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Common-Cause Failure Database and Analysis System: Software Reference Manual

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ABSTRACT

This volume of the Common-Cause Failure Database and Analysis System report provides an overview of common cause failure methods for use in the U.S. commercial nuclear power industry. It summarizes how data (on common cause failure events) are gathered, evaluated, and coded. It then describes the process for estimating probabilistic risk assessment (PRA) common cause failure parameters. It also references other volumes of this report for specific details.

Equipment failures that contribute to common cause failure events are identified through searches of Licensee Event Reports (LERs) and Nuclear Plant Reliability Data System (NPRDS) failure reports. Once common cause failure events are identified by reviewing reports of equipment failures, INEEL staff enters the event information into a personal computer data analysis system (CCF system) using the method presented in this and companion volumes. The events stored in the CCF system are utilized for common cause failure PRA parameter estimations using common cause failure quantification methods.

CONTENTS

FIGURES

EXECUTIVE SUMMARY

The U.S. Nuclear Regulatory Commission's (NRC's) Office for Analysis and Evaluation of Operational Data (AEOD) and the Idaho National Engineering and Environmental Laboratory (INEEL) have developed and maintain a common cause failure (CCF) database for the U.S. commercial nuclear power industry. Previous studies documented methods for identifying and quantifying CCFs. This report extends previous methods by introducing a method for identifying CCF events, a collection of events from industry failure data, and a computerized system for quantifying probabilistic risk assessment (PRA) parameters and uncertainties.

A CCF event consists of component failures that meet four criteria: (1) two or more individual components fail or are degraded, including failures during demand, in-service testing, or from deficiencies that would have resulted in a failure if a demand signal had been received; (2) components fail within a selected period of time, such that success of the PRA mission would be uncertain; (3) component failures result from a single shared cause and coupling mechanism; and (4) a component failure is not due to the failure of equipment outside the established component boundary.

Two data sources are used to select equipment failure reports to be reviewed for CCF event identification: the Nuclear Plant Reliability Data System (NPRDS), which contains component failure information, and the Sequence Coding and Search System (SCSS), which contains Licensee Event Reports (LERs). These sources served as the developmental basis for the CCF data collection and analysis system. The CCF data collection and analysis system consists of (1) CCF event identification methodology, (2) event coding guidance, and (3) a software system to estimate CCF parameters.

The CCF event identification process includes reviewing failure data to identify CCF events and counting independent failure events. The process allows the analyst to consistently screen failures and identify CCF events. The CCF event coding process provides guidance for the analyst to consistently code CCF events. Sufficient information is recorded to ensure accuracy and consistency. Additionally, the CCF events are stored in a format that allows PRA analysts to review the events and develop an understanding of how they occurred.

A software system stores CCF events, independent failure counts, and automates PRA parameter estimations. The system employs two quantification models: alpha factor and multiple Greek letter. These models are used throughout the nuclear industry. In addition, these parameter estimations can be utilized in a PRA to estimate basic event probability and uncertainty.

ACRONYMS

AEOD	Nuclear Regulatory Commission's (NRCs) Office for the Analysis and Evaluation of Operational Data
CCF	Common Cause Failure
CD-ROM	Compact Disk Read Only Memory
DOS	Disk Operating System
INEEL	Idaho National Engineering and Environmental Laboratory
INPO	Institute of Nuclear Power Operations
NPRDS	Nuclear Plant Reliability Data System
NRC	Nuclear Regulatory Commission
PRA	Probabilistic Risk Assessment
Windows NT	A 32 bit operating system created by Microsoft for high end computers.
Windows 95	A 32 bit operating system created by Microsoft for smaller computers.

Common Cause Failure Database and Analysis System Volume 4—Software Reference Manual

1. INTRODUCTION

The Nuclear Regulatory Commission (NRC) Office for the Analysis and Evaluation of Operational Data (AEOD) and the Idaho National Engineering and Environmental Laboratory (INEEL) have developed and maintain a common cause failure (CCF) database for the U.S. commercial nuclear power industry. This database contains the events known as common cause failures that have occurred in commercial nuclear power plants throughout the United States. Common cause failure events are characterized by failure or degradation of multiple (typically redundant) components owing to a same shared cause within a short period of time. The CCF events have been obtained from review of the Nuclear Plant Reliability Data System (NPRDS) failure reports and Licensee Event Reports (LERs) obtained from the Sequence Coding and Search System (SCSS) database. Volumes 2 and 3 of this report contain more detailed discussion about CCF event definition and classification.

For this project, the INEEL also developed computer software to enable probabilistic risk assessment (PRA) analysts to obtain CCF parameter estimations for use in reliability and risk analysis studies. This software is based on the impact vector method described in Reference 2. This volume of the report describes in detail how to use the software, including how to search the database for events of interest, and how to use the event information to obtain the parameter estimates.

1.1 Hardware and Software Requirements

The purpose of this section is give the user an overview of the hardware and software requirements to use the CCF Disk Operating System (DOS) (CCFDOS) application and/or CCF Windows (CCFWIN) application.

1.1.1 CCFDOS Software Requirements

To run CCFDOS you must have MS-DOS 5.0 or higher.

1.1.2 CCFWIN Software Requirements

To run CCFWIN you must have Windows 95 or Windows NT 3.41 or 4.0.

1.1.3 CCFDOS Hardware Requirements

To run CCFDOS you must have the minimum hardware configuration outlined below:

- IBM-PC compatible computer with at least a 386 processor
- 8 MB RAM
- 15 MB free disk space.

1.1.4 CCFWIN Hardware Requirements

To run CCFWIN you must have the minimum hardware configuration outlined below:

- IBM-PC compatible computer with at least a 486 processor
- 8 MB RAM (Windows 95)
- 16 MB RAM (Windows NT)
- 15 MB free disk space.

1.2 Installing CCF

This section will provide the user an overview of how to install the CCFDOS and CCFWIN programs.

1.2.1 Installing CCFDOS

This software package contains installation floppy disks and/or a CD-ROM that allows you to easily install CCFDOS on your system. To install from the floppy diskette set:

1. Insert CCF Installation Disk #1 into drive A (or drive B)

2. Type the following DOS command at the DOS prompt:

   A:INSTALL C: (or B:INSTALL C:),

where

A (or B) = drive with the installation disk

C = drive where CCFDOS will be installed.

To install from the CD-ROM:

1. Insert CCF CD-ROM into the CD-ROM drive (D:)

2. Type the following DOS command at the DOS prompt:

   D:INSTALL C: (or E:INSTALL C:),

where

D (or E) = drive with the installation CD-ROM

C = drive where CCFDOS will be installed.

1.2.2 Installing CCFWIN

CCFWIN can be installed from the floppy diskette set or CD-ROM. To install from the floppy disk:

1. Insert the disk labeled CCF Disk 1 into the floppy drive.
2. From the Start Bar, click **Run**.
3. Type a:\setup.
4. The Setup program will guide you through the installation process. Follow the instructions on the screen.

To install from CD-ROM:

1. Insert the CCF CD-ROM into the CD-ROM drive.
2. From the Start Bar, click **Run**.
3. Type x:\setup where x is the drive letter of your CD-ROM drive.
4. The Setup program will guide you through the installation process. Follow the instructions on the screen.

1.3 Starting CCF

The CCF system software allows you to search events and create applications in the CCF database.

1.3.1 Starting CCFDOS

To start CCFDOS, at the DOS prompt type **CCFDOS** and press **<Enter>**. The CCF title screen appears. Press **<Enter>** to continue. Type your password to proceed to the main menu screen (Figure 1).

NOTE: You have three chances to enter your password correctly. If you fail to enter your password correctly or you bypass this screen, CCF will deny access to the software system and you will be back at the DOS prompt. If your password has been corrupted, or a password has not been obtained. contact Ted Wood (INEEL) at (208) 526-8729 or Dale Rasmuson (AEOD, NRC) at (301) 415-7571.

The CCF main menu has the following options:

SEARCH—Searches for events and assigns the events to an application. An application is simply a collective list of events interpreted for a specific situation, such as a plant or system. SEARCH has extensive search capabilities including wildcard searches. (See Section 2 for details.)

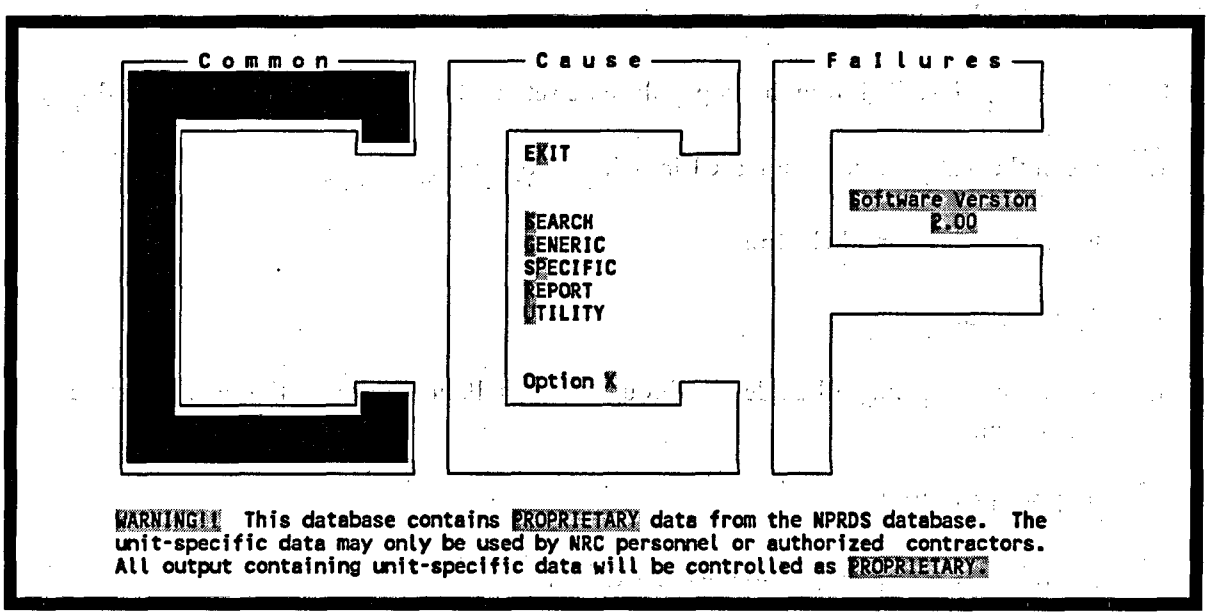


Figure 1. CCF main menu.

GENERIC—Generically analyzes individual events, estimates CCF model parameters, and summarizes the results of an application. You can also perform mapped and unmapped calculations on generic models. (See Section 3 for details.)

SPECIFIC—Specifically analyzes individual events, estimates CCF model parameters, and summarizes the results of an application. (See Section 4 for details.)

REPORT—Generates reports containing information about applications, events, plants, systems, component types, failure modes, proximate causes, coupling factors, shock types, operational status, event types, and defense mechanisms. (See Section 5 for details.)

UTILITY—Performs miscellaneous utility functions including rebuilding the database, specifying the monitor type currently in use, calculating hypothetical ("what if") situations, and changing your current password. (See Section 6 for details.)

When you select an option in the main menu, the monitor displays a brief description of the option at the bottom of the screen.

1.3.2 Starting CCFWIN

To start CCFWIN, double click the CCFWIN program icon, or click Programs on the Start Bar and select CCF for Windows.

1.4 Function Keys

Function keys perform special commands and functions, depending on which screen you're using. CCF designated four function keys to provide specific commands throughout this software application. The function keys <F1>, <F8>, <F9>, and <F10> provide the following features:

<F1> Help—Displays associated online help messages.

<F8> Mark—Functions as a toggle switch for marking or unmarking an item in a list. An asterisk marks the item for inclusion in the search. To mark or unmark an item, simply highlight the item and press <F8>.

<F9> All—Operates as a toggle switch for marking or unmarking ALL items in a selection list.

<F10> Range—Serves as a toggle switch for sequentially marking or unmarking a range of items in a list. To mark a range, highlight the first item to include and press <F10>. The message "Range selected—Highlight end of range . . . " appears at the bottom of the screen. Scroll through the list and find the last item to include and press <F10>. Asterisks will appear in front of all items that fall within the designated range. To remove the asterisks from the selected applications, simply press <F10> and select the same range. Press <F10> again and CCF will unmark the selected applications.

1.5 CCF Windows Version

The purpose of this section is give the user an overview of the CCF Windows (CCFWIN) application interface. Other than this section the remainder of this manual deals with the CCFDOS application. CCFWIN provides the same functionality as the DOS version, but the user interface is very different. The CCFWIN application has extensive online help which can guide you through its use.

1.5.1 Exiting CCFWIN

To leave the CCFWIN application, select File from the menu bar. Select the Exit submenu option. The CCF database will be closed and the application will be terminated.

1.5.2 The Windows Interface

1.5.2.1 Screen Display. CCFWIN allows a more intuitive user interface by not limiting the screens to 80 characters of fixed fonts as in DOS. In many cases several DOS screens are replaced by one Windows dialog box.

1.5.2.2 Menus. CCFWIN uses dialogs with radio buttons or layered menus to replace the multiple menu screens required in DOS. This allows the user to select all of the options at once without having to move through multiple menus.

1.5.2.3 Functions Keys. In CCFWIN the DOS function keys have been replaced by buttons or pop-up menus. To invoke a pop-up menu, click the right mouse button. While holding down the right mouse button select the desired menu option by highlighting it and then releasing the mouse button.

1.5.2.4 Field Validation Lists. In CCF DOS, <F2> was pressed to get a list of valid field entries, but in CCFWIN combo boxes are used. The user can click down an arrow button to the side of the combo box to obtain a list of valid entries.

1.5.2.5 List Boxes. Windows list boxes are used in many places in CCFWIN. In some list boxes, multiple items can be selected for processing. The following discussion provides some hints on selecting list box items.

An item in a list box is "selected" if it is highlighted that is, displayed in a different color than the other items in the list. There are various ways to select items in a list. To select a single item, click on the desired item. It should now be highlighted. To select multiple contiguous items, click on the first desired item in the list and drag up or down the list to the last desired item. Alternately, click the first desired item, then while holding down the <SHIFT>key, click the last desired item. To select multiple non-contiguous items in the list, click several desired items while pressing the <CTRL> (control) key. All of the selected items should now be highlighted.

1.6 NPRDS Conditions of Use

BY USING THE COMMON CAUSE FAILURE DATABASE, WHICH CONTAINS NPRDS DATA, YOU AGREE TO THE FOLLOWING CONDITIONS: The data contained in the NPRDS are the exclusive property of the Institute of Nuclear Power Operations (INPO) and the U.S. nuclear utility members of INPO. NPRDS may be used only to promote safety and reliability in the operation of commercial nuclear power plants.

INPO strictly prohibits any use of NPRDS, or data obtained through NPRDS, in marketing, advertising, solicitations, proposals, and similar activities.

Data obtained through NPRDS are confidential. Disclosure is prohibited without the express written advance consent of INPO. In addition disclosure of data that identify an individual nuclear power plant is prohibited without the express, written, advance consent of the Member of INPO that has primary authority for the operation of that plant. Any disclosure to the U.S. Nuclear Regulatory Commission is permitted, without any consent, provided that the disclosure is accompanied by a statement that NPRDS data are confidential, commercial information and the exclusive property of INPO. Any individual or organization that obtains access to NPRDS by means of contract with an INPO Member shall return to the Member all NPRDS data, user identification codes, passwords, documentation, and similar items at the conclusion of the contract.

2. SEARCH

SEARCH scans the CCF database for specific common cause events. You can also save the list of events as an application for future use (e.g., Generic and Specific analysis applications).

To search for an event, either type S in the option field of the main menu or use the up and down arrow keys to highlight SEARCH on the main menu. Press <Enter> to access the Initial Search Database screen (Figure 2).

```
                    Search Database      Total Selected Events  2578

L-029-83-0119-BO ELECTRICAL DISTURBANCE TRIPS BATTERY INPUT BREAKERS.
L-029-83-1080-CR OFFSITE ELECTRICAL DISTURBANCE OPEN BATTERY BREAKERS.
L-029-85-1156-CO 4160V BREAKERS FAIL TO OPEN ON CONTAINMENT ISOLATION SIGNAL.
L-029-86-1081-CX 480V OVERLOAD RELAY COILS UNDERSIZED.
L-029-87-1487-VS MAIN STEAM SAFETY VALVES SET TOO HIGH.
L-029-87-1855-VS PRIMARY CODE SAFETY VALVES SETPT IN EXCESS OF TS REQUIREMENT
L-029-90-0590-FR DIESEL ENGINE CAPACITY (400 KW) TOO LOW DUE TO DESIGN ERROR
L-029-91-0591-FS EMERGENCY GENERATORS EDG1 AND EDG3 CONTROL RELAY ARCING.

Name  L-029-83-0119-BO Src LER            Plant YANKEE ROWE      Power---%
Title ELECTRICAL DISTURBANCE TRIPS BATTERY INPUT BREAKERS.        P1 1.00
                                                                  P2 1.00
System    DCP Proxim Cause IC   CCCG Size       2  Op-Det BO Mode O P3 0.00
Component BCH Shock Type   NL   Timing Factor  1.00 Event Type   EXP P4 ----
Fail Mode NO  Coupl Factor EI   Shared Cause Fc1.00 Event Level  SYS P5 ----
Plnt Type P   Mult Units?  N    Date     1983/03/23 Defense Mech FSB P6 ----

<Esc>  <Enter>   <Del>      <F3>   <F4>     <F5>      <F6>   <F7>    <F8>
Exit   Search  Remove Event View  Descrip Narrative  Report Reset  Save List
```

Figure 2. Initial Search Database screen.

The screen consists of two windows. The top window contains all events currently stored in the CCF database. This window displays the first eight events stored in the database. You may scroll through the entire list of events using either the <PgUp> and <PgDn> keys or the up and down arrow keys. As you scroll through the list of events, the bottom window displays detailed information about the highlighted event. As the database increases in size, you may be forced to scroll through several pages of events before locating a desired event. You can use the speed search feature to facilitate your search. To use speed search, simply start typing the first few characters of the event code you are trying to locate. As you type each letter, speed search simultaneously highlights the closest event matching your entry.

NOTE: All CCF selection screens employ the speed search function (e.g., applications, plants, and component types).

SEARCH provides the following functions:

<Esc> Exit—Terminates SEARCH, and then displays the save/cancel window if you performed any Search functions; otherwise, <Esc> returns to the main menu.

<Enter> Search—Initiates the search function. This function allows you to easily search for events. To start the Search function, press **<Enter>** (see Section 2.1).

<Del> Remove Event—Deletes an event from the top window. When you highlight an event and press **<Del>**, a message will appear asking if you wish to remove this event from the list. Respond **Y** or **N** and press **<Enter>**.

<F1> Online Help (not displayed at the bottom of the screen)—Provides direct access to CCF subjects without interrupting work in progress or using this manual to answer questions about CCF. Press **<F1>** to access the glossary of subjects. Tab through the list and highlight the desired subject. Press **<Enter>** to view the text. If related information exists, you can tab to the highlighted subjects within the help text or tab to the subjects listed under "See also" and press **<Enter>**. Press **<F1>** to access the Hypertext Help window. Press **<F10>** to back out of the screens or press **<Esc>** to exit the online help and return to the program.

<F3> View—Views the event data. Highlight the desired event and press **<F3>**. A screen will appear showing event information, including component degradation values. You can also view any comments attached to the event by pressing **<F4>** in the View Event screen. After you finish viewing the information, press **<Enter>** or **<Esc>** to return to the previous screen.

<F4> Description—Directly views the description associated with the selected event without accessing the View Event screen first. Highlight the desired event and press **<F4>**. A window containing the associated description for that event will appear. Press **<Esc>** to exit the description window.

<F5> Narrative—Directly views the narrative associated with the selected event without accessing the View Event screen first. Highlight the desired event and press **<F4>**. A window containing the associated narrative for that event will appear. Press **<Esc>** to exit the narrative window.

<F6> Report—Generates the Qualified Events Report (see Section 2.5).

<F7> Reset—Resets the event list to reflect the original list. This is the same list of events displayed in the top window when you first entered CCF (i.e., all events in the database). Reset restores anything deleted during the CCF session.

<F8> Save List—Saves the event list in an application. Once a search has been completed, you can save the event for future use.

NOTE: Each time you select the SEARCH option from the main menu, the top window will display all events in the database. Once you execute a search, CCF displays only those events that meet your criteria in this window. Further searches will be evaluated against the entire database, and the top window will be updated accordingly. Events appearing in this window may be saved before you exit by selecting the **<F5>** option. This list can then be used for subsequent studies.

