayed. On this screen all the fault trees residing in the current directory are displayed. Four options are available: Exit, eXtract Trees, Clear Extracted Trees, and Display Extracted Trees.

5.6.1 Exit

This option returns you to the previous screen (Figure 42). To invoke this option, enter an <E> in the option field and press <Enter>, or press the <Esc> key.

5.6.2 eXtract Trees

This option allows you to remove specific trees from the data base. To invoke this option, enter

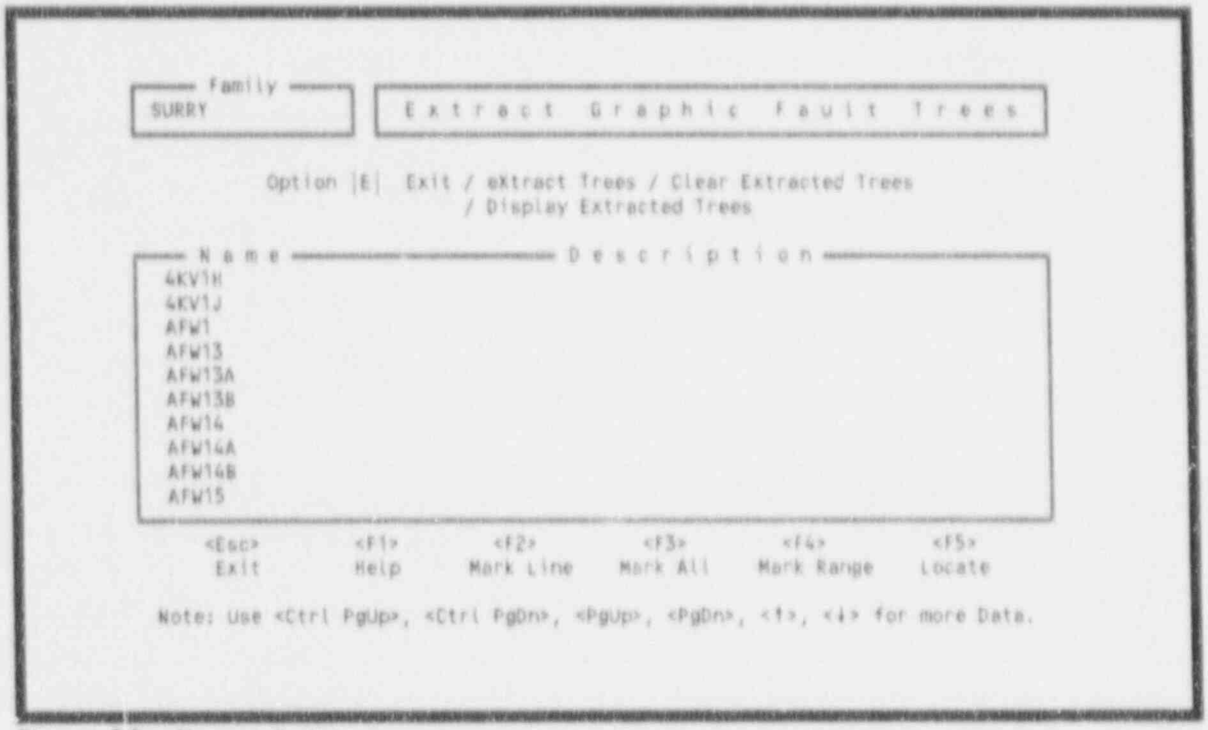


Figure 60. Extract fault trees screen.

an <X> in the option field, highlight the tree to be extracted or mark the trees to be extracted (using the function keys) and press <Enter>. A message will be displayed notifying you that the tree(s) was successfully extracted.

5.6.3 Clear Extracted Trees

This option allows you to clear all extracted trees from a file. To invoke this option, enter a <C> in the option field, highlight the file to be cleared or mark the files using the function keys, and press <Enter>. A warning screen will appear (Figure 61) telling you that all existing *.DLS files will be deleted. Enter a <Y> to delete or an <N> to terminate the process. Remember, this deletion only deletes the extracted picture file. The picture file will still reside in the data base.

5.6.4 Display Extracted Trees

This option allows you to display all the extracted trees to date. To invoke this option, enter a <D> in the option field and press <Enter>. A screen similar to the one shown in Figure 62 will be displayed. Press <Enter> to return to the previous screen.

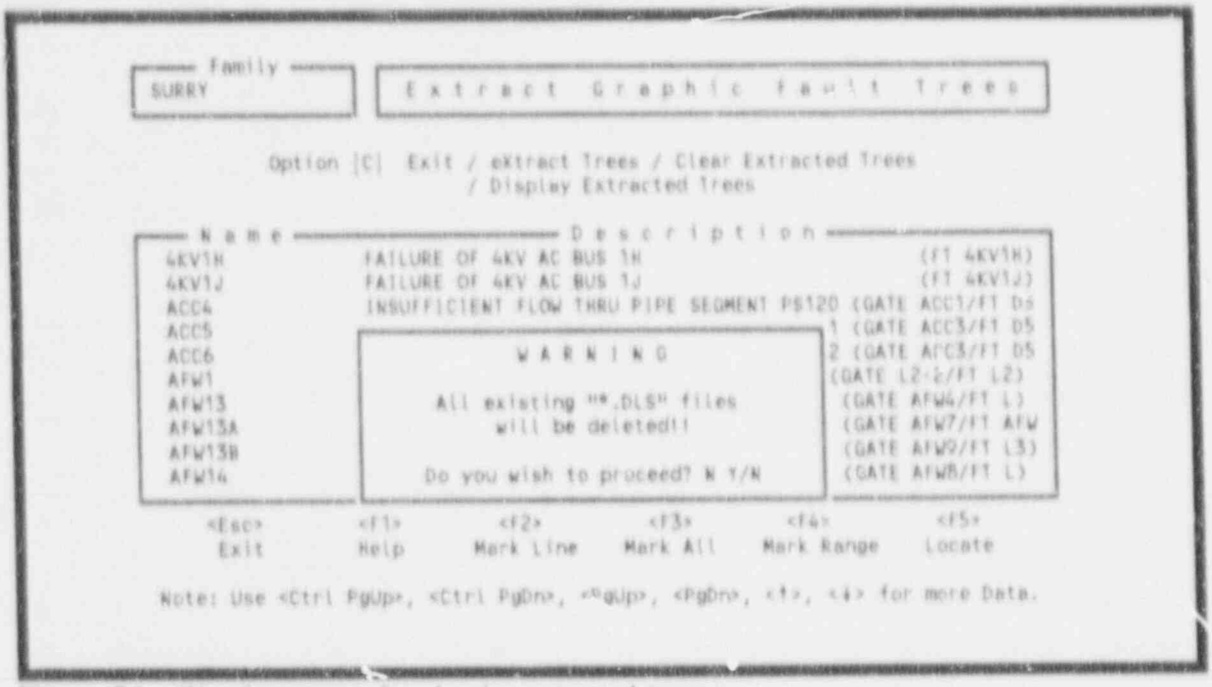


Figure 61. Warning screen for clearing extracted trees.

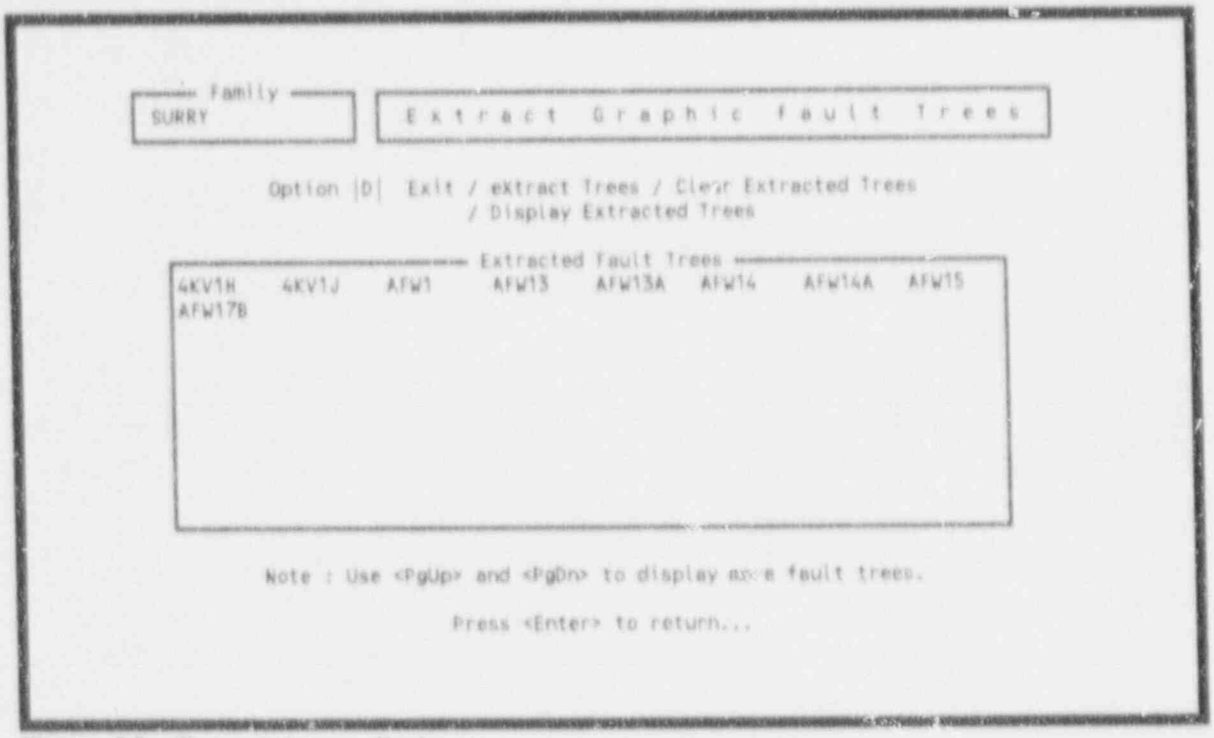


Figure 62. Extracted trees display.

5.7 Define Plotter Pens

This option allows you to assign colors to the plotter pens. When you invoke this option, a screen will be displayed showing 16 colors. Select the color to be mapped by positioning the cross hair over the desired color and pressing the left mouse button. You will then be prompted to **Enter number of pen >**. Enter the number of the pen that will contain the selected color. Continue this process until all pens have been defined. To terminate the process, position the cursor on the STOP symbol and press the left mouse button.

6.0 FAULT TREE ANALYSIS

The Fault Tree Analysis option consists of the following four functions.

1. Analyze Systems includes updating the cut sets, quantifying the cut sets, and running uncertainty analyses.

2. Display Results presents the analyses in various report forms.

3. The Cut Set Editor provides the means to modify the fault tree cut sets.

4. Logic Editor provides a means for editing the fault tree logic in an alphanumeric format.

Keys that you will frequently use are

<Esc>	Escape cancels your last choice and returns you to the previous screen.
<F1>	Help briefly explains the function of a field and may show you examples of data entered.
<F2>	Mark/Unmark 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/Unmark range of items tags large numbers of items for processing.
<F5>	Locate an item displays a blank field in the center of the screen, and a message **Please enter name to locate** will appear. The user should enter all or part of 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.

To invoke this option, highlight FAULT Tree Analysis and press <Enter>. The fault tree analysis main menu is shown in Figure 63. The options available from the fault tree analysis main menu are: Exit, Analyze Systems, Display Results, Cut Set Editor, and Logic Editor. These options and their functions are discussed in the following paragraphs.

6.1 Exit

The Fault Tree Analysis screen appears with Exit <E> as the default choice in the command line (see Figure 63). Press <Enter> to return to the IRRAS main menu.

6.2 Analyze Systems

This option provides the means to recalculate system values after events and/or cut sets have been modified. To invoke the option, highlight Analyze Systems or type <A> in the option field, and press <Enter>. Figure 64 shows the main screen for system analysis that lists the systems defined for the current family. The letters c, q, and u (in any combination) may precede a system name and are defined

```
Family
SURRY                    F a u l t   T r e e   A n a l y s i s

                         Exit

                         Analyze Systems

                         Display Results

                         Cut Set Editor

                         Logic Editor

                         Option [D]
```

Figure 63. Fault tree analysis main menu.

```
Family
SURRY                    A n a l y z e   S y s t e m s

Option [E]  Exit / Generate Cut Sets / Cut Set Update / Quantification
            Monte Carlo Uncertainty / Latin Hypercube Uncertainty

N a m e                  D e s c r i p t i o n
c u C                    CONTAINMENT SPRAY
    CS                   CONTAINMENT SYSTEMS
c   CV                   CORE VULNERABLE TO CD
    D1                   HIGH PRESSURE INJECTION - AUTOMATIC
c u D2                   HIGH PRESSURE INJECTION - MANUAL
cqu D3                   HIGH PRESSURE INJECTION - RCP SEALS
cqu D4                   HIGH PRESSURE INJECTION - EMERGENCY BORATION
cqu D5                   ACCUMULATORS
cqu D6                   LOW PRESSURE INJECTION
cqu F1                   INSIDE SPRAY RECIRCULATION

<Esc>     <F1>     <F2>        <F3>       <F4>         <F5>
Exit      Help     Mark Line   Mark All   Mark Range   Locate
```

Figure 64. System analysis main menu.

as follows:

c - flags the system as having cut sets that must be recalculated
q - flags the system as having cut sets that must be requantified
u - flags the system as needing uncertainty distributions recalculated.

Once these functions have been executed the corresponding letter is removed from the display. The options available from the Analyze Systems screen are Exit, Generate Cut Sets, Cut Set Update, Quantification, Monte Carlo Uncertainty, and Latin Hypercube Uncertainty.

IRRAS writes the summary information generated during analysis to a file that the user can read to determine the results of a batch operation involving several systems or sequences. This file is called "SCREEN.CPY." When either Analyze Systems or Analyze Sequences is executed, IRRAS deletes a file in the current family subdirectory called "SCREEN.OLD." The file "SCREEN.CPY" is then renamed to "SCREEN.OLD." The summary screens for any operations performed during this session (using the Analyze option) are then written to the file "SCREEN.CPY." The user may exit IRRAS, change to the specified subdirectory, and print, edit, or review this file.

6.2.1 Exit

To return to the Fault Tree Analysis menu, type an <E> (Exit) in option field and press <Enter>, or press the <Esc> key.

6.2.2 Generate Cut Sets

This option allows you to generate the cut sets for a selected system based on cut set generation cutoff values. You are given the opportunity to specify several cut set generation cutoff values that will be used to determine if a cut set is to be retained or discarded from the selected system.

You are given the ability to generate cut sets for a selected system, a group of systems, or all systems within the current family. To invoke the Generate Cut Sets for a single selected system, type <G> (Generate Cut Sets) in the option field, highlight the desired system, and press <Enter>. To invoke this process for a group of systems, mark the desired systems using the function keys F2, F3, and F4, type a <G> in the option field, and press <Enter>. To invoke this option for all systems in the current family, clear all marked entries with the F3 key, type <G> 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 Generate Cut Sets for all records that need processing (e.g., for <G> the systems must have a "C" in front of the name, etc.), or type an <N> to terminate the update for all systems.

Whether you are generating cut sets for a single system, a group of systems, or for all systems the Cut Set Generation Cutoff Values screen shown in Figure 65 will be displayed. You may change any of the data fields on this screen. Each field is described below. The default values that appear on this screen may be reset to new values by selecting the Utility Options from the IRRAS main menu and then invoking the Define Constants option.

Perform Cut Set Prob Truncation?	If you enter a <Y>, then the only cut sets whose product for all of its event probabilities is greater than or equal to the value in the Cutoff Value field will be kept. All other cut sets will be removed. If you enter an <N>, then the probability for the cut set will not be relevant for determining if the cut set should be retained or discarded.

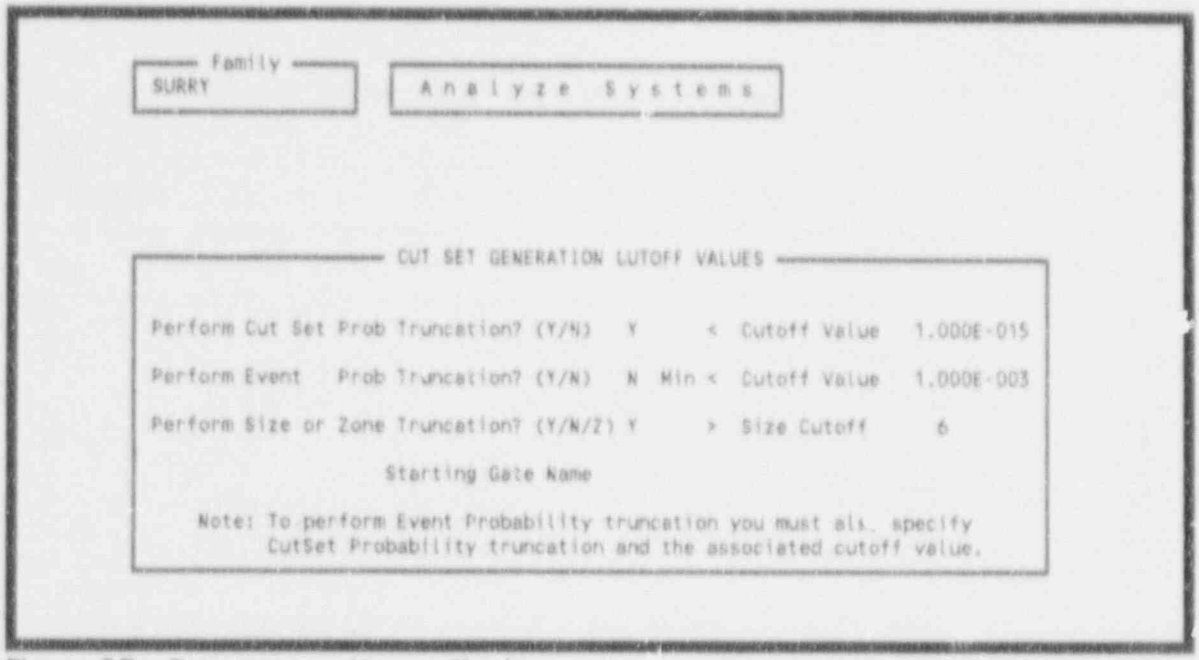


Figure 65. Cut set generation cutoff values.

Perform Event Prob Truncation	-	If you enter a <Y>, then you must also enter <Y> for "Perform Cut Set Prob Truncation." This option will check all cut sets that are below the probability cutoff (Min < Cutoff Value field) and remove them only if they contain an event whose probability is below this value.
Perform Size or Zone Truncation?	-	If you enter a <Y>, then only the cut sets whose number of events is less than or equal to the value specified in the Size Cutoff field will be kept in the cut sets for that system. All other cut sets will be removed. If you enter an <N>, then the number of events in a cut set will be irrelevant for determining if the cut set should be retained or discarded. If you enter a <Z>, then only zone flagged events will be checked.
Starting Gate Name	-	If you specify a gate in this field, then this gate will be the gate assumed to be the top gate of the tree. If you do not specify a name, the top gate will be determined by finding the gate that is not referenced by any other gate. This is usually the same as the system or subsystem name.

During processing the screen shown in Figure 66 is displayed and updated as the calculations proceed. Upon completion of the cut set generation, the results are displayed as shown in Figure 67.

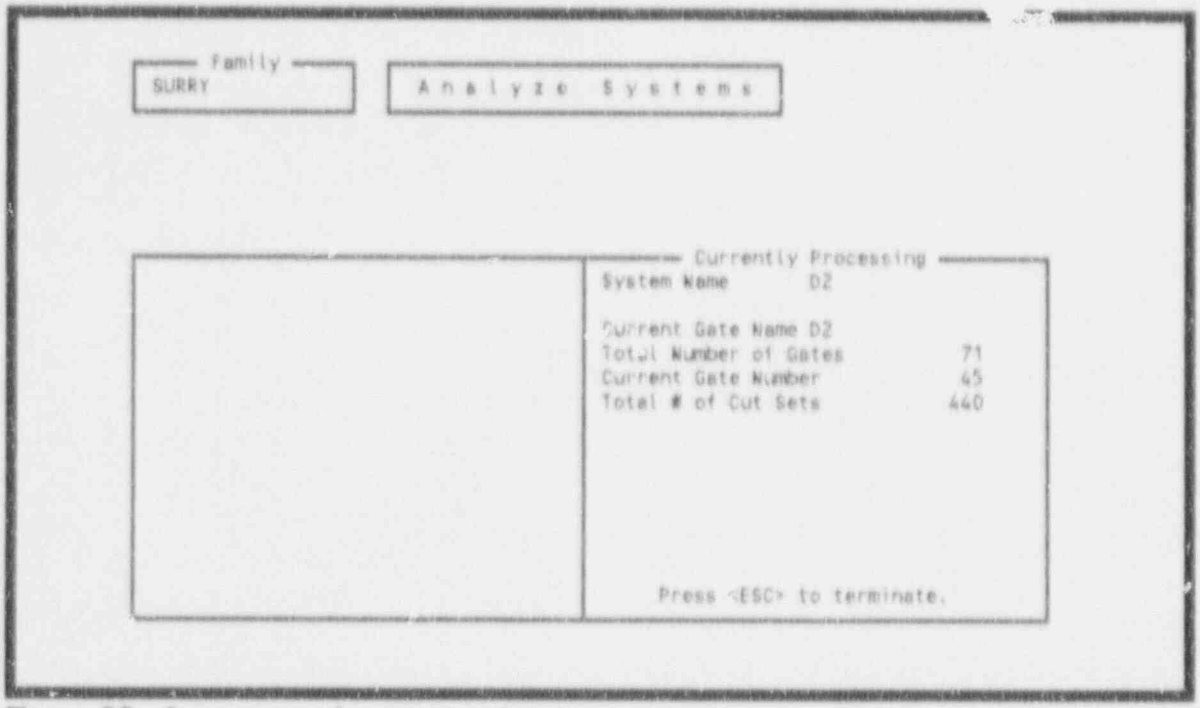


Figure 66. Status screen for cut set update.

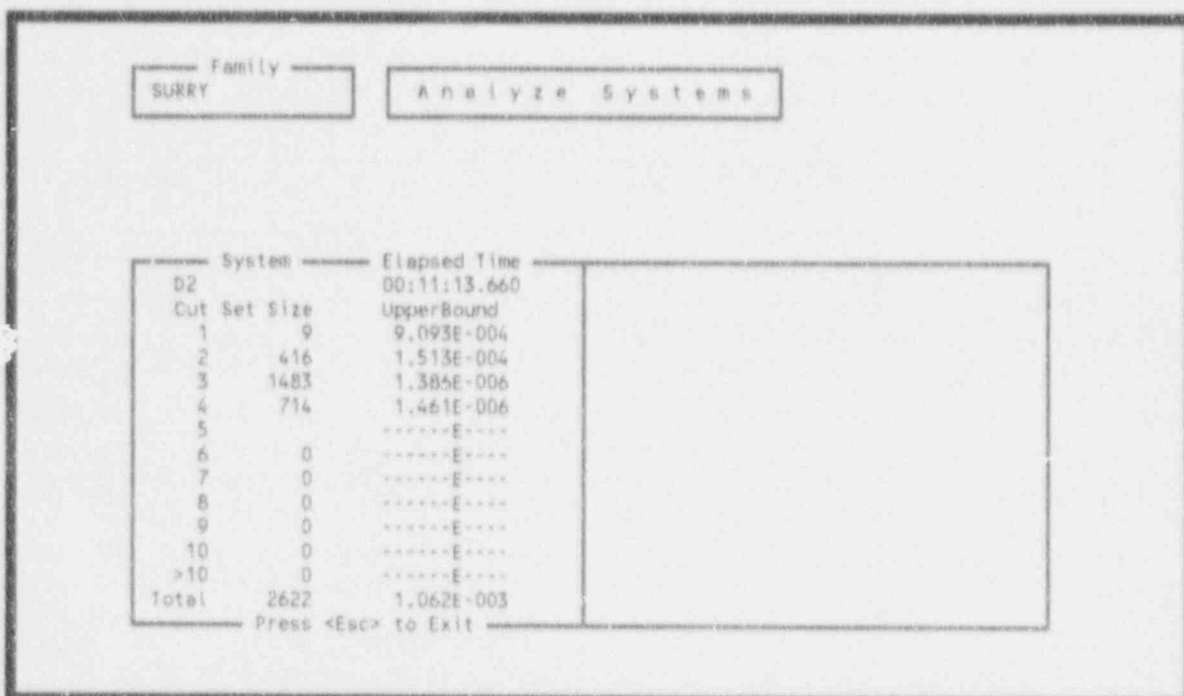


Figure 67. Results of the cut set update.

There is a limit on the number of cut sets that can be stored for a given system. If the number of cut sets generated by this option exceeds this limit, then a message is displayed indicating that cut sets were truncated beyond what the user specified. The screen showing the summary information for all generated cut sets is displayed. When complete, you are returned to Figure 66 where the "c" in front of the processed cut sets will be removed.

6.2.3 Cut Set Update

This option will update the alternate cut sets for a selected system based on cut set generation cutoff values. You are given the opportunity to specify several cut set generation cutoff values that will be used to determine if a cut set is to be retained or discarded from the selected system. You are also given the choice of using either the base case cut sets or the alternate case cut sets as the starting set of cut sets to be updated. The updated version of the cut sets will be saved as the new alternate cut sets for the system.

You are given the ability to update the alternate cut sets for a selected system, the alternate cut sets for a group of systems, or the alternate cut sets for all of the systems within the current family. To invoke the Cut Set Update process for a single selected system, type <C> (Cut Set Update) in the option field, highlight the desired system, and press <Enter>. To invoke this process for a group of systems, mark the desired systems using the function keys F2, F3, and F4, type a <C> in the option field, and press <Enter>. To invoke this option for all systems in the current family, clear all marked entries with the F3 key type <C> 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 Cut Set Update for all of the systems, or type an <N> to discontinue the update for all systems.

Whether you are updating alternate cut sets for a single system, a group of systems, or for all systems the Cut Set Generation Cutoff Values screen shown in Figure 68 will be displayed. You may change any of the data fields on this screen. The default values that appear on this screen may be reset to new values by selecting Utility Options on the IRRAS main menu and then invoking the Define Constants option.

If you type a <Y> in the Perform Pr[illegible] Cutoff field, then only the cut sets whose product f[illegible] all of its event probabilities is greater than or equal to the value in the Cutoff Value field will be kept. All other cut sets will be removed from alternate case cut sets for that system. If you type an <N> in this field, then the probability for the cut set will not be relevant for determining if the cut set should be retained or discarded.

If you type a <Y> in the Perform Cut Set Size Cutoff field, then only the cut sets whose number of events is less than or equal to the value in the Size Cutoff field will be kept in the alternate case cut sets for that system. All other cut sets will be removed. If you type an <N> in this field, then the number of events in a cut set will be irrelevant for determining if the cut set should be retained or discarded.

If you enter a <Y> in the Use Base Case Cut Sets field, then the base case cut sets will be used as the cut sets to be updated and then stored in the alternate case cut sets. However, if an <N> was entered in this field, the alternate cut sets will be used as the cut sets to be updated and then resaved in the alternate case cut sets

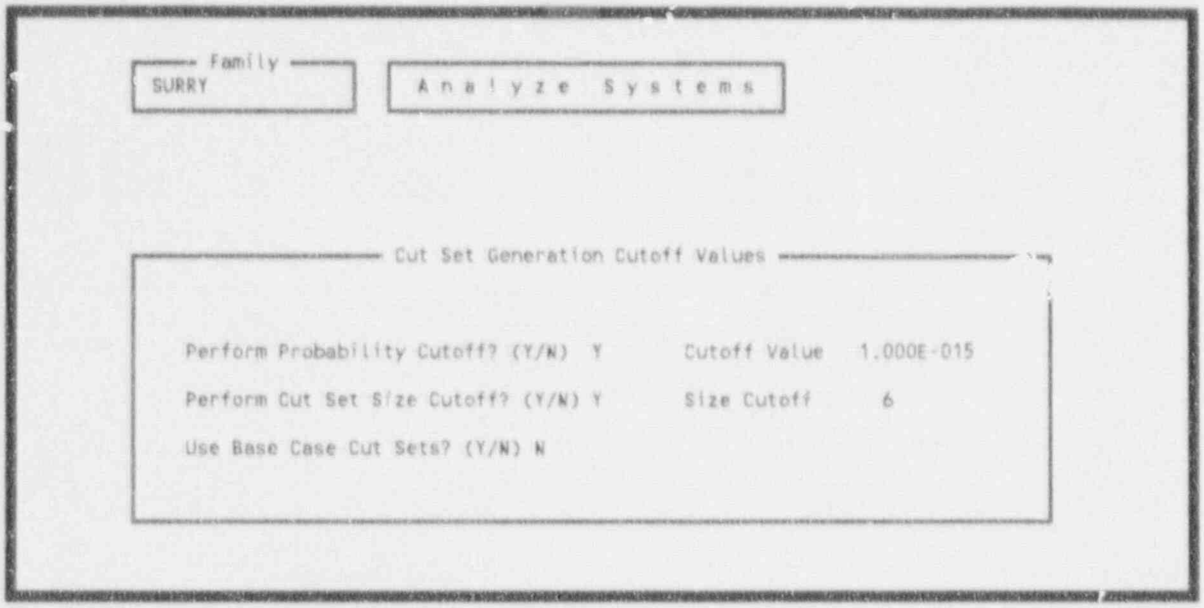


Figure 68. Cut set generation cutoff values.

During processing the screen shown in Figure 69 is displayed and updated as the calculations proceed. Upon completion of the cut set update, the results are displayed as shown in Figure 67. When finished viewing the results, press <Enter> to return to Figure 64.

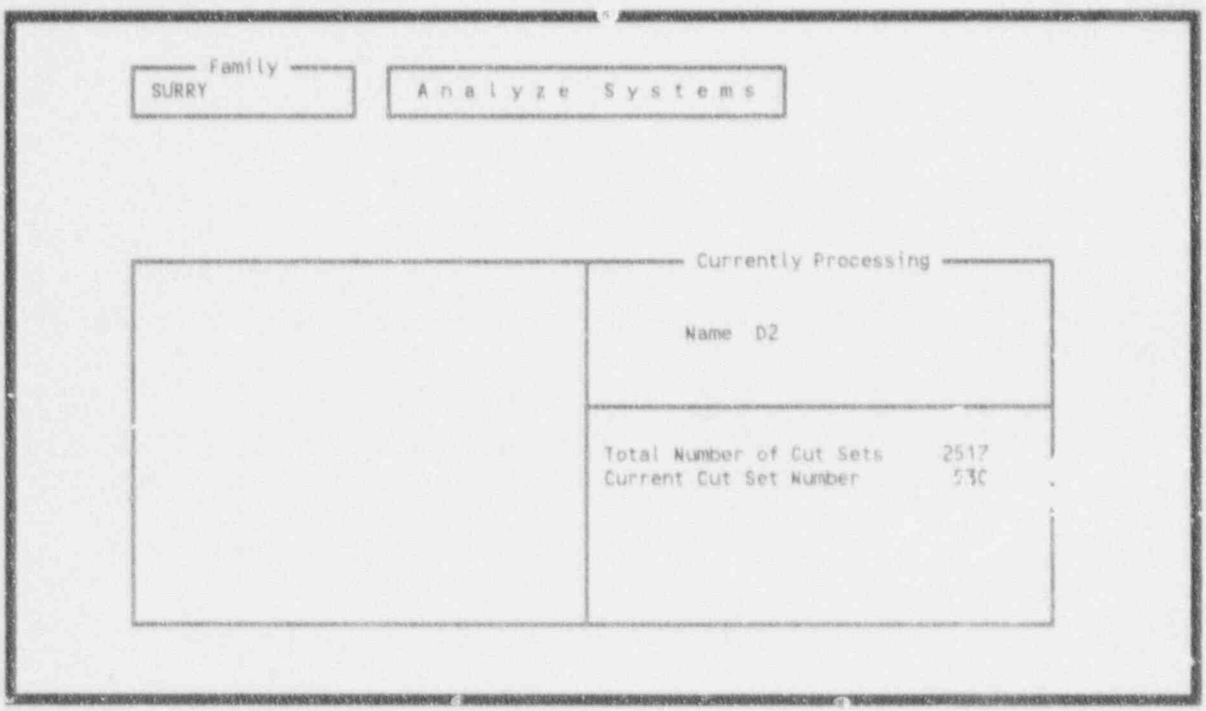


Figure 69. Status screen for cut set update.

The cut set update flag 'c' will then be removed from every system on the Analyze Systems screen in which the cut set update process has been performed. If an error of some kind occurs during the update process then the message **Error in Cut Set analysis** will be displayed at the bottom of the screen. Once the cut sets are updated, they are also automatically quantified and the appropriate "q" flag is cleared.

6.2.4 Quantification

The quantification process will calculate a new minimum cut set upper bound for the system cut sets using the current data values (event change sets and alternate case cut sets). The new minimum cut set upper bound is saved with the alternate case cut sets for the selected system.

You are given the ability to requantify the alternate cut sets for a selected system, for a group of systems, or for all of the systems within the current family. To invoke the Quantification process for a single selected system, type <Q> (Quantification) in the option field of the Analyze Systems screen, highlight the desired system, and press <Enter>. To invoke this process for a group of systems, mark the desired systems using the function keys F2, F3, and F4, type a <Q> in the option field and press <Enter>. To invoke this option for all systems in the current family, type <Q> 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 Quantification process for all of the systems, or type an <N> to discontinue this process.

During processing the message **Quantification in progress** appears at the bottom of the screen. If an error occurs, the message **Error quantifying cut sets** will be displayed at the bottom of the screen.

Upon completion of the quantification process, the results are displayed as shown in Figure 70. The requantify flag 'q' will then be removed from every system on the Analyze Systems screen for which the quantification process has been performed.

6.2.5 Uncertainty Analysis

This option allows you to run an uncertainty analysis on a system using one of the two sampling techniques provided. The two sampling techniques are the Monte Carlo simulation technique and the Latin Hypercube simulation technique.

To use the Monte Carlo sampling technique to obtain an uncertainty analysis for a system or a group of systems, you must type an <M> the option field of the Analyze Systems screen and press <Enter>. However, if you wish to use the Latin Hypercube sampling technique, then type an <L> in the option field and press <Enter>.

You are given the option of running an uncertainty analysis on the alternate cut sets for either a single system, for a group of systems, or for all of the systems within the current family. To invoke this process for a single selected system, type <L> or <M> (Latin Hypercube / Monte Carlo) in the option field, highlight the desired system, and press <Enter>. To invoke this process for a group of systems, mark the desired systems using the function keys F2, F3, and F4, type a <L> or <M> in the option field and press <Enter>. To invoke this process for all systems in the current family, type <L> or <M> 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 uncertainty analysis for all of the

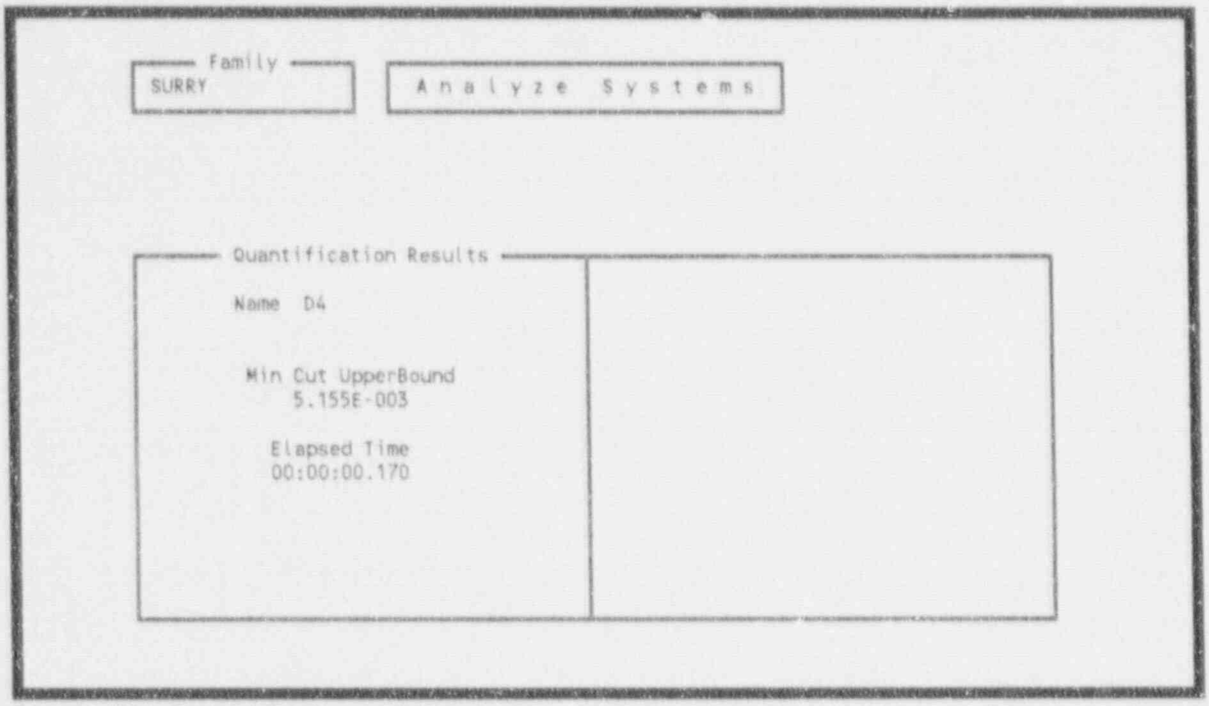


Figure 70. Results of the quantification process

systems, or type an <N> to discontinue the analysis.

Once the sampling technique for the uncertainty analysis has been selected and the desired system(s) selected, the Uncertainty Calculation Values screen will be displayed (see Figure 71 for Monte Carlo sampling). This screen prompts you to enter the number of samples to be generated during the simulation and the initial value of the seed for the random number generator. There will be a default seed in the field for the random seed. You may use this value or enter a new value for the seed. To obtain a random seed from the system clock, you must enter a zero in this field. There will also be a default value in the field for the number of samples. You may use this value or enter another value. You may change the default values for both the number of samples and the random seed in the Utility Options, Define Constants suboption.

When using the Monte Carlo sampling technique for the uncertainty analysis, if the number of samples entered is less than ten, then the number of samples will be increased to ten before the uncertainty analysis process will continue. Any number of samples greater than or equal to ten will be allowed, but a number of at least 1000 is probably a better value for improving the reliability of the Monte Carlo results.

When using the Latin Hypercube Sampling (LHS) technique, if the number of samples entered is less than twice the total number of unique events in the system, then the number of samples will be increased to two times the total number of unique events before the analysis will continue. The LHS technique gives its best results if the number of samples is at least twice the total number of unique events.

```
Family
SURRY                      A n a l y z e   S y s t e m s


         Monte Carlo Uncertainty Calculation Values

  Number of samples to use in Monte Carlo simulation     1000

  Seed for random number generator                          0

NOTE: Use "0" as the seed to get a random seed from the clock.
                  Press <Enter> to continue...
```

Figure 71. Monte Carlo calculation values.

Once the number of samples has been accepted and a seed obtained from the system clock (if necessary), checks will be run to ensure the events with the same correlation classes have consistent failure data, uncertainty data, and distribution types. If any events with inconsistencies exist, an error message will be displayed and the uncertainty analysis process will be terminated so that the inconsistent values may be corrected.

If an error of some type occurs during the uncertainty analysis process, the process is terminated and the message **Error in Uncertainty analysis** is displayed at the bottom of the Analyze Systems screen.

If all of the events successfully pass the correlation class checks, then the distribution parameters for the events will be checked to ensure that they are valid. If any of the parameters are invalid, error messages will be displayed and the process will be terminated so the distribution parameters may be corrected.

After both of these checks have been passed, a point estimate will be calculated for the selected system. At this point the samples for each event will be generated using the selected sampling technique, either Monte Carlo Sampling technique or the Latin Hypercube Sampling technique. The uncertainty analysis function provides you with eight different distribution types for both sampling techniques. The distribution types include normal, lognormal, beta, gamma, chi-squared, exponential, uniform and the user-defined histograms.

During processing the current status screen will be displayed and updated as the samples are generated. Figure 72 illustrates the current status screen for the Monte Carlo sampling technique. When the requested number of samples has been generated or the user has terminated the process of generating the samples by pressing the <Esc> key, statistical information will be calculated using the generated samples. A sample mean, median, and standard deviation will be calculated for the selected system. Coefficients of skewness and kurtosis, and quantile values will also be calculated for the system. This data will be saved in the data base for the selected system.

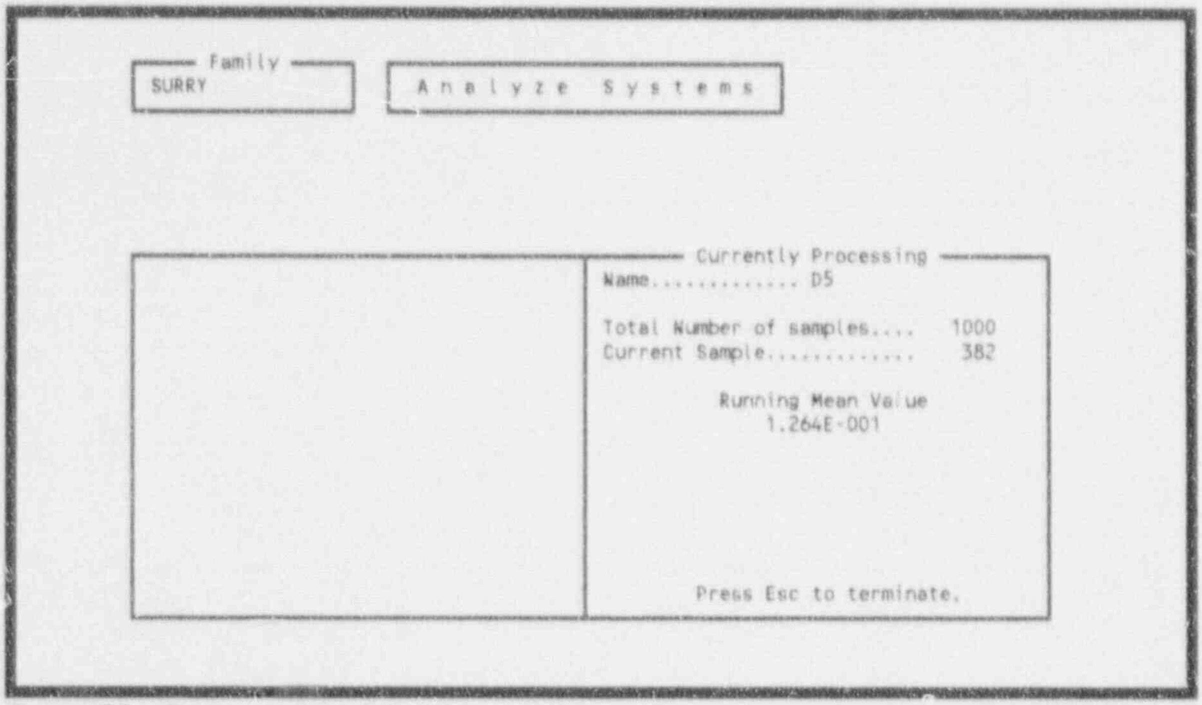


Figure 72. Current status of the Monte Carlo sampling.

Upon completion of these calculations, the following values will be displayed on the Uncertainty Results screen for viewing: the system name, random seed used, the number of samples generated in this process, the total number of events and cut sets in the system being processed, the point estimate, the mean, the median, the 5th and 95th percentile values, the minimum and maximum generated sample values, the standard deviation, the skewness and kurtosis, and the time involved to perform the analysis. Figure 73 illustrates the Uncertainty Results screens for the Monte Carlo sampling techniques, respectively.

If only one system was selected (highlighted) for the uncertainty analysis process, then you will need to press <Enter> to return to the Analyze Systems screen from the Uncertainty Results screen. However, if more than one system is being processed, the Uncertainty Results screen will be displayed for each system, and when all of the selected systems have been processed, you will automatically be returned to the Analyze Systems screen.

6.3 Display Results

To display the results of your system analysis, highlight Display Results or type <D> on the Fault Tree Analysis screen and press <Enter>. The Display System Results screen will be displayed showing a list of the systems contained in the data base (Figure 74). The following options are available: Exit, Cutsets, Importance, and Uncertainty.

```
Family
SURRY                    A n a l y z e   S y s t e m s

Uncertainty Results
Name                 D5
Random Seed   48850  Events          10
Sample Size    1000  Cut Sets        33
Point estimate            1.306E-001
Mean Value                1.256E-001
5th Percentile Value      4.642E-002
Median Value              1.103E-001
95th Percentile Value     2.581E-001
Minimum Sample Value      2.282E-002
Maximum Sample Value      4.571E-001
Standard Deviation        6.811E-002
Skewness                  1.410E+000
Kurtosis                  5.538E+000
Elapsed Time            00:01:04.320
```

Figure 73. Monte Carlo uncertainty results.

```
Family
SURRY                 D i s p l a y   S y s t e m   R e s u l t s

        Option |E| Exit / Cutsets / Importance / Uncertainty

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>          <F5>
        Exit           Help          Locate
```

Figure 74. Display system results screen.

6.3.1 Exit

This option terminates the process and returns to the Fault Tree Analysis screen (Figure 63). To invoke the option, type <E> in the option field and press <Enter>, or press the <Esc> key.

6.3.2 Cutsets

To invoke this option, enter a <C> in the option field, highlight the desired system, and press <Enter>. This option displays the system's cut sets (Figure 75), their percent of contribution to the system, the frequency, and the event names that make up the cut sets. The system minimum upper bound, the number of cut sets that make up the system, the current partition upper bound, the percentage that the partition contributes to the system, and the number of cut sets in the partition are displayed at the bottom of the screen. In addition, five suboptions are available. Each option is discussed in the following paragraphs.

Family: SURRY — Cut Sets — Cut Set: D1

Option [B] Exit / Partition / Report / Basic Events / Complement

Num	%	Frequency	Event Names	
1	24.49	2.600E-004	HPI-CCF-FT-115BD	
2	24.49	2.600E-004	HPI-CCF-FT-867CD	
3	9.42	1.000E-004	HPI-CKV-FT-CV225	
4	9.42	1.000E-004	HPI-CKV-FT-CV25	
5	9.42	1.000E-004	HPI-CKV-FT-CV410	
6	4.43	4.700E-005	CPC-CCF-LF-STRAB	
7	3.77	4.000E-005	HPI-XVM-PG-XV24	
8	2.89	3.072E-005	CPC-MDP-FS-SW10B	CPC-MDP-FR-SW10A
9	1.39	1.475E-005	CPC-MDP-FR-SW10B	CPC-MDP-FR-SW10A
10	0.85	9.000E-006	HPI-MOV-FT-1115C	HPI-MOV-FT-1115E

Min Cut 1.061E-003 Num 560 Part==> 1.061E-003 100.00% Num 560

Figure 75. Cut sets display.

6.3.2.1 Exit. This option terminates the process and returns to the previous screen. To invoke this option, type <E> and press <Enter>, or press the <Esc> key.

6.3.2.2 Partition. The partition option allows you to redefine a system as a subset of the original cut sets. This is accomplished by defining a set of events to be used to determine whether a cut set belongs to a partition. The functions available to perform this task are: Exit, Include, Exclude, Complement, Reset, and View Events.

To invoke this option, type <P>, highlight a system, and press <Enter>. This will bring up the screen shown in Figure 76.

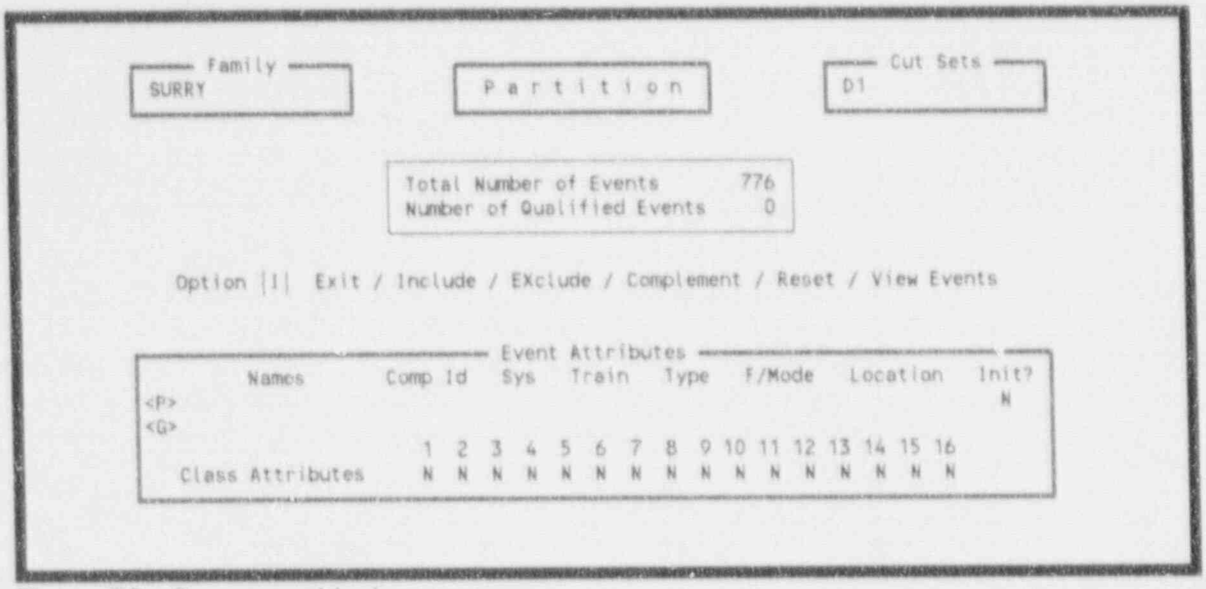


Figure 76. System partitioning menu.

Exit: This option terminates the process and returns to the previous screen. To invoke this option, type <E> and press <Enter>, or press <Esc>.

Include: To establish a partition via this option, type <I> in the option field, then fill in the entry fields that are to be used to qualify the events that may be used in the new partition and press <Enter>. The application proceeds to qualify the events and when complete will update the Number of Qualified Events field that appears at the top of the screen. In this case, qualified events are those events that contain the included attributes. Returning to the Cut Sets screen via the Exit option, you will see that the system cut set list contains only those cut sets that are made up of qualified events. Figure 77 was the result of specifying the event name "HPI-CKV-FT-CV410" for the "Include" option. If the system cut sets do not contain any of the qualified events, then the message **No cutsets qualify** is displayed at the bottom of the screen.

EXclude: To establish a partition via this option, type <X> in the option field, then fill in the entry fields on the screen that are to be used to remove events from the list of qualified events. The application proceeds to remove the events. When complete, the Number of Qualified Events field that appears at the top of the screen will be updated accordingly. Returning to the Cut Sets screen via the Exit option you will see that the system cut set list contains only those cut sets that are made up of qualified events. Figure 78 was the result of specifying the event name "HPI-CKV-FT-CV410" for the "EXclude" option. If the system cut sets do not contain any of the qualified events, then the message **No cutsets qualify** is displayed at the bottom of the screen.

Family: SURRY | Cut Sets | Cut Set: D1

Option |P| Exit / Partition / Report / Basic Events / Complement

Num	%	Frequency	Event Names
1	9.42	1.000E-004	HPI-CKV-FT-CV410

Min Cut 1.061E-003 Num 560 Part==> 1.000E-004 9.41% Num 1

Figure 77. Using Include to partition a system.

Family: SURRY | Cut Sets | Cut Set: D1

Option |P| Exit / Partition / Report / Basic Events / Complement

Num	%	Frequency	Event Names	
1	24.49	2.600E-004	HPI-CCF-FT-115BD	
2	24.49	2.600E-004	HPI-CCF-FT-B67CD	
3	9.42	1.000E-004	HPI-CKV-FT-CV225	
4	9.42	1.000E-004	HPI-CKV-FT-CV25	
5	4.43	4.700E-005	CPC-CCF-LF-STRAB	
6	3.77	4.000E-005	HPI-XVM-PG-XV24	
7	2.89	3.072E-005	CPC-MDP-FS-SW10B	CPC-MDP-FR-SW10A
8	1.39	1.475E-005	CPC-MDP-FR-SW10B	CPC-MDP-FR-SW10A
9	0.85	9.000E-006	HPI-MOV-FT-1115C	HPI-MOV-FT-1115E

Min Cut 1.061E-003 Num 560 Part==> 1.061E-003 100.00% Num 560

Figure 78. Using EXclude to partition a system.

Complement: To establish a partition via this option, type <C> in the option field, and press <Enter>. This causes all currently qualified events to be disqualified, and all unqualified events to become the set of qualified events. The Number of Qualified Events field at the top of the screen will change accordingly. Returning to the Cut Sets screen via the Exit option you will see that the system cut set list contains only those cut sets that are made up of qualified events. If the system cut sets do not contain any of the qualified events then the message **No Cut Sets Qualify** is displayed at the bottom of the screen.

Reset: This option sets all events in the data base to qualified. This, of course, removes all partitioning from the current system cut sets. To activate this option, type <R> in the option field and press <Enter>. (Assume the partition shown in Figure 77). The original cut set list is the result, as shown in Figure 75.

View Events: This option displays the list of family events and allows you to mark those events that are to be considered qualified events (Figure 79). To activate this option, type <V> in the option field and press <Enter>. Using <F2>, <F3>, or <F4> keys, mark the events that are considered qualified and press <Enter>. You will be returned to the Partition screen where the number of qualified events will be updated accordingly (Figure 80). If the system cut sets do not contain any of the qualified events, then the message **No cutsets qualify** is displayed at the bottom of the screen.

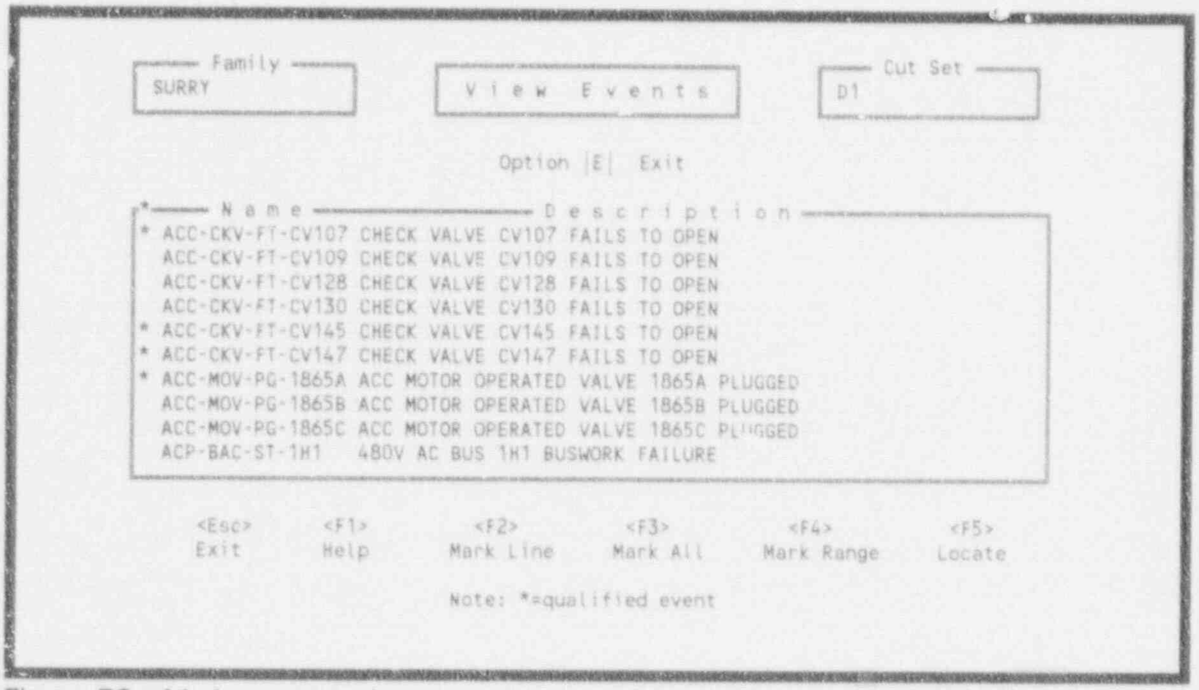


Figure 79. Mark events to view.

```
 Family                                          Cut Sets
 SURRY              P a r t i t i o n            D1

              Total Number of Events        776
              Number of Qualified Events      6

   Option |V|  Exit / Include / EXclude / Complement / Reset / View Events

                         Event Attributes
          Names       Comp Id   Sys   Train   Type   F/Mode   Location   Init?
 <P>                                                                       N
 <G>
                      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
```

Figure 80. Results of marking events to view.

6.3.2.3 Report. The Report option allows you to generate a report of the data that is displayed on the screen. The report may be displayed on the console, sent to an attached printer, or saved in a disk file for later processing (Figure 81). To invoke this option, type <R> in the option field, and press <Enter>. Upon pressing <Enter>, Figure 81 is displayed. This screen shows a default title and file name. You may change these defaults to meet your needs.

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

                         Report Title
   Partition Cut Set Report

                       Output File Name
            CON

   NOTE:  File Name =  "CON"  - Output report to the screen.
                       "PRN"  - Output report to the printer.
                       "   "  - No report is produced.
                       <ESC>  - No report is produced.
                       other  - Valid DOS file name.  Examples are:
                                A:LISTING, C:\REPORT\REP1, and RESULTS.
```

Figure 81. Partition report type selection.

6.3.2.4 Basic Events. The Basic Event option provides the following detailed information about the events that make up a cut set: name, description, probability, component ID, system, component type, failure mode, and location (Figure 82). To invoke this option, type <B> in the option field, highlight a cut set, and press <Enter>.

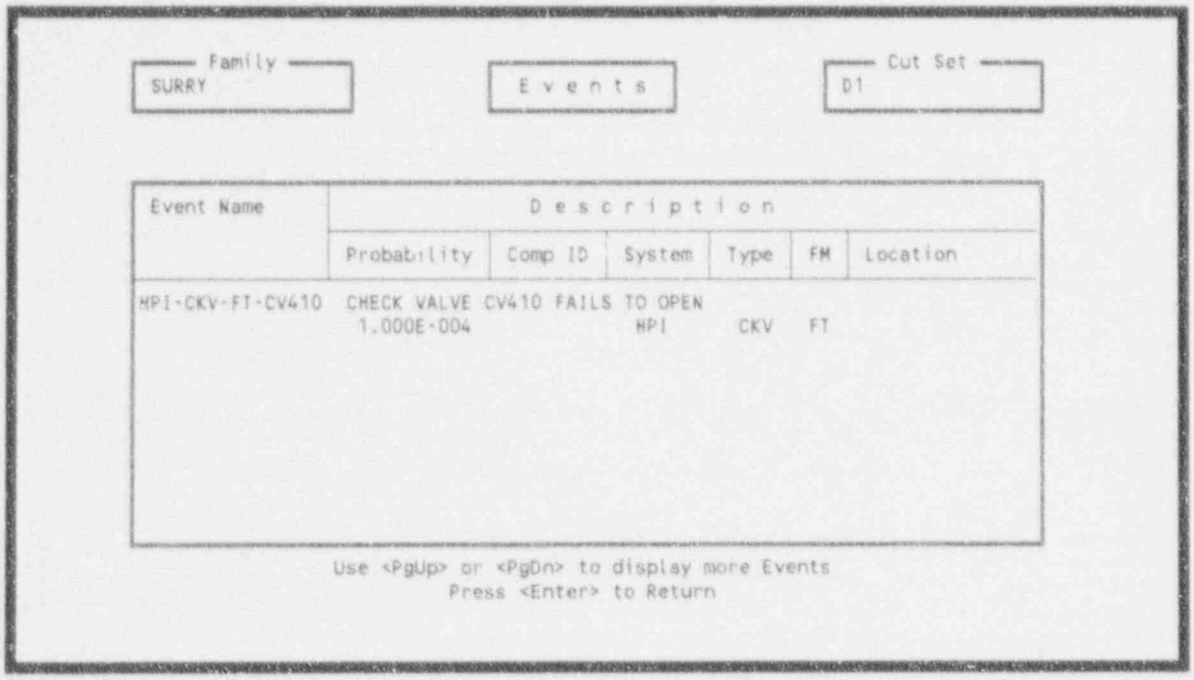


Figure 82. Details of a cut sets basic events.

6.3.2.5 Complement. The Complement option operates on the current system partition. Its function is to set all currently qualified cut sets to unqualified. This allows you to split a system into two partitions and then switch between the two partitions to view the results. To invoke this option, type <C> in the option field, and press <Enter>. (Assume the partition shown in Figure 77). The resulting display is shown in Figure 78.

6.3.3 Importance

This option calculates and displays the following three important measures for each event in the system:

- Fussell-Vesely importance - an indication of the percentage of the minimal cut set upper bound contributed by the basic event.
- Risk Reduction Ratio - an indication of how much the minimal cut set upper bound would decrease if the basic event was made perfect (never fail).
- Risk Increase Ratio - an indication of how much the minimal cut set upper bound would increase if the basic event was always failed.

If the Intervals flag is set in the Constants Menu, the Birnbaum measure (the partial derivative), the Risk Reduction Interval, and the Risk Increase Interval will be displayed.

To invoke this option, type <I> in the option field, highlight a system (or you may process all records by not specifying a system), and press <Enter>. By default, when the importance data are first displayed it is sorted, high to low, by Fussell-Vesely importance value (Figure 83).

Family		Cut Set
SURRY	I m p o r t a n c e	D1

Option [D] Exit / Description / Partition / Report / Sort

Event Name	# of Occur	Probability	F-V	Risk Reduc. Ratio	Risk Incre. Ratio
HPI-CCF-FT-B67CD	1	2.600E-004	2.447E-001	1.324E+000	9.418E+002
HPI-CCF-FT-115BD	1	2.600E-004	2.447E-001	1.324E+000	9.418E+002
HPI-CKV-FT-CV225	1	1.000E-004	9.409E-002	1.104E+000	9.418E+002
HPI-CKV-FT-CV25	1	1.000E-004	9.409E-002	1.104E+000	9.418E+002
HPI-CKV-FT-CV410	1	1.000E-004	9.409E-002	1.104E+000	9.418E+002
CPC-MDP-FR-SW10A	32	3.840E-003	5.846E-002	1.062E+000	1.608E+001
CPC-CCF-LF-STRAB	1	4.700E-005	4.422E-002	1.046E+000	9.418E+002
HPI-XVM-PG-XV24	1	4.000E-005	3.763E-002	1.039E+000	9.418E+002
CPC-MDP-FS-SW10B	20	8.000E-003	3.469E-002	1.036E+000	5.298E+000
SIS-ACT-FA-SISA	23	1.600E-003	1.689E-002	1.017E+000	1.149E+001

Figure 83. Initial display of importance measures.

6.3.3.1 Exit. Returns you to the previous screen.

6.3.3.2 Description. Displays the full description for the highlighted event on the bottom of the screen. To invoke this option, enter a <D>, highlight the desired event, and press <Enter>. If no event is highlighted, the message **An event must be selected first...** is displayed.

6.3.3.3 Partition. This option invokes the same process as described in Section 6.3.2.2, except the effect is to limit which events are displayed/reported.

6.3.3.4 Report. This option invokes the same process as described in Section 6.3.2.3.

6.3.3.5 Sort. When you invoke this option, Figure 84 will be displayed. As shown, the data can be sorted by the following: Name, Occurrence, Probability, F-V, Reduction, and Increase.

```
Family                                        Cut Set
SURRY            I m p o r t a n c e          D1

Sort Options :  Exit Sort / Name / Occurrence / Probability / F-V
                Reduction / Increase

Event Name       # of    Probability    F-V        Risk Reduc.  Risk Incre.
                 Occur                                Ratio        Ratio
HPI-CKV-FT-CV410    1    1.000E-004   9.409E-002   1.104E+000   9.418E+002
```

Figure 84. Importance measures sorted by probability.

6.3.4 Uncertainty

The Uncertainty option displays the distribution and confidence limits of a system for both base and current data values. These values were calculated using either the Latin Hypercube or the Monte Carlo simulation technique. To invoke this option, type <U> (Uncertainty) in the option field of the Display System Results screen, highlight the desired system, and press <Enter>. Figure 85 shows the base and current case uncertainty data for a highlighted system.

From this screen you may either return to the System Display screen or view the quantile values associated with the current case data or the base case data. To return to the System Display screen, type an <E> (Exit) in the option field and press <Enter>, or press the <Esc> key. To view the quantile values for the current case, type a <C> in the option field and press <Enter>. A screen showing the quantile values will appear (Figure 86). To return to the previous screen, press <Enter>. If you wish to view base case quantile values, type a <B> in the option field and press <Enter>.

6.4 Cut Set Editor

The cut set editor provides you with the means to edit the base case/alternate system cut sets. IRRAS provides room for two sets of cut sets in the data base: base case and alternate, or current case. Whenever IRRAS creates cut sets, they are stored in the current case location. The user may save a set of cut sets to the base case location by performing a Base Case Update. The user can choose to edit either base case or alternate cut sets; however, the results are always stored in the alternate case location.

Family: SURRY

UNCERTAINTY DATA

System: C

Option |C| Exit / Current Quantile Values / Base Quantile Values

Base

Mean	4.699E-004	Median	4.237E-004	Mincut	2.687E-001
Std. Dev	1.212E-004	Skewness	1.657E+000	Kurtosis	4.822E+000
5th %	3.654E-004	Minimum	3.654E-004	Seed	53990
95th %	7.919E-004	Maximum	7.919E-004	Samples	15

Size Cutoff 6 Probability Cutoff 1.000E-015

Current

Mean	4.699E-004	Median	4.237E-004	Mincut	2.687E-001
Std. Dev	1.212E-004	Skewness	1.657E+000	Kurtosis	4.822E+000
5th %	3.654E-004	Minimum	3.654E-004	Seed	53990
95th %	7.919E-004	Maximum	7.919E-004	Samples	15

Size Cutoff 6 Probability Cutoff 1.000E-015

Figure 85. Uncertainty data display.

Distribution Quantile Level (in per cent)	95% Confidence Interval On Quantile Level in % (+/-)	Quantile Value	CURRENT CASE 95% Confidence Interval on Quantile Lower Bound	Upper Bound
0.5	6.9	3.6546E-004	3.6546E-004	3.6546E-004
1.0	8.4	3.6546E-004	3.6546E-004	3.6546E-004
2.5	11.2	3.6546E-004	3.6546E-004	3.7003E-004
5.0	14.4	3.6546E-004	3.6546E-004	3.7021E-004
10.0	18.5	3.7003E-004	3.6546E-004	3.9247E-004
20.0	23.6	3.9247E-004	3.6546E-004	4.2324E-004
25.0	25.2	3.9247E-004	3.6546E-004	4.2375E-004
30.0	26.5	3.9301E-004	3.7003E-004	4.2375E-004
40.0	28.1	4.2324E-004	3.7021E-004	4.6749E-004
50.0	28.6	4.2375E-004	3.9247E-004	4.9533E-004
60.0	28.1	4.6749E-004	4.0875E-004	4.9592E-004
70.0	26.5	4.9265E-004	4.2375E-004	6.9206E-004
75.0	25.2	4.9533E-004	4.2375E-004	7.9197E-004
80.0	23.6	4.9592E-004	4.6644E-004	7.9197E-004
90.0	18.5	6.9206E-004	4.9533E-004	7.9197E-004
95.0	14.4	7.9197E-004	4.9592E-004	7.9197E-004
97.5	11.2	7.9197E-004	6.9206E-004	7.9197E-004
99.0	8.4	7.9197E-004	7.9197E-004	7.9197E-004
99.5	6.9	7.9197E-004	7.9197E-004	7.9197E-004

Figure 86. Quantile values display.

Any event name entered during cut set editing may be preceded by a "/" to indicate that it is to be treated as a complemented event. The probability of a complemented event is 1 - the failure probability.

To invoke this option, highlight Cut Set Editor or type <C> in the option field and press <Enter>. Figure 87 shows the Cut Set Editor screen listing the system names and descriptions. Whether the system has associated base case cut sets and/or alternate cut sets is indicated by the letter B and A preceding the system name. To edit the base case cut set, select <B>, highlight a system showing a letter B, and press <Enter>. Likewise, to edit an alternate cut set select <A>, highlight a system showing a letter A, and press <Enter>. If a system name is not flagged with a B or A it may still be edited.

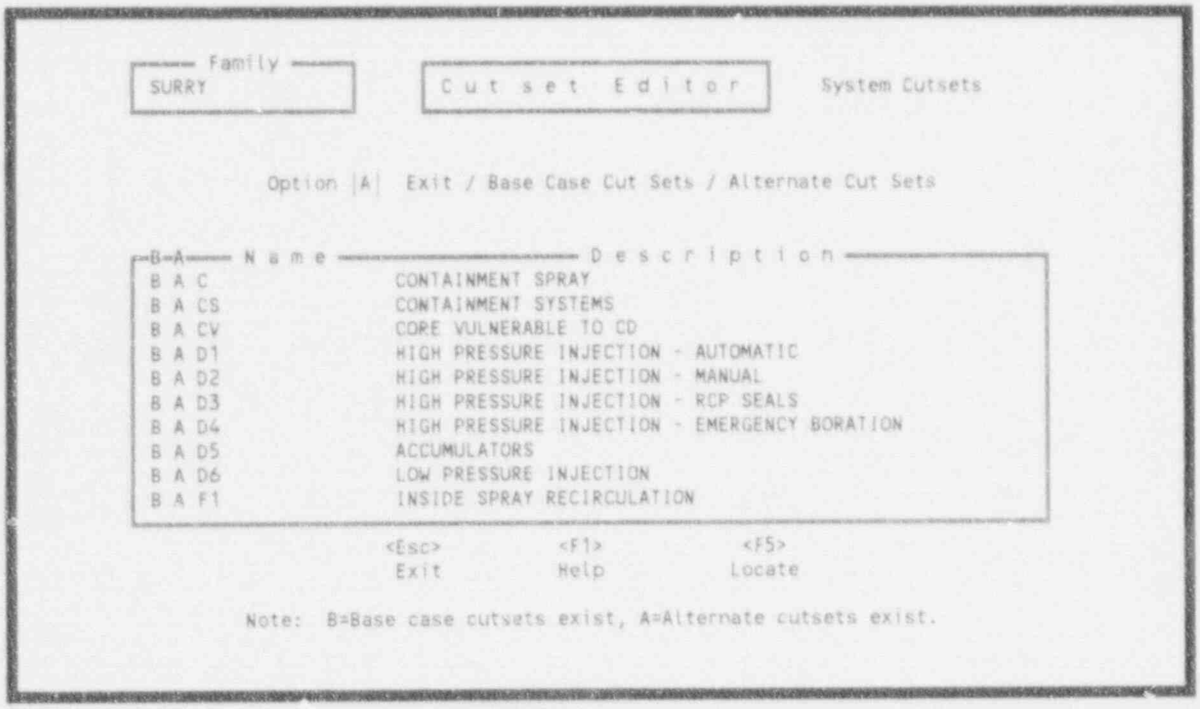


Figure 87. System selection for cut set editor.

In any case, a screen similar to the one shown in Figure 88 is displayed. This screen shows 14 editing options that are activated by a single key stroke. The 14 options include: Exit, Add, Modify, Delete, Locate, Next, Previous, Search, Options, Insert Events, Replace Events, Copy Cutset and Replace Events, Undo, and Find and Delete Cut Set. The Add, Modify, and Delete functions will perform their function on either the entire cut set or on a single event in a cut set depending upon where the cursor is positioned at the time the key to activate the function is pressed. If the cursor is in the first column of the screen, then the function will be performed on the entire cut set. However, if the cursor is in one of the other four columns, then the function will be performed on the event where the cursor is positioned.

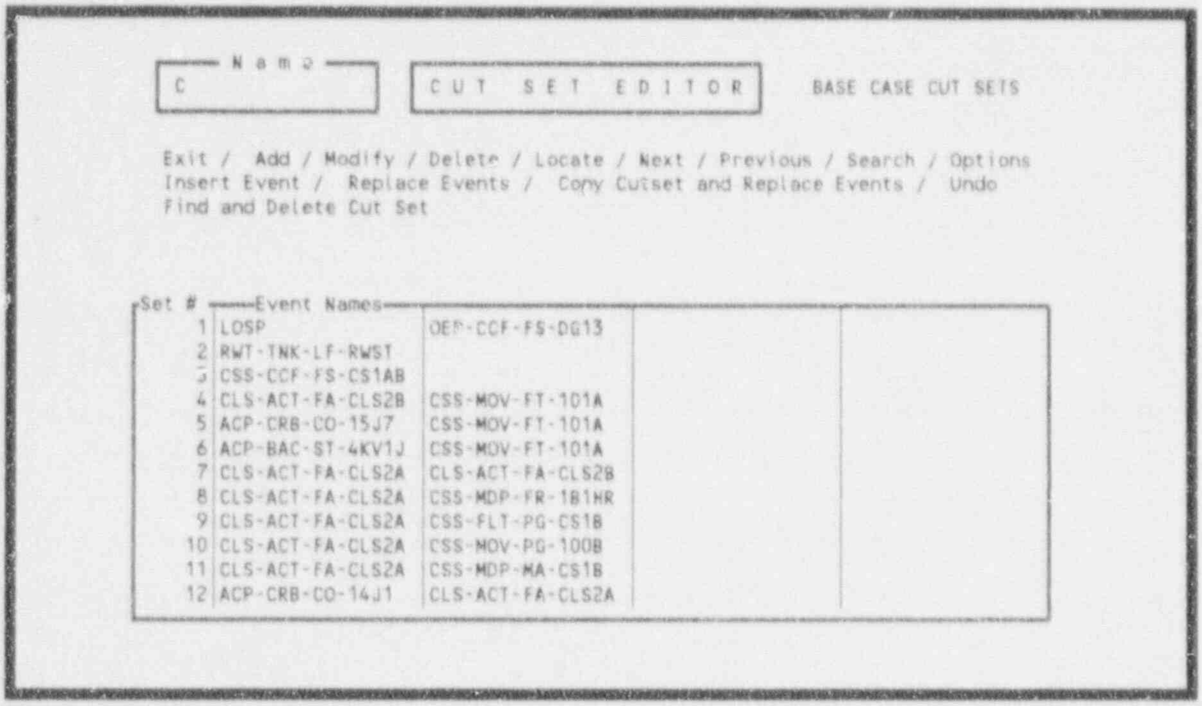


Figure 88. Cut set editor main menu.

To move the cursor about the editing window, use the keyboard cursor pad. The arrow keys move one field in each respective direction. The <Home> key places the cursor in the upper right corner of the window. The <PgUp> key moves the window up one page (12 lines). The <PgDn> key moves the window down one page. <Ctrl-PgUp> and <Ctrl-PgDn> moves to the top and bottom of the file. Pressing the function key <F1> toggles between two cut set editor screens. One screen shows the editing options and the other shows the available cursor movements.

6.4.1 Exit

This option returns you to the Cutset Editor screen (Figure 87). After pressing <E> (Exit) you are asked if the changes are to be saved or discarded (Figure 89). If the changes are saved, the sequence and plant frequencies must be recalculated to reflect the new cut set configurations.

6.4.2 Add

This option allows you to add a cut set to a system or an event to a cut set. To add a new cut set, move the cursor into the set number column and press <A>. The cut set display is cleared, and the cursor is placed in the event name column (Figure 90). The event names that make up the cut set may be entered using the <Tab> key to move between fields, and the <Enter> key to end the addition. The window is then updated and the cursor is positioned on the new cut set (Figure 91). The <Insert> key also invokes the Add option.

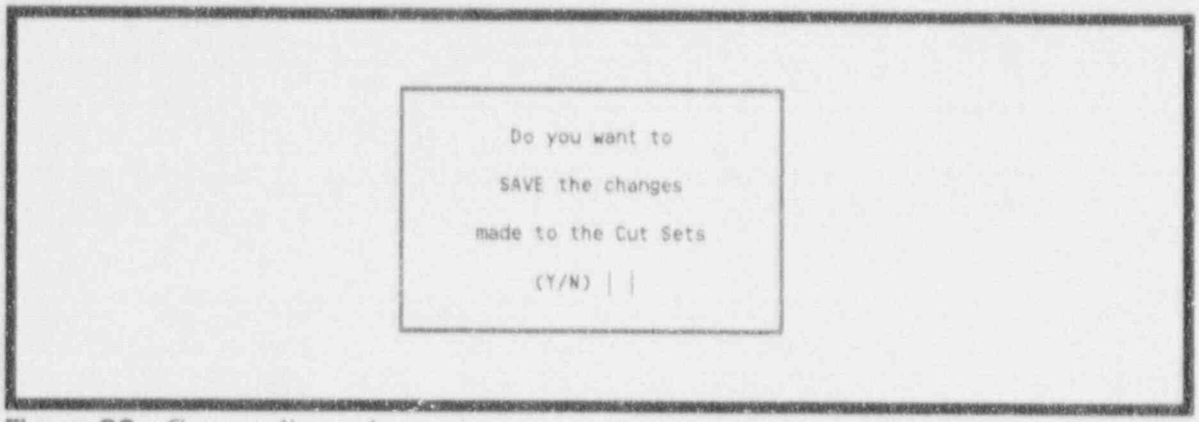


Figure 89. Cut set editor exit screen.

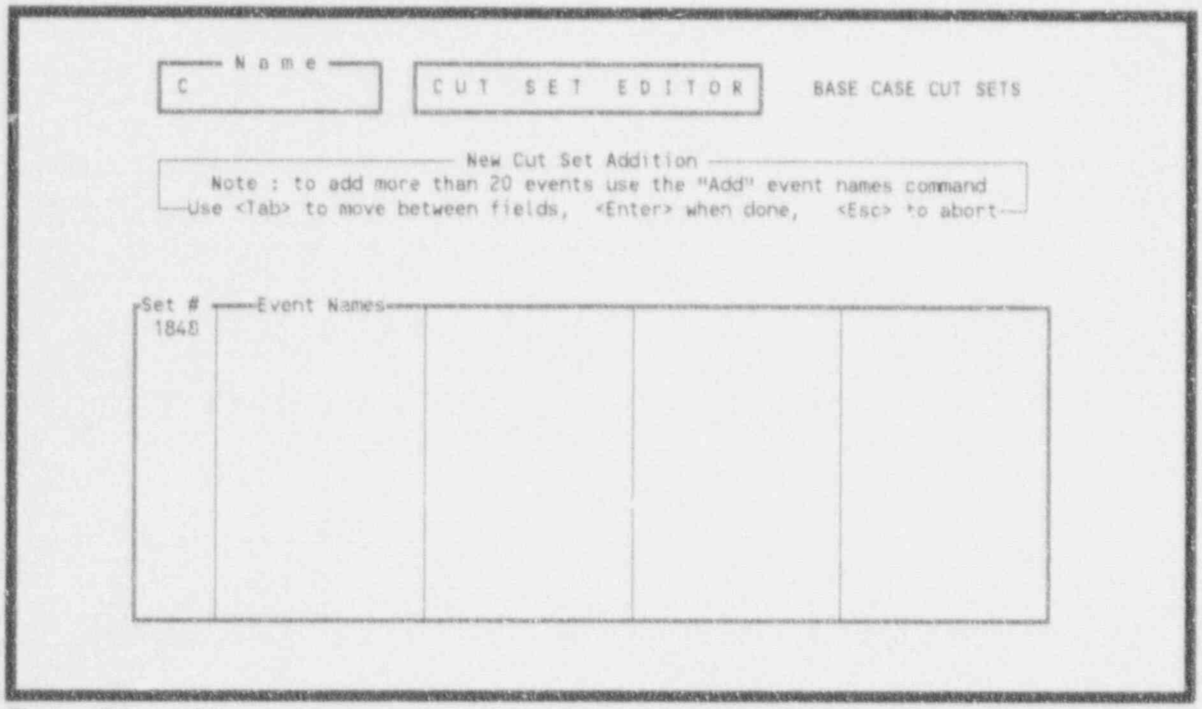


Figure 90. Adding a new cut set to a system.

To add an event to a cut set place the cursor in the row of the cut set you wish the event to be in, press <A>, and enter the event name. Figure 92 shows the editor screen ready to add an event name. Figure 93 shows the results of adding a new event.

Name: C

CUT SET EDITOR

BASE CASE CUT SETS

Exit / Add / Modify / Delete / Locate / Next / Previous / Search / Options
Insert Event / Replace Events / Copy Cut Set and Replace Events / Undo
Find and Delete Cut Set

Set #	Event Names			
1837	ACP-CRB-CO-15H8	ACP-CRB-CO-15J8	OEP-DGN-FS-DG03	OEP-DGN-MA-DG01
1838	ACP-CRB-CO-15H8	ACP-CRB-CO-15J8	OEP-CRB-FT-15H3	OEP-DGN-FR-DG03
1839	ACP-CRB-CO-15H8	ACP-CRB-CO-15J8	OEP-CRB-FT-15H3	OEP-DGN-MA-DG03
1840	ACP-CRB-CO-15H8	ACP-CRB-CO-15J8	OEP-CRB-FT-15H3	OEP-CRB-FT-15J3
1841	ACP-CRB-CO-15H8	ACP-CRB-CO-15J8	OEP-CRB-FT-15H3	OEP-DGN-FC-DG3U2
1842	ACP-CRB-CO-15H8	ACP-CRB-CO-15J8	OEP-CRB-FT-15H3	OEP-DGN-FS-DG03
1843	ACP-CRB-CO-15H8	ACP-CRB-CO-15J8	OEP-DGN-FR-DG03	OEP-DGN-FS-DG01
1844	ACP-CRB-CO-15H8	ACP-CPB-CO-15J8	OEP-DGN-FS-DG01	OEP-DGN-MA-DG03
1845	ACP-CRB-CO-15H8	ACP-CRB-CO-15J8	OEP-CRB-FT-15J3	OEP-DGN-FS-DG01
1846	ACP-CRB-CO-15H8	ACP-CRB-CO-15J8	OEP-DGN-FC-DG3U2	OEP-DGN-FS-DG01
1847	ACP-CRB-CO-15H8	ACP-CRB-CO-15J8	OEP-DGN-FS-DG01	OEP-DGN-FS-DG03
1848	ACP-CRB-CO-15H8A			

Figure 91. Results of adding a new cut set.

Name: C

CUT SET EDITOR

BASE CASE CUT SETS

Add
Enter the Event name to be added to this Cut Set
Use <Enter> when done, and <Esc> to abort

Set #	Event Names			
1801	ACP-CRB-CO-15J8	OEP-BAC-ST-FDRF	OEP-CRB-FT-15H3	OEP-DGN-FC-DG3U2
1802	ACP-CRB-CO-15J8	OEP-BAC-ST-FDRF	OEP-CRB-FT-15H3	OEP-DGN-FS-DG03
1803	ACP-CRB-CO-15J8	OEP-BAC-ST-FDRF	OEP-DGN-FR-DG03	OEP-DGN-FS-DG01
1804	ACP-CRB-CO-15J8	OEP-BAC-ST-FDRF	OEP-DGN-FS-DG01	OEP-DGN-MA-DG03
1805	ACP-CRB-CO-15J8	OEP-BAC-ST-FDRF	OEP-CRB-FT-15J3	OEP-DGN-FS-DG01
1806		OEP-BAC-ST-FDRF	OEP-DGN-FC-DG3U2	OEP-DGN-FS-DG01
1807	ACP-CRB-CO-15J8	OEP-BAC-ST-FDRF	OEP-DGN-FS-DG01	OEP-DGN-FS-DG03
1808	ACP-CRB-CO-15H8	OEP-BAC-ST-FDRD	OEP-DGN-FR-DG01	OEP-DGN-FR-DG03
1809	ACP-CRB-CO-15H8	OEP-BAC-ST-FDRD	OEP-DGN-FR-DG01	OEP-DGN-MA-DG03
1810	ACP-CRB-CO-15H8	OEP-BAC-ST-FDRD	OEP-CRB-FT-15J3	OEP-DGN-FR-DG01
1811	ACP-CRB-CO-15H8	OEP-BAC-ST-FDRD	OEP-DGN-FC-DG3U2	OEP-DGN-FR-DG01
1812	ACP-CRB-CO-15H8	OEP-BAC-ST-FDRD	OEP-DGN-FR-DG01	OEP-DGN-FS-DG03

Figure 92. Adding an event to a cut set.

Name: C

CUT SET EDITOR   BASE CASE CUT SETS

Exit / Add / Modify / Delete / Locate / Next / Previous / Search / Options
Insert Event / Replace Events / Copy Cut Set and Replace Events / Undo
Find and Delete Cut Set

Set #	Event Names			
1801	ACP-CRB-CO-15J8	OEP-BAC-ST-FDRF	OEP-CRB-FT-15H3	OEP-DGN-FC-DG3U2
1802	ACP-CRB-CO-15J8	OEP-BAC-ST-FDRF	OEP-CRB-FT-15H3	OEP-DGN-FS-DG03
1803	ACP-CRB-CO-15J8	OEP-BAC-ST-FDRF	OEP-DGN-FR-DG03	OEP-DGN-FS-DG01
1804	ACP-CRB-CO-15J8	OEP-BAC-ST-FDRF	OEP-DGN-FS-DG01	OEP-DGN-MA-DG03
1805	ACP-CRB-CO-15J8	OEP-BAC-ST-FDRF	OEP-CRB-FT-15J3	OEP-DGN-FS-DG01
1806	ACP-CRB-CO-15J8	OEP-BAC-ST-FDRF	OEP-DGN-FC-DG3U2	OEP-DGN-FS-DG01
	ACP-CRB-CO-XBRF			
1807	ACP-CRB-CO-15J8	OEP-BAC-ST-FDRF	OEP-DGN-FS-DG01	OEP-DGN-FS-DG03
1808	ACP-CRB-CO-15H8	OEP-BAC-ST-FDRD	OEP-DGN-FR-DG01	OEP-DGN-FR-DG03
1809	ACP-CRB-CO-15H8	OEP-BAC-ST-FDRD	OEP-DGN-FR-DG01	OEP-DGN-MA-DG03
1810	ACP-CRB-CO-15H8	OEP-BAC-ST-FDRD	OEP-CRB-FT-15J3	OEP-DGN-FR-DG01
1811	ACP-CRB-CO-15H8	OEP-BAC-ST-FDRD	OEP-DGN-FC-DG3U2	OEP-DGN-FR-DG01

Figure 93. A new event added to a cut set.

6.4.3 Modify

To modify events of an entire cut set, place the cursor in the first column of the screen and press the <M> key. This will display a screen containing the first 20 events (if available) of the cut set to be modified (Figure 94). After making modifications to the events of the cut set, press <Enter> to save the modifications or press <Esc> to abort the modification process.

To change a single event in a cut set, position the cursor on the desired event and press the <M> key. This will display the Change Event Name screen (Figure 95) to allow you to modify the current event. When modifying an event, you may use all of the alphanumeric keys, in addition to the <Ins> and <Del> keys.

6.4.4 Delete

This option allows you to delete an entire cut set or an individual event. Placing the cursor on a cut set number and pressing <D> causes the entire cut set to be deleted. If the cursor is placed on an event name, the event at that location only is deleted from the cut set.

When the delete option is invoked, the option list on the display is replaced by a veto menu. For deletions, the Veto option is always turned on unless you specifically turn it off. The veto options function as follows:

```
Name                CUT SET EDITOR          BASE CASE CUT SETS
C

                    Modify Entire Cutset
The first 20 events of the cut set are being displayed.   Modify the
event names and press enter to save the changes made to the cutset.
              Use <Enter> when done, and <Esc> to abort

Set #  Event Names
1803   ACP-CRB-CO-15J8    OEP-BAC-ST-FDRF    OEP-DGN-FR-DG03    OEP-DGN-FS-DG01
```

Figure 94. Modifying a cut set.

```
Name                CUT SET EDITOR          BASE CASE CUT SETS
C

                    Change Event Name
  Event names which do not exist will be added to the events list
              Use <Enter> when done, and <Esc> to abort

Set #  Event Names
   1   LOSP               OEP-CCF-FS-DG13
   2   RWT-TNK-LF-RWST
   3   CSS-CCF-FS-CS1AB
   4   CLS-ACT-FA-CLS2B   CSS-MOV-FT-101A
   5   ACP-CRB-CO-15J7    CSS-MOV-FT-101A
   6   ACP-BAC-ST-4KV1J   CSS-MOV-FT-101A
   7   CLS-ACT-FA-CLS2A   CLS-ACT-FA-CLS2B
   8   CLS-ACT-FA-CLS2A   CSS-MDP-FR-1B1HR
   9   CLS-ACT-FA-CLS2A   CSS-FLT-PG-CS1B
  10   CLS-ACT-FA-CLS2A   CSS-MOV-PG-100B
  11   CLS-ACT-FA-CLS2A   CSS-MDP-MA-CS1B
  12   ACP-CRB-CO-14J1    CLS-ACT-FA-CLS2A
```

Figure 95. Modifying an event name.

Stop. Typing <S> aborts the delete operation for the highlighted cut set or event.

Continue the process. Typing <C> and pressing <Enter> results in deleting a cut set or event.

6.4.5 Locate

The locate option allows you to search the list of all existing events and the list of all the newly added events for events that meet the desired search criteria. Events that meet the desired search criteria are considered to be qualified events. You are then able to locate the first occurrence of one of these qualified events from the current set of cut sets.

To invoke this option, press the <L> key. This will display the locate menu (Figure 96). From this screen, the following four options are available: Exit, Locate, Next, and Previous. The number of unique events that exist in the current set of cut sets is listed on this screen, along with the number of currently qualified events.

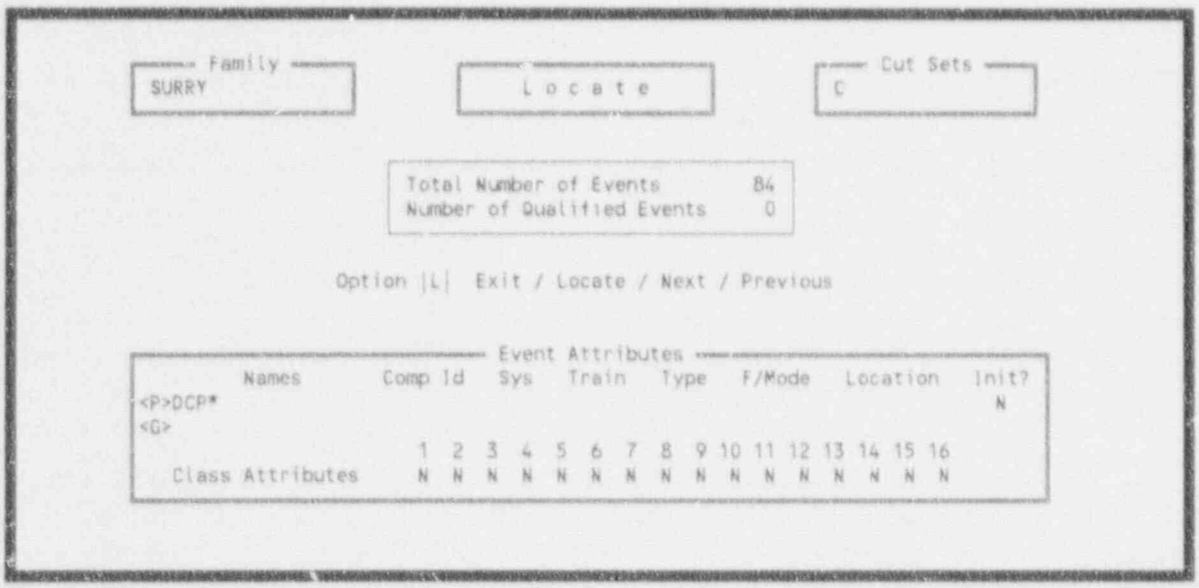


Figure 96. Locate an event in the cut set list.

6.4.5.1 Exit. If the locate function has been performed and an event name exists in the name field of this screen, then upon entering an <E> in the option field, the cursor will be placed on the first occurrence of that event name within the current set of cut sets. If the event does not exist within the current cut sets, then a message stating the event was not found will be displayed.

If the locate function has not been performed then entering an <E> in the option field will simply terminate the locate function. This may also be terminated by pressing the <Esc> key.

6.4.5.2 Locate. This option searches the list of all existing events and the list of all newly added events for events that meet the desired search criteria. This option allows wild card search characters for the two name fields on the screen. A question mark (?) matches any single character in its specified position, and an asterisk (*) matches a character string of any length. This option will use any of the filled event attribute fields on the screen as search criteria. Any events that meet the selected search criteria are considered to be qualified events. The number of currently qualified events will then be updated on the screen. The first qualified event will be displayed on the screen (see Figure 97).

> **NOTE:** It is possible for an event to be a qualified event and still not exist in the current set of cut sets, because the entire data base is searched in the qualification process.

```
 ─── Family ───            ┌─────────────┐          ─── Cut Sets ───
 SURRY                     │ L o c a t e │          C
                           └─────────────┘

                  Total Number of Events        84
                  Number of Qualified Events    10

              Option |L|  Exit / Locate / Next / Previous

 ──────────────────────── Event Attributes ─────────────────────────
        Names        Comp Id   Sys   Train   Type   F/Mode   Location   Init?
 <P>DCP-BAT-LP                 DCP           BAT      LP                  N
 <G>DCPBAT
                      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
```

Figure 97. Results of a locate request.

6.4.5.3 Next. This option will display the next qualified event from the list of qualified events.

6.4.5.4 Previous. This option will display the previous qualified event from the list of qualified events.

6.4.6 Next

This option allows you to go to the next occurrence of the event name that was specified in the locate option. To invoke the option, type <N>.

6.4.7 Previous

This option allows you to go back to the previous occurrence of the event name specified in the locate option. To invoke the option, type <P>.

6.4.8 Search

This option provides a fast locate feature for a single event name. As each letter of the event name is typed the cut set list is scanned for the first occurrence of the letter. To invoke the option, type <S>, which will replace the option list with the search request on the screen display (Figure 98). The search starts with the top cut set of the current display. Type the desired event name and press <Enter>. The cursor will be positioned on the first occurrence of the requested event. At this point, <N> (Next) and <P> (Previous) will allow you to move through the cut set list positioning the cursor on the next or previous occurrence of the requested event name.

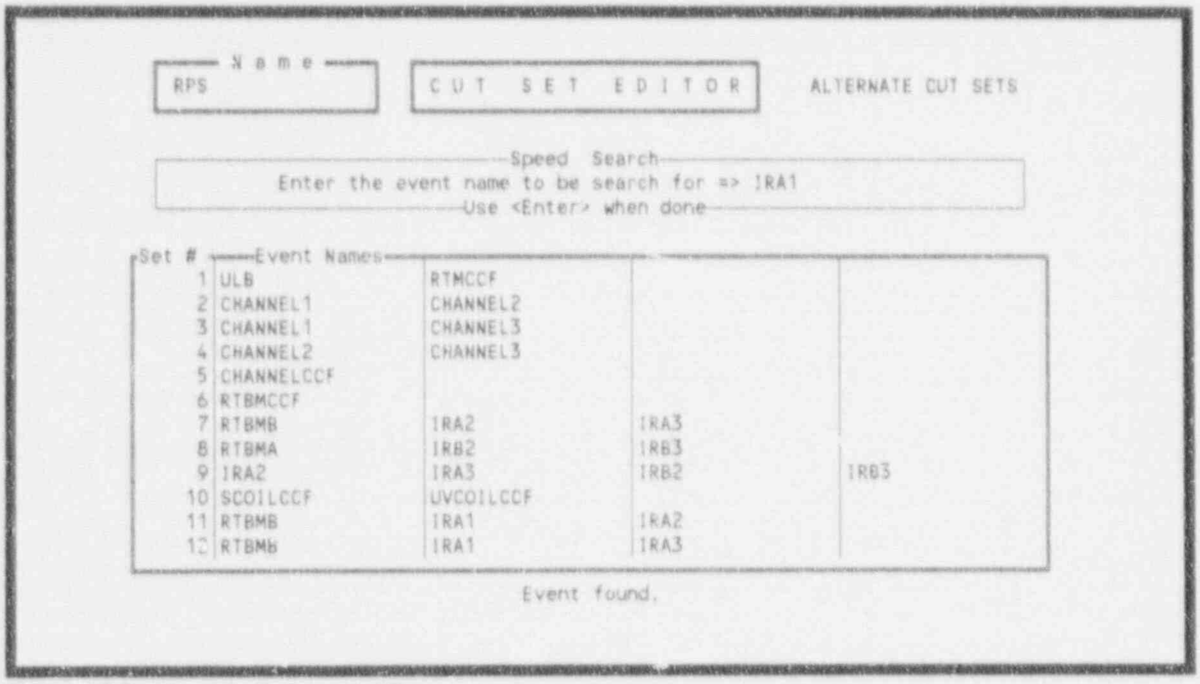


Figure 98. Search for a specific event.

6.4.9 Options

The Options command provides the capability of setting Cut Set Editor defaults. To invoke this option, type <O>. The normal option list will be replaced with the "default" option list on the screen display (Figure 99). The default options are:

- Range - This option sets the maximum number of cut sets with the specified string that will be located. Range is used by the Replace, Insert, Copy and Replace, and Find and Delete commands. By default, Range is set to 9999.

- Veto - Veto tells each operation to ask again if you wish to modify the cut set data. By default, this is turned off.

- Delete Veto - Functions the same as Veto. However, it applies only to the Delete command. By default, this is turned on.

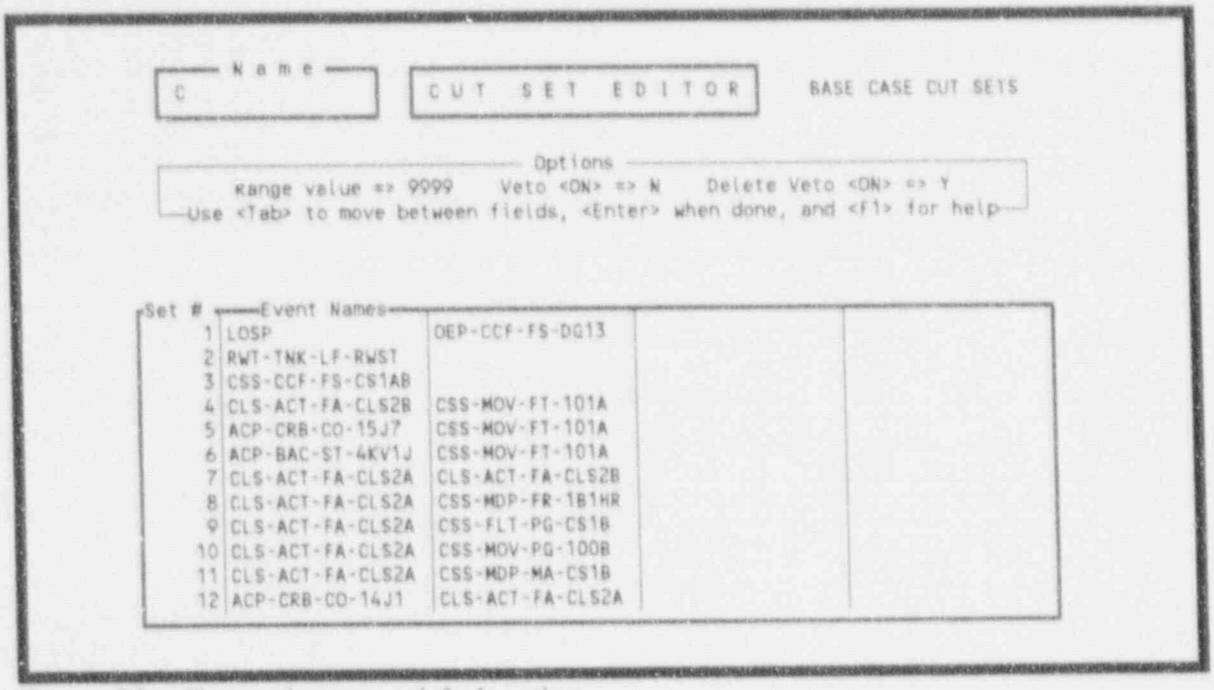


Figure 99. Change the cut set default options.

6.4.10 Insert Event

This option allows you to execute a global insertion of an event. You specify a search string consisting of up to five event names and the name of the event to be inserted. In all cut sets containing the "search string" the specified event to be inserted will be added. The search starts with the cut set at the top of the current display. To invoke this option, type <I>. The option list will be replaced on the screen with the Find/Insert request as shown in Figure 100.

6.4.11 Replace Events

This option allows you to specify a search string and replace every occurrence of that string with a specified event name. The search string may consist of up to five event names. The replacement is a global function in that all occurrences of the search string will be replaced by the specified event name. The replacement event name may be left blank, which will delete all occurrences of the search string from the cut set list. The search starts with the cut set at the top of the current display. To invoke the option, type <R>. The option list on the screen will be replaced with the Find/Replace request (Figure 101).

6.4.12 Copy Cutset and Replace Events

This option allows you to search for cut sets containing a specific string, copy the cut sets (minus the events specified in the search string), and add a specific event to the new cut set. You may specify up to five event names as a search string. If the event name to be added is left blank, the process is terminated. The search starts with the cut set at the top of the current display. To invoke this option, type <C>. The option list on the display will be replaced with the Copy/Replace request (Figure 102).

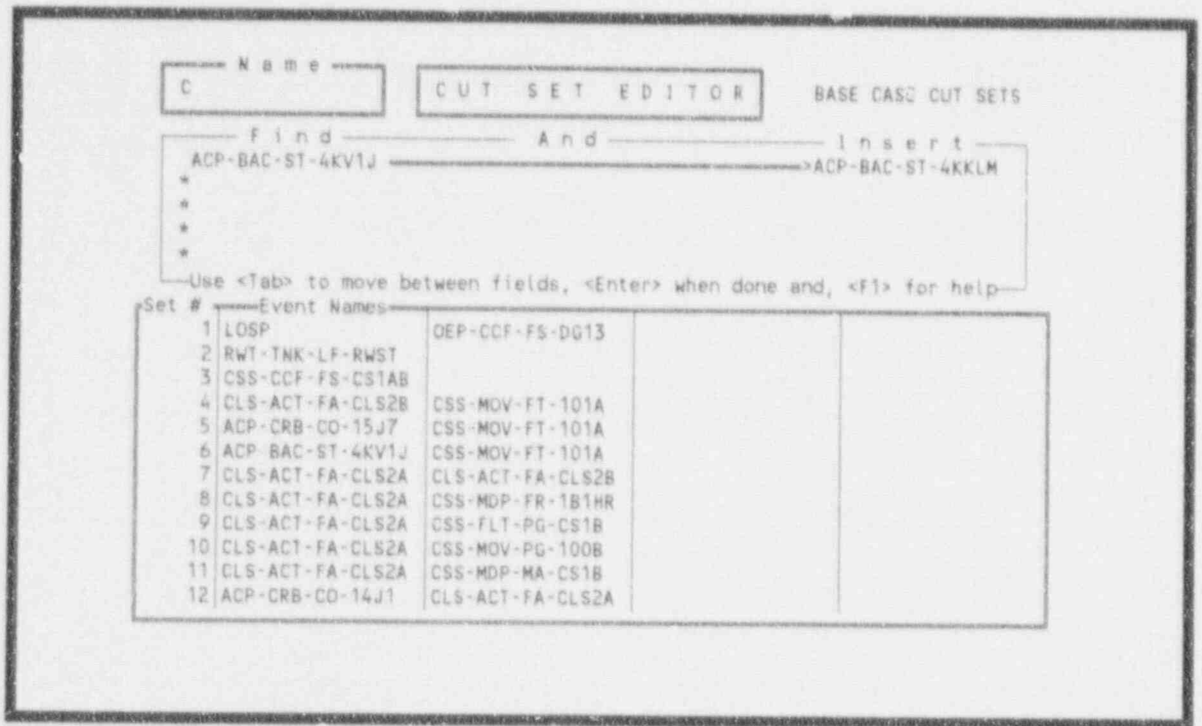


Figure 100. Global insertion of an event.

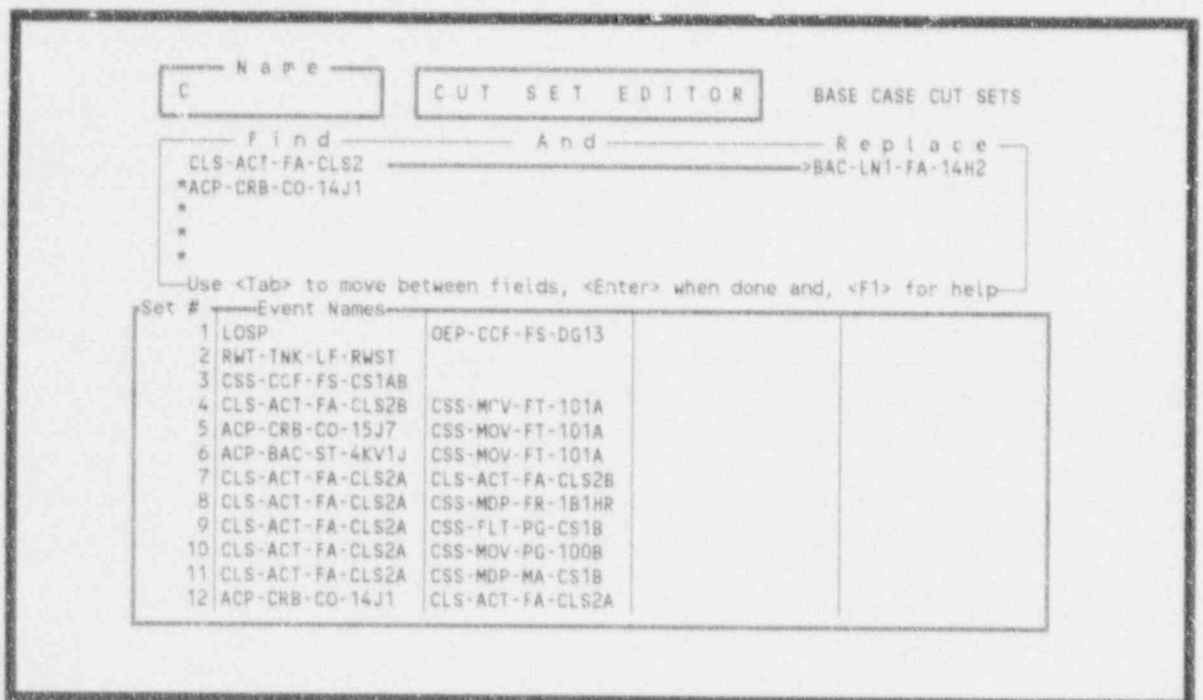


Figure 101. Find and replace a string.

```
 ┌── N a m e ──┐   ┌───────────────────────┐
 │ C           │   │ C U T   S E T   E D I T O R │   BASE CASE CUT SETS
 └─────────────┘   └───────────────────────┘
 ┌──── F i n d ──────────── A n d ────── C o p y  &  R e p l a c e ─┐
   ACP-CRB-CO-15J7  ──────────────────────────>ACP-AAA-LM-15N4
  *ACP-BAC-ST-4KV1J
  *
  *
  *
 └─Use <Tab> to move between fields, <Enter> when done and, <F1> for help─┘
┌Set # ──Event Names──────────────────────────────────────────────────┐
     1 │LOSP            │DEP-CCF-FS-DG13 │                │                │
     2 │RWT-TNK-LF-RWST │                │                │                │
     3 │CSS-CCF-FS-CS1AB│                │                │                │
     4 │CLS-ACT-FA-CLS2B│CSS-MOV-FT-101A │                │                │
     5 │ACP-CRB-CO-15J7 │CSS-MOV-FT-101A │                │                │
     6 │ACP-BAC-ST-4KV1J│CSS-MOV-FT-101A │                │                │
     7 │CLS-ACT-FA-CLS2A│CLS-ACT-FA-CLS2B│                │                │
     8 │CLS-ACT-FA-CLS2A│CSS-MDP-FR-1B1HR│                │                │
     9 │CLS-ACT-FA-CLS2A│CSS-FLT-PG-CS1B │                │                │
    10 │CLS-ACT-FA-CLS2A│CSS-MOV-PG-100B │                │                │
    11 │CLS-ACT-FA-CLS2A│CSS-MDP-MA-CS1B │                │                │
    12 │ACP-CRB-CO-14J1 │CLS-ACT-FA-CLS2A│                │                │
└────────────────────────────────────────────────────────────────────┘
```

Figure 102. Copy and replace a cut set.

6.4.13 Undo

This option allows you to recover the last item deleted. The item may be an entire cut set or a single event. A deletion may be undone only if the Undo Delete command is used immediately after the deletion has occurred. To invoke the option, type <U>.

6.4.14 Find and Delete Cut Set

This option allows you to delete all cut sets that contain a specified string. You may specify up to five event names as a search string. The search begins at the cut set at the top of the current display. To invoke this option, type <F>. The option list will be replaced with the find and delete request (Figure 103).

6.5 Logic Editor

This option allows you to modify the logic of a system or subsystem. When you invoke this option, Figure 104 will be displayed. You may toggle the display to list systems or subsystems (see Section 6.5.3). Three options are available: Exit, Logic Editor, and Sub-System.

6.5.1 Exit

This option terminates the process and returns you to the Fault Tree Analysis screen (Figure 63). To invoke this option, enter an <E> in the option field and press <Enter>, or press the <Esc> key.

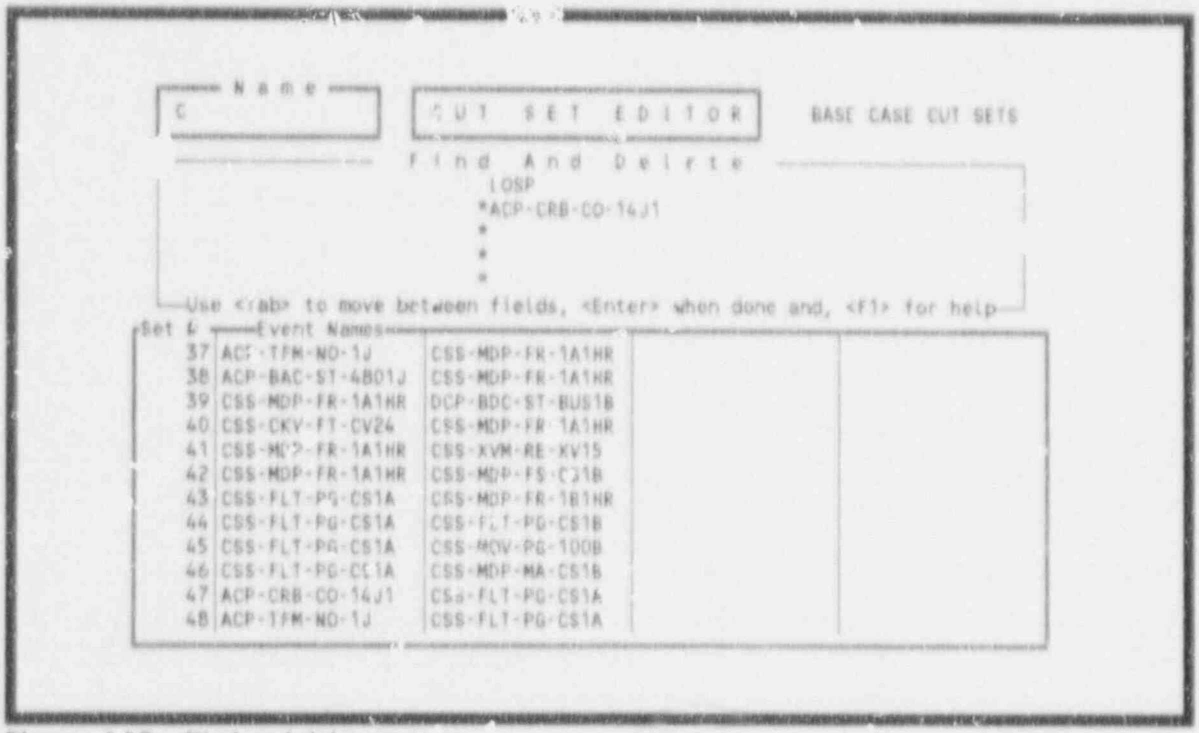


Figure 103. Find and delete cut sets.

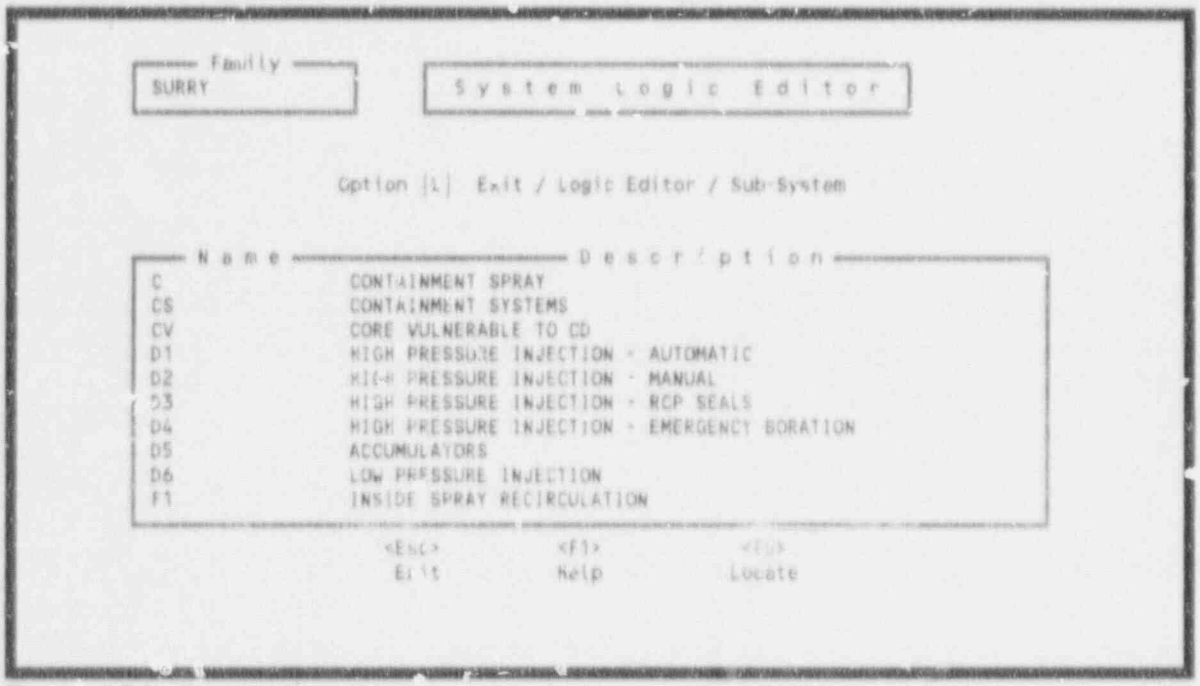


Figure 104. Logic editor display.

6.5.2 Logic Editor

To invoke this option, enter an <L> in the option field, highlight the desired system, and press <Enter>. If you do not highlight a system, the message **A record must be highlighted first** will be displayed. After highlighting a system and pressing <Enter>, Figure 105 will be displayed. All gates, types, and inputs contained in the selected system or subsystem will be displayed. Thirteen editing options are available. Each option will be discussed in the following paragraphs.

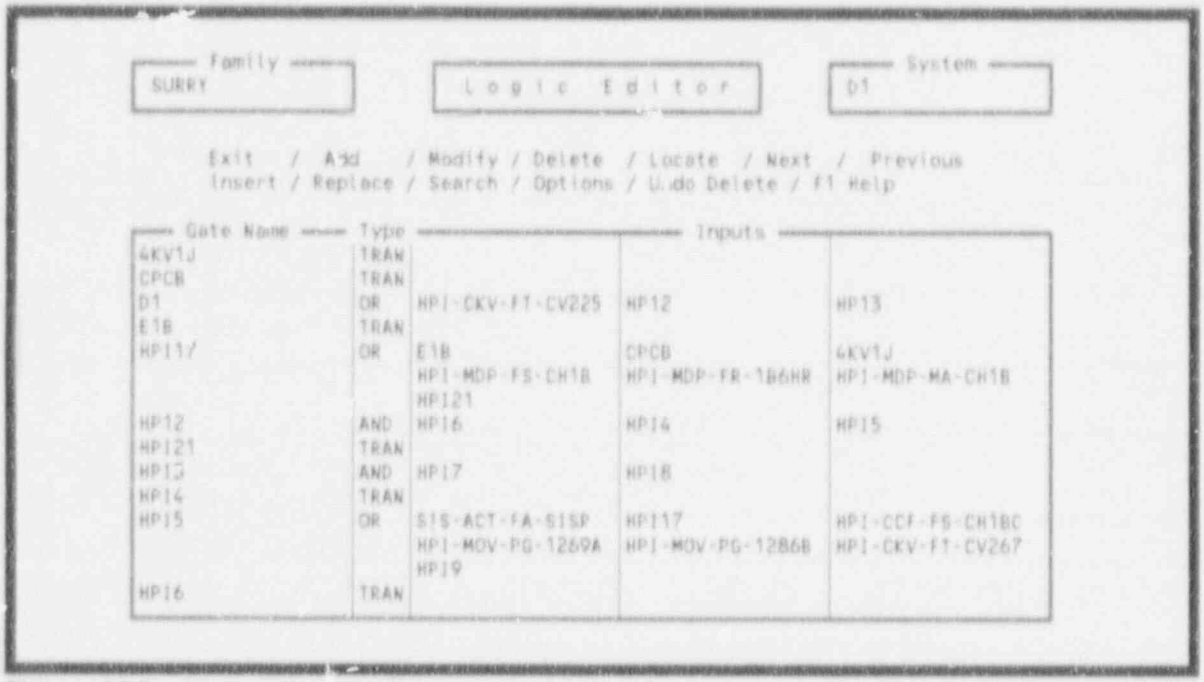


Figure 105. Logic editor display screen.

6.5.2.1 Exit. This option terminates the process and returns you to the System Logic Editor screen. To invoke this option, type an <E> and press <Enter>, or press the <Esc> key.

6.5.2.2 Add. This option allows you to enter a new gate name or input into the selected system or subsystem. To invoke this option, enter an <A> while positioned in the gate name column or at the desired input row or column. When you invoke this option, Figure 106 will be displayed.

On this screen, you enter the following fields:

Gate Name	-	Enter the new gate name. If you enter a name that already exists, the message **Duplicate gate names are not allowed** is displayed. You are returned to the gate name prompt to re-enter a valid name.
Type	-	Enter the gate type. Valid gate types include AND, OR, and TRAN.
Inputs	-	Enter any inputs (event names) for the new gate. After you enter an input, a window will be displayed asking you to identify the input as a

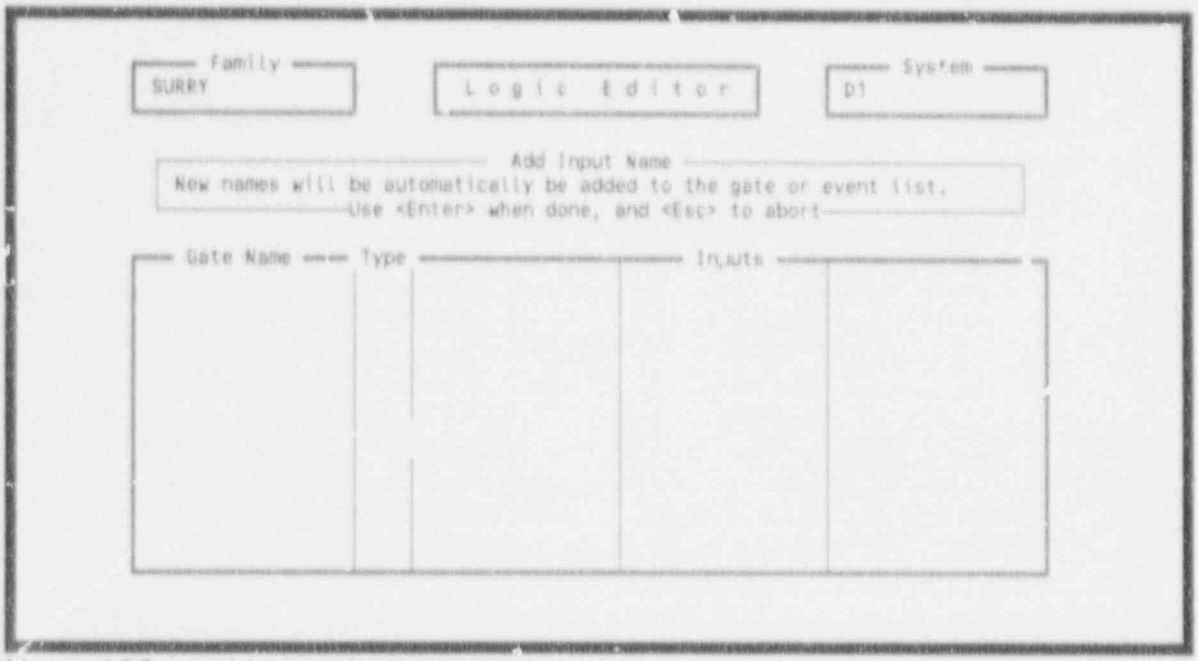


Figure 106. Add input to logic editor.

<G> (gate), <E> (event), or <A> (to abort the process). Press <Enter> to terminate the process.
If you are adding input to an existing gate, position the cursor at the desired location and press <A>. A blank highlight line will appear. Enter the input name and press <Enter>. The new input will appear on the screen.

6.5.2.3 Modify. This option allows you to modify any of the data displayed on the screen. To invoke this option, highlight the data you wish to update using the arrow or tab keys, and type an <M>. When you invoke this option, Figure 107 will be displayed. Use the insert, delete, or arrow keys to modify the highlighted text. You may only modify the highlighted text. Press <Enter> to exit and save the changes, or press the <Esc> key to exit without saving the changes.

6.5.2.4 Delete. This option allows you to delete any gate or event displayed on the screen. To invoke this option, highlight the gate or event you wish to delete using the arrow or tab keys and type a <D>. When you invoke this option, Figure 108 will be displayed. The following options are available:

Modify	-	Deletes the current event or gate name but first prompts you with the veto options.
Skip	-	Skips the selected delete.
Continue to end	-	Deletes without asking if you wish to delete.
End	-	Terminates the delete process.

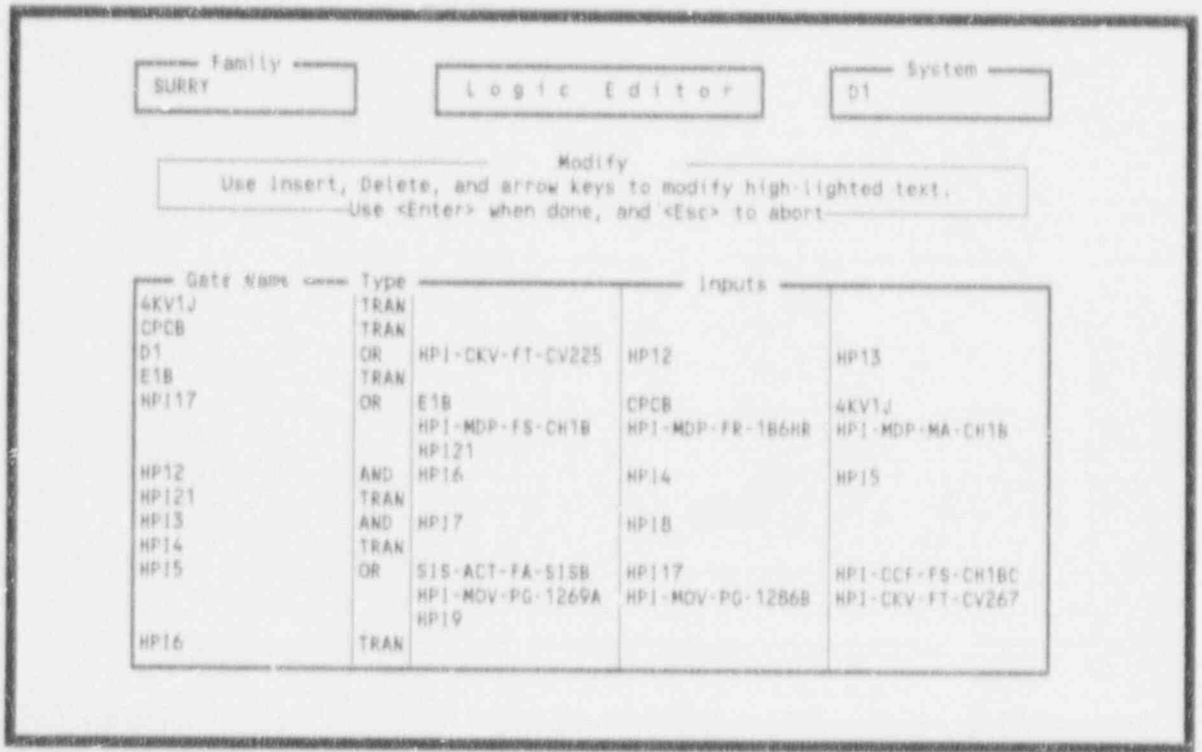


Figure 107. Modify logic editor data.

6.5.2.5 Locate. This option allows you to locate a specified gate or event. When you invoke this option, Figure 109 will appear at the top of the screen prompting you to enter the name you wish to locate. The input is case-sensitive, so you must enter the name exactly as it appears. Enter the gate or event name and press <Enter>. If found, the entered name or event will be highlighted and the message **Name Found** will be displayed at the bottom of the screen. If the event or name is not located, the message **Not found** will be displayed.

6.5.2.6 Next. This option highlights the next record in the display.

6.5.2.7 Previous. This option locates the previous record in the display.

6.5.2.8 Insert. This option allows you to insert a gate or event name. When you invoke this option, Figure 110 is displayed. This option uses two names: the find and the insert/replace name. The find name is the name to be matched. It may contain any number of "*" or "?" characters. These wild card characters have the same meaning as they do in DOS file names. The insert field cannot contain any wild card characters, and will be used exactly as typed.

6.5.2.9 Replace. This option allows you to replace a gate or event name. When you invoke this option, Figure 111 is displayed. This option uses two names: the find name and the replace name. The find name is the name to be matched. It may contain any number of wild card characters. The 'replace with' field cannot contain any wild card specifications.

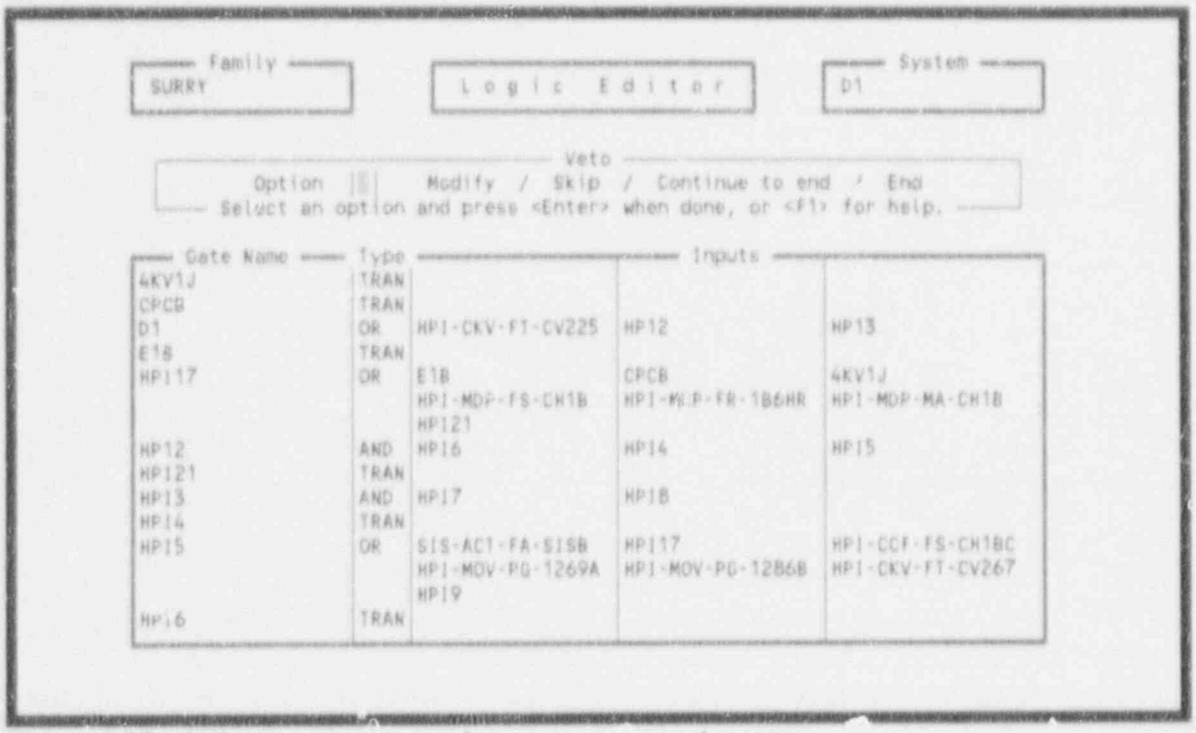


Figure 108. Delete a gate or event from a system or subsystem.

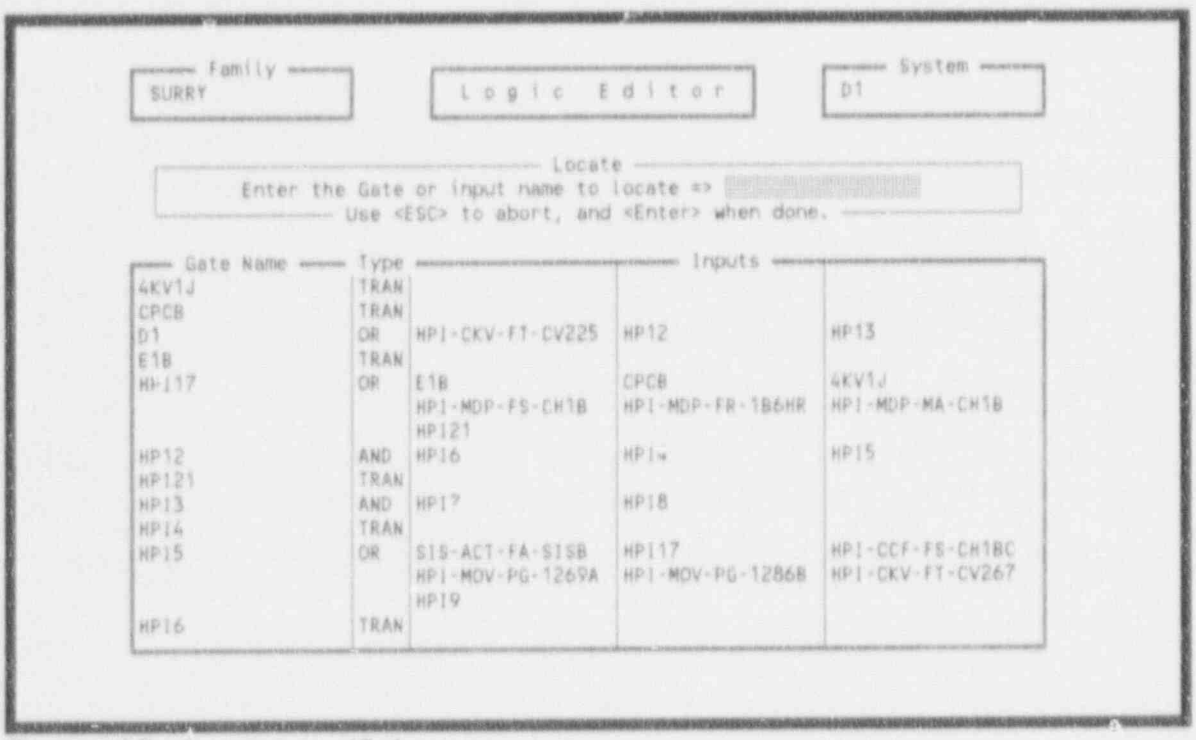


Figure 109. Locate a specified gate or event.

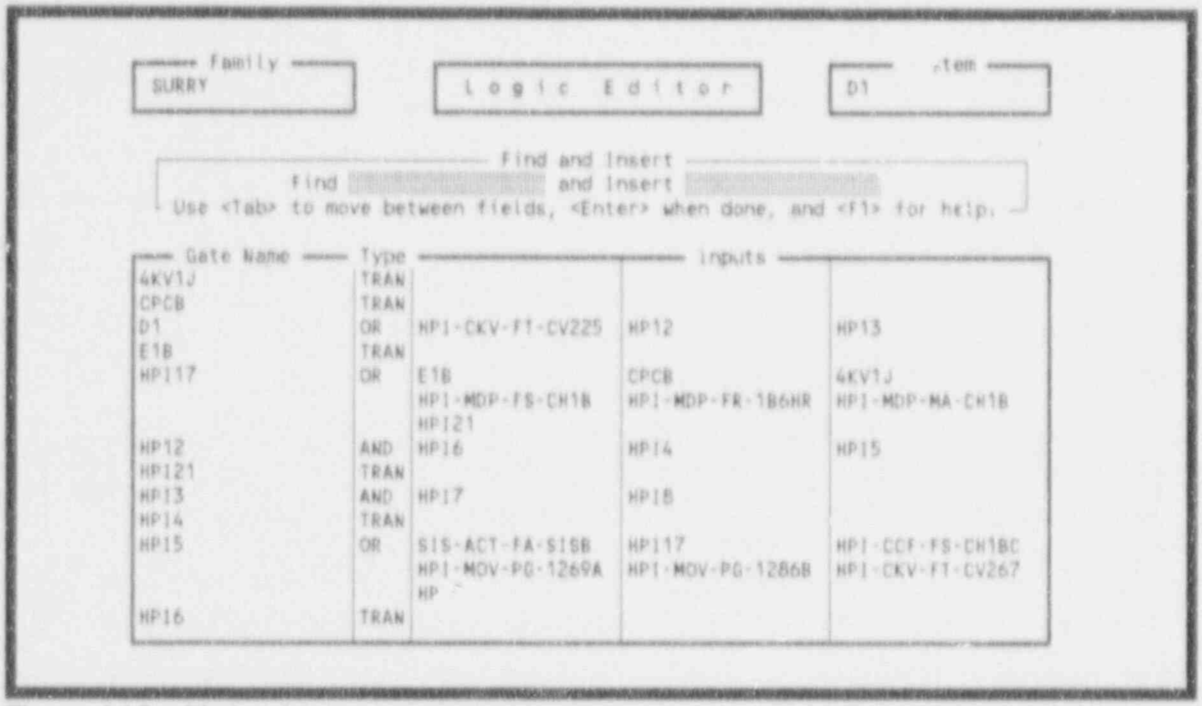


Figure 110. Find and insert a gate or event.

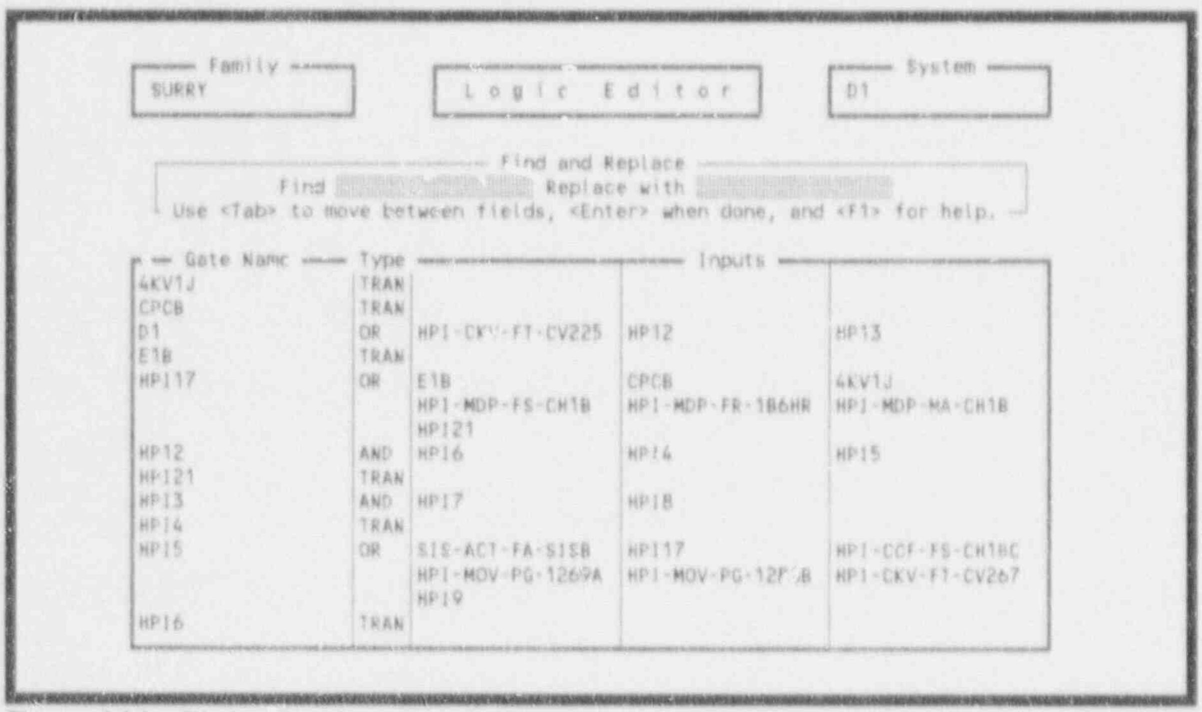


Figure 111. Find and replace an event or gate.

6.5.2.10 Search. This option allows you to perform a speed search. When you invoke this option, Figure 112 will be displayed. Enter the name to be located. As you start entering characters, the search will begin. If no record is found, the message **Input not found!!** will be displayed, and you will be returned to the Logic Editor Display.

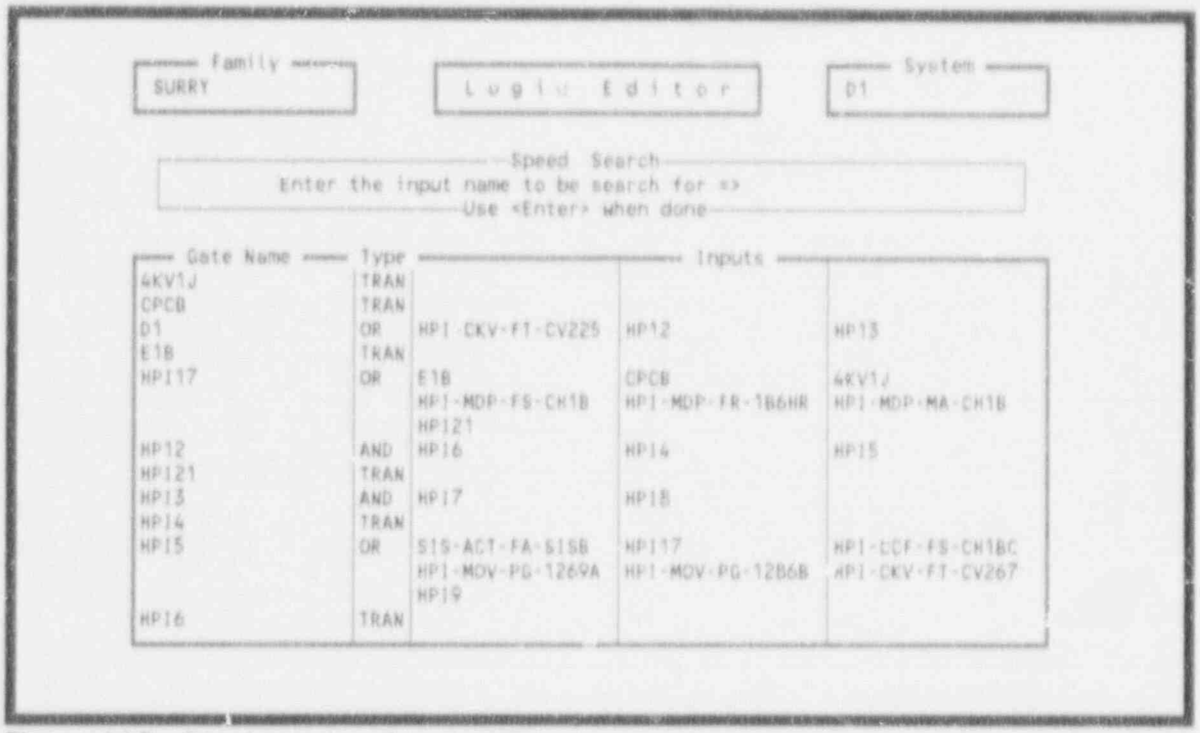


Figure 112. Speed search option.

6.5.2.11 Options. This option allows you to set the veto options. When you invoke this option, Figure 113 will be displayed. The following options may be set:

Veto	-	Veto tells each operation to ask again if you wish to modify the data. By default this is turned off.
Delete Veto	-	Functions the same as Veto. However, it applies only to the Delete command. By default this is turned on.
Help	-	Activates the on-line general help messages. When this is turned off, the help messages will not appear.

6.5.2.12 Undo Delete. This option allows you to retrieve your last delete. If you have accidentally deleted an event or gate, you may invoke this option to retrieve it. Only your last deletion may be retrieved.

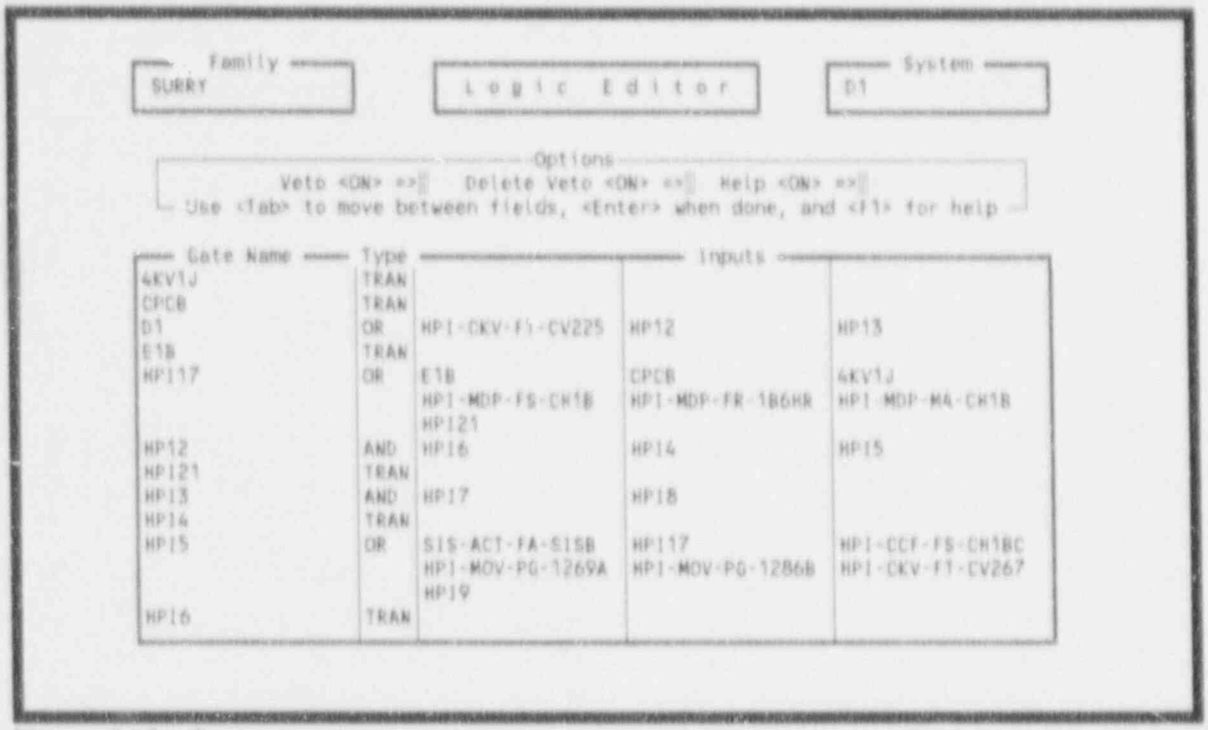


Figure 113. Set veto options screen.

6.5.2.13 F1 Help. This option displays the cursor movements that allow you to easily move through the Logic Editor Display (see Figure 114). To move the cursor about the editing window, use the keyboard cursor pad. The arrow keys move one field in each respective direction. The <Home> key places the cursor in the upper right corner of the window. The <PgUp> key moves the window up one page (12 lines). The <PgDn> key moves the window down one page (12 lines). The <Ctrl-PgUp> and <Ctrl-PgDn> keys move to the top and bottom of the file, respectively. Pressing the <F1> key toggles between two cut set editor screens. One screen shows the editing options and other shows the cursor movements.

NOTE: When you press the <Esc> key to terminate the Logic Display, Figure 115 is displayed.

6.5.3 Sub-System

Toggles the System Logic editor display to list systems or subsystems on the screen. To invoke this option, enter an <S> in the option field, and press <Enter>. To toggle back to the previous display, simply enter an <S> in the option field and press <Enter>.

```
Family                                      System
SURRY              L o g i c   E d i t o r   D1

   <↑>Cursor Up   <↓>Cursor Down   <←>Cursor Left   <→>Cursor Right
<End>End of Page   <Home>Top of Page   <PgUp>Page Up   <PgDn>Page Down
   <Ctrl-PgUp>Top of File   <Ctrl-PgDn>End of File   <F1> Help

Gate Name        Type                         Inputs
4KV1J            TRAN
CPCB             TRAN
D1               OR    HPI-CKV-FT-CV225   HP12               HP13
E1B              TRAN
HPI17            OR    E1B                CPCB               4KV1J
                       HPI-MDP-FS-CH1B    HPI-MDP-FR-1B6HR   HPI-MDP-MA-CH1B
                       HP121
HP12             AND   HP16               HP14               HP15
HP121            TRAN
HP13             AND   HP17               HP18
HP14             TRAN
HP15             OR    SIS-ACT-FA-SISB    HPI17              HPI-CCF-FS-CH1BC
                       HPI-MOV-PG-1269A   HPI-MOV-PG-1286B   HPI-CKV-FT-CV267
                       HP19
HP16             TRAN
```

Figure 114. Cursor movements help display.

```
C - Check data, if ok then save and exit,
                if not ok then continue editing.

R - Return to editing after checking data.

E-  Exit WITHOUT saving changes.