Once you have completed SEARCH and located the desired events, you can save the list of events by pressing <F5> (see Section 2.3), or you can exit without saving the list of events by pressing <Esc>. When you press <Esc>, Figure 3 is displayed. Here, CCF will give you another chance to save the list before exiting. At the prompt, you may save and exit or exit without saving before returning to the main menu, or select cancel and return to the previous screen.

```
                          Search Database    Total Selected Events   194

L-213-87-0582-VO IMPROPER GREASING FOR CONTAINMENT SPRAY MOVS.
L-245-82-1297-CX DC BREAKERS FOUND TRIPPED DUE TO WATER DAMAGE.
L-254-84-0756-VO BOTH RESIDUAL HEAT REMOVAL MOVS FAIL TO OPEN; DESIGN ERROR
L-261-81-0674-VC PWR                                  NOT FULLY SHUT
L-271-86-0742-VO HYDR   Notice: Data not saved!        PREVENTED OPENING
L-271-86-0757-VO HYDR                                 E OF NEW GREASE.
L-277-92-0758-VO RESI     Save    EXit    Cancel      RES: CRACKED YOKES.
L-278-85-0759-VO SHUT                                 CLOSE; REMOVAL OF FUSE
                                Option X

Name  L-245-82-1297-C                                 TONE 1      Power---%
Title DC BREAKERS FOUND TRIPPED DUE TO WATER DAMAGE.                P1 1.00
                                                                    P2 1.00
System    MSS Proxim Cause IE  CCCG Size      3  Op-Det BO Mode D P3 1.00
Component MOV Shock Type   L   Timing Factor  1.00 Event Type  CCF P4 ----
Fail Mode SA  Coupl Factor EE  Shared Cause Fc1.00 Event Level  SYS P5 ----
Plnt Type B   Mult Units?  N   Date     1982/03/18 Defense Mech MON P6 ----

<Esc>  <Enter>   <Del>      <F3>  <F4>    <F5>      <F6>   <F7>   <F8>
Exit   Search  Remove Event View Descrip Narrative Report Reset Save List
```

Figure 3. Exit prompt.

2.1 Search Fields

The Search Criteria screen (Figure 4) appears when you start the Search function (press <Enter>). This function requires search criteria to perform a search. You may enter values into any combination of fields. For most fields, you may also press <F2> to select a value from a list of values. A brief description of these fields follows. See Volume 3[1] for more details about these fields.

Name—Enter the event code number assigned to the event by the data coder.

Plant—Enter the name of the nuclear power plant (<F2> is available).

Type—Enter the plant type (B for BWR or P for PWR).

Start Date and/or End Date—Enter the start date and end date of a date range. All events that occurred after the start date and/or before the end date will be selected. The format is yyyy/mm/dd.

System—Enter a three-character designator. If you select the list option <F2> and use individually marked systems in the search, an "@" will appear in the search field. Refer to Section 1.4 for information regarding <F8>, <F9>, and <F10> functions to mark the system.

```
                    Search Criteria

                Enter the event search mask.

Example 1:  Event Code "A*" and Proximate Cause "??X" would specify all
            events beginning with the letter "A" and having a three
            character proximate cause ending with the letter "X".

Example 2:  System "@" will search for all events having any of the
            systems marked in the system list (shown by pressing <F2>,
            and marked by pressing <F8>, <F9>, or <F10>).

Name                                    Plant                    Type
Start Date   ----/--/--  End Date   ----/--/--                (BWR, PWR)
System            Proximate Cause       CCCG Size          --
Component         Shock Type            Op Stat- Det    Mode
Failure Mode      Coupling Factor       Event Type         CCF
                                        Event Level

          <Esc>        <F1>        <F2>        <Enter>
          Exit         Help        List        Search
```

Figure 4. Search Criteria screen.

Proximate Cause—Proximate cause characterizes the condition that is readily identified as the condition that leads to failure (a symptom).

CCCG Size—Enter the system size or number of redundant components.

Component—Enter a three-character designator (<F2> is available).

Shock Type—Enter L or NL (<F2> is available). Shock type classifies the event as either a lethal or nonlethal shock to the system.

Operation Status-Detected—Indicates when the event was detected.

Operation Status-Mode—Indicates during what condition the event is significant.

Failure Mode—Enter a two-character designator (<F2> is available).

Coupling Factor—Enter a two- or four-character designator (<F2> is available). The coupling factor explains why and how a failure is systematically induced in several components.

Event Type—Enter a three-character designator (<F2> is available). Event type places events into type categories.

Event Level—Enter SYS, COM, or leave blank. Event Level indicates whether the event qualifies as a functional-level failure or a component-level failure.

The Search function uses all marked items to perform the search; therefore, you will probably want to change these defaults. Specific function keys have been defined that allow you to mark or unmark items in

the selection list (See Section 1.4). Position the cursor in a field and press <F2>. For example, position the cursor in the failure mode field and press <F2>. A screen similar to Figure 5 will appear. Scroll through the list using the up and down arrow keys or the <PgUp> and <PgDn> keys. When the desired failure mode is highlighted, press <Enter>. Or, you may use the <F8>, <F9>, or <F10> keys to mark the desired events. In either case, you will return to Figure 4 where the selected failure mode is written into the failure mode search field. As a default, the system will select all event codes, plants, types, systems, proximate causes, coupling factors, and shock types (i.e., marked with an asterisk).

```
                    Search Criteria

 MF   REDUCED FLOW, NO HEAT TRANSFER EFFECT
*NO   NO VOLTAGE/AMPERAGE OUTPUT
*OO   FAIL TO CLOSE (NORMALLY OPEN)
*PG   FAILURE TO TRANSFER HEAT/PLUGGED
 SA   SPURIOUS ACTUATION
 SD   SETPOINT DRIFT
*VR   FAIL TO REMAIN CLOSED (DETECTABLE LEAKAGE)
 XA   HUMAN ERROR OF ALIGNMENT
          Note: "*" indicates a wild card match or marked item

Name                                  Plant                    Type
Start Date   1992/01/01  End Date   1992/12/31                (BWR, PWR)
System            Proximate Cause     CCCG Size        --
Component         Shock Type          Op Stat- Det     Mode
Failure Mode      Coupling Factor     Event Type         CCF
                                      Event Level

   <Esc>        <Enter>        <F8>        <F9>        <F10>
   Exit         Select         Mark        All         Range
```

Figure 5. Failure mode selection list.

2.2 Using Wildcards

You can specify wildcards for all optional search fields. The wildcards equate to those used in DOS. That is, an asterisk (*) represents an entire word or a group of characters, while the question mark (?) represents a single character. For example, entering an A* in the System field, will locate all events for a system starting with the letter A (e.g., ACS and ACT). On the other hand, entering A? will locate only those events with a two-character system identifier.

2.3 Saving Search Results

Once you locate the desired events, you may save the results. Press <F8> to save the list to an existing application or create a new application in which to save the list (see Section 2.4). If you wish to exit the screen without saving the list, press <Esc>. In addition, if you decide to start over, press <F7> to return to the original list of events (this will be the list of events since the last save).

2.4 Saving Results in Application

Pressing <F8> displays the Select Applications screen (Figure 6). If you are saving to an existing application, simply highlight the application and press <Enter>. Now, you must decide what to do with any duplicate events (Figure 7). If a selected event already exists in the application, you need to specify whether to replace the existing event with the selected event. Enter a Y or N and press <Enter>. The events will be copied to the specified application. If you wish to create a new application for storing the selected events, highlight NEW APP and press <Enter>. The cursor will be in the lower portion of the screen. Enter the new application name (mandatory), description (optional), and CCCG level (mandatory—value from 2 to 6) for the newly created application, and press <Enter>. You will be returned to the top portion of the Select Applications screen (see Figure 6). Here, the newly created application will be highlighted in the list. With the new application name highlighted, press <Enter>. CCF will copy the selected events into the new application. When CCF finishes the copy process, it will return you back to the search menu.

2.5 Search Reports

To generate a long or short Qualified Events report, press <F6> at the Search Database screen to access the Search Report screen (Figure 8). Use the up and down arrow keys to highlight either the long or short report format or enter L or S into the Option field. Press <Enter> to access the Report Options screen (Figure 9). By default, the report is written to a file called SEARCH.RPT in the current directory. This can be changed by entering CON to display the report on the screen, PRN to print the report to the printer, or a valid DOS filename to save the report. Both reports contain detailed information about qualified events (Figures 10 and 11). Press <Enter> to initiate the report. Your screen should display the message, "Qualified Events report being generated" to verify the operation. Once CCF generates the report, the program will exit the Report Options screen and return to the Search Database screen with a verification message displayed at the bottom of the screen.

```
                    Select Application

<NEW APP>
DGN-3          DIESEL GENERATOR FAILURES MAPPED TO TARGET SIZE 3
EPS-4
RHR-PMP-FO-4   RHR PMP'S FAILURES MAPPED TO SIZE 4

Name          <NEW APP>
Description

     CCCG Level --          Component Type              Failure Mode

                <Esc>          <Enter>          <F3>
                Exit           Select           Edit
```

Figure 6. Select Application screen to store events.

```
                    Select Application

<NEW APP>
DGN-3          DIESEL GENERATOR FAILURES MAPPED TO TARGET SIZE 3
EPS-4
RHR-PMP-FO-
                          Notice
                You have selected an application which already
                contains events.  The events you have selected
                will be added to this application.

                If a selected event  already  exists  in  this
                application, you must specify whether  or  not
                to  replace  the  existing  event   with   the
                selected event.

Name
Descriptio            Replace duplicate events? (Y/N)  N

     CCCG                                                e Mode

                <Esc>        <Enter>        <F3>
                Exit         Select         Edit
```

Figure 7. Replace duplicate events prompt.

```
                    Search Reports

                EXit

                Long Report Format
                Short Report Format

                 Option L
```

Figure 8. Search Reports screen.

```
                    Report Options

                        Report Title
                   Qualified Events Report

                      Output File Name
                 SEARCH.RPT

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 9. Search—Report Options screen.

Qualified Events Report

Total Records Found : 182

(Search Mask)

Event Name :		Component Type :		Shock Type :	
Plant Name :		Failure Mode :	FS	Op-Det: Mode:	
Plant Type :		Proximate Cause :		Event Type :	CCF
System :		Coupling Factor :		Event Level :	

==========

Name	L-029-91-0591-FS	Plant	YANKEE ROWE			Power	0%
System	EPS	Failure Mode	FS	Shared Cause Fct	1.00	Event Level	SYS
Component	DGN	Fail Mode App	1.00	Timing Factor	1.00	Defense Mech	MON
Shock Type	L	Prox Cause	DC	Op- Detect BO Mode	D		
CCCG Size	3	Coupl Factor	HQIC	Event Type	CCF		

Title EMERGENCY GENERATORS EDG1 AND EDG3 CONTROL RELAY ARCING.

Component Degradation Values

Use?	P	Date	Time	Use?	P	Date	Time
1 X	0.50	1991/11/05	11:05:00	9	----	----/--/--	--:--:--
2 X	0.50	1991/11/05	10:00:00	10	----	----/--/--	--:--:--
3 X	0.10	----/--/--	00:00:00	11	----	----/--/--	--:--:--
4	----	----/--/--	--:--:--	12	----	----/--/--	--:--:--
5	----	----/--/--	--:--:--	13	----	----/--/--	--:--:--
6	----	----/--/--	--:--:--	14	----	----/--/--	--:--:--
7	----	----/--/--	--:--:--	15	----	----/--/--	--:--:--
8	----	----/--/--	--:--:--	16	----	----/--/--	--:--:--

LER 029-91-005.
240/480 Vac starting contactor coil was in systems designed for 250Vdc which caused control relay arcing across contacts making an automatic restart of the EDGs not possible.

Plant in Mode 5, Refueling Shutdown. Found during surveillance testing of EDGs 1 and 3. EDG 2 out of service for repairs to its generator output air circuit breaker.

11/05/91

POWER LEVEL - 000%. THE PLANT WAS IN MODE 5, AT 0% REACTOR POWER, WITH A MAIN COOLANT SYSTEM TEMPERATURE OF 103 DEGREES FAHRENHEIT. EDG NO. 2 WAS OUT OF SERVICE. DURING WEEKLY SURVEILLANCE TESTING OF EDG NOS. 1 AND 3, EXCESSIVE ARCING WAS OBSERVED ACROSS CONTACTS IN A CONTROL RELAY. THE EDGS WERE REMOVED FROM SERVICE FOR EVALUATION, AND DECLARED INOPERABLE. AT 1115 HOURS, AN UNUSUAL EVENT WAS DECLARED DUE TO THE LOSS OF ALL THREE EDGS. AT 1300 HOURS, EDG NO. 2 WAS RETURNED TO SERVICE AND THE UNUSUAL EVENT WAS TERMINATED. THE ROOT CAUSE OF THE CONTROL RELAY ARCING WAS THE INSTALLATION OF 240/480 VAC STARTING CONTACTOR COILS IN A SYSTEM DESIGNED FOR 125 VDC. SHORT TERM CORRECTIVE ACTION INCLUDES REPLACEMENT OF THE AC COILS WITH DC COILS AND REPLACEMENT OF THE STARTER CONTACTOR WITH ONE RATED FOR DC APPLICATIONS. LONG TERM CORRECTIVE ACTION IS TO UPGRADE THE EDG CIRCUITRY DURING THE PRESENT REFUELING OUTAGE. ALTHOUGH EDGS NOS. 1 AND 3 WERE DECLARED INOPERABLE, THEY REMAINED CAPABLE OF BEING STARTED AND LOADED IF NEEDED. THERE WAS NO ADVERSE

1994/10/06 12:27:37 page 1

Figure 10. Example of Qualified Events Report—long report format.

```
                                Qualified Events Report

                                                          Total Records Found :  182
Name                Title/
Plant               Component Degradation Values/
          Fail  F Mode Prox  Time Coupl Share Shk  Comp CCCG  Oper Evt   Evt  Def
Pwr  Sys Mode  Applic Caus  Fact Fact  Cause Typ  Code Size  Stat Type  Lev  Mec
---  --- ----  ------ ----  ---- ----  ----- ---  ---- ----  ---- ----  ---  ---
L-029-91-0591-FS EMERGENCY GENERATORS EDG1 AND EDG3 CONTROL RELAY ARCING.
YANKEE ROWE       0.50 0.50 0.10 ---- ---- ---- ---- ---- ---- ---- ---- ----
  0% EPS  FS     1.00  DC    1.00 HQIC   1.00  L    DGN   3    BO D CCF  SYS  MON

L-029-91-0603-FS DEFECTIVE WIRE CRIMPING IN EMERGENCY DIESEL GEN CIRCUITS
YANKEE ROWE       1.00 0.10 0.10 ---- ---- ---- ---- ---- ---- ---- ---- ----
100% EPS  FS     1.00  DC    1.00 OMTP   1.00  NL   DGN   3    BO O CCF  SYS  MAI

L-206-83-2128-FS CHARGING PUMPS REMOVED FROM SERVICE ERRONEOUSLY.
SAN ONOFRE 1      1.00 1.00 ---- ---- ---- ---- ---- ---- ---- ---- ---- ----
  0% HPI  FS     1.00  HA    1.00 OOOS   1.00  L    PMP   2    BO D CCF  SYS  MON

L-247-84-0001-FS TWO AUX FEEDWATER PUMPS FAILED TO START-RELAY FAILURE
INDIAN POINT 2    1.00 1.00 ---- ---- ---- ---- ---- ---- ---- ---- ---- ----
---% AFW  FS     1.00  IE    1.00 EE     1.00  L    MOT   2    BO D CCF  SYS  PBR

L-247-84-2130-FS HI PRESS SFTY INJ PUMPS FAIL TO START, BORON SOLIDIFICATION
INDIAN POINT 2    1.00 1.00 1.00 ---- ---- ---- ---- ---- ---- ---- ---- ----
100% HPI  FS     1.00  IE    1.00 EI     1.00  L    PMP   3    BO O CCF  SYS  MON

L-247-86-0688-FS 2 OF 3 EMERG DIESEL GENERATOR OUTPUT BREAKERS FAIL TO CLOSE.
INDIAN POINT 2    0.00 1.00 1.00 ---- ---- ---- ---- ---- ---- ---- ---- ----
100% EPS  FS     1.00  IC    0.01 HDCP   0.50  NL   DGN   3    BO O CCF  COM  MON

L-247-91-0689-FS 2 EDGS FAIL TO AUTOMATICALLY LOAD: UNIT TRIP LOCKOUT RELAYS
INDIAN POINT 2    1.00 1.00 0.10 ---- ---- ---- ---- ---- ---- ---- ---- ----
  0% EPS  FS     1.00  HA    1.00 OMTS   1.00  L    DGN   3    BO D CCF  SYS  MON

L-249-94-2373-FS DEGRADED AIR START SYSTEM ON EMERGENCY DIESEL GENERATORS
DRESDEN 3         0.10 0.01 ---- ---- ---- ---- ---- ---- ---- ---- ---- ----
 99% EPS  FS     1.00  DC    1.00 HDCP   1.00  NL   DGN   2    BO O CCF  SYS  DIV

L-250-84-0006-FS AUX FEEDWATER PUMP GOVERNOR FAILURE - LACK OF TEST PROCEDURE
TURKEY POINT 3    1.00 1.00 0.10 ---- ---- ---- ---- ---- ---- ---- ---- ----
---% AFW  FS     1.00  PA    1.00 OMTP   1.00  L    TUR   3    BO D CCF  SYS  MAI

L-255-81-0596-FS EDG SHUTDOWN SEQUENCERS FAILED-DIRTY CONTACTS/STUCK CLUTCH
PALISADES         1.00 1.00 ---- ---- ---- ---- ---- ---- ---- ---- ---- ----
  0% EPS  FS     1.00  PA    1.00 OMTC   1.00  NL   DGN   2    BO D CCF  SYS  MAI

L-255-86-0322-FS SERVICE WATER PUMP PERFORMANCE LESS THAN FSAR REQUIREMENTS
PALISADES         0.10 0.10 0.10 0.00 ---- ---- ---- ---- ---- ---- ---- ----
  0% ESW  FS     1.00  DC    1.00 HQIC   1.00  L    PMP   3    BO O CCF  SYS  DIV

    1997/05/28                  13:41:15                          page     1
```

Figure 11. Example of Qualified Events Report—short report format.

3. GENERIC

GENERIC edits applications and events, analyzes the events of an application, and summarizes the values of applications statistically. The Edit function modifies, inserts, and deletes data contained in an application. The Event function deletes, views comments, or analyzes existing events of an application. From the Generic Event Analysis screen, Analyze allows you to calculate "what if" type situations. The Application Summary function allows you to summarize CCF statistics using various modeling techniques, performing mapped or unmapped calculations, using a staggered testing scheme, and create reports.

To run the GENERIC option, type G in the Option field of the main menu or use the up and down arrow keys to highlight the GENERIC option. Press <Enter> to access the Applications screen (Figure 12).

```
                    Applications

ACP_4KV_BKR_U_CC 4160 VAC CIRCUIT BRKRS, FAIL TO CLOSE, 94/95 UPDATE, 11-4-96
ACP_4KV_BKR_U_CX 4160 VAC CIRCUIT BRKRS, SPURIOUS OPEN, 94/95 UPDATE, 11-4-96
AFW_AOV_UPD_VC   AUX FEEDWATER AOVS, FAIL TO CLOSE, 94/95 UPDATE, 11-25-96
AFW_AOV_UPD_VO   AUX FEED AOVS, FAIL TO OPEN, 94/95 UPDATE, 11-25-96
AFW_AOV_UPD_VR   AUX FEED AOVS, FAIL TO REMAIN CLOSED, 94/95 UPDATE, 11-25-96
AFW_CKV_UPD_VC   PWR AUX FEED CHK VLVES, FAIL TO CLOSE, 94/95 UPD, 11-23-96
AFW_CKV_UPD_VO   PWR AUX FEED CHK VLVS, FAIL TO OPEN, 94/95 UPD, 11-23-96
AFW_CKV_UPD_VR   AUX FEED CHK VLV, FAIL TO REMAIN CLOSED, 94/95 UPD, 11-23-96

Name        ACP_4KV_BKR_U_CC
Description 4160 VAC CIRCUIT BRKRS, FAIL TO CLOSE, 94/95 UPDATE, 11-4-96

      CCCG Size  6          Component Type              Failure Mode

      <Esc>       <F3>       <F4>       <F5>       <Enter>
      Exit        Edit       Events     Copy       Appl. Summary
```

Figure 12. Generic—Application list.

GENERIC provides the following functions:

<Esc> Exit—Terminates the Applications screen and returns to the main menu.

<F3> Edit—Edits the application (see Section 3.1).

<F4> Events—Removes events from a list, views event comments, analyzes an event, and performs summary statistics for an application (see Section 3.2).

<F5> Copy—Copies an application to a new application (see Section 3.3).

<Enter> Applications Summary—Directly performs summary statistics for an application (see Section 3.4).

3.1 Editing Applications

The Edit function modifies, adds, or deletes an application or a group of applications. To edit an application, press <F3> to access the Edit Applications screen (Figure 13).

```
                    Edit Applications

ACP_4KV_BKR_U_CC 4160 VAC CIRCUIT BRKRS, FAIL TO CLOSE, 94/95 UPDATE, 11-4-96
ACP_4KV_BKR_U_CX 4160 VAC CIRCUIT BRKRS, SPURIOUS OPEN, 94/95 UPDATE, 11-4-96
AFW_AOV_UPD_VC   AUX FEEDWATER AOVS, FAIL TO CLOSE, 94/95 UPDATE, 11-25-96
AFW_AOV_UPD_VO   AUX FEED AOVS, FAIL TO OPEN, 94/95 UPDATE, 11-25-96
AFW_AOV_UPD_VR   AUX FEED AOVS, FAIL TO REMAIN CLOSED, 94/95 UPDATE, 11-25-96
AFW_CKV_UPD_VC   PWR AUX FEED CHK VLVES, FAIL TO CLOSE, 94/95 UPD, 11-23-96
AFW_CKV_UPD_VO   PWR AUX FEED CHK VLVS, FAIL TO OPEN, 94/95 UPD, 11-23-96
AFW_CKV_UPD_VR   AUX FEED CHK VLV, FAIL TO REMAIN CLOSED, 94/95 UPD, 11-23-96

Name        ACP_4KV_BKR_U_CC
Description 4160 VAC CIRCUIT BRKRS, FAIL TO CLOSE, 94/95 UPDATE, 11-4-96

      CCCG Size  6        Component Type            Failure Mode

<Esc>    <Enter>   <Ins>    <Del>    <F8>    <F9>    <F10>
Exit     Modify    Add      Delete   Mark    All     Range
```

Figure 13. Generic—Edit Applications screen.

Edit provides the following functions:

<Esc> Exit—Terminates the Edit Application screen and returns to the Applications screen.

<Enter> Modify—Changes the name, description, CCCG level, component type, or failure mode of the selected application (see Section 3.1.1).

<Ins> Add—Adds a new application to the database (see Section 3.1.2).

<Del> Delete—Removes an application from the database. To delete an application, highlight the application and press <Del>. A verification window will ask if you want to delete the highlighted record. Enter either Y or N and press <Enter>. If you enter Y, the application will be deleted immediately. If you have marked any applications (using <F8>, <F9>, or <F10>), CCF will only ask once before it deletes all of the marked applications.

3.1.1 Modifying an Application

To modify an application, highlight the desired application and press <**Enter**> to access the Modify Application screen (Figure 14). Make any necessary changes to the fields and press <**Enter**> to save the changes.

```
                    Modify Application

ACP_4KV_BKR_U_CC 4160 VAC CIRCUIT BRKRS, FAIL TO CLOSE, 94/95 UPDATE, 11-4-96
ACP_4KV_BKR_U_CX 4160 VAC CIRCUIT BRKRS, SPURIOUS OPEN, 94/95 UPDATE, 11-4-96
AFW_AOV_UPD_VC   AUX FEEDWATER AOVS, FAIL TO CLOSE, 94/95 UPDATE, 11-25-96
AFW_AOV_UPD_VO   AUX FEED AOVS, FAIL TO OPEN, 94/95 UPDATE, 11-25-96
AFW_AOV_UPD_VR   AUX FEED AOVS, FAIL TO REMAIN CLOSED, 94/95 UPDATE, 11-25-96
AFW_CKV_UPD_VC   PWR AUX FEED CHK VLVES, FAIL TO CLOSE, 94/95 UPD, 11-23-96
AFW_CKV_UPD_VO   PWR AUX FEED CHK VLVS, FAIL TO OPEN, 94/95 UPD, 11-23-96
AFW_CKV_UPD_VR   AUX FEED CHK VLV, FAIL TO REMAIN CLOSED, 94/95 UPD, 11-23-96

Name        ACP_4KV_BKR_U_CC
Description 4160 VAC CIRCUIT BRKRS, FAIL TO CLOSE, 94/95 UPDATE, 11-4-96

      CCCG Size  6        Component Type            Failure Mode

          <Esc>       <F1>       <F2>       <Enter>
          Exit        Help       List       Modify
```

Figure 14. Generic—Modify Application screen.

NOTE: Use <**Tab**> to move from field to field on the screen.

Modify Application provides the following functions:

<**Esc**> Exit—Terminates the Modify Application screen and returns to the Edit Application screen.

<**F1**> Help—Provides direct access to CCF subjects without interrupting work in progress or using this manual to answer questions about CCF. Press <**F1**> to access the glossary of subjects. Tab through the list and highlight the desired subject. Press <**Enter**> to view the text. If related information exists, you can tab to the highlighted subjects within the help text or tab to the subjects listed under "See also" and press <**Enter**>. Press <**F1**> to access the Hypertext Help window. Press <**F10**> to back out of the screens or press <**Esc**> to exit the online help and return to the program.

<**F2**> List—Provides a list of either component types or failure modes for the appropriate fields. You can select a component type or failure mode from the list by highlighting a list item and pressing <**Enter**>.

<Enter> Modify—Saves changes to the Name, Description, CCCG Level, Component Type, and Failure Mode fields. Simultaneously, <Enter> returns to the Edit Applications screen.

3.1.2 Adding an Application

To add an application, press <Ins> to access the Add Application screen (Figure 15). Type in the name (mandatory), description (optional), CCCG level (mandatory), component type (optional), failure mode (optional), and press <Enter>.

```
                    Add Application

ACP_4KV_BKR_U_CC 4160 VAC CIRCUIT BRKRS, FAIL TO CLOSE, 94/95 UPDATE, 11-4-96
ACP_4KV_BKR_U_CX 4160 VAC CIRCUIT BRKRS, SPURIOUS OPEN, 94/95 UPDATE, 11-4-96
AFW_AOV_UPD_VC   AUX FEEDWATER AOVS, FAIL TO CLOSE, 94/95 UPDATE, 11-25-96
AFW_AOV_UPD_VO   AUX FEED AOVS, FAIL TO OPEN, 94/95 UPDATE, 11-25-96
AFW_AOV_UPD_VR   AUX FEED AOVS, FAIL TO REMAIN CLOSED, 94/95 UPDATE, 11-25-96
AFW_CKV_UPD_VC   PWR AUX FEED CHK VLVES, FAIL TO CLOSE, 94/95 UPD, 11-23-96
AFW_CKV_UPD_VO   PWR AUX FEED CHK VLVS, FAIL TO OPEN, 94/95 UPD, 11-23-96
AFW_CKV_UPD_VR   AUX FEED CHK VLV, FAIL TO REMAIN CLOSED, 94/95 UPD, 11-23-96

Name
Description

      CCCG Size --        Component Type            Failure Mode

        <Esc>        <F1>        <F2>        <Enter>
        Exit         Help        List          Add
```

Figure 15. Generic—Add Application screen.

NOTE: Use <Tab> to move from field to field on the screen.

Add Application provides the following functions:

<Esc> Exit—Terminates the Add Application screen and returns to the Edit Application screen.

<F1> Online Help—Provides direct access to CCF subjects without interrupting work in progress or using this manual to answer questions about CCF. Press <F1> to access the glossary of subjects. Tab through the list and highlight the desired subject. Press <Enter> to view the text. If related information exists, you can tab to the highlighted subjects in the help text or tab to the subjects listed under "See also" and press <Enter>. Press <F1> to access the Hypertext Help window. Press <F10> to back out of the screens or press <Esc> to exit the online help and return to the program.

<F2> List—Provides a list of either component types or failure modes for the appropriate fields. You can add a component type or failure mode from the list by highlighting a list item and pressing <Enter>.

<Enter> Add—Adds the new application and returns to the Edit Applications screen.

3.2 Event Analysis

The Events function deletes an event, views comments and narratives of an event, or analyzes an event within an application. To select the Event function, highlight the desired application, and press <F4> to access the Event Analysis screen (Figure 16).

```
                                  Event Analysis                 Application
                                                                 EDG_FS_DEMO

L-029-91-0591-FS EMERGENCY GENERATORS EDG1 AND EDG3 CONTROL RELAY ARCING.
L-029-91-0603-FS DEFECTIVE WIRE CRIMPING IN EMERGENCY DIESEL GEN CIRCUITS
L-247-86-0688-FS 2 OF 3 EMERG DIESEL GENERATOR OUTPUT BREAKERS FAIL TO CLOS
L-247-91-0689-FS 2 EDGS FAIL TO AUTOMATICALLY LOAD: UNIT TRIP LOCKOUT RELAY
L-249-94-2373-FS DEGRADED AIR START SYSTEM ON EMERGENCY DIESEL GENERATORS
L-255-81-0596-FS EDG SHUTDOWN SEQUENCERS FAILED-DIRTY CONTACTS/STUCK CLUTCH
L-255-94-2374-FS EDGS HAD DEGRADED LOAD CARRYING CAPACITY; GOVERNOR INADEQU
L-259-81-0691-FS AIR START MOTORS ON 3 OF 4 EMERG DIESEL GENS FAILED TO STA

Name  L-029-91-0591-FS Src LER              Plant YANKEE ROWE      Power---%
Title EMERGENCY GENERATORS EDG1 AND EDG3 CONTROL RELAY ARCING.       P1 0.50
                                                                     P2 0.50
System    EPS Proxim Cause DC   CCCG Size       3   Op-Det BO Mode D P3 0.10
Component EDG Shock Type   L    Timing Factor  1.00 Event Type   CCF P4 ----
Fail Mode FS  Coupl Factor HQIC Shared Cause Fc1.00 Event Level  SYS P5 ----
Plnt Type P   Date   1991/11/05 Mult Units?    N    Defense Mech MON P6 ----
                                                                     P7 ----
<Esc>    <Del>      <F4>       <F5>      <Enter>       <F8>          P8 ----
Exit     Delete     Comments   Narrative Imp.Vector  Appl. Summary
```

Figure 16. Generic—Event Analysis screen.

The top window lists all events contained in the application selected. The bottom window contains the information associated with the highlighted event. See Reference 1 of this report for more details about the following fields:

Name—Provides the event code number assigned to the event by the data coder.

Plant—Identifies the name of the nuclear power plant where the CCF event occurred.

Power—States the percentage of full power at the time of the CCF event.

Title—Gives a short description of the event.

System—Names the system that includes the failed component.

Component—Identifies the name of the component that experienced the CCF event.

Fail Mode—Defines the failure in terms of which function the components did not perform.

Plant Type—Define the type of plant where the CCF event occurred P-Pressurized Water Reactor and B-Boiling Water Reactor.

Proximate Cause—Characterizes the condition that is readily identified as leading to failure (a symptom) of a component or function.

Shock Type—Relates the relationship of one component failure to another. That is, the shock type classifies the event as lethal (L) or nonlethal shock (NL) to the system.

Coupling Factor—Describes the mechanism that ties the multiple failures together.

Date—Date of the event.

CCCG Level—Indicates the system size or number of redundant components that can be exposed to a CCF event.

Timing Factor—This is a measure of how close in time multiple failures occurred as represented by 'q. This value ranges from 0.00 to 1.00.

Shared Cause Factor—Ties two failures together. This value ranges from 0.00 to 1.00, representing the analyst's assessment of the degree of presence of a factor or factors causing the propagation of the failure to more than one component. This factor provides the flexibility to classify events for which detailed information is not furnished to determine the presence of coupling factors. A value of 1 indicates that the analyst believes the failures in the event were coupled. Values less than one represent more uncertainty about the dependency of the failures.

Multiple Units—States if the event affected more than one unit at a site.

Operational Status-Detected—Shows when the event was detected.

Operational Status-Mode—Shows when the event occurred.

Event Type—Establishes which events are used in Probabilistic Risk Assessment (PRA) CCF parameter estimations.

Event Level—Establishes whether the failure affected just the component or the system.

Defense Mechanism—Describes the defenses that you can apply to the coupling factor to prevent the CCF event from occurring.

Component Degradation (P1-P8)—There are eight component degradation values. This value ranges from 0.00 to 1.00 and indicates the extent that the degraded component failed (see Reference 1).

Event Analysis provides the following functions:

<Esc> Exit--Terminates the Event Analysis screen and returns to the Applications screen.

<Del> Delete—Removes an event from the selected application. To delete an event, highlight the event and press **<Del>**. A prompt will ask if this event is to be removed from the application. Enter **Y** or **N** and press **<Enter>**. If **Y** is entered, CCF removes the event from the list immediately.

<F4> Comments—Views comments associated with the event. You cannot edit these comments.

<F5> Narratives—Views narratives associated with the event. You cannot edit these narratives.

<Enter> Impact Vector—Performs an event impact vector analysis (see Section 3.2.1).

<F8> Application Summary —Summarizes the CCF statistics summary (see Section 3.4).

3.2.1 GENERIC Event Analysis

To access the Event Analysis screen (Figure 17), highlight the desired event and press **<Enter>**. The description window displays the first event (or the event highlighted) and its associated information. The information includes the default values for the component degradation level, timing factor, shared cause factor, and average impact vector. (You can change the default values of these fields.) CCF uses the component degradation level values, timing factor, and shared cause factor to calculate the average impact vector (shown in the bottom portion of the screen). Also, you can directly input the average impact vector, bypassing the CCF calculation altogether. A brief explanation of these fields follows.

Component Degradation—You can supply up to eight component degradation values. This value ranges from 0.00 to 1.00 and indicates the extent that the degraded component failed (see Reference 1).

Average Impact Vector—The calculation results based on algorithms built in CCF define the average impact vector. You may input your own numbers, if desired, instead of using the CCF results. (See Volume 2.)[2]

NOTE: Use **<Tab>** to move from field to field on the screen.

```
Event
L-219-86-1158-CC        Generic Event Analysis        1 of 21

Title  4160V BREAKERS WITH POTENTIAL RESTART FAILURE.

Proximate Cause  DE                Component Degradation Level
Coupling Factor  HDCP      P1  P2  P3  P4  P5  P6  P7  P8
Event Type       CCF       0.10 0.10 0.10 0.01 0.01 0.01 ---- ----
CCF Shock Type   L
Failure Mode     OO                     Timing Factor  1.00
CCCG Size        6                Shared Cause Factor  1.00

                    Average Impact Vector
F1      F2      F3      F4      F5      F6      F7      F8
0.2572  0.0335  0.0018  0.0000  0.0000  0.0000  ------  ------

<Esc>  <F1>   <Enter>    <F3>       <F4>     <F5>    <F6>     <F7>  <F8>
Exit   Help   Calculate  View Event Comment  Narr.   Previous Next  Save
```

Figure 17. Generic—Event Analysis screen.

Generic Event Analysis provides the following functions:

<Esc> Exit—Terminates the GENERIC Event Analysis screen and returns to the Event Analysis screen.

<F1> Online Help—Provides direct access to CCF subjects without interrupting work in progress or using this manual to answer questions about CCF. Press **<F1>** to access the glossary of subjects. Tab through the list and highlight the desired subject. Press **<Enter>** to view the text. If related information exists, you can tab to the highlighted subjects in the help or tab to the subjects listed under "See also" and press **<Enter>**. Press **<F1>** to access the Hypertext Help window. Press **<F10>** to back out of the screens or press **<Esc>** to exit the online help and return to the program.

<F2> List—Provides a list of degradation values that you can insert in the Component Degradation Level fields. To select a value for a field, press **<F2>**, highlight a value in the list, and press **<Enter>**. Exit the list by pressing **<Esc>**.

NOTE: **<F2>** is available for the Component Degradation Level fields only.

<Enter> Calculate—Calculates the average impact vector based on the information provided. However, you may want to use specific values for the average impact vector. CCF allows you to edit this field. In addition, CCF will only perform the calculations if requested.

<F3> View Event—Views information about the event, including the component degradation levels. View Event also allows you to view comments associated with the event. After you finish viewing the information, press <Enter> or <Esc> to return to the previous screen.

<F4> Comment—Directly views comments associated with the event without accessing the View Event screen. You cannot edit these comments.

<F5> Narrative—Directly views narrative associated with the event without accessing the View Event screen. You cannot edit these narratives.

<F6> Previous—Displays the previous event. This allows you to scroll back through the events in an application one record at a time.

<F7> Next—Displays the next event. This allows you to scroll forward through the events in an application one record at a time.

<F8> Save—Saves the current screen selections and values as the default values for the next time you summarize the statistics of the application. The message "Record saved" will appear at the bottom of the screen to verify this operation. The next event will be displayed.

3.3 Copy Application

Copy Application allows you to make copies of existing applications. All the events for the selected application can be copied to a new application. To run Copy Application, highlight the application you wish to copy and press <F5>. The Copy Application screen (Figure 18) allows you to make the copy of that application.

CCF Copy Application screen provides the following functions:

<Esc> Exit—Terminates the CCF Copy Application screen and returns to the Applications screen.

<Enter> Copy—Copies the selected application to the application specified.

3.4 Application Summary

Application Summary calculates summary statistics for an application based, in part, on the impact vectors of the events belonging to that application. In addition, Calculate lets you perform these calculations based solely upon their own input numbers, rather than using an application event list. To run Application Summary, highlight the application you want and press <Enter>. The CCF Summary Statistics screen (Figure 19) allows you to include mapping of the events and/or staggering the testing scheme for the events in your calculations. You may also look at point estimates of events using the Alpha-Factor model, Multiple Greek Letter model, or both models.

```
                    Copy Application

ACP_4KV_BKR_U_CC 4160 VAC CIRCUIT BRKRS, FAIL TO CLOSE, 94/95 UPDATE, 11-4-96
ACP_4KV_BKR_U_CX 4160 VAC CIRCUIT BRKRS, SPURIOUS OPEN, 94/95 UPDATE, 11-4-96
AFW_AOV_UPD_VC   AUX FEEDWATER AOVS, FAIL TO CLOSE, 94/95 UPDATE, 11-25-96
AFW_AOV_UPD_VO   AUX FEED AOVS, FAIL TO OPEN, 94/95 UPDATE, 11-25-96
AFW_AOV_UPD_VR   AUX FEED AOVS, FAIL TO REMAIN CLOSED, 94/95 UPDATE, 11-25-96
AFW_CKV_UPD_VC   PWR AUX FEED CHK VLVES, FAIL TO CLOSE, 94/95 UPD, 11-23-96
AFW_CKV_UPD_VO   PWR AUX FEED CHK VLVS, FAIL TO OPEN, 94/95 UPD, 11-23-96
AFW_CKV_UPD_VR   AUX FEED CHK VLV, FAIL TO REMAIN CLOSED, 94/95 UPD, 11-23-96

Name        ACP_4KV_BKR_U_CC
Description 4160 VAC CIRCUIT BRKRS, FAIL TO CLOSE, 94/95 UPDATE, 11-4-96

      CCCG Size  6          Component Type              Failure Mode

                 <Esc>        <F1>        <Enter>
                 Exit         Help         Copy
```

Figure 18. Generic—Copy Application screen.

```
Application CCCG        CCF Summary Statistics        Application
      6                                              ACP_4KV_BKR_U_CC

                 Events Mapped to CCCG Size? (Y/N)  Y
               Model (Alpha, Multiple Greek, Both)  A
               If Multiple Greek, Use Staggered?    Y
          Number of independent events (unadjusted)   191.00

     Average event CCCG Size                    6.57
     Events included in calculations             21 of   21

                        Impact Vector
              N1        N2        N3        N4
            14.6225   4.8550    1.3557    0.0250
              N5        N6        N7        N8
             1.8006   2.1000   ---------  ---------

     <Esc>    <F1>    <Enter>    <F3>    <F5>    <F7>
     Exit     Help    Calculate  Model   Save    Reports
```

Figure 19. Generic—CCF Summary Statistics screen.

CCF Summary Statistics provides the following functions:

<Esc> Exit—Terminates the CCF Summary Statistics screen, and then displays the Save/Cancel window if you performed any application summaries; otherwise, <Esc> returns to the Applications screen.

<F2> Independent Event Totals—Breaks down the number of independent events. This function is available when you place your cursor in the Number or Independent Events field. Press <F2> to access the Independent Event Totals screen (Figure 20).

```
Application CCCG          CCF Summary Statistics          Application
      6                                                 ACP_4KV_BKR_U_CC

 Independent Event Totals                 <Esc>
*+—Sys—Cmp—FM—Source——Total-              Exit
   ACP  CB4  FI  LER        73.00
   ACP  CB4  FI  NPRDS       3.00         <F1>
*+ ACP  CB4  OO            --------        Help
*+ ACP  CB4  OO  LER        58.00                          191.00
*+ ACP  CB4  OO  NPRDS     133.00         <F3>
   ACP  CB4  SA            --------      By Plant
   ACP  CB4  SA  LER       110.00
   ACP  CB4  SA  NPRDS      33.00  <F8> <F9> <F10>        f   21
   ACP  CB4  CC            --------  Mark  All Range
   ACP  CB4  CC  LER        20.00
   ACP  CB4  CC  NPRDS      31.00        <Enter>
                                        Use Total
  Marked Total =   191.00
                                       <PgUp/PgDn>
                                      Prev/Next Page

"+" system, comp, fail mode found in app
"*" value included in totals                          <F7>
                                                     Reports
```

Figure 20. Generic—Breakdown of independent event total.

NOTE: The <F2> key is enabled for the Number of Independent Events field only.

<Enter> Calculate—Recalculates the impact vectors and the point estimations of the models if you change your mapped and/or staggered selections for the application.

<F3> Model—Displays the point estimations for both models and the Bayesian Uncertainty Distribution for the Alpha-Factor Model (see Sections 3.4.1 and 3.4.2).

<F5> Save—Saves the current screen selections and values as the default values for the next time you summarize the statistics of the application. The message "Record saved" will appear at the bottom of the screen to verify this operation.

<F7> Report—Generates a special quantification report or an application report (see Section 3.5).

You can also alter the values included in the marked total value by adding or deleting independent events with the <F8>, <F9>, and <F10> keys (see Section 1.4).

<Esc> Exit—Terminates the Independent Event Totals screen without changing the number of independent events field used in the calculation.

<Enter> Use Total—Terminates the Independent Event Totals screen and changes the number of independent event field used in the calculation to the marked total shown on this screen.

<F3> By Plant—Breaks down the number of independent events for the highlighted entry by the plants which contributed to the total (Figure 21).