          (C, R, or E)  |C|
```

Figure 115. Save/abort changes screen.

7.0 CREATE EVENT TREES

This option allows you to graphically build and edit event trees and output them to several hard copy hardware devices. To select this option, highlight the "CREATE Event Trees" option on the IRRAS main menu or enter a <C> and press <Enter>. When you invoke this option, Figure 116 will be displayed. As shown, the following options are displayed:

Exit	Returns you to the IRRAS main menu.
Create Event Trees	Allows you to build and edit event tree diagrams.
Link Event Trees	Allows you to define linkage rules and generate sequence logic.
Plot Trees	Allows you to plot graphics files or generate HPGL formatted files.
Graphics Load	Allows you to load event tree graphic files (i.e., .ETG files).
eXtract Event Trees	Allows you to extract event trees, clear extracted event trees, and display extracted event trees.
Define Plotter Pens	Allows you to assign colors to your plotter pens.

Each of these options is discussed in the following paragraphs.

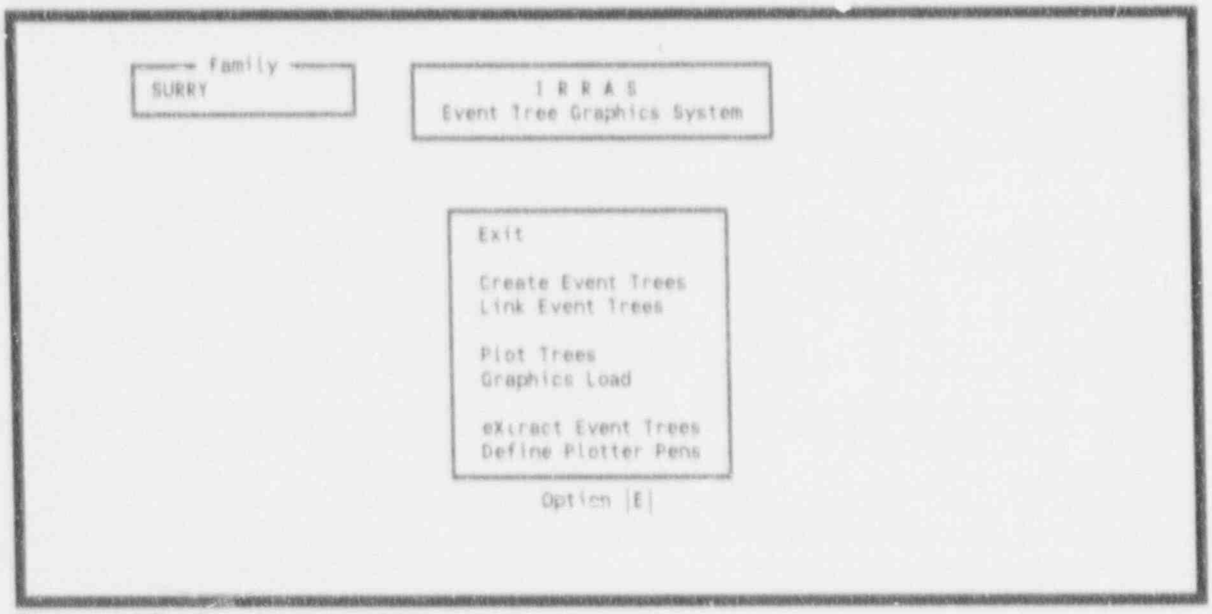


Figure 116. Event tree graphics system menu.

7.1 Exit

This option terminates the event tree option and returns you to the IRRAS main menu. To invoke this option, highlight the Exit option and press <Enter>.

7.2 Create Event Trees

This option allows you to construct or edit an event tree diagram. You may start building the diagram from scratch or from an existing file to generate or modify logic. When this option is selected, Figure 117 is displayed. The editing commands are shown in the left column, while the rest of the screen is the drawing surface. The commands shown in all upper-case letters (excluding EXIT) have additional pop-up menus associated with them. The cursor is used to position pop-up menus and select menu options.

To invoke any of the editing commands (using a mouse), position the cursor over the desired editing command on the active menu. The active menu is the last menu you pulled up or moved. When the editing command box is highlighted (a white line outlines the box), press the left mouse button. The command is now invoked. Each editing command is described in the following paragraphs.

7.2.1 EXIT

This option terminates the editing session and returns you to the previous screen (Figure 116). To invoke this option, position the cursor over the EXIT box and press the left mouse button or <Enter>.

7.2.2 Move (←→)

The move command, which is represented by ←→, allows you to position the editing command menu anywhere on the screen. When you invoke this command, a white outline surrounds the entire editing column. Drag the cursor to position the outline at the desired location and press the left mouse button or <Enter>. The menu will be displayed at the new location.

7.2.3 Show

This command clears the screen and re-displays the currently defined diagram.

7.2.4 EDIT

This command allows you to make changes to the event tree. When you invoke this option, an additional pop-up menu is displayed (Figure 118). As shown, six options are available: EDIT, Add, Del, Copy, Pass, and Page.

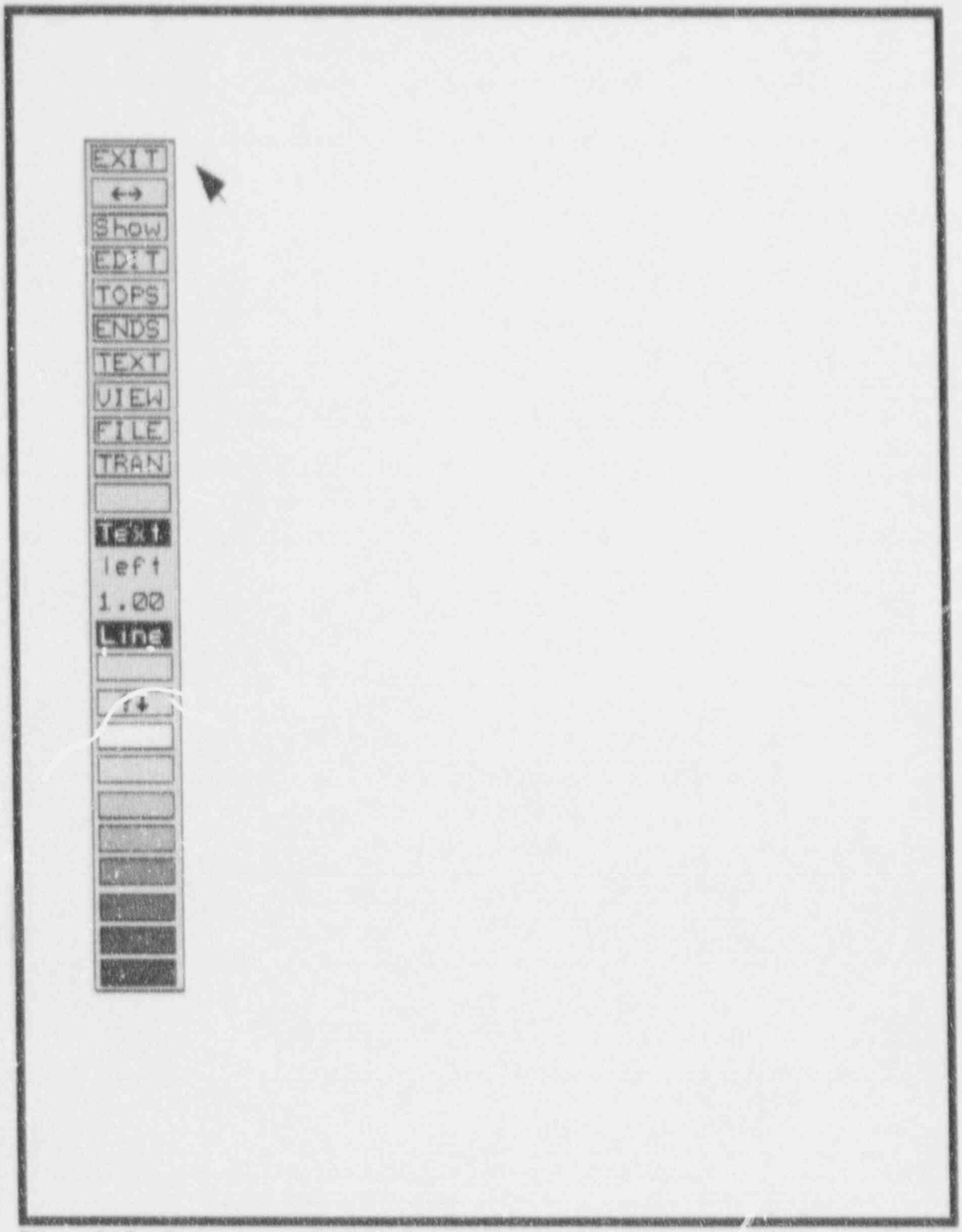


Figure 117. Create event tree editing commands.

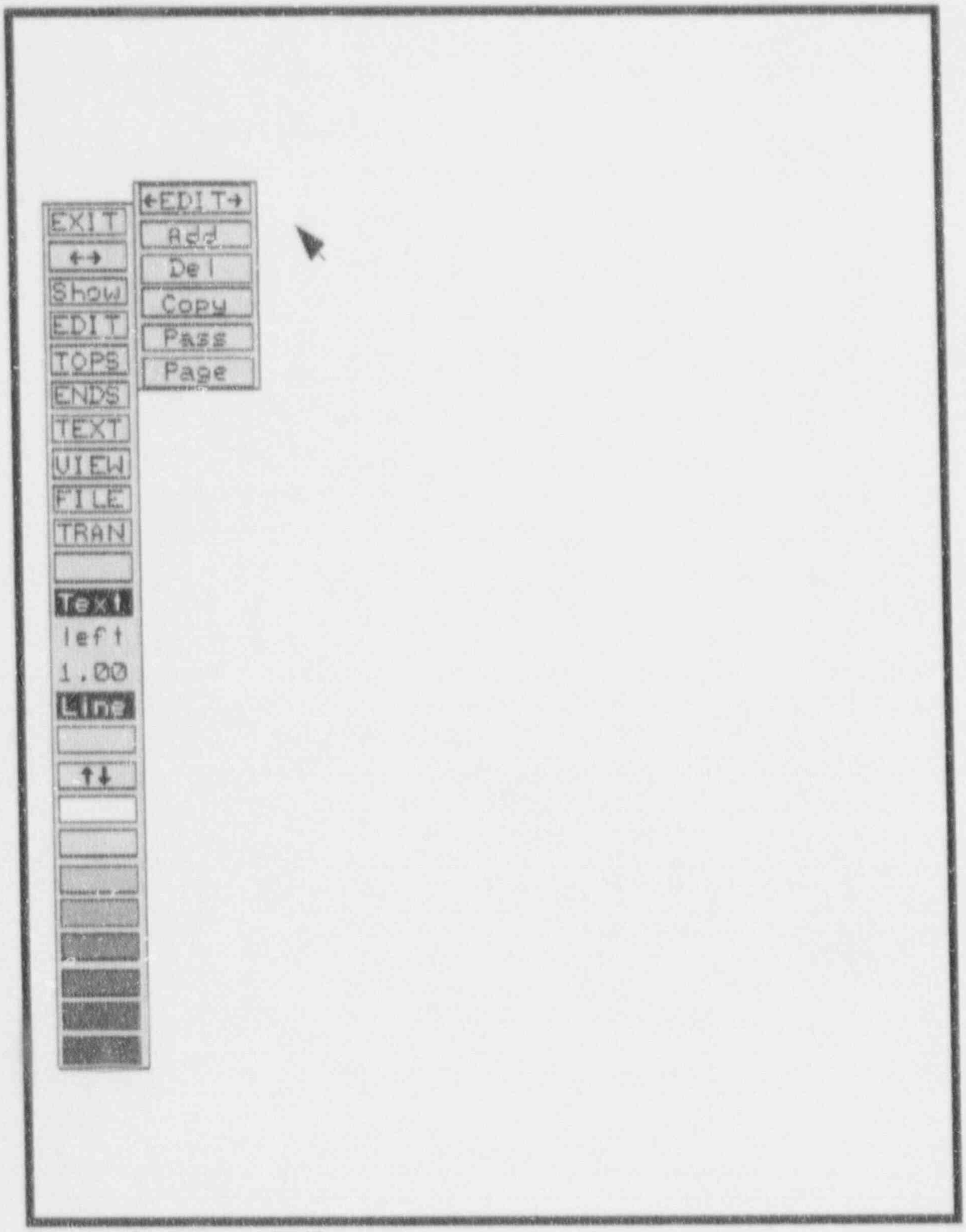


Figure 118. Event tree EDIT pop-up menu.

7.2.4.1 ←EDIT→. This option allows you to move the pop-up menu to a new location on the screen. To invoke this option, position the cursor on the ←EDIT→ box and press the left mouse button. An outline will appear. Move the outline to the new location on the screen and press the left mouse button. The menu will be moved to the new location.

7.2.4.2 Add. This option allows you to add a branch to the event tree. When you invoke this option, you will be prompted to **Pick the intersecting point of the new branch.** The cursor will change from a filled cursor arrow to an 'empty' cursor arrow. Position the cursor over the place where the new branch is to be added and press the left mouse button. A small box will appear. Next, you will be prompted to **Pick the vertical position of the new branch.** The vertical position determines whether the new branch will be added above or below the existing branch. Position the cursor to the desired vertical position and press the left mouse button. The diagram is redrawn with the new branch added. The prompt to **Pick the intersecting point of the new branch** will return. At this point you can select another location to add a branch or press the right mouse button to terminate the add process.

7.2.4.3 Del. This option allows you to delete branches from the tree. When you invoke this option, you will be prompted to **Pick the branch to be deleted**. Position the cursor on the branch to be deleted and press the left mouse button. The selected branch will be highlighted and the message **Delete highlighted branch? Left = YES, Right = NO** will be displayed. If the highlighted branch should be deleted, press the left mouse button; if not, press the right mouse button. If you responded yes, the diagram will be redrawn to reflect the deletion. In either case, the prompt **Pick the branch to be deleted** will return. At this point you may select another branch to delete, or press the right mouse button to terminate the deletion process.

7.2.4.4 Copy. This option allows you to copy existing branches of the tree to new locations. When you invoke this option, you will be prompted to **Pick beginning of the branch to copy**. Position the cursor at the start of the branch to be copied and press the left mouse button. Next, you will be prompted to **Pick copy location**. There are three ways to use the copy command. In each case you select the existing branch to be copied. Then you may either place the cursor over the start of a pass, at the start of a branch and replace the existing branch, or place the cursor at the start of a branch and add the copied logic to the branch. Depending on the copying method you use, you will be prompted with **Replace = left button, Add = Right button**. If this branch is a replacement for an existing branch, press the left mouse button. If this branch is an addition, press the right mouse button. If this branch is an addition, you will be prompted to **Pick vertical location of the start of new sub-tree**. Pick the new location and press the left mouse button.

7.2.4.5 Pass. This option allows you to change a branch to a pass. When you invoke this option you will be prompted to **Pick the branch that is to be made a pass**. Position the cursor on the branch to be converted and press the left mouse button. The entire branch is highlighted and you will be prompted with **Make highlight branch a pass? Left = YES, Right = NO**. If this is the branch you wish to change into a pass press the left mouse button; otherwise, press the right mouse button. If you respond yes, the branch is converted to a pass. If you respond no, the process is terminated. In either case, the prompt **Pick the branch that is to be made a pass** will return. At this point you may select another branch, or press the right mouse button to terminate this procedure.

7.2.4.6 Page. This option allows you to separate a large drawing into separate pages. When you invoke this option, you will be prompted to **Pick beginning of the branch to page**. Position the cursor at the branch where the new page is to start and press the left mouse button. The message **Create Transfer Here? [Y]** will appear. If this is the point where the page should appear, press Y; otherwise enter an "N."

When you highlight a section of the drawing and enter a "Y" to transfer, the block will be moved to the next page and a transfer will be created automatically by the system. If you respond "N" to the transfer the diagram will not be broken up and a transfer will not be created. In either case, the prompt **Pick beginning of the next branch to page** will appear. At this point, you may select another location to page or press the right mouse button to terminate the paging process.

7.2.5 TOPS

This option allows you to make changes to the top events. When you invoke this option, an additional pop-up menu will be displayed (Figure 119). As shown, the following options are available: TOPS, Add, Del, Edit, Name?,Width, Size, FONT, and DESC.

7.2.5.1 ←TOPS→. This option allows you to move the pop up menu to a new location on the screen. To invoke this option, position the cursor on the ←TOPS→ box and press the left mouse button. An outline will appear. Move the outline to the new location and press the left mouse button. The menu will be moved to the new location.

7.2.5.2 Add. This option allows you to add a new event. For example, an event tree might have the existing events 1, 2, 3, and 4. A new event is needed between events 2 and 3. You select this event and will be prompted to **Pick the event that will follow the new event**. The cursor will change from an arrow to a cross hair. Position the cross hair at the desired event (in this example, we would pick event 3) and press the left mouse button. The prompt **Enter new event name:** will be displayed. Enter the event name (up to 16 characters are allowed) and press <Enter>. The diagram will be redrawn and displayed showing the newly added event and the event list will be updated.

7.2.5.3 Del. This option allows you to delete an event. To delete an event all branch points that logically fall below the event must be converted to passes. When you invoke this option you will be prompted to **Pick the event that is to be deleted**. The cursor will change from an arrow to a cross hair. Position the cursor on the event to be deleted and press the left mouse button. If the branch points have not been converted to passes, the message **The event picked is currently being used in the tree** will be displayed. If you want to delete the event you must go back and convert the branch points using the PASS option under the EDIT command. When the deletion is successful, the tree will be updated and redisplayed.

7.2.5.4 Edit. This option allows you to change an event name. When you invoke this option you will be prompted to **Pick the event name to be edited**. The cursor changes from an arrow to a cross hair. Position the cursor on the event in the diagram or the event name displayed at the top to be renamed and press the left mouse button. The prompt **Enter new event name for xxx:** will be displayed. Enter the new name (up to 16 characters are allowed) and press <Enter>. The event name will be changed at the top of the diagram.

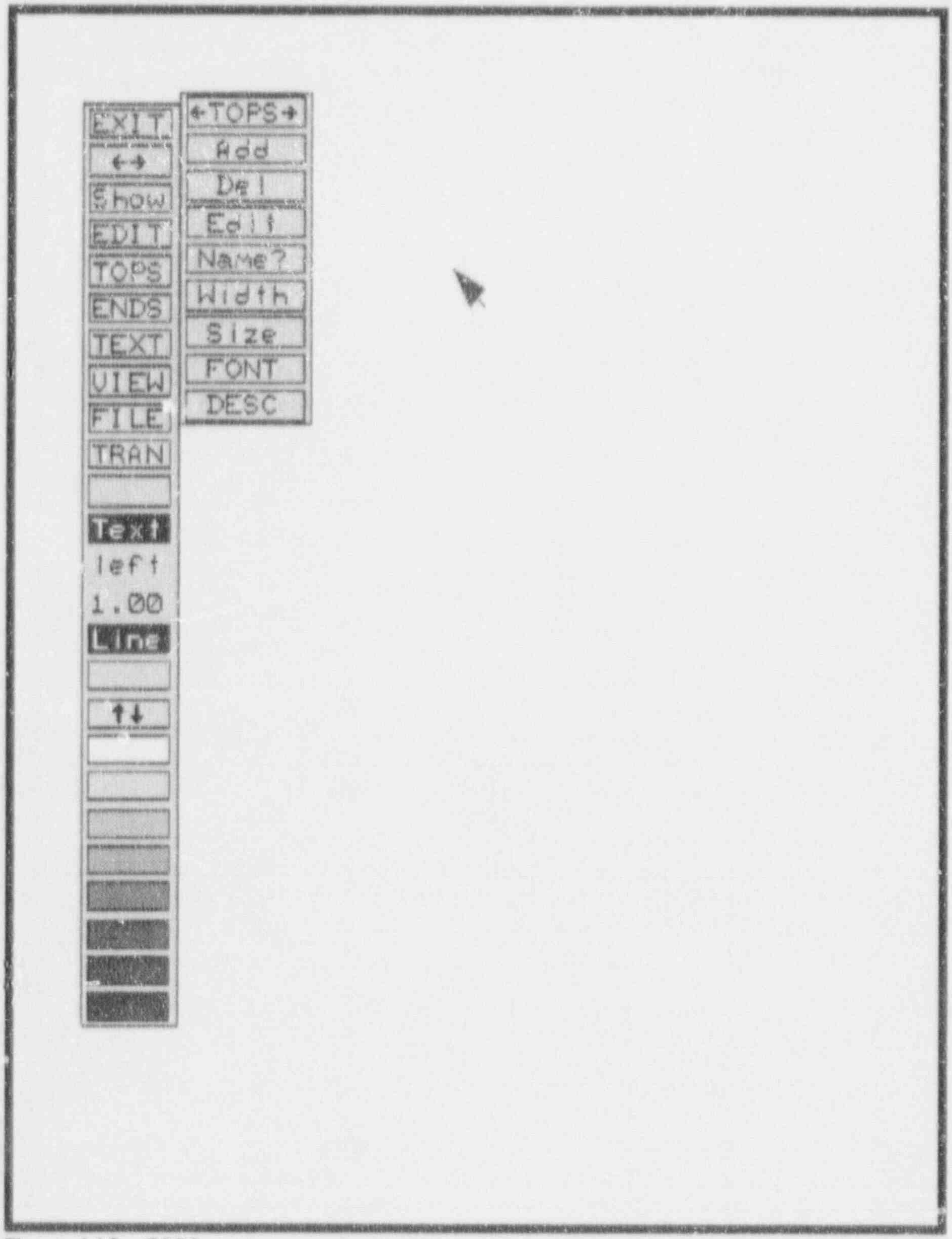


Figure 119. TOPS pop-up menu.

7.2.5.5 Name?. To conserve space on the diagram, a limited number (default is 5) of characters of the event name are displayed on the diagram. Use this option to display the complete event name (all 16 characters). When you invoke this option you will be prompted to **Pick an event name.** The cursor will change from an arrow to a cross hair. Position the cursor on the desired event name at the top of the diagram and press the left mouse button. The entire event name will be displayed on the prompt line at the bottom of the screen. The cross hair will remain so you may select additional event names to display or press the right mouse button to terminate the process.

7.2.5.6 Width. This option allows you to change the displayed width of the event names. When you invoke this option, you will be prompted to **Enter top width size <old size>**. Enter the new top width size and press <Enter>. You may enter a value greater than 1 (default is 5). If you press <Enter> without entering a value, the width does not change. If the width is changed, the tree will be redisplayed with the new width.

7.2.5.7 Size. This option allows you to change the text size of the event names. When you invoke this option, you will be prompted to **Enter new top name text size <old value>**. Enter the new text size and press <Enter>. You may enter a value of 0.01 to 9.00. If you press <Enter> without entering a new value, the text size does not change. If the text size is changed, the tree will be redisplayed with the new top text size.

7.2.5.8 FONT. This option allows you to select the font type for the event names and headers. When you select this option, an additional pop-up menu will be displayed (see Figure 120). Select the desired font type by positioning the cursor over the font and pressing the left mouse button. You must select a font (or cancel) in order to continue. If the font type is changed, the tree will be redisplayed with the new event name font type.

7.2.5.9 DESC. This option allows you to edit event description text and set various attributes of the descriptions including text size, font type, and number of lines of description to display. When you invoke this option, an additional pop-up menu will be displayed (see Figure 121).

7.2.5.9.1 ←DESC→ —This option allows you to move the pop-up menu to a new location on the screen. To invoke this option, position the cursor on the ←DESC→ box and press the left mouse button. An outline will appear. Move the outline to the new location and press the left mouse button. The menu will be moved to the new location.

7.2.5.9.2 Edit—This option allows you to edit or add any event name descriptions contained in the displayed diagram. When you select this option, you will be prompted to **Pick the event description to be edited**. To select the event description to edit, move the cursor over the event or event description and press the left mouse button. A window will appear displaying the selected description and the prompt **Edit Description - Press <Esc> when done** will appear. If no description exists, enter a description. To modify the description, simply type over the existing description. Use the <Ins> and <Del> keys to add and delete characters as necessary. In addition, you may use the Backspace and End keys. The Backspace key deletes the character to the left of the cursor and moves the rest of the characters to the left one space. The End key positions the cursor at the end of the current line. When complete, press <Esc>. You will be prompted to **Pick the event description to be edited**. At this point you may select another description to edit or press the right mouse button to terminate the process.

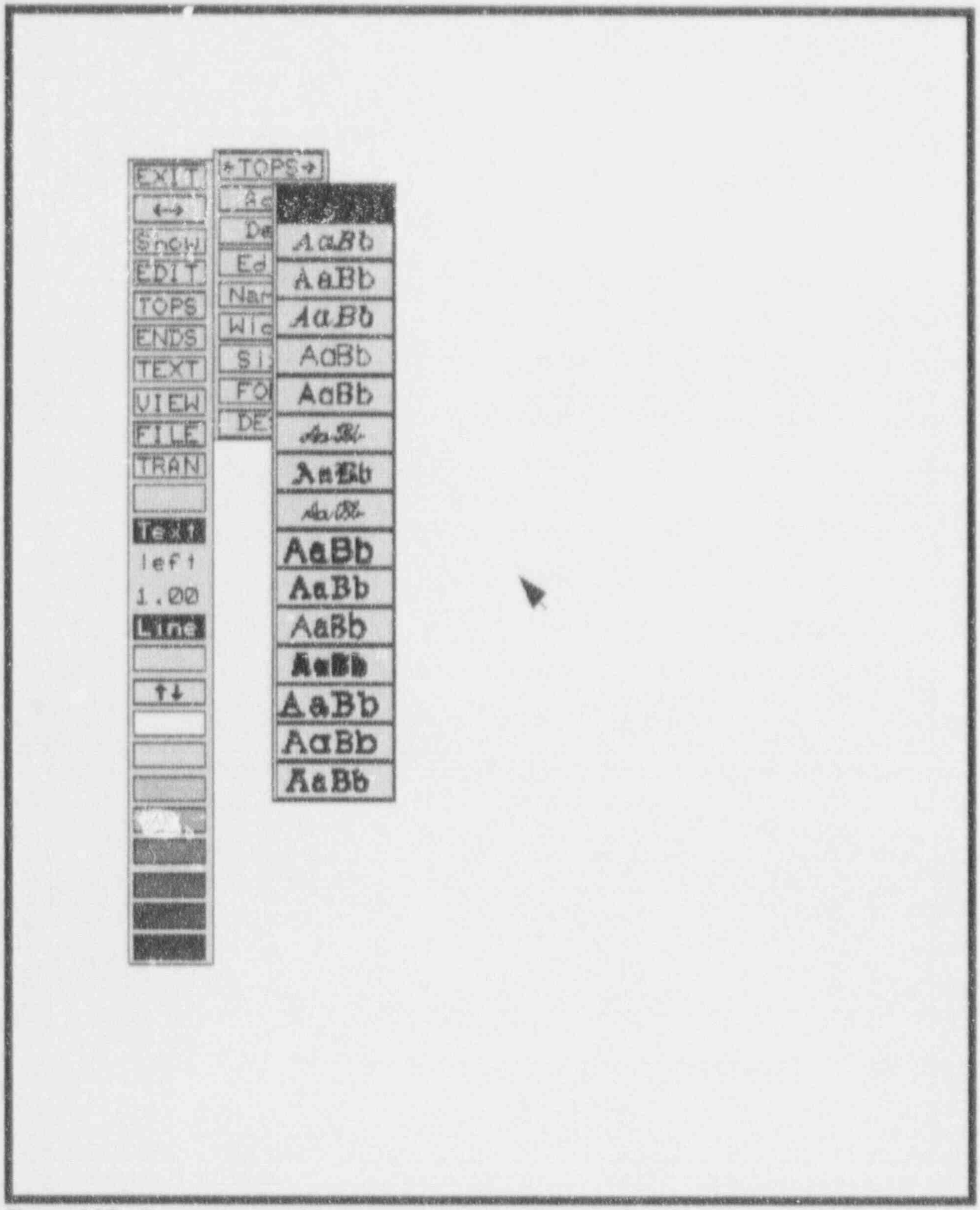


Figure 120. Font type menu for event names and headers.

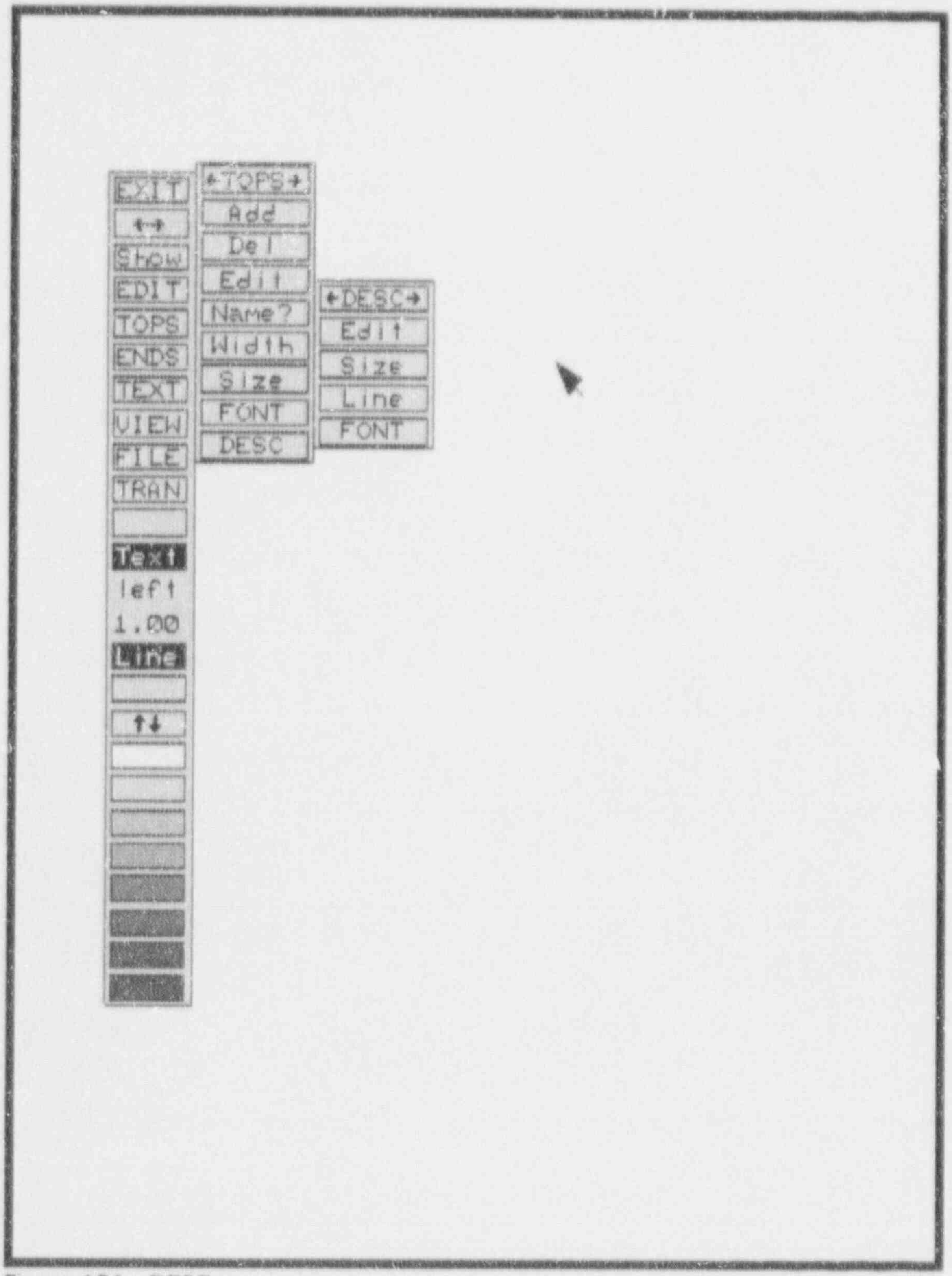


Figure 121. DESC pop-up menu.

7.2.5.9.3 Size—This option allows you to specify the height of the event descriptions in your diagram. The prompt **Enter new top description text size: <old size>** will be displayed. At this prompt, enter the desired text size and press <Enter>. You may enter a value of 0.01 to 9.0. The event descriptions will be displayed in the new size.

7.2.5.9.4 Line—This option allows you to specify the number of lines in event descriptions. When you invoke this option, you will be prompted to **Enter new top description line count: <old count>**. At this prompt, enter the desired line count and press <Enter>. You may enter a value of 0 or greater. The event descriptions will be displayed with the new line count.

7.2.5.9.5 FONT—This option allows you to select the font type for the event descriptions. When you select this option, an additional pop-up menu will be displayed (see Figure 122). Select the desired font type by positioning the cursor over the font and pressing the left mouse button. You must select a font (or cancel) to continue. If the font type is changed, the event descriptions will be redisplayed.

7.2.6 ENDS

At the end of each sequence is a unique number and some textual information. This information includes the sequence name, end state name, and two other fields used for user defined information. You may provide a sequence name or the software will use defaults of A, B, C, etc. (See Generating Sequence Logic section for a discussion of using numbers instead of names.) When a branch (sequence) is added, the names or "ends" are given defaults. Each default equates to a blank screen. Also, a display option is given to each end. This allows you to turn on or off the information. Usually you will have the text turned off while building your event tree. Each list or column of information has a header. The header may be placed at any horizontal location. Display information is associated with each header. Individual sequences and/or column information may be turned off or on. Sequence and header information, along with the display and placement attributes, are modified through the ENDS command. When you invoke this command, an additional pop-up menu is displayed (Figure 123). As shown, the following options are available: ENDS, End States, Edit Header, Place Header, Edit Height, Edit Size, and FONT.

7.2.6.1 ←ENDS→. This option allows you to move the pop-up menu to a new location on the screen. To invoke this option, position the cursor on the ←ENDS→ box and press the left mouse button. An outline will appear. Move the outline to the new location and press the left mouse button. The menu will be moved to the new location.

7.2.6.2 End States. This option allows you to display information about the end state. When you invoke this option you will be prompted to **Pick the leaf corresponding to the desired endstate information.** The cursor is placed on the tree at the end of the sequences. The cursor will only move in the vertical direction allowing you to pick only leaf branches. Position the cursor at the desired end state and press the left mouse button. A window will appear displaying the sequence names, end state names, frequencies, and the data contained in the two user-defined fields for the selected end state. Next, you will be prompted to **Pick the box to be edited**. Position the cross hair over the box to be edited and press the left mouse button. If you choose to edit the sequence names, end state names, or frequency values you will be prompted to **Enter Text:**. Enter the desired text and press <Enter>. If a name already exists, it will be overwritten with the new name you entered.

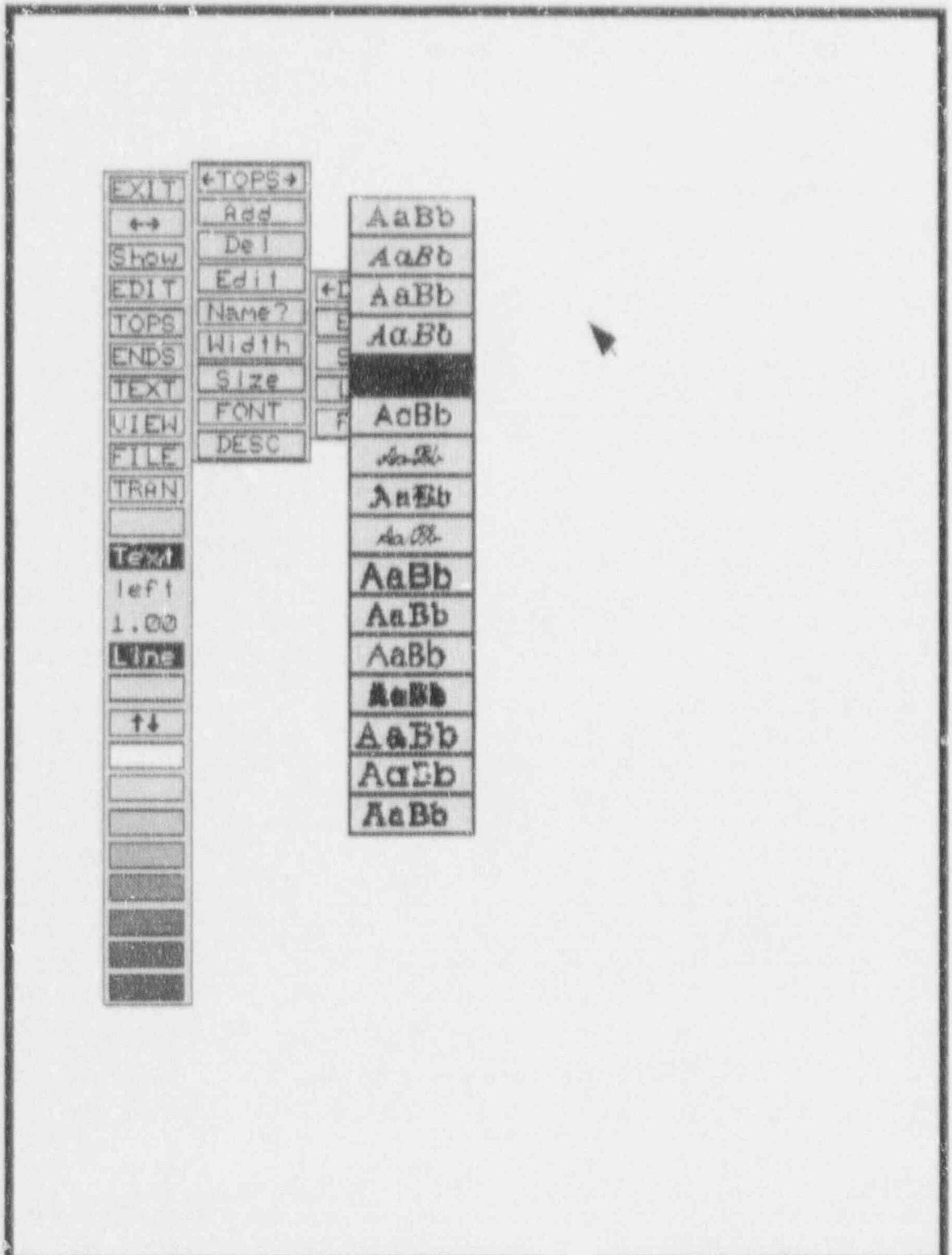


Figure 122. Font selection for event descriptions.

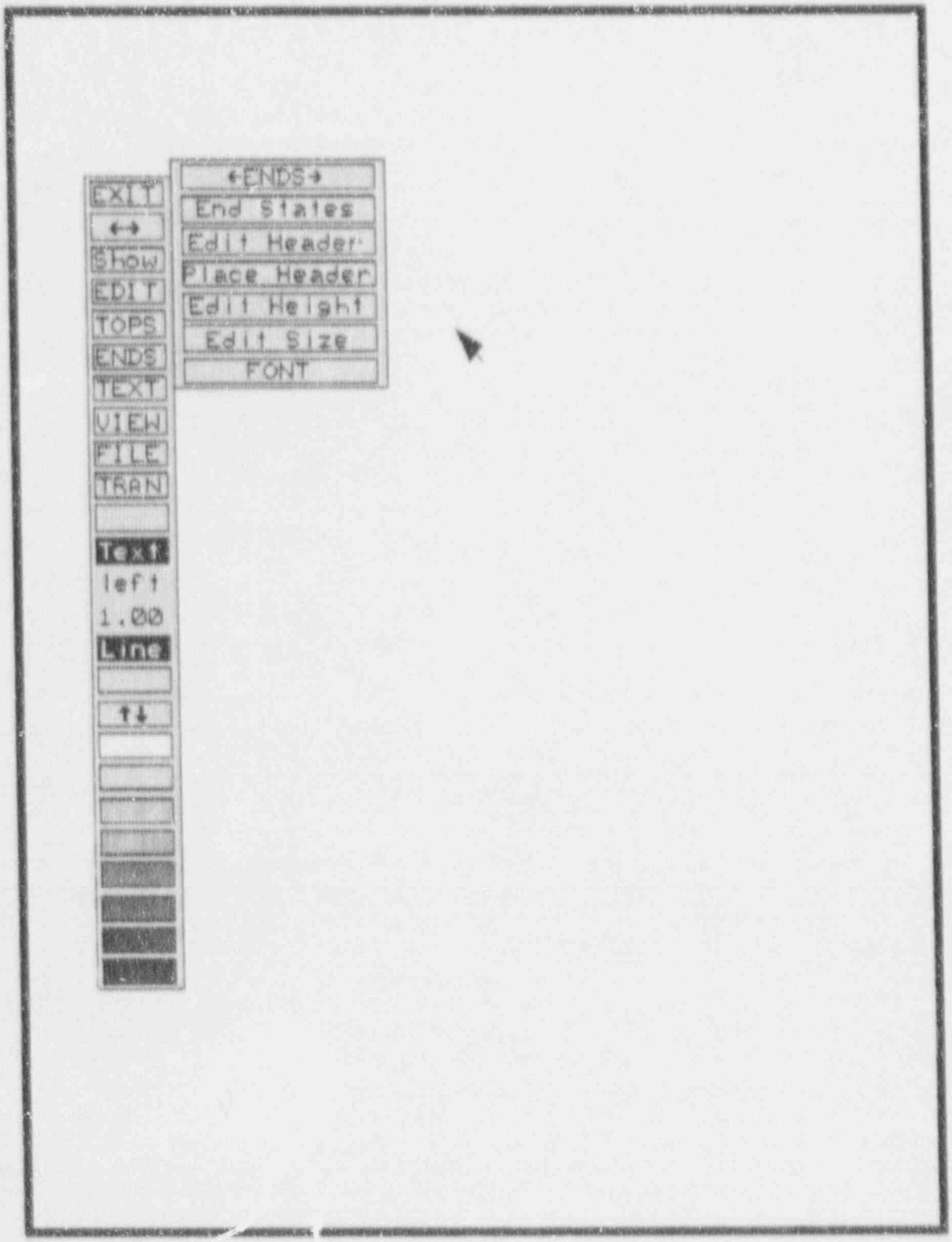


Figure 123. ENDS pop-up menu.

The two remaining fields are toggle switches. The toggles allow you to specify whether or not to display the item.

IRRAS provides four columns of information for the user to add additional information about each sequence in an event tree. IRRAS requires that the first column be the sequence name, the second must be the end state, the third is used to store the sequence frequency, and the fourth is user defined. The column names and positions may be changed by the user, but the information stored in each column must be as explained above.

To terminate this process, press the right mouse button. The window will disappear and you will be returned to the **Pick the leaf corresponding to the desired endstate information** prompt. At this point, you may select another end state or press the right mouse button to terminate the process.

7.2.6.3 Edit Header. This option allows you to edit header information. When you invoke this option, a window appears. This window contains sequence names, end state names, frequencies, and two user defined fields contained in the header. Next, you will be prompted to **Pick the box to be edited**. Position the cross hair over the box to be edited and press the left mouse button. If you selected to edit sequence names, end state names, or frequency values you will be prompted to **Enter text:**. Enter the desired text and press <Enter>. If the box contained data, it will be replaced by the text you just entered. To terminate this process, press the right mouse button.

7.2.6.4 Place Header. This option allows you to move a header to another location on the screen. When you invoke this option you will be prompted to **Pick the header that is to be relocated.** Position the cross hair on the header contained in the listing on the right side of the screen or on the title to the left of the status/tops line at the top of the screen to be moved and press the left mouse button. You will be prompted to **Pick the placement point for the header**. Position the cursor on the desired location and press the left mouse button. The headers will be moved to the new location. The prompt **Pick the header that is to be relocated** will return. At this point, you may select another header to relocate or press the right mouse button to terminate the process.

7.2.6.5 Edit Height. This option allows you to specify the height or distance between branches (nodes) of the diagram. When you invoke this option, you will be prompted to **Enter new node height <old height> >**. At this prompt, enter the desired node height and press <Enter>. You may enter a value greater than 0.0. The tree will be redisplayed with the new node height.

7.2.6.6 Edit Size. This option allows you to specify the height of the end state text in your diagram. When you invoke this option, you will be prompted to **Enter new end state text size: <old value>**. At this prompt, enter the desired text size and press <Enter>. You may enter a value of 0.01 to 9.0. The tree will be displayed with the new end state text size.

7.2.6.7 FONT. This option allows you to select the font type for the end state text. When you select this option, an additional pop-up menu will be displayed (see Figure 124). Select the desired font type by positioning the cursor over the font and pressing the left mouse button. You must select a font (or cancel) in order to continue.

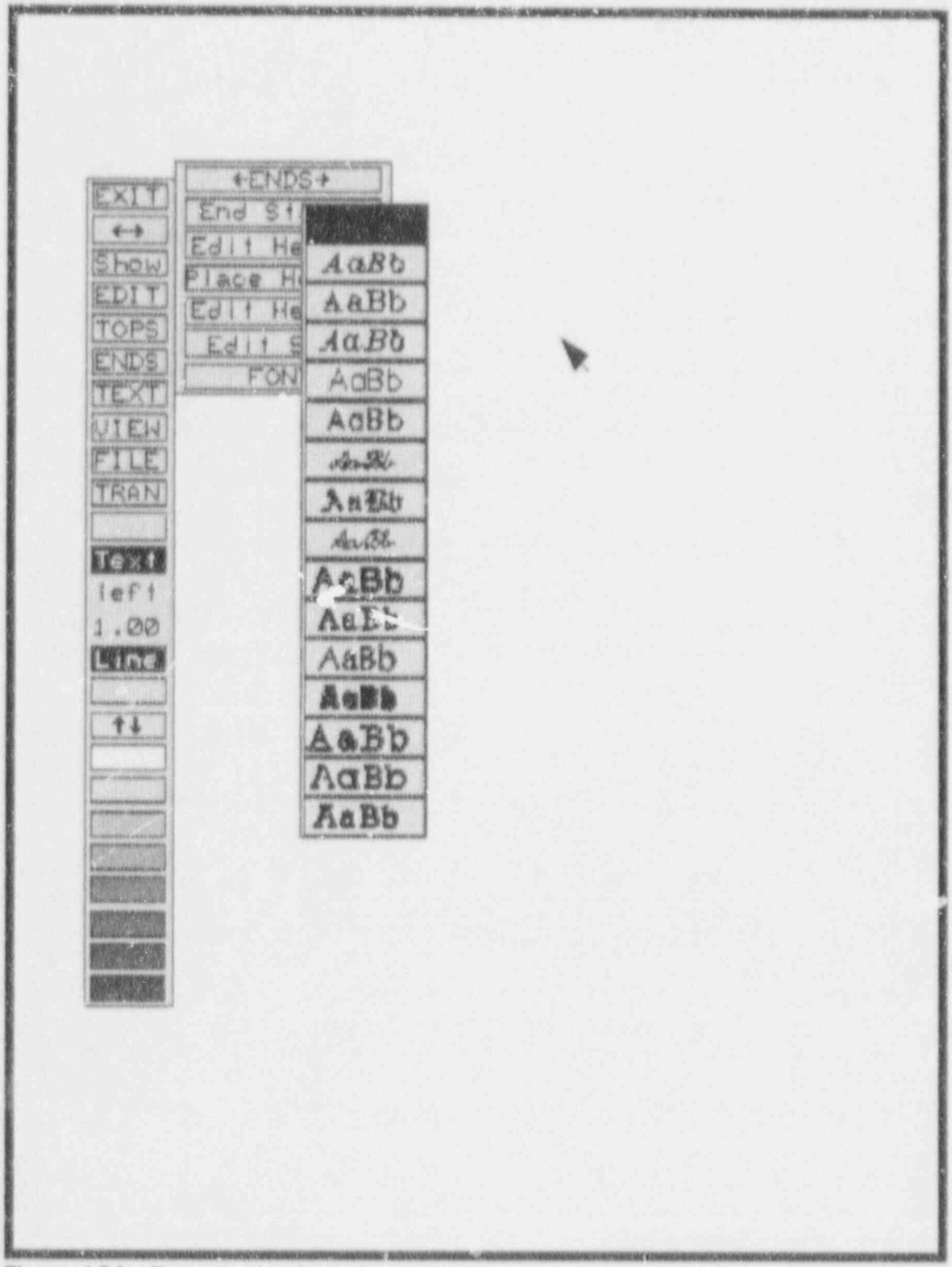


Figure 124. Font selection for end state text.

7.2.7 TEXT

This option allows you to add text to the diagram at any location, in any size and color. When you invoke this command, an additional pop-up menu is displayed (Figure 125). As shown, seven options are available: TEXT, FONT, Write, Move, Copy, Erase, and EDIT.

7.2.7.1 ←TEXT→. This option allows you to move the pop-up menu to a new location on the screen. To invoke this option, position the cursor on the ←TEXT→ box and press the left mouse button. An outline will appear. Move the outline to the new location and press the left mouse button. The menu will be moved to the new location.

7.2.7.2 FONT. This option allows you to select the font type for the text. When you select this option an additional pop-up menu will be displayed (Figure 126). Select the desired font by positioning the cursor over the font and pressing the left mouse button. You must select a font (or cancel) in order to continue. All new text will be displayed in the selected font. Remember, you are changing the default font type using this option. No existing text will be changed to this new font type. To change existing text, select the TEXT option, the EDIT suboption, and invoke the FONT command. You may then mark existing text to be changed to the default font.

7.2.7.3 Write. This option allows you to write text at any location on the screen. When you invoke this option you will be prompted to **Pick text placement location.** Position the cursor at the desired location and press the left mouse button. A window will appear in the top left corner of the screen. Enter the desired text. When complete, press <Esc>. If the show text option is turned on (See VIEW option), the newly added text will be displayed on the screen. Next, you will be prompted to **Pick next text placement location:**. At this point you may select another location to write text or press the right mouse button to terminate the process.

7.2.7.4 Move. This option allows you to move the selected text to a new location on the screen. When you invoke this option you will be prompted to **Pick region to be moved - press CANCEL to quit**. You select the region by marking the opposite corners of the text to be moved. Position the cross hair at the text you want to move and press the left mouse button. A small dot appears. Drag the cursor across the desired text until the box totally surrounds the text. Press the left mouse button again. The message **Pick reference point - press CANCEL to quit** will be displayed. The reference point is used to give you some indication of the position of the text being moved relative to the box. Position the cross hair at the location where you want the selected text to be moved to. Next, you will be prompted to **Pick placement point - press CANCEL to reselect**. Use the mouse to move the box to the exact position where you want the box to appear. When you are satisfied with the new position press the left mouse button. The selected text will be moved to the new location. The prompt **Pick placement point - press CANCEL to reselect** will be displayed again. At this point you may select another location to move the text, or press the right mouse button or <Esc> key to terminate the process.

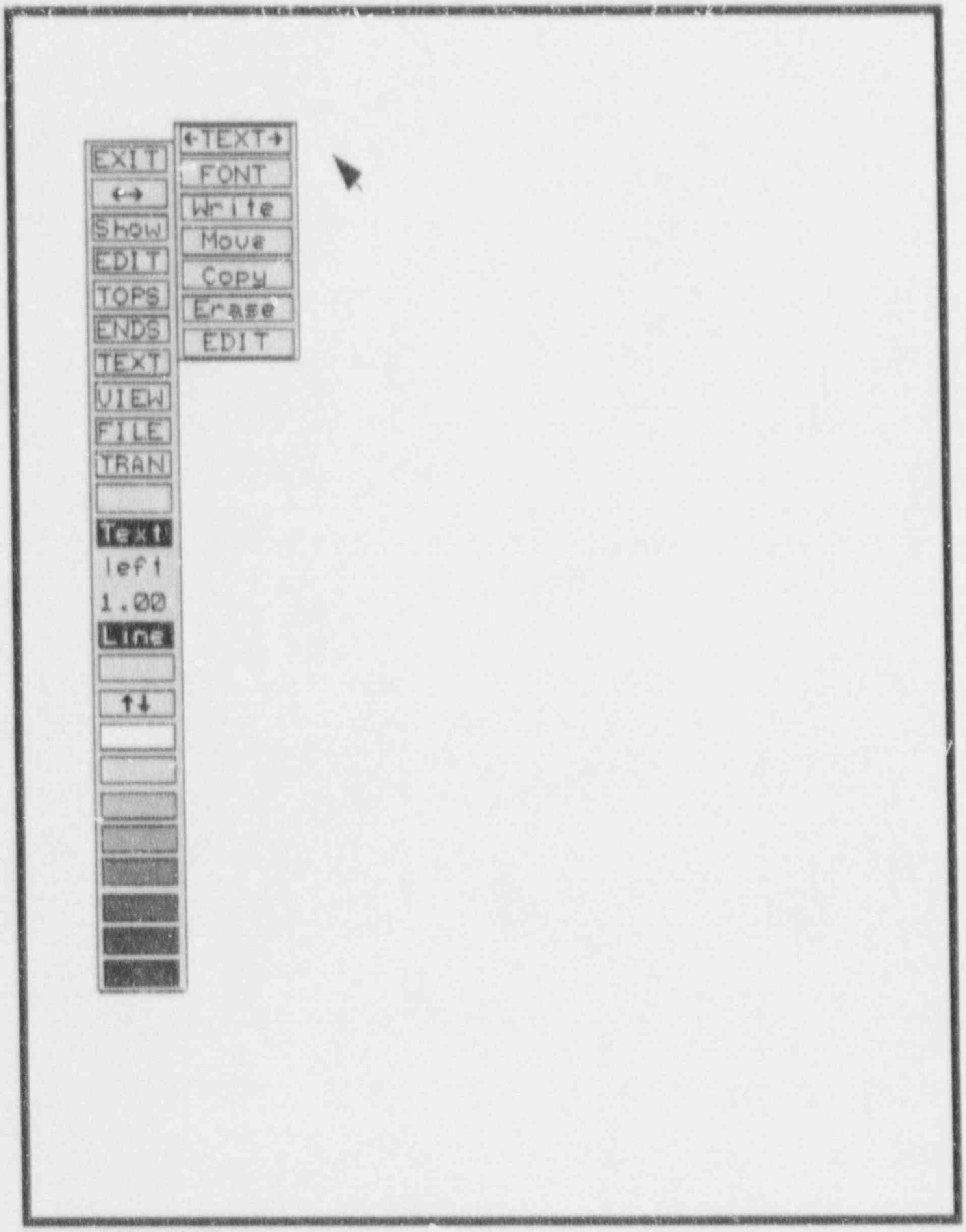


Figure 125. TEXT pop-up menu.

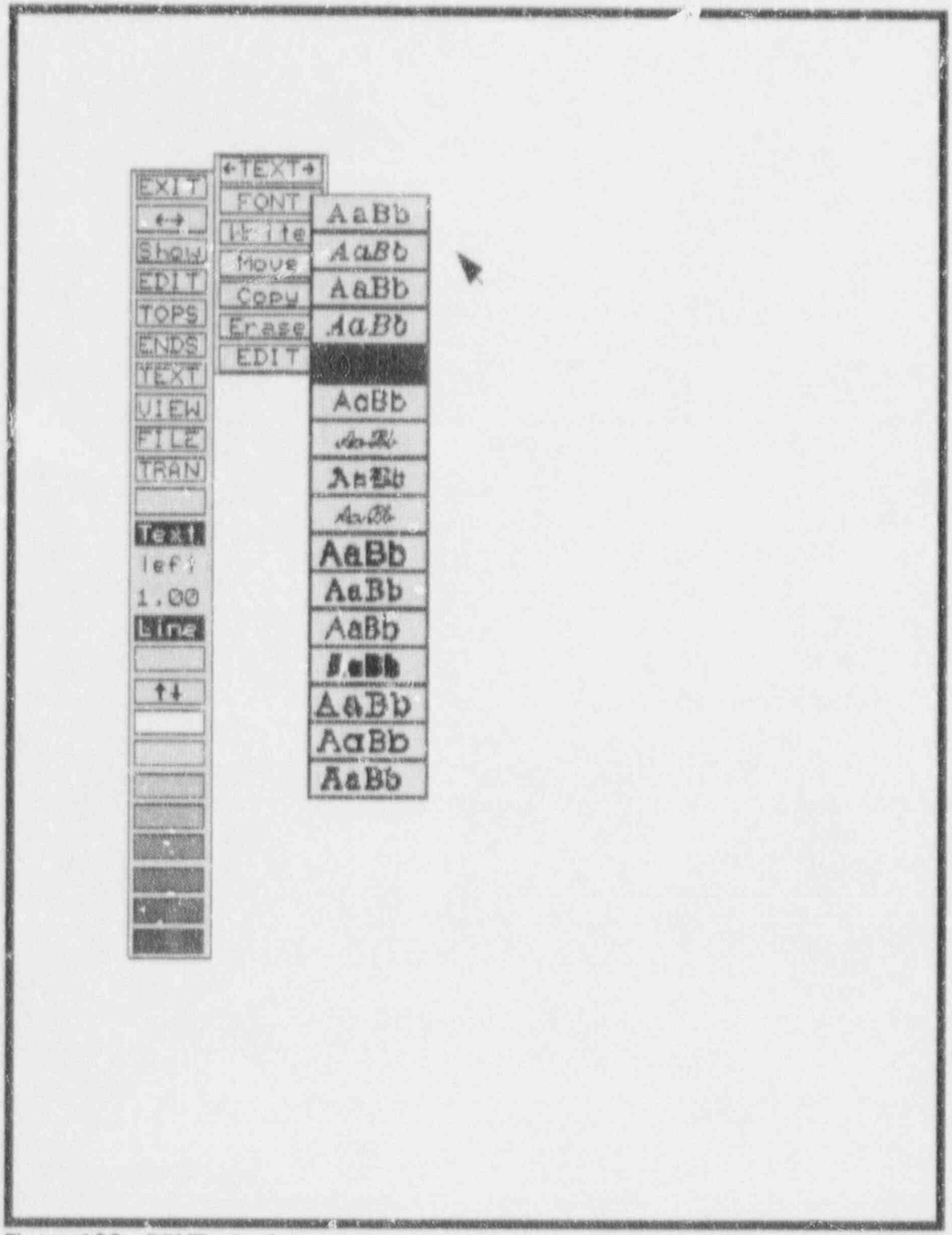


Figure 126. FONT selection screen.

7.2.7.5 Copy. This option allows you to copy the selected text to a new location on the screen. When you invoke this option you will be prompted to **Pick region to be copied - press CANCEL to quit**. You select the region by marking the opposite corners of the text to be copied. Position the cross hair at the text you want to copy and press the left mouse button. A small dot appears. Drag the cursor across the desired text until the box totally surrounds the text. Press the left mouse button again. The message **Pick reference point - press CANCEL to quit** will be displayed. The reference point is used to give you some indication of the position of the object being copied relative to the box. Position the cross hair at the location where you want the selected region to be copied to. Next, you will be prompted to **Pick placement point - press CANCEL to reselect**. Use the mouse to move the box to the exact position where you want the text to appear. When you are satisfied with the new position press the left mouse button. The selected text will be moved to the new location. The prompt **Pick placement point - press CANCEL to reselect** will be displayed again. At this point you may select another location to copy the text to, or press the right mouse button or <Esc> key to terminate the process.

7.2.7.6 Erase. This option allows you to delete selected text. When you invoke this option you will be prompted to **Pick region to be deleted**. You select the region by marking the opposite corners of the text to be deleted. Position the cross hair at the text you want to move and press the left mouse button. A small dot appears. Drag the cursor across the desired text until the box totally surrounds the text. Press the left mouse button again. The message **Delete this region? left = YES, Right = NO** will be displayed. If this is the text to be deleted, press the left mouse button; otherwise press the right button. Next, you will be prompted to **Pick next region to be deleted**. At this point you may select more text to delete or press the right mouse button or <Esc> key to terminate the process.

NOTE: If the text is not deleted, check the size of the outline box used to mark the region. It must be large enough to encompass all the text desired; otherwise, no text will be deleted.

7.2.7.7 EDIT. This option allows you to edit text and set various attributes of the text including color, size, font, and justification. When you invoke this option, an additional pop-up menu will be displayed (Figure 127).

7.2.7.7.1 ←EDIT TXT→ —This option allows you to move the pop-up menu to a new location on the screen. To invoke this option, position the cursor on the ←EDIT TXT→ box and press the left mouse button. An outline will appear. Move the outline to the new location and press the left mouse button. The menu will be moved to the new location.

7.2.7.7.2 Text—This option allows you to edit any of the text contained in the displayed diagram. When you select this option you will be prompted to **Box text to be edited**. You select the text to be edited by boxing the opposite corners of the text region. Position the cross hair at the beginning of the text you wish to modify and press the left mouse button. A small dot will appear. Drag the cursor over the text until the outline surrounds the text you wish to modify. When the text is completely surrounded, press the left mouse button. A window will appear displaying the selected text. To modify the text, simply type over the existing text. Use the <Ins> and <Del> keys to add and delete characters as necessary. In addition, you may use the Backspace and End keys. The Backspace key deletes the character to the left of the cursor and moves the rest of the characters to the left one space. The End key positions the cursor at the end of the current line. When complete, press <Esc>. You will be prompted to **Pick next text to be edited**. At this point you may select additional text to edit

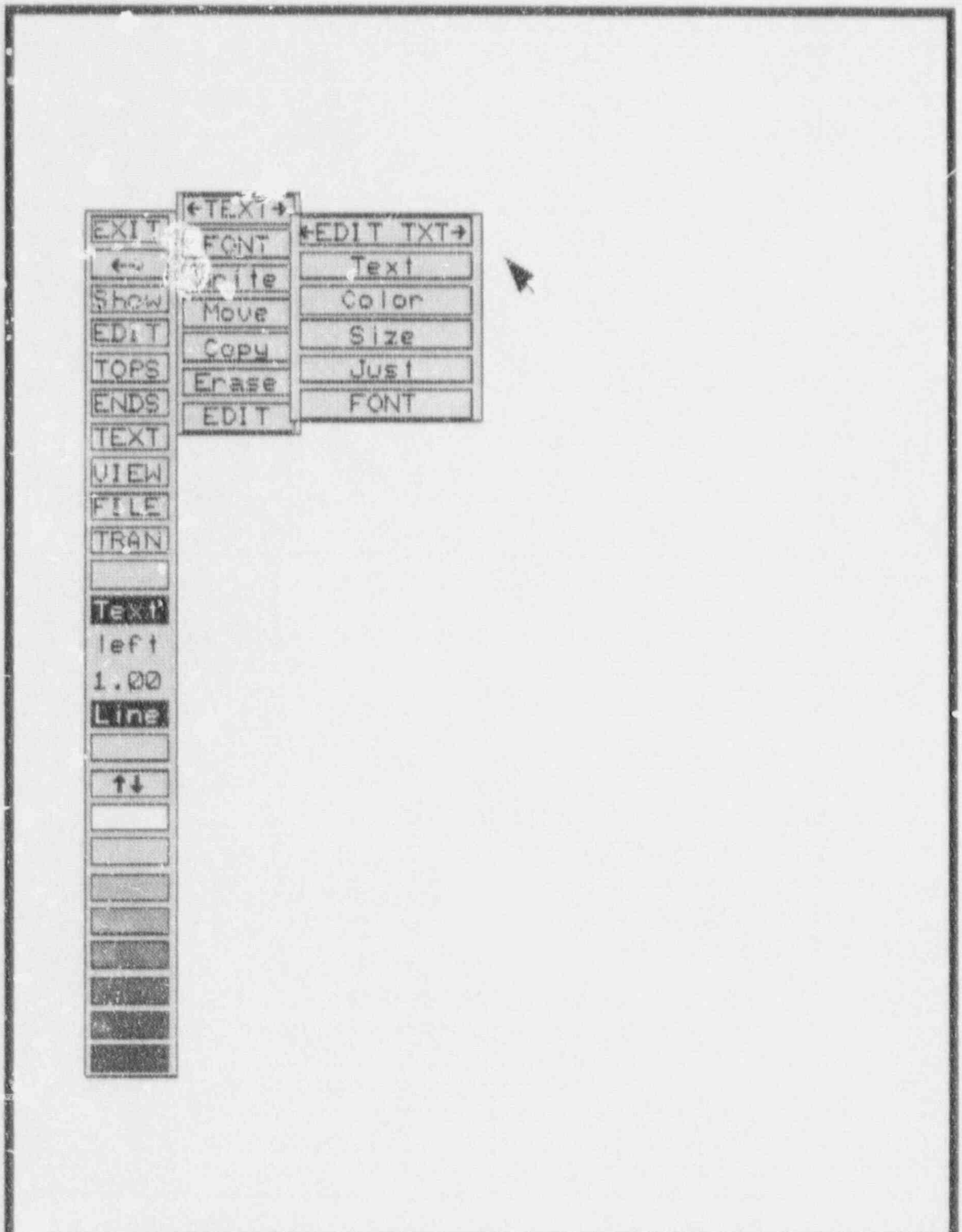


Figure 127. EDIT pop up menu.

or press the right mouse button to terminate the process.

7.2.7.7.3 Color—This option allows you to change the color of selected text in your event tree diagram. When you invoke this option you will be prompted to **Box the text to be changed**. Position the cursor at the beginning of the text you wish to change and press the left mouse button. A small dot will appear. Drag the cursor over the text until the outline box surrounds all the desired text. Press the left mouse button. Next, you will be prompted to **Pick the new text color from the color bar**. To select a color, position the cursor over the desired color and press the left mouse button. The text will immediately change to the new color. The prompt **Box next region to be changed** will be displayed. At this point you may select more text to change or press the right mouse button to terminate the process.

7.2.7.7.4 Size—This option allows you to specify the height of selected text in your diagram. When you invoke this option, you will be prompted to **Box the text to be changed**. Position the cross hair at the beginning of the text you wish to change and press the left mouse button. A small dot will appear. Drag the cursor over the text until the outline surrounds all the desired text. When all the desired text is surrounded, press the left mouse button. Next, the prompt **Enter the new text size >** will be displayed. At this prompt enter the desired text size and press <Enter>. You may enter a value of .001 to 9.0. The selected text will be displayed in the new size. Next, you will be prompted to **Box next region to be changed**. At this point you may select more text to be changed or press the right mouse button to terminate this process.

7.2.7.7.5 Just—This option allows you to justify selected portions of the text in your diagram. Justification is where the text will be placed offset from the placement point. When you invoke this option you will be prompted to **Box the text to be changed**. Position the cursor at the beginning of the text to be changed and press the left mouse button. A small dot will appear. Drag the cursor over the text until the outline completely surrounds it. When the desired text is completely surrounded press the left mouse button. You will be prompted to **Enter text justification -('L'=Left, 'R'=Right, 'C'=Center) >**. Enter the desired justification and press <Enter>. The prompt **Box next region to be changed** will be displayed. At this point you may select additional text to modify or press the right mouse button to terminate this process. See Section 6.2.12 for a compete discussion on setting the justification.

7.2.7.7.6 FONT—This option allows you to select the font type for selected text. When you select this option an additional pop-up menu will be displayed (Figure 128). Select the desired font type by positioning the cursor over the font and pressing the left mouse button. You must select a font (or cancel) in order to [illegible]. Next, you will be prompted to **Box the text to be changed**. Position the cursor over the text to be changed and press the left mouse button. A small dot will appear. Drag the cursor over the text to be modified. When the box completely surrounds the desired text, press the left mouse button. The selected text will be displayed in the new font type. Next, you will be prompted to **Box next region to be changed**. At this point you may select more text or press the right mouse button to terminate the process.

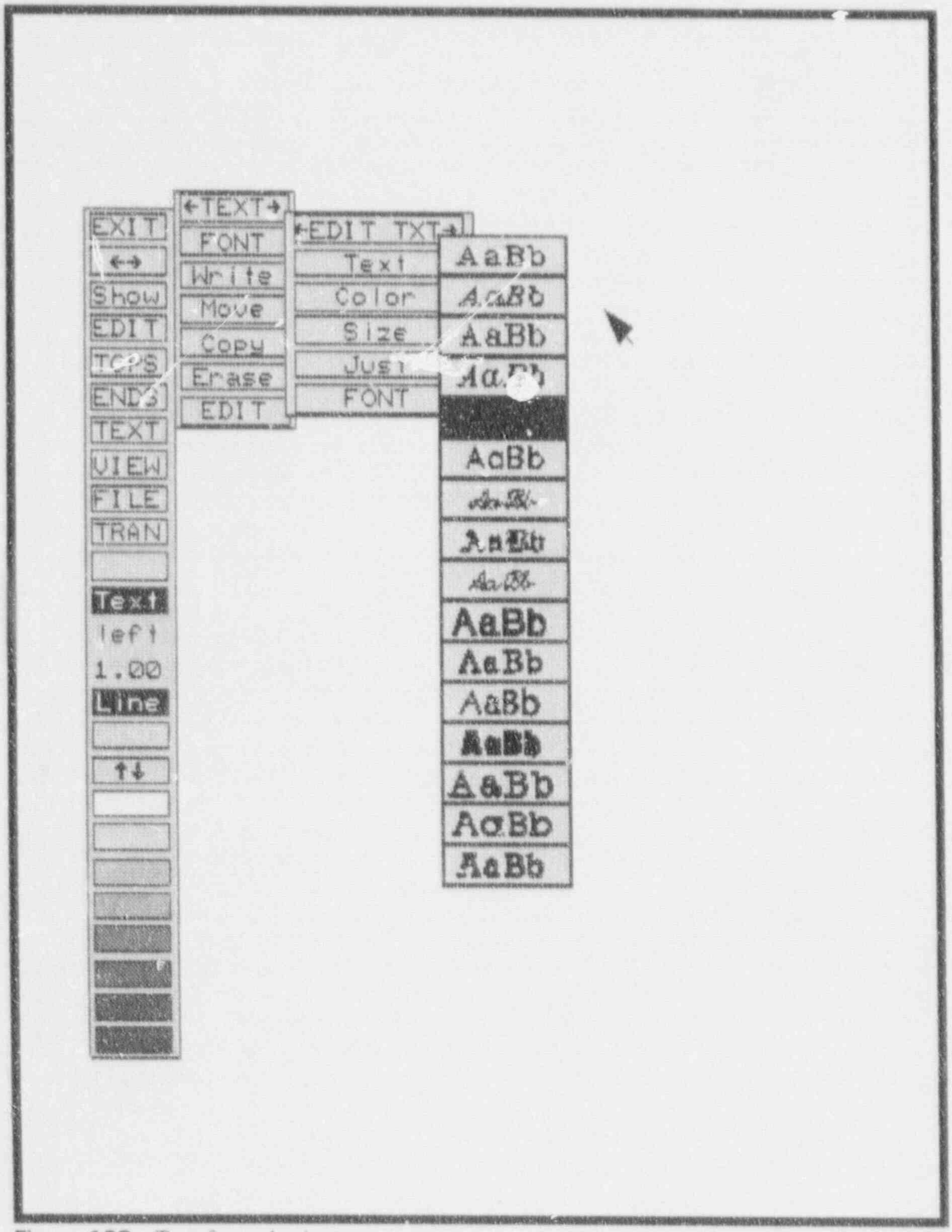


Figure 128. Text font selection menu.

7.2.8 VIEW

This option allows you to change the position and size of the displayed diagram. You may move the drawing up, down, right, left, zoom in, zoom out, or restore the drawing to its original size and/or position. You may also toggle to display/not display text and turn on and off the grid. When you select this option, Figure 129 will be displayed. The VIEW submenu consists of the following options:

- Page ↑: Invoking this option allows you to shift the diagram up one page (previous page). To invoke this option, position the cursor in the Page ↑ box and press the left mouse button <Enter>. The diagram's previous page will be displayed. If no previous page exist, only the header information will appear.

- Page ↓: Invoking this option allows you to shift the diagram down one page (next page). To invoke this option, position the cursor in the Page ↓ box and press the left mouse button or <Enter>. The diagram's next page will be displayed. If no next page exist, only the header information will appear.

- Page →: Invoking this option allows you to shift the diagram to the right one page (one screen). To invoke this option, position the cursor in the Page → box and press <Enter>. The diagram will shift to the right one screen. If no figure exists on this new screen, only the header information will appear.

- Page ←: Invoking this option allows you to shift the diagram to the left one page (one screen). To invoke this option, position the cursor in the Page ← box and press <Enter>. The diagram will shift to the left one screen. If no figure exists on this new screen, only the header information will appear.

- Scroll: Invoking this option allows you to move the diagram to another location on the screen, To invoke this option, position the cursor in the Scroll box and press the left mouse button. A white outline box appears, with a cross hair placed in the center of the outline. Position the cursor at the desired location and press the left mouse button. The cross hair serves as a reference point for placing the drawing. The reference point (+) is used to give you some indication of the position of the object being moved relative to the screen.

- Zoom in: Invoking this option allows you to fill the screen with a small portion of the original display (magnifies the selected portion of the screen). To invoke this option, position the cursor in the Zin (zoom in) box and press the left mouse button or <Enter>. The message **Pick first corner** will be displayed. Move the cursor at the start of the diagram to be enlarged and press the left mouse button. A small dot appears. Next, you will be prompted to **Pick next corner**. Drag the cursor across the desired area until it is completely surrounded by the outline box. Press the left mouse button. The portion of the original display enclosed by the box will now fill the entire screen. The display can be restored to its original size by invoking the Zres (zoom restore) option.

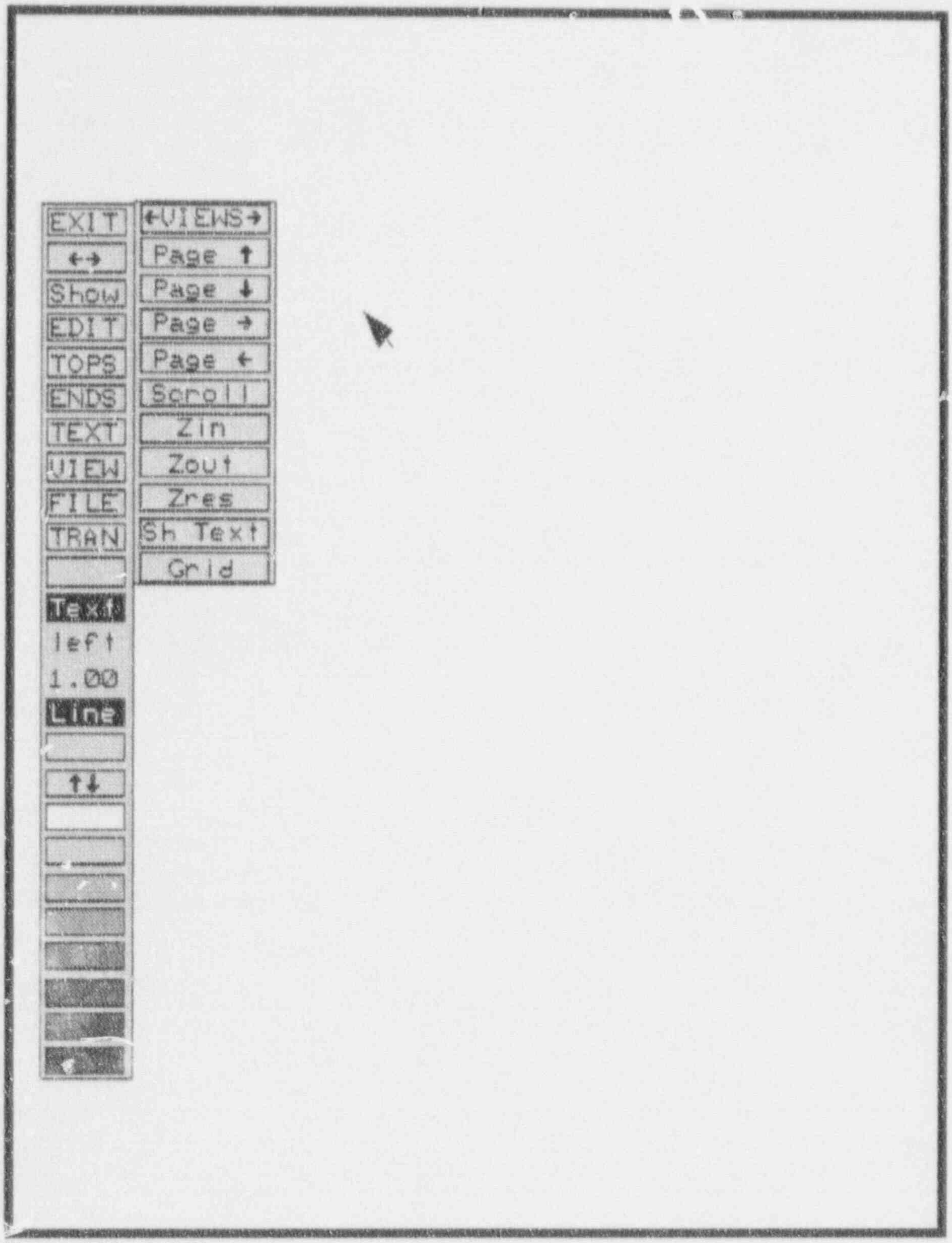


Figure 129. VIEW pop-up menu.

- Zoom out: Invoking this option allows you to shrink the screen by approximately 50%. To invoke this option, position the cursor in the Zout (zoom out) box and press the left mouse button or <Enter>. The entire display will be reduced, while the drawing space is increased. To restore the display to its original size, invoke the Zres option.

- Zoom Restore: This option restores any display created by zoom in or zoom out to the original display size or to the last saved file. To invoke this option, position the cursor in the Zres box and press the left mouse button or <Enter>.

- Sh Text: This option allows you to toggle the display the text setting from Sh Text to No Text. Sh Text displays all defined text. No Text does not display the text.

- Grid: This option displays a grid behind your diagram to allow you to line up symbols and text. This is a toggle switch. To turn the grid on, position the cursor in the Grid option box and press the left mouse button or <Enter>. To turn the grid off, repeat the same steps.

7.2.9 FILE

This option allows you to perform various file manipulation functions including loading, saving, listing and creating event tree files. When you invoke this option, an additional pop-up menu will be displayed (Figure 130). Each of these pop-up commands is discussed in the following paragraphs.

7.2.9.1 ←FILE→. This option allows you to move the pop-up menu to a new location on the screen. To invoke this option, position the cursor on the ←FILE→ box and press the left mouse button. An outline will appear. Move the outline to the new location and press the left mouse button. The menu will be moved to the new location.

7.2.9.2 Load. This is one of the options that can be used to load a file. When you invoke this option, you will be prompted to **Enter file name >**. At this prompt, enter the file name and press <Enter>. You must know the name of the file before initiating this option. The LIST command also allows you to load a file, but in addition it will display a list of available files.

7.2.9.3 Save. This option allows you to save the current file. When you invoke this command you will be prompted to **Enter file name or CR for file** ***current file name***. At this point you may enter a new file name or choose the default file name provided by pressing <Enter>. The file is then written to disk. If you enter a new file name, do not provide an extension. The extension ".ETG" is provided by IRRAS.

7.2.9.4 New. This option allows you to create a new event tree (file). When this command is invoked you will be prompted to **Enter Initiating Event or Top Name**. Enter the event or name and press <Enter>. You will then be asked **Is this an Initiating Event**. Respond with a Y or N. You will then be prompted to **Enter Event Name #1**. Enter an event name and press <Enter>. This prompt will repeat (with the event number increasing each time) until you press <Enter> without entering a name. The newly created event tree will then be displayed on the screen. The default form of an event tree will contain a success/fail branch at the first event and a don't care or pass extending through the ending event.

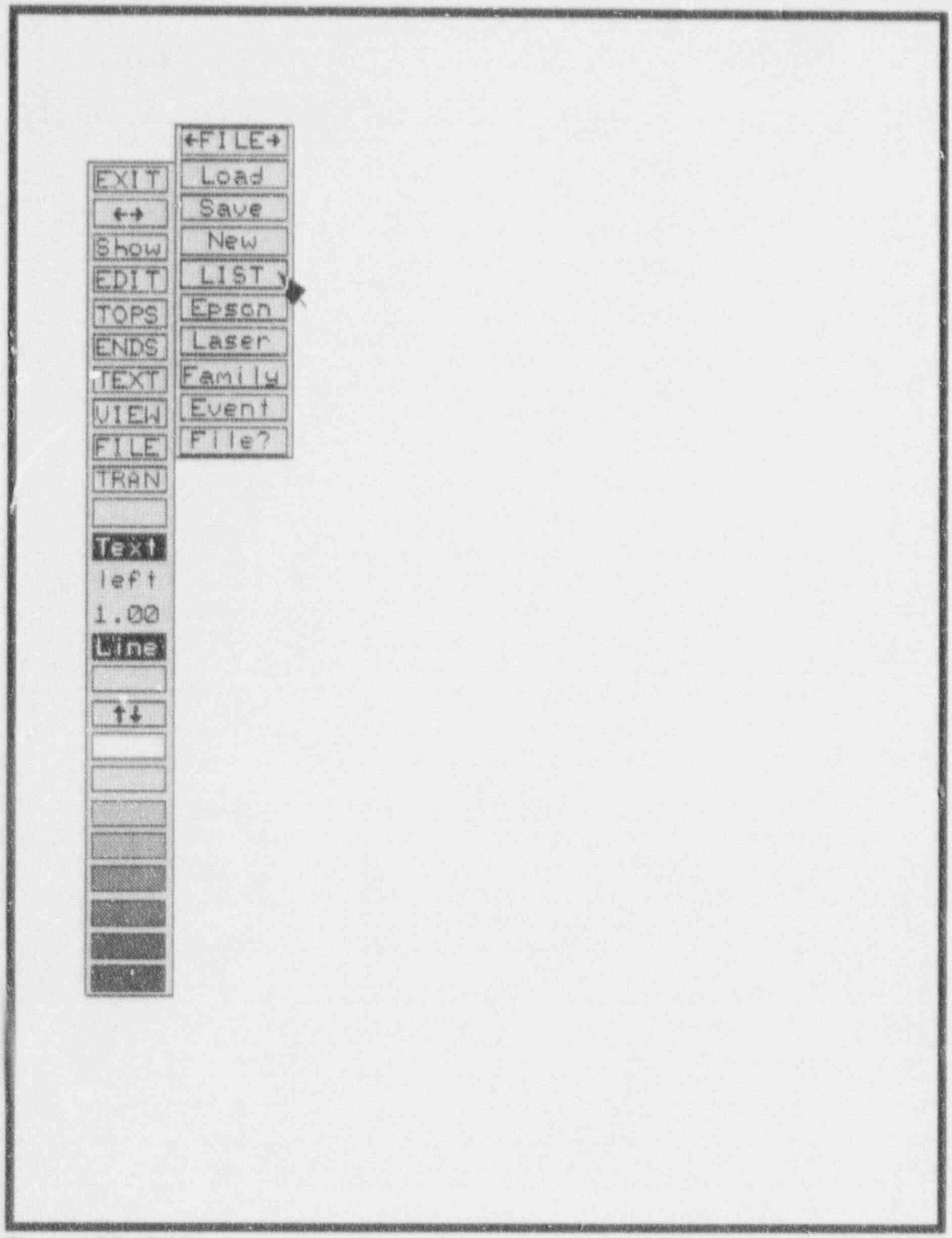


Figure 130. FILE pop-up menu.

7.2.9.5 LIST. This is one of the two options used to load an event tree diagram. When you invoke this option, an additional pop-up menu will be displayed listing the files available. You will be prompted to **Pick the file to load**. To select a file to be loaded, position the cursor on the desired file name and press the left mouse button. The selected diagram will be displayed on the screen. You may now proceed with other editing functions.

7.2.9.6 Epson. This option formats the current diagram for an Epson printer and sends it to the attached local Epson printer.

7.2.9.7 Laser. This option formats the current diagram for a laser printer and sends it to the local laser printer to be printed.

7.2.9.8 Family. This option allows you to view and change the name of the family corresponding to the current diagram. The default family name is provided. When you invoke this option you will be prompted to **Type in the New Name or <Return> for *family name*>**. Enter a new file name if desired, or press <Enter> to accept the default family.

7.2.9.9 Event. This option allows you to view and change the event tree file name. The current file name for the event tree is provided. When you invoke this option, you will be prompted to **Type in the New Name or <Return> for *current file name* >**. Enter a new file name and press <Enter> or leave blank and press <Enter> to keep the current file name.

7.2.9.10 File?. This option allows you to view the current file name. When this option is invoked the current file name is displayed at the bottom left corner of the screen. If no file name is assigned to the current diagram, the default file name of **NONAME.ETG** will be displayed.

7.2.10 TRAN

This option allows you to add, delete, and modify transfer file names as well as transfer to and from files that are added as transfers. When you invoke this option, an additional pop-up menu will be displayed (Figure 131). Each pop-up option is discussed in the following paragraphs.

7.2.10.1 Add. The add option allows you to place a transfer file name in the diagram. This transfer file name can then be selected and you can transfer back and forth between the two event tree diagrams or any number of diagrams (files) that are included in the transfer list. When you invoke this option you will be prompted to **Pick the leaf where the transfer is to be placed**. The cursor will move vertically along the end of the event branches. Position the cursor on the desired transfer point and press the left mouse button. The prompt **Enter transfer file name** will be displayed. Enter the appropriate file name and press <Enter>. A "T" is placed after the selected sequence number and the entered file name is placed in the corresponding end state slot. The prompt **Pick the leaf where the transfer is to be placed** will return. At this point you may select another transfer point or press the right mouse button to terminate the process.

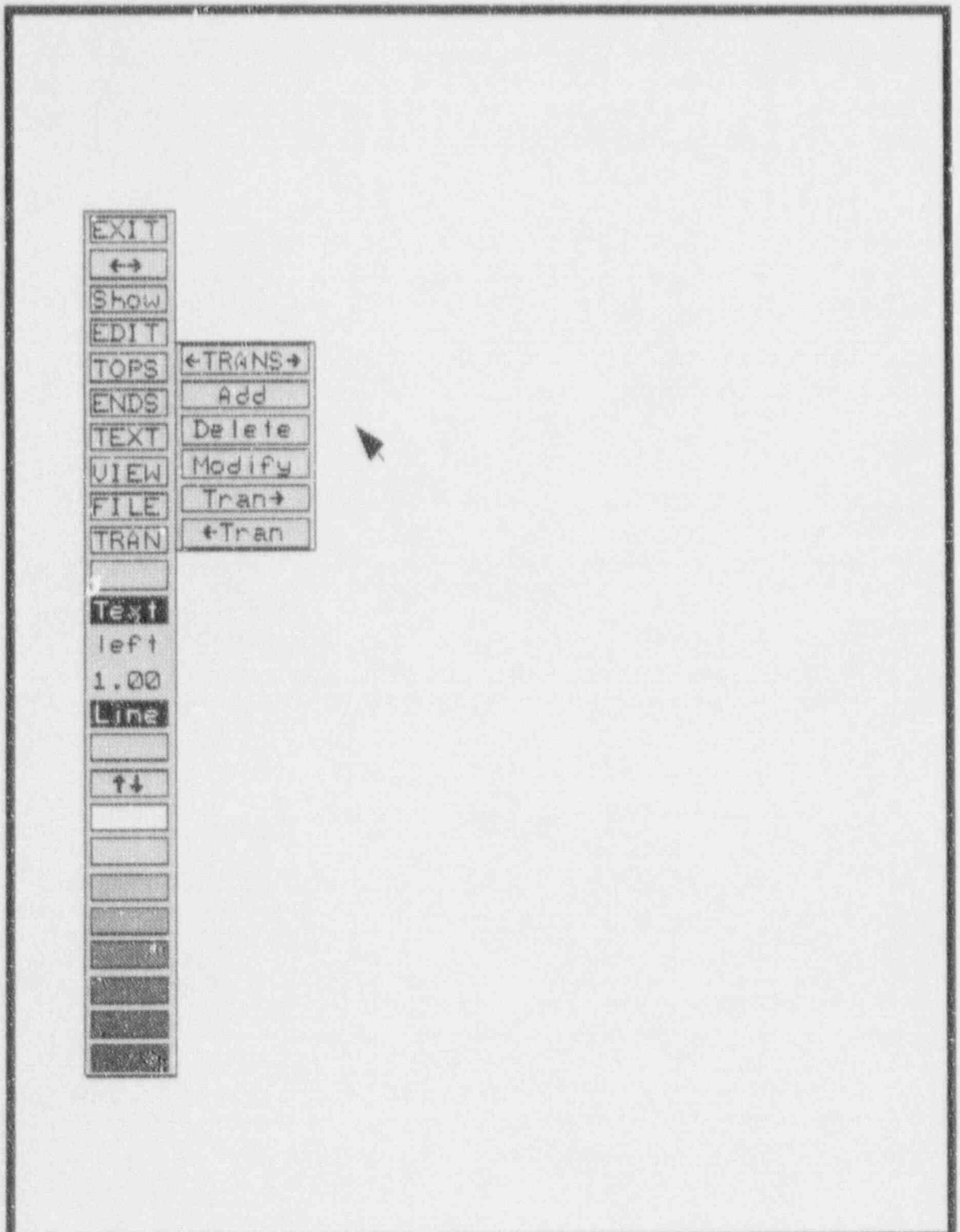


Figure 131. TRAN pop-up menu.

7.2.10.2 Delete. This option allows you to delete transfer file names from the diagram. When you invoke this option you will be prompted to **Pick the leaf corresponding to the transfer to be deleted**. Position the cursor on the leaf branch where a transfer has been previously added and press the left mouse button. The "T" will be deleted and the corresponding sequence name will be removed from the transfer list. You will be returned to the previous prompt. At this point you may select another transfer point to delete or press the right mouse button to terminate the process.

7.2.10.3 Modify. This option allows you to change the transfer file name. When you invoke this option you will be prompted to **Pick the leaf corresponding to the transfer to be edited**. Position the cursor on the transfer leaf and press the left mouse button. The prompt **Type in the New Name or <Return> for** ***current transfer file name*** **>**. Enter the new transfer file name or press <Enter> to retain the existing file name.

7.2.10.4 Tran→. This option allows you to work with multiple files simultaneously. When you invoke this option you will be prompted to **Pick the leaf corresponding to the desired transfer file name**. The selected file is then loaded into the system. This option will allow you to transfer back and forth to various files.

7.2.10.5 ←Tran. After a transfer to another file has been made, you use this option to return to the previous file. When you invoke this option you will be prompted to **Pick the file to transfer to**. A pop-up window will appear showing you a list of available transfer files. Select a file by positioning the cursor on the desired file and pressing left mouse button. If no files exist, the message **No transfer files** will be displayed.

7.2.11 Text

This option allows you to set a default color for the text in your diagram. To invoke this option, position the cursor over the Text box and press the left mouse button. You will be prompted to **Pick a new color from the color bar**. Position the cursor on the desired color and press the left mouse button. (**NOTE:** The ↑↓ is active. Use this option to display additional color selections.) The Text box will change to the selected color. All text created in your diagram from now on will be displayed in this new color. Any existing text in your diagram will retain the old color. To change the color of the existing text, you must invoke the TEXT option and select the EDIT suboption and invoke the Color command (see Section 7.2.7).

7.2.12 cntr/left/rght

This option allows you to set the justification for your diagram. Justification is where the text will be placed offset from the placement point. This works as a toggle switch. To change justification, position the cursor over the cntr (left or rght) box and press the left mouse button. You will see the box change from cntr to rght (right). Press the left mouse button again and the box will change from rght to left.

Left justification means the text will be anchored at the left bottom corner, or the text will flow to the right of where it was placed. Center justification means the text will be centered about the placement point. Right justification means the text will be placed to the left of the placement point. Set the toggle switch for the desired justification.

7.2.13 Text Size

This option allows you to set a default text size for your diagrams. Text sizes range from .001 to 9.0. For the purpose of writing general text in event trees, a text size of about 0.5 is appropriate. The size looks too small on the screen, but it is a good size for sending to a laser printer. When you invoke this option you are prompted to **Enter new text size >**. Enter the desired size and press <Enter>. The Text Size box will reflect the current default setting. Remember, here you are setting the default text sizes. You may always change the text size for selected text by invoking the TEXT option, selecting the EDIT suboption, and invoking the Size command (see Section 7.2.7).

7.2.14 Line

This option allows you to select a color for the lines in your diagram. When you invoke this option you will be prompted to **Pick a new color from the color bar**. Position the cursor over the desired color and press the left mouse button. The Line box will change to reflect the newly selected color. (Remember, you may use the color feature (↑↓) to display additional colors). All new lines generated in your diagram will be this default color.

7.2.15 ↑↓ (Color)

This option allows you to scroll the color bar to display the additional color selections available. Position the cursor on the scroll box (↑↓) and press the left mouse button or <Enter> key. The next series of colors will be displayed.

NOTE: When you try to exit the Create Event Trees option without saving your changes, you will be prompted with **ARE YOU SURE? Enter "Y" to Quit anyway**. At this point you may enter a <Y> to quit without saving or press <Enter> to terminate the exit procedure.

7.3 Link Event Trees

This option allows you to define linkage rules and generate sequence logic. When you invoke this option, Figure 132 will be displayed. As shown, four options are available: Exit, Generate Sequences, Link Editor, and Sequence Editor. In addition, the following special function keys are available here and in the remaining functions discussed in Section 7.

<Esc>	Returns you to the Event Tree Graphics System Menu (Figure 116).
<F1>	Displays on-line help messages.
<F2>	Marks a file for further processing. When you mark a file, an asterisk will appear in front of the file name.
<F3>	Marks all the displayed files for further processing.

<F4> Allows you to mark a range of files for further processing.

<F5> Allows you to locate a specific file for further processing. When you invoke this function, Figure 133 will be displayed. Enter the file name to locate and press <Enter>. The specified file will be highlighted. If the file name does not exist, then the next file name in alphabetical order will be highlighted.

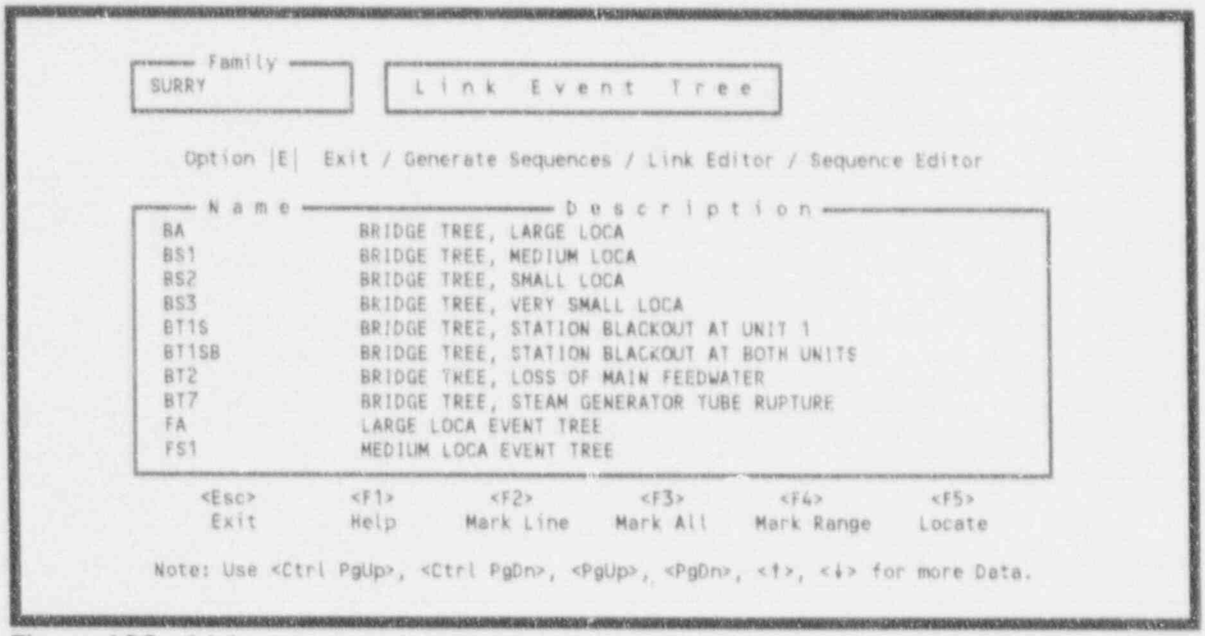


Figure 132. Link event tree screen.

To display additional event trees, use the <PgUp>, <PgDn> and arrow keys.

7.3.1 Exit

This option returns you to the Event Tree Graphics System menu (Figure 116). To invoke this option, enter an <E> in the option field and press <Enter>, or press the <Esc> key.

7.3.2 Generate Sequences

This option allows you to generate sequence logic for event trees. During sequence generation the sequence logic is created as specified in the event tree logic, and then the linkage rules are applied. To invoke this option for a single selected event tree, enter a <G> in the option field, highlight the desired event tree, and press <Enter>. To invoke this process for a group of event trees, mark the desired event trees using the function keys F2, F3, and F4, enter a <G> in the option field, and press <Enter>. To invoke this option for all event trees in the current family clear all marked entries, type a <G> 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 generate sequences for all of the event trees, or type an <N> to terminate the sequence generation process.