```
Application CCCG          CCF Summary Statistics          Application
      6                                                 ACP_4KV_BKR_U_CC

 Independent Event Totals                <Esc>
*+—Sys—Cmp—FM—Source——T  Independent Event Total
   ACP  CB4  FI  LER
   ACP  CB4  FI  NPRDS     Sys: ACP  Comp: CB4
*+ ACP  CB4  OO        ---  FM:  FI   Src:  LER          <Esc>
*+ ACP  CB4  OO  LER                                     Exit
*+ ACP  CB4  OO  NPRDS   1 —Plant————————Total—
   ACP  CB4  SA        ---   BEAVER VALLEY 1      2.00   <F1>
   ACP  CB4  SA  LER     1   BEAVER VALLEY 2      5.00   Help
   ACP  CB4  SA  NPRDS       BROWNS FERRY 1       1.00
   ACP  CB4  CC        ---   BRUNSWICK 1          1.00
   ACP  CB4  CC  LER         CALVERT CLIFFS 1     1.00
   ACP  CB4  CC  NPRDS       CALVERT CLIFFS 2     1.00
                             CLINTON 1            1.00
   Marked Total =   191.00   COOPER STATION       4.00
                             CRYSTAL RIVER 3      1.00
                             DIABLO CANYON 2      1.00

"+" system, comp, fail mode            Total:    73.00
"*" value included in totals
                                                  Reports
```

Figure 21. Generic—Breakdown of independent event totals by plant.

3.4.1 Alpha-Factor Model

The Alpha-Factor Model displays Bayesian Distributions, point estimates, and uncertainty summary information for the model. To initiate this model, type an A in the Model field (Figure 19). Press <F3> to access the Select Display Type (Figure 22). Use the up and down arrow keys to highlight the appropriate uncertainty calculation method or type the highlighted letter into the Option field. Press <Enter> to access either the Point Estimate screen (see Section 3.4.1.1), the Nonhomogeneous Bayesian Plant to Plant Distribution menu (see Section 3.4.1.2), the Homogeneous Bayesian screen (see Section 3.4.1.3), or the Uncertainty Summary screen (see Section 3.4.1.4).

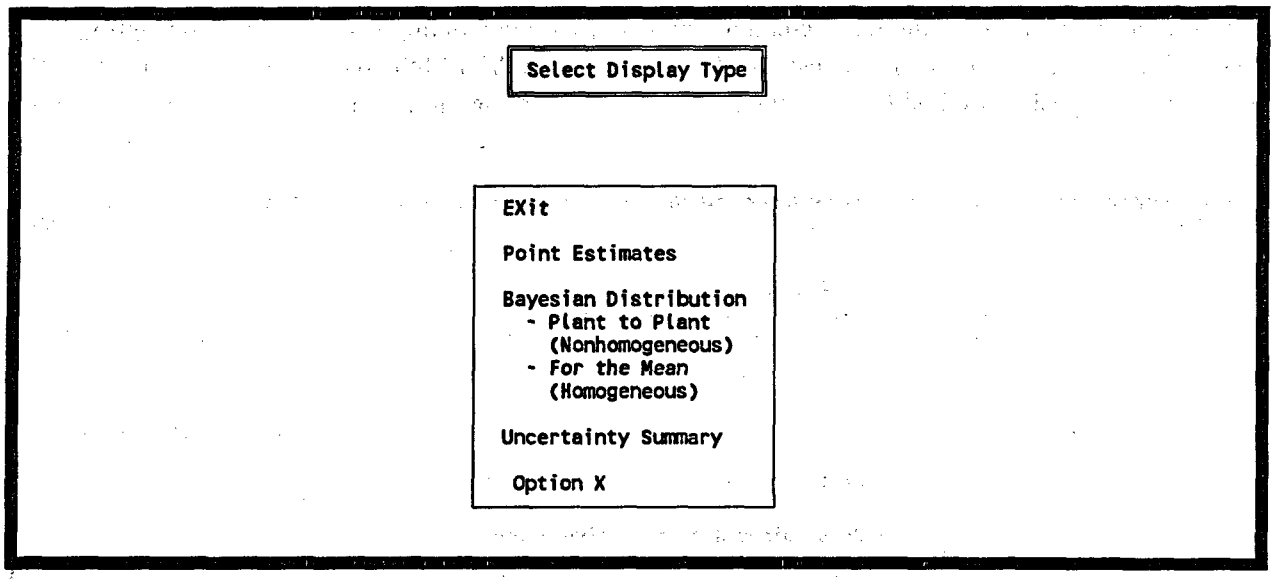


Figure 22. Generic—Alpha-Factor Model menu.

3.4.1.1 Point Estimate. The Alpha-Factor Model Point Estimate screen (Figure 23) provides the following functions:

<Esc> Exit—Terminates this screen and returns to the Alpha-Factor model menu.

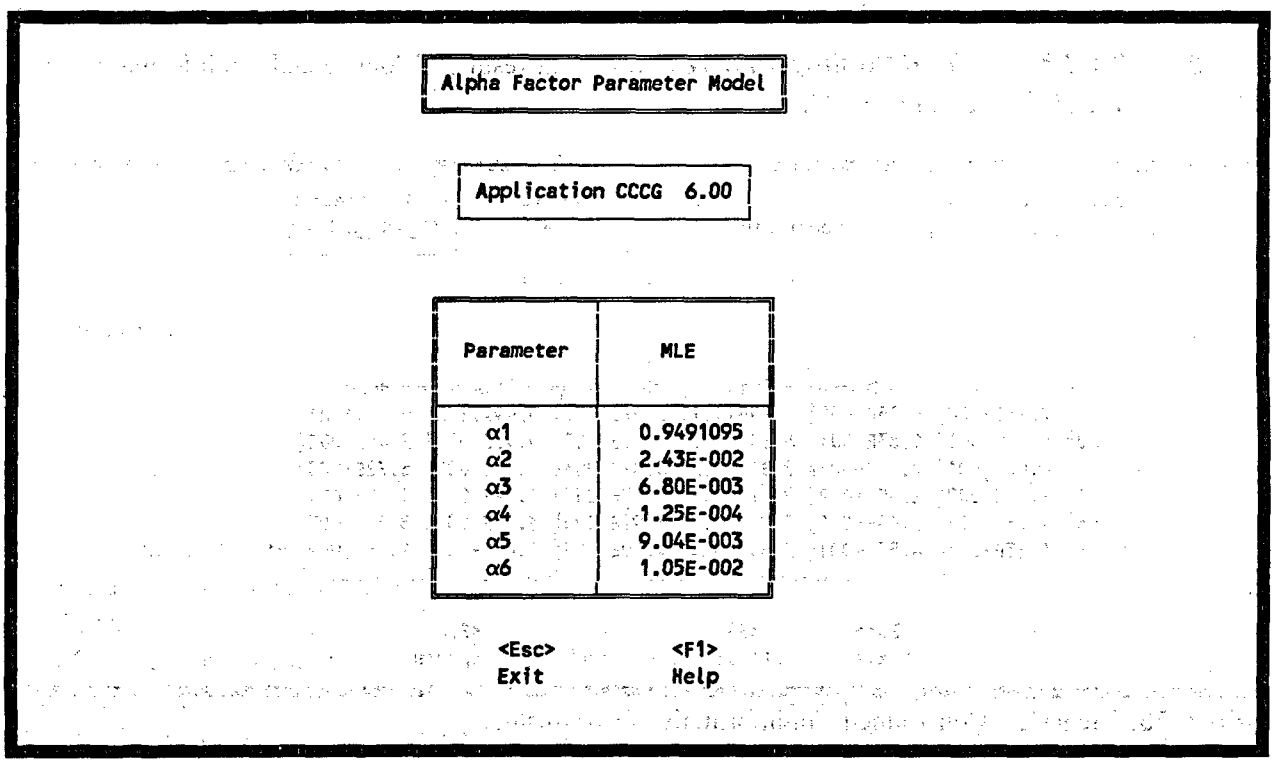


Figure 23. Generic—Alpha-Factor Model Point Estimate screen.

3.4.1.2 Nonhomogeneous Bayesian Distributions or Plant to Plant Distributions. The Nonhomogeneous Bayesian Model Selection Menu is shown in Figure 24. Use the up and down arrow keys

to highlight the appropriate model calculation method or type the highlighted letter into the Option field. Press <Enter> to access either the Constrained Noninformative Prior Method (see Section 3.4.1.2.1) or the Hierarchical Bayesian Method (see Section 3.4.1.2.2). Press <Esc> to return to the Alpha-Factor Model menu.

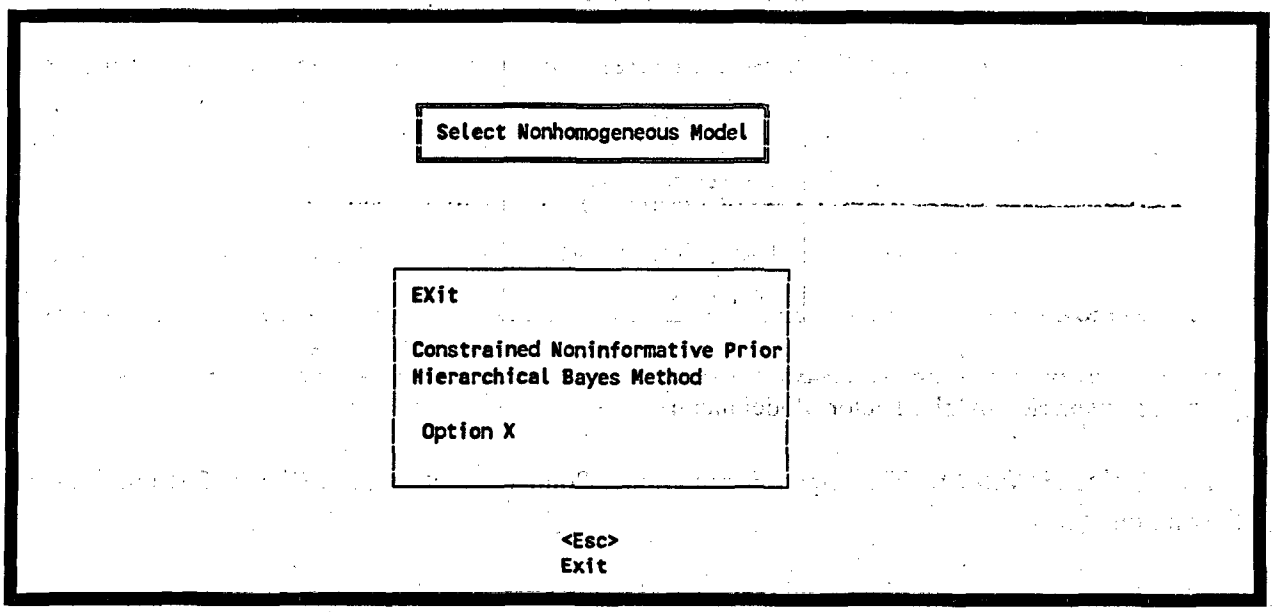
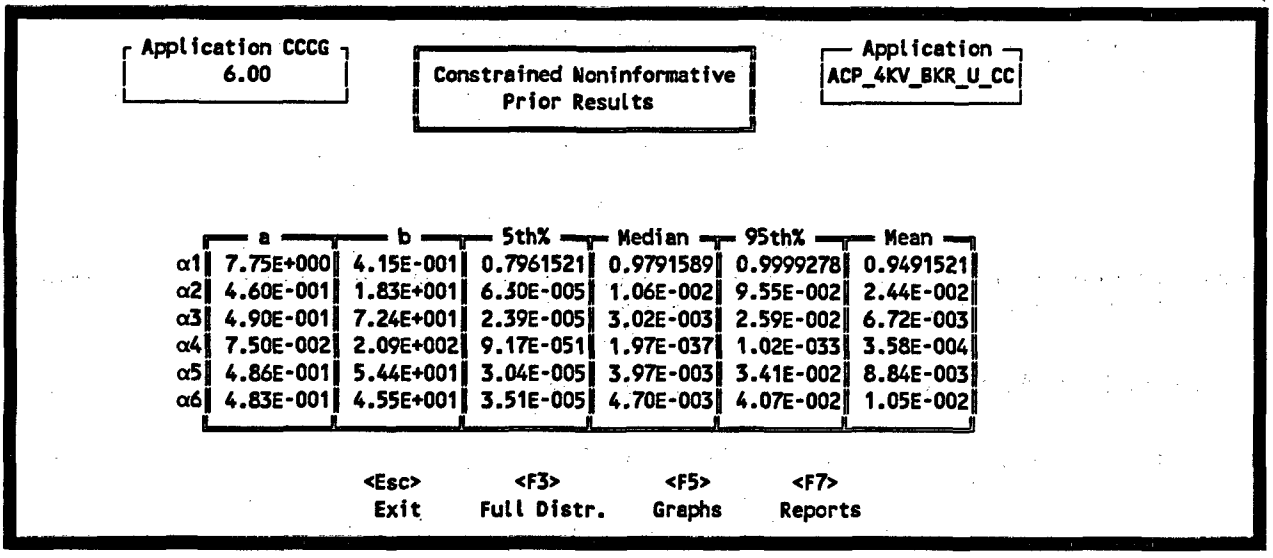


Figure 24. Generic—Nonhomogeneous Model menu.

3.4.1.2.1 Constrained Noninformative Prior—The results of Constrained Noninformative Prior calculations are displayed in Figure 25.



	a	b	5th%	Median	95th%	Mean
α1	7.75E+000	4.15E-001	0.7961521	0.9791589	0.9999278	0.9491521
α2	4.60E-001	1.83E+001	6.30E-005	1.06E-002	9.55E-002	2.44E-002
α3	4.90E-001	7.24E+001	2.39E-005	3.02E-003	2.59E-002	6.72E-003
α4	7.50E-002	2.09E+002	9.17E-051	1.97E-037	1.02E-033	3.58E-004
α5	4.86E-001	5.44E+001	3.04E-005	3.97E-003	3.41E-002	8.84E-003
α6	4.83E-001	4.55E+001	3.51E-005	4.70E-003	4.07E-002	1.05E-002

Figure 25. Generic—Constrained Noninformative Prior Results.

The Constrained Noninformative Prior Results provides the following functions:

<Esc> Exit—Terminates this screen and returns to the Nonhomogeneous Model menu.

<F3> Full Distribution—Displays the full distribution for each applicable alpha. (Figure 26).

<F5> Graphs—Plots the probability density or cumulative distribution. To initiate this function, press <F5>, enter the plot type either cumulative or density and press <Enter>. Next enter the alpha parameter to plot (from 1 to CCCG number), and then press <Enter> to plot the distributions.

<F7> Reports—Prints an Estimation Report of the Constrained Noninformative Prior Results.

Q	α1 -----E----	α2 -----E----	α3 -----E----	α4 -----E----	α5 -----E----	α6 -----E----
0.005	6.13E-001	4.23E-007	2.18E-007	5.96E-034	2.65E-007	2.96E-007
0.010	6.64E-001	1.91E-006	8.97E-007	6.15E-030	1.10E-006	1.24E-006
0.025	7.38E-001	1.40E-005	5.82E-006	1.24E-024	7.27E-006	8.29E-006
0.050	7.96E-001	6.32E-005	2.39E-005	1.28E-020	3.03E-005	3.48E-005
0.100	8.55E-001	2.86E-004	9.90E-005	1.32E-016	1.26E-004	1.46E-004
0.200	9.13E-001	1.30E-003	4.13E-004	1.36E-012	5.34E-004	6.25E-004
0.250	9.31E-001	2.14E-003	6.59E-004	2.68E-011	8.56E-004	1.00E-003
0.300	9.45E-001	3.22E-003	9.71E-004	3.05E-010	1.26E-003	1.48E-003
0.400	9.65E-001	6.25E-003	1.81E-003	1.41E-008	2.37E-003	2.80E-003
0.500	9.79E-001	1.06E-002	3.03E-003	2.76E-007	3.97E-003	4.69E-003
0.600	9.88E-001	1.70E-002	4.74E-003	3.15E-006	6.23E-003	7.38E-003
0.700	9.94E-001	2.63E-002	7.22E-003	2.47E-005	9.51E-003	1.12E-002
0.750	9.96E-001	3.27E-002	8.91E-003	6.24E-005	1.17E-002	1.39E-002
0.800	9.97E-001	4.08E-002	1.10E-002	1.50E-004	1.46E-002	1.73E-002
0.900	9.99E-001	6.77E-002	1.82E-002	8.16E-004	2.41E-002	2.86E-002
0.950	9.99E-001	9.60E-002	2.59E-002	2.08E-003	3.42E-002	4.06E-002
0.975	1.00E+000	1.24E-001	3.38E-002	3.80E-003	4.46E-002	5.30E-002
0.990	1.00E+000	1.62E-001	4.45E-002	6.54E-003	5.86E-002	6.96E-002
0.995	1.00E+000	1.90E-001	5.27E-002	8.85E-003	6.94E-002	8.22E-002

<Esc>

Figure 26. Generic—Full distribution of the constrained noninformative prior results.

The Full Distribution screen provides the following function:

<Esc> Exit—Terminates this screen and returns to the Constrained Noninformative Prior Results screen.

3.4.1.2.2 Hierarchical Bayesian Method—The results of Hierarchical Bayesian menu is displayed in Figure 27.

```
Hierarchical Bayesian Method

EXit

View Previous Results
Run New Calculation

Option: X

<Esc>      <Enter>
Exit       Continue
```

Figure 27. Generic—Hierarchical Bayesian Method menu.

Use the up and down arrow keys to highlight the appropriate selection or type the highlighted letter into the Option field. Press <Enter> to either View Previous Results (see Section 3.4.1.2.3.1) or Run New Calculation (see Section 3.4.1.2.3.2). Press <Esc> to return to the Nonhomogeneous Model menu screen.

3.4.1.2.3.1 Hierarchical Bayesian Method—View Previous Results—The results of the last Hierarchical Bayesian calculation saved will be displayed in Figure 28.