```
 ---- Family ----     ---------------------------
|SURRY          |    | L i n k   E v e n t   T r e e |
 ---------------      ---------------------------

   Option [E]  Exit / Generate Sequences / Link Editor / Sequence Editor

  ---- 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

  | Please enter the name to locate              ...then press <Enter>. |

  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 Line   Mark All   Mark Range   Locate

 Note: Use <Ctrl PgUp>, <Ctrl PgDn>, <PgUp>, <PgDn>, <↑>, <↓> for more Data.
```

Figure 133. Locate a specific system using <F5>.

In all three cases, after pressing <Enter>, Figure 134 will be displayed. On this screen you must enter a file name where the report will be written. The following options are provided:

CON	-	Sends the report to the screen.
PRN	-	Sends the report to the printer.
filename	-	Sends the report to the specified hard disk file name. A default name is provided, which can be changed by simply typing over the default name.
blank	-	No report is generated, but the sequences are generated.
<Esc>	-	Terminates the process without generating the sequences.

In addition, the prompt **Use Number for Sequence Names?** appears. If you respond <Y>, IRRAS uses the sequence numbers to create a name. If you respond <N>, the sequence name is used. In either case, the value is created by taking the number or name and each time a transfer is encountered, it adds a "-" and an incremented number for that transfer (e.g., K-X, 2-1, 2-2, 2-3 etc.).

Finally, you may specify the mutually exclusive top name. This allows the user to specify a set of events that can be eliminated from the final list of cut sets. You may leave this field blank or specify a top name.

The Sequence Generation report contains the listing of the sequences' names, the systems that make up the sequences, any substitutions of systems (based on the linkage rules), and any transfers to other event trees.

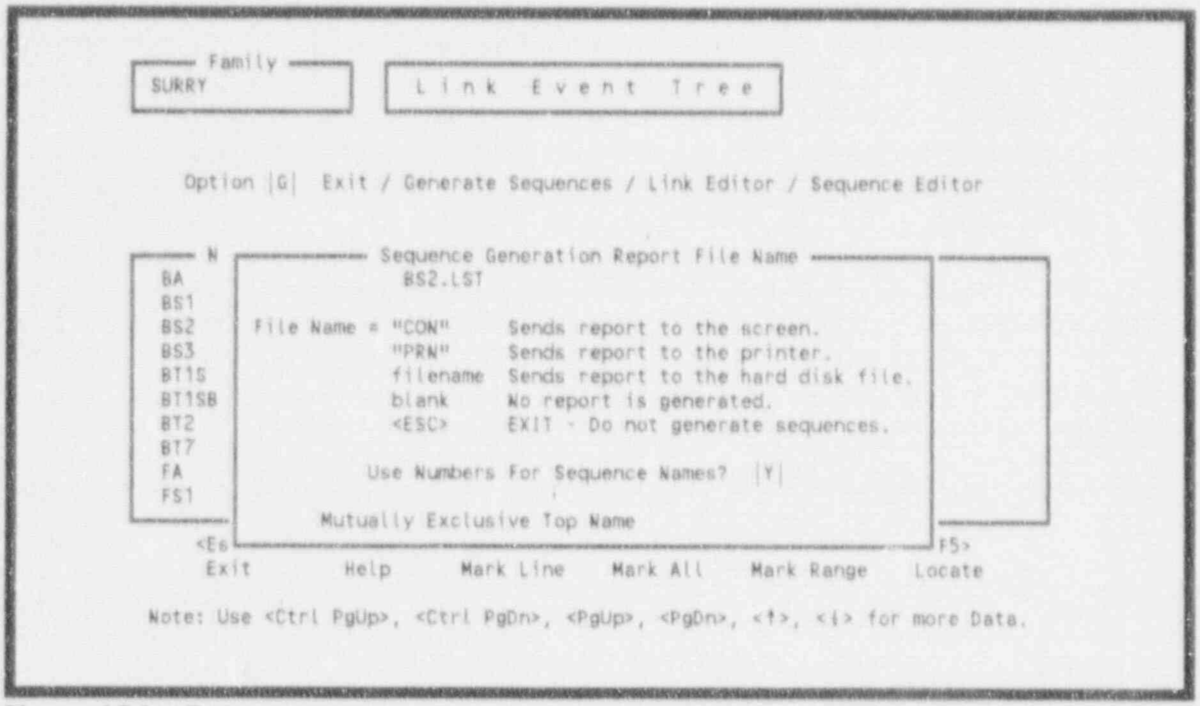


Figure 134. Generate sequences output screen.

After sequence generation begins, the first message displayed is **Reading Logic for event tree: <event tree name>.** As each sequence in that event tree is generated, the message **Processing sequence: <sequence name>** is displayed. If there are any transfers in the event tree, the reading logic message will be displayed again, but this time with the name of the event tree being transferred to. When all the sequences for the event tree have been created, the message **Deleting old/unused sequences for <event tree name>** will appear. At this time all the sequences for the event tree that are no longer valid will be removed.

Invalid sequences can result in several ways. First, the logic of an event tree may be such as to create sequences that have tops in them that are both failed and successful. These are invalid and are deleted. Second, the user may have modified the event tree logic, reducing the number of sequences for the tree. Sequences that existed previously are invalid, also. Sequences that have an end state value of "OK," "SUCCESS" or begin with an "@" character are never generated by IRRAS.

7.3.3 Link Editor

This option allows you to specify linkage rules for an event tree. A linkage rule is a special case, an exception, or substitution to the normal sequence generation. During sequence generation the sequence logic is created as specified in the event tree logic, and then the linkage rules are applied. For example, event tree A contains a sequence named SEQ-1. According to the strict logic of the event tree, the systems that make up SEQ-1's logic are SYS-1, SYS-2, SYS-3, and SYS-4. A linkage rule would enable you to replace all occurrences of SYS-4 in any sequence in the event tree with SYS-5. Or, you may only want to replace SYS-4 with SYS-5 if and only if SYS-2 and SYS-3 are also present in the sequence logic.

You can only invoke this option for a single event tree (i.e., one event tree at a time). To invoke this option, enter an <L> in the option field, highlight the desired event tree, and press <Enter>.

When you press <Enter>, Figure 135 will be displayed showing the rules (if any) for the event tree shown in the upper right hand corner. The message **Reading in tops and systems names** will be displayed. A top is a system that is used in the selected event tree. Then, the message **Reading in rules** will be displayed. The rules (if any) for the event tree will then be shown. The first # column is the rule number or the order in which the rules will be applied. Rule 2 takes precedence over rule 1 and rule n takes precedence over rule n-1. The second and third columns are the conditional columns. If a top or system must exist before a substitution can take place, those tops will be named here. There is no limit on the number of conditional tops for a rule. The fourth or replaced top column contains the tops to be substituted and the fifth column contains the tops/systems to use in place of the replaced tops. The following options are available: Exit, Add, Insert, Copy, Delete, and Restore.

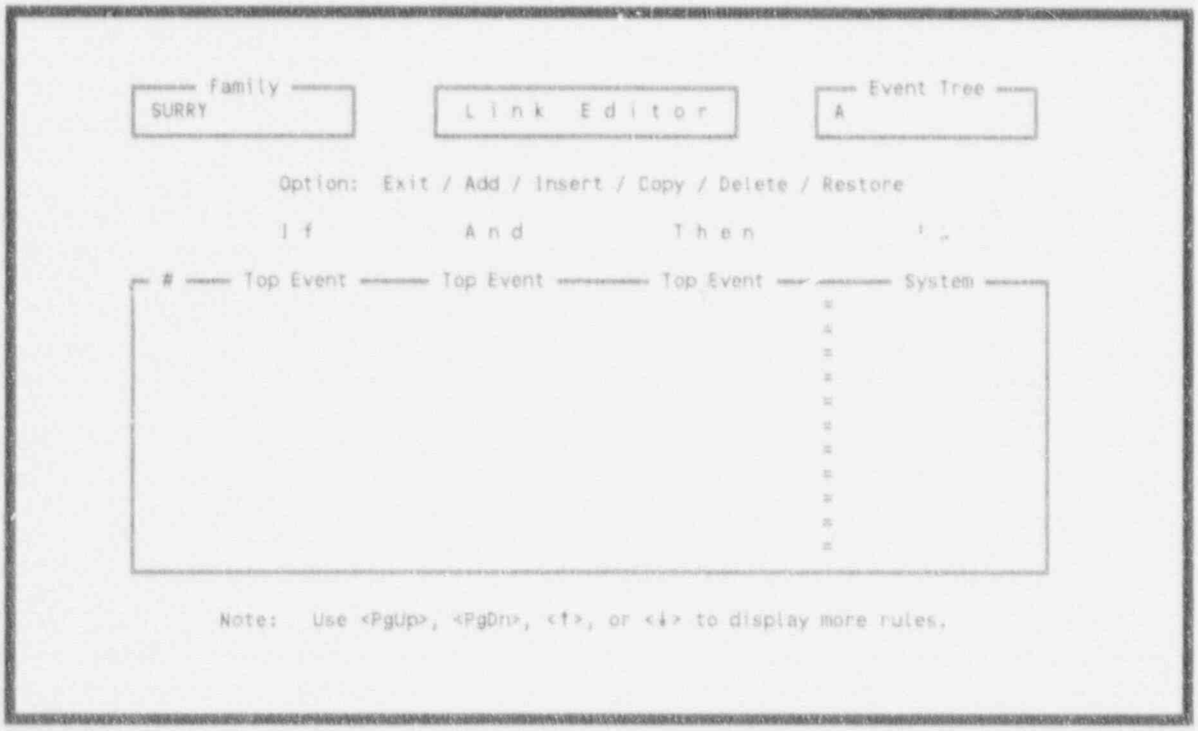


Figure 135. Link editor screen.

7.3.3.1 Exit. This option returns you to the Link Event Tree menu. To invoke this option type an <E> and press <Enter>, or press the <Esc> key. Figure 136 will be displayed asking you if you want to save the rules and then exit. To save the rules in the data base, type a <Y>, and press <Enter>. To exit without saving the rules, type a <N> and press <Enter>.

7.3.3.2 Add. This option allows you to add a new rule or modify an existing rule if the cursor is in the first column, or add/modify a top or system if the cursor is in any other column. To add a rule, move the cursor to the first column and type an <A>. A default rule number will appear in the first column. Press <Enter> and the cursor will be moved to the second column. A line of dashes will appear above the rule that is being added. This is to assist in keeping the rules separated. To add a conditional top, type <A>, enter the name of the conditional top, and type <Enter>. If the name you entered is not a top for this event tree, the message **Name not found...** is displayed. A list of all the tops

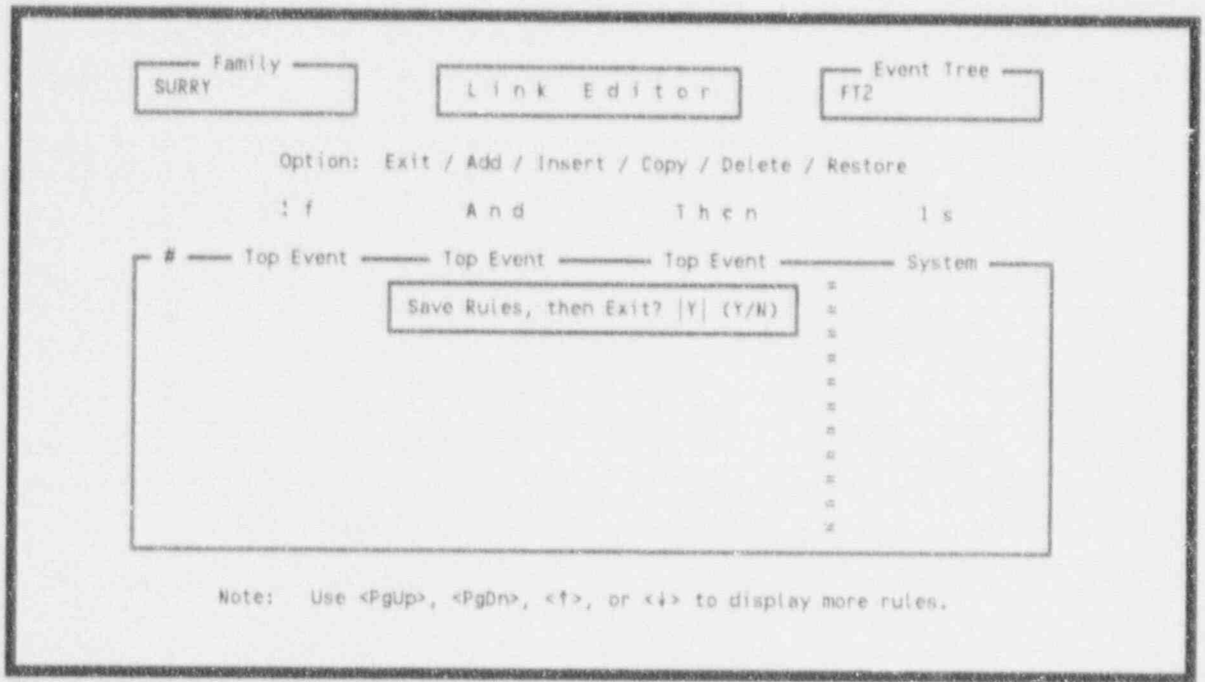


Figure 136. Save linkage rules screen.

for this event tree is displayed in a help form on the right side of menu. To select one the tops from the help form, type <F1>, move the cursor to the top to be added, and press <Enter> (see Figure 137). All conditional tops and replaced tops are added in this same way. The replacement top is added in much the same way with some differences. When you type <A>, the list of all systems in the family is displayed in a help form on the left hand side of the form (see Figure 138). Any system in the family can be entered here, and the message **Name not found...** will be displayed if the name entered is not a system. To modify a rule, position the cursor over the top/system to be changed, type <A>, and enter the new top/system name just as you do on an add.

7.3.3.3 Insert. This option adds one blank line after the line containing the cursor, regardless of the column the cursor is in.

7.3.3.4 Copy. This option copies one rule after another. Figure 139 contains the copy menu. The rule number of the rule closest to the cursor will be in the first blank, but you may enter any other existing rule in its place. To copy the desired rule, enter an existing rule in the second blank and a copy of the first rule will be placed after the second rule.

7.3.3.5 Delete. This option deletes the entire selected rule if in the first column, or a top or system if in any other column. To delete a rule, place the cursor in the first column of the rule to be deleted and type a <D>. To delete a system or top, place the cursor in the column where the desired system or top is located and type a <D>.

7.3.3.6 Restore. This option restores the last deleted rule if the cursor is in the first column, or a top or system if the cursor is in any other column.

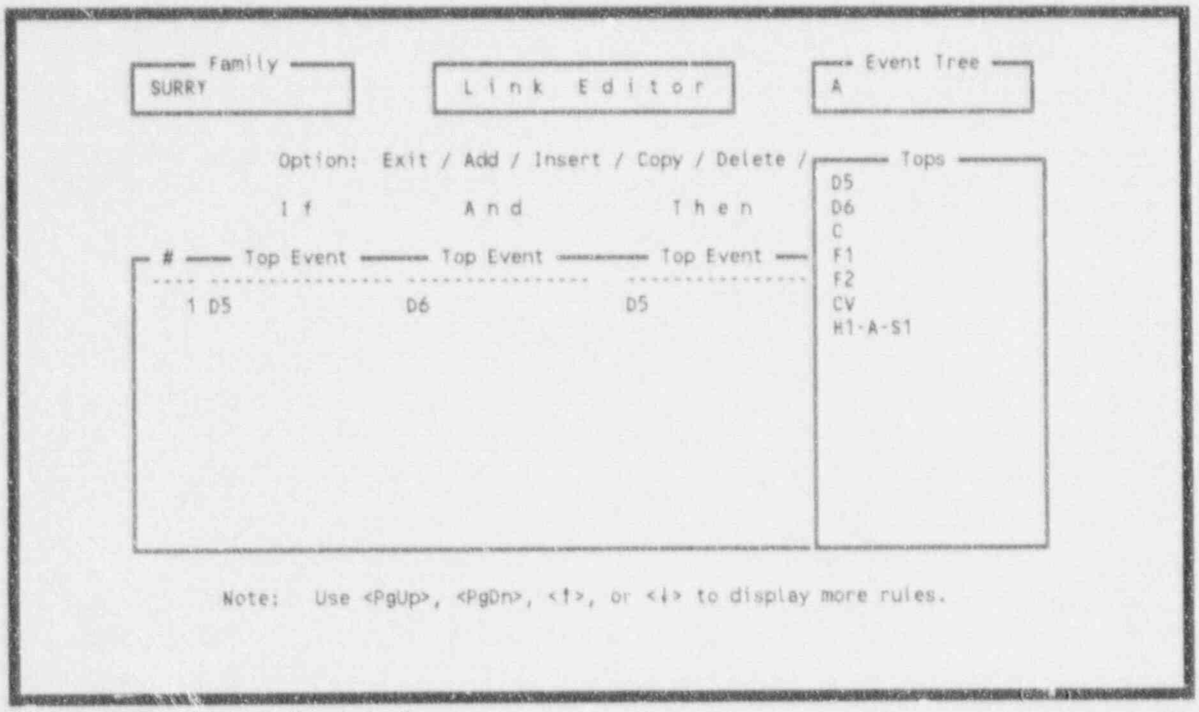


Figure 137. Tops listing help form.

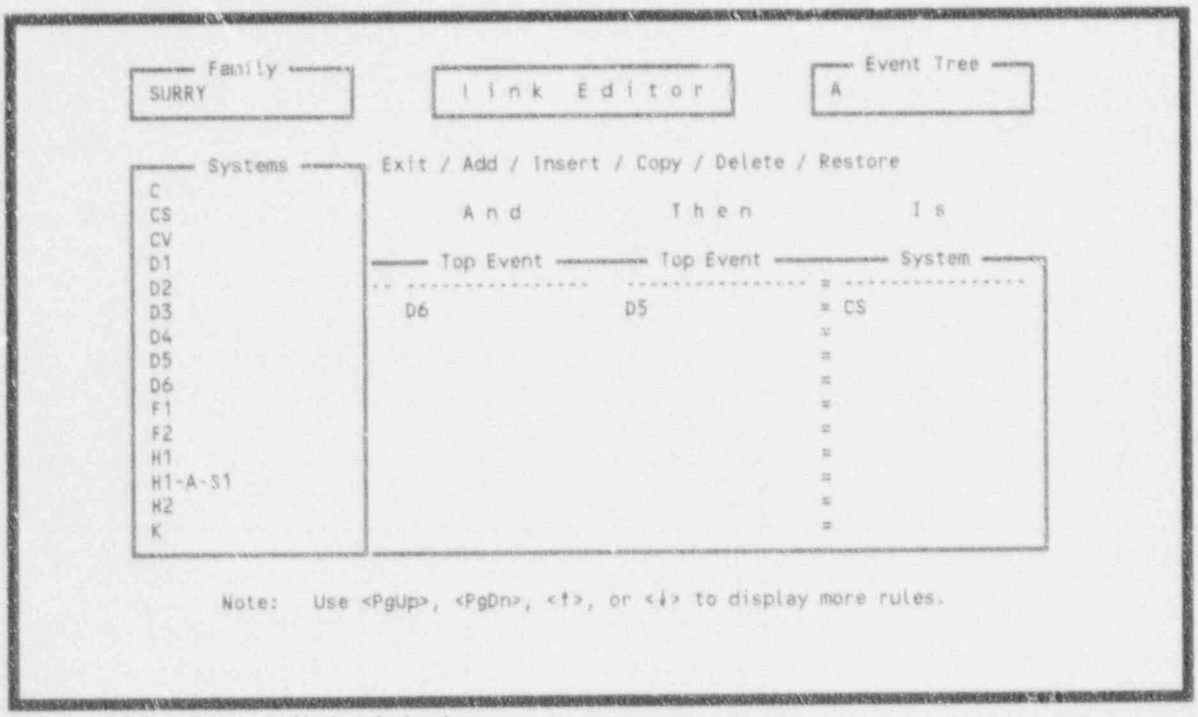


Figure 138. Systems listing help form.

```
  ---- Family ----             +-------------------+      ---- Event Tree ----
  SURRY                        | L i n k   E d i t o r |  A

           Option:  Exit / Add / Insert / Copy / Delete / Restore
           Copy Rule    1 after Rule    0  (0 = First, 9999 = Last)
            I f            A n d            T h e n            I s

  - # --- Top Event ------ Top Event ------- Top Event -------- System ----
  ---- ---------------- ----------------  ---------------- = ----------------
     1 D5               D6                D5               = CS
                                                           =
                                                           =
                                                           =
                                                           =
                                                           =
                                                           =
                                                           =
                                                           =
                                                           =

      Note:   Use <PgUp>, <PgDn>, <↑>, or <↓> to display more rules.
```

Figure 139. Copy linkage rules menu.

NOTE: **Please note there is a one to one relationship between replaced tops and replacement tops/system. In other words, a group of systems cannot replace one top and group of tops cannot be replaced by one system. An example of a multi-branch failure is shown in Figure 140.**

7.3.4 Sequence Editor

This option allows you to edit sequence names, end states, and assign frequencies after an event tree has been created. To invoke this option, enter an <S> in the option field, highlight the desired event tree, and press <Enter>. Figure 141 will be displayed showing all the sequence names and event states defined for the selected event tree.

NOTE: Any changes made using this option, will be made throughout the entire system (i.e., the corresponding drawing will be updated).

As shown, eight options are available. Each of these options is discussed in the following paragraphs.

7.3.4.1 Exit. This option terminates the sequence editor and returns you to Figure 132.

```
Family                                            Event Tree
IP2                 L i n k   E d i t o r         SS-ET11A

          Option:  Exit / Add / Insert / Copy / Delete / Restore

          I f           A n d           T h e n           I s

 # ── Top Event ──── Top Event ────── Top Event ────── System
    1 SS1                              SS1            = SS2
                                       SS1            = SS3
                                       SS1            = SS4
                                       SS1            = SS5
                                       SS1            = SS6
                                       SS1            = SS7
                                       SS1            = SS8
                                                      =
                                                      =
                                                      =

      Note:   Use <PgUp>, <PgDn>, <↑>, or <↓> to display more rules.
```

Figure 140. Multi-branch failure example.

```
Family                                                Event Tree
SURRY             S e q u e n c e   E d i t o r       FT2

      Option |E| Exit / Frequency / '@' Status / Line Edit / Transfer
                     Global Replace / Header Edit / Change Transfer

 NUM. * T SEQUENCE-NAMES   END-STATE-NAMES  EXTRA-#1        EXTRA-#2
    1      T2               @OK
    2      T2D3             @OK
    3      T2D3W            @OK
    4      T2L              @OK
    5      T2LH2            @CM
    6      T2LH1            @CM
    7      T2LCS            @OK
    8      T2LCSH2          @CM
    9      T2LCSH1          @CM
   10      T2LCSCV          @CM

                        * - Marked, T - Transfer

   <Esc>      <F1>      <F2>         <F3>        <F4>         <F5>
   Exit       Help      Mark Entry   Mark All    Mark Range   Locate
```

Figure 141. Sequence editor menu.

7.3.4.2 Frequency. This option will display the frequencies or min cut upper bound values associated with the selected sequence. To invoke this option, enter an <F> in the option field, highlight a sequence (or mark a series of sequences), and press <Enter>. The EXTRA-#1 column will now read FREQUENCY and the corresponding frequencies will be displayed. You may now invoke the Line Edit command to modify frequencies, if desired.

7.3.4.3 @Status. An "@" means that the corresponding sequence will not be generated; it will be ignored. This option allows you to set the current state of a sequence (i.e., sequence will be generated or ignored). To invoke this option, enter an "@" in the option field, highlight the sequence whose status is to be changed, and press <Enter>. Depending on the current status, an "@" will appear or disappear from the STATE column.

7.3.4.4 Line Edit. This option allows you to edit the data displayed one line at a time. To invoke this option, enter an <L> in the option field, highlight the line you wish to edit using the arrow keys, and press <Enter>. The selected sequence will appear in a window. You may change any of the fields displayed by simply typing over the existing data. Press the tab key to move from field to field. When complete, press <Esc> to exit without saving the changes made. Otherwise, press <Enter>. When you exit the Sequence Editor option, you will be asked whether or not you wish to save changes before exiting.

7.3.4.5 Transfer. This option will follow the transfer of the selected sequence. If changes were made to the current event tree, you will be asked if you wish to save those changes before following the transfer.

7.3.4.6 Global Replace. This option allows you to replace a specified string at every occurrence with another string. To invoke this option, type a <G> in the option field and press <Enter>. Figure 142 will be displayed. First, you enter the string for which to search. Press the <Tab> key once and enter the replacement string. Press the <Tab> key once more, and enter the column (1, 2, 3, or 4) on which to perform the search. If the search string is found, all occurrences of the search string will be replaced by the string specified in the replacement string. If the string is not found, the message **No such string found** will be displayed at the bottom of the screen and you will be returned to the previous screen.

7.3.4.7 Header Edit. This option allows you to change the headers that appear across the top of the columns (note: EXTRA-#1 and EXTRA-#2 are user-defined fields). To invoke this option, type an <H> and press <Enter>. An outline will surround the headers that may be changed. Simply type over the existing header. Use the <Tab> key to move from field to field. When complete, press <Esc> to terminate without saving the header changes. When you exit the Sequence Editor you will be asked whether or not you wish to save all changes made before exiting.

7.3.4.8 Change Transfer. This works as a toggle switch to turn on and off transfer points. If the sequence was marked as a transfer, this option will turn off the transfer. If the sequence was not marked as a transfer, it turns on the transfer.

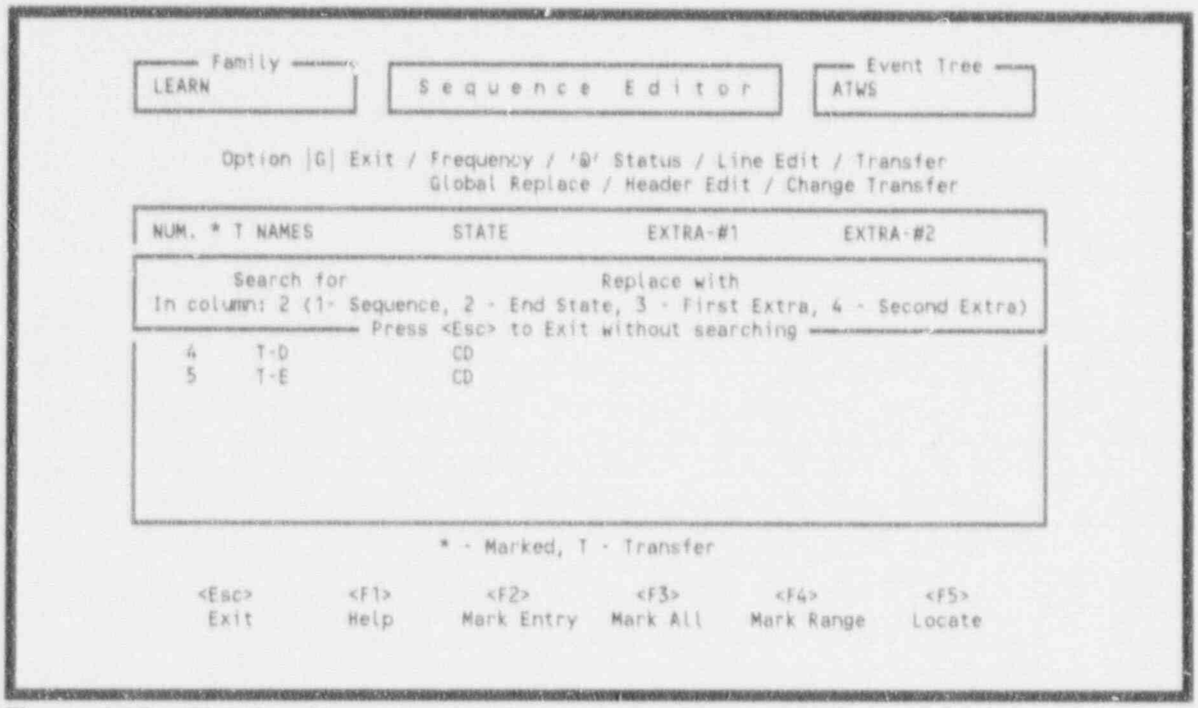


Figure 142. Global replacement using the sequence editor.

7.4 Plot Trees

This option allows you to plot graphics files. This option operates the same as the Plot Tree option for fault trees discussed in Section 5.2, except in this option you will be working with event trees. Refer to Section 5.2 for the detailed user instructions.

7.5 Graphics Load

This option allows you to load event tree graphic files. When you invoke this option, Figure 143 will be displayed. As shown, two options are available: Exit and Load.

7.5.1 Exit

This option returns you to the previous screen. To invoke this option, enter an <E> in the option field and press <Enter>, or press the <Esc> key.

7.5.2 Load

This option allows you to load event tree graphics into the system. A conversion of the selected file will be performed. To invoke this option, enter an <L> in the option field, highlight the file or mark the files to be loaded using the function keys, and press <Enter>. A message will be displayed telling you that the selected file(s) is being converted.

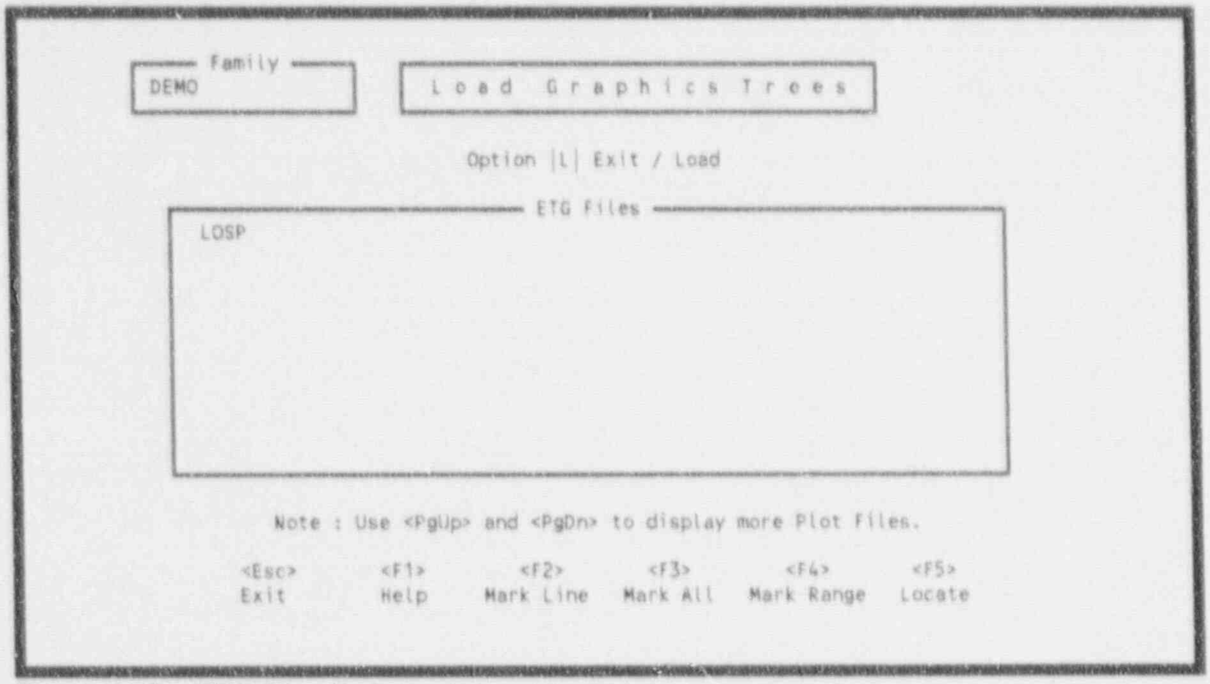


Figure 143. ETG files display.

7.6 eXtract Event Trees

This option allows you to extract event trees from the system. When you invoke this option, Figure 144 will be displayed. On this screen all the event trees residing in the current directory are displayed. Four options are available: Exit, eXtract Trees, Clear Extracted Trees, and Display Extracted Trees.

7.6.1 Exit

This option returns you to the Event Tress Graphics System menu (Figure 116). To invoke this option, enter an <E> in the option field and press <Enter>, or press the <Esc> key.

7.6.2 eXtract Trees

This option allows you to remove specific event trees from the data base. To invoke this option, enter an <X> in the option field, highlight the tree to be extracted or mark the trees to be extracted (using the function keys) and press <Enter>. A message will be displayed notifying you that the tree(s) was successfully extracted.

7.6.3 Clear Extracted Trees

This option allows you to clear all extracted trees from a file. To invoke this option, enter a <C> in the option field, highlight the file to be cleared or mark the files using the function keys, and press <Enter>. A warning screen will appear (Figure 145) telling you that all existing *.ETG files will be deleted. Enter a <Y> to delete or an <N> to terminate the process.

```
 Family                 
SURRY                    Extract Graphic Event Trees

        Option |E|  Exit / eXtract Trees / Clear Extracted Trees
                     / Display Extracted Trees

 Name ─────────────────── Description ──────────
 A
 ATWS1
 ATWS2
 S1
 S2
 S3
 T1S1
 T1SB
 T2
 T3

  <Esc>     <F1>     <F2>        <F3>       <F4>        <F5>
  Exit      Help     Mark Line   Mark All   Mark Range  Locate

Note: Use <Ctrl PgUp>, <Ctrl PgDn>, <PgUp>, <PgDn>, <↑>, <↓> for more Data.
```

Figure 144. Extract graphic event trees screen.

```
 Family
SURRY                    Extract Graphic Event Trees

        Option |C|  Exit / eXtract Trees / Clear Extracted Trees
                     / Display Extracted Trees

 Name ─────────────────── Description ──────────
 A
 ATWS1
 ATWS2
 S1
 S2              W A R N I N G
 S3
 T1S1        All existing "*.ETG" files
 T1SB           will be deleted!!
 T2
 T3          Do you wish to proceed? N Y/N

  <Esc>     <F1>     <F2>        <F3>       <F4>        <F5>
```

Figure 145. Warning screen for extracting trees.

7.6.4 Display Extracted Trees

This option allows you to display all the extracted trees to date. To invoke this option, enter a <D> in the option field and press <Enter>. A screen similar to the one shown in Figure 146 will be displayed. Press <Enter> to return to the previous screen.

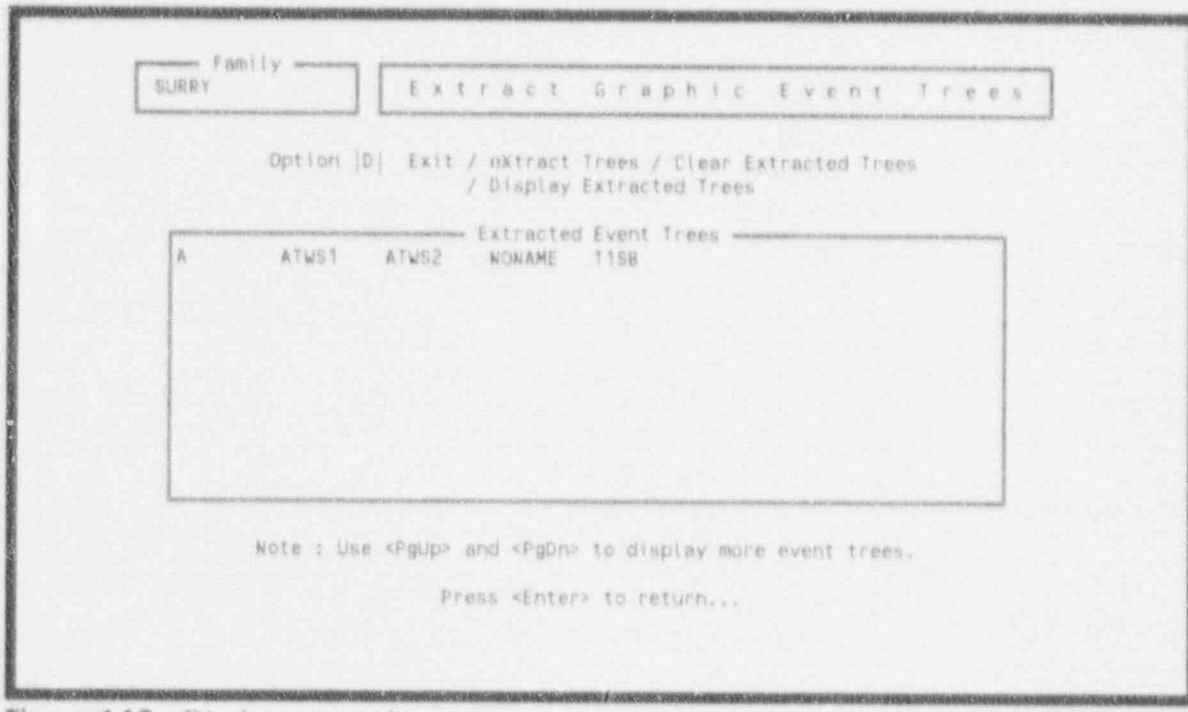


Figure 146. Display extracted trees screen.

7.7 Define Plotter Pens

This option allows you to assign colors to the plotter pens. When you invoke this option, a screen will be displayed showing 16 colors. Select the color to be mapped by positioning the cross hair over the desired color and pressing the left mouse button. You will then be prompted to **Enter number of pen >**. Enter the number of the pen that will contain the previously defined color. Continue this process until all pens have been defined. To terminate the process, position the cursor on the STOP symbol and press the left mouse button.

8.0 ANALYZE SEQUENCES

The Analyze Sequences option consists of the following four options:

1. Analyze Sequences includes updating the cut sets, quantifying the cut sets, and running uncertainty analyses.

2. Display Results presents the analyses in various report forms.

3. The Cut Set Editor provides the means to modify the event tree cut sets.

4. Link Event Trees allows you to define linkage rules and generate sequence logic.

Keys that you will frequently use are

<Esc>	Escape cancels your last choice and returns you to the previous screen.
<F1>	Help briefly explains the function of a field and may show you examples of data entered.
<F2>	Mark/Unmark 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/Unmark 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.

To invoke this option, highlight ANALYZE Sequences and press <Enter>. The event tree analysis main menu is shown in Figure 147. The options available from the event tree analysis main menu are: Exit, Analyze Sequences, Display Results, Cut Set Editor, and Link Event Trees. These options and their functions will be discussed in the following paragraphs.

8.1 Exit

The Event Tree Analysis screen appears with Exit as the default choice in the command line (see Figure 147). Press <Enter> to return to the IRRAS main menu.

8.2 Analyze Sequences

This option provides the means to recalculate sequence values after events and/or cut sets have been modified. To invoke the option, highlight Analyze Sequences or type <A> in the option field, and press <Enter>. Figure 148 shows the main screen for sequence analysis that lists the sequences defined for the current family. The letters c, q, and u (in any combination) may precede a sequence name and are defined as follows:

```
Family                    Event Tree
SURRY                      Analysis

                     Exit

                     Analyze Sequences

                     Display Results

                     Cut Set Editor

                     Link Event Trees

                        Option [E]
```

Figure 147. Event tree analysis main menu.

```
Family
SURRY                 Analyze Sequence

Option [E]  Exit / Generate Cut Sets / Cut Set Update / Quantification
            Uncertainty Analysis / Split Fraction

   Name          Tree          Description
   A-D5          FA            LARGE LOCA - ACCUMULATOR FAILURE
   A-D6          FA            LARGE LOCA - INJECTION FAILURE
   A-H1          FA            LARGE LOCA - RECIRCULATION FAILURE
   S1-D1         FS1           MEDIUM LOCA - INJECTION FAILURE
   S1-D6         FS1           MEDIUM LOCA - INJECTION FAILURE
   S1-H1         FS1           MEDIUM LOCA - RECIRCULATION FAILURE
   S2-D1         FS2           SMALL LOCA - INJECTION FAILURE
   S3-D1         FS3           VERY SMALL LOCA - INJECTION FAILURE
 u SBO-BATT2     FT1SB         SBO (U1, U2) - STUCK OPEN PORV
 u SBO-L2        FT1SB         SBO (U1, U2) - AFW FAILURE

<Esc>   <F1>   <F2>        <F3>       <F4>         <F5>
Exit    Help   Mark Line   Mark All   Mark Range   Locate
```

Figure 148. Sequence analysis main menu.

c - flags the sequence as having cut sets that must be recalculated
q - flags the sequence as having cut sets that must be requantified
u - flags the sequence as needing uncertainty distributions recalculated

Once these functions have been executed the corresponding letter is removed from the display. The options available from the Analyze Sequences screen are Exit, Generate Cut Sets, Cut Set Update, Quantification, Uncertainty Analysis, and Split Fraction. You have the choice of using either the Monte Carlo sampling technique or the Latin Hypercube sampling technique for running the uncertainty analysis process.

IRRAS writes the summary information generated during analysis to a file that the user can read to determine the results of a batch operation involving several systems or sequences. This file is called "SCREEN.CPY." When either Analyze Systems or Analyze Sequences is executed, IRRAS deletes a file in the current family subdirectory called "SCREEN.OLD." The file "SCREEN.CPY" is then renamed to "SCREEN.OLD." The summary screens for any operations performed during this session (using the Analyze option) are then written to the file "SCREEN.CPY." The user may exit IRRAS, change to the specified subdirectory, and print, edit, or review this file.

8.2.1 Exit

To return to the Event Tree Analysis menu, type an <E> (Exit) in option field and press <Enter>, or press the <Esc> key.

8.2.2 Generate Cut Sets

This option allows you to generate the cut sets for a selected sequence based on cut set generation cutoff values. You are given the opportunity to specify several cut set generation cutoff values that will be used to determine if a cut set is to be retained or discarded from the selected sequence.

You are given the ability to generate cut sets for a selected sequence, a group of sequences, or all sequences within the current family. To invoke the Generate Cut Sets for a single selected sequence, type <G> (Generate Cut Sets) in the option field, highlight the desired sequence, and press <Enter>. To invoke this process for a group of sequences, mark the desired sequences using the function keys F2, F3, and F4, type a <G> in the option field, and press <Enter>. To invoke this option for all sequences in the current family, clear all marked entries with the F3 key, type <C> 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 Generate Cut Sets for all records that need processing (e.g., for <G> the sequences must have a "c" in front of the sequence name, etc.) or type an <N> to terminate the update for all sequences.

Whether you are generating cut sets for a single sequence, a group of sequences, or for all sequences, the Cut Set Generation Cutoff Values screen shown in Figure 149 will be displayed. You may change any of the data fields on this screen. Each field is described below. The default values that appear on this screen may be reset to new values by selecting the Utility Options from the IRRAS main menu and then invoking the Define Constants option.

Perform Cut Set Prob Truncation?	If you enter a <Y>, then the only cut sets whose product for all of its event probabilities is greater than or

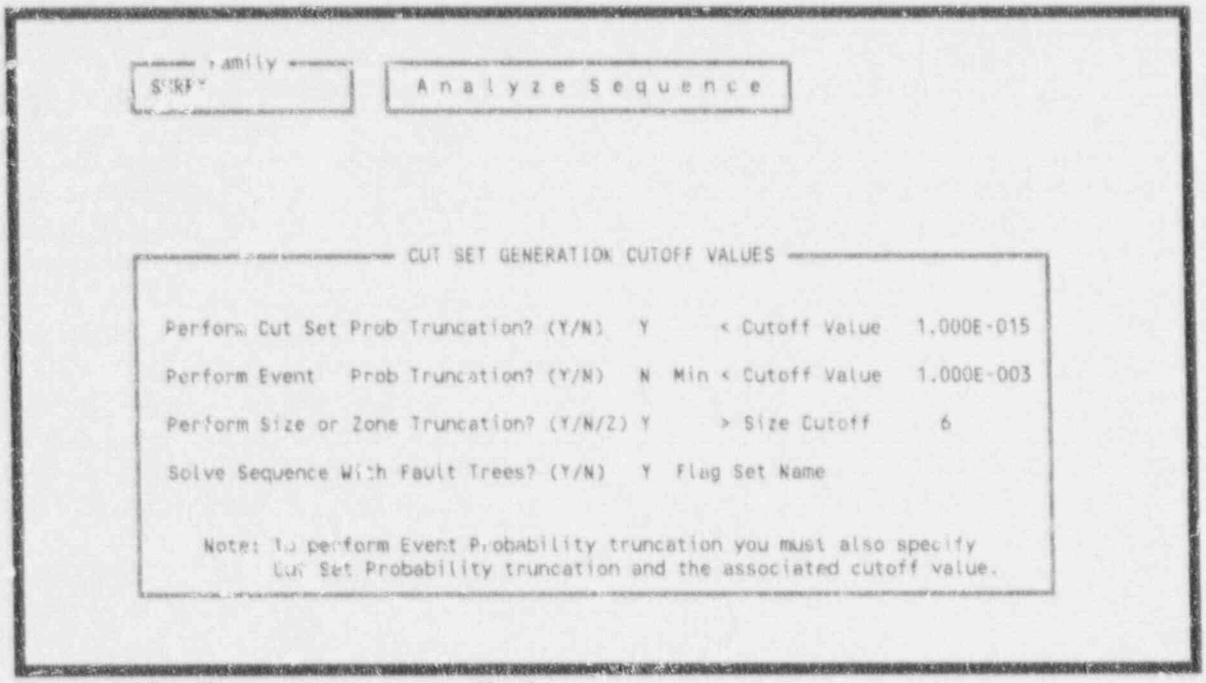


Figure 149. Cut set generation cutoff values.

equal to the value in the Cutoff Value field will be kept. All other cut sets will be removed.
If you enter an <N>, then the probability for the cut set will not be relevant for determining if the cut set should be retained or discarded.

Perform Event Prob Truncation?

If you enter a <Y>, then you must also enter <Y> for "Perform Cut Set Prob Truncation." This option will check all cut sets that are below the probability cutoff (MIN < Cutoff Value field) and remove them only if they contain an event whose probability is below this value.

Perform Cut Set Size Truncation

If you enter a <Y>, then only the cut sets whose number of events is less than or equal to the value specified in the Size Cutoff field will be kept in the cut sets for that system. All other cut sets will be removed.
If you enter an <N>, then the number of events in a cut set will be irrelevant for determining if the cut set should be retained or discarded.
If you enter a <Z>, then only zone flagged events will be checked.

Solve Sequence With Fault Trees

If you enter a <Y>, IRRAS uses the system fault trees to solve the tree; otherwise the system cut sets are used.

Cutoff Value	V ue set for probability truncation.
MIN < Cutoff Value	Value set for event probability truncation.
> Size Cutoff	Value set for cut set size truncation.
Flag Set Name	The flag set name is the name of a change set (see Section 4.5.2) containing a set of events to be set to either "T," "F," or "I" and flags to be set to "X," "Y," or "1." These events must be individual settings (i.e., not class changes). If this field is left blank, then IRRAS checks to see if there is a default setting for this sequence. The default can be set using the Event Tree Sequences suboption under the Modify Data Base option (see Section 9.3.6). If there is a default setting, then IRRAS uses it; otherwise, IRRAS uses no flags. If the flag set name is set to "NONE," then no flags are used. This option allows the user to specify changes to the flags for each sequence without having to regenerate the failure data each time. The fault tree logic is pruned before it is solved, dependent on these flags.

During processing, the screen shown in Figure 150 is displayed and updated as the calculations proceed. Upon completion of the cut set generation, the results are displayed as shown in Figure 151.

8.2.3 Cut Set Update

This option will update the alternate cut sets for a selected sequence based on cut set generation cutoff values. This option operates the same for sequences as it does for systems. Rather than repeat the instructions, the reader is referred to Section 6.2.3.

8.2.4 Quantification

The quantification process will calculate a new minimum cut set upper bound for the sequence cut sets using the current data values (event change sets and alternate case cut sets). The new minimum cut set upper bound is saved with the alternate case cut sets for the selected sequence. This option operates the same for sequences as it does for systems. Rather than repeat the instructions, the reader is referred to Section 6.2.4.

8.2.5 Uncertainty Analysis

This option allows you to run a single uncertainty analysis for a sequence or an overall uncertainty analysis for a group of sequences. When you enter a <U> and press <Enter>, Figure 152 is displayed. As shown, the four types of overall uncertainty analyses available are: an analysis for a single sequence, a group of marked sequences, an analysis for all sequences having a particular end state, or an analysis for all sequences within the current family.

```
Family
SURRY                    A n a l y z e   S e q u e n c e

                                      Currently Processing
                         Sequence Name        A-F1-F2H1

                         Current System       F2
                         Total Number of Systems         7
                         Current System Number           2



                              Press <ESC> to terminate.
```

Figure 150. Status screen for cut set update.

```
Family                                                       Event Tree
SURRY                    A n a l y z e   S e q u e n c e     S3-D1

Sequence          Elapsed Time
  A-D5            00:00:01.860
  Cut Set Size    UpperBound
     1      0     ------E----
     2     33      1.329E-003
     3      0     ------E----
     4      0     ------E----
     5      0     ------E----
     6      0     ------E----
     7      0     ------E----
     8      0     ------E----
     9      0     ------E----
    10      0     ------E----
   >10      0     ------E----
Total      33      1.329E-003
         Press <Esc> to Exit
```

Figure 151. Results of the cut set update.

```
 Family
 SURRY                    Analyze Sequence

        Uncertainty Options [ ]  Exit / Single / Group / ENd State / Family

        Name           Tree               Description
      A-D5             FA                 LARGE LOCA - ACCUMULATOR FAILURE
      A-D6             FA                 LARGE LOCA - INJECTION FAILURE
      A-H1             FA                 LARGE LOCA - RECIRCULATION FAILURE
      S1-D1            FS1                MEDIUM LOCA - INJECTION FAILURE
      S1-D6            FS1                MEDIUM LOCA - INJECTION FAILURE
      S1-H1            FS1                MEDIUM LOCA - RECIRCULATION FAILURE
      S2-D1            FS2                SMALL LOCA - INJECTION FAILURE
      S3-D1            FS3                VERY SMALL LOCA - INJECTION FAILURE
    u SBO-BATT2        FT1SB              SBO (U1, U2) - STUCK OPEN PORV
    u SBO-L2           FT1SB              SBO (U1, U2) - AFW FAILURE

    <Esc>     <F1>     <F2>        <F3>        <F4>          <F5>
    Exit      Help     Mark Line   Mark All    Mark Range    Locate
```

Figure 152. Select an uncertainty option.

There are two different sampling techniques provided to the user for generating the samples that will be used in the uncertainty analysis calculations. The two sampling techniques are the Monte Carlo simulation technique and the Latin Hypercube simulation technique.

8.2.5.1 Exit. This option terminates the uncertainty analysis process and returns you to Figure 148. To invoke this option enter an <E> in the option field and press <Enter>, or press the <Esc> key.

8.2.5.2 Single. To generate a single uncertainty analysis, enter an <S> in the option field. The Sequence Uncertainty menu will be displayed (Figure 153). From this menu you may run a single uncertainty analysis for either a single highlighted sequence, for a group of marked sequences, or for all of the sequences within the current family.

To invoke the uncertainty analysis process for a single selected sequence type <L> or <M> (Latin Hypercube / Monte Carlo) in the option field, highlight the desired sequence, and press <Enter>. To invoke this process for a group of sequences, mark the desired sequences using the function keys F2, F3, and F4, type an <L> or <M> in the option field and press <Enter>. To invoke this process for all sequences in the current family, clear all marked sequences and then type an <L> or <M> in the option field and press <Enter>. A message **Process all entries? (Y/N)** will appear at the bottom of the screen. Type a <Y> to continue the uncertainty analysis for all of the sequences, or type an <N> to terminate the analysis.

When you have entered the desired sampling technique for the uncertainty analysis, the Uncertainty Calculation Values screen will be displayed (Figure 154 shows the Monte Carlo calculation values). This screen prompts you to enter the number of samples to be generated during the simulation and the initial value of the seed for the random number generator. A default seed value for the random

```
   Family
 SURRY                     S e q   U n c e r t a i n t y

 Option [E]  Exit / Monte Carlo Uncertainty / Latin Hypercube Uncertainty

 *-u-C---- N a m e -------- T r e e ---------- D e s c r i p t i o n --------
  u + A-D5                 A               LARGE LOCA - ACCUMULATOR FAILURE
  u + A-D6                 A               LARGE LOCA - INJECTION FAILURE, NOT RW
    + A-D6-C-F1            A               LARGE LOCA - INJECTION FAILURE, FM RWS
  u + A-F1-F2-H1           A               LARGE LOCA - RECIRCULATION FAILURE, FM
  u + A-H1                 A               LARGE LOCA - RECIRCULATION FAILURE, NO
  u + S1-D1                S1              MEDIUM LOCA - INJECTION FAILURE, NOT R
    + S1-D1-C-F1           S1              MEDIUM LOCA - INJECTION FAILURE, FM RW
  u + S1-D6                S1              MEDIUM LOCA - INJECTION FAILURE, NOT R
  u + S1-F1-F2-H1          S1              MEDIUM LOCA - RECIRCULATION FAILURE, F
  u + S1-H1                S1              MEDIUM LOCA - RECIRCULATION FAILURE, N

 <Esc>     <F1>      <F2>         <F3>        <F4>          <F5>
 Exit      Help      Mark Line    Mark All    Mark Range    Locate

 Note :  * = marked Sequence, u = recalculate uncertainty, + = Cut sets exist
```

Figure 153. Sequence uncertainty menu.

seed will be provided. You may use this value or enter a new value for the seed. To obtain a random seed from the system clock, enter a zero in this field. There will also be a default value in the field for the number of samples. You may use this value or enter another value. You may change the default values for both the number of samples and the random seed in the Utility Options, Define Constants suboption.

```
   Family
 SURRY                     S e q   U n c e r t a i n t y

 ---------- Monte Carlo Uncertainty Calculation Values ----------

      Number of samples to use in Monte Carlo simulation      1000

      Seed for random number generator                           0

     NOTE: Use "0" as the seed to get a random seed from the clock.