```
Application CCCG 6.00        Bayesian Distribution
                             Using Beta Binomial Calculation        Application ACP_4KV_BKR_U_CC

      a            b            5th%         Median       95th%        Mean
α1  7.07E+001  2.39E+000  9.27E-001  9.71E-001  9.92E-001  9.67E-001
α2  -----E----  -----E----  -----E----  -----E----  -----E----  -----E----
α3  -----E----  -----E----  -----E----  -----E----  -----E----  -----E----
α4  -----E----  -----E----  -----E----  -----E----  -----E----  -----E----
α5  -----E----  -----E----  -----E----  -----E----  -----E----  -----E----
α6  -----E----  -----E----  -----E----  -----E----  -----E----  -----E----

<Esc>      <F3>       <F5>      <F7>
Exit       Full Distr.  Plot      Print
```

Figure 28. Generic—Hierarchical Bayesian Method results.

The Hierarchical Bayesian Method results screen provides the following functions:

<Esc> Exit—Terminates this screen and returns to the Hierarchical Bayesian menu screen.

<F3> Full Distribution—Displays the full posterior distribution for each applicable alpha (Figure 26).

<F5> Plot Distribution—Plots the probability density or cumulative distribution. To initiate this function, press <F5>, enter the plot type either cumulative or density and press <Enter>. Next enter the alpha parameter to plot (from 1 to CCCG number), and then press <Enter> to plot the distributions.

<F7> Print Model—Prints an Estimation Report of the Hierarchical Bayesian Method Distribution. See Sections 3.4.1 and 3.4.3 for more details.

3.4.1.2.3.2 Hierarchical Bayesian Method—Run New Calculations—An introduction screen (Figure 29) provides information about the Hierarchical Bayesian calculation.

Intermediate files may be saved during the computation. To save these files select yes in Save Files and enter a file name.

Save Files: N (Y/N)
File Name : DATAFILE

	Run Calc.	Use Ln Scale	Cmp Bnds	User Defined Boundaries Alpha Minimum	Alpha Maximum	Alpha Pts	Beta Minimum	Beta Maximum	Beta Pts
1	X			3.29E-001	1.77E+003	100	1.23E-002	1.58E+001	100
2	X		X	-----E----	-----E----	---	-----E----	-----E----	---
3	X		X	-----E----	-----E----	---	-----E----	-----E----	---
4	X		X	-----E----	-----E----	---	-----E----	-----E----	---
5	X		X	-----E----	-----E----	---	-----E----	-----E----	---
6	X		X	-----E----	-----E----	---	-----E----	-----E----	---

<Esc> Exit <Enter> Continue

Figure 29. Generic—Hierarchical Bayesian Method—Run new calculation initial screen.

To create intermediate files, enter Y, and enter a name for the file(s). The Hierarchical Bayesian method may be run for an individual alpha, several alpha values, or for all of the alpha values. To run the calculation for an alpha place an X in the Run Calculation Column. If you wish to have the computer generate the boundaries, place an X in the Computer Ends column. If you wish to use the Log Normal Scale, place an X in the Use Ln Scale Column.

<Esc> Exit—Terminates this screen and returns to the Hierarchical Bayesian menu screen.

<Enter> Continue—Continues with the Hierarchical Bayesian Calculation.

Calculation progress updates will be displayed at the bottom of the screen throughout the calculation. To terminate the calculation at anytime, press <Esc>. A message will appear asking you to confirm the termination of the calculation, press Y to terminate, N to cancel the terminate and continue the calculation. Once the calculation has completed the Hierarchical Bayesian Method Results screen (Figure 28) will be displayed.

3.4.1.3 Homogeneous Bayesian Distributions. The results of Homogeneous Bayesian calculations are displayed in Figure 30.

Application CCCG 6.00 | Alpha-Factor Model Distributions | Application ACP_4KV_BKR_U_CC

Prior Distribution Summary

	a	b	5th%	Median	95th%	Mean
α1	9.50E+000	5.00E-001	0.8126362	0.9757208	0.9997943	0.9499999
α2	2.50E-001	9.75E+000	4.49E-007	4.64E-003	1.21E-001	2.50E-002
α3	5.00E-002	9.95E+000	5.88E-028	5.88E-008	2.76E-002	5.00E-003
α4	5.00E-002	9.95E+000	5.88E-028	5.88E-008	2.76E-002	5.00E-003
α5	5.00E-002	9.95E+000	5.88E-028	5.88E-008	2.76E-002	5.00E-003
α6	1.00E-001	9.90E+000	6.27E-015	6.27E-005	5.95E-002	1.00E-002

Posterior Distribution Summary

	a	b	5th%	Median	95th%	Mean	MLE
α1	1.98E+002	1.06E+001	0.9218828	0.9504991	0.9713753	0.9490712	0.9491095
α2	5.10E+000	2.03E+002	9.84E-003	2.29E-002	4.41E-002	2.44E-002	2.43E-002
α3	1.40E+000	2.07E+002	7.03E-004	5.21E-003	1.78E-002	6.71E-003	6.80E-003
α4	7.50E-002	2.08E+002	1.28E-020	2.77E-007	2.08E-003	3.59E-004	1.25E-004
α5	1.85E+000	2.06E+002	1.43E-003	7.35E-003	2.14E-002	8.86E-003	9.04E-003
α6	2.20E+000	2.06E+002	2.11E-003	9.02E-003	2.41E-002	1.05E-002	1.05E-002

<Esc> Exit | <Enter> Calculate | <F3> Full Distrib | <F5> Plot | <F7> Print

Figure 30. Generic—Homogeneous Bayesian Distributions.

The Homogeneous Bayesian Distribution screen provides the following functions:

<Esc> Exit—Terminates this screen and returns to the Alpha Factor Model menu.

<Enter> Calculate—Allows you to enter distribution parameters from A1 to CCCG size and then calculates the prior and posterior distribution summaries.

NOTE: The Program calculates the distributions using the set of input values in column "a". Default values in column "a" are provided, based on the CCCG size. You can input your own "a" values and recalculate the distributions. Save the application to retain the new values; otherwise, exit from the option, and the program will default back to the original values suggested in column "a". Note that any time you change the CCCG size for the application, the program will default to the suggested values in column "a" for the new CCCG size.

<F3> Full Distribution—Displays the full posterior distribution for each applicable alpha (Figure 25).

<F5> Plot Distribution—Plots the probability density for the prior and posterior distributions. To initiate this function, press <F5>, enter the alpha parameter to plot (from 1 to 6), and then press <Enter> to plot the distributions.

<F7> Print Model—Prints an Estimation Report of the Bayesian Distribution. See Sections 3.5.1 and 3.5.3 for more details.

3.4.1.4 Bayesian Uncertainty Summary. The results of Bayesian Uncertainty calculations are displayed in Figure 31.

Application CCCG
6.00

Bayesian Distribution
Summary of Uncertainty Results
for α1

Application
ACP_4KV_BKR_U_CC

Type: Generic

Uncertainty	a	b	5th%	Median	95th%	Mean
Constrained Noninformat.	+0.00E+000	+0.00E+000	+0.00E+000	+0.00E+000	+0.00E+000	+0.00E+000
Hierarchical Bayesian	7.07E+001	2.39E+000	9.27E-001	9.71E-001	9.92E-001	9.67E-001
From the Mean	+0.00E+000	+0.00E+000	+0.00E+000	+0.00E+000	+0.00E+000	+0.00E+000

<Esc> Exit | <F7> Print | <F8> Previous Screen | <F9> Next Screen

Figure 31. Generic—Bayesian uncertainty summary.

The Bayesian Uncertainty Summary screen (Figure 31) provides the following functions:

<Esc> Exit—Terminates this screen and returns to the Alpha Factor Model menu.

<F7> Print Model—Prints an Uncertainty Summary Report of the Bayesian Distributions. See Sections 3.5.1 and 3.5.3 for more details.

<F8> Previous Screen—Displays the previous alpha comparison screen.

<F9> Next Screen—Displays the next alpha comparison screen.

3.4.2 Multiple Greek Letter Model

To initiate the Multiple Greek Letter models (Figure 32), type an M in the Model field (Figure 19) and press the F3 key to generate the model.

```
Multiple Greek Letter Parametric Model

Application CCCG  6.00

| Parameter | MLE |
|---|---|
| 1-Beta | 1.58E-001 |
| Beta | 7.26E-001 |
| Gamma | 8.42E-001 |
| Delta | 9.95E-001 |
| Epsilon | 5.83E-001 |
| Mu | -----E---- |

<Esc>      <F1>
Exit       Help
```

Figure 32. Generic—Multiple Greek Factor Parametric Model.

3.5 Generic Report Options

The Report option allows you to create the following reports:

- Application (unmapped events)
- Event Summary Statistics (unmapped events)
- Application (mapped events)
- Application Summary (mapped events)
- Detailed Events (mapped events)
- Event Summary Statistics (mapped events)
- Application Event Report (mapped events)

Figure 33 or Figure 34 appears if you type N or Y in the Events Mapped to CCCG Size field respectively. See Sections 3.5.1 through 3.5.7 for specific details about the reports.

```
Search Reports

EXit

Application Report
EVent Summary Statistics

  Option X
```

Figure 33. Generic—Unmapped—event, Search Reports screen.

```
Search Reports

EXit

Application Report
APplication Summary
Detailed Events
EVent Summary Statistics
Application Event Report

  Option X
```

Figure 34. Generic—Mapped—event, Search Reports screen.

3.5.1 Application Report (Generic Unmapped)

1. Type N to perform calculations without mapping the event.

2. Press <F7> to access the Search Reports screen (Figure 33).

3. Type A or highlight Application Report.

4. Press <Enter> to access the Report Options screen (Figure 35). CCF provides a default report title and output file name; however, you may change the defaults by simply typing over the existing text.

```
                    Report Options

                    Report Title
              Event Summary Statistics

                    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 35. Generic—Report Options screen.

5. Specify an output destination. As a default, the screen will display the report (CON). You may change this to one of the following:

   PRN Prints the report on the attached printer.

   " " If the file name is left blank, no report will be generated.

   <Esc> No report will be generated.

   other Enter a valid DOS filename. The report will be printed to that file. This file can then be printed later or transferred to another machine via a diskette.

6. Press <Enter> once you supply an output destination. A report similar to Figure 36 will be generated.

3.5.2 Event Summary Statistics Report

1. Type N to perform calculations without mapping the event.

2. Press <F7> to access the Search Reports screen (Figure 33).

3. Type V or highlight Event Summary Statistics.

4. Press <Enter> to access the Report Options screen (Figure 35). CCF provides a default report title and output file name; however, you may change the defaults by simply typing over the existing text.

```
                    Estimation Report (Generic Impact)

                       Application  ACP_CB4_CC

Common Cause Component Group    6        Average event CCCG size        5.90
Adjusted Independent events     173.00   Total events in application     21
Unadjusted independent events   173.00

 Included
 in Total  Sys  Cmp  FM  Source  Totals
           ACP  CB4  CR          --------
           ACP  CB4  CR  LER        65.00
           ACP  CB4  CR  NPRDS       4.00
     *     ACP  CB4  CC          --------
     *     ACP  CB4  CC  LER        55.00
     *     ACP  CB4  CC  NPRDS     118.00
           ACP  CB4  CX          --------
           ACP  CB4  CX  LER       103.00
           ACP  CB4  CX  NPRDS      36.00
           ACP  CB4  CO          --------
           ACP  CB4  CO  LER        19.00
           ACP  CB4  CO  NPRDS      29.00
           ACP  CB4  CH  LER        33.00

                              Alpha Model

     N1    27.6072   N4     0.0008        α1  9.68E-001   α4  3.86E-006
     N2     4.7485   N5     0.0000        α2  2.29E-002   α5 +0.00E+000
     N3     0.8637   N6     1.0000        α3  4.16E-003   α6  4.82E-003

Events:
  L-XXX-86-1158-CC, L-XXX-87-1161-CC, L-XXX-80-1163-CC, L-XXX-80-1173-CC,
  L-XXX-87-1181-CC, L-XXX-82-1183-CC, L-XXX-86-1188-CC, L-XXX-81-1193-CC,
  L-XXX-88-1201-CC, L-XXX-85-1202-CC, L-XXX-85-1203-CC, L-XXX-87-1206-CC,
  N-XXX-85-1215-CC, N-XXX-85-1216-CC, N-XXX-87-1217-CC, N-XXX-86-1218-CC,
  N-XXX-87-1219-CC, N-XXX-92-1221-CC, N-XXX-89-1223-CC, N-XXX-90-1226-CC,
  N-XXX-86-1228-CC

    1995/09/07                  11:55:37                        page     1
```

Figure 36. Generic—Example of a Generic Impact Estimation Report.

5. Specify an output destination. As a default, the screen will display the report (CON). You may change this to one of the following:

PRN Prints the report on the attached printer.

" " If the file name is left blank, no report will be generated.

<Esc> No report will be generated.

other Enter a valid DOS filename. The report will be printed to that file. This file can then be printed later or transferred to another machine via a diskette.

6. Press <Enter> once you supply an output destination. A report similar to Figure 37 will be generated.

3.5.3 Application Report (Generic Mapped Impact)

1. Type Y to perform mapped calculations.

2. Press <F7> to access the Search Reports screen (Figure 34).

3. Type R or highlight Application Event Report and press <Enter>.

4. The Select Report Type menu will be displayed.

5. Select the uncertainty model for the report.

6. Press <Enter> to access the Report Options screen (Figure 35). CCF provides a default report title and output file name; however, you may change the defaults by simply typing over the existing text.

7. Specify an output destination. As a default, the screen will display the report (CON). You may change this to one of the following:

PRN Prints the report on the attached printer.

" " If the file name is left blank, no report will be generated.

<Esc> No report will be generated.

other Enter a valid DOS filename. The report will be printed to that file. This file can then be printed later or transferred to another machine via a diskette.

8. Press <Enter> once you supply an output destination. A report similar to the report provided in selected uncertainty option will be generated (Figure 38).

```
                    Event Summary Statistics

        Application  EDG_FS_DEMO                    Component
        Total Events   55                           Failure Mode
                                                    CCCG Size     6

CCCG SIZE          [2](26), [3](15), [4](11), [5](3)

SHOCK TYPES        NL(44), L(11)

COMPONENT TYPES    EDG(55)

FAILURE MODES      FS(55)

COUPLING FACTORS   HDCP(19), OMTC(9), HQMM(6), OMTS(6), OMTP(4), HDSC(3),
                   HQIC(3), EI(2), EE(1), OOOP(1), OOOS(1)

PROXIMATE CAUSES   IC(20), DC(7), DE(4), DM(4), HA(4), HP(4), IE(4), PA(4),
                   HX(1), QI(1), QP(1), U(1)

SYSTEMS            EPS(55)

PLANTS             SEQUOYAH 1(4), BROWNS FERRY 1(3), FARLEY 1(3),
                   INDIAN POINT 3(3), BRUNSWICK 1(2), CLINTON 1(2),
                   INDIAN POINT 2(2), PALISADES(2), PALO VERDE 1(2),
                   SUSQUEHANNA 1(2), VOGTLE 2(2), YANKEE ROWE(2),
                   ARKANSAS 1(1), BEAVER VALLEY 2(1), BRAIDWOOD 1(1),
                   BRAIDWOOD 2(1), BROWNS FERRY 3(1), CALVERT CLIFFS 2(1),
                   DRESDEN 3(1), FARLEY 2(1), GRAND GULF 1(1), HATCH 2(1),
                   MCGUIRE 1(1), NORTH ANNA 2(1), PALO VERDE 2(1),
                   PALO VERDE 3(1), PEACH BOTTOM 2(1), PERRY 1(1),
                   ROBINSON 2(1), SOUTH TEXAS 2(1), SUMMER 1(1), SURRY 1(1),
                   SUSQUEHANNA 2(1), THREE MILE ISLND(1), VERMONT YANKEE(1),
                   VOGTLE 1(1), ZION 1(1), ZION 2(1)

OP ST (WHEN DET)   BO(50), OP(5)

OP STATUS (MODE)   O(34), D(21)

EVENT TYPE         CCF(55)

DEFENSE MECHAN.    MON(26), MAI(14), FSB(6), DIV(5), NON(2), UKN(2)

     1997/06/14                 02:05:56                    page   1
```

Figure 37. Generic—Example of a Generic Event Summary Statistics Report.

```
                    Estimation Report (Generic Mapped Impact)

                         Application  EDG_FS_DEMO

 Common Cause Component Group    6        Average event CCCG size        2.83
 Adjusted Independent events     1643.10  Total events in application     55
 Unadjusted independent events    775.00

  Included
  in Total  Sys  Cmp  FM  Source  Totals
            EPS  EDG  FR          --------
            EPS  EDG  FR  LER       587.00
            EPS  EDG  FR  NPRDS       2.00
     *      EPS  EDG  FS          --------
     *      EPS  EDG  FS  LER       764.00
     *      EPS  EDG  FS  NPRDS      11.00
            EPS  EDG  FX  LER        23.00

                              Alpha Model

     N1     7.8655   N5     8.2757        α1  0.9665335   α5  4.84E-003
     N2    12.4137   N6    13.2901        α2  7.26E-003   α6  7.78E-003
     N3    14.1969   N7  ---------        α3  8.31E-003   α7 -----E----
     N4     8.9886   N8  ---------        α4  5.26E-003   α8 -----E----
Events:
  L-029-91-0591-FS, L-029-91-0603-FS, L-247-86-0688-FS, L-247-91-0689-FS,
  L-249-94-2373-FS, L-255-81-0596-FS, L-255-94-2374-FS, L-259-81-0691-FS,
  L-259-82-0692-FS, L-259-86-0597-FS, L-261-93-0598-FS, L-271-84-0600-FS,
  L-277-95-2376-FS, L-280-91-0694-FS, L-286-87-1237-FS, L-286-90-0693-FS,
  L-286-92-0702-FS, L-295-94-2588-FS, L-296-88-1172-FS, L-304-94-2378-FS,
  L-317-80-0619-FS, L-320-80-0627-FS, L-325-82-0699-FS, L-325-82-0700-FS,
  L-327-80-0622-FS, L-327-80-0623-FS, L-327-80-0624-FS, L-327-82-0701-FS,
  L-339-87-0638-FS, L-348-80-0703-FS, L-348-81-0705-FS, L-348-81-0706-FS,
  L-364-81-0707-FS, L-366-83-0708-FS, L-369-90-0645-FS, L-387-82-0710-FS,
  L-387-85-0647-FS, L-388-84-0651-FS, L-395-85-0652-FS, L-412-93-0654-FS,
  L-416-82-0711-FS, L-424-90-0735-FS, L-425-90-0734-FS, L-425-91-0659-FS,
  L-440-87-0660-FS, L-456-90-0736-FS, L-457-90-0747-FS, L-461-92-0725-FS,
  L-461-93-0726-FS, L-499-91-0728-FS, L-528-85-0685-FS, L-528-87-0533-FS,
  L-529-87-0540-FS, L-530-87-0731-FS, N-313-84-1240-FS

     1997/06/14                 02:11:19                        page    1
```

Figure 38. Generic—Example of a Generic Application report.

3.5.4 Application Summary Report (Generic Mapped Impact)

1. Type **Y** to perform mapped calculations.

2. Press **<F7>** to access the Search Reports screen (Figure 34).

3. Type **P** or highlight Application Summary Report.

4. Press **<Enter>** to access the Report Options screen (Figure 35). CCF provides a default report title and output file name; however, you may change the defaults by simply typing over the existing text.

5. Specify an output destination. As a default, the screen will display the report (CON). You may change this to one of the following:

   PRN Prints the report on the attached printer.

   " " If the file name is left blank, no report will be generated.

   <Esc> No report will be generated.

   other Enter a valid DOS filename. The report will be printed to that file. This file can then be printed later or transferred to another machine via a diskette.

6. Press <**Enter**> once you supply an output destination. A report similar to Figure 39 will be generated.

```
                          Applications Listing

                 CCCG
  Application    Size                    Description
---------------- -- ------------------------------------------------------------
EDG_FS_DEMO       6 DEMO APPLICATION:  EVENTS WITH COMPONENT EDG AND SYSTEM FS
                    L-029-91-0591-FS, L-029-91-0603-FS, L-247-86-0688-FS,
                    L-247-91-0689-FS, L-249-94-2373-FS, L-255-81-0596-FS,
                    L-255-94-2374-FS, L-259-81-0691-FS, L-259-82-0692-FS,
                    L-259-86-0597-FS, L-261-93-0598-FS, L-271-84-0600-FS,
                    L-277-95-2376-FS, L-280-91-0694-FS, L-286-87-1237-FS,
                    L-286-90-0693-FS, L-286-92-0702-FS, L-295-94-2588-FS,
                    L-296-88-1172-FS, L-304-94-2378-FS, L-317-80-0619-FS,
                    L-320-80-0627-FS, L-325-82-0699-FS, L-325-82-0700-FS,
                    L-327-80-0622-FS, L-327-80-0623-FS, L-327-80-0624-FS,
                    L-327-82-0701-FS, L-339-87-0638-FS, L-348-80-0703-FS,
                    L-348-81-0705-FS, L-348-81-0706-FS, L-364-81-0707-FS,
                    L-366-83-0708-FS, L-369-90-0645-FS, L-387-82-0710-FS,
                    L-387-85-0647-FS, L-388-84-0651-FS, L-395-85-0652-FS,
                    L-412-93-0654-FS, L-416-82-0711-FS, L-424-90-0735-FS,
                    L-425-90-0734-FS, L-425-91-0659-FS, L-440-87-0660-FS,
                    L-456-90-0736-FS, L-457-90-0747-FS, L-461-92-0725-FS,
                    L-461-93-0726-FS, L-499-91-0728-FS, L-528-85-0685-FS,
                    L-528-87-0533-FS, L-529-87-0540-FS, L-530-87-0731-FS,
                    N-313-84-1240-FS

     1997/06/14                 02:12:18                      page     1
```

Figure 39. Generic—Example of a Generic Application Summary report.

3.5.5 Detailed Events (Generic Mapped)

1. Type **Y** to perform mapped calculations.

2. Press <**F7**> to access the Search Reports screen (Figure 34).

3. Type **P** or highlight Application Summary Report.

4. Press <Enter> to access the Report Options screen (Figure 35). CCF provides a default report title and output file name; however, you may change the defaults by simply typing over the existing text.

5. Specify an output destination. As a default, the screen will display the report (CON). You may change this to one of the following:

   PRN Prints the report on the attached printer.

   " " If the file name is left blank, no report will be generated.

   <Esc> No report will be generated.

   other Enter a valid DOS filename. The report will be printed to that file. This file can then be printed later or transferred to another machine via a diskette.

6. Press <Enter> once you supply an output destination. A report similar to Figure 40 will be generated.

3.5.6 Event Summary Statistics (Generic Mapped)

1. Type Y to perform mapped calculations.

2. Press <F7> to access the Search Reports screen (Figure 34).

3. Type V or highlight Event Summary Statistics.

4. Press <Enter> to access the Report Options screen (Figure 35). CCF provides a default report title and output file name; however, you may change the defaults by simply typing over the existing text.