                      Press <Enter> to continue...
```

Figure 154. Monte Carlo calculation values.

When using the Monte Carlo sampling technique for the uncertainty analysis, if the number of samples entered is less than ten, then the number of samples will be increased to ten before the uncertainty analysis process will continue. Any number of samples greater than or equal to ten will be allowed, but a number of at least 1000 is probably a better value for improving the reliability of the Monte Carlo results.

When using the Latin Hypercube sampling (LHS) technique, if the number of samples entered is less than twice the total number of unique events in the sequence, then the number of samples will be increased to two times the total number of unique events before the analysis will continue. The LHS technique gives its best results if the number of samples is at least twice the total number of unique events.

Once the number of samples has been accepted and a seed obtained from the system clock if necessary, checks will be run to ensure the events with the same correlation classes have consistent failure data, uncertainty data, and distribution types. If any events with inconsistencies exist, an error message will be displayed and the uncertainty analysis process will be terminated so that the inconsistent values may be corrected.

If an error of some type occurs during the uncertainty analysis process, the process is terminated and the message **Error in Uncertainty analysis** is displayed at the bottom of the Analyze Sequence screen. If all of the events successfully pass the correlation class checks, then the distribution parameters for the events will be checked to ensure that they are valid. If any of the parameters are invalid, error messages will be displayed and the process will be terminated so the distribution parameters may be corrected by the user.

After both of these checks have been passed, a point estimate will be calculated for the selected sequence. At this point the samples for each event will be generated using the selected sampling technique, either Monte Carlo Sampling technique or the Latin Hypercube Sampling technique. The uncertainty analysis function provides the user with eight different distribution types for both of the two sampling techniques. The distribution types include Normal, Lognormal, Beta, Gamma, Chi-Squared, Exponential, Uniform and the user-defined histograms.

During processing the current status screen will be displayed and updated as the samples are generated. Figure 155 illustrates the current status screen for the Monte Carlo sampling technique. When the requested number of samples has been generated or the user has terminated the process of generating the samples by pressing the <Esc> key, statistical information will be calculated using the generated samples. A sample mean, median, and standard deviation will be calculated for the selected sequence. Coefficients of skewness and kurtosis, and quantile values will also be calculated for the sequence. This data will be saved in the data base for the selected sequence.

Upon completion of these calculations, the following values will be displayed on the Uncertainty Results screen for viewing: the sequence name, random seed used, the number of samples generated in this process, the total number of events and cut sets in the sequence being processed, the point estimate, the mean, the median, the 5th and 95th percentile values, the minimum and maximum generated sample values, the standard deviation, the skewness and kurtosis, and the time involved to perform the analysis. Figure 156 illustrates the Uncertainty Results screen for the Monte Carlo sampling technique.

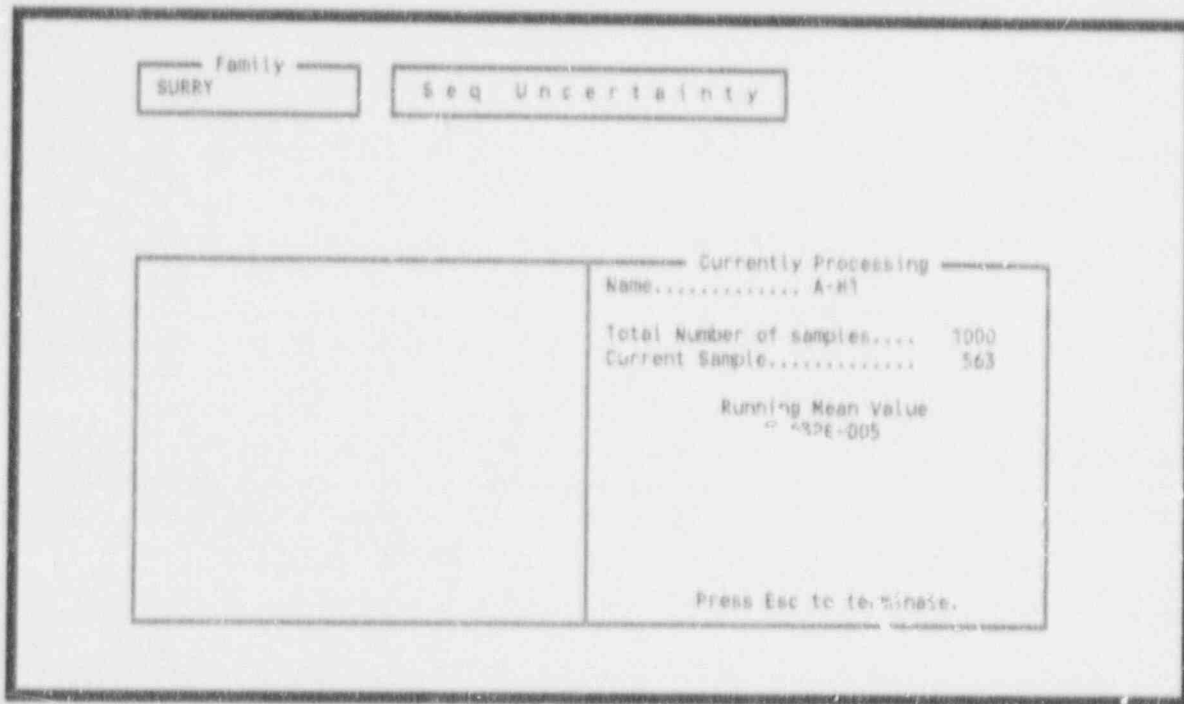


Figure 155. Current status of the Monte Carlo sampling.

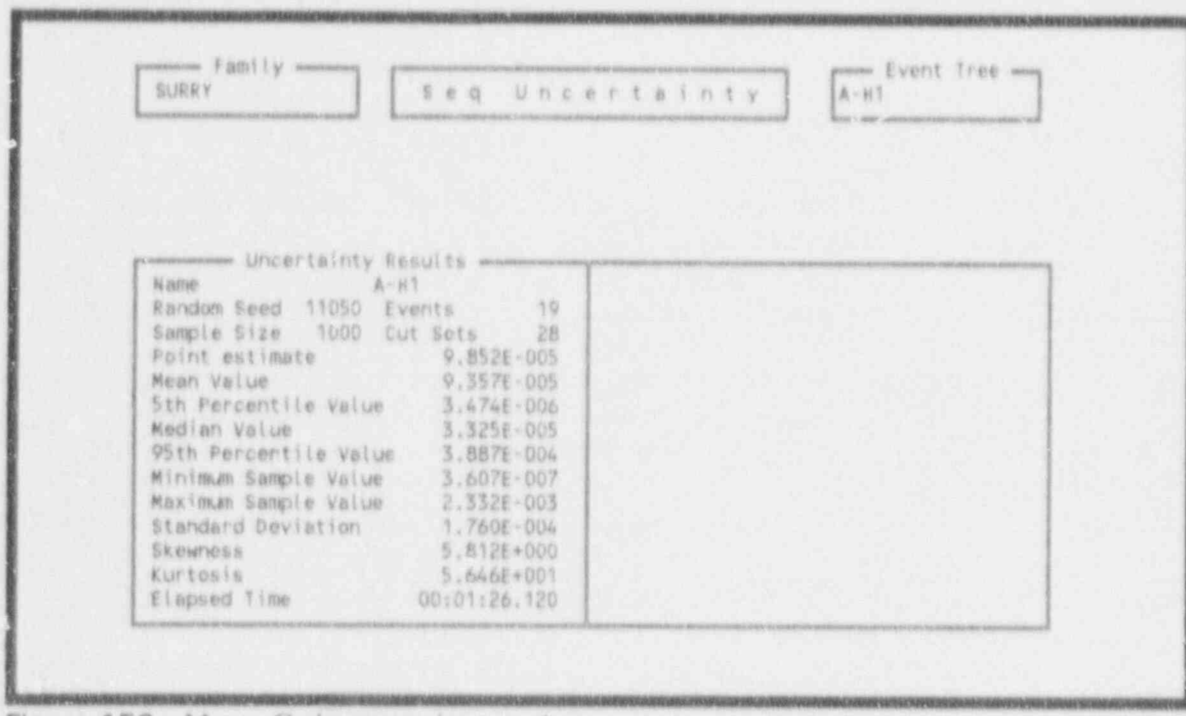


Figure 156. Monte Carlo uncertainty results.

If only one sequence was selected (highlighted) for the uncertainty analysis process, then you will need to press <Enter> to return to the Analyze Sequence screen from the Uncertainty Results screen. However, if more than one sequence is being processed, the Uncertainty Results screen will be displayed for each sequence, and when all of the selected sequences have been processed you will be returned automatically to the Analyze Sequence screen.

8.2.5.3 Group. To generate an overall uncertainty analysis for a group of sequences, enter a <G> in the option field. The Group Uncertainty menu will be displayed (Figure 157).

```
 ----- Family -----     ---------------------------------
| SURRY            |   |  G r o u p  U n c e r t a i n t y |
 ------------------     ---------------------------------

    Option [M]  Exit / Monte Carlo Uncertainty / Latin Hypercube Uncertainty

*=C---- N a m e ------ T r e e ------------ D e s c r i p t i o n ----------
|  + A-D5           A                LARGE LOCA - ACCUMULATOR FAILURE          |
|  + A-D6           A                LARGE LOCA - INJECTION FAILURE, NOT RWST  |
|  + A-D6-C-F1      A                LARGE LOCA - INJECTION FAILURE, FM RWST   |
|  + A-F1-F2-H1     A                LARGE LOCA - RECIRCULATION FAILURE, FM S  |
|  + A-H1           A                LARGE LOCA - RECIRCULATION FAILURE, NOT   |
|  + S1-D1          S1               MEDIUM LOCA - INJECTION FAILURE, NOT RWS  |
|  + S1-D1-C-F1     S1               MEDIUM LOCA - INJECTION FAILURE, FM RWST  |
|  + S1-D6          S1               MEDIUM LOCA - INJECTION FAILURE, NOT RWS  |
|  + S1-F1-F2-H1    S1               MEDIUM LOCA - RECIRCULATION FAILURE, FM   |
|  + S1-H1          S1               MEDIUM LOCA - RECIRCULATION FAILURE, NOT  |
 ---------------------------------------------------------------------------
   <Esc>     <F1>      <F2>         <F3>         <F4>          <F5>
   Exit      Help      Mark Line    Mark All     Mark Range    Locate

              Note :  * = marked Sequence,   + = Cut sets exist
```

Figure 157. Group uncertainty menu.

To invoke the overall uncertainty analysis process for a single group of sequences, type <L> or <M> (Latin Hypercube / Monte Carlo) in the option field, and press <Enter>. To invoke the process for a group of sequences, mark the desired groups using the function keys <F2>, <F3>, and <F4>, type an <L> or <M> in the option field, and press <Enter>. To invoke this process for all groups, clear all marked groups and then type an <L> or <M> in the option field and press <Enter>. A message **Process all entries? <Y/N>** will appear at the bottom of the screen. Type a <Y> to continue the uncertainty analysis for all groups, or type an <N> to terminate the analysis.

When you have entered the desired sampling technique for the uncertainty analysis, the Uncertainty Calculation Values screen will be displayed. This screen is similar to the one shown in Figure 154 (refer to Section 8.2.5.2 for details). Once you have entered valid values for the uncertainty calculations, the uncertainty analysis process will begin. During processing the current group status screen will be displayed and updated as the samples are generated. Twenty-five samples will be generated at a time, before the status screen will be updated with a new calculated mean value. Figure 158 illustrates the current group status screens for the Monte Carlo sampling technique. When the requested number of samples has been generated or the user has terminated the process of generating the samples by pressing the <Esc> key, statistical information will be calculated using the generated samples. A sample mean, median, and standard deviation will be calculated for the entire group of sequences. Coefficients of skewness, kurtosis, and quantile values will also be calculated for the group.

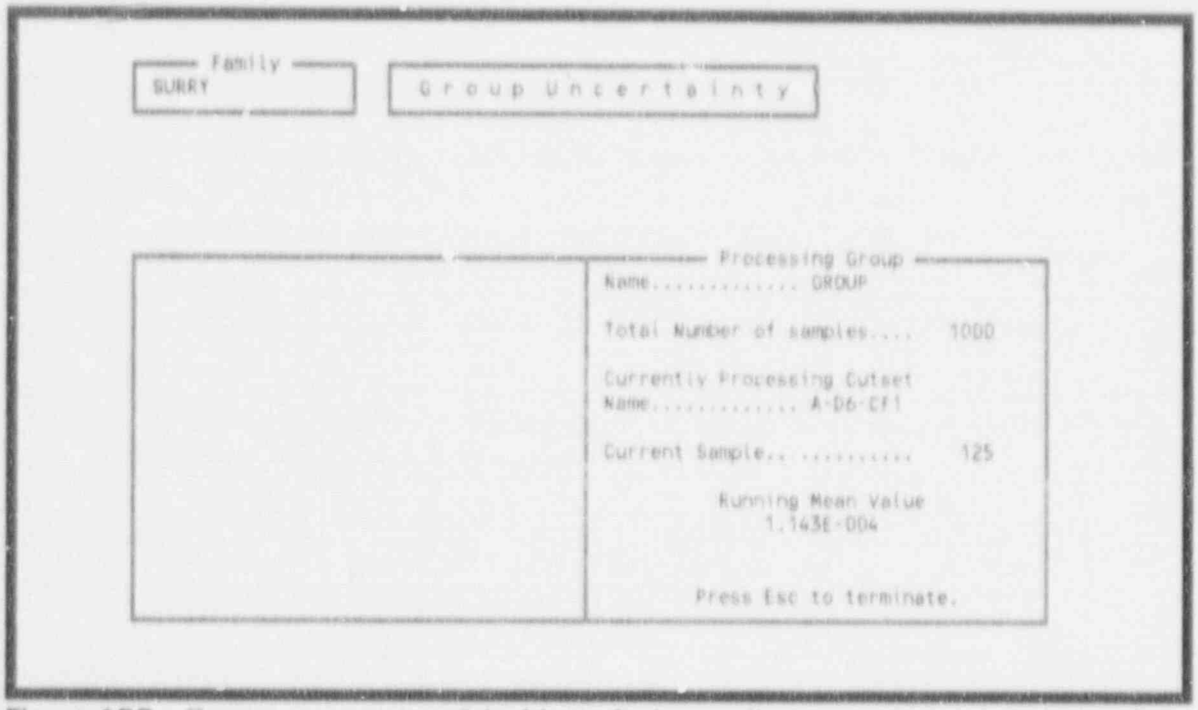


Figure 158. Current group status of the Monte Carlo sampling.

Upon completion of these calculations, the following values will be displayed on the Uncertainty Results screen for viewing: the group name, random seed used, the number of samples generated in this process, the total number of events and cut sets in the group of sequences being processed, the point estimate, the mean, the median, the 5th and 95th percentile values, the minimum and maximum generated sample values, the standard deviation, the skewness and kurtosis, and the time involved to perform the analysis. The results of overall uncertainty analysis for a group of sequences is not stored in the data base. Figure 159 illustrates the group Uncertainty Results screen for the Monte Carlo sampling technique.

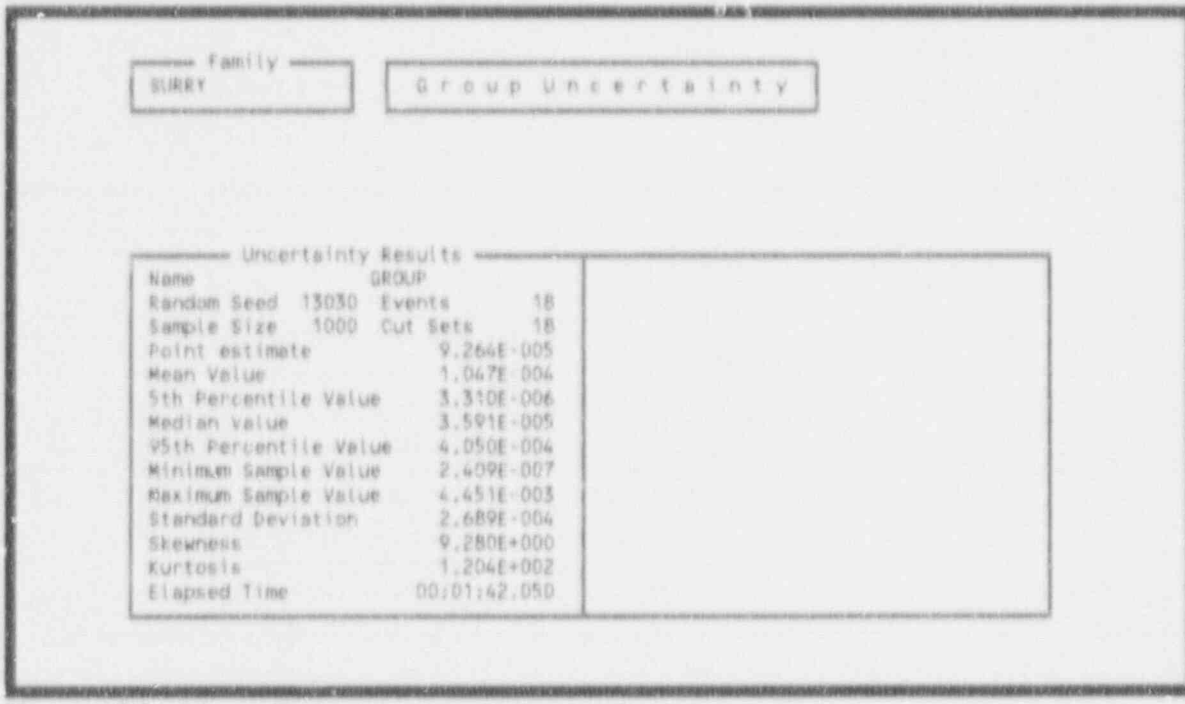


Figure 159. Monte Carlo group uncertainty results.

8.2.5.4 ENd State. To generate an overall uncertainty analysis for all of the sequences within a selected End State, enter an <N> in the option field. The End State Uncertainty menu will be displayed (Figure 160). From this menu, mark the sequences using the F2, F3, and F4 function keys that will make up the group. From this menu you may run an overall uncertainty analysis for either a single highlighted End State, for a group of marked End States, or for all of the End States within the current family.

To invoke the uncertainty analysis process for a single selected End State type <L> or <M> (Latin Hypercube / Monte Carlo) in the option field, highlight the desired End State, and press <Enter>. To invoke this process for a group of End States, mark the desired End States using the function keys F2, F3, and F4, type an <L> or <M> in the option field and press <Enter>. To invoke this process for all the End States in the current family, clear all marked sequences and then type an <L> or <M> in the option field and press <Enter>. A message **Process all entries? (Y/N)** will appear at the bottom of the screen. Type a <Y> to continue the uncertainty analysis for all of the End States, or type an <N> to terminate the analysis.

When you have entered the desired sampling technique for the uncertainty analysis, the Uncertainty Calculation Values screen (see Figure 154) will be displayed. Once you have entered valid values for the uncertainty calculations, the uncertainty analysis process will begin. During processing the current End State status screen will be displayed and updated as the samples are generated.

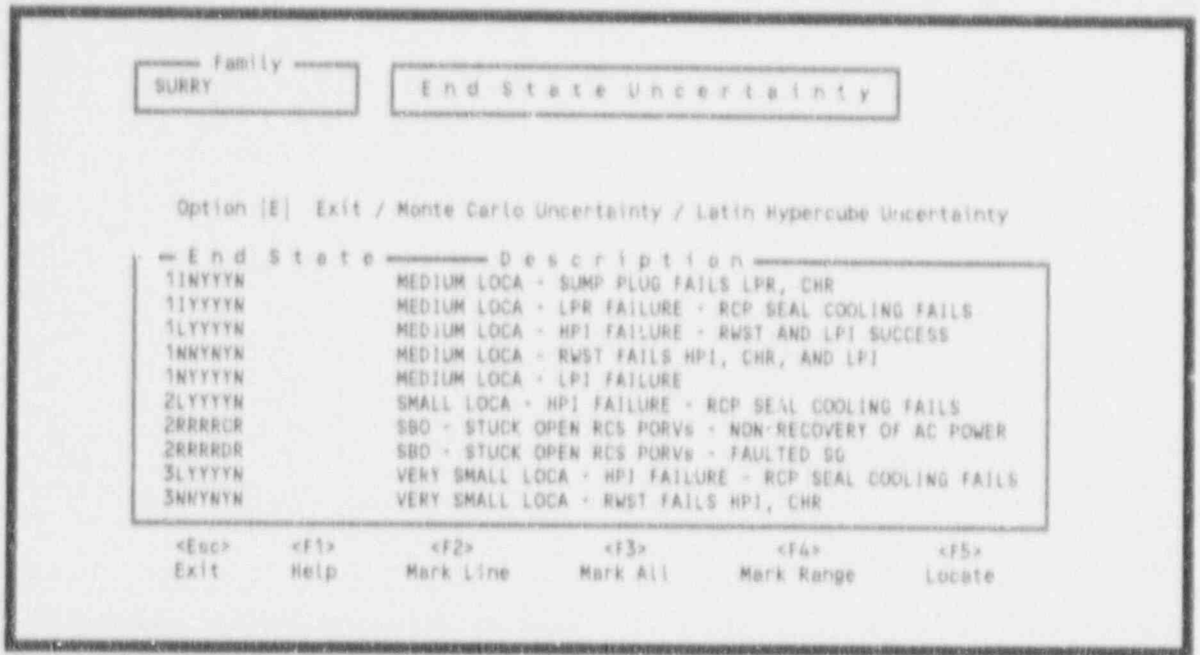


Figure 160. End State uncertainty menu.

Twenty-five samples will be generated at a time, before the status screen will be updated with a new calculated mean value. Figure 161 illustrates the current End State status screen for the Latin Hypercube sampling technique. When the requested number of samples has been generated or the user has terminated the process of generating the samples by pressing the <Esc> key, statistical information will be calculated using the generated samples. A sample mean, median, and standard deviation will be calculated for the entire group of sequences within the current End State. Coefficients of skewness and kurtosis, and quantile values will also be calculated for the End State. This data will be saved in the data base for the current End State.

Upon completion of these calculations, the following values will be displayed on the Uncertainty Results screen for viewing: the End State name, random seed used, the number of samples generated in this process, the total number of events and cut sets in the End State being processed, the point estimate, the mean, the median, the 5th and 95th percentile values, the minimum and maximum generated sample values, the standard deviation, the skewness and kurtosis, and the time involved to perform the analysis. Figure 162 illustrates the End State Uncertainty Results screen for the Latin Hypercube sampling technique.

If only one End State was selected (highlighted) for the overall uncertainty analysis process, press <Enter> to return to the Analyze Sequence screen from the Uncertainty Results screen. However, if more than one End State is being processed, the Uncertainty Results screen will be displayed for each End State, and when all of the selected End States have been processed you will be returned automatically to the Analyze Sequence screen.

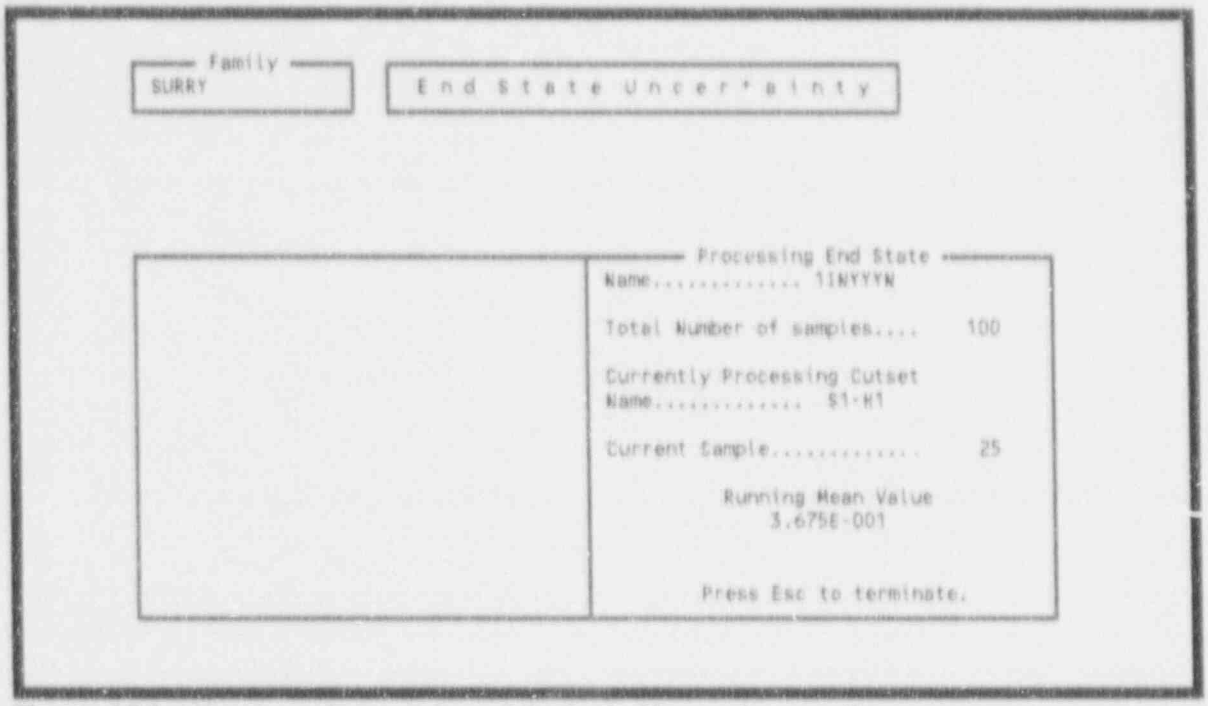


Figure 161. Current end state status of the Latin Hypercube sampling.

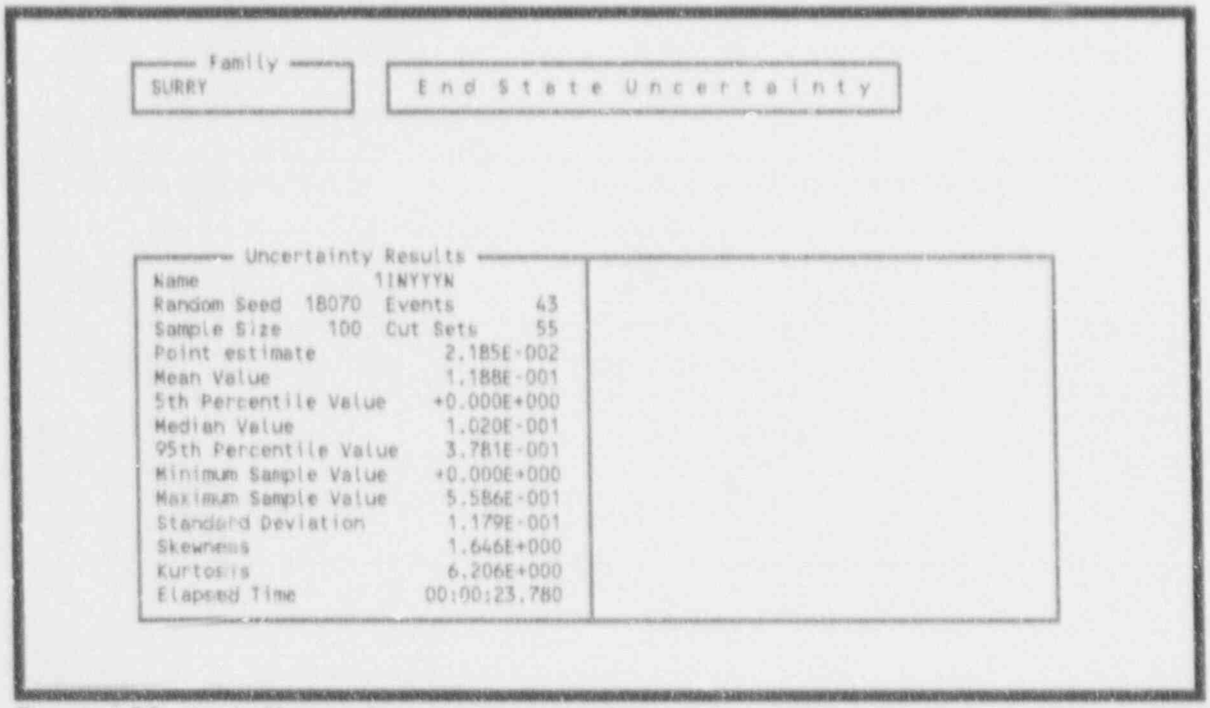


Figure 162. Latin Hypercube end state uncertainty results.

8.2.5.5 Family. To generate an overall uncertainty analysis for all of the sequences within the current family, enter an <F> in the option field. The Family Uncertainty menu will be displayed (Figure 163). From this menu, you select the type of uncertainty analysis to be performed on the family (Monte Carlo or Latin Hypercube).

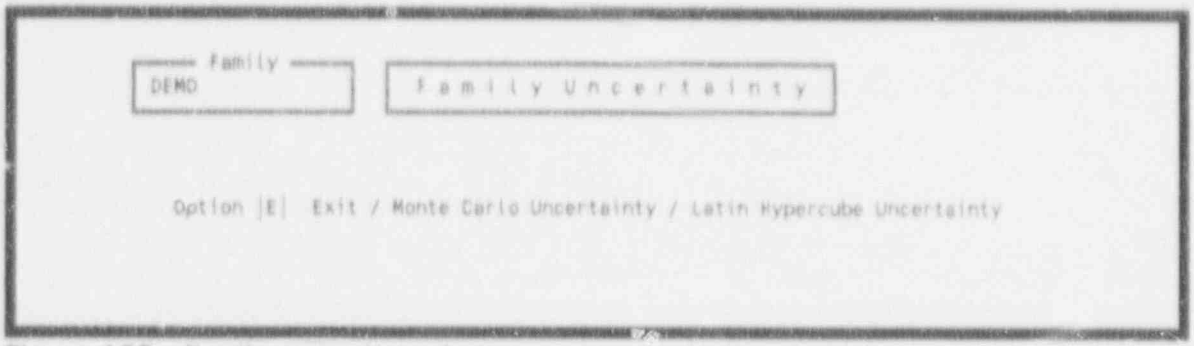


Figure 163. Family uncertainty selection menu.

When you have entered the desired sampling technique for the uncertainty analysis, the Uncertainty Calculation Values screen (Figure 154) will be displayed. Once you have entered valid values for the uncertainty calculation, the uncertainty analysis process will begin. During processing, the current family status screen will be displayed and updated as the samples are generated.

Twenty-five samples will be generated at a time before the status screen will be updated with a new calculated mean value. Figure 164 illustrates the current family status screen for the Latin Hypercube sampling technique. When the requested number of samples has been generated or the user has terminated the process of generating the samples by pressing the <Esc> key, statistical information will be calculated using the generated samples. A sample mean, median, and standard deviation will be calculated for the entire family. Coefficient of skewness and kurtosis, and quantile values will be calculated for the family. This data will be saved in the data base for the current family.

Upon completion of these calculations, the following values will be displayed on the Uncertainty Results screen for viewing: the Family name, random seed used, the number of samples generated in the process, the total number of events and cut sets in the Family being processed, the point estimate, the mean, the median, the 5th and 95th percentile values, the minimum and maximum generated sample values, the standard deviation, the skewness and kurtosis, and the time involved to perform the analysis. Figure 165 illustrates the Family Uncertainty results screens for the Latin Hypercube sampling technique.

8.2.6 Split Fraction

This option allows you to quantify the sequence cut sets using the mincut upper bound values that have been calculated for each successful or failed system which make up this sequence. This option does not generate cut sets and is usually used to give you a quick approximation of the actual result. The actual results may be obtained by generating cut sets and quantifying these cut sets.

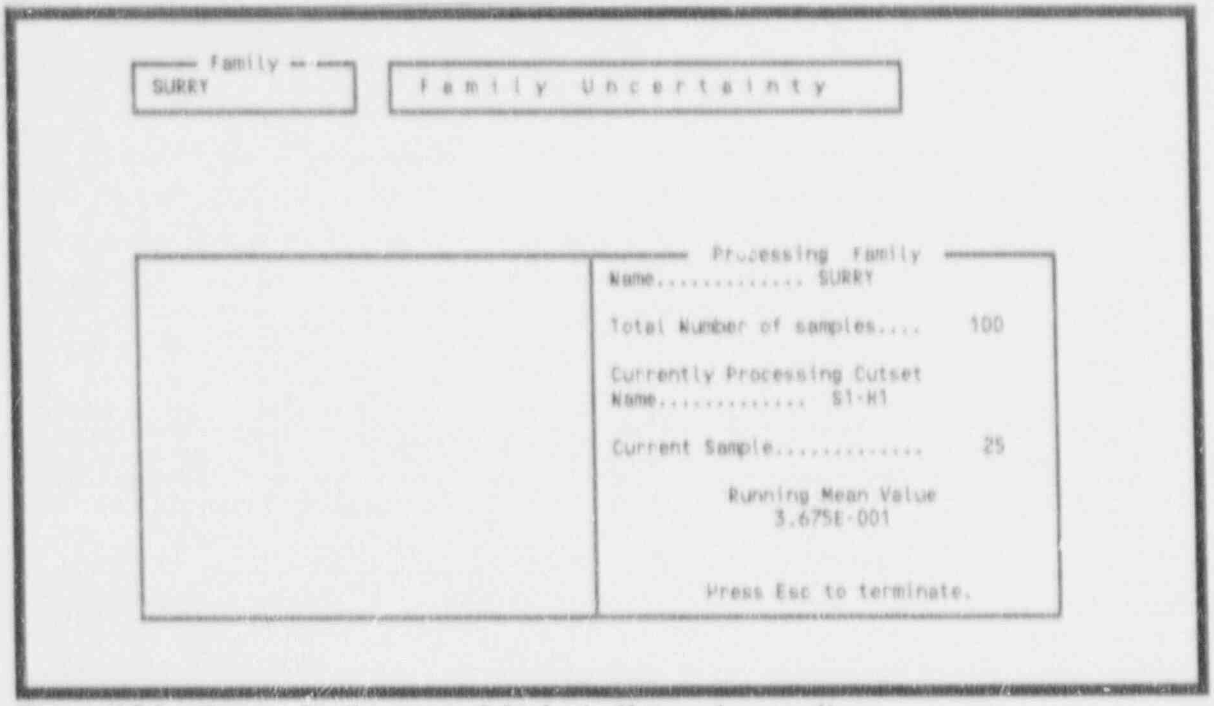


Figure 164. Current family status of the Latin Hypercube sampling.

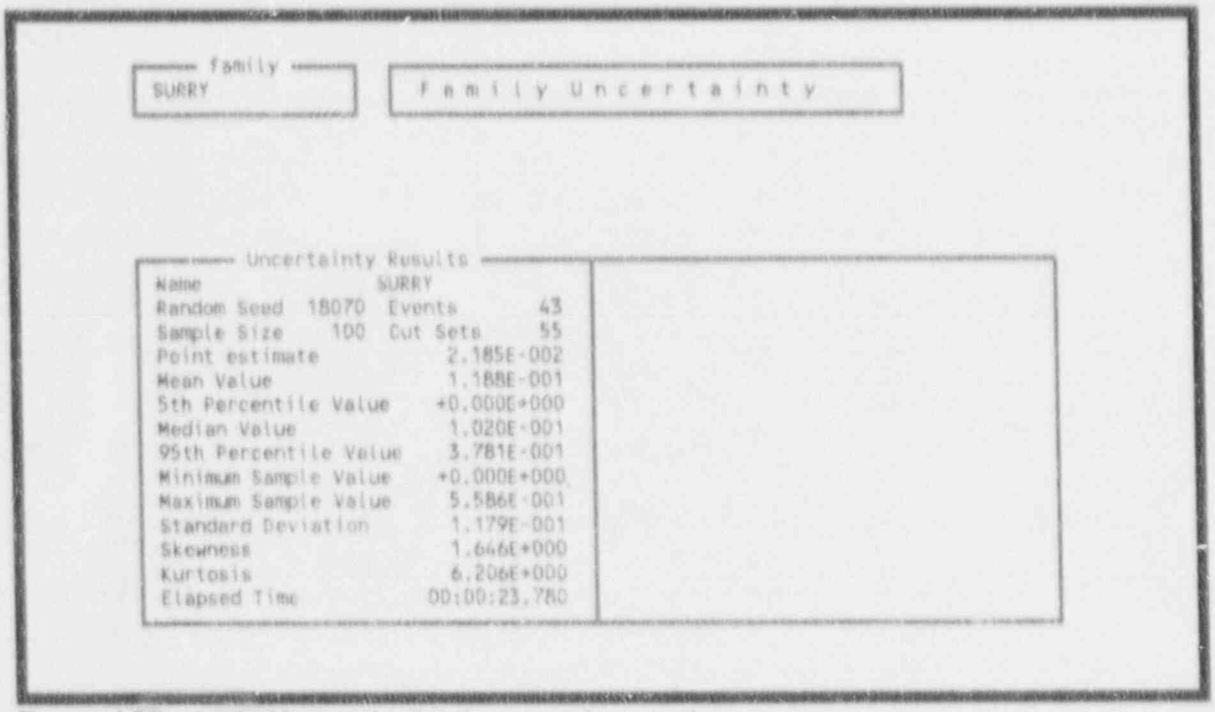


Figure 165. Latin Hypercube family uncertainty results.

To invoke this option, enter an <S> in the option field, highlight the desired sequence, and press <Enter>. The quantification results are shown in a screen similar to the one shown in Figure 166.

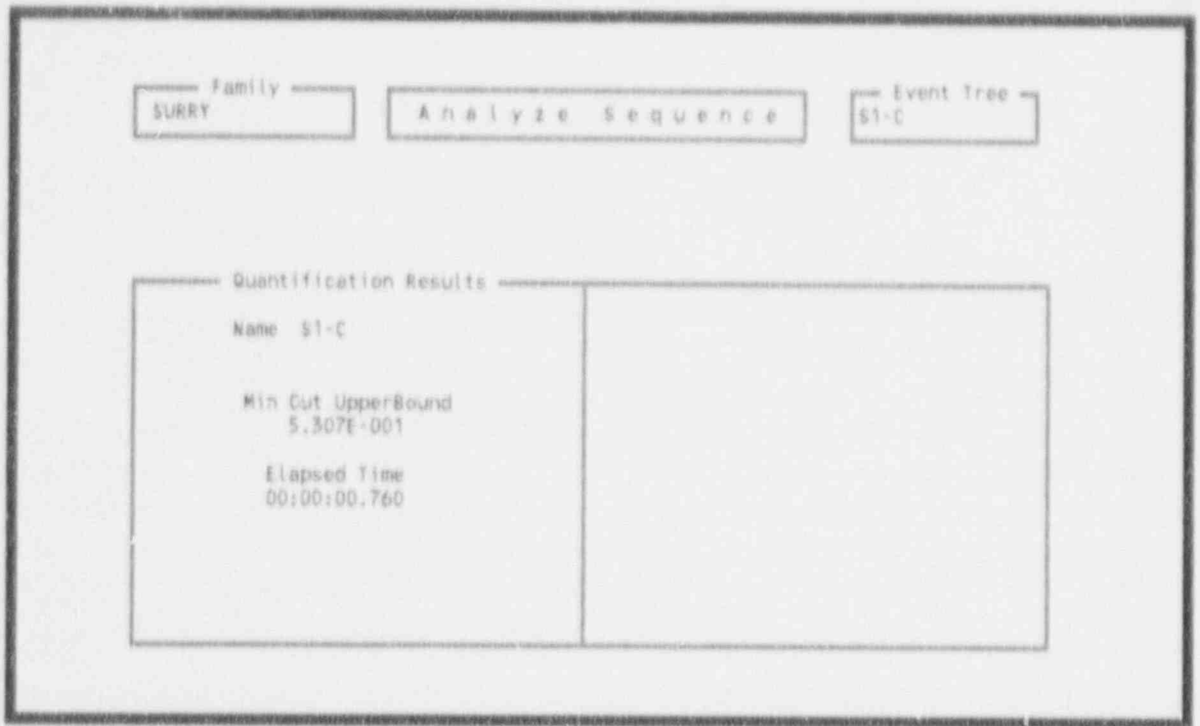


Figure 166. Split fraction display screen.

As with previous options, you may specify several sequences or a range of sequences using the <F2> and <F4> function keys, respectively. To process all sequences, enter an <S> in the option field and press <Enter>. The message **Process all entries?** will be displayed. At this prompt, enter a <Y>.

8.3 Display Results

This option allows you to display the results of your sequence analysis. To display the results, highlight Display Results or type a <D> on the Event Tree Analysis menu and press <Enter>. The Display Sequence Results screen will be displayed showing the list of sequences available in the current family. This option operates the same for sequences as it does for systems. Rather than repeat the user instructions, the reader is referred to Section 6.3.

8.4 Cut Set Editor

The cut set editor provides you with the means to edit the base case/alternate sequence cut sets. This option operates the same for sequences as it does for systems. Rather than repeat the user instructions, the reader is referred to Section 6.4.

8.5 Link Event Trees

This option allows you to define linkage rules and generate sequence logic. This option is identical to the Link Trees Option discussed in the Create Event Trees module in Section 7.3. Rather than repeat the user instructions, the reader is referred to Section 7.3.

9.0 MODIFY DATA BASE

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 Data Base and press <Enter>. Figure 167 will be displayed.

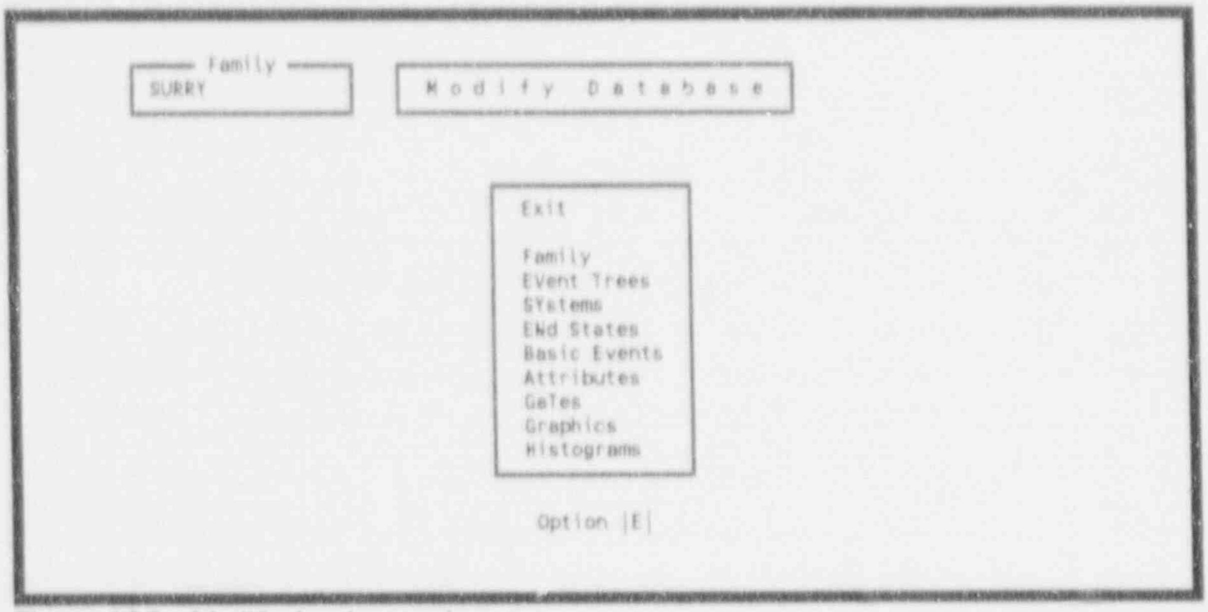


Figure 167. Modify data base main menu.

In general, each of the options shown in Figure 167 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.

9.1 Exit

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

9.2 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 168 will be displayed.

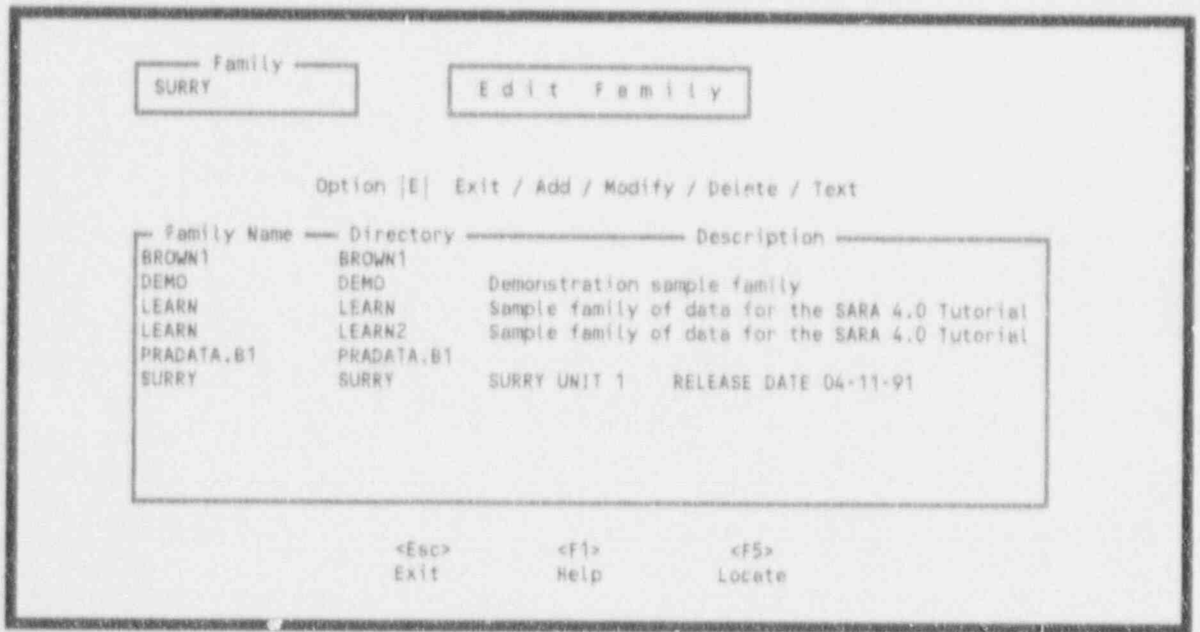


Figure 168. Family editing menu.

9.2.1 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.

9.2.2 Add

This option allows you to add a family to the data base. To invoke this option type <A> in the option field and press <Enter>. The Add Family screen (shown in Figure 169) 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.

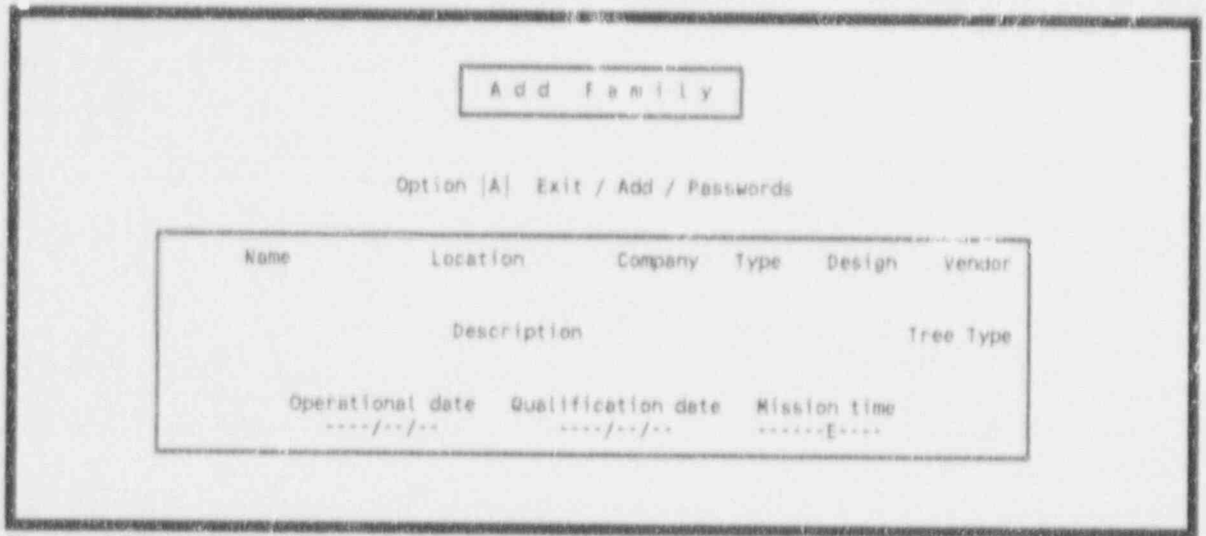


Figure 169. Editing screen for adding a family.

9.2.2.1 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.

9.2.2.2 Add. This option performs the actual addition of the family to the data base. 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.

9.2.2.3 Passwords. This option not yet available.

9.2.3 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 170. The options at this point are Exit, Modify, and Passwords.

9.2.3.1 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.

9.2.3.2 Modify. This option applies the actual modification of the family data to the data base. 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.

9.2.3.3 Passwords. This option not yet available.

```
                          Modify Family

              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 170. Editing screen for modifying a family.

9.2.4 Delete

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

This option allows you to delete family data records from the data base. To invoke this option, type <D> in the option field and press <Enter>. The Delete Family screen is shown in Figure 171 The options at this point are Exit and Delete.

```
                          Delete Family

                     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 171. Editing screen for deleting a family.

9.2.4.1 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.

9.2.4.2 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 172). 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.

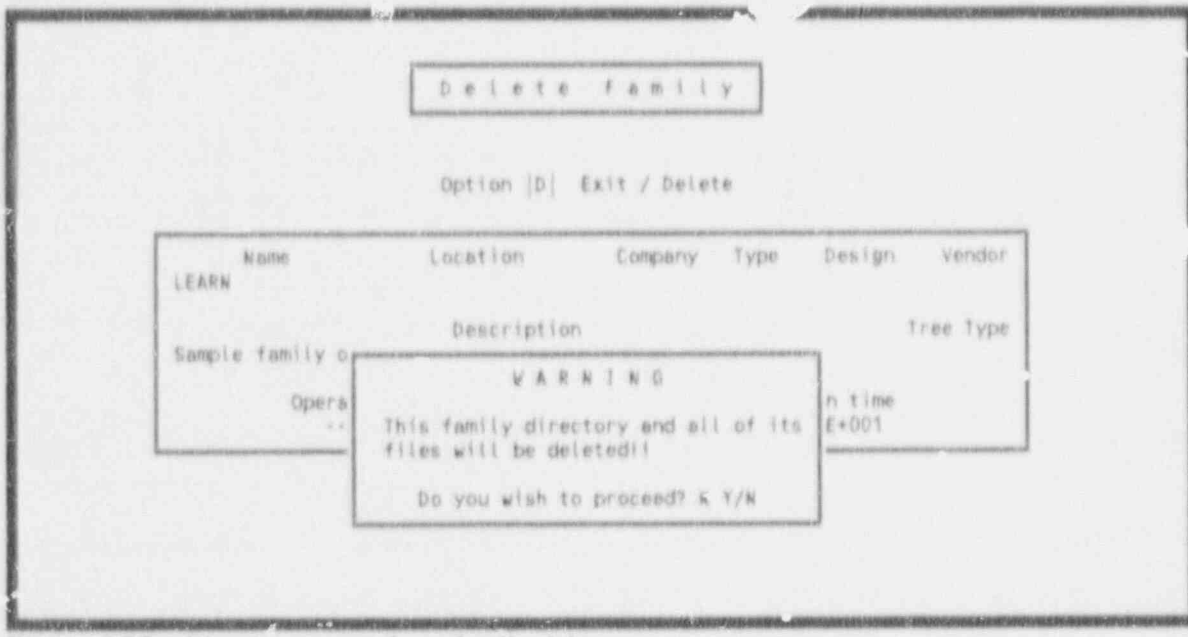


Figure 172. Warning screen for a family delete.

9.2.5 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.

9.3 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 173). The modification options are: Exit, Add, Modify, Delete, Text, Sequences, Base Case Update, and Clear Alternate Case.

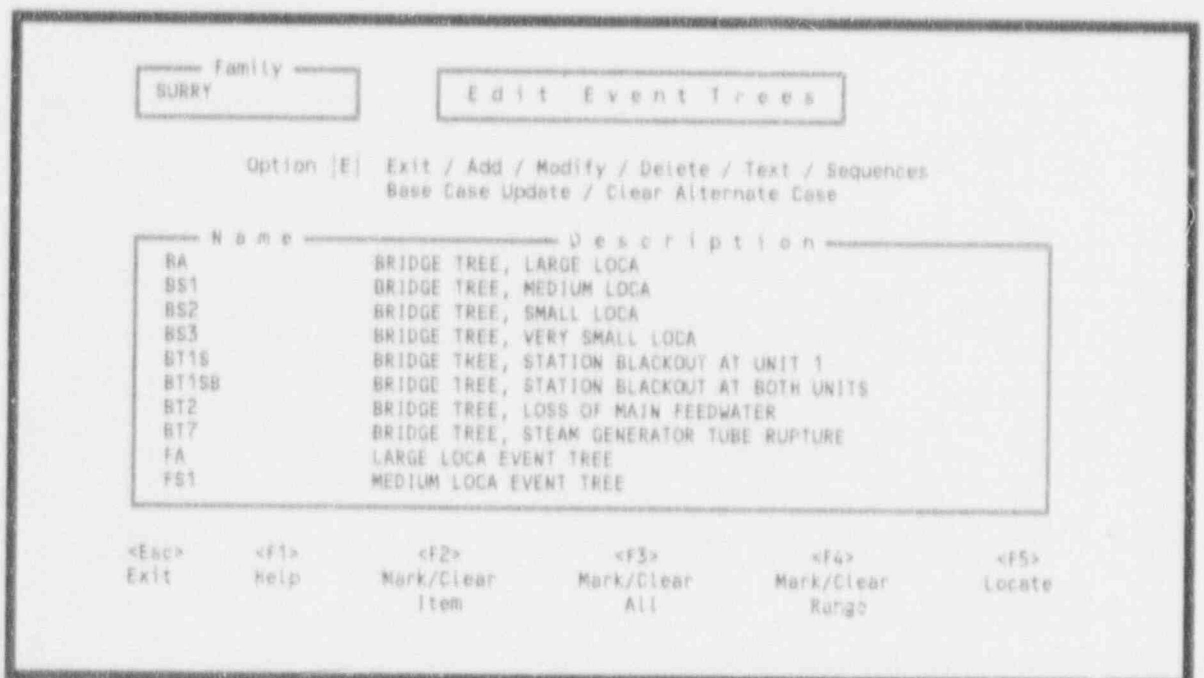


Figure 173. Selection screen for event tree editing.

9.3.1 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.

9.3.2 Add

When the user creates event trees using the graphical event tree editor or loads a graphical event tree from another data base, an event tree record is automatically added to the data base. 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 174). The options at this point are Exit and Add.

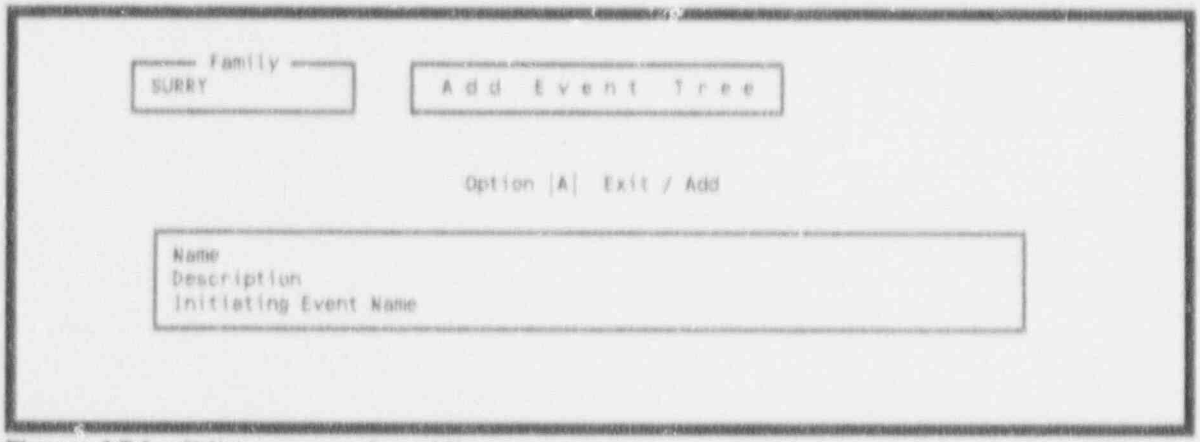


Figure 174. Editing screen for adding an event tree.

9.3.2.1 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.

9.3.2.2 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 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.

9.3.3 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 175. The options at this point are Exit and Modify.

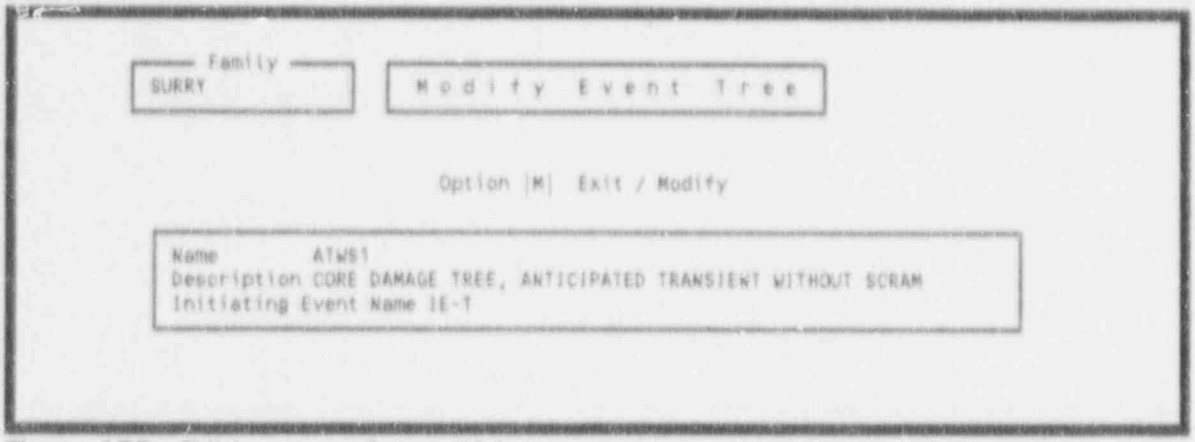


Figure 175. Editing screen for modifying an event tree.

9.3.3.1 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.

9.3.3.2 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.

9.3.4 Delete

This option allows you to delete an event tree record and associated sequence records from the data base. 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 176. The options at this point are Exit and Delete.

9.3.4.1 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.

9.3.4.2 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 177). If you respond Y (yes), all sequence records associated with the event tree will be deleted from the data base. You will be returned to the Edit Event Trees screen with the message **Record deleted** displayed.

```
┌─── Family ───┐  ┌─────────────────────────────┐
│ SURRY        │  │  D e l e t e   E v e n t   T r e e  │
└──────────────┘  └─────────────────────────────┘

                Option [E]  Exit / Delete

  ┌──────────────────────────────────────────────────────────────┐
  │ Name        ATWS1                                            │
  │ Description CORE DAMAGE TREE, ANTICIPATED TRANSIENT WITHOUT SCRAM │
  └──────────────────────────────────────────────────────────────┘
```

Figure 176. Editing screen for deleting an event tree.

```
┌─── Family ───┐  ┌─────────────────────────────┐
│ SURRY        │  │  D e l e t e   E v e n t   T r e e  │
└──────────────┘  └─────────────────────────────┘

                Option [D]  Exit / Delete

  ┌──────────────────────────────────────────────────────────────┐
  │ Name        ATWS1                                            │
  │ Description CORE DAMAGE TREE, ANTICIPATED TRANSIENT WITHOUT SCRAM │
  └──────────────────────────────────────────────────────────────┘

          ┌───────────────────────────────────────┐
          │             W A R N I N G             │
          │                                       │
          │ Deleting an Eventree will also delete │
          │ all  sequences  associated  with  the │
          │ Eventree !!                           │
          │                                       │
          │    Do you wish to proceed? N Y/N      │
          └───────────────────────────────────────┘
```

Figure 177. Warning screen for an event tree deletion.

9.3.5 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 9.2.5.

9.3.6 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 178 will be displayed. The editing options for sequences are: Exit, Add, Modify, Delete, Text, Base Case Update, and Clear Alternate Case.

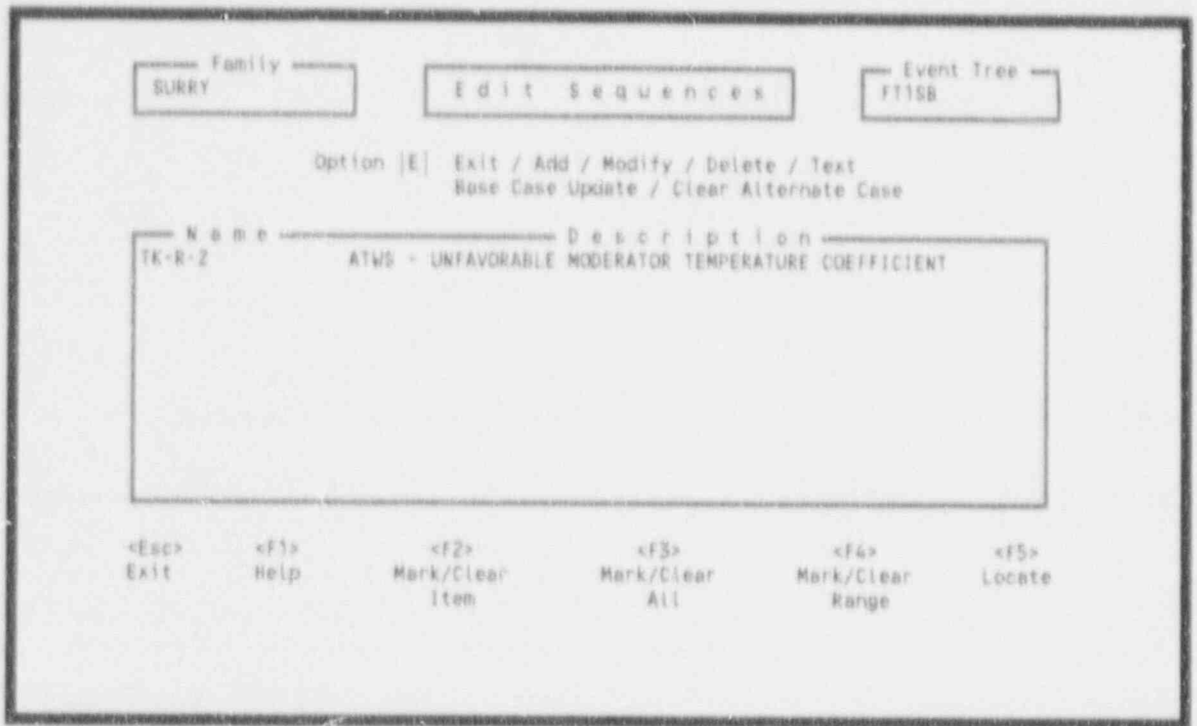


Figure 178. Sequence selection screen for editing.

9.3.6.1 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.

9.3.6.2 Add. This option allows you to add a sequence record to the data base. To invoke this option, type <A> in the option field and press <Enter>. The Add Sequence screen is shown in Figure 179. The options at this point are Exit and Add.

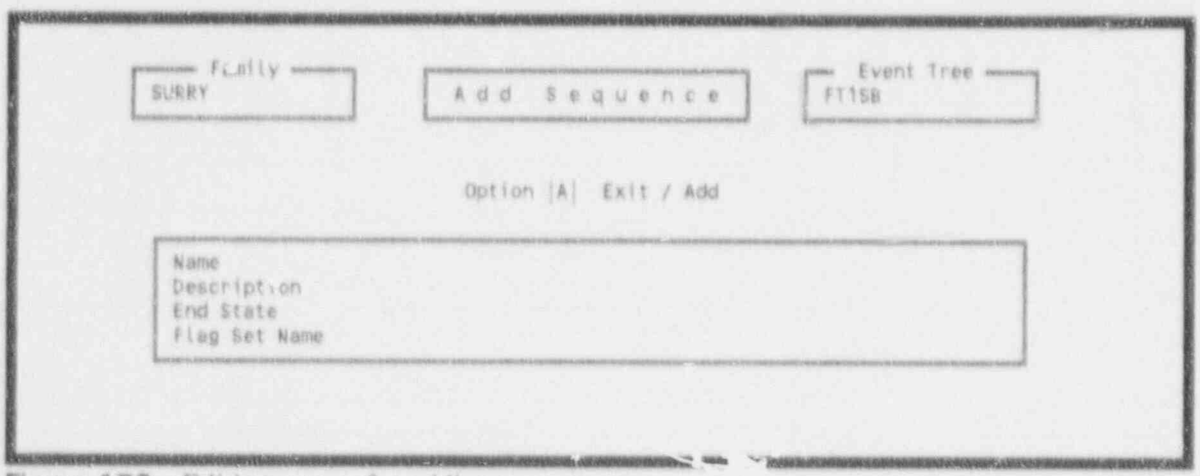


Figure 179. Editing screen for adding a sequence.

9.3.6.2.1 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.

9.3.6.2.2 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. IRRAS 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.

9.3.6.3 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 180. The options at this point are Exit and Modify.

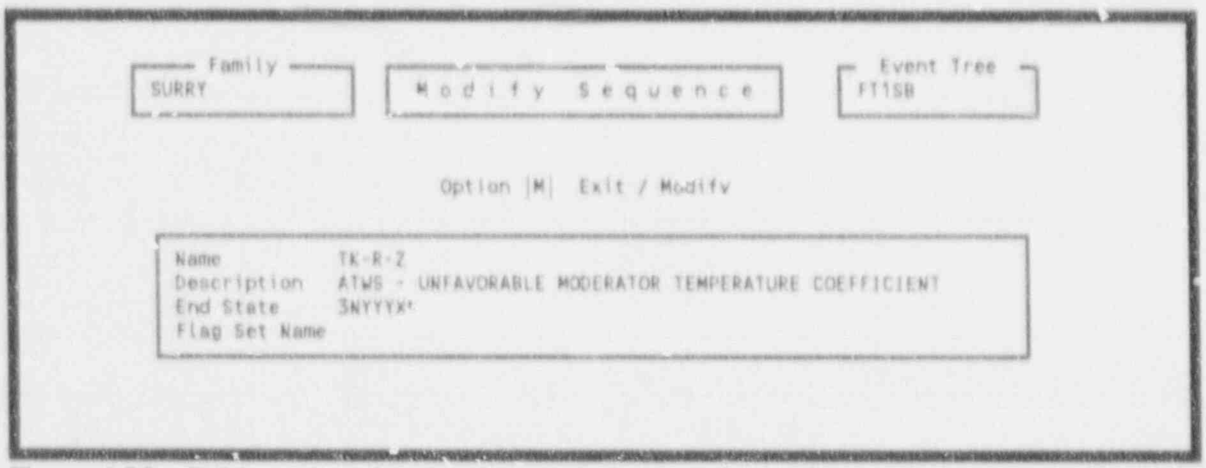


Figure 180. Editing screen for modifying a sequence.

9.3.6.3.1 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.

9.3.6.3.2 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.

9.3.6.4 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 181. Two options are available: Exit and Delete.

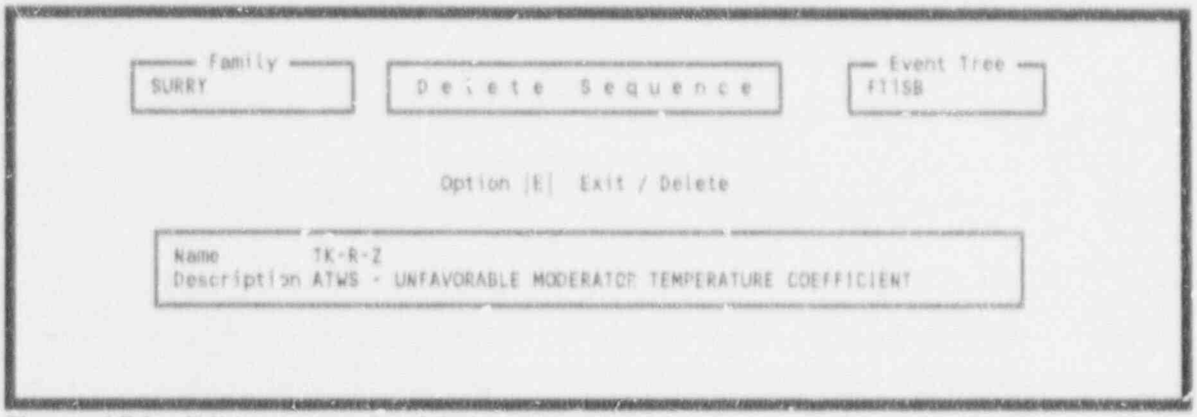


Figure 181. Editing screen for deleting a sequence.

9.3.6.4.1 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.

9.3.6.4.2 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.

9.3.6.5 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 9.2.5.

9.3.6.6 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 182) 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.

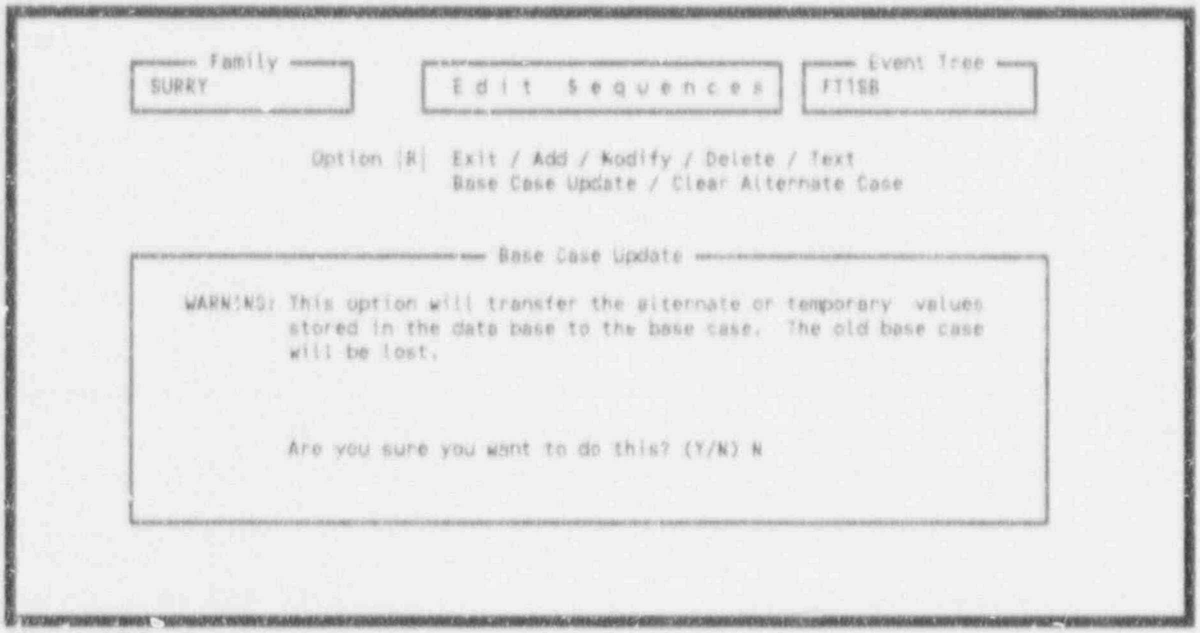


Figure 182. Base case update for sequences.

9.3.6.7 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 183). To continue enter a <Y> and press <Enter>, otherwise enter an <N> and press <Enter> to terminate the process.

9.3.7 Base Case Update

This option operates the same as described in Section 9.3.6.6, except all sequences for the specified event tree are updated.

9.3.8 Clear Alternate Case

This option operates the same as described in Section 9.3.6.7, except the alternate case information for all sequences for the specified event tree is cleared (see Figure 184).

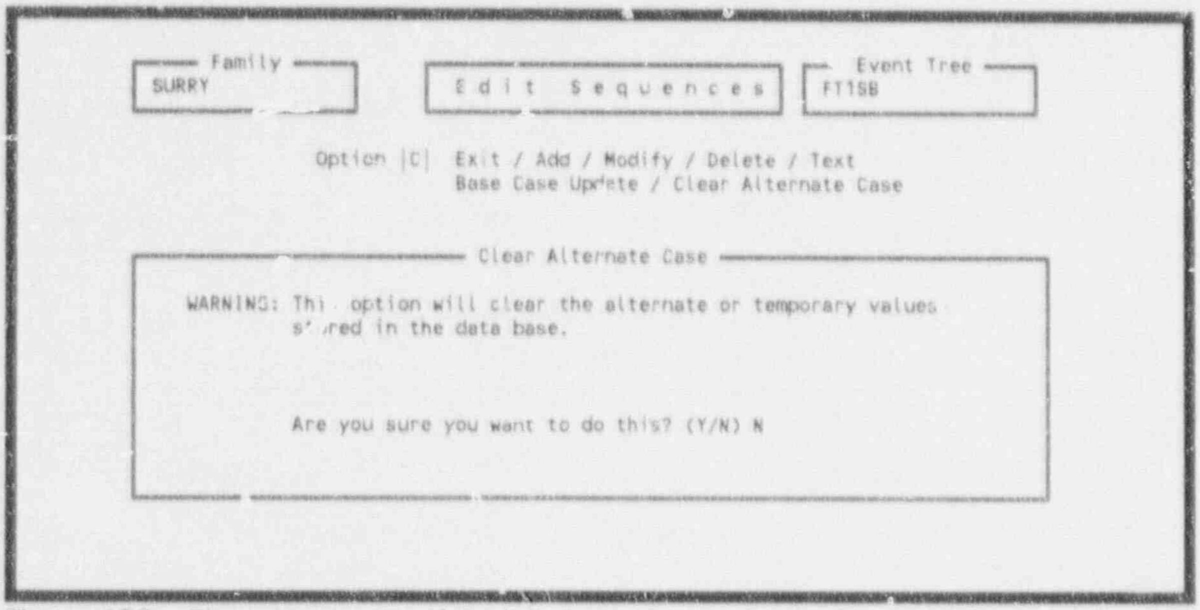


Figure 183. Clear alternate case for selected sequence(s).

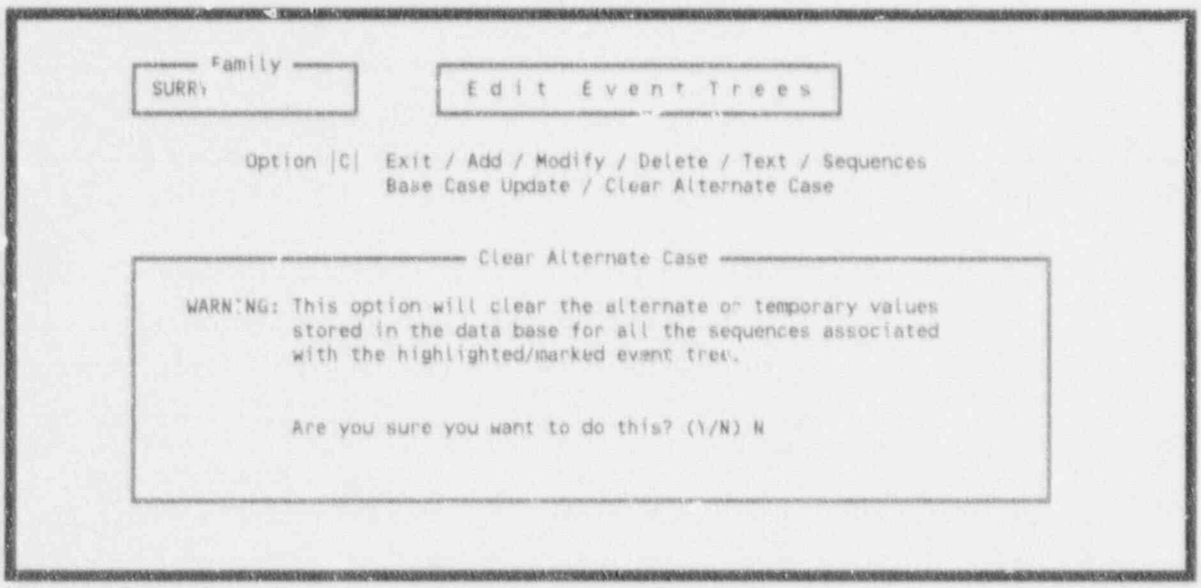


Figure 184. Clear alternate case for event trees.

9.4 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 185). The modification options are: Exit, Add, Modify, Delete, Text, Base Case Update, and Clear Alternate Case.

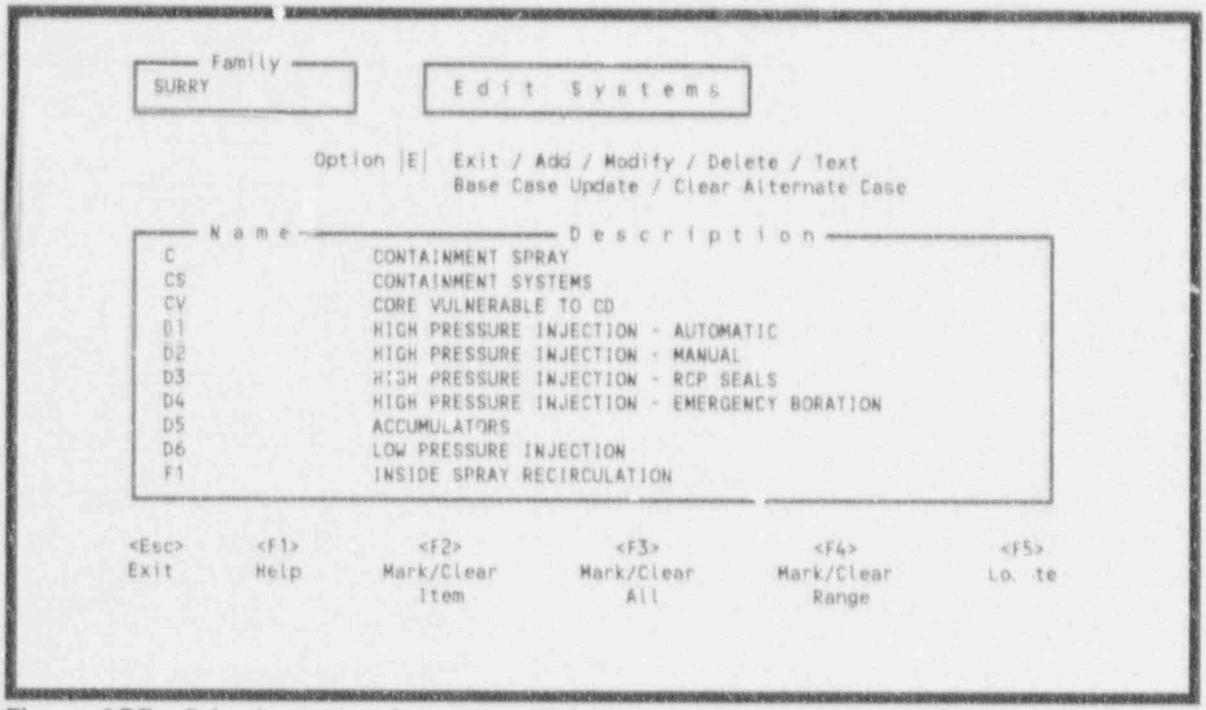


Figure 185. Selection screen for system editing.

9.4.1 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.

9.4.2 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 186. The options at this point are Exit and Add.

9.4.2.1 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.

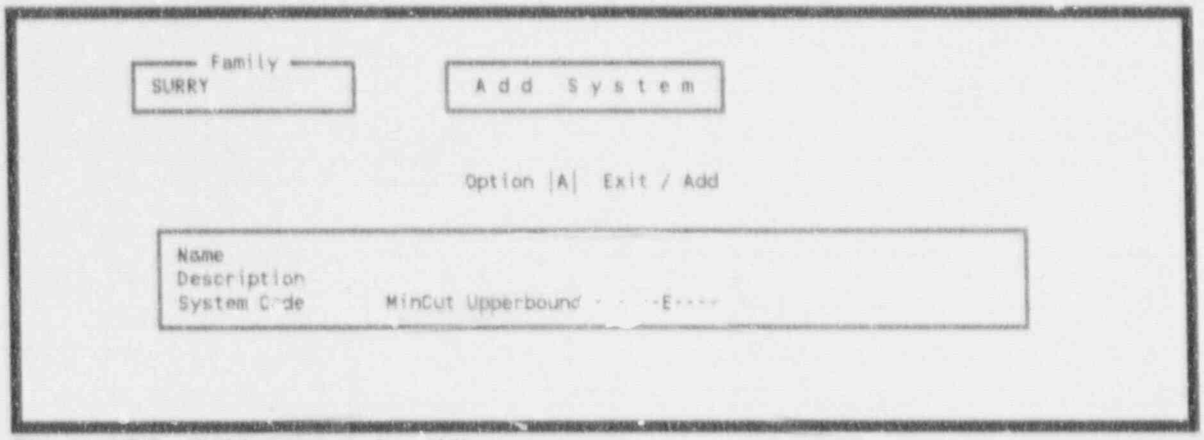


Figure 186. Editing screen for adding a system.

9.4.2.2 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.

9.4.3 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 187. The options at this point are Exit and Modify.

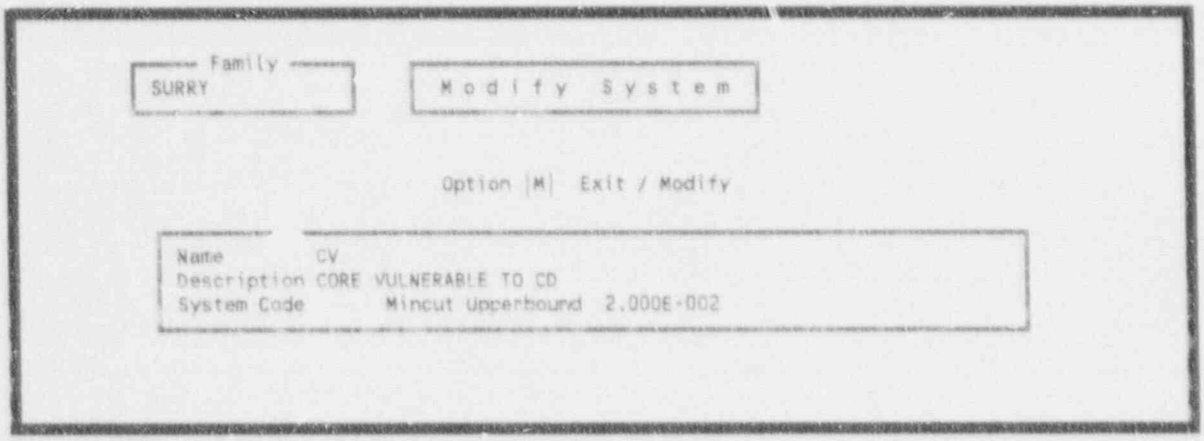


Figure 187. Editing screen for modifying a system.

9.4.3.1 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.

9.4.3.2 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.

9.4.4 Delete

This option allows you to delete a system record from the data base. To invoke this option, type <D> in the option field, highlight a system and press <Enter>. The Delete System screen is shown in Figure 188. The options at this point are Exit and Delete.

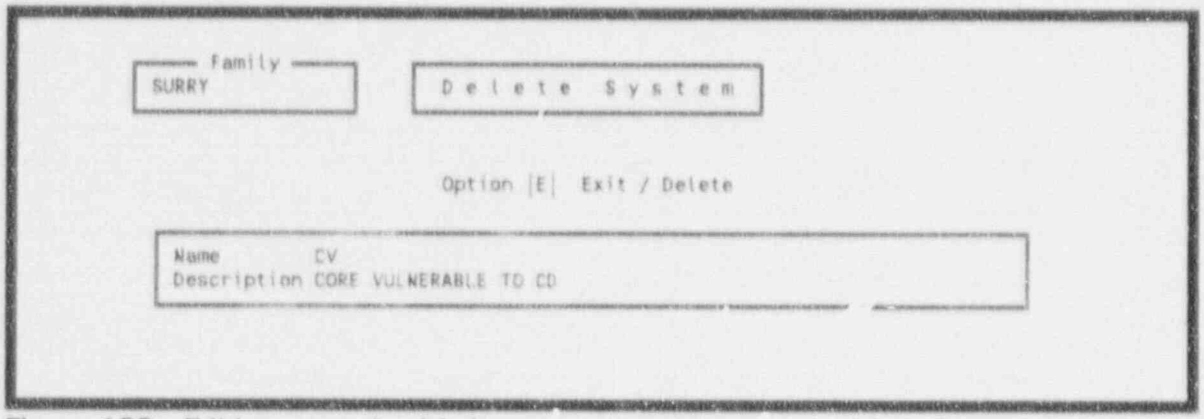


Figure 188. Editing screen for deleting a system.

9.4.4.1 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.

9.4.4.2 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.

9.4.5 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 9.2.5.

9.4.6 Base Case Update

This option operates the same as described for sequences in Section 9.3.6.6. Here, the update is performed on an entire system(s).

9.4.7 Clear Alternate Case

This option operates the same as described for sequences in Section 9.3.6.7. Here, the clearing is performed on an entire system(s).

9.5 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 189. The modification options are: Exit, Add, Modify, Delete, and Text.

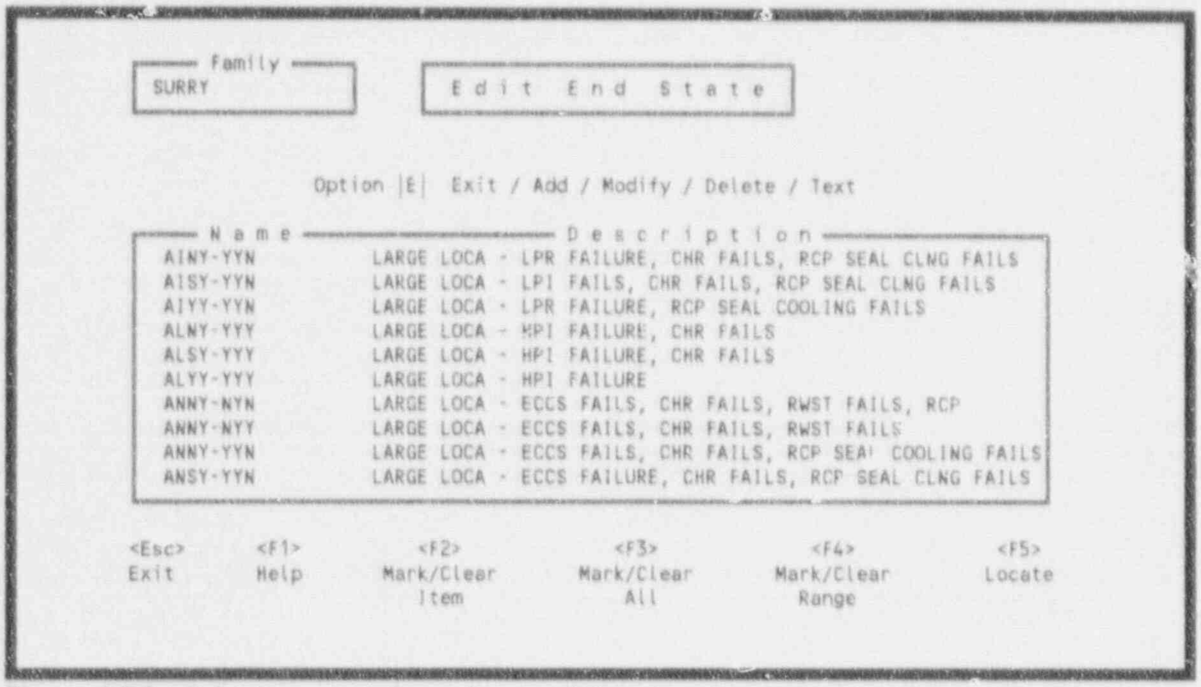


Figure 189. Selection screen for end state editing.

9.5.1 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.

9.5.2 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 190. The options at this point are Exit and Add.

9.5.2.1 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.

9.5.2.2 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

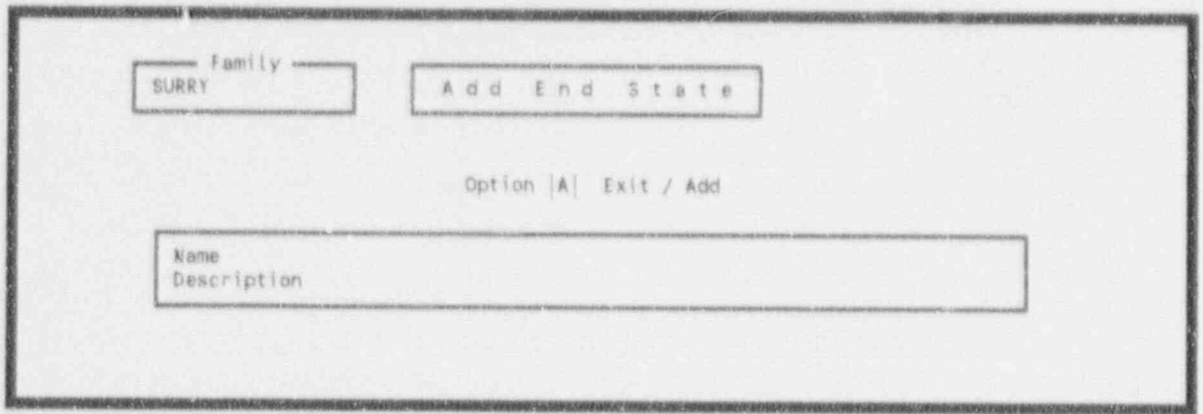


Figure 190. Editing screen for adding an end state.

End State screen with the message **Record added** displayed.

9.5.3 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 191. The options at this point are Exit and Modify.

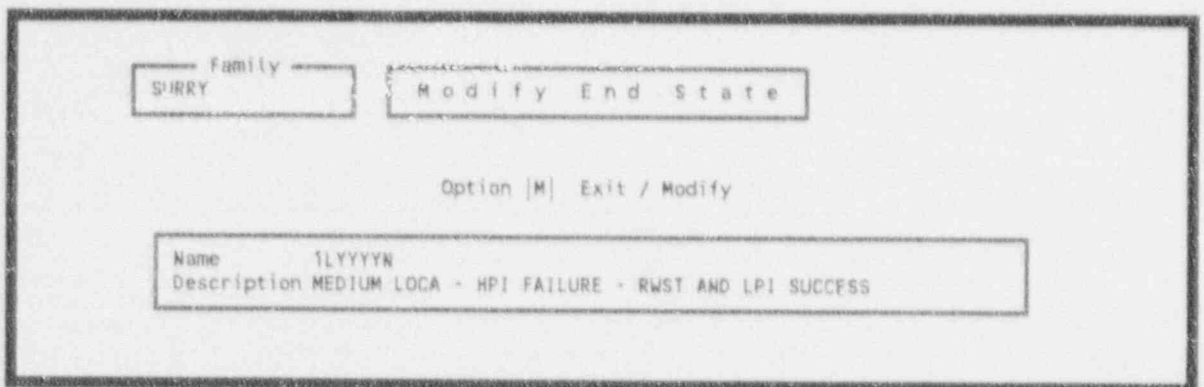


Figure 191. Editing screen for modifying an end state.

9.5.3.1 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.

9.5.3.2 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.

9.5.4 Delete

This option allows you to delete an end state record from the data base. 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 192. 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 192. Editing screen for deleting an end state.

9.5.4.1 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.

9.5.4.2 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.

9.5.5 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 9.2.5.

9.6 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 193). The modification options are: Exit, Add, Modify, Delete, and Remove Unused Events.

9.6.1 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.

9.6.2 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 194. The options at this point are Exit and Add.