5. Specify an output destination. As a default, the screen will display the report (CON). You may change this to one of the following:

   PRN Prints the report on the attached printer.

   " " If the file name is left blank, no report will be generated.

   <Esc> No report will be generated.

   other Enter a valid DOS filename. The report will be printed to that file. This file can then be printed later or transferred to another machine via a diskette.

6. Press <Enter> once you supply an output destination. A report similar to Figure 41 will be generated.

Application Detail Report

Application EDG_FS_DEMO

Common Cause Component Group	6	Average event CCCG size	2.83
Adjusted Independent events	1643.10	Total events in application	55
Unadjusted independent events	775.00		

Included in Total	Sys	Cmp	FM	Source	Totals
	EPS	EDG	FR		--------
	EPS	EDG	FR	LER	587.00
	EPS	EDG	FR	NPRDS	2.00
*	EPS	EDG	FS		--------
*	EPS	EDG	FS	LER	764.00
*	EPS	EDG	FS	NPRDS	11.00
	EPS	EDG	FX	LER	23.00

Alpha Model

N1	7.7671	N5	8.1359	α1	0.9672358	α5	4.76E-003
N2	12.1000	N6	13.2831	α2	7.08E-003	α6	7.78E-003
N3	13.7509	N7	---------	α3	8.05E-003	α7	-----E----
N4	8.6516	N8	---------	α4	5.06E-003	α8	-----E----

Events:

L-029-91-0591-FS, L-029-91-0603-FS, L-247-86-0688-FS, L-247-91-0689-FS,
L-249-94-2373-FS, L-255-81-0596-FS, L-255-94-2374-FS, L-259-81-0691-FS,
L-259-82-0692-FS, L-259-86-0597-FS, L-261-93-0598-FS, L-271-84-0600-FS,
L-277-95-2376-FS, L-280-91-0694-FS, L-286-87-1237-FS, L-286-90-0693-FS,
L-286-92-0702-FS, L-295-94-2588-FS, L-296-88-1172-FS, L-304-94-2378-FS,
L-317-80-0619-FS, L-320-80-0627-FS, L-325-82-0699-FS, L-325-82-0700-FS,
L-327-80-0622-FS, L-327-80-0623-FS, L-327-80-0624-FS, L-327-82-0701-FS,
L-339-87-0638-FS, L-348-80-0703-FS, L-348-81-0705-FS, L-348-81-0706-FS,
L-364-81-0707-FS, L-366-83-0708-FS, L-369-90-0645-FS, L-387-82-0710-FS,
L-387-85-0647-FS, L-388-84-0651-FS, L-395-85-0652-FS, L-412-93-0654-FS,
L-416-82-0711-FS, L-424-90-0735-FS, L-425-90-0734-FS, L-425-91-0659-FS,
L-440-87-0660-FS, L-456-90-0736-FS, L-457-90-0747-FS, L-461-92-0725-FS,
L-461-93-0726-FS, L-499-91-0728-FS, L-528-85-0685-FS, L-528-87-0533-FS,
L-529-87-0540-FS, L-530-87-0731-FS, N-313-84-1240-FS

1997/06/14 02:12:35 page 1

Figure 40. Generic—Example of Mapped Detailed Event report.

```
                    Event Summary Statistics

        Application  ACP_CB4_CC                    Component
        Total Events   21                          Failure Mode
                                                   CCCG Size     6

CCCG SIZE          [6](10), [8](7), [2](4)

SHOCK TYPES        NL(17), L(4)

COMPONENT TYPES    CB4(21)

FAILURE MODES      CC(21)

COUPLING FACTORS   OMTC(10), HDCP(4), HQIC(3), HDSC(2), HQMM(1), OMTP(1)

PROXIMATE CAUSES   IC(15), DC(2), DE(2), PA(1), U(1)

SYSTEMS            ACP(21)

PLANTS             BROWNS FERRY 1(2), BROWNS FERRY 2(2), DAVIS-BESSE 1(2),
                   BEAVER VALLEY 2(1), BRUNSWICK 2(1), COOPER STATION(1),
                   DIABLO CANYON 2(1), DRESDEN 2(1), FARLEY 1(1),
                   FITZPATRICK(1), FORT CALHOUN 1(1), GINNA(1), LASALLE 2(1),
                   OYSTER CREEK(1), SALEM 1(1), SAN ONOFRE 1(1),
                   WASHINGTON NP 2(1), WATERFORD 3(1)

OPERATION STATUS   BOD(11), BOO(10)

EVENT TYPE         CCF(21)

DEFENSE MECHAN.    MAI(12), MON(9)

    1995/09/07                 17:09:11                    page    1
```

Figure 41. Generic—Example of Mapped Event Summary Statistics report.

3.5.7 Application Event Report (Generic Mapped)

1. Type **Y** to perform mapped calculations.

2. Press <F7> to access the Search Reports screen (Figure 34).

3. Type **A** or highlight Application Report.

4. Press <Enter> to access the Report Options screen (Figure 35). CCF provides a default report title and output file name; however, you may change the defaults by simply typing over the existing text.

5. Specify an output destination. As a default, the screen will display the report (CON). You may change this to one of the following:

PRN Prints the report on the attached printer.

" " If the file name is left blank, no report will be generated.

<Esc> No report will be generated.

other Enter a valid DOS filename. The report will be printed to that file. This file can then be printed later or transferred to another machine via a diskette.

6. Press **<Enter>** once you supply an output destination. A report similar to Figure 11 will be generated. The report will contain the application events instead of the search events in Figure 11, but the information for each event is the same.

4. SPECIFIC

SPECIFIC edits applications and events, analyzes the events of an application, and summarizes the values of applications statistically. The Edit function allows you to modify, insert, and delete data contained in an application. The Event function allows you to delete, view comments, or analyze existing events of an application and to calculate "what-if" type situations. SPECIFIC provides mapped calculations and results from adjusted as well as unadjusted independent events. The Application Summary function summarizes CCF statistics using various modeling techniques for point estimations, selecting a staggered testing scheme, and creating reports. To run the SPECIFIC option, type **P** in the Option field of the main menu or use the up and down arrow keys to highlight SPECIFIC. Press **<Enter>** to access the Applications screen (Figure 42). SPECIFIC provides the following functions:

```
                    Applications

ACP_4KV_BKR_U_CC 4160 VAC CIRCUIT BRKRS, FAIL TO CLOSE, 94/95 UPDATE, 11-4-96
ACP_4KV_BKR_U_CX 4160 VAC CIRCUIT BRKRS, SPURIOUS OPEN, 94/95 UPDATE, 11-4-96
AFW_AOV_UPD_VC   AUX FEEDWATER AOVS, FAIL TO CLOSE, 94/95 UPDATE, 11-25-96
AFW_AOV_UPD_VO   AUX FEED AOVS, FAIL TO OPEN, 94/95 UPDATE, 11-25-96
AFW_AOV_UPD_VR   AUX FEED AOVS, FAIL TO REMAIN CLOSED, 94/95 UPDATE, 11-25-96
AFW_CKV_UPD_VC   PWR AUX FEED CHK VLVES, FAIL TO CLOSE, 94/95 UPD, 11-23-96
AFW_CKV_UPD_VO   PWR AUX FEED CHK VLVS, FAIL TO OPEN, 94/95 UPD, 11-23-96
AFW_CKV_UPD_VR   AUX FEED CHK VLV, FAIL TO REMAIN CLOSED, 94/95 UPD, 11-23-96

Name        ACP_4KV_BKR_U_CC
Description 4160 VAC CIRCUIT BRKRS, FAIL TO CLOSE, 94/95 UPDATE, 11-4-96

      CCCG Size  6          Component Type          Failure Mode

      <Esc>       <F3>       <F4>       <F5>       <Enter>
      Exit        Edit       Events     Copy       Appl. Summary
```

Figure 42. Specific—Application list for the Specific option.

<Esc> Exit—Terminates Applications screen and returns to the main menu.

<F3> Edit—Edits the application (see Section 3.1).

<F4> Events—Removes events from a list, views event comments, analyzes an event, and performs summary statistics for an application (see Section 4.1).

<F5> Copy—Copies an application to a new application. (see Section 3.3)

<Enter> Application Summary—Directly performs summary statistics for an application (see Section 4.2).

4.1 Event Analysis

The Events function deletes an event, views comments of an event, or analyzes an event within an application. To select the Events function, highlight the desired application and press **<F4>** to access the Event Analysis screen (Figure 43).

```
                                  Event Analysis          Application
                                                          ACP_4KV_BKR_U_CC

L-219-86-1158-CC 4160V BREAKERS WITH POTENTIAL RESTART FAILURE.
L-244-87-1161-CC 4160V BREAKERS FAIL TO CLOSE.
L-259-80-1163-CC ALTERNATE BKRS FAIL TO CLOSE AND NORMAL BKRS FAIL TO RECLO
L-277-88-1234-CC 4160V BREAKER CLOSURE CIRCUITRY DISABLED.
L-286-84-1094-CC 4160V BREAKERS FAIL TO OPERATE DURING LOSS OF OFFSITE POWE
L-309-94-2427-CC SEVERAL 4KV BREAKERS WOULD NOT CLOSE
L-309-95-2428-CC CRACKED INTERNAL CAM FOLLOWERS IN AC BREAKERS
L-324-82-1183-CC STARTUP XFMR BREAKER & #3 DIESEL BREAKER FAILED TO CLOSE

Name  L-219-86-1158-CC Src LER            Plant OYSTER CREEK     Power---%
Title 4160V BREAKERS WITH POTENTIAL RESTART FAILURE.              P1 0.10
                                                                  P2 0.10
System    ACP Proxim Cause DE   CCCG Size       6   Op-Det BO Mode D P3 0.10
Component CB4 Shock Type   L    Timing Factor  1.00 Event Type   CCF P4 0.01
Fail Mode OO  Coupl Factor HDCP Shared Cause Fc1.00 Event Level  SYS P5 0.01
Plnt Type B   Date   1986/12/06 Mult Units?    N    Defense Mech MON P6 0.01
                                                                  P7 ----
<Esc>     <Del>       <F4>       <F5>      <Enter>       <F8>      P8 ----
Exit     Delete    Comments   Narrative  Imp.Vector  Appl. Summary +--------+
```

Figure 43. Specific—Event Analysis screen.

The top window lists all events contained in the application selected. The bottom window contains the information associated with the highlighted event. See Reference 1 of this report for more details about the following fields.

Name—Provides the event code number assigned to the event by the data coder.

Plant—Identifies the name of the nuclear power plant where the CCF event occurred.

Power—States the percentage of full power at the time of the CCF event.

Title—Gives a short description of the event.

System—Names the system that includes the failed component.

Component—Identifies the name of the component that experienced the CCF event.

Fail Mode—Defines the failure in terms of which function the components did not perform.

Plant Type—Define the type of plant where the CCF event occurred P-Pressurized Water Reactor and B-Boiling Water Reactor.

Proximate Cause—Characterizes the condition that is readily identified as leading to failure (a symptom) of a component or function.

Shock Type—Relates the relationship of one component failure to another. That is, the shock type classifies the event as lethal (L) or nonlethal shock (NL) to the system.

Coupling Factor—Describes the mechanism that ties the multiple failures together.

Date—Date of the event.

CCCG Level—Indicates the system size or number of redundant components that can be exposed to a CCF event.

Timing Factor—This is a measure of how close in time multiple failures occurred as represented by "q." This value ranges from 0.00 to 1.00.

Shared Cause Factor—Ties two failures together. This value ranges from 0.00 to 1.00, representing the analyst's assessment of the degree of presence of a factor or factors causing the propagation of the failure to more than one component. This factor provides the flexibility to classify events for which detailed information is not furnished to determine the presence of coupling factors. A value of 1 indicates that the analyst believes the failures in the event were coupled. Values less than one represent more uncertainty about the dependency of the failures.

Multiple Units—States if the event affected more than one unit at a site.

Operational Status-Detected—Shows when the event was detected.

Operational Status-Mode—Shows when the event occurred.

Event Type—Establishes which events are used in Probabilistic Risk Assessment (PRA) CCF parameter estimations.

Event Level—Establishes whether the failure affected just the component or the system.

Defense Mechanism—Describes the defenses that you can apply to the coupling factor to prevent the CCF event from occurring.

Component Degradation (P1-P8)—There are eight component degradation values. This value ranges from 0.00 to 1.00 and indicates the extent that the degraded component failed (see Reference 1).

Event Analysis provides the following functions:

<Esc> Exit—Terminates the Event Analysis screen and returns to the Applications screen.

<Del> Delete—Removes an event from the selected application. To delete an event, highlight the event and press <Del>. A prompt will ask if this event is to be removed from the application. Enter Y or N and press <Enter>. If Y is entered, CCF removes the event from the list immediately.

<F4> Comments—Views comments associated with the event. You cannot edit these comments.

<F5> Narratives—Views narratives associated with the event. You cannot edit these narratives.

<Enter> Impact Vector—Performs an event analysis (see Section 3.2.1).

<F8> Application Summary —Summarizes the CCF statistics summary (see Section 3.4).

4.1.1 SPECIFIC Event Impact Vector Analysis

To access the Application Specific Event Analysis screen (Figure 44), highlight the desired application and press <Enter>. The description window displays the first event (or the event highlighted) and its associated information. You can change the default values for the following fields: Cause, Shock Type, Component Degradation Level, Coupling, Map Up Factor, Event Type, Fail Mode, Timing Factor, Shared Cause Factor, Average Impact Vector, and Application Specific Impact. CCF uses these values to calculate the average impact vectors and the application specific impact vectors (shown in the bottom portion of the screen). Also, you can directly input the average impact vector, bypassing the CCF calculation altogether. A brief description of the Map Up Factor, Component Degradation Level, Average Impact Vector, and Application Specific Impact fields follows.

Map Up Factor—Reflects whether the target system size is larger, equal, or smaller than the original system (see Reference 2).

Component Degradation—You can supply up to four component degradation values. This Level (Value) value ranges from 0.00 to 1.00 and indicates to what extent a degraded component failed (see Reference 1).

Average Impact Vector—The calculation results (based on algorithms built in CCF) that define the average impact vector. You may input your own numbers, if desired, instead of using the CCF results (see Reference 2).

Application Specific—The calculation results (based on algorithms built in CCF) that adjust the Impact original impact vector by accounting for qualitative and quantitative differences between the original and target systems (see Reference 2).

```
Application
ACP_4KV_BKR_U_CC   Application Specific Event Analysis   1 of 21

Event Code  L-219-86-1158-CC
Title       4160V BREAKERS WITH POTENTIAL RESTART FAILURE.

Applicability Factors     Component Degradation Level
                          P1   P2   P3   P4   P5   P6   P7   P8
Cause          1.00       0.10 0.10 0.10 0.01 0.01 0.01 ---- ----
Coupling       1.00
Map Up Factor  1.00            Timing Factor  1.00     Event CCCG Size  6
Failure Mode   1.00      Shared Cause Factor  1.00     Appl. CCCG Size  6
                                                      Event Type     CCF

********************** Application Specific Impact Vector **********************

N/A   F1    F2    F3    F4    F5    F6    F7    F8
      ------ ------ ------ ------ ------ ------ ------ ------

<Esc>  <Enter>  <F1>  <F2>  <F3>      <F4>     <F5>    <F6>     <F7>  <F8>
Exit   Calculate Help  List View Event Comments Narr. Previous Next  Save
```

Figure 44. Specific—Application Specific Event Analysis screen.

NOTE: Use **<Tab>** to move from field to field on the screen.

Application Specific Event Analysis provides the following functions:

<Esc> Exit—Terminates the SPECIFIC Event Analysis screen and returns to the Event Analysis screen.

<Enter> Calculate—Calculates the impact vector based on the information provided. However, you may want to use specific values for the average impact vector. CCF allows you to edit this field.

<F2> List—Provides an L or NL selection for the Shock Type field. To select an L or NL, press **<F2>**, highlight your selection, and press **<Enter>**. Exit the list by pressing **<Esc>**.

<F3> View Event—Views event information, including the component degradation values. You can also view the comments associated with this event by pressing **<F4>** in the View Event screen.

<F4> Comments—Edits comments associated with the event analysis.

<F5> Narrative—Edits narrative associated with the event analysis.

<F6> Previous—Displays the previous event. This allows you to scroll back through the events in an application one record at a time.

<F7> Next—Displays the next event. This allows you to scroll forward through the events in an application one record at a time.

<F8> Save—Saves the current screen selections and values as the default values for the next time you summarize the statistics of the application. The message "Record saved" will appear at the bottom of the screen to verify this operation. The next event will then be displayed.

4.2 Application Summary

Application Summary calculates summary statistics for an application based, in part, on the impact vectors of the events belonging to that application. In addition, Calculate lets you perform these calculations based solely upon their input numbers, rather than using an application event list. To run Applications Summary, highlight the application you want and press <F8>. The CCF Summary Statistics screen (Figure 45) allows you to stagger the testing scheme in the calculations. You may also look at point estimates of events using the Alpha-Factor Model Distribution, Multiple Greek Letter Distributions, or look at the Bayesian Distribution for the Alpha-Factor Model.

```
Application CCCG        CCF Summary Statistics        Application
      6                                              ACP_4KV_BKR_U_CC

                 Model (Alpha, Multiple Greek, Both)  A
                 If Multiple Greek, Use Staggered?    Y
           Number of independent events (unadjusted)   191.00
             Number of independent events (adjusted)   174.42

     Average event CCCG Size                    6.57
     Events included in calculations             21 of   21

                          Impact Vector
              N1        N2        N3        N4
            14.6225   4.8550    1.3557    0.0250
              N5        N6        N7        N8
            1.8006    2.1000   ---------  ---------

     <Esc>    <F1>    <Enter>    <F3>    <F5>    <F7>
     Exit     Help    Calculate  Model   Save    Reports
```

Figure 45. Specific—CCF Summary Statistics screen.

CCF Summary Statistics provides the following functions:

<Esc> Exit—Terminates the CCF Summary Statistics screen, and then displays the Save/Cancel window if you performed any application summaries; otherwise, <Esc> returns to the Applications screen.

<F2> Independent Event Totals—Breaks down the number of independent events. This function is available when you place your cursor in the Number or Independent Events field. Press <F2> to access the Independent Event Totals screen (Figure 46).

NOTE: The <F2> key is enabled for the Number of Independent Events field only.

```
Application CCCG                 CCF Summary Statistics                Application
      4                                                              EDG_FR_NEW

 Independent Event Totals                    <Esc>
*+—Sys—Cmp—FM—Source——Total-                 Exit
*+  EPS  DGN  FR  LER      567.00
*+  EPS  DGN  FR  NPRDS      2.00            <F1>
    EPS  DGN  FS  LER      750.00            Help
    EPS  DGN  FS  NPRDS     11.00
    EPS  DGN  FX  LER       23.00            <F3>                569.00
                                            By Plant

                                         <F8> <F9> <F10>
                                         Mark  All Range         f   59

                                            <Enter>
                                           Use Total                    N6
   Marked Total =   569.00                                      00      0.0000
                                         <PgUp/PgDn>
                                        Prev/Next Page

"+" system, comp, fail mode found in app
"*" value included in totals                                      <F7>
                                                                 Reports
                 Press <F2> for breakdown of total
```

Figure 46. Specific—Breakdown of independent event total.

<Enter> Calculate—Recalculates the impact vectors and the point estimations of the models if you change your mapped and/or staggered selections for the application.

<F3> Model—Displays the point estimations for both models and the Bayesian Uncertainty Distribution for the Alpha-Factor Model (see Sections 4.2.1 and 4.2.2).

<F5> Save—Saves the current screen selections and values as the default values for the next time you summarize the statistics of the application. The message "Record saved" will appear at the bottom of the screen to verify this operation.

<F7> Report—Generates a special quantification report or an application report (see Section 4.3).

You can also alter the values included in the marked total value by adding or deleting independent events with the <F8>, <F9>, and <F10> keys (see Section 1.4).

<Esc> Exit—Terminates the Independent Event Totals screen without changing the number of independent events field used in the calculation.

<Enter> Use Total—Terminates the Independent Event Totals screen and changes the number of independent event field used in the calculation to the marked total shown on this screen.

<F3> By Plant—Breaks down the number of independent events for the highlighted entry by theplants which contributed to the total (Figure 47).

```
Application CCCG                CCF Summary Statistics                Application
     4                                                               EDG_FR_NEW

 Independent Event Totals                  <Esc>
*+—Sys—Cmp—FM—Source——T  —Independent Event Total——
*+  EPS  DGN  FR  LER     5
*+  EPS  DGN  FR  NPRDS
    EPS  DGN  FS  LER     7  Sys: EPS  Comp: DGN
    EPS  DGN  FS  NPRDS      FM:  FR   Src:  LER
    EPS  DGN  FX  LER                                  <Esc>
                                                       Exit
                             —Plant————————Total——
                             *  ARKANSAS 1          5.00   <F1>
                             *  ARKANSAS 2          5.00   Help
                             *  BEAVER VALLEY 1     0.00
                             *  BEAVER VALLEY 2     1.00
                             *  BIG ROCK POINT      3.00
                             *  BRAIDWOOD 1         1.00
                             *  BRAIDWOOD 2         1.00
  Marked Total =   569.00    *  BROWNS FERRY 1      4.00
                             *  BROWNS FERRY 2      1.00
                             *  BROWNS FERRY 3      4.00
                                              ———————
"+" system, comp, fail mode                Total:  567.00
"*" value included in totals                                Reports
                 Press <F2> for breakdown of total
```

Figure 47. Specific—Breakdown of independent event totals by plant.

4.2.1 Alpha-Factor Model

The Alpha-Factor Model displays Bayesian Distributions, point estimates, and uncertainty summary information for the model. To initiate this model, type an A in the Model field. Press <F3> to access the Select Display Type (Figure 48). Use the up and down arrow keys to highlight the appropriate uncertainty calculation method or type the highlighted letter into the Option field. Press <Enter> to access either the Point Estimate screen (Figure 49), the Nonhomogeneous Bayesian Plant to Plant Distribution menu (see Section 4.2.1.2), the Homogeneous Bayesian screen (see Section 4.2.1.3), or the Uncertainty Summary screen (see Section 4.2.1.4).

4.2.1.1 Point Estimate. The Alpha-Factor Model Point Estimate screen provides the following functions:

<Esc> Exit—Terminates this screen and returns to the Alpha-Factor model menu.

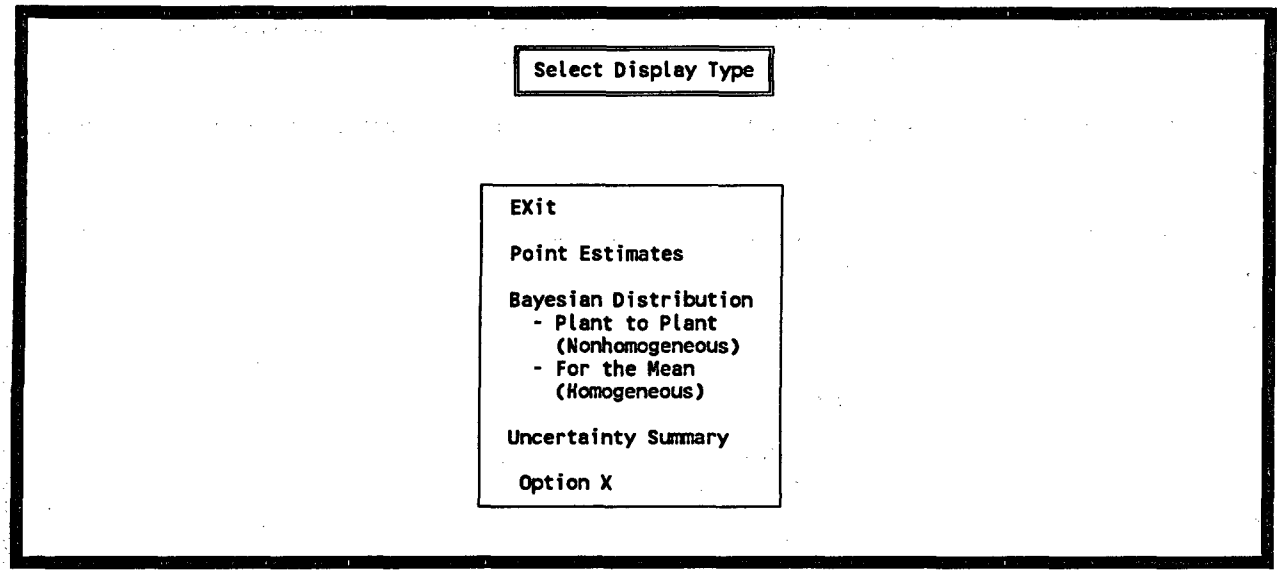
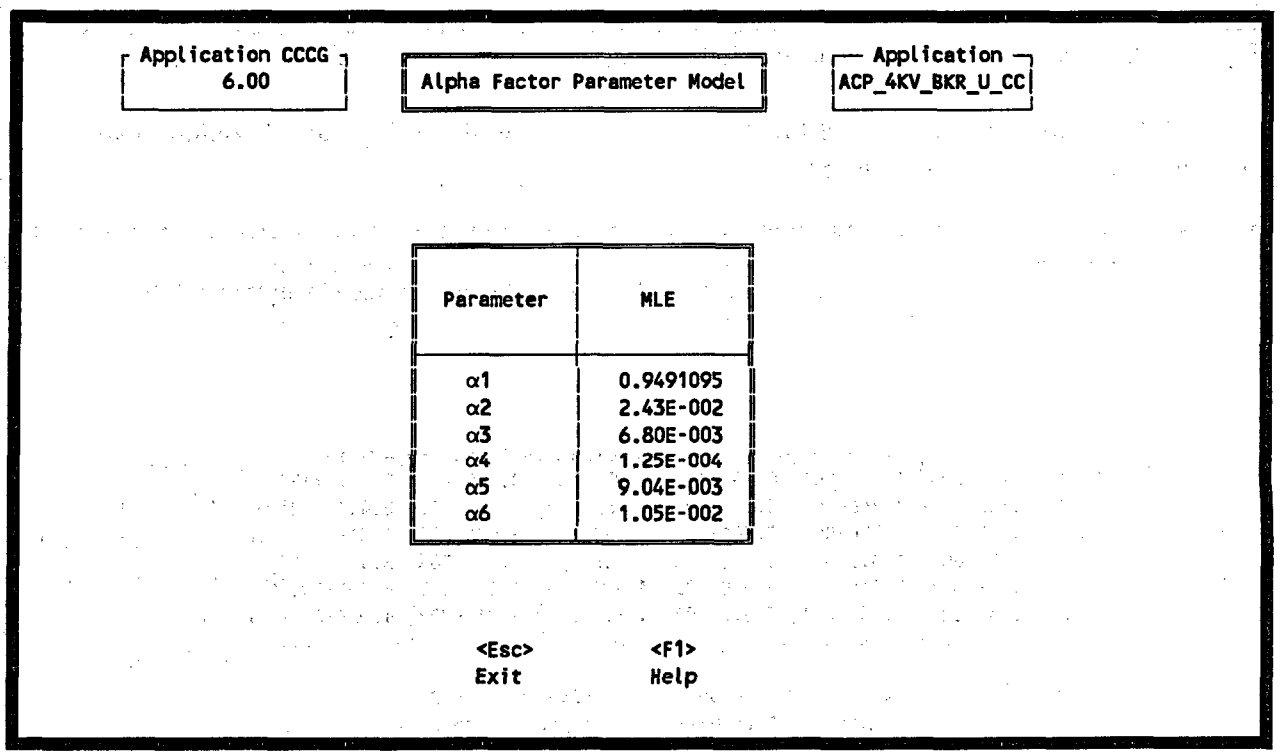


Figure 48. Specific—Alpha-Factor Model menu.



Parameter	MLE
α1	0.9491095
α2	2.43E-002
α3	6.80E-003
α4	1.25E-004
α5	9.04E-003
α6	1.05E-002

Figure 49. Specific—Alpha-Factor Model Point Estimate screen.

4.2.1.2 Nonhomogeneous Bayesian Distributions or Plant to Plant Distributions. The Nonhomogeneous Bayesian Model Selection Menu is shown in Figure 50. Use the up and down arrow keys to highlight the appropriate model calculation method or type the highlighted letter into the Option field. Press **<Enter>** to access either the Constrained Noninformative Prior Method (see Section 3.4.1.2.1) or the

Hierarchical Bayesian Method (see Section 3.4.1.2.2). Press <Esc> to return to the Alpha-Factor Model menu.

```
Select Nonhomogeneous Model

EXit

Constrained Noninformative Prior
Hierarchical Bayes Method

 Option X

<Esc>
Exit
```

Figure 50. Specific—Nonhomogeneous Model menu.

4.2.1.2.1 Constrained Noninformative Prior—The results of Constrained Noninformative Prior calculations are displayed in Figure 51.

```
Application CCCG
     6.00

Constrained Noninformative
      Prior Results

Application
ACP_4KV_BKR_U_CC
```

	a	b	5th%	Median	95th%	Mean
α1	7.74E+000	4.15E-001	0.7958122	0.9791301	0.9999279	0.9490712
α2	4.60E-001	1.84E+001	6.30E-005	1.06E-002	9.55E-002	2.44E-002
α3	4.90E-001	7.25E+001	2.39E-005	3.02E-003	2.58E-002	6.71E-003
α4	5.00E-001	1.39E+003	1.42E-006	1.63E-004	1.37E-003	3.59E-004
α5	4.86E-001	5.44E+001	3.04E-005	3.97E-003	3.42E-002	8.86E-003
α6	4.83E-001	4.55E+001	3.50E-005	4.70E-003	4.06E-002	1.05E-002

```
<Esc>    <F3>       <F5>     <F7>
Exit  Full Distr.  Graphs  Reports
```

Figure 51. Specific—Constrained Noninformative Prior Results.

The Constrained Noninformative Prior Results provides the following functions:

<Esc> Exit—Terminates this screen and returns to the Nonhomogeneous Model menu.

<F3> Full Distribution—Displays the full distribution for each applicable alpha. (Figure 52).

<F5> Graphs—Plots the probability density or cumulative distribution. To initiate this function, press <F5>, enter the plot type either cumulative or density and press <Enter>. Next enter the alpha parameter to plot (from 1 to CCCG number), and then press <Enter> to plot the distributions.

<F7> Reports—Prints an Estimation Report of the Constrained Noninformative Prior Results.

Q	A*1 1.91E+001	A*2 5.95E+000	A*3 4.70E+000
0.005	4.08E-001	5.60E-002	3.47E-002
0.010	4.31E-001	6.49E-002	4.14E-002
0.025	4.65E-001	7.95E-002	5.28E-002
0.050	4.94E-001	9.37E-002	6.42E-002
0.100	5.28E-001	1.12E-001	7.94E-002
0.200	5.68E-001	1.37E-001	1.00E-001
0.250	5.84E-001	1.47E-001	1.09E-001
0.300	5.98E-001	1.57E-001	1.18E-001
0.400	6.22E-001	1.75E-001	1.34E-001
0.500	6.45E-001	1.93E-001	1.50E-001
0.600	6.67E-001	2.12E-001	1.67E-001
0.700	6.90E-001	2.33E-001	1.86E-001
0.750	7.03E-001	2.45E-001	1.98E-001
0.800	7.16E-001	2.59E-001	2.11E-001
0.900	7.51E-001	2.96E-001	2.46E-001
0.950	7.78E-001	3.29E-001	2.78E-001
0.975	8.01E-001	3.58E-001	3.06E-001
0.990	8.25E-001	3.92E-001	3.40E-001
0.995	8.40E-001	4.16E-001	3.63E-001

<Esc>
Exit

Figure 52. Specific—Full distribution of the Alpha-Factor model.

4.2.1.2.2 Hierarchical Bayesian Method—The results of Hierarchical Bayesian menu is displayed in Figure 53.

```
Hierarchical Bayesian Method

EXit

View Previous Results
Run New Calculation

Option: X

<Esc>      <Enter>
Exit       Continue
```

Figure 53. Specific—Hierarchical Bayesian Method menu.

Use the up and down arrow keys to highlight the appropriate selection or type the highlighted letter into the Option field. Press <Enter> to either View Previous Results (see Section 4.2.1.2.2.1) or Run New Calculation (see Section 4.2.1.2.2.2). Press <Esc> to return to the Nonhomogeneous Model menu.

4.2.1.2.2.1 Hierarchical Bayesian Method—View Previous Results—The results of the last Hierarchical Bayesian calculation saved will be displayed in Figure 54.

The Hierarchical Bayesian Method results screen provides the following functions.

```
Average CCCG
  2.83

Bayesian Distribution
Using Beta Binomial Calculation

Application
EDG_FR_NEW
```

	a	b	5th%	Median	95th%	Mean
α1	1.00E+001	5.30E-001	8.89E-001	9.60E-001	9.91E-001	9.50E-001
α2	6.64E+000	2.14E+002	1.36E-002	2.87E-002	5.15E-002	3.00E-002
α3	3.46E-001	2.39E+001	1.00E-004	3.07E-003	7.00E-002	1.42E-002

```
<Esc>      <F3>        <F5>      <F7>
Exit       Full Distr. Plot      Print
```

Figure 54. Specific—Hierarchical Bayesian Method results.

<Esc> Exit—Terminates this screen and returns to the Hierarchical Bayesian menu screen.

<F3> Full Distribution—Displays the full posterior distribution for each applicable alpha (Figure 52).

<F5> Plot Distribution—Plots the probability density or cumulative distribution. To initiate this function, press <F5>, enter the plot type either cumulative or density and press <Enter>. Next enter the alpha parameter to plot (from 1 to CCCG number), and then press <Enter> to plot the distributions.

<F7> Print Model—Prints an Estimation Report of the Hierarchical Bayesian Method Distribution. See Sections 3.5.1 and 3.5.5 for more details.

4.2.1.2.2.2 Hierarchical Bayesian Method—Run New Calculations—An introduction screen (Figure 55) provides information about the Hierarchical Bayesian calculation.

```
Intermediate files may be saved during the computation.  To save these files
select yes in Save Files and enter a file name.

Save Files: N (Y/N)
File Name : DATAFILE
```

	Run Calc.	Use Ln Scale	Cmp Bnds	User Defined Boundaries Alpha Minimum	Alpha Maximum	Alpha Pts	Beta Minimum	Beta Maximum	Beta Pts
1	X			3.29E-001	1.77E+003	100	1.23E-002	1.58E+001	100
2	X		X	-----E----	-----E----	---	-----E----	-----E----	---
3	X		X	-----E----	-----E----	---	-----E----	-----E----	---
4	X		X	-----E----	-----E----	---	-----E----	-----E----	---
5	X		X	-----E----	-----E----	---	-----E----	-----E----	---
6	X		X	-----E----	-----E----	---	-----E----	-----E----	---

```
<Esc>      <Enter>
Exit       Continue
```

Figure 55. Specific—Hierarchical Bayesian Method—Run new calculation initial screen.

To create intermediate files, enter Y, and enter a name for the file(s). The Hierarchical Bayesian method may be run for an individual alpha, several alpha values, or for all of the alpha values. To run the calculation for an alpha place an X in the Run Calculation Column. If you wish to have the computer generate the boundaries, place an X in the Computer Ends column. If you wish to use the Log Normal Scale, place an X in the Use Ln Scale Column.

<Esc> Exit—Terminates this screen and returns to the Hierarchical Bayesian menu screen.

<Enter> Continue—Continues with the Hierarchical Bayesian Calculation.

Calculation progress updates will be displayed at the bottom of the screen throughout the calculation. To terminate the calculation at anytime, press <Esc>. A message will appear asking you to confirm the termination of the calculation, press Y to terminate, N to cancel the terminate and continue the calculation.

Once the calculation has completed the Hierarchical Bayesian Method Results screen (Figure 54) will be displayed.

4.2.1.3 Homogeneous Bayesian Distributions. The results of Homogeneous Bayesian calculations are displayed in Figure 56.

Application CCCG 6.00

Alpha-Factor Model Distributions

Application ACP_CB4_CC

Prior Distribution Summary

	a	b	5th%	Median	95th%	Mean
α1	9.50E+000	5.00E-001	8.12E-001	9.75E-001	9.99E-001	9.50E-001
α2	2.50E-001	9.75E+000	2.83E-006	4.64E-003	1.21E-001	2.50E-002
α3	5.00E-002	9.95E+000	2.09E-007	7.84E-007	2.76E-002	5.00E-003
α4	5.00E-002	9.95E+000	2.09E-007	7.84E-007	2.76E-002	5.00E-003
α5	5.00E-002	9.95E+000	2.09E-007	7.84E-007	2.76E-002	5.00E-003
α6	1.00E-001	9.90E+000	4.00E-007	6.47E-005	5.95E-002	1.00E-002

Posterior Distribution Summary

	a	b	5th%	Median	95th%	Mean	MLE
α1	2.11E+002	8.90E+000	9.35E-001	9.60E-001	9.78E-001	9.59E-001	9.60E-001
α2	1.89E+000	2.18E+002	1.43E-003	7.15E-003	2.06E-002	8.59E-003	7.84E-003
α3	9.13E-001	2.19E+002	1.66E-004	2.77E-003	1.28E-002	4.15E-003	4.11E-003
α4	5.08E-002	2.19E+002	1.50E-007	8.87E-006	1.23E-003	2.31E-004	3.80E-006
α5	1.85E+000	2.18E+002	1.35E-003	6.97E-003	2.03E-002	8.41E-003	8.56E-003
α6	4.20E+000	2.15E+002	6.80E-003	1.76E-002	3.63E-002	1.91E-002	1.95E-002

<Esc> Exit | <Enter> Calculate | <F3> Full Distrib | <F5> Plot | <F7> Print

Figure 56. Specific—Homogeneous Bayesian Distribution.

The Homogeneous Bayesian Distribution screen provides the following functions:

<Esc> Exit—Terminates this screen and returns to the Alpha Factor Model menu.

<Enter> Calculate—Allows you to enter distribution parameters from A1 to CCCG size and then calculates the prior and posterior distribution summaries.

NOTE: The Program calculates the distributions using the set of input values in column "a". Default values in column "a" are provided, based on the CCCG size. You can input your own "a" values and recalculate the distributions. Save the application to retain the new values; otherwise, exit from the option, and the program will default back to the original values suggested in column "a". Note that any time you change the CCCG size for the application, the program will default to the suggested values in column "a" for the new CCCG size.

<F3> Full Distribution—Displays the full posterior distribution for each applicable alpha (Figure 52).

<F5> Plot Distribution—Plots the probability density for the prior and posterior distributions. To initiate this function, press <F5>, enter the alpha parameter to plot (from 1 to 6), and then press <Enter> to plot the distributions.

<F7> Print Model—Prints an Estimation Report of the Bayesian Distribution. See Sections 3.5.1 and 3.5.5 for more details.

4.2.1.4 Bayesian Uncertainty Summary. The results of Bayesian Uncertainty calculations are displayed in Figure 57.

Application CCCG 6.00

Bayesian Distribution
Summary of Uncertainty Results
for α1

Application ACP_4KV_BKR_U_CC

Type: Specific

Uncertainty	a	b	5th%	Median	95th%	Mean
Constrained Noninformat.	+0.00E+000	+0.00E+000	+0.00E+000	+0.00E+000	+0.00E+000	+0.00E+000
Hierarchical Bayesian	7.07E+001	2.39E+000	9.27E-001	9.71E-001	9.92E-001	9.67E-001
From the Mean	+0.00E+000	+0.00E+000	+0.00E+000	+0.00E+000	+0.00E+000	+0.00E+000

<Esc> Exit <F7> Print <F8> Previous Screen <F9> Next Screen

Figure 57. Specific—Bayesian Uncertainty Summary.

The Bayesian Uncertainty Summary screen (Figure 57) provides the following functions.

<Esc> Exit—Terminates this screen and returns to the Alpha Factor Model menu.

<F7> Print Model—Prints an Uncertainty Summary Report of the Bayesian Distributions. See Sections 3.5.1 and 3.5.5 for more details.

<F8> Previous Screen—Displays the previous alpha comparison screen.

<F9> Next Screen—Displays the next alpha comparison screen.

4.2.2 Multiple Greek Letter Model

To initiate the Multiple Greek Letter models (Figure 58), type an M in the Model field (Figure 45).

```
Multiple Greek Factor Parametric Model

Application CCCG  4

| Parameter | MLE |
|---|---|
| Beta | 5.85E-002 |
| Gamma | 5.54E-001 |

<Esc>      <Enter>      <F1>
Exit       Summary      Help
```

Figure 58. Specific—Multiple Greek Factor Parametric Model.

4.3 Search Reports

Press <F7> to access the Search Reports options. See Sections 3.5.3 through 3.5.6 for more details about these report options.

5. REPORT

REPORT generates report outputs based on: applications, independent events (IE) totals, events, event text, etc. To generate a report, type **R** or use the up and down arrow keys to highlight REPORTS. Press **<Enter>** to access the Reports main menu (Figure 59).