```
 ---- 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 193. Selection screen for basic event editing.

```
 ---- Family ----            --------------------
| SURRY          |          | A d d   E v e n t  |
 ----------------            --------------------

                      Option |A|  Exit / Add

 -------------------------- Event Attributes ---------------------------
|           Names        Comp Id   Sys   Train   Type   F/Mode  Location  Init? |
|  <P>                                                                     N    |
|  <A>                                                                          |
|  <G>                    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                                                                  |
 -------------------------------------------------------------------------------
     ------ Uncertainty Data ---------------- Failure Data -------
    | Distribution Type -------->   | Calculation Type --------->   |
    | (press <F1> for list of types)| (press <F1> for list of types)|
    | Value ------------> ------E---| Probability ------> ------E---|
    | Correlation Class ------>     | Lambda -----------> ------E---|
    |-------- Process Flag ---------| Tau --------------> ------E---|
    | Flag ---------------------->  | Mission Time -----> ------E---|
     ---------------------------------------------------------------
```

Figure 194. Editing screen for adding a basic event.

9.6.2.1 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.

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

9.6.3 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 195. The options at this point are Exit and Modify.

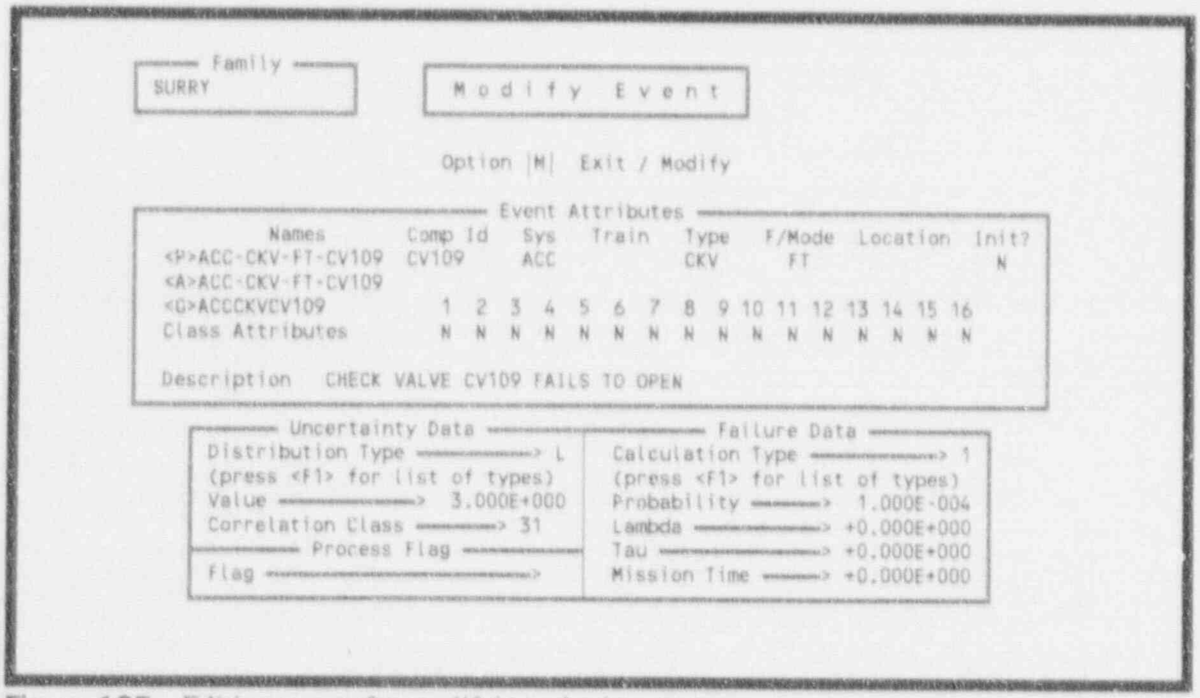


Figure 195. Editing screen for modifying a basic event.

9.6.3.1 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.

9.6.3.2 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.

9.6.4 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 196. The options at this point are Exit and Delete.

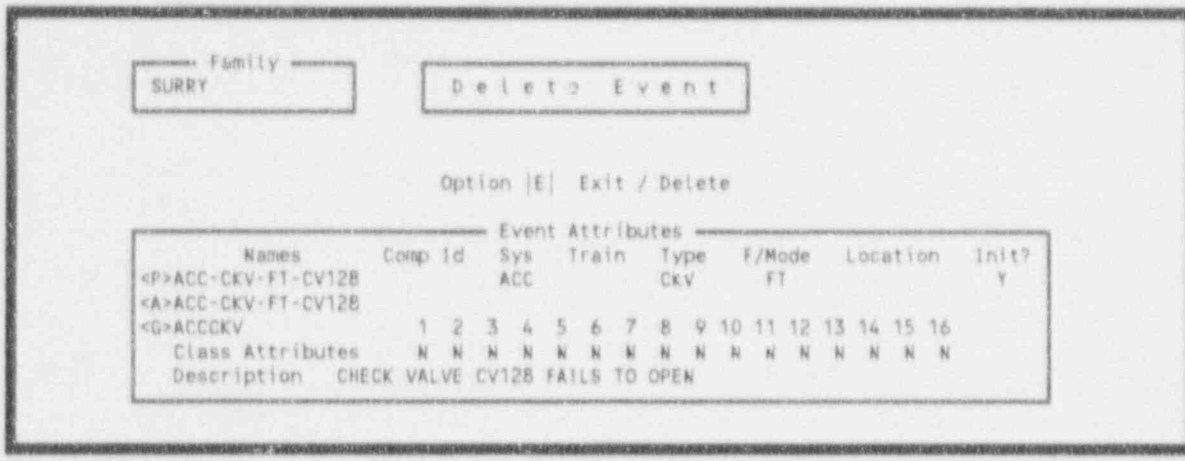


Figure 196. Editing screen for deleting a basic event.

9.6.4.1 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.

9.6.4.2 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.

9.6.5 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 197).

9.7 Attributes

This option allows you to edit the six attributes in the current family (Figure 198): Systems, Locations, Failure Modes, Class Attributes, Basic Event Types, and Trains. The options available within each of these attributes are: Exit, Add, Modify, and Delete.

The Edit Attributes screen shown in Figure 198 and succeeding screens (Figure 199 - Figure 202) 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.

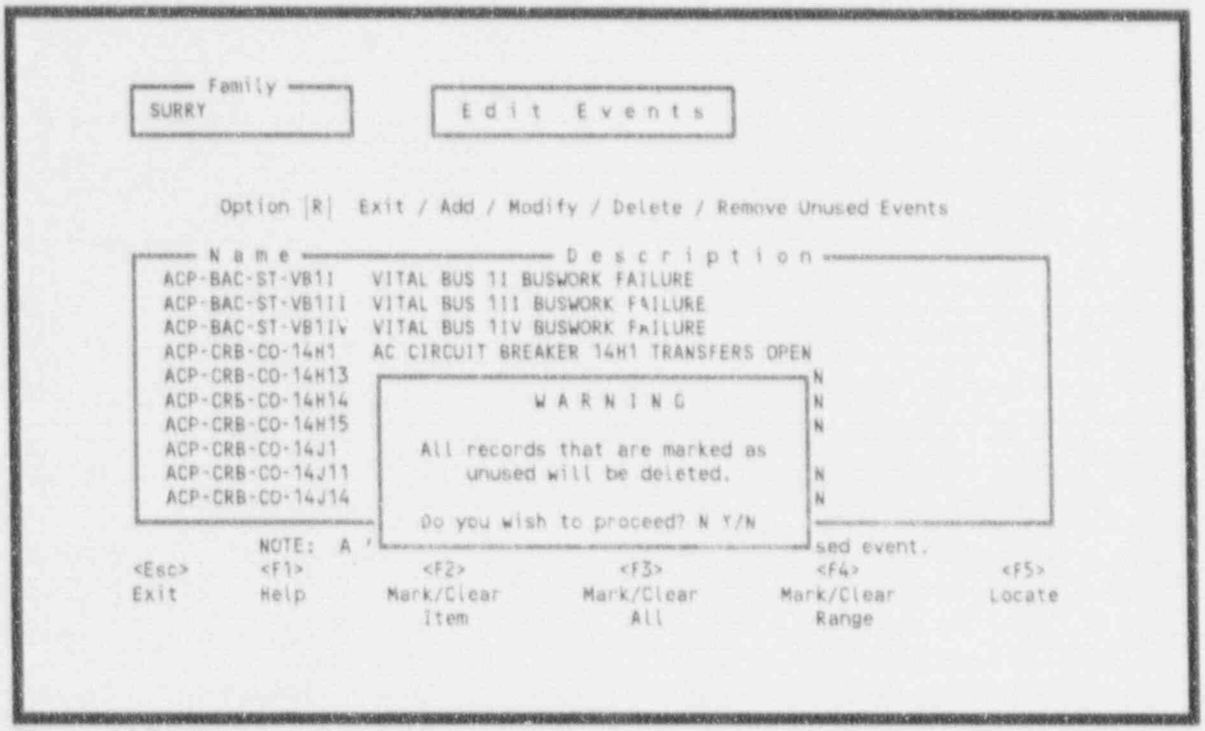


Figure 197. Remove unused events prompt.

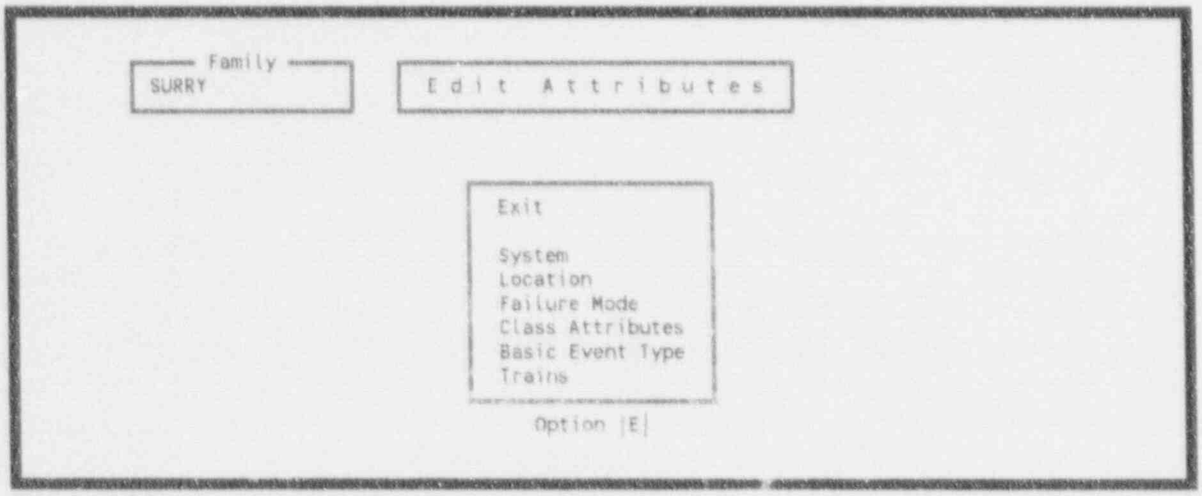


Figure 198. Attribute selection for editing.

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 198). 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.

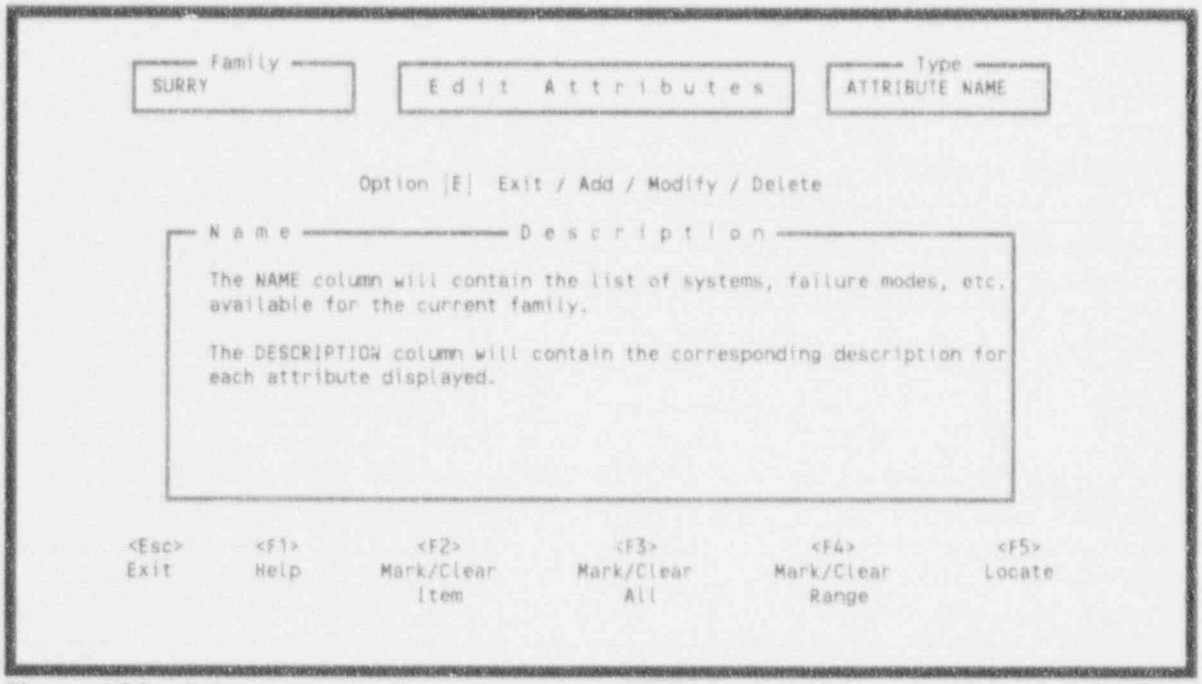


Figure 199. Selection screen for attribute editing.

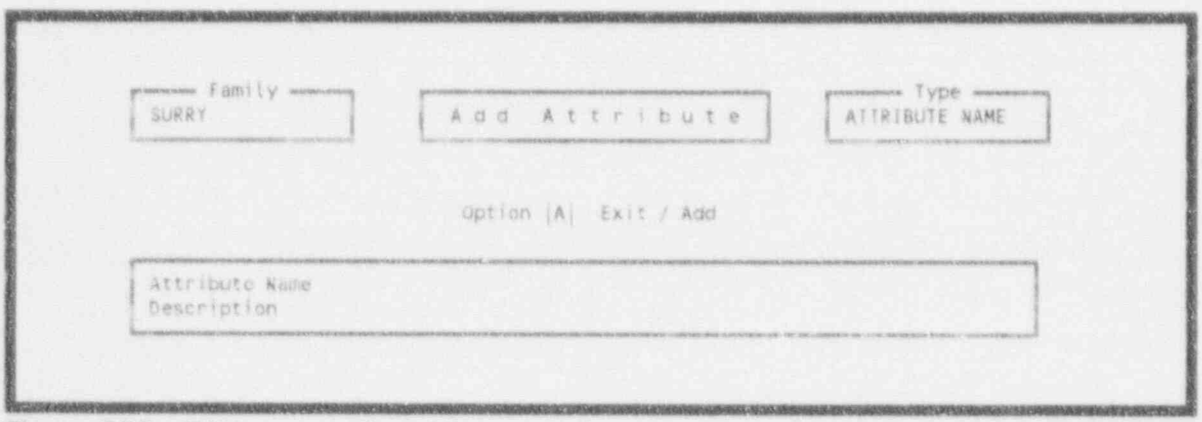


Figure 200. Editing screen for adding an attribute.

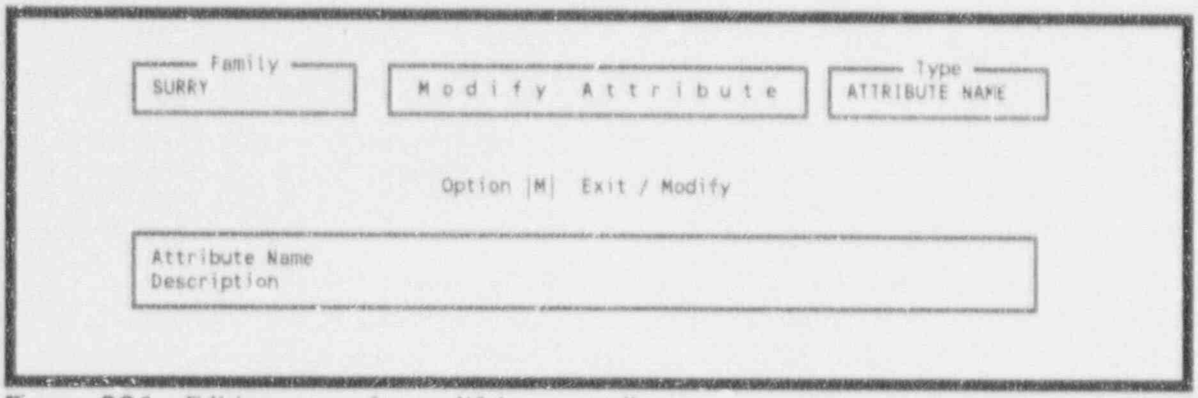


Figure 201. Editing screen for modifying an attribute.

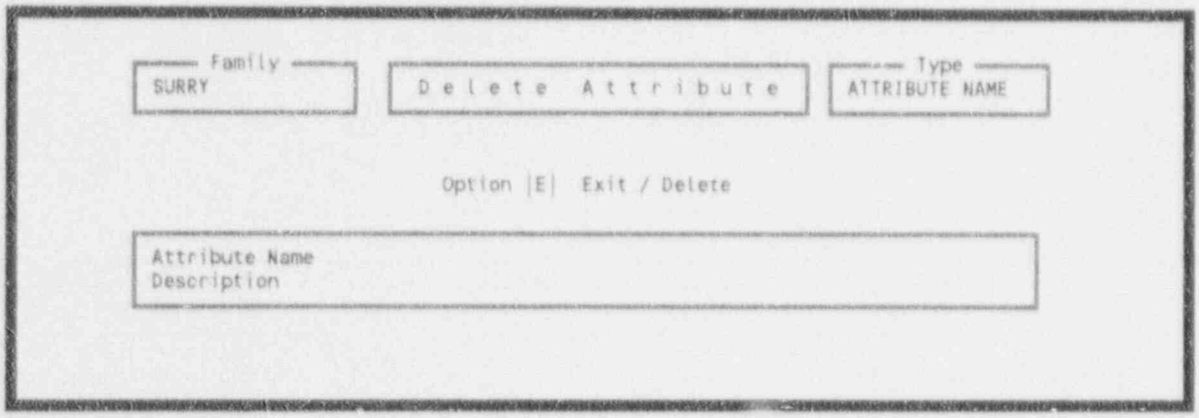


Figure 202. Editing screen for deleting an attribute.

9.7.1 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.

9.7.2 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 200. The options at this point are Exit and Add.

9.7.2.1 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.

9.7.2.2 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.

9.7.3 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 201. The options at this point are Exit and Modify.

9.7.3.1 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.

9.7.3.2 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.

9.7.4 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 202. The options at this point are Exit and Delete.

9.7.4.1 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.

9.7.4.2 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.

9.8 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 203). The modification options are: Exit, Add, Modify, and Delete.

9.8.1 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.

9.8.2 Add

This option allows you to add a gate record to the current family. To invoke this option, type <A> in the option field and press <Enter>. The Add Gate screen is shown in Figure 204. The options at this point are Exit and Add.

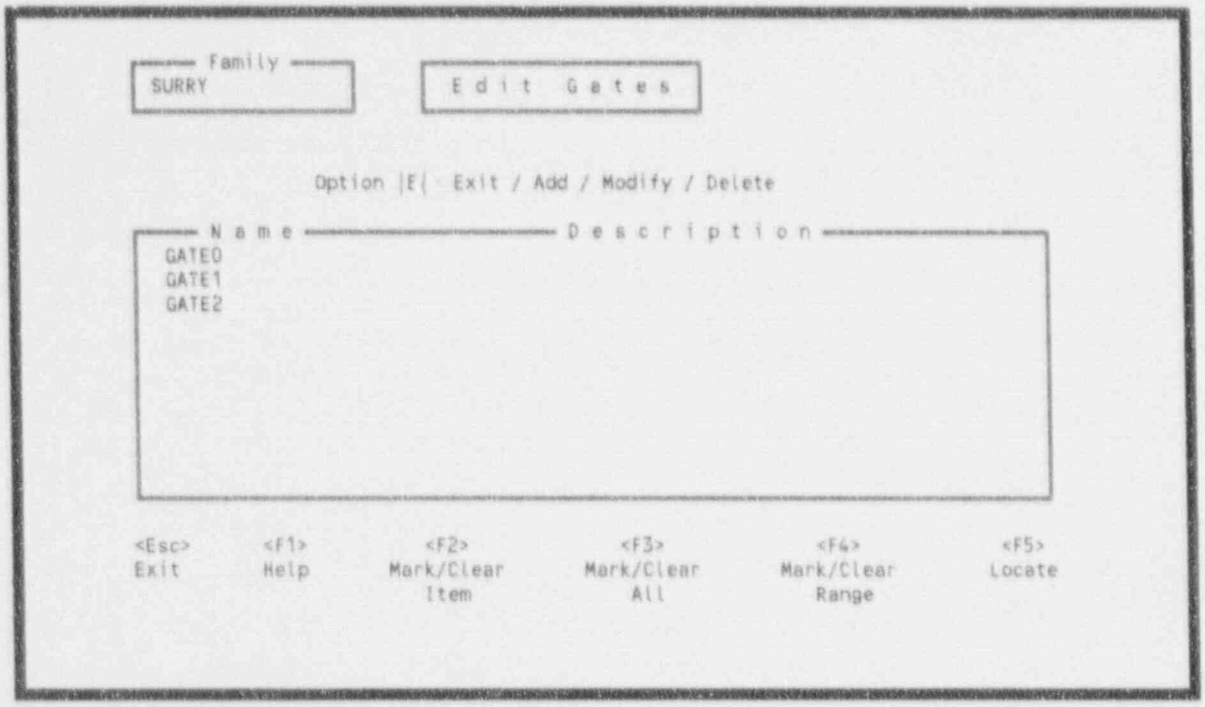


Figure 203. Selection screen for gate editing.

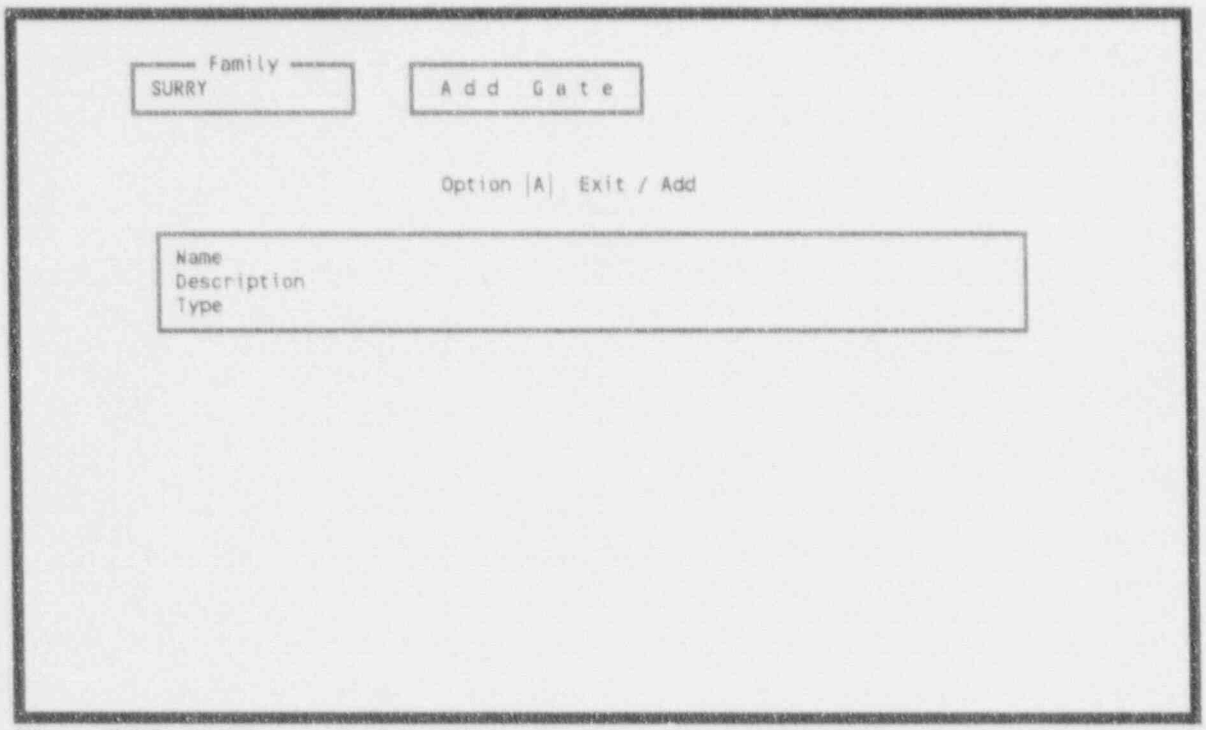


Figure 204. Editing screen for adding a gate.

9.8.2.1 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.

9.8.2.2 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.

9.8.3 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 205. The options at this point are Exit and Modify.

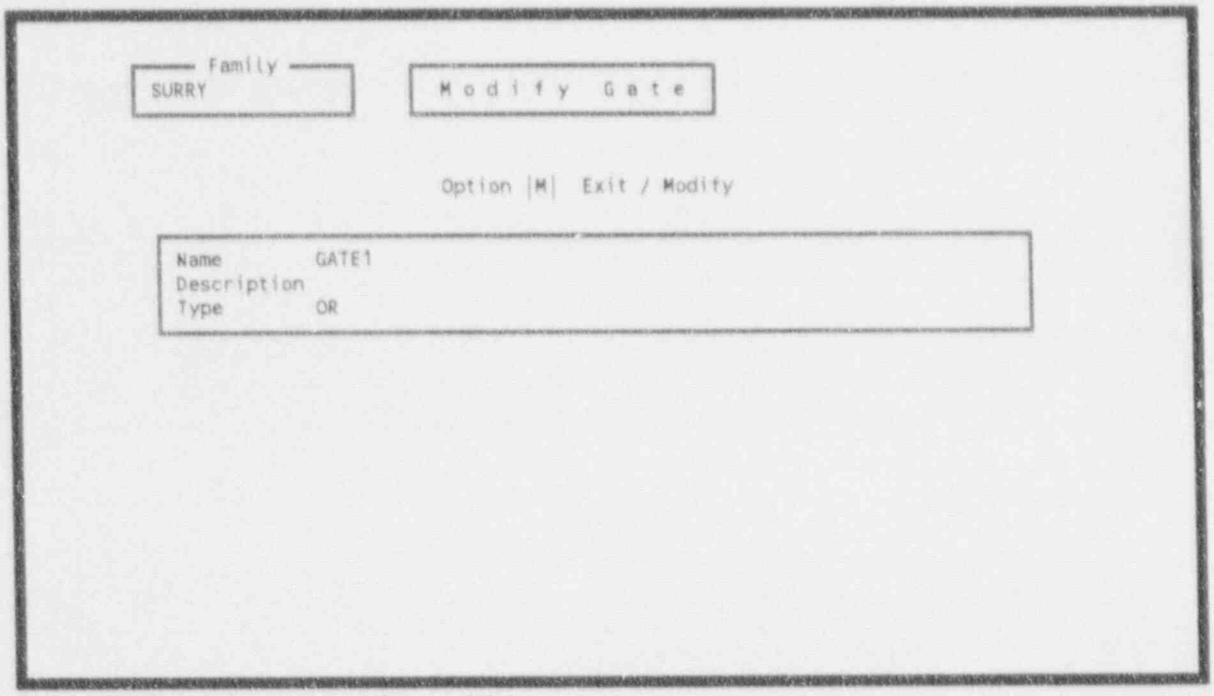


Figure 205. Editing screen for modifying a gate.

9.8.3.1 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.

9.8.3.2 Modify. This option performs the actual modification of the gate record. To invoke 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.

9.8.4 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 206. The options at this point are Exit and Delete.

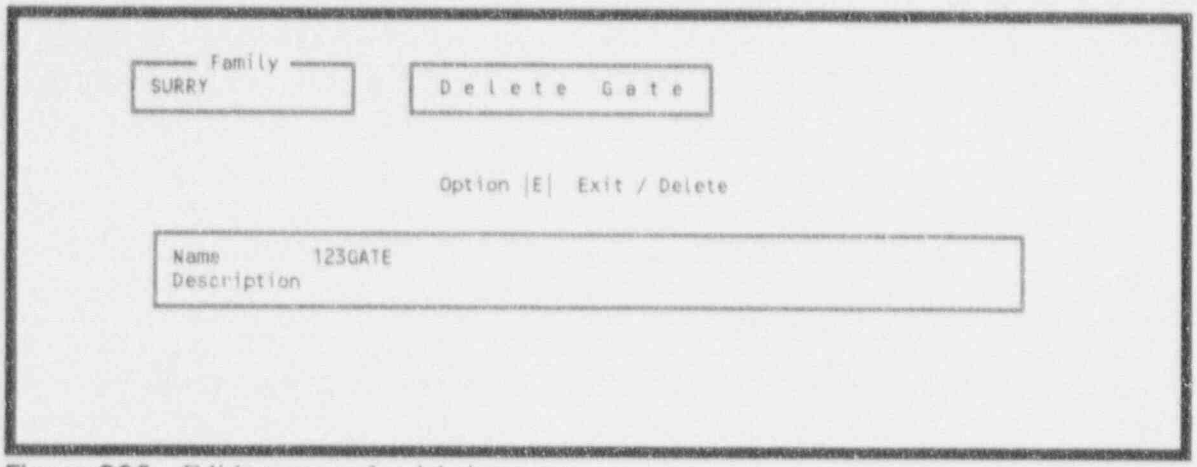


Figure 206. Editing screen for deleting a gate.

9.8.4.1 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.

9.8.4.2 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.

9.9 Graphics

This option allows you to edit three categories of graphics data records (Figure 207). 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 208 and succeeding screens Figure 209 through Figure 211 are consistent throughout the graphics option for each of the three categories.

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.

```
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 207. Selection of graphics type for editing.

```
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 PIPE 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 208. 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 209. Editing screen for adding a graphics picture.

```
Family
SURRY                M o d i f y   G r a p h i c   P i c t u r e

                  Option |M|  Exit / Modify

Name          4KV1J
Description
```

Figure 210. Editing screen for modifying a graphics picture.

```
Family
SURRY                D e l e t e   G r a p h i c   P i c t u r e

                  Option |E|  Exit / Delete

Name          AFW1
Description
```

Figure 211. Editing screen for deleting a graphics picture.

9.9.1 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.

9.9.2 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 208, listing the fault tree graphics (pictures), will be displayed. The option available are Exit, Add, Modify, and Delete.

9.9.2.1 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.

9.9.2.2 Add. This option allows you to add a graphics picture record to the data base. To invoke this option, type <A> in the option field and press <Enter>. The Add Graphics Picture screen is shown in Figure 209. The options at this point are Exit and Add.

9.9.2.2.1 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.

9.9.2.2.2 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.

9.9.2.3 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 210. The options at this point are Exit and Modify.

9.9.2.3.1 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.

9.9.2.3.2 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.

9.9.2.4 Delete. This option allows you to delete a graphics picture from the data base. 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 211. The options at this point are Exit and Delete.

9.9.2.4.1 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.

9.9.2.4.2 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.

9.9.3 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 208, listing the event tree graphics pictures, will be displayed. The option available are Exit, Add, Modify, and Delete.

9.9.3.1 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.

9.9.3.2 Add. This option allows you to add a graphics picture record to the data base. To invoke this option, type <A> in the option field and press <Enter>. The Add Graphic Picture screen is shown in Figure 209. The options at this point are Exit and Add.

9.9.3.2.1 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.

9.9.3.2.2 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.

9.9.3.3 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 210. The options at this point are Exit and Modify.

9.9.3.3.1 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.

9.9.3.3.2 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.

9.9.3.4 Delete. This option allows you to delete a graphics picture from the data base. 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 211. The options at this point are Exit and Delete.

9.9.3.4.1 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.

9.9.3.4.2 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 complete, you will be returned to the Edit Graphics screen with the message **Record deleted** displayed at the bottom of the screen.

9.9.4 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 208, listing the P&ID graphics pictures, will be displayed. The option available are Exit, Add, Modify, and Delete.

9.9.4.1 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.

9.9.4.2 Add. This option allows you to add a graphics picture record to the data base. To invoke this option, type <A> in the option field and press <Enter>. The Add Graphic Picture screen is shown in Figure 209. The options at this point are Exit and Add.

9.9.4.2.1 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.

9.9.4.2.2 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.

9.9.4.3 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 210. The options at this point are Exit and Modify.

9.9.4.3.1 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.

9.9.4.3.2 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 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.

9.9.4.4 Delete. This option allows you to delete a graphics picture from the data base. 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 211. The options at this point are Exit and Delete.

9.9.4.4.1 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.

9.9.4.4.2 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.

9.10 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 not be expressed with one of the predefined distribution types. The Edit Histograms screen (Figure 212) 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 212 will be displayed.

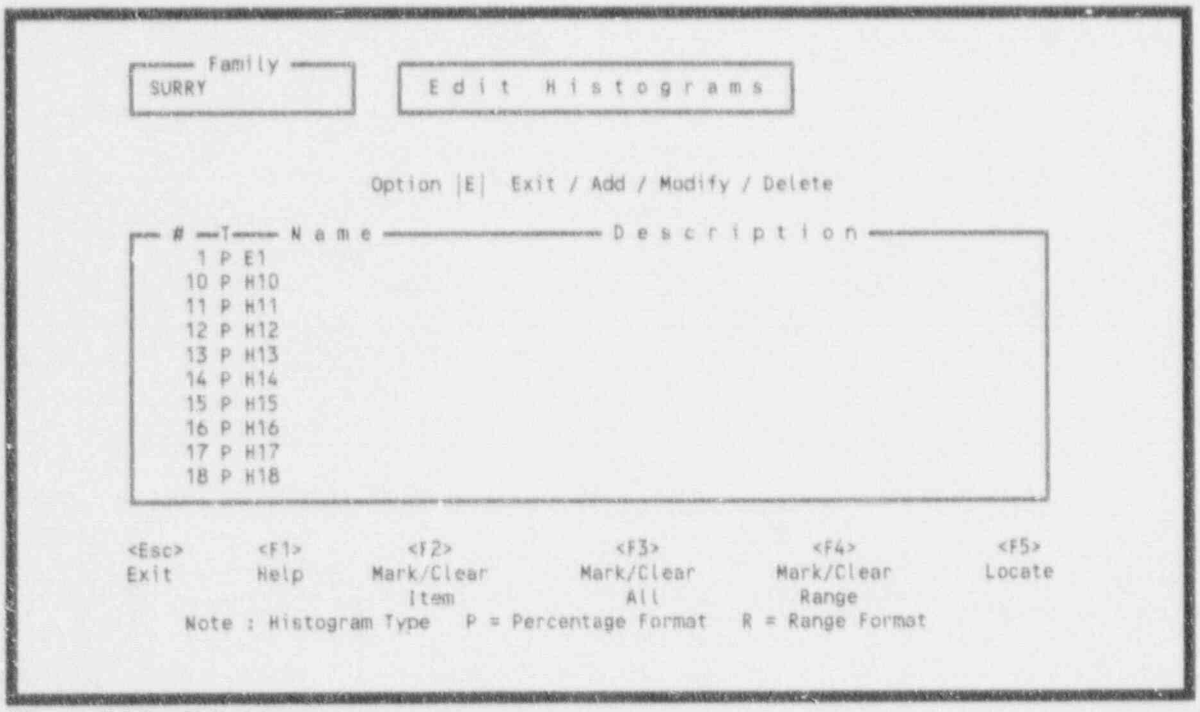


Figure 212. Edit histograms menu.

9.10.1 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.

9.10.2 Add Histograms

This option allows you to create a user-defined distribution type. To add a new histogram to the data base, type an <A> (Add) in the option field and press <Enter>. At this point, Figure 213 is displayed and you are given the choice of adding the histogram data in either a percentage format or range format.

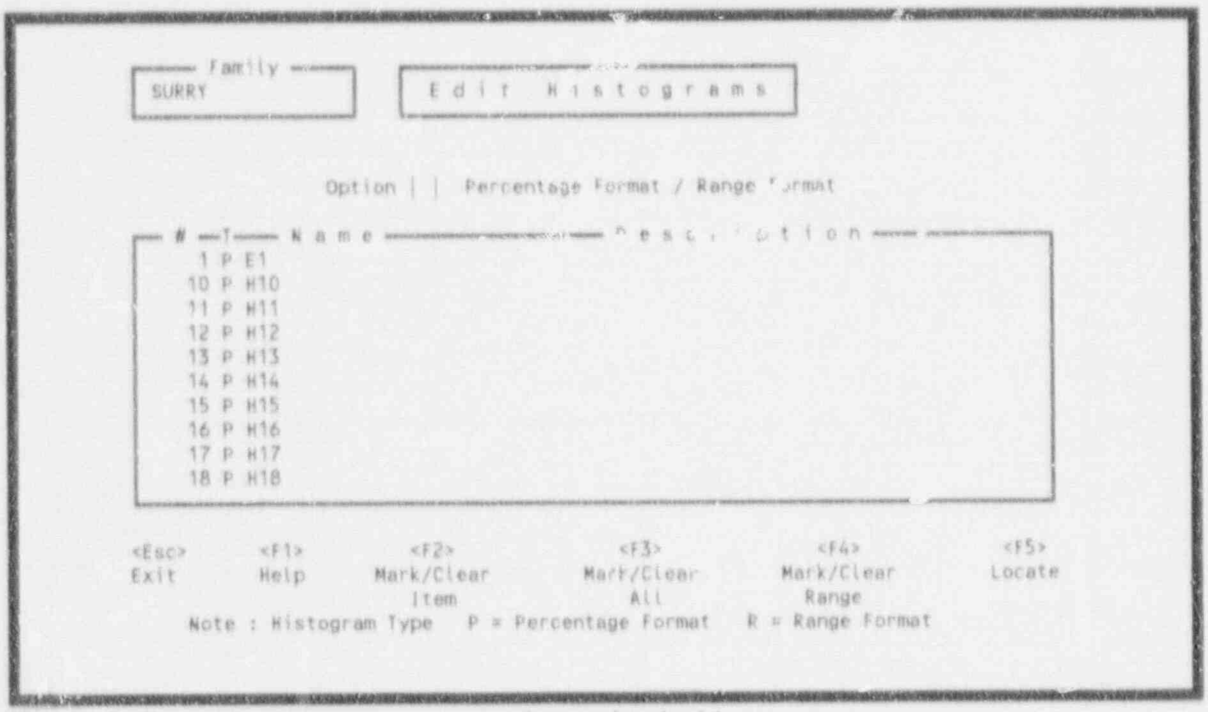


Figure 213. Select percentage or range format for the histogram.

If you wish to add a percentage histogram to the data base, 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 214 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 215). 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.

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

                  Option |A|  Exit / Add           Percent Sum     97.00
                                                   Percent Left     3.00
                       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   ------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 214. 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
                                                   Percent Left      .00
                       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 215. Add the remaining percent to create a valid histogram.

Another way to input a histogram is to use the range format. To add a range histogram to the data base, enter an <R> (Range> in the option field of the Add Histogram screen. This action will bring up a Range Format Histogram screen (Figure 216). 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 216 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 70.0 (Bin 2), the height for the sub-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).

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

                     Option |A| Exit / Add

 --------------------------- 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 216. 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.

9.10.3 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 217 demonstrates the screen for modifying histograms in percentage format.

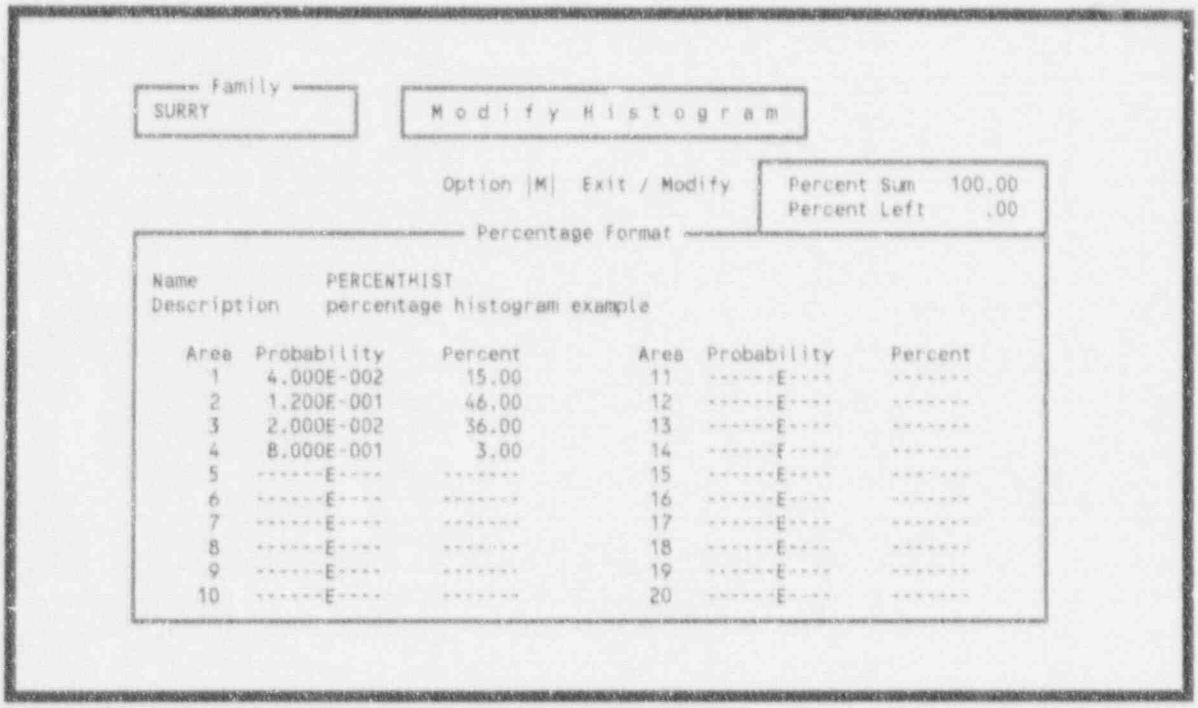


Figure 217. Modify a percentage histogram.

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 218 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.

```
 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 218. Modify a range histogram.

9.10.4 Delete Histograms

To delete an existing histogram from the data base, 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 histogram being displayed, press the <Esc> key or enter an <E> (Exit) in the option field and press <Enter>. Figure 219 and Figure 220 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 219. 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	1.00[illegible]00	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 220. Delete a range histogram.

10.0 REPORT ON DATA BASE

This option allows you to obtain information about the selected family. Reports are available for family, basic events, attributes, systems, event trees, sequences, end states, and user information. To invoke this option, type an <R> or highlight REPORTS on the IRRAS main menu and press <Enter>. The REPORTS main menu is shown in Figure 221. Each report is discussed in the following paragraphs.

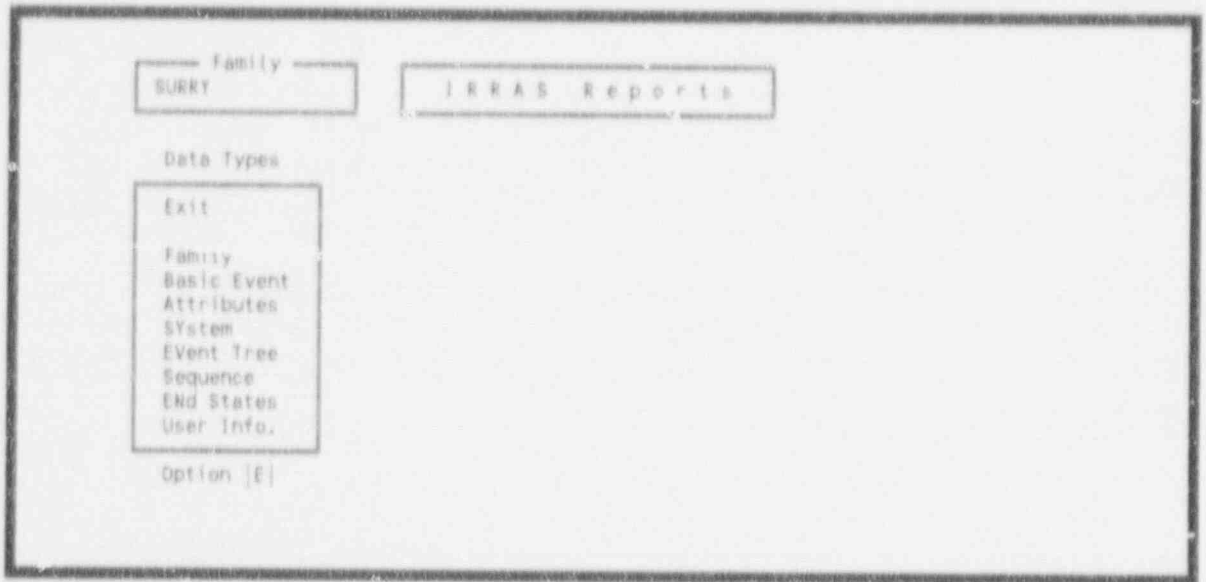


Figure 221. Report on data base main menu.

The following special function keys are available:

Esc	Escape exits the Family Reports option and returns you to the IRRAS Reports menu.
<F1>	Help briefly explains the function of a field and may show examples of data entered.
<F2>	Mark Family tags items for use in the selected option.
<F3>	Mark All removes the mark (*) from the listed items. If no items are marked, this option will mark all of the items.
<F4>	Mark Range quickly tags large numbers of items for processing.
<F5>	Locate will display a blank field in the center of the screen, and a message **Please enter the 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.

These function keys are available in all report options.

10.1 Exit

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

10.2 Family

This option allows you to generate a family summary report listing all the families and associated descriptions contained in the current data base or a report containing any descriptive text associated with the family. When you invoke this option, Figure 222 will be displayed. As shown, two options are available: Summary and Text. When you invoke the family report option by pressing <Enter>, Figure 223 will be displayed. This screen lists all the families currently contained in the data base.

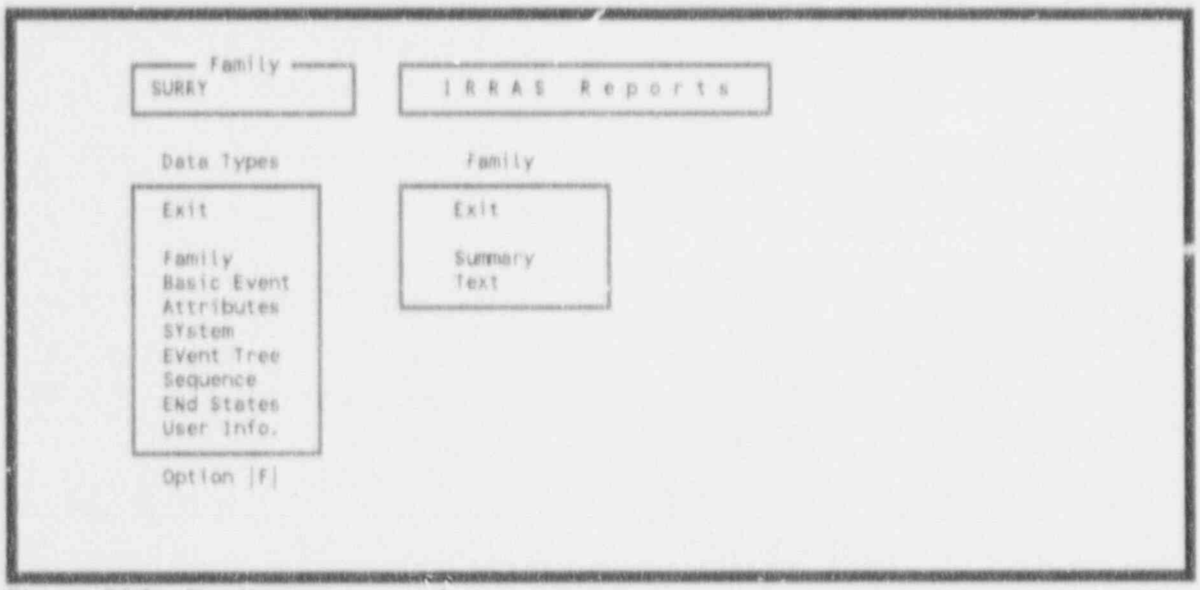


Figure 222. Family summary option.

10.2.1 Exit

This option returns you to the IRRAS reports menu. To invoke this option, type <E> in the option field and press <Enter>.

10.2.2 Summary

This option generates a summary report listing all the families and associated descriptions contained in the data base. When you invoke this option, Figure 224 will be displayed. On this screen you must specify the output destination for the report. The following output destinations are provided:

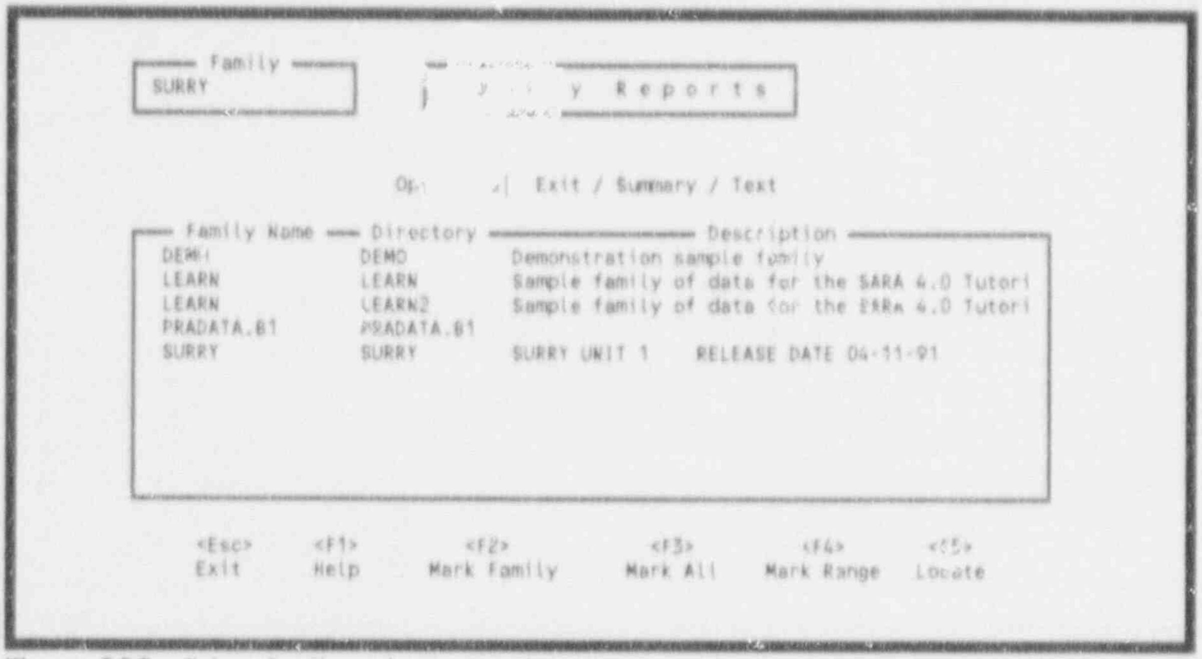


Figure 223. Select family and report option menu.

CON	-	Sends the report to the screen.
PRN	-	Sends the report to the printer.
blank	-	Terminates the option and returns you to the Reports Main Menu without generating the report.
<Esc>	-	Terminates the process and returns you to the main menu (same as blank).
other	-	Writes the report to the specified file name.

NOTE: **These output options are available throughout the Report module.**

10.2.3 Text

This option allows you to view and edit any descriptive text associated with a specific family. To invoke this option, enter a <T> in the option field, highlight or mark a family(s), and press <Enter>. The output destination screen will appear. Select the desired destination and press <Enter>. The report contains all descriptive text associated with the selected family.

10.3 Basic Event

The basic event report option allows you to generate an overview, probabilities, uncertainty data, and cross reference reports (Figure 225). You indicate the basic event report you want to generate by highlighting the desired report using the arrow keys and pressing <Enter>.

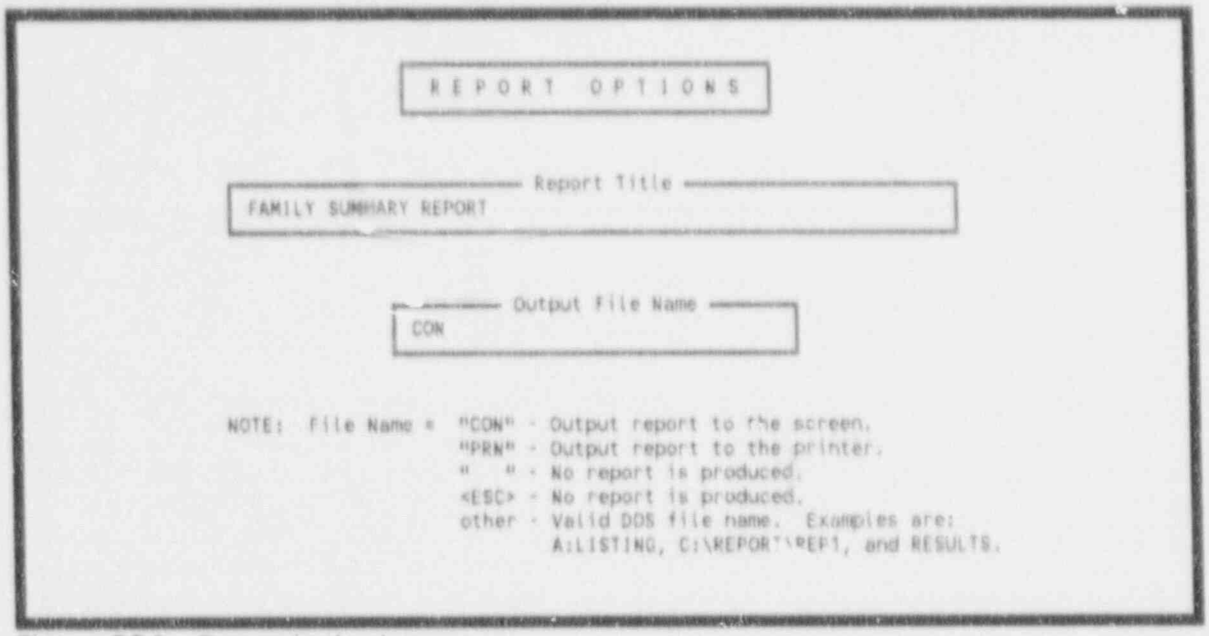


Figure 224. Output destination screen.

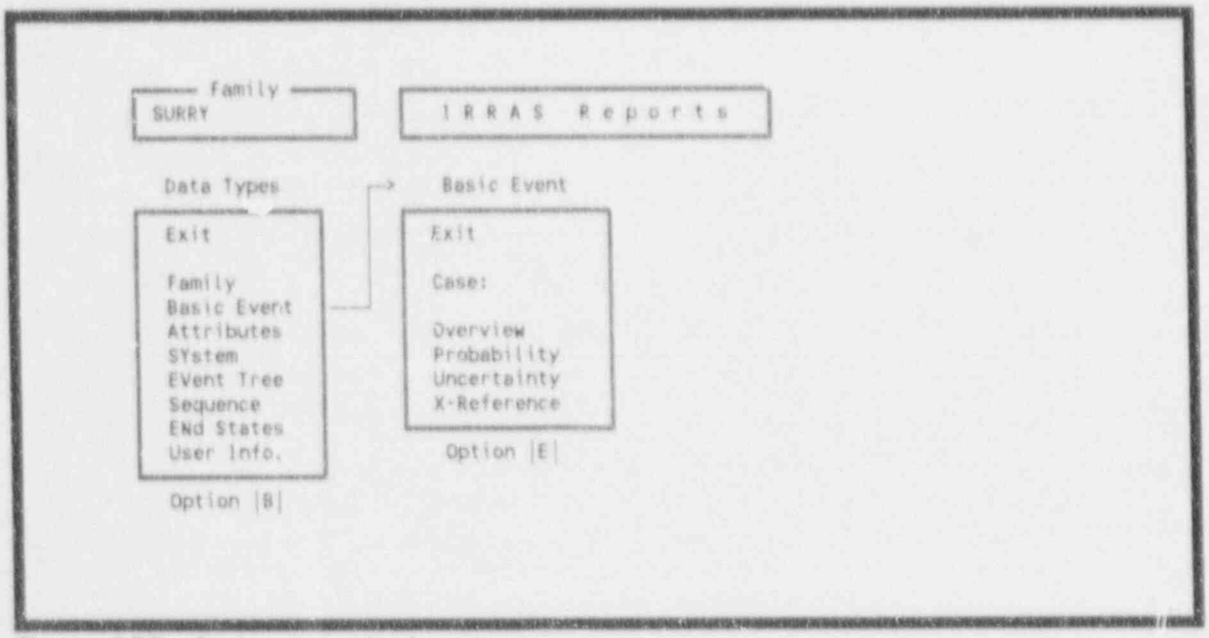


Figure 225. Basic event selection screen.

10.3.1 Basic Event Overview

This option allows you to generate a basic event summary report. The overview report includes the basic event number, primary and secondary name, component type and ID, system location, and attribute fail mode. To invoke this option, highlight Overview and press <Enter>. Figure 226 will be displayed. Two options are available: Exit and Overview. Exit terminates the process and returns you to the previous menu. Overview generates the report based on your event selections. On this screen, you must do one of the following:

1) Press <Enter> to report all basic events.
2) Highlight a basic event and press <Enter>.
3) Mark a group of basic events and press <Enter>.

NOTE: For most report options, you must perform the selection process described above.

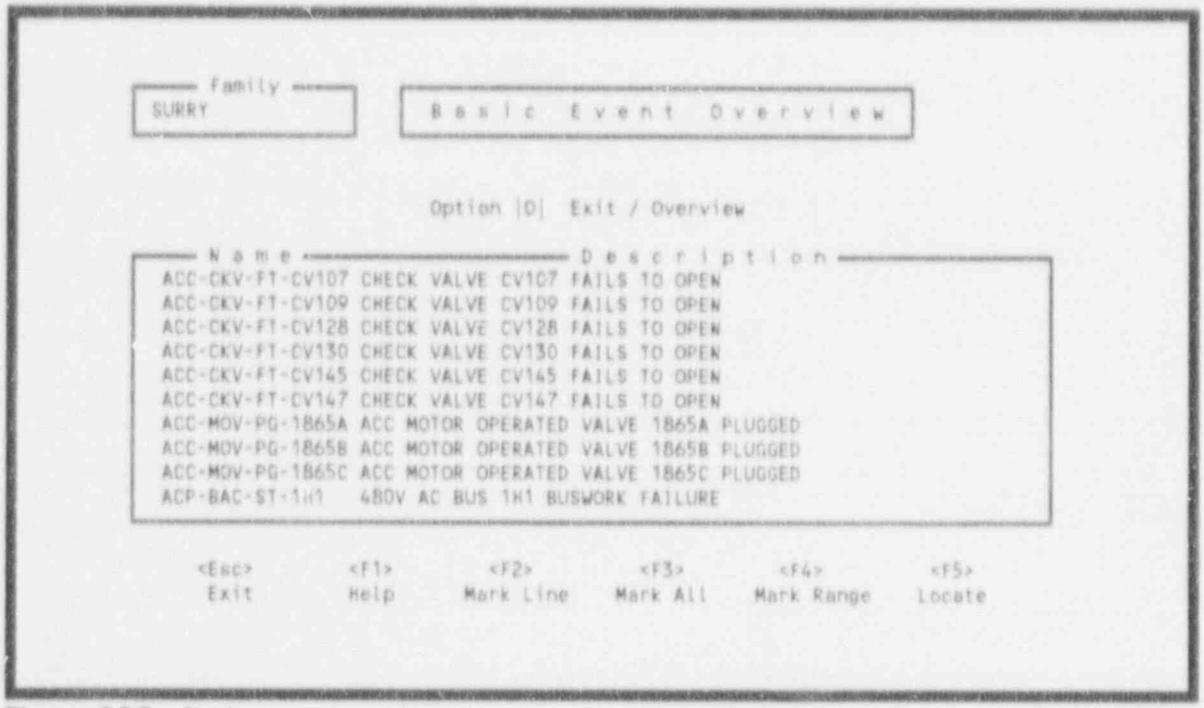


Figure 226. Basic event overview screen.

After a basic event(s) has been selected, the output destination screen will be displayed. Type in the desired destination and press <Enter>.

10.3.2 Basic Event Probability Report

This option allows you to generate a basic event probability report. The probability report shows the event number, primary name, failure calculation type, mean probability, and event lambda and tau values. To invoke this option, highlight Probability and press <Enter>. Figure 227 will be displayed. Two options are available: Exit and Probability. Exit terminates the process and returns you to the previous menu. Probability generates the report based on the event selections. Select the events as described in Section 10.3.1.

After a basic event(s) has been selected, the output destination screen will be displayed. Type in the desired destination and press <Enter>.

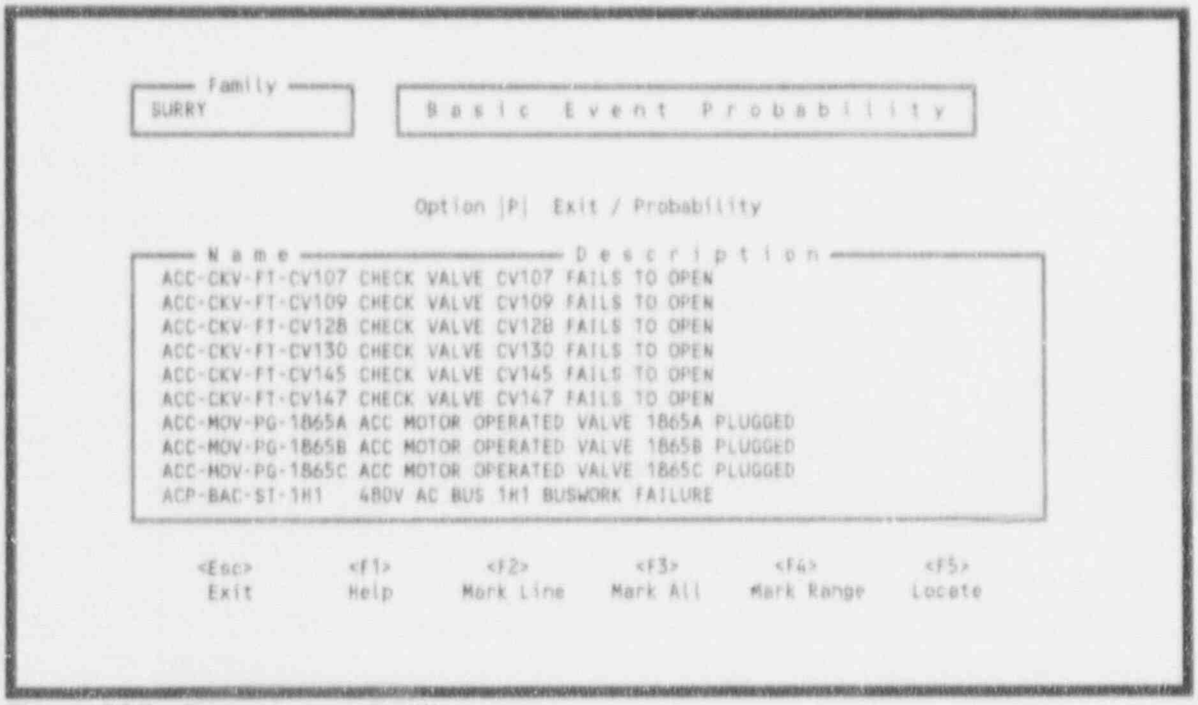


Figure 227. Basic event probability screen.

10.3.3 Basic Event Uncertainty Report

This option allows you to generate a basic event uncertainty report. The report shows the event number, primary name, distribution type, mean probability, uncertainty value, and correlation class. To invoke this option, highlight Uncertainty and press <Enter>. Two options are available: Exit and Uncertainty. Exit terminates the process and returns you to the previous menu. Uncertainty generates the report based on your event selections. Select the events as described in Section 10.3.1.

After a basic event(s) has been selected, the output destination screen will be displayed. Select the desired destination and press <Enter>. When the report is complete, you will be returned to the Basic Event Uncertainty screen. At this point, you may select another event or enter an <E> in the option field and press <Enter> to return to the IRRAS Report Menu.

10.3.4 Basic Event Cross Reference Report

This option allows you to generate a basic event cross reference report. To invoke this option, highlight X-Reference and press <Enter>. Figure 228 will be displayed. As shown, there are three cross-reference reports available: Sequence Cut Set, System Cut Set, and System Logic. Select the events as described in Section 10.3.1.

10.3.4.1 Sequence Cut Set. This option produces a sequence cut set cross reference. The report provides an event to sequence cross reference. The report will include the event number, event name and associated sequence names.

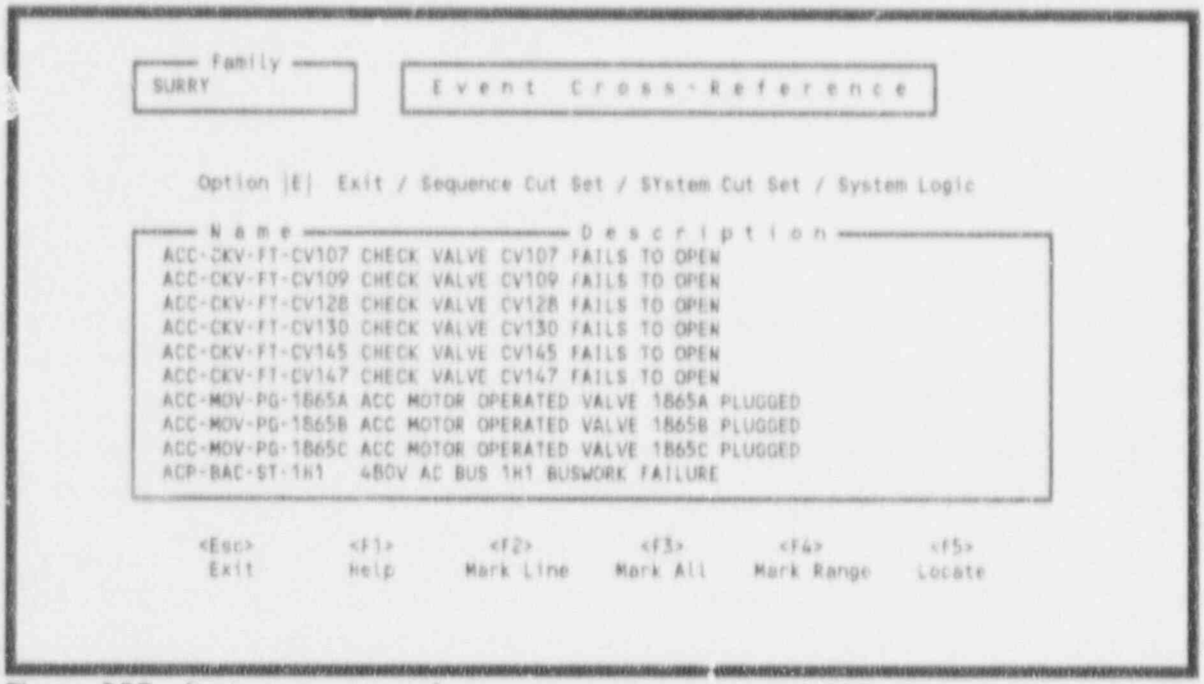


Figure 228. Basic event cross reference screen.

To invoke this option, mark the desired event(s), enter an <S> in the option field, and press <Enter>. You may include all sequences by entering an <S> in the option field and pressing <Enter>. The message **Process all records** will be displayed. Enter a <Y> to include all sequences in the report or enter an <N> to terminate the process. In any case, upon pressing <Enter>, the output destination screen will be displayed. Select the desired destination and press <Enter>.

10.3.4.2 System Cut Set. This option produces a system cut set cross reference. This report provides an event to system cross reference. The report includes the event number, the event name and the corresponding system name.

To invoke this option, mark the desired event(s), enter a <Y> in the option field, and press <Enter>. You may include all systems by entering a <Y> in the option field and pressing <Enter>. The message **Process all records** will be displayed. Enter a <Y> to include all systems in the report or enter an <N> to terminate the process. In any case, upon pressing <Enter>, the output destination screen will be displayed. Select the desired destination and press <Enter>.

10.3.4.3 System Logic. This option procedures a system logic cross reference. This report provides an event to system logic cross reference. The report includes the event number, the event name and the corresponding system names.

To invoke this option, mark the desired event(s), enter an <L> in the option field, and press <Enter>. You may include all system logic by entering an <L> in the option field and pressing <Enter>. The message **Process all records** will be displayed. Enter a <Y> to include all system logic in the report or enter an <N> to terminate the process. In any case, upon pressing <Enter>, the output destination screen will be displayed. Select the desired destination and press <Enter>.

10.4 Attributes

This option is not yet available.

10.5 SYstem

This option allows you to generate a variety of system reports. These include summary, logic, cut sets, importance, and cross reference reports. When you invoke this option, Figure 229 will be displayed. You indicate the system report you want to generate by highlighting the desired report using the arrow keys and pressing <Enter>.

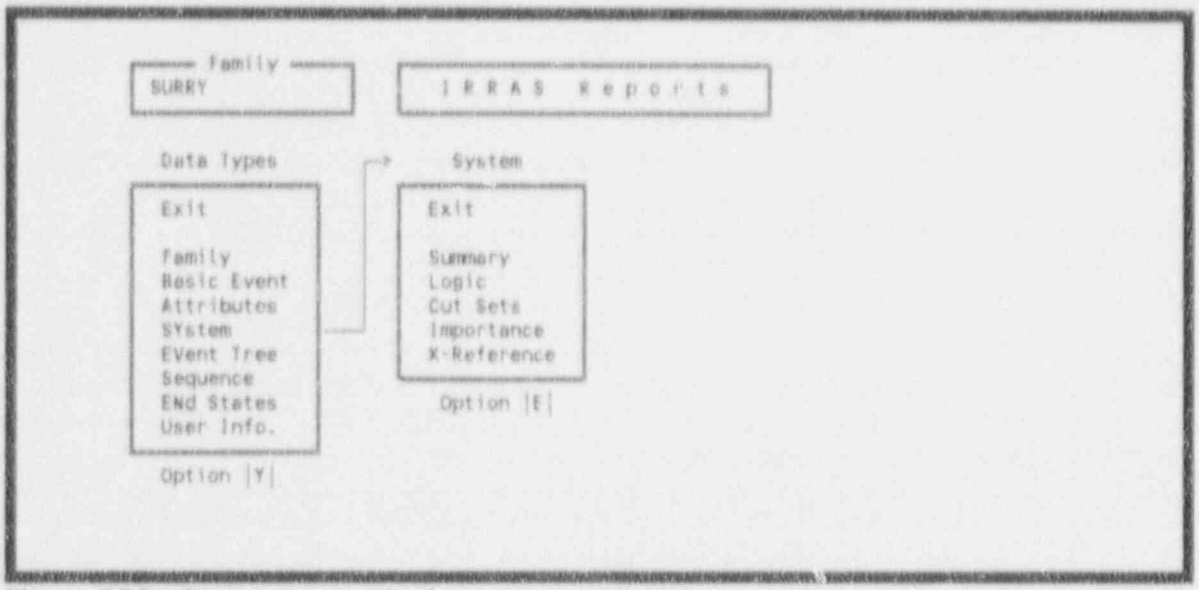


Figure 229. System report selection screen.

10.5.1 System Summary Report

This option allows you to generate a system summary that can be based on current or base case values. When you invoke this option, Figure 230 will be displayed. Three system summary reports are available: Summary, Combination, and Uncertainty. Select the desired system option and press <Enter>.

10.5.1.1 Summary. This option allows you to generate the System Brief Summary Report. This report contains the names of the systems residing in the current family, the associated minimum cut set upper bound, and the system description. When you invoke this option, the output destination screen will be displayed. On this screen, you must indicate the desired output destination (see Section 10.2.2).

10.5.1.2 COmbination. This option allows you to generate the System Combination Report. This report contains all systems in the current family, the minimum cut set, mean, and number of cut sets in the system. When you invoke this option, the output destination screen will be displayed. On this

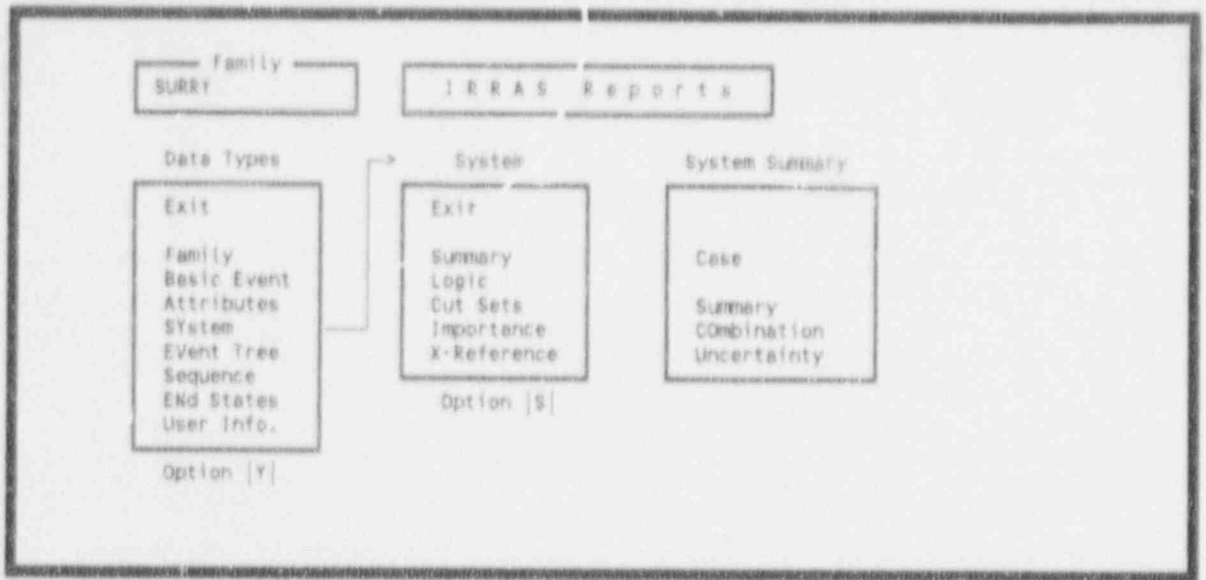


Figure 230. System summary report selection screen.

screen, you must indicate the desired output destination (see Section 10.2.2).

10.5.1.3 Uncertainty. This option allows you to generate the System Uncertainty Value Report. This report contains all systems in the current family, the mean and median values, standard deviation, the 5th and 95th percentile, the minimum and maximum values, and the seed size. When you invoke this option, the output destination screen will be displayed. On this screen, you must indicate the desired output destination (see Section 10.2.2).

10.5.2 System Logic Report

This option allows you to generate system logic reports. When you invoke this option, Figure 231 will be displayed. On this screen, all systems names or subtree names contained in the current family are displayed. You may use the Subtrees option to toggle the display from system names to subtree names. If you toggle to subtrees, the report will be based on subtrees not systems. On this screen, you must select the desired systems or subtrees (see Section 10.3.1) to include in the report.

As shown, three report options are available: Logic, Expanded, and Modified.

10.5.2.1 Logic. This option allows you to generate the System Logic Report consisting of the gate names, types, and inputs for the specified system(s) or subtree(s). When you invoke this option, the output destination screen will be displayed. On this screen, you must indicate the desired output destination (see Section 10.2.2).

To invoke this option, mark the system(s) or subtrees to include, enter an <L> in the option field and press <Enter>.

10.5.2.2 eXpanded. This option allows you to generate the System Expanded Logic Report consisting of the gate names, types, and inputs for the specified system(s). When you invoke this option, you will be prompted to enter a starting gate for the report. You may specify a gate or press <Enter>

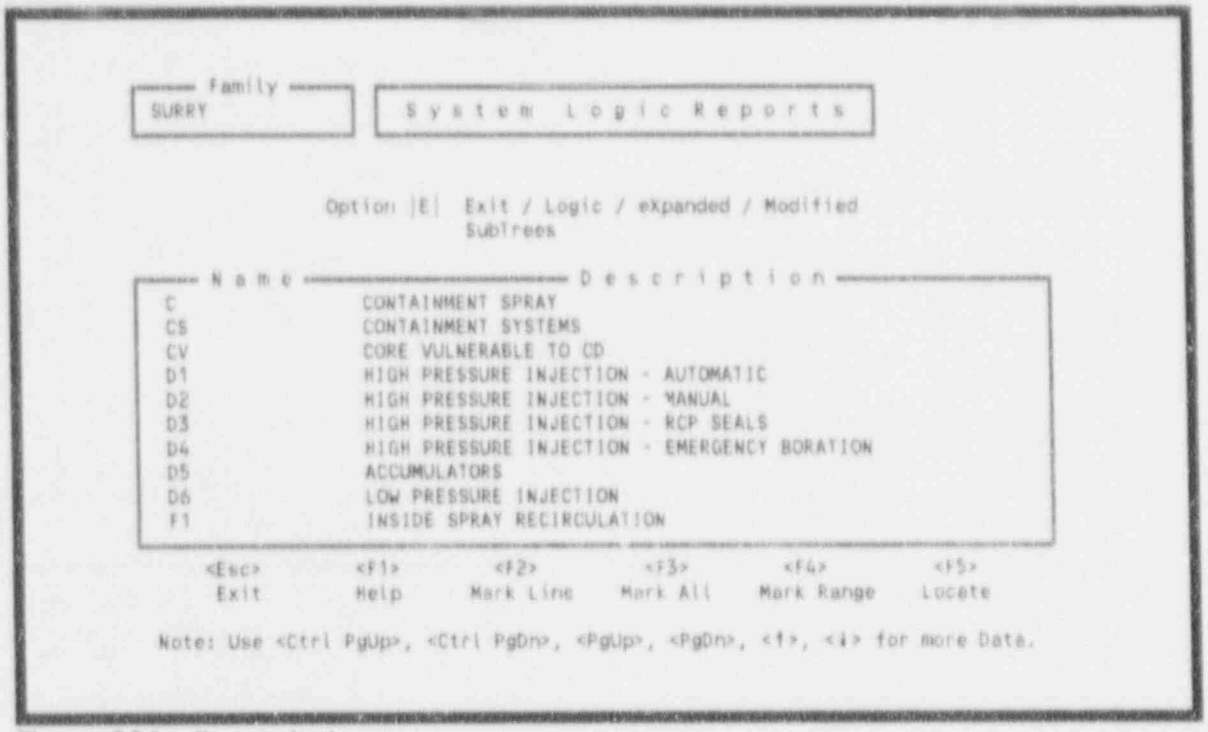


Figure 231. System logic report screen.

to include all gates. Next, the output destination screen will be displayed. On this screen, you must indicate the desired output destination (see Section 10.2.2).

To invoke this option, mark the system(s) or subtree(s) to include, enter an <X> in the option field, and press <Enter>.

10.5.2.3 Modified. This option allows you to generate the System Modified Logic Report consisting of the gate names, types, and inputs for the specified system(s). When you invoke this option, you will be prompted to enter a starting gate for the report. You may specify a gate or press <Enter> to include all gates. Next, the output destination screen will be displayed. On this screen, you must select the desired output destination (see Section 10.2.2).

To invoke this option, mark the system(s) or subtree(s) to include, enter an <M> in the option field, and press <Enter>.

10.5.3 Cut Sets Report

This option allows you to generate cut set reports based on alternate or base case values. Use the <T>oggle Alternate Cut Set option to set the values to alternate or base case. The Word ALTERNATE or BASE will appear in the upper right corner. When you invoke this option, Figure 232 will be displayed. On this screen, all names of the systems residing in the current family will be displayed. On this screen, you must select the systems to include in the report (see Section 10.3.1).

```
  -- Family --          System  Cut  Sets      ALTERNATE
  SURRY

  Option [E]  Exit / Cut Set / Quantified Cut Set / Toggle Alternate Cut Set

  -- 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 Line   Mark All   Mark Range   Locate
```

Figure 232. Cut sets report screen.

As shown, two report options are available: Cut Set or Quantified Cut Set.

10.5.3.1 Cut Set. This option allows you to generate the System Cut Sets Report which consists of the cut set number, size, and all corresponding cut sets (alternate or base). When you invoke this option, Figure 233 will be displayed. You can modify any of the default values provided by simply typing over the existing data. Upon pressing <Enter>, the output destination screen will be displayed. On this screen, you must select the desired output destination (see Section 10.2.2).

To invoke this option, mark the system(s) to include, enter a <C> in the option field, and press <Enter>.

10.5.3.2 Quantified Cut Set. This option allows you to generate the System Cut Set (Quantification) Report for quantified cut sets only. The report consists of the cut set number, percent of total, percent of the cut set, probability/frequency and all associated cut sets (alternate or base) for the selected system(s). When you invoke this option, Figure 233 will be displayed. You can modify any of the default values provided by simply typing over the existing data. Upon pressing <Enter>, the output destination screen will be displayed. On this screen, you must select the desired output destination (see Section 10.2.2).

To invoke this option, mark the system(s) to include, enter a <Q> in the option field, and press <Enter>.

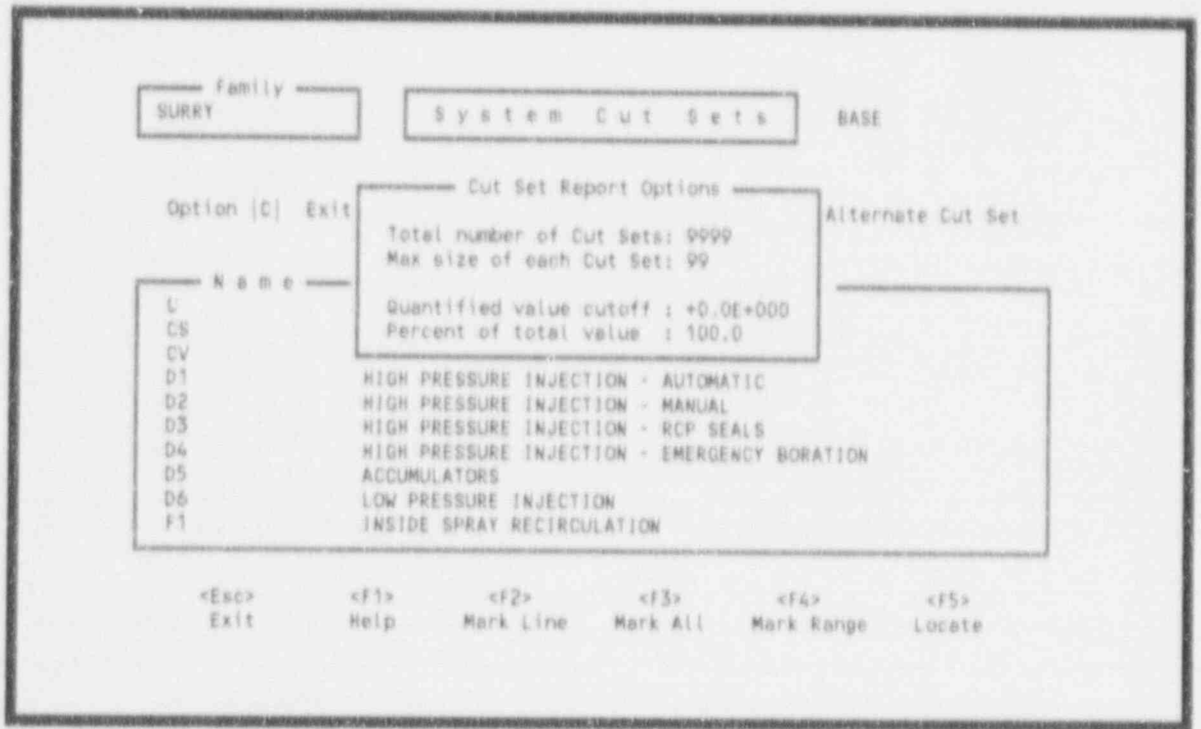


Figure 233. Cut set default report settings.

10.5.4 System Importance

This option allows you to generate importance reports based on alternate or base case values. Use the <T>oggle Alternate Cut Set option to set the values to alternate or base case. The Word ALTERNATE or BASE will appear in the upper right corner. When you invoke this option, Figure 234 will be displayed. On this screen, all names of the systems residing in the current family will be displayed. On this screen, you must select the systems to include in the report (see Section 10.3.1).

As shown, two report options are available: Importance and Sort Criteria.

10.5.4.1 Importance. This option allows you to generate the System Importance Measures report consisting of event names, number of times the event occurs, probability of failure, Fussell-Vesely importance value, risk reduction interval, and risk increase interval for the selected system(s). When you invoke this option, the output destination screen will be displayed. On this screen, you must select the desired output destination (see Section 10.2.2).

To invoke this option, mark the system(s) to include, enter an <I> in the option field, and press <Enter>.

10.5.4.2 Sort Criteria. This option allows you to select the sort order in which to display the System Importance Measures Report. When you invoke this option, Figure 235 will be displayed.

As shown, the following sort options are available:

Name Sorted by event name

```
 ---- family ----       | S y s t e m   I m p o r t a n c e |      ALTERNATE
| SURRY         |

   Option [E]  Exit / Importance / Sort Criteria / Toggle Alternate Cut Set

 ---- 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 Line    Mark All    Mark Range    Locate
```

Figure 234. System importance screen.

```
 ---- Family ----       | S y s t e m   I m p o r t a n c e |      ALTERNATE
| SURRY         |

   Sort Criteria [F]  Name / Occurrence Count / Probability of Failure /
                      F-V or Birnbaum / Risk Reduction / Risk Increase

 ---- 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 Line    Mark All    Mark Range    Locate
```

Figure 235. Sort selection screen.

Occurrence Count	-	Sorted by the number of occurrences (most to fewest)
Probability of Failure	-	Sorted by the probability failures
F-V or Birnbaum	-	Sorted in Fussell-Vesely or Birnbaum order
Risk Reduction	-	Sorted in risk reduction ratio order
Risk Increase	-	Sorted in risk increase ratio order

10.5.5 X-Reference

This option allows you to generate cross reference reports for either systems or subsystems. When you invoke this option, Figure 236 will be displayed. You may use the Level option to toggle between systems and subsystems. Two types of reports are available: Uses and Used By.

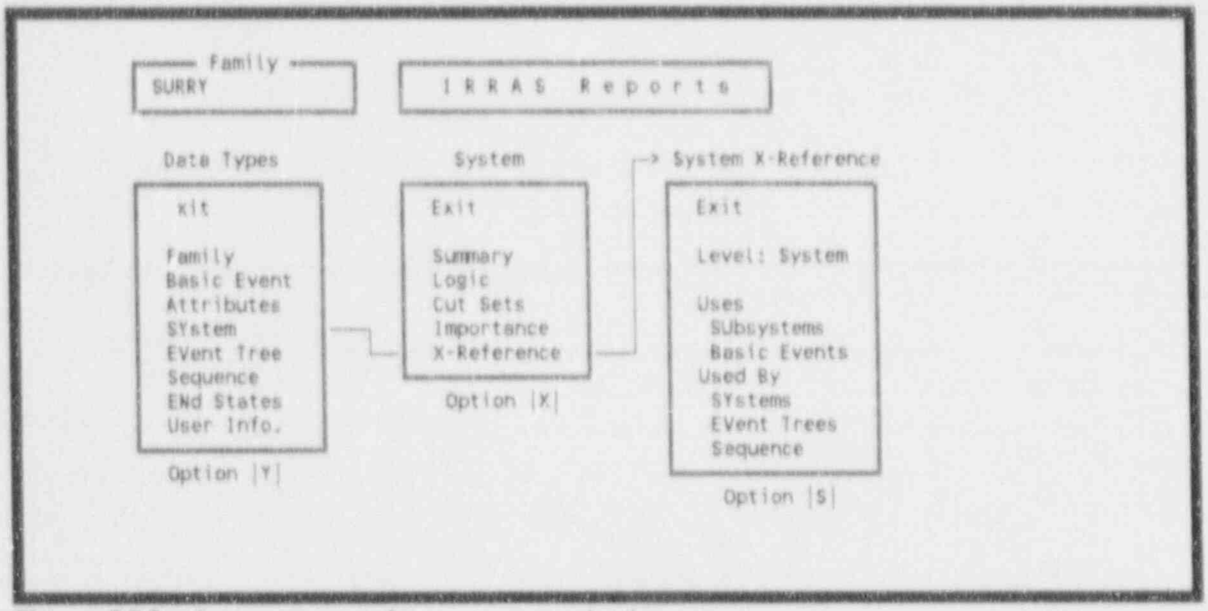


Figure 236. System cross reference report selection screen.

10.5.5.1 Uses. This type of report allows you to list either the subsystems or basic events that a subsystem references, or uses.

10.5.5.1.1 Subsystems—This option allows you to generate the System Hierarchy Report consisting of a system/subsystem and a list of all subsystems it uses. When you invoke this option, a list of systems or subsystems will be displayed. On this screen you must select the desired systems or subtrees (see Section 10.3.1). After a subsystem(s) has been selected, the output destination screen will be displayed. Type in the desired destination and press <Enter>.

10.5.5.1.2 Basic Events—This option allows you to generate the System/Basic Event Reference Report consisting of a system/subsystem and a list of all basic events that it uses. When you invoke this option, a list of systems or subsystems will be displayed. On this screen you must select the desired systems or subtrees (see Section 10.3.1). After a subsystem(s) has been selected, the output destination screen will be displayed. Type in the desired destination and press <Enter>.

10.5.5.2 Used By. This type of report allows you to list all the systems/subsystems, event trees, or sequences that use a particular system/subtree.

10.5.5.1.2 Subsystems—This option allows you to generate the SubTree Cross Reference Report consisting of a subsystem and a list of all systems/subtrees that reference or use it. When you invoke this option, a list of systems or subsystems will be displayed. On this screen you must select the desired systems or subtrees (see Section 10.3.1). After a subsystem(s) has been selected, the output destination screen will be displayed. Type in the desired destination and press <Enter>.

10.5.5.1.3 Event Trees—This option not yet available.

10.5.5.1.4 Subsystems—This option not yet available.

10.6 EVent Tree

This option allows you to generate a variety of event tree reports. When you invoke this option, Figure 237 will be displayed. You indicate which event tree report you want to generate by highlighting the desired report using the arrow keys and pressing <Enter>. As shown, the following reports may be generated: Logic/Rules, Initiating Events, Cross Reference, and System.

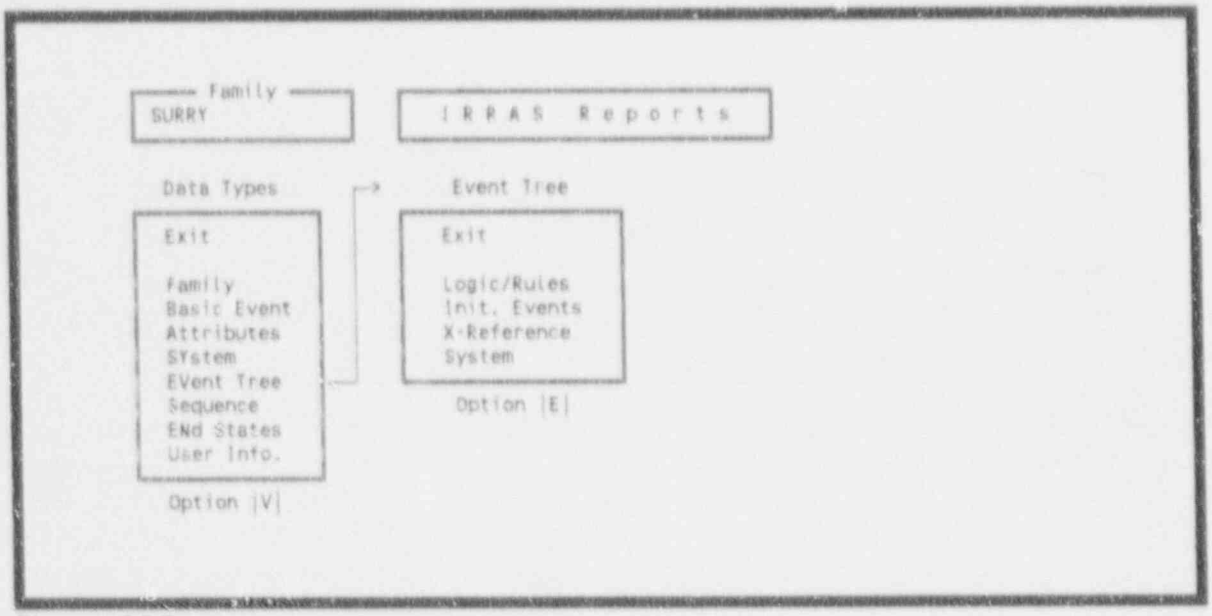


Figure 237. Event tree report selection screen.

10.6.1 Logic/Rules

This option allows you to generate the Event Tree Logic Report and the Event Tree Rules report. When you invoke this option, Figure 238 will be displayed. On this screen all event trees contained in the current family are displayed. On this screen, you must select the event trees to include in the report (see Section 10.3.1).

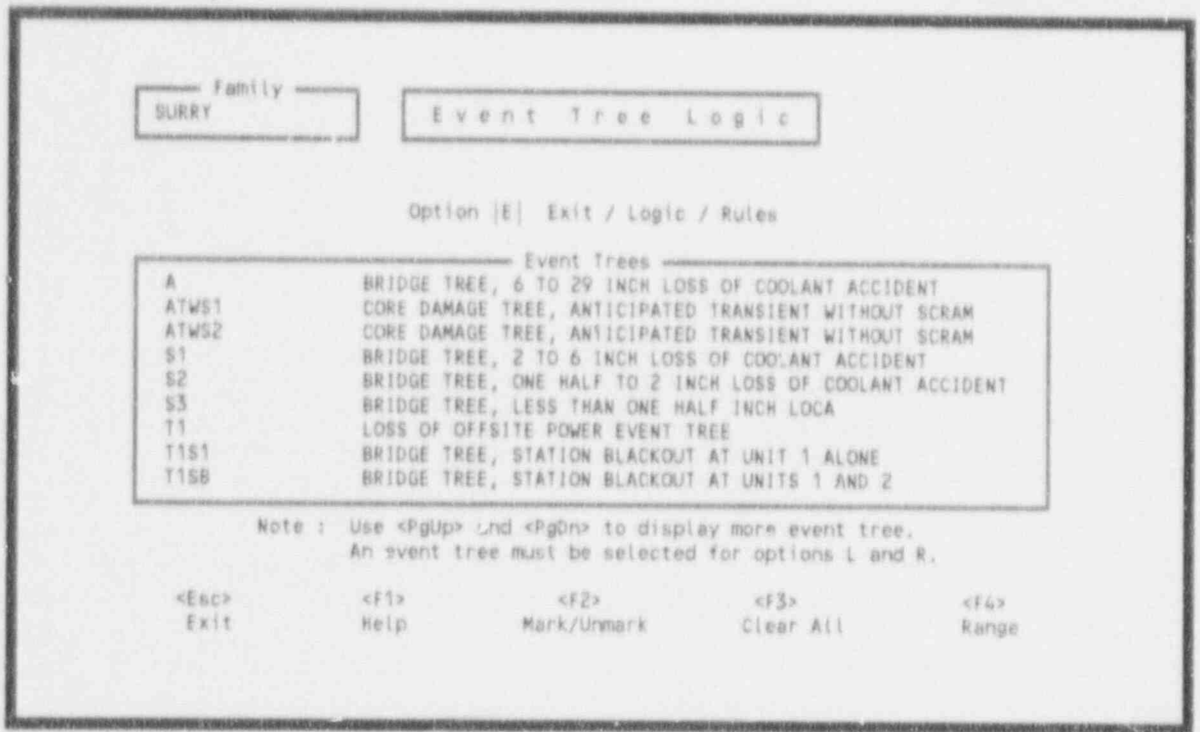


Figure 238. Logic/Rules selection screen.

As shown, two report options are available: Logic and Rules.

10.6.1.1 Logic. This option produces the Event Tree Logic Report. This report lists all sequence names and the associated logic (pass/fail) associated with each selected event tree. To invoke this option, mark the event trees, enter an <L> in the option field, and press <Enter>. When you invoke this option, the output destination screen will be displayed. On this screen, you must select the desired output destination (see Section 10.2.2).

10.6.1.2 Rules. This option produces the Event Tree Rules Report. This report lists all linkage rules (exceptions) associated with each selected event tree. To invoke this option, mark the event trees, enter an <R> in the option files, and press <Enter>. The same output options are available as described in Section 10.2.2.

10.6.2 Initiating Event Report

This option allows you to generate the Event Tree Initiating Events Report. This report contains the event tree name and the corresponding event tree description and initiating event for all event trees in the current family. When you invoke this option, the output destination screen will be displayed. On this screen, you must select the desired output destination (see Section 10.2.2).

10.6.3 System

This option is not yet available.

10.7 Sequence

This option allows you to generate a variety of sequence reports. When you invoke this option, Figure 239 will be displayed. You indicate which sequence report you want to generate by highlighting the desired report using the arrow keys and pressing <Enter>. As shown, the following reports may be generated: Summary, Logic, Cut Sets, and Importance.

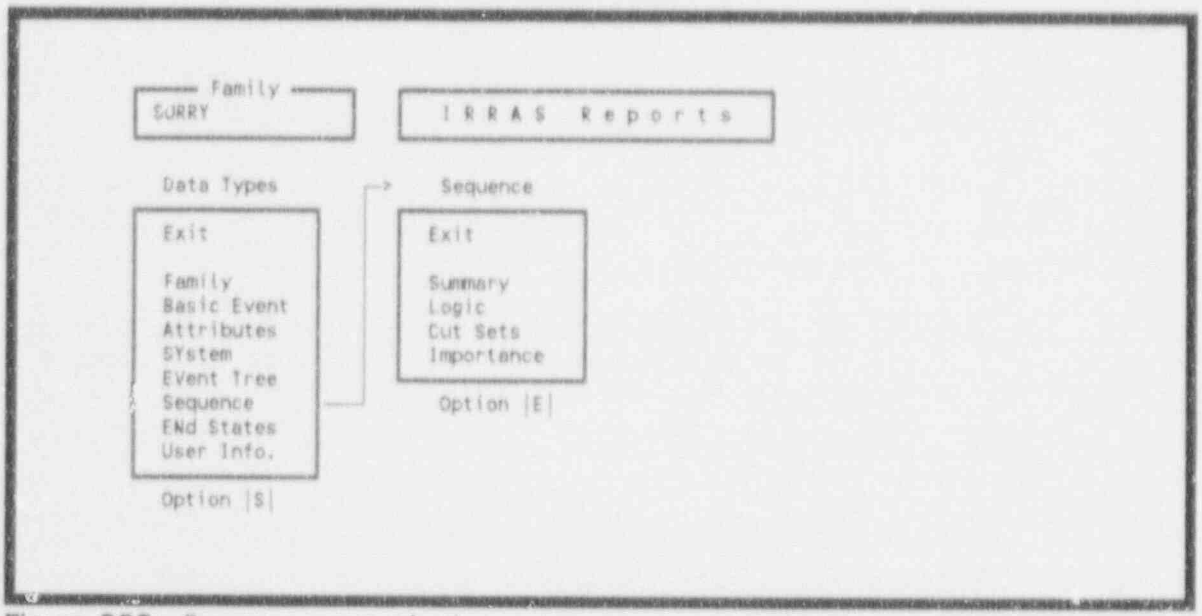


Figure 239. Sequence report selection screen.

10.7.1 Summary

When you invoke this option Figure 240 will be displayed. As shown four different summary reports may be generated: Brief, Summary, Combination and Uncertainty. Each of these reports can be generated using the Current or Base case values.

10.7.1.1 Brief Summary. This option allows you to generate the Sequence Brief Summary Report. The report lists each sequence name contained in the current family, the minimum cut set upper bound, and the sequence description. When you invoke this option, the output destination screen will be displayed. On this screen you must select the desired output destination (see Section 10.2.2).

10.7.1.2 Summary. This option allows you to generate the Sequence Summary Report. The report lists each sequence number and name contained in the current family and the minimum cut set upper bound. When you invoke this option, the output destination screen will be displayed. On this screen, you must select the desired output destination (see Section 10.2.2).

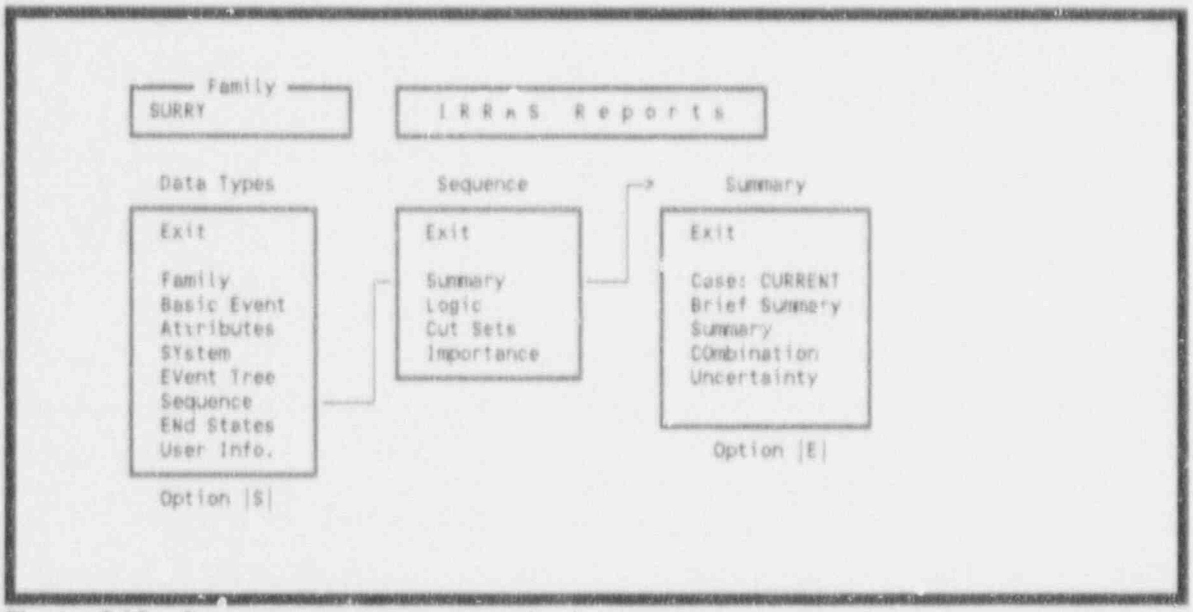


Figure 240. Sequence summary report selection menu.

10.7.1.3 COmbination. This option allows you to generate the Sequence Combination Report. The report lists each sequence number and name contained in the current family, the minimum cut set value, the mean cut set value, and the number of cut sets contained in each sequence. When you invoke this option, the output destination screen will be displayed. On this screen, you must select the desired output destination (see Section 10.2.2).

10.7.1.4 Uncertainty. This option allows you to generate the Sequence Uncertainty Values Report. The report lists each sequence number and name contained in the current family, the mean and median values, standard deviation, 5th and 95th percentile, minimum and maximum range values, and the seed size. When you invoke this option, the output destination screen will be displayed. On this screen, you must select the desired output destination (see Section 10.2.2).

10.7.2 Logic

This option allows you to generate the Sequence Logic Report. This report contains every sequence number and name contained in the current family, and the logic paths (pass/fail) for the event tree, initiating event, and logic. When you invoke this option, the output destination screen will be displayed. On this screen, you must select the desired output destination (see Section 10.2.2).

10.7.3 Cut Sets

This option allows you to generate two sequence cut set reports using alternate or base cut set values. Use the Toggle Alternate Cut Set option to set the desired values to alternate or base case. The word ALTERNATE or BASE will appear in the upper right corner. When you invoke this option, Figure 241 will be displayed. All sequences contained in the current family are displayed. On this screen, you must indicate the sequences to include in the report.

As shown, two options are available: Cut Set and Quantified Cut Set.

```
  Family
 SURRY            Sequence Cut Sets     ALTERNATE

 Option |E|  Exit / Cut Set / Quantified Cut Set / Toggle Alternate Cut Set

                    Event
 Name               Tree         Description
 A-C-F1-CV           A
 A-C-H1              A
 A-D5                A           LARGE LOCA - ACCUMULATOR FAILURE
 A-D5-C              A
 A-D5-C-F1           A
 A-D5-F1             A
 A-D5-F1-F2          A
 A-D6                A           LARGE LOCA - INJECTION FAILURE, NOT RWST
 A-D6-C              A
 A-D6-C-F1           A           LARGE LOCA - INJECTION FAILURE, FM RWST

 <Esc>     <F1>      <F2>        <F3>       <F4>         <F5>
 Exit      Help      Mark Line   Mark All   Mark Range   Locate
```

Figure 241. Sequence cut sets selection screen.

10.7.3.1 Cut Set. This option allows you to generate the Sequence Cut Sets Report, which consists of the cut set number, size and cut set name for each selected sequence. To invoke this option, mark the sequence(s) to include, enter a <C> in the option field, and press <Enter>. When you invoke this option, Figure 242 will be displayed. You can modify any of the default values provided by simply typing over the existing data. Upon pressing <Enter>, the output destination screen will be displayed. On this screen, you must select the desired output destination (see Section 10.2.2).

10.7.3.2 Quantified Cut Set. This option allows you to generate the Sequence Cut Sets (Quantification) Report, which consists of the cut set number, percent of total, percent of cut set, probability/frequency and all associated cut sets (alternate or base) for the selected sequence(s). To invoke this option, mark the sequence(s) to include, enter a <Q> in the option field, and press <Enter>. When you invoke this option, a screen similar to the one shown in Figure 242 will be displayed. You can modify any of the default values provided by simply typing over the existing data. Upon pressing <Enter>, the output destination screen will be displayed. On this screen, you must select the desired output destination (see Section 10.2.2).

10.7.4 Importance

This option allows you to generate reports based on alternate or base case values. Use the Toggle Alternate Cut Set to set the values to alternate or base case. The word ALTERNATE or BASE will appear in the upper right corner (Figure 243). When you invoke this option, Figure 243 will be displayed. On this screen, all sequence names residing in the current family will be displayed. On this screen, you must select the sequences to include in the report (see Section 10.3.1).

```
 ┌── Family ──┐   ┌──────────────────────────────┐
 │ SURRY      │   │ S e q u e n c e   C u t   S e t s │   BASE
 └────────────┘   └──────────────────────────────┘

 Option [C]  Exit ┌──── Cut Set Report Options ────┐ Alternate Cut Set
                  │ Total number of Cut Sets: 9999  │
                  │ Max size of each Cut Set: 99    │
 ┌── N a m e ──   │                                 │ t i o n ─────┐
 │ A-C-F1-CV      │ Quantified value cutoff : +0.0E+000 │          │
 │ A-C-H1         │ Percent of total value  : 100.0 │              │
 │ A-D5           └─────────────────────────────────┘ R FAILURE    │
 │ A-D5-C           A                                              │
 │ A-D5-C-F1        A                                              │
 │ A-D5-F1          A                                              │
 │ A-D5-F1-F2       A                                              │
 │ A-D6             A       LARGE LOCA - INJECTION FAILURE, NOT RWST│
 │ A-D6-C           A                                              │
 │ A-D6-C-F1        A       LARGE LOCA - INJECTION FAILURE, FM RWST │
 └─────────────────────────────────────────────────────────────────┘

    <Esc>     <F1>     <F2>        <F3>       <F4>         <F5>
    Exit      Help     Mark Line   Mark All   Mark Range   Locate
```

Figure 242. Cut set report options.

```
 ┌── Family ──┐   ┌──────────────────────────────────┐
 │ SURRY      │   │ S e q u e n c e   I m p o r t a n c e │   ALTERNATE
 └────────────┘   └──────────────────────────────────┘

  Option [E]  Exit / Importance / Sort Criteria / Toggle Alternate Cut Set

                   E v e n t
 ┌── N a m e ───── T r e e ────────── D e s c r i p t i o n ──────┐
 │ A-C-F1-CV        A                                              │
 │ A-C-H1           A                                              │
 │ A-D5             A       LARGE LOCA - ACCUMULATOR FAILURE       │
 │ A-D5-C           A                                              │
 │ A-D5-C-F1        A                                              │
 │ A-D5-F1          A                                              │
 │ A-D5-F1-F2       A                                              │
 │ A-D6             A       LARGE LOCA - INJECTION FAILURE, NOT RWST│
 │ A-D6-C           A                                              │
 │ A-D6-C-F1        A       LARGE LOCA - INJECTION FAILURE, FM RWST │
 └─────────────────────────────────────────────────────────────────┘

    <Esc>     <F1>     <F2>        <F3>       <F4>         <F5>
    Exit      Help     Mark Line   Mark All   Mark Range   Locate
```

Figure 243. Sequence importance selection screen.

As shown, two options are available: Importance and Sort Criteria.

10.7.4.1 Importance. This option allows you to generate the Sequence Importance Measures Report which consists of event names, number of times the event occurs, probability of failure, Fussell-Vesely importance value, risk reduction interval, and risk increase interval for the selected sequence(s). To invoke this option, mark the sequence(s) to include, enter an <I> in the option field, and press <Enter>. When you invoke this option, the output destination screen will be displayed. On this screen, you must select the desired output destination (see Section 10.2.2).

10.7.4.2 Sort Criteria. This option allows you to select the sort order in which to display the Sequence Importance Measures Report. When you invoke this option, Figure 244 will be displayed.

```
 ---- Family ----     +---------------------------------+
| SURRY           |   | S e q u e n c e   I m p o r t a n c e |   ALTERNATE
 -----------------    +---------------------------------+

   Sort Criteria |F|  Name / Occurrence Count / Probability of Failure /
                      F-V or Birnbaum / Risk Reduction / Risk Increase
                     E v e n t
 ---- N a m e ------ T r e e ------------ D e s c r i p t i o n ----------
|  A-C-F1-CV        A                                                    |
|  A-C-H1           A                                                    |
|  A-D5             A              LARGE LOCA - ACCUMULATOR FAILURE      |
|  A-D5-C           A                                                    |
|  A-D5-C-F1        A                                                    |
|  A-D5-F1          A                                                    |
|  A-D5-F1-F2       A                                                    |
|  A-D6             A              LARGE LOCA - INJECTION FAILURE, NOT RWST |
|  A-D6-C           A                                                    |
|  A-D6-C-F1        A              LARGE LOCA - INJECTION FAILURE, FM RWST |
 -------------------------------------------------------------------------

   <Esc>      <F1>      <F2>        <F3>       <F4>         <F5>
   Exit       Help      Mark Line   Mark All   Mark Range   Locate
```

Figure 244. Sort criteria selection screen.

As shown, the following sort options are available:

Name	-	Sorted by event name
Occurrence Count	-	Sorted by the number of occurrences (most to fewest)
Probability of Failure	-	Sorted by probability failures
F-V or Birnbaum	-	Sorted by Fussell-Vesely or Birnbaum values
Risk Reduction	-	Sorted in risk reduction ratio order
Risk Increase	-	Sorted in risk increase ratio order

10.8 ENd States

This option allows you to generate two end state reports. When you invoke this option, Figure 245 will be displayed. You indicate the end state report you want to generate by highlighting the desired report using the arrow keys and pressing <Enter>. As shown, the following reports may be generated: Brief Summary and Uncertainty. Each of these reports can be generated using the Current or Base Case values. The Case option (<C>) is a toggle that allows you to set the case to current or base case.

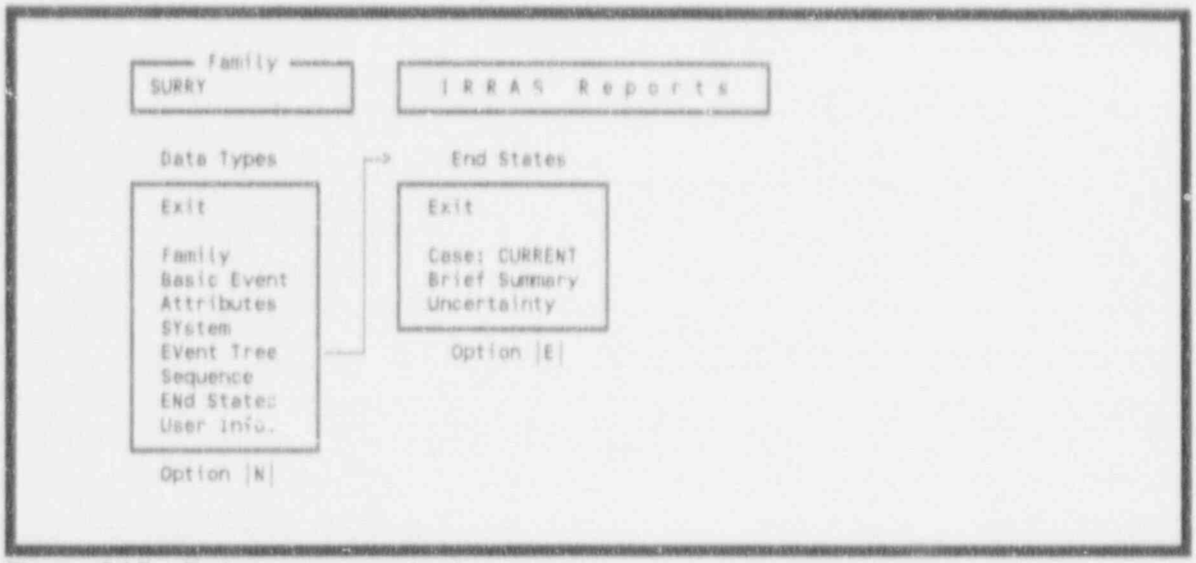


Figure 245. End state report selection screen.

10.8.1 Brief Summary

This option allows you to generate the End State Brief Summary Report. This report lists each end state name contained in the family, the minimum cut set upper bound, and the end state description. When you invoke this option, the output destination screen will be displayed. On this screen, you must select the desired output destination (see Section 10.2.2).

10.8.2 Uncertainty

This option allows you to generate the End State Uncertainty Values Report. This report lists each end state number and name contained in the current family, the mean and median values, standard deviation, 5th and 95th percentile, minimum and maximum range values, and the seed size. When you invoke this option, the output destination screen will be displayed. On this screen, you must select the desired output destination (see Section 10.2.2).

10.9 User Info

User Information Reports not yet available.

11. UTILITY OPTIONS

The IRRAS Utility Options allow you to perform routine functions that are required by IRRAS such as defining constants, recovering the data base, and MAR-D data exchange. When you invoke this option, Figure 246 will be displayed.

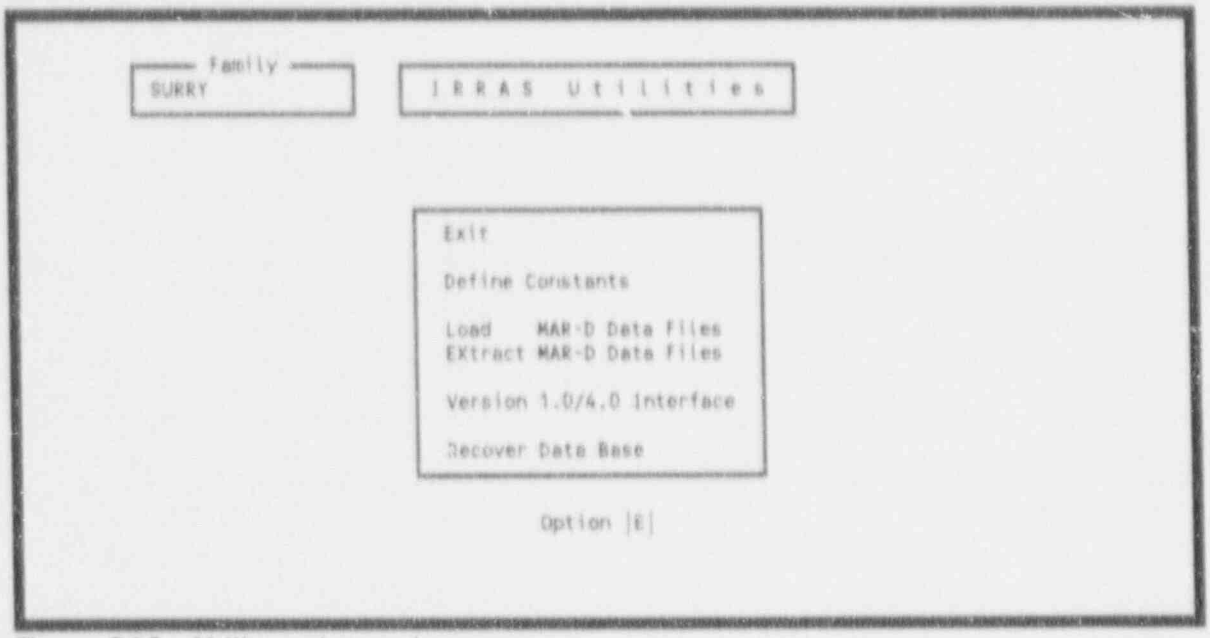


Figure 246. Utility options main menu.

11.1 Exit

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

11.2 Define Constants

The Define Constants <D> 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 247 is displayed. Table 1 provides a brief description of each of the fields in Figure 247.

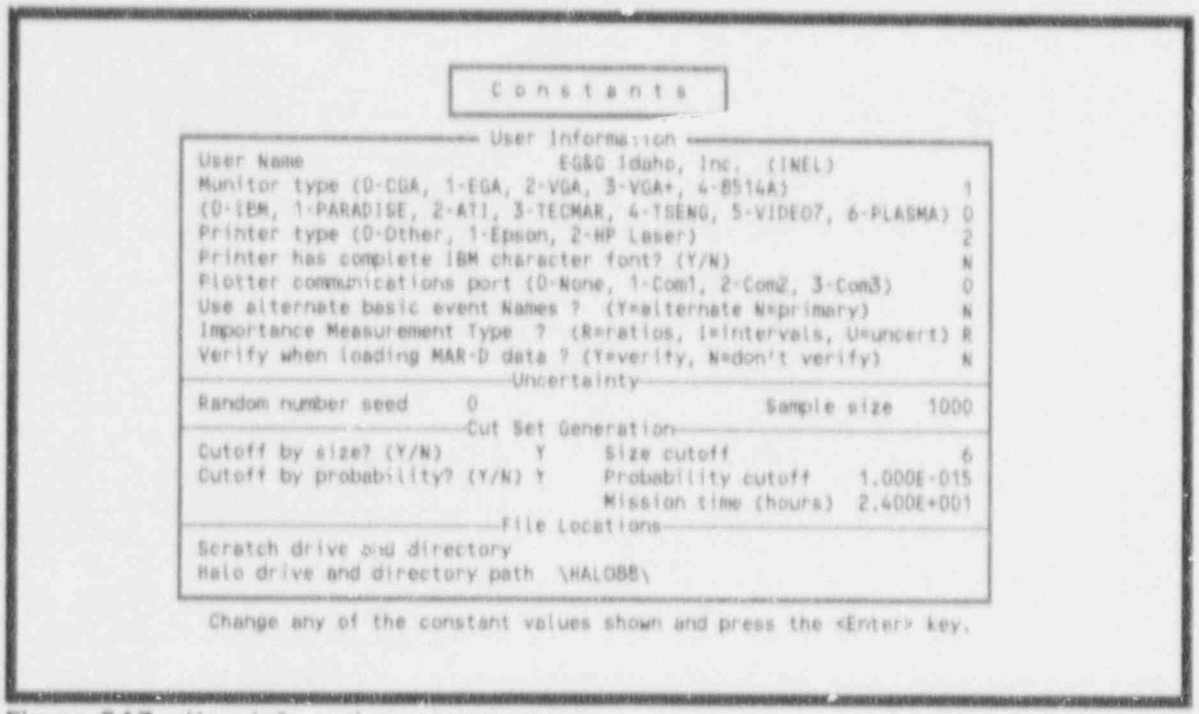


Figure 247. User information constants screen.

Table 1. 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 chocked. 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 1. (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.[illegible]00E+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 IRRAS 4.0 should use (\HALO88\)

After setting the User Information constants, press <Enter>. The next screen displays the Fault Tree Graphics Constants (Figure 248). Table 2 provides a brief description of each of the fields in Figure 248.

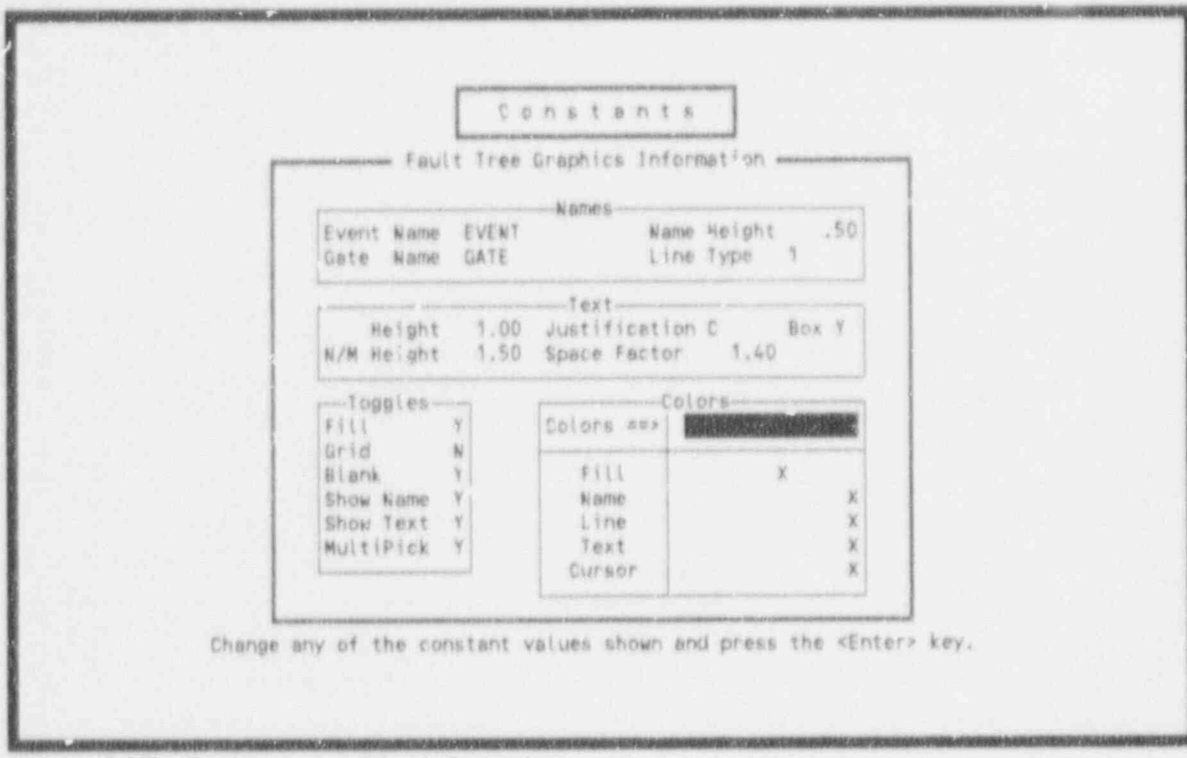


Figure 248. Fault tree graphics information.

Table 2. 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 2. (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 249). Make any changes needed and press <Enter>. Table 3 provides a brief description of each of the fields in Figure 249.

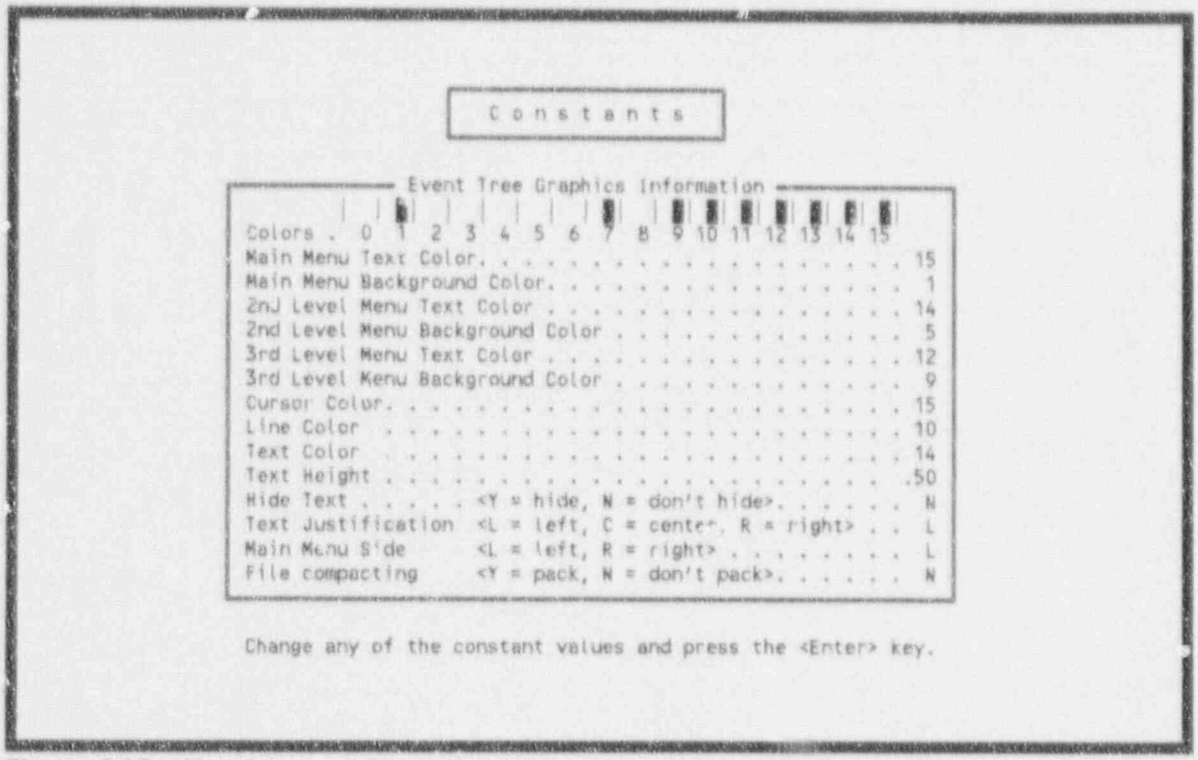


Figure 249. Event tree graphics information.

Table 3. 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 = 1[illegible] (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.

11.3 Load MAR-D Data Files

The Load MAR-D Data Files option facilitates loading of Probabilistic Risk Assessment (PRA) data from the Models and Results Data Base (MAR-D). The process converts information from the generic format found in the MAR-D data base to the IRRAS data base format. When you select this option, Figure 250 will be displayed.

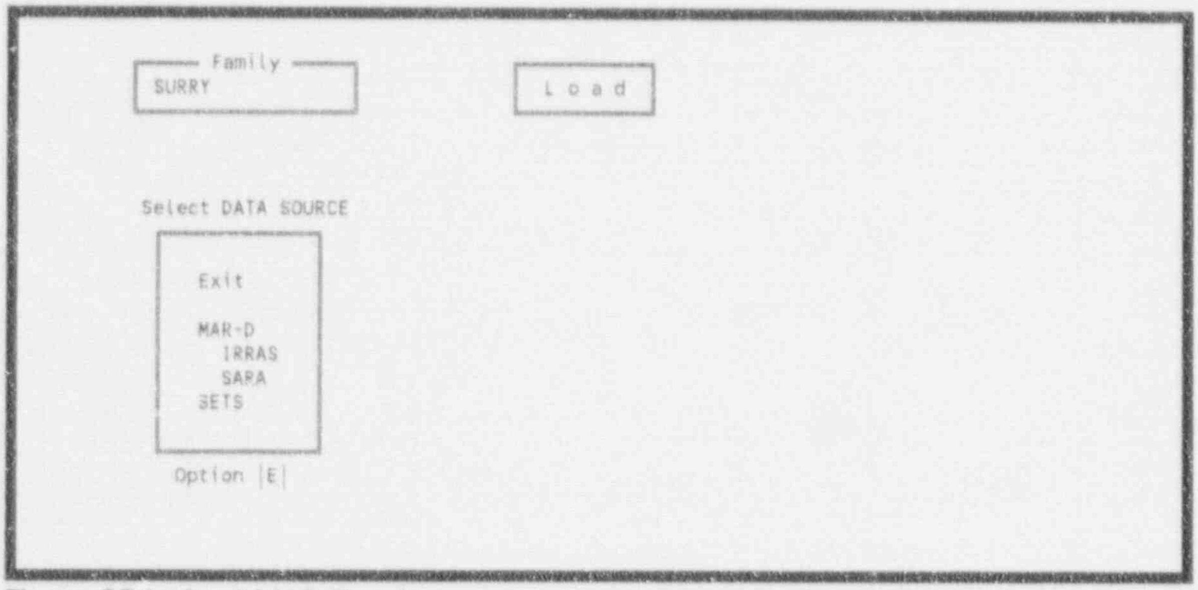


Figure 250. Load MAR-D main menu.

Before loading any data, a family must be created through the MODIFY Database Family option. Copy the files you wish to load into that family's directory (use the DOS copy command or the File Copy option under Select Family). Select 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 250 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 251). The right arrow or <Enter> will take you to this second menu (Figure 252). Again, as you cursor down through the data types, menus will appear listing the specifics of what types of data can be loaded (Figure 253). After choosing the data to load (Figure 254), the form in Figure 255 will appear listing the files that contain that data and have the proper extension.

Each of the subsections below contains additional information on loading various types of data. In general, new data loaded into the data base overwrites old data of the same name.

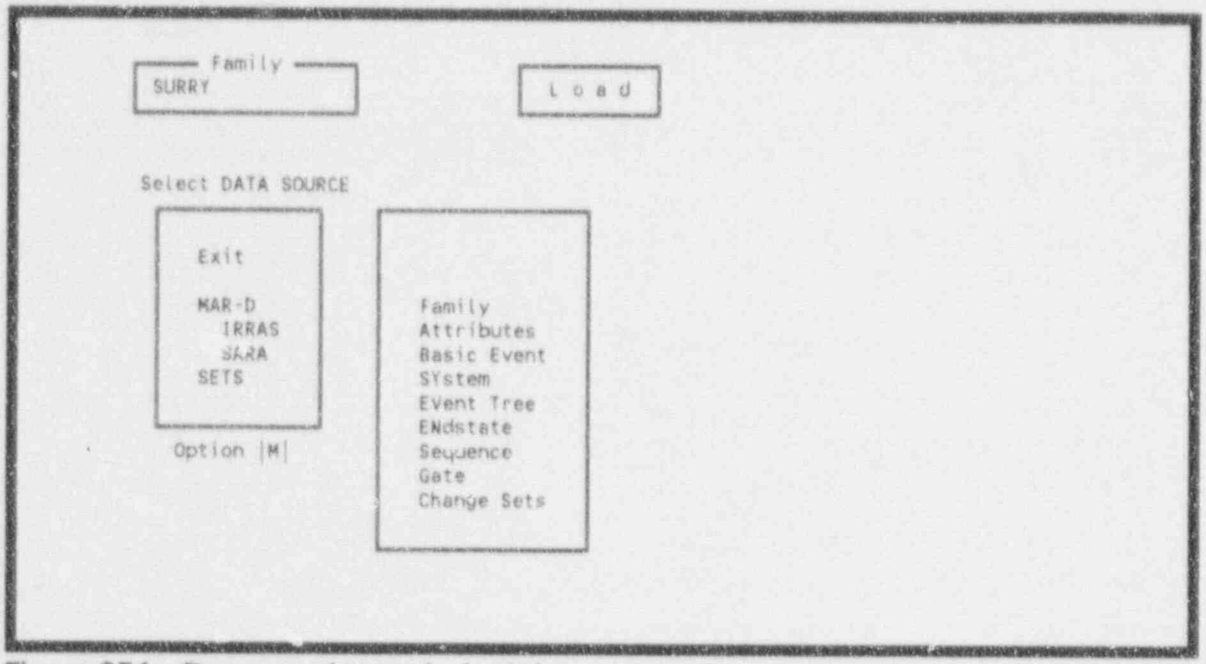


Figure 251. Data types that can be loaded.

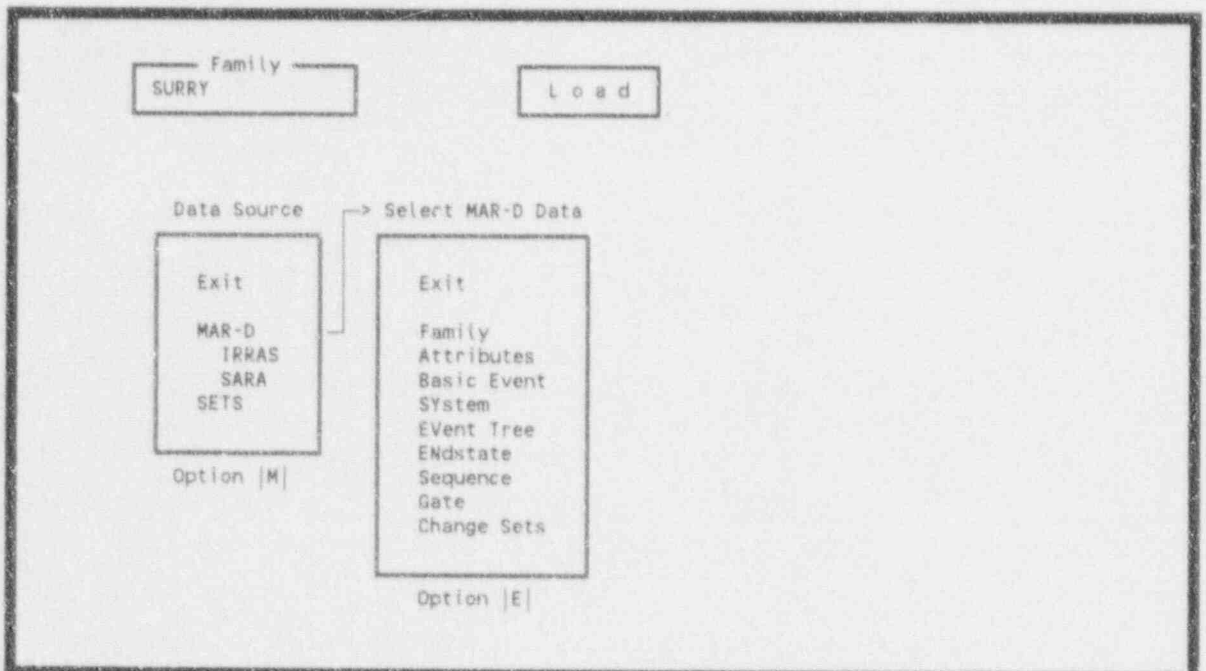


Figure 252. Data type selection screen for loading.

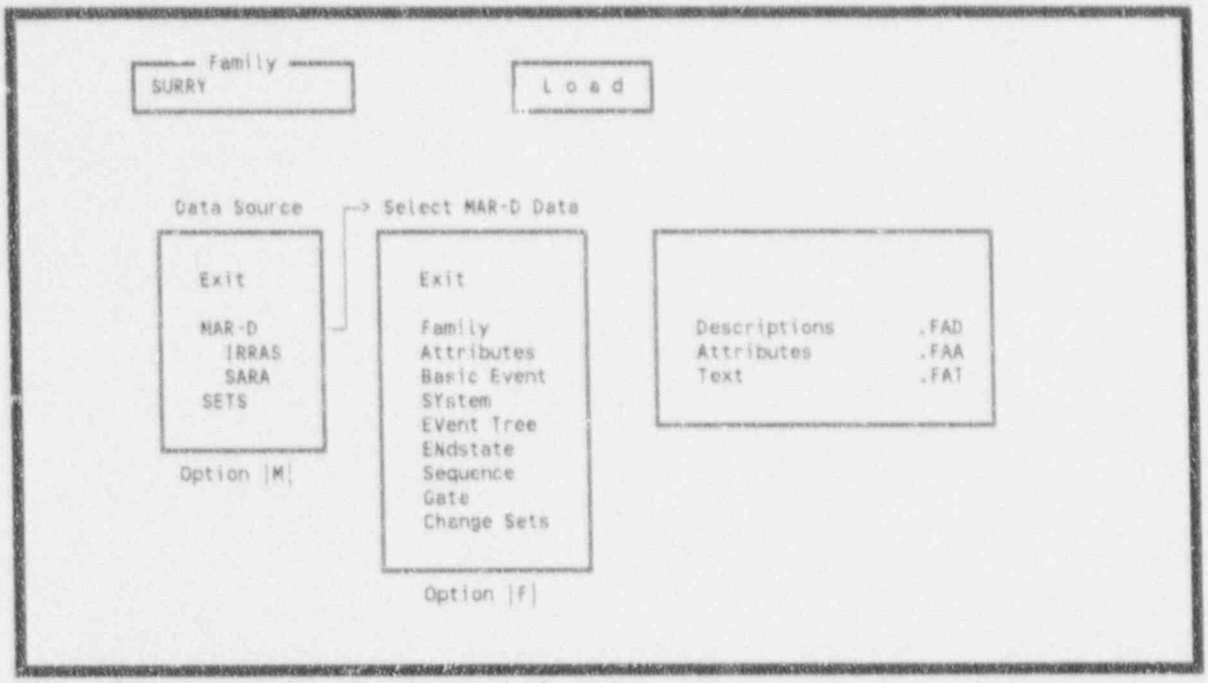


Figure 253. Actual data files that can be loaded.

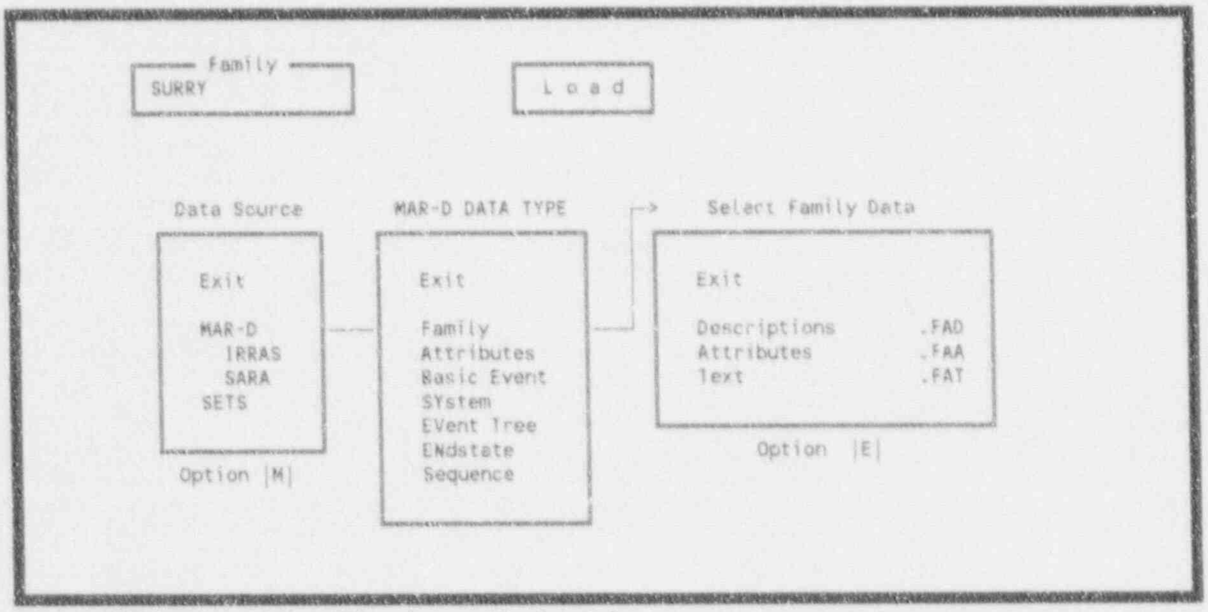


Figure 254. Actual data files that can be loaded.

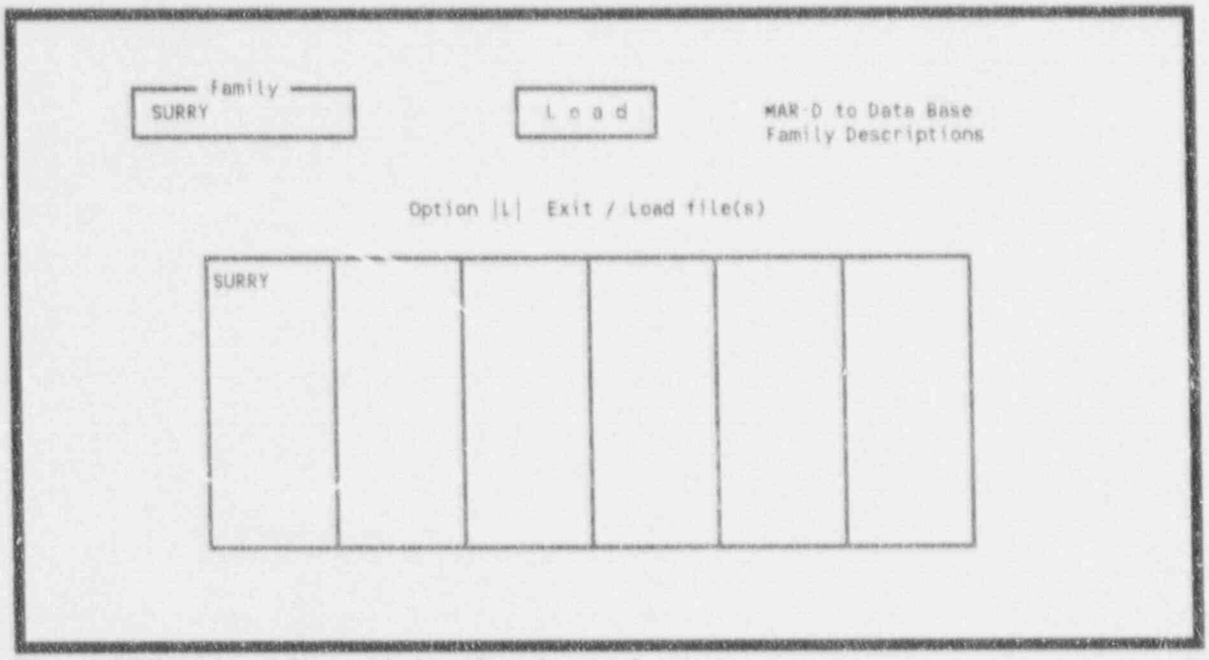


Figure 255. List of files with the selected extension.

11.3.1 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 (Figure 247). Data files that have no prerequisite loaded files (*.CTD, *.FTD, *.BED, etc.) are assumed to be correct and are loaded directly into the data base 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 4 for a listing of files and their prerequisite files and dependent fields.

Table 4. MAR-D files load order dependencies

Group	File	Prereq. files	Dependent fields
Family:	.FAD	----	----
	.FAT	----	----
	.FTT	----	----
NOTE: consistency checking for family names is active for all files.			
Attributes:	.CAD	----	----
	.CTD	----	----
	.FMD	----	----
	.LCD	----	----
	.STD	----	----
BasicEvents:	.BED	----	----
	.BEI	.BED	Event Name
	.BEA	.BED	Event Name
		.CAD	Class Attr
		.CTD	Comp Type
		.FMD	Fail Mode
		.LCD	Location
		.STD	System Type

```
-----------------------------------------------------------------------------------------
Systems:      .FTD          ----          ----
              .DLS          ----          ----
              .FTL          .BED          Event 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.
-----------------------------------------------------------------------------------------
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.
-----------------------------------------------------------------------------------------
EndStates:    .ESD          ----          ----
              .ESI          ????          ????
              .EST          .ESD          End State Name
-----------------------------------------------------------------------------------------
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
```

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. 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 on 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.

11.3.2 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 B). 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.

11.3.3 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 B.

11.3.4 Basic Event

Event descriptions, failure rates, and attributes can be loaded into the data base. 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 B.

11.3.5 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 database 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 B.

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

11.3.6 EVent Tree

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

11.3.7 ENdstate

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

11.3.8 Sequence

Sequence cut sets for MAR-D (IRRAS, SARA) file formats can be loaded. In the MAR-D format, sequence descriptions, 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.

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.

11.3.9 Gate

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

11.3.10 Change Sets

All change set information used in the GENERATE change set option can be loaded via this file.

11.4 EXtract MAR-D Data Files

Data can be output in MAR-D (IRRAS, SARA) format using the EXtract MAR-D Data Files option. The extracted file is created in the current family subdirectory. The default output file name for description, information, and attribute data is 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 identical with the LOAD menus (see Figure 256 through Figure 260). A data tool type is selected, then a data type, and finally the specific data to be output. In outputting some data, a fourth menu appears. Read the note at the bottom of the screen as well as the appropriate section on extracting that data type.

11.4.1 Family

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

11.4.2 Attributes

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

11.4.3 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.

11.4.4 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 is 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.

11.4.5 EVent Tree

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

11.4.6 ENdstate

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

11.4.7 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, then that event tree's sequences are displayed and can be output. If all event trees are selected, the sequences for each event tree will be output to a file with that event tree's name. If a single event tree is selected, the output sequence menu containing all of the sequences associated with that event tree will be displayed. 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.

11.4.8 Gate

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

11.4.9 Change Sets

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

For further details see *Models and Results Data Base User's Guide Ver. 2.0, October 1989, EGG-CATT-8249.*

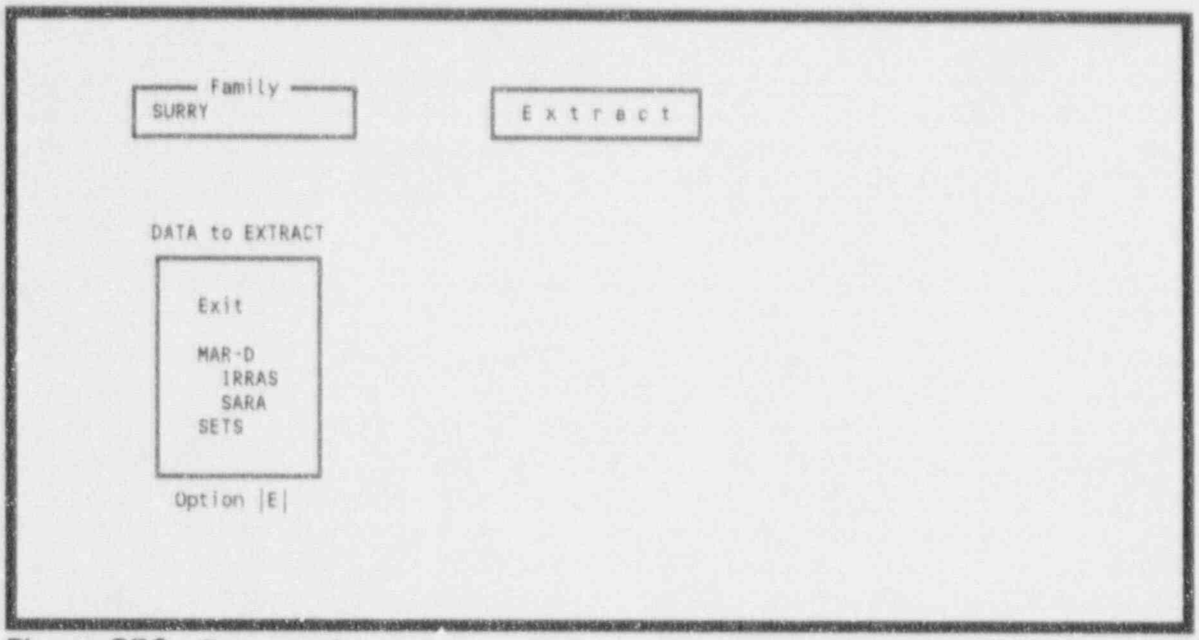


Figure 256. Extract main menu.

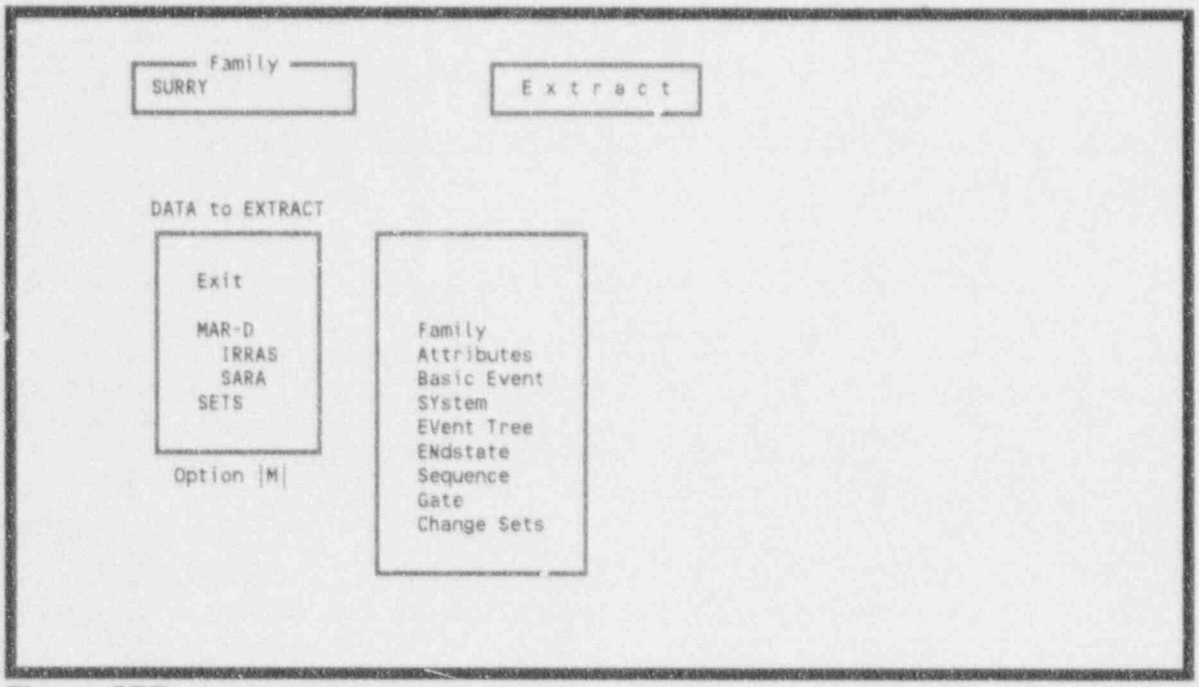


Figure 257. Data types that can be extracted.

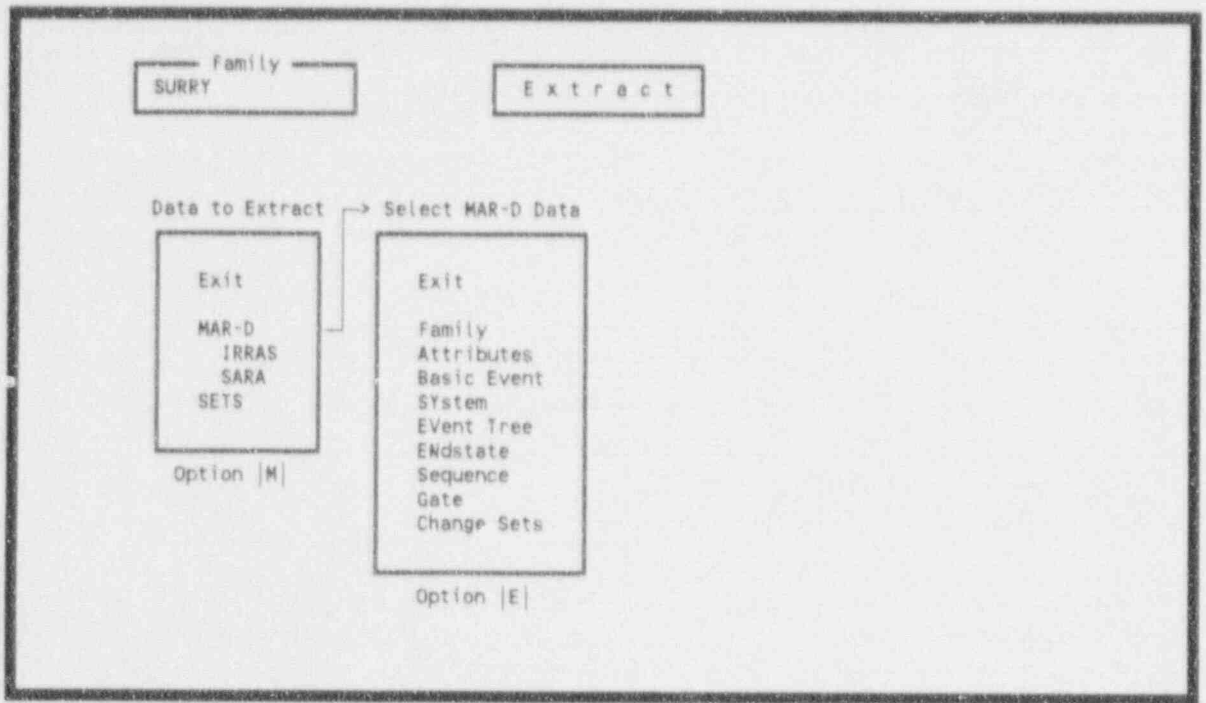


Figure 258. Data type selection screen for extracting.

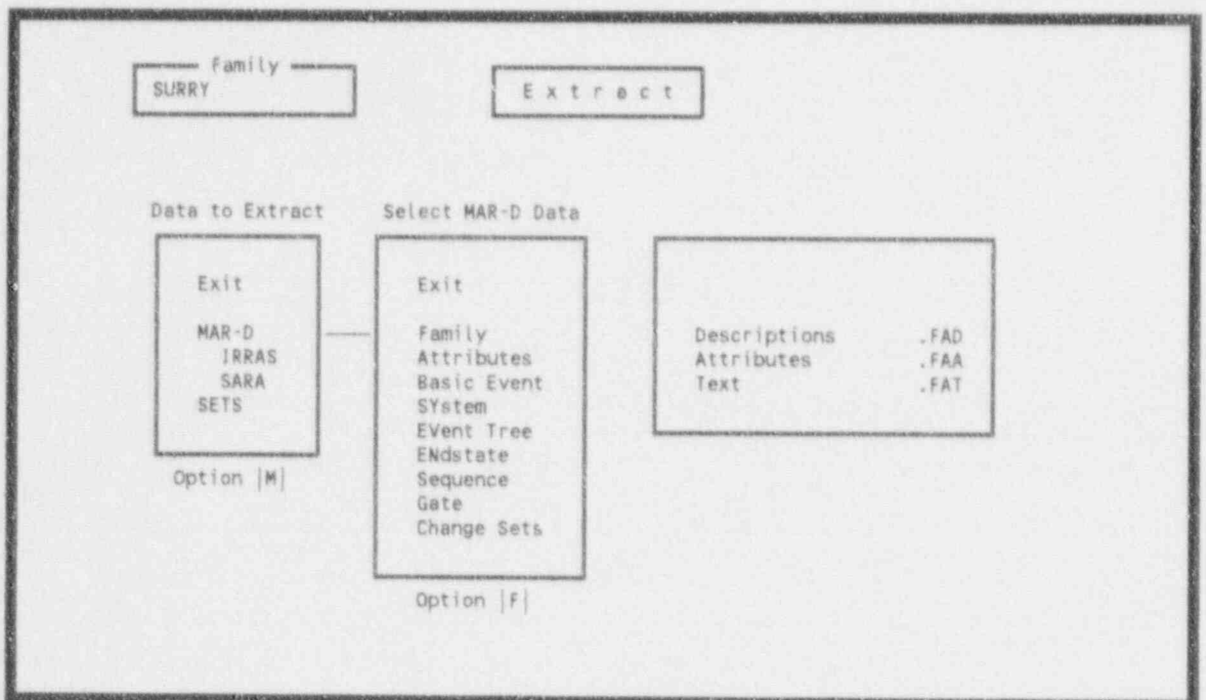


Figure 259. Actual data files that can be extracted.

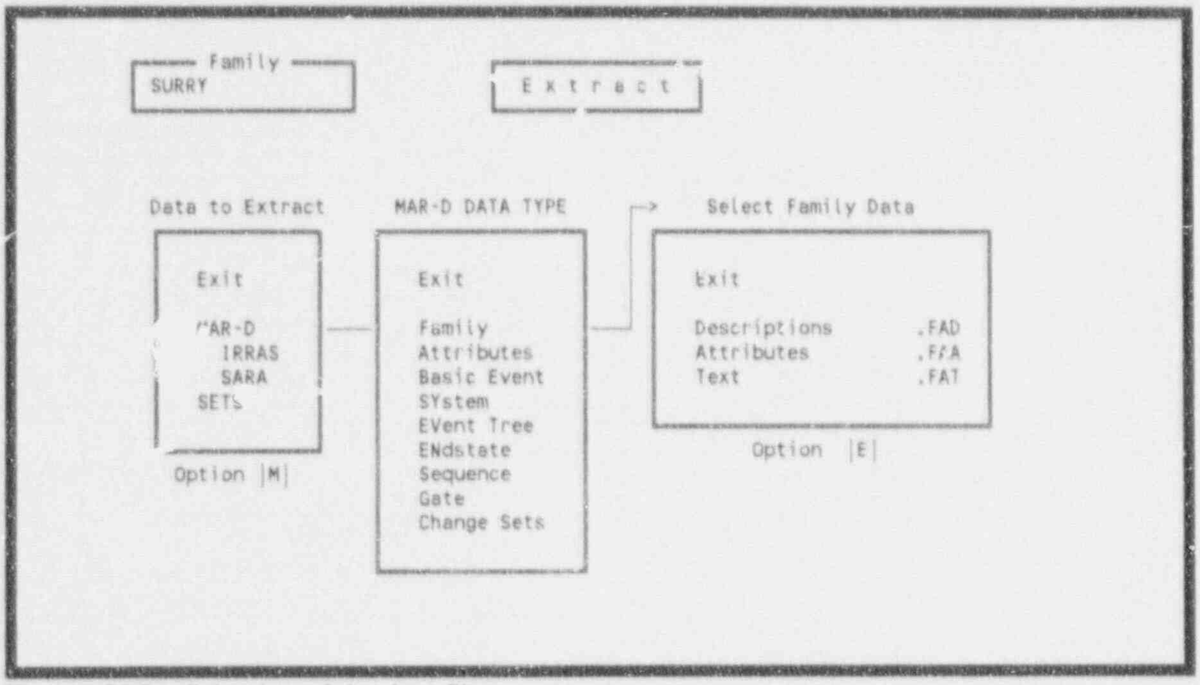


Figure 260. Selection of the data file type to extract.

11.5 Version 1.0/4.0 Interface

This option allows you to convert data files created using IRRAS Version 1.0 software to IRRAS Version 4.0 or from Version 4.0 to Version 1.0. When you invoke this option, Figure 261 will be displayed. As shown, three options are available: Exit, 1 to 4, and 4 to 1. In addition, the following keys have special functions:

<Esc>	Returns to the Utilities Menu (Figure 246).
<←>	Returns to the Utilities Menu (Figure 246).
<→>	Selects the option currently highlighted (works like <Enter>).

11.5.1 Exit

This option returns you to the Utility Menu. To invoke this option, enter an <E> in the option field or highlight Exit and press <Enter>, or press the <Esc> key.

11.5.2 Convert 1.0 to 4.0

This option allows you to convert data files created with IRRAS Version 1.0 into IRRAS Version 4.0 data files. To invoke this option, type <1> in the option field, or highlight <1 to 4> and press <Enter> or <right arrow>. When you select this option, Figure 262 will be displayed. On this

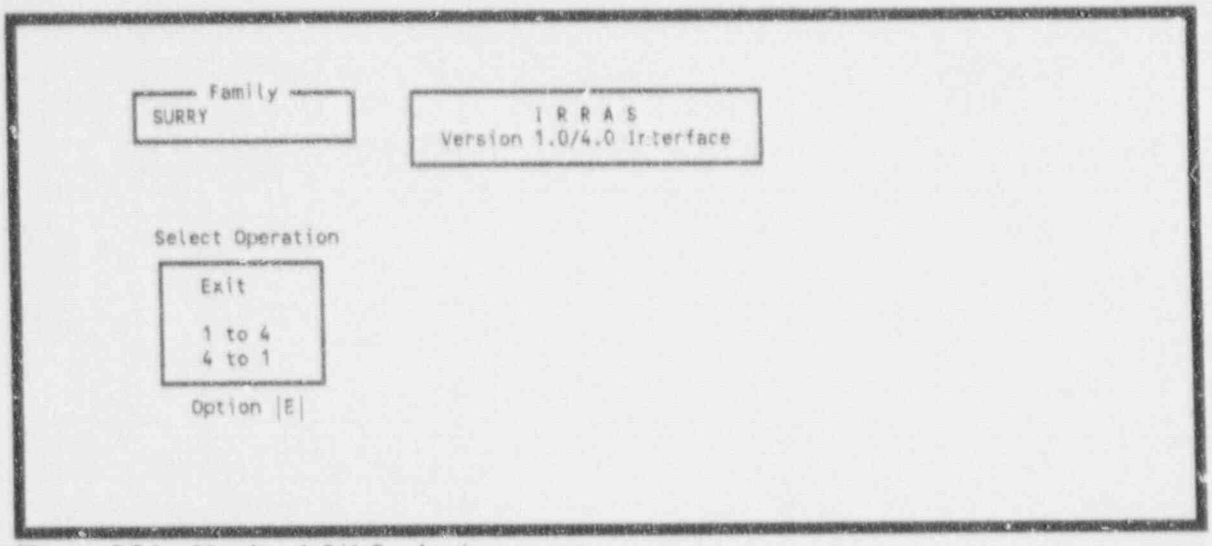


Figure 261. Version 1.0/4.0 selection screen.

screen you must select what type of data to convert from Version 1.0 to Version 4.0. Five types of data files can be converted: Basic Event Failure Rates, Fault Tree Logic, System Cut Sets, Sequence Cut Sets, and Fault Tree Graphics.

11.5.2.1 Failure Rates. This option allows you to convert basic events and their failure rates generated in Version 1.0 to Version 4.0. Version 1.0 of IRRAS stored this information in files with a ".RAT" extension, one ".RAT" file per family. When you invoke this option, Figure 263 will be displayed, listing all 1.0 files with the ".RAT" extension. To invoke this option for a single ".RAT" file, enter an <L> in the option field, highlight the desired file name, and press <Enter>. To invoke this process for a group of files, mark the desired files using the function keys F2, F3, and F4, enter an <L> in the option field, and press <Enter>. To invoke this option for all ".RAT" files, clear all marked entries, enter an <L> 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 convert all files, or type an <N> to terminate the conversion.

11.5.2.2 Fault Trees. This option allows you to convert fault tree logic generated in Version 1.0 to Version 4.0. Version 1.0 of IRRAS stored this information in files with a ".TRE" extension, one ".TRE" file per fault tree. When you invoke this option, Figure 264 will be displayed, listing all 1.0 files with the ".TRE" extension. To invoke this option for a single logic file, enter an <L> in the option field, highlight the desired file name, and press <Enter>. To invoke this process for a group of logic files, mark the desired files using the function keys F2, F3, and F4, enter an <L> in the option field, and press <Enter>. To invoke this option for all logic files, clear all marked entries, enter an <L> 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 convert all files, or type an <N> to terminate the conversion.

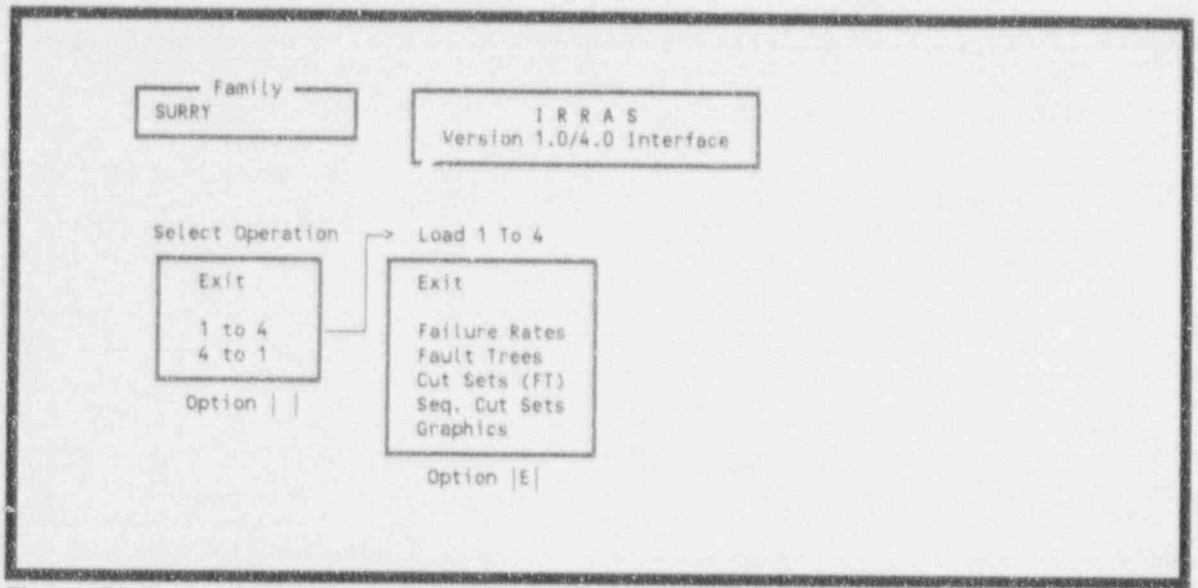


Figure 262. Load selection screen.

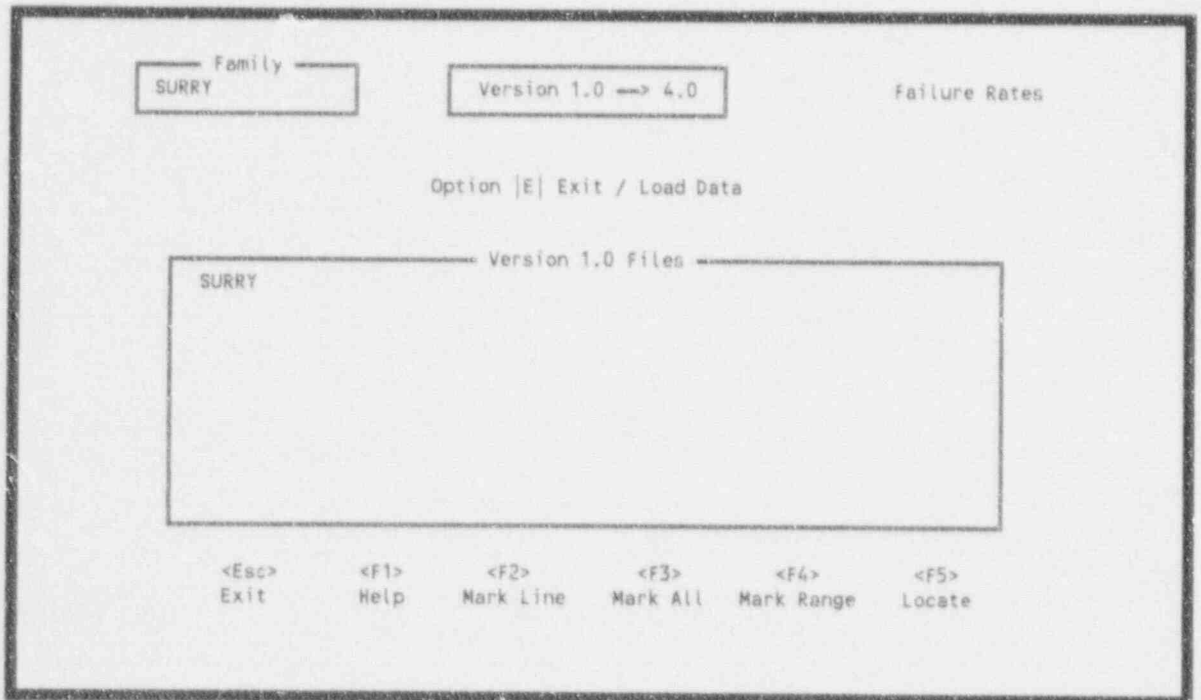


Figure 263. Family selection screen.

```
 Family                  Version 1.0 ---> 4.0                Fault Trees
 SURRY

                        Option |L| Exit / Load Logic

            ------------------ Version 1.0 Files ------------------
 4KV1H     4KV1J     A         AFW1      AFW14     AFW17B    ATWS1
 ATWS2     S1        S2        S3        T1S1      T1SB      T2
 T3        T5A       T5B       T7

 <Esc>     <F1>      <F2>       <F3>       <F4>        <F5>
 Exit      Help      Mark Line  Mark All   Mark Range  Locate
```

Figure 264. Fault tree selection screen.

11.5.2.3 Cut Sets (FT). This option allows you to convert system cut sets generated in Version 1.0 to Version 4.0. Version 1.0 of IRRAS stored this information in files with a ".CUT" extension, one ".CUT" file per system. When you invoke this option, a screen similar to the one shown in Figure 264 will be displayed, listing all files with the ".CUT" extension. To invoke this option for a single cut set file, enter an <L> in the option field, highlight the desired file name, and press <Enter>. To invoke this process for a group of cut set files, mark the desired files using the function keys F2, F3, and F4, enter an <L> in the option field, and press <Enter>. To invoke this option for all cut set files, clear all marked entries, enter an <L> 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 convert all files, or type an <N> to terminate the conversion.

11.5.2.4 Sequence Cut Sets. This option allows you to convert sequence cut sets generated in Version 1.0 to Version 4.0. Version 1.0 of IRRAS stored this information in files with a ".CUT" extension, one ".CUT" file per sequence. When you invoke this option, a screen similar to the one shown in Figure 264 will be displayed, listing all files with the ".CUT" extension. To invoke this option for a single cut set file, enter an <L> in the option field, highlight the desired file name, and press <Enter>. To invoke this process for a group of cut set files, mark the desired files using the function keys F2, F3, and F4, enter an <L> in the option field, and press <Enter>. To invoke this option for all cut set files, clear all marked entries, enter an <L> 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 convert all files, or type an <N> to terminate the conversion.

NOTE: **IRRAS Version 1.0 does not distinguish between system and sequence cut set files. They both have the same extension. Only those ".CUT"**

files that correspond to a system should be marked and loaded with the Cut Sets option. Also, only those ".CUT" files that correspond to a sequence should be loaded with the Sequence Cut Sets option.

When you invoke this option you will be prompted to specify the event tree you wish to load the sequence cut sets under.

11.5.3 Convert 4.0 to 1.0

This option allows you to convert data files created with IRRAS Version 4.0 into IRRAS Version 1.0 data files. To invoke this option, type <2> in the option field, or highlight <4 to 1> and press <Enter> or <→>. When you select this option, Figure 265 will be displayed. On this screen you must select what type of data to convert from Version 4.0 to Version 1.0. Four types of data files can be converted: basic event failure rates, fault tree logic, system cut sets, and sequence cut sets.

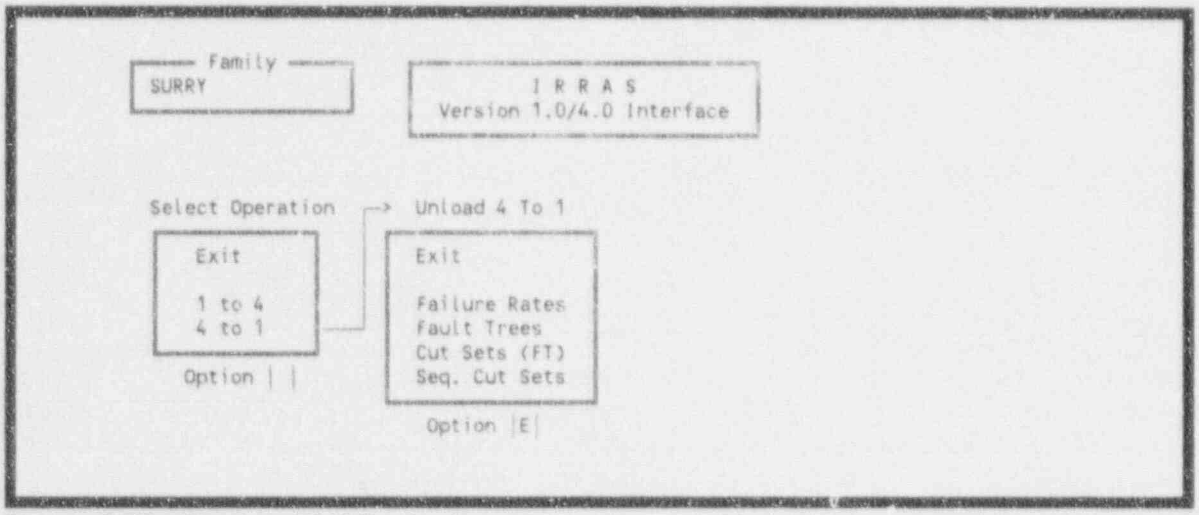


Figure 265. Version 4.0/1.0 selection screen.

11.5.3.1 Failure Rates. This option allows you to output basic event failure rates generated in Version 4.0 to a Version 1.0 compatible format (as ".RAT" files). To invoke this option, type an <F> in the option field, or highlight "Failure Rates" and press <Enter> or <→>. Figure 266 will be displayed. On this screen, you have three options: Exit, Current Probability Unload, or Base Probability Unload.

11.5.3.1.1 Exit—This option returns you to the 4 to 1 menu. To invoke this option type <E> in the option field and press <Enter>, or press the <Esc> key.

11.5.3.1.2 Current Probability Unload—This option unloads or outputs all the basic events of the current family along with the current probability for each of those events into the file specified by the output file name field with the ".RAT" extension. To invoke this option, enter a <C> in the option field, modify the output file name (if desired), and press <Enter>.

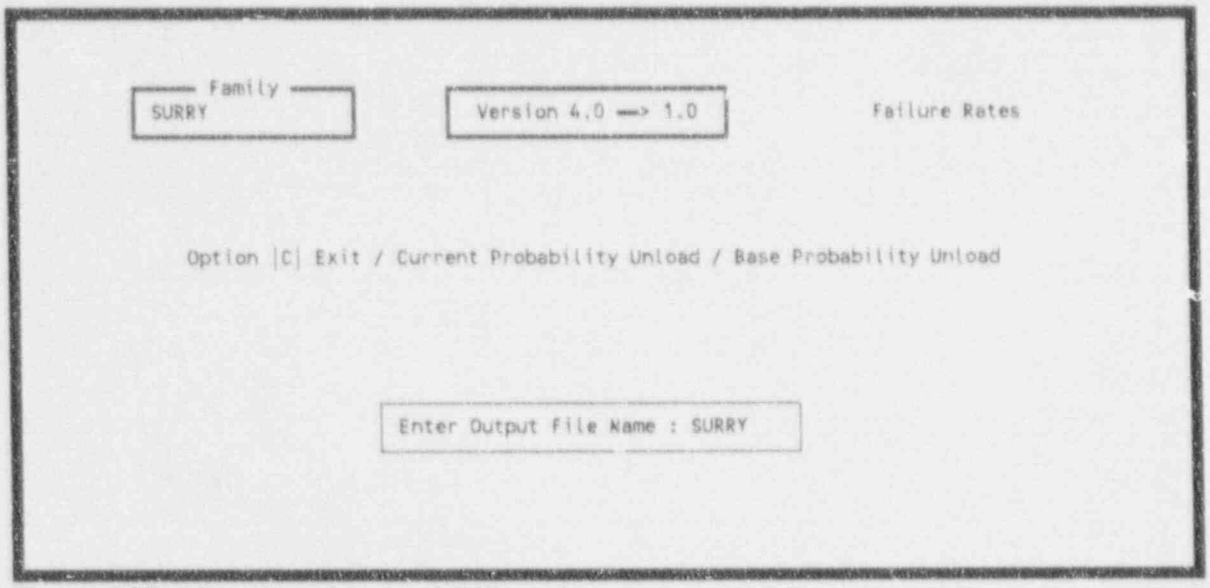


Figure 266. Current vs base probability values.

11.5.3.1.3 Base Probability Unload—This option unloads or outputs all the basic events of the current family along with the base case probability for each of those events into the file specified by the output file name field with the ".RAT" extension. To invoke this option, enter a <B> in the option field, modify the output file name (if desired), and press <Enter>.

11.5.3.2 Fault Trees. This option allows you to output fault tree logic generated in Version 4.0 to a Version 1.0 compatible format (as ".TRE" files). To invoke this option, type a <T> in the option field, or highlight "Fault Trees" and press <Enter> or <→>. Figure 267 will be displayed listing all the fault trees in the current family. On this screen, you have three options: Exit, Logic, or Modified Logic.

11.5.3.2.1 Exit—This option returns you to the 4 to 1 menu. To invoke this option, type <E> in the option field and press <Enter>, or press the <Esc> key.

11.5.3.2.2 Logic—This option outputs the logic as it is stored in the Version 4.0 data base to a file with the ".TRE" extension appended to the first eight characters of the fault tree name. To invoke this option for a single fault tree, enter an <L> in the option field, highlight the desired fault tree, and press <Enter>. To invoke this process for a group of fault trees, mark the desired fault trees using the function keys F2, F3, and F4, enter an <L> in the option field, and press <Enter>. To invoke this option for all fault trees, clear all marked entries, enter an <L> 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 convert fault trees, or type an <N> to terminate the conversion.

11.5.3.2.3 Modified Logic—This option outputs the modified logic from the Version 4.0 data base, to a file with the ".TRE" extension appended to the first eight characters of the fault tree name. The modified logic is the fault tree logic as it is modified by IRRAS Version 4.0 to generate minimal cut sets. To invoke this option for a single fault tree, enter an <M> in the option field, highlight the desired fault tree, and press <Enter>. To invoke this process for a group of fault trees,

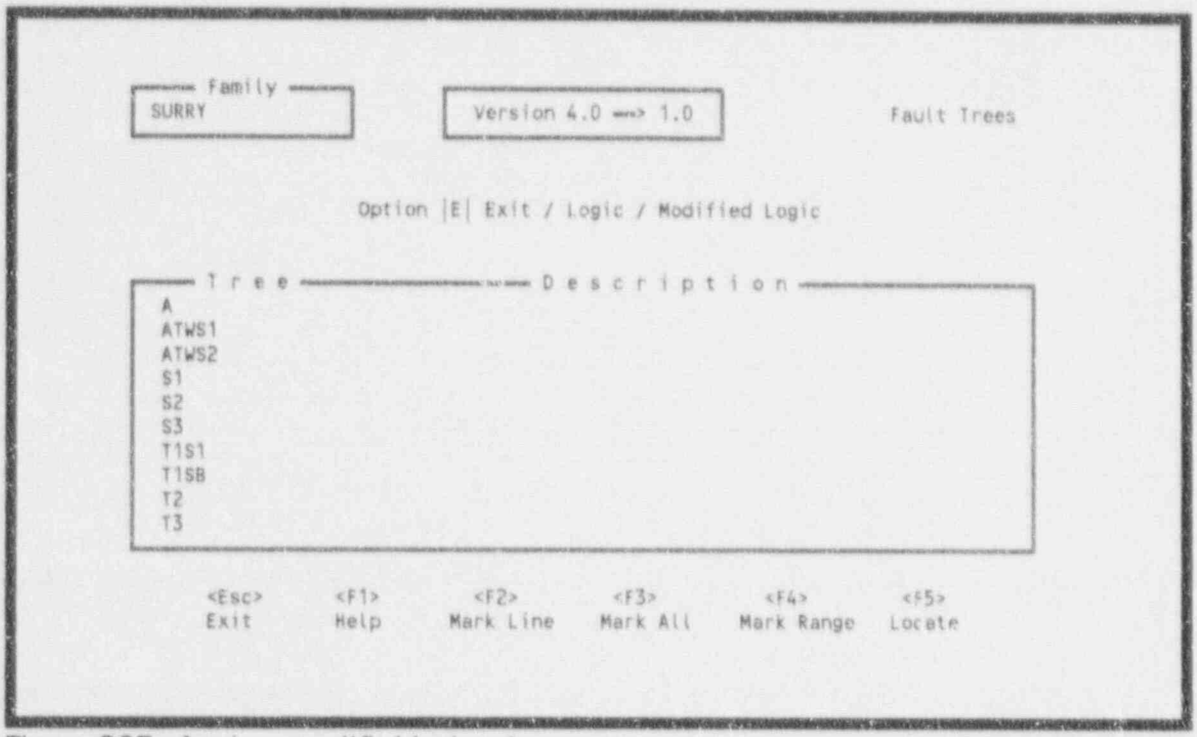


Figure 267. Logic vs modified logic values.

mark the desired fault trees using the function keys F2, F3, and F4, enter an <M> in the option field, and press <Enter>. To invoke this option for all fault trees, clear all marked entries, enter an <M> 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 convert fault trees, or type an <N> to terminate the conversion.

11.5.3.3 Cut Sets. This option allows you to convert system cut sets generated by IRRAS Version 4.0 to Version 1.0 ".CUT" files. To invoke this option, type a <C> in the option field, or highlight "Cut Sets (FT)" and press <Enter> or <→>. Figure 268 will be displayed listing all the systems in the current family. On this screen, you have three options: Exit, Basecase, or Alternate.

11.5.3.3.1 Exit—This option returns you to the 4 to 1 menu. To invoke this option type <E> in the option field and press <Enter>, or press the <Esc> key.

11.5.3.3.2 Basecase—This option outputs the base case cut sets for the systems to files with the ".CUT" extension appended to the first eight characters of the system names. To invoke this option for a single system cut set, enter a <B> in the option field, highlight the desired system, and press <Enter>. To invoke this process for a group of system cut sets, mark the desired entries using the function keys F2, F3, and F4, enter a <B> in the option field, and press <Enter>. To invoke this option for all system cut sets, clear all marked entries, enter 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 convert all system cut sets, or type an <N> to terminate the conversion.

11.5.2.3.3 Alternate—This option outputs the alternate or temporary cut sets for the systems to files with the ".CUT" extension appended to the first eight characters of the system names. To invoke this option for a single system cut set, enter an <A> in the option field, highlight the desired

```
 ------ Family ------        Version 4.0 ---> 1.0          System Cut Sets
| SURRY            |
 

                 Option |E|  Exit / Basecase / Alternate

 -- S y s t e m ---------------- 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 Line   Mark All   Mark Range   Locate
```

Figure 268. System selection screen.

system, and press <Enter>. To invoke this process for a group of system cut sets, mark the desired entries using the function keys F2, F3, and F4, enter an <A> in the option field, and press <Enter>. To invoke this option for all system cut sets, clear all marked entries, enter an <A> 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 convert all system cut sets, or type an <N> to terminate the conversion.

11.5.3.4 Sequence Cut Sets. This option allows you to convert sequence cut sets generated by IRRAS Version 4.0 to Version 1.0 ".CUT" files. To invoke this option, type an <S> in the option field, or highlight "Seq. Cut Sets" and type <Enter> or <→>. Figure 269 will be displayed listing all the sequences in the current f... On this screen, you have three options: Exit, Base Case, or Alternate.

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

11.5.3.4.2 Base Case—This option outputs the base case cut sets for the sequences to files with the ".CUT" extension appended to the first eight characters of the sequence names. To invoke this option for a single sequence cut set, enter a <B> in the option field, highlight the desired sequence, and press <Enter>. To invoke this process for a group of sequence cut sets, mark the desired entries using the function keys F2, F3, and F4, enter a <B> in the option field, and press <Enter>. To invoke this option for all sequence cut sets, clear all marked entries, enter 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 convert all sequence cut sets, or type an <N> to terminate the conversion.

11.5.2.4.3 Alternate—This option outputs the alternate or temporary cut sets for the

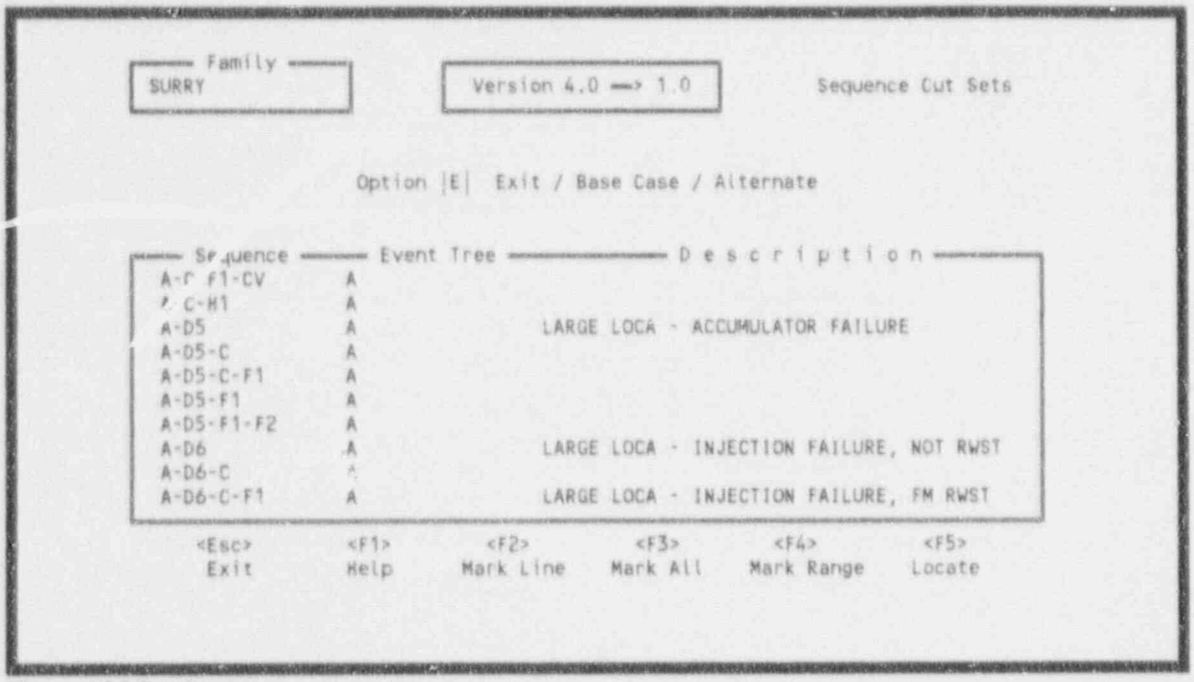


Figure 269. Sequence cut sets screen.

sequence to files with the ".CUT" extension appended to the first eight characters of the sequence names. To invoke this option for a single sequence cut set, enter an <A> in the option field, highlight the desired sequence, and press <Enter>. To invoke this process for a group of sequence cut sets, mark the desired entries using the function keys F2, F3, and F4, enter an <A> in the option field, and press <Enter>. To invoke this option for all sequence cut sets, clear all marked entries, enter an <A> 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 convert all sequence cut sets, or type an <N> to terminate the conversion.

NOTE: IRRAS Version 1.0 does not distinguish between system and sequence cut set files. They both have the same extension. If a sequence and a system have the same name (through the first eight characters), the last one unloaded will overwrite any of the same name.

11.6 Recover Data Base

NOTE: **Before recovering the data base, 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 Data Base <R> option allows you to restructure the data base and re-index the data. Some indications that a data base 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 data base anytime because the rebuild process compacts the data and generally helps the software run faster. The screen shown in Figure 270 appears when this option is selected. As shown, several different recovery methods are available. Each method is discussed in the following paragraphs.

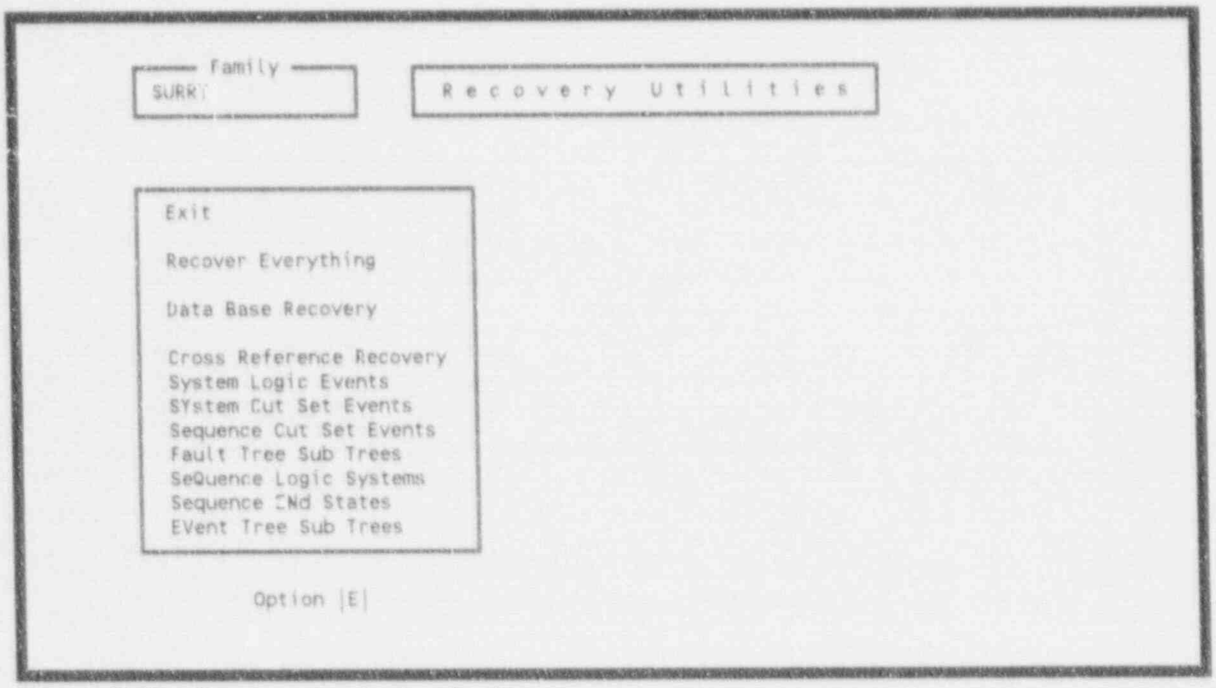


Figure 270. Recover data base selection screen.

11.6.1 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 data base has not been damaged, this option will restructure and optimize your data base.

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 271). 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.

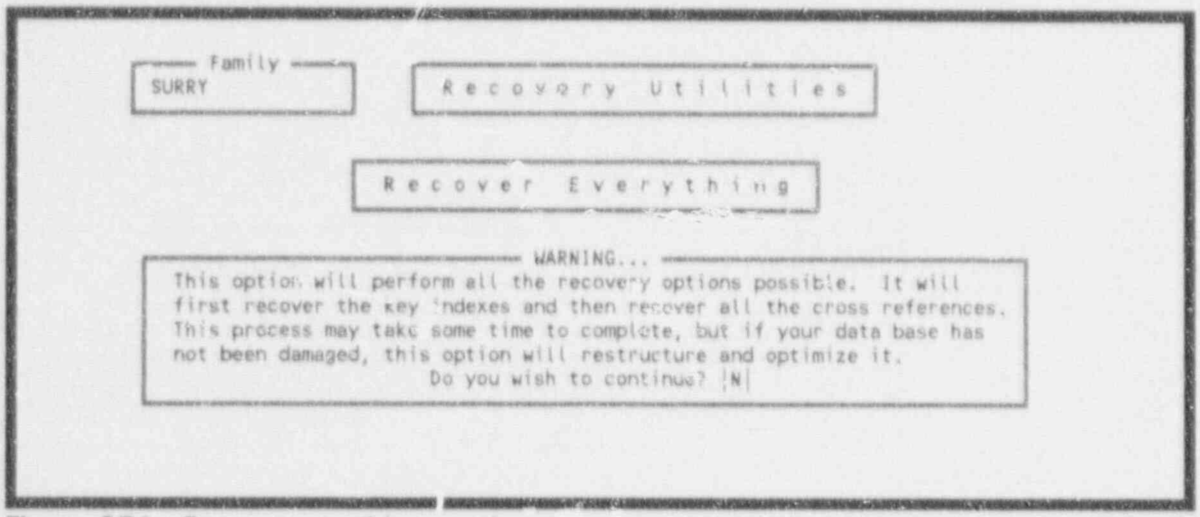


Figure 271. Recover everything warning screen

11.6.2 Data Base Recovery

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

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 272). 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.

11.6.3 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 273). 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

                    D a t a   B a s e   R e c o v e r y

 WARNING...
 All data base files will be rebuilt by this option.  If you suspect
 that your database has been damaged, you can use this option to try to
 recover the data files.  This process may take some time to complete.
 If your database has not been damaged, this option will restructure and
 optimize your data base.
                     Do you wish to continue? [N]
```

Figure 272. Data base recovery warning screen.

```
 Family
 SURRY                    R e c o v e r y   U t i l i t i e s

                   S y s t e m   L o g i c   E v e n t s

 WARNING...
 This option will rebuild the system logic events cross reference
 list.  It reads each system's logic and notes each event used therein.
 If no logic exists, an appropriate message will appear and the recovery
 process will continue.
                     Do you wish to continue? [N]
```

Figure 273. System logic events warning screen.

11.6.4 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 274). 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 y s t e m   C u t   S e t   E v e n t s

                              WARNING...
 This option will rebuild the system cut set events cross reference
 lists.  It reads each system'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 274. System cut set events warning screen.

11.6.5 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 275). 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 275. Sequence cut set events warning screen.

11.6.6 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 data base, that subtree will be added to the data base.

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 276). 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.

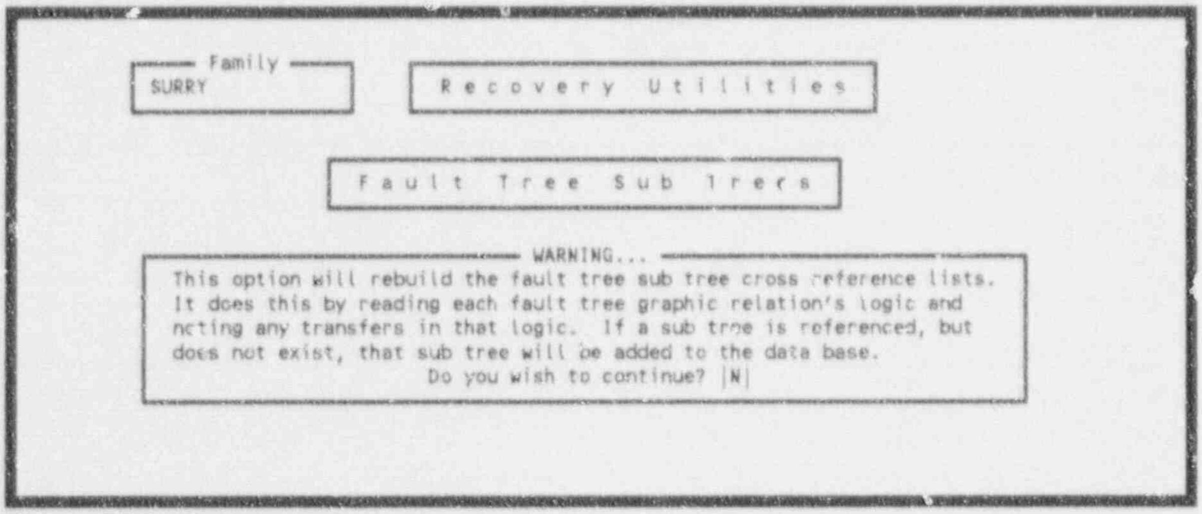


Figure 276. Fault tree subtrees.

11.6.7 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 277). 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.

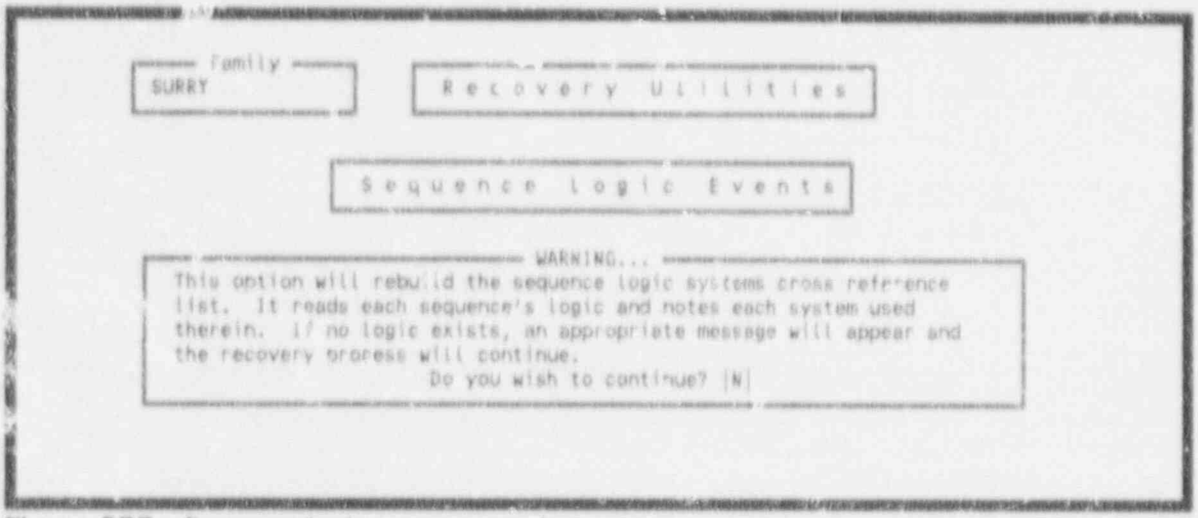


Figure 277. Sequence logic systems warning screen.

11.6.8 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 278). 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.

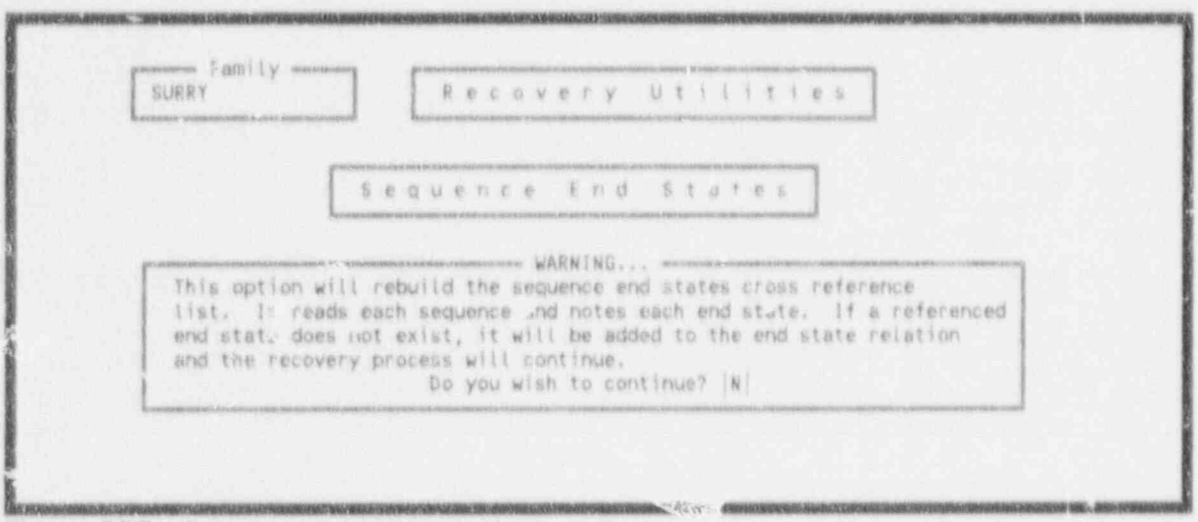


Figure 278. Sequence end states warning screen.

11.6.9 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 data base, that subtree will be added to the data base.

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 279). 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.

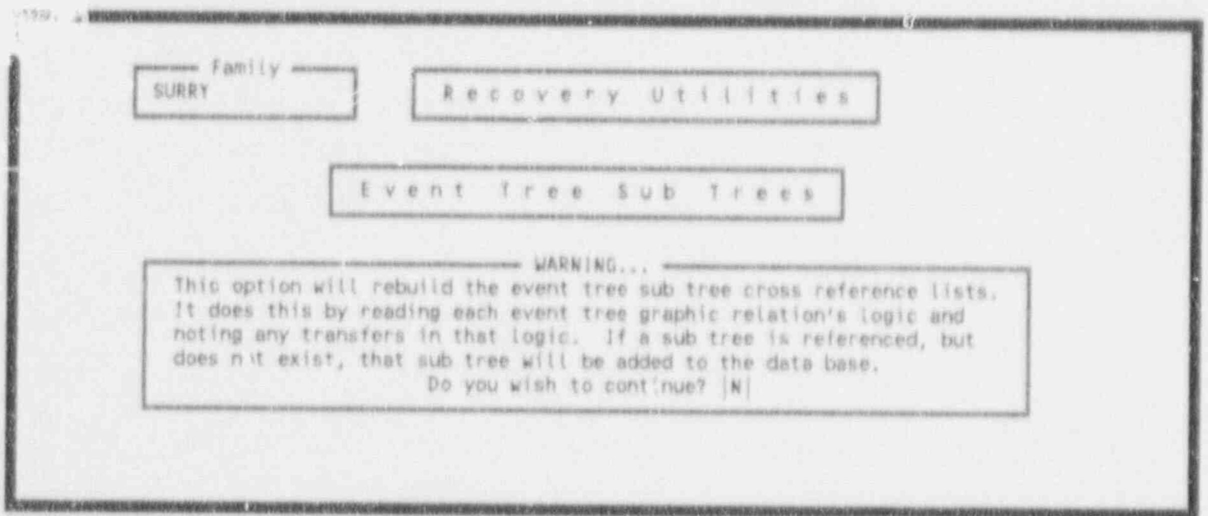


Figure 279. Event tree subtrees warning screen.

APPENDIX A

HARDWARE REQUIREMENTS AND INSTALLATION PROCEDURES

APPENDIX A

HARDWARE REQUIREMENTS AND INSTALLATION PROCEDURE

The IRRAS 4.0 system requires the following hardware configurations:

IBM-PC/XT/AT PS2 or 100% compatible 640K main memory
DOS 3.3 or later
20M hard disk (minimum)
Math co-processor (optional)
16 color enhanced monitor (EGA or better)
graphics input devices - keyboard or mouse.

If an enhanced graphics adapter is used, it must have the memory expansion option to extend the standard 4 colors to 16. This option is an upgrade to the IBM EGA board, but is usually standard on boards manufactured by other vendors. IRRAS 4.0 does not support the 4-color mode on the EGA adapter.

The recommended configuration contains a VGA color monitor and adapter, a mouse as the graphics input device, and a math co-processor. The keyboard can serve as the graphics input device but is not nearly as user-friendly as the mouse. IRRAS will not run as fast if a math co-processor is not present.

NOTE: The IRRAS 4.0 system requires the above specified amount of random access memory (RAM). This memory must be available for the program and not used by memory resident programs, such as "Side-Kick". Also certain memory resident programs may interfere with the execution of IRRAS 4.0. These should be unloaded before using IRRAS 4.0. The MS/DOS command "CHKDSK" can be used to display the amount of memory available on your machine.

To install the system on your hard drive C, put the #1 diskette in drive A and type A:INSTALL C: <Enter>. For PS2 users with an external 5 1/4" drive, use the MS/DOS Command ASSIGN to assign your external drive as the A drive. You will be prompted when you should insert the remaining disks. Be certain to insert the disks in the order specified in the installation procedure. The directories \PRADATA.B1\DEMO, and \HALO88 will be created and loaded with the appropriate software.

NOTE: You must have at least 10 megabytes of disk storage on your destination disk before installing IRRAS.

After the installation is completed, you need to locate and modify your CONFIG.SYS file. This file is in the root directory. If you do not have a file by this name, you must create one. In either case, the following parameters must be included in the file, if not already present.

```
FILES=30
BUFFERS=15
DEVICE=ANSI.SYS
```

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

The installation procedure will create a batch procedure, IRRAS.BAT, for executing IRRAS 4.0 in the \PRADATA.B1 directory. This procedure may be used directly or adapted to meet your specific needs. If you choose not to modify the procedure, the following format is used to execute IRRAS 4.0. Type:

```
CD\PRADATA.B1
IRRAS
```

This completes the installation of the IRRAS 4.0 software. The user must now ensure that the proper graphics input device is hooked up and ready for use. When this is done, the IRRAS 4.0 system is ready for use. Refer to Section 11.2 for a discussion on defining constants for your configuration.

APPENDIX B

DATA INTERCHANGE FORMATS

PRA Models and Results Data Base
Data Interchange Formats. December 18, 1991

B.1 MAR-D (IRRAS, SARA)

B.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.

B.1.2 Family (Plant) Information

B.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

B.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

B.1.2.3 Family Textual Information.

File Name:
xxxxxx.FAT
File Format:
family
-- text --
where

family	- 16 character	Family name

B.1.3 Basic Event Information

B.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

B.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.

B.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.

B.1.4 Event Attribute Descriptions

B.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

B.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

B.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

B.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

B.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

B.1.5 Fault Tree Information

B.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

B.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)

B.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
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

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.

B.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.

B.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

B.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

B.1.6 Event Tree Information

B.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

B.1.6.2 Event Tree Attributes.

File Name:
xxxxxx.ETA
File Format:
family =
name,init
. . . , . . .
where

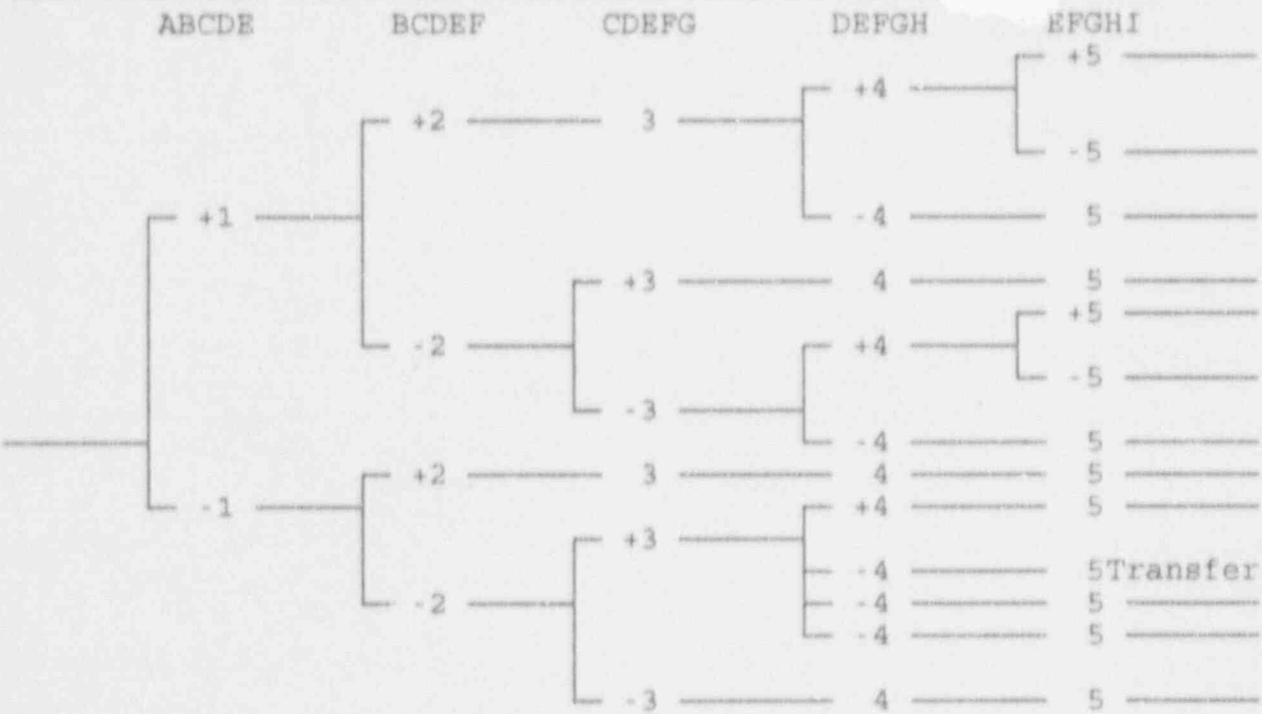
family	- 16 character	Family name
name	- 16 character	Event tree name
init	- 16 character	Initiating event name

B.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



B.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

^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.

B.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

B.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

B.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.

B.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

B.1.7.2 End State Information.

File Name:
xxxxxx.ESI
File Format:
family =
****************** will be defined later *************

B.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

B.1.8 Sequence Information

B.1.8.1 Sequence Names and Descriptions.

File Name:
    xxxxxx.SQD
File Format:
    family,eventree =
    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

B.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

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.

B.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

B.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 "/".

B.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

B.1.9 Piping and Instrumentation Diagrams

B.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)

B.1.10 Gate

B.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

B.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

B.1.11 Change Sets

B.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

B.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)

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

B.2 SETS

B.2.1 Sequences

B.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.

B.2.2 Fault Trees

B.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.
```

where

fault-tree-name - The name of the fault tree.

gate-type - The type of gate being defined.

AG = AND g .e
OG = OR gate
EOR = Exclusive OR gate (converted to SG)
EAG = Exclusive AND gate (converted to SG)
SG = Special Gate

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.

BE = Basic Event
CE = Conditional Event
UE = Undeveloped Event
DE = Developed Event
EE = External Event

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

B.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.

B.2.3 Basic Events

B.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

B.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.

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The Integrated Reliability and Risk Analysis System (IRRAS) is a state-of-the-art microcomputer-based probabilistic risk assessment (PRA) model development and analysis tool to address key nuclear plant safety issues. IRRAS is an integrated software tool that gives the user the ability to create and analyze fault trees and accident sequences using a microcomputer. This program provides functions that range from graphical fault tree construction to cut set generation and quantification.

Version 1.0 of the IRRAS program was released in February of 1987. Since that time, many user comments and enhancements have been incorporated into the program providing a much more powerful and user-friendly system. This version has been designated IRRAS 4.0 and is the subject of this Reference Manual. Version 4.0 of IRRAS provides the same capabilities as Version 1.0 and adds a relational data base facility for managing the data, improved functionality, and improved algorithm performance.

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