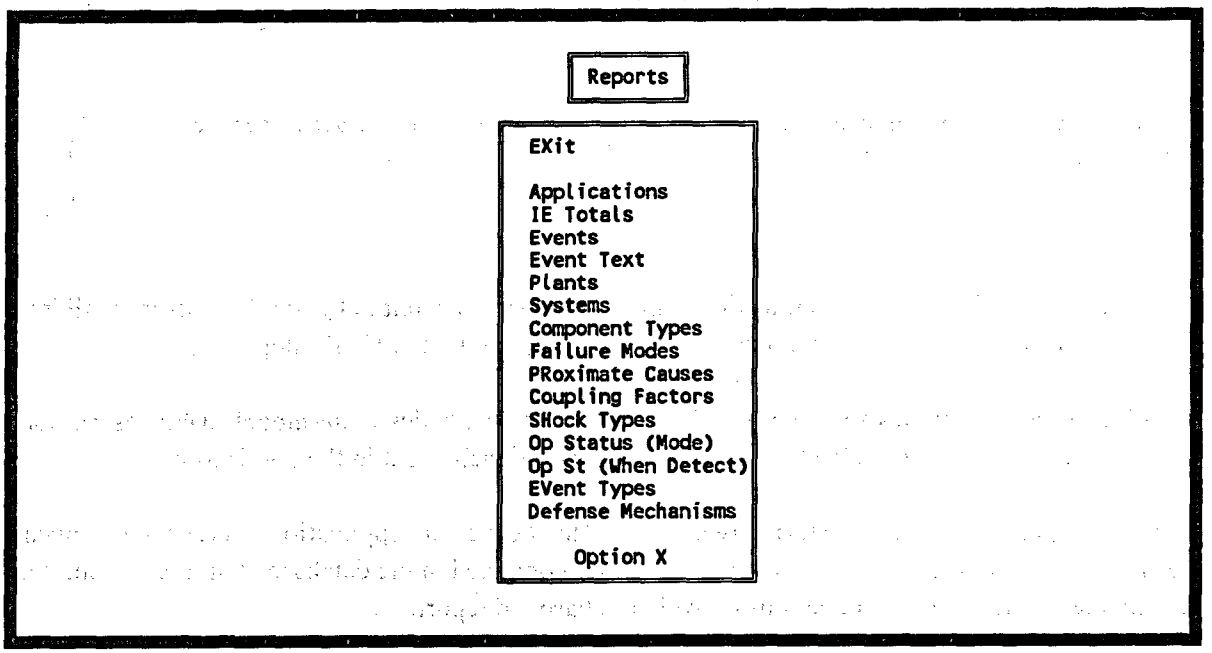


Figure 59. Reports main menu.

5.1 Applications

Applications generates a report based on selected applications. To select applications, Type **A** or use the up and down arrow keys to highlight Applications. Press **<Enter>** to access the Application Reports screen (Figure 60).

Choose either a generic or specific report and press **<Enter>** to access the Application Reports options screen (Figure 61). The following reports are available to either selection:

Application Summary—Generates an application listing showing the application name, CCCG level, description, and associated events for each application selected.

Calculation Results—Furnishes the application name, CCCG, average event redundancy, adjusted or unadjusted independent events, total number of events in application, included in total (events included in the calculation), system, component, failure mode, source, total events in application, alpha-model values, and associated events.

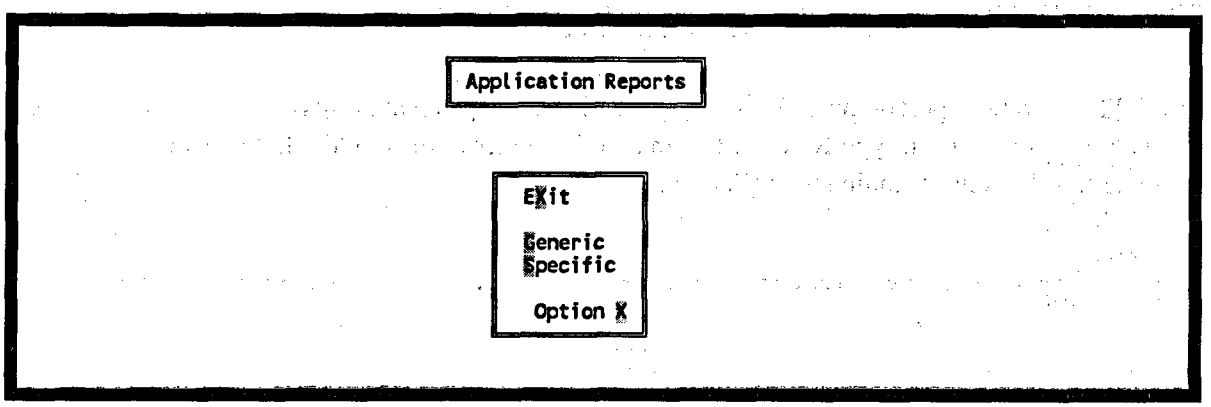


Figure 60. Application Reports menu.

Event Statistics—Provides the application name, component, a count of the total events that fall into the various CCCG, shock types, coupling factors, failure modes, and other CCF categories.

Detailed Events—Provides a hard copy of the CCF summary statistics, alpha model, event description, event analysis, and plant-specific impact vector assessments for each event in the application.

Whatever report type you select, a screen similar to the Select Applications screen will appear (Figure 62). This screen displays all applications currently contained in the database. On this screen, you must indicate the application or applications on which to base the report.

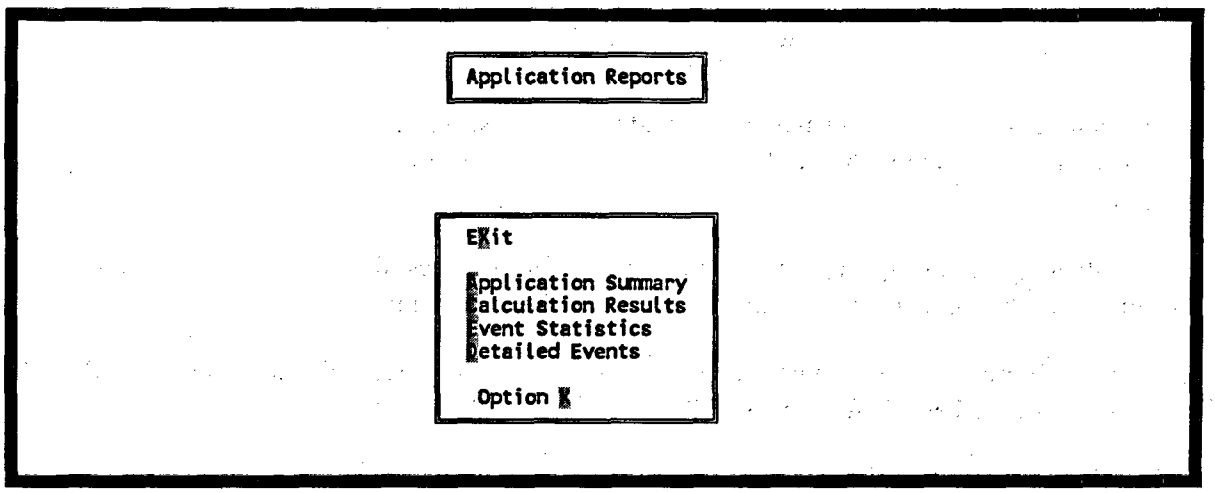


Figure 61. Application Reports options menu.

```
                    Select Applications

AFWMOTFS
AFWPMPFR
AFWPMPFS
AFWPMPFX
AFWTURFR
AFWTURFS
AFWVLVVC
AFWVLVVO

Name          AFWPMPFS
Description

     CCCG Level  4          Component Type              Failure Mode

   <Esc>          <Enter>          <F8>          <F9>          <F10>
   Exit           Select           Mark          All           Range
```

Figure 62. Select applications to report.

Select Applications provides the following functions:

<Esc> Exit—Terminates the Select Applications screen and returns to the Application Reports menu.

<Enter> Select—Chooses the currently highlighted application (or applications) for reporting. Press <Enter> to access the Report Option screen (Figure 63). CCF provides a default report title; however, you may change this by simply typing-over existing text. In addition, you must specify an output destination. As a default, the screen will display the report. However, you may change this to one of the following:

- **PRN** Prints the report on the attached printer.
- **" "** If the file name is left blank, no report will be generated.
- **<Esc>** No report will be generated.
- **other** Enter a valid DOS filename. The report will be printed to that file. This file can then be printed later or transferred to another machine via a diskette.

Once you supply an output destination, press <Enter>. The report will be generated.

```
Report Options

Report Title
Applications Listing

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 63. Report Options screen—Applications Listing.

5.2 Events

To produce this report, type E on the Reports main menu (Figure 59) or use the up and down arrow keys to highlight Events. Press <Enter> to access the Events Report screen (Figure 64). On this screen, you must indicate the sort order for the report. As shown, you can sort the report by plant name, system, component types, or failure modes. Sort the events by highlighting an order or select an order by entering the highlighted letter. Press <Enter> to access the Report Options screen (Figure 63). Refer to Section 5.1.

```
Events Report

Sort Events By...

  Name
  System
  Component
  Failure Mode

  Option
```

Figure 64. Select sort order for Events Report.

5.3 Event Text

To create this report, type an **T** on the Report main menu or use the up and down arrow keys to highlight Event Text. Press **<Enter>** to access the Event Reports screen (Figure 65). Select the events to report using **<F8>**, **<F9>**, and **<F10>** as described in Section 1.4. Once you have marked the events, press **<Enter>** to access the Report Options screen (Figure 63). Refer to Section 5.1.

```
                    Event Reports

L-XXX-80-0014-FS NEITHER AFP STARTED DUE TO AUTOSTART DEFEAT SWITCH ON
L-XXX-83-0010-FR THRUST BEARING TEMPERATURE HIGH DUE TO IMPROPER MAINTENANCE
L-XXX-83-0055-FR LEAKING CHECK VALVE CAUSED AFPS TO BECOME VAPOR BOUND
L-XXX-87-0004-FR BOTH M-D AFPS TRIPPED DUE TO SUCTION PRESSURE FLUCTUATIONS
N-XXX-68-0024-FR ALL DIESEL GENERATORS FAILED TO RUN.
N-XXX-72-0026-FS DIESEL GENERATOR WOULDN'T START DUE TO DESIGN DEFICIENCY.
N-XXX-73-0023-FS BOTH DIESELS FAILED TO START DUE TO WATER IN AIR SYSTEM.
N-XXX-73-0025-FS NEITHER DIESEL GENERATOR COULD RESTART.
N-XXX-73-0027-FR INCORRECT LINEUP PREVENTED DIESEL GENERATOR OPERATION.
N-XXX-73-0035-FR DIESEL AIR START SOLENOID VALVE RELAY CIRCUIT DESIGN ERROR.
N-XXX-74-0018-FR RHR SUCTION VALVE CLOSURE CAUSED RCS BOILING.
N-XXX-75-0032-FR DIESEL GENERATOR CONTROL WIRES BURNED.
N-XXX-76-0012-FS RHR PUMPS PREVENTED FROM RESTARTING
N-XXX-76-0054-FS FEEDWATER PUMP FAILED DUE TO VAPOR BOUND
N-XXX-77-0020-FR DIESEL GENERATOR RADIATOR TUBES PLUGGED.

<Esc>     <Enter>    <F8>     <F9>     <F10>
Back      Report     Mark     All      Range
```

Figure 65. Select Event Report screen.

5.4 Plants

To start this report, type **P** on the Reports main menu or use the up and down arrow keys to highlight Plants. Press **<Enter>** to access the Plants Report screen (Figure 66). From this screen, you must indicate the sort order for the report. As shown, you can sort the plants by plant name or plant type. Select an order by entering the highlighted letter or highlighting Name or Type. Press **<Enter>** to access the Report ptions screen (Figure 63). Refer to Section 5.1.

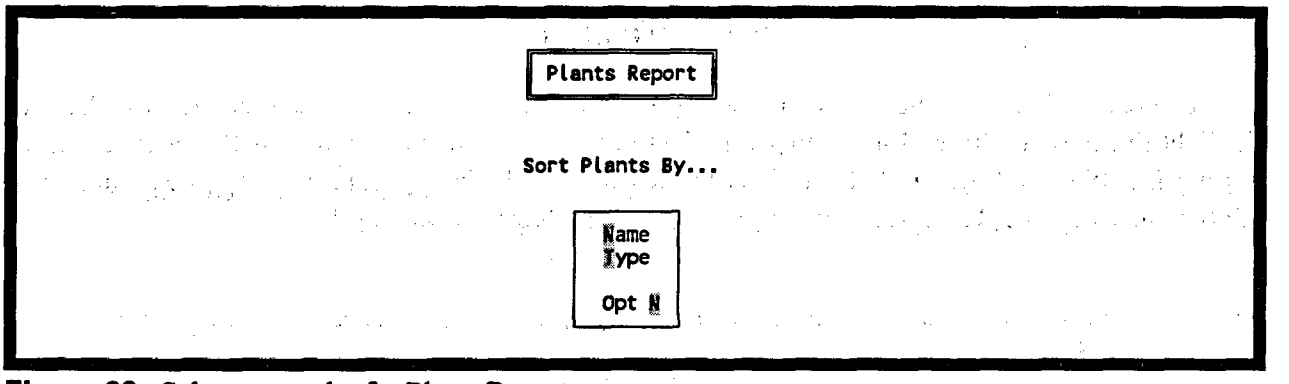


Figure 66. Select sort order for Plants Report.

5.5 Other Report Options

You can run the other report options listed in the Reports menu by typing the highlighted letter or using the up and down arrow keys to highlight option. Press <Enter> to access the Report Options screen (Figure 63). Refer to Section 5.1.

6. UTILITY

UTILITY rebuilds the database, changes the monitor type, calculates "what if" situations, converts parameters from one model to another, or changes your password. To select UTILITY, type **U** on the main menu or use the up and down arrow keys to highlight UTILITY. Press **<Enter>** to access the main menu of the Utilities screen (Figure 67). The following sections discuss each Utility option.

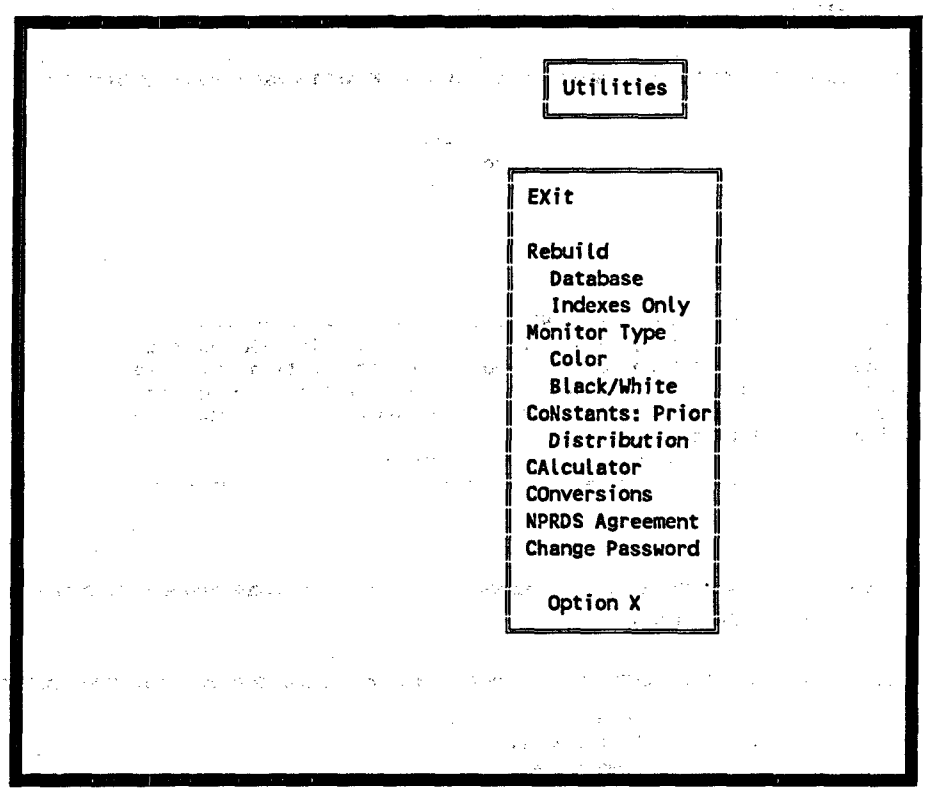


Figure 67. Utility main menu.

6.1 Rebuild

Rebuild restructures the database and re-indexes the data. If the data seems corrupted, perform a rebuild. However, you may rebuild the database anytime because the rebuild process compacts the data and generally helps the software run faster.

There are two types of rebuild: Database and Indexes Only. The Database option rebuilds all database files. The Indexes Only option reconstructs all index files (e.g., *.IDX). Use the Indexes Only option when access to data via the index files has been corrupted.

6.1.1 Database Option

If the database has been damaged, use the Database option to recover all data files; otherwise, use this option to restructure and optimize the database.

To recover the database, type **D** or use the up and down arrow keys to highlight Database. Press **<Enter>** to access the Database Recovery screen (Figure 68). Enter a **Y** and press **<Enter>** to continue, or enter an **N** and press **<Enter>** to terminate the rebuild process.

6.1.2 Indexes Only Option

To rebuild the indexes only, type **I** or use the up and down arrow keys to highlight Indexes Only. Press **<Enter>** to access the Index Recovery screen (Figure 69). Enter a **Y** and press **<Enter>** to continue, or enter an **N** and press **<Enter>** to terminate the rebuild process.

```
Database Recovery

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 database.
                    Do you wish to continue? |N|
```

Figure 68. Database Recovery screen.

```
Index Recovery

WARNING...
All database indexes 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 will be somewhat faster than the
Rebuild Data Base option, but will not restructure and optimize your
database (if needed) -- only attempt to correct index errors.
                    Do you wish to continue? |N|
```

Figure 69. Index Recovery screen.

6.2 Monitor Type

You can specify monitor type and select color or black and white. CCF will adjust appropriately.

6.3 Constants-Prior Distribution

You can specify constant values used in the CCF uncertainty calculations for prior distribution parameters To select Constants, type **N** or use the up and down arrow keys to highlight Constant. Press **<Enter>** to access the prior distribution parameters screen (Figure 70). From this screen, you may specify the initial "a" and "b" parameters to be used in the uncertainty distribution calculations. Enter the "a" and "b" values in the appropriate fields. Press **<Enter>** to save the information and return to the Constants menu. Press **<Esc>** to terminate and return to the Constants menu.

Prior Distribution Default Values

	2	3	4	5	6
a1 b1	9.50E+000 5.00E-001	9.50E+000 5.00E-001	9.50E+000 5.00E-001	9.50E+000 5.00E-001	9.50E+000 5.00E-001
a2 b2	5.00E-001 9.50E+000	4.00E-001 9.60E+000	3.50E-001 9.65E+000	3.00E-001 9.70E+000	2.50E-001 9.75E+000
a3 b3		1.00E-001 9.90E+000	5.00E-002 9.95E+000	5.00E-002 9.95E+000	5.00E-002 9.95E+000
a4 b4			1.00E-001 9.90E+000	5.00E-002 9.95E+000	5.00E-002 9.95E+000
a5 b5				1.00E-001 9.90E+000	5.00E-002 9.95E+000
a6 b6					1.00E-001 9.90E+000

<Esc> Exit w/o Save <Enter> Exit w/ Save

Figure 70. Prior Distribution constants.

6.4 Calculator

Calculator allows you to perform "what if" sensitivity type calculations. The calculator option is not tied to an application; therefore, the calculations are based solely on the input of numbers. To calculate "what if" calculations, type **A** or use the up and down arrow keys to highlight Calculator. Press **<Enter>** to access the Calculator screen (Figure 71). On this screen, you may supply the following data:

Mapped — Enter **Y** or **N** for mapped or unmapped calculations.

Staggered — Enter a **Y** or **N** for staggered calculations.

Model	Enter an A (alpha) or M (Multiple Greek) to indicate type of modeling desired.
Number of independent events	Enter the number of independent events associated with this application.
CCCG level	Enter the number of redundant components in a system. This number ranges from 2 to 8.
N1 to N8	Enter values to represent the total impact vectors for the number of events being postulated.

```
                    Calculator

        Model (Alpha, Multiple Greek, Both)
        If Multiple Greek, Use Staggered?    Y
              Number of independent events      0.00
                                CCCG Size  --

              Expected Number of Events
        N1        N2        N3        N4
---------  ---------  ---------  ---------
        N5        N6        N7        N8
---------  ---------  ---------  ---------

      <Esc>        <F1>        <Enter>
      Exit         Help         Model
```

Figure 71. Calculator screen.

After you complete data entry, choose one of the following functions.

<Esc>	Exit—Terminates the Calculator screen and returns to the Utilities menu.
<Enter>	Model—Displays the point estimations for both models and the Bayesian Uncertainty for the Alpha-Factor Model. See Sections 3.4.1 and 3.4.2.

6.5 Conversions

Conversion allows you to covert parameters from the Multiple Greek Letter model to the equivalent parameters for the Alpha-Factor Model and vice-versa. Select Conversion by typing **O** from the utility main menu or using the up and down arrow keys to highlight the option. Press **<Enter>** to access the Select Conversion Type screen (Figure 72).

```
Select Conversion Type

EXit

MGL to Alpha
Alpha to MGL

  Option X
```

Figure 72. Select Conversion Type screen.

To initiate the process, type **M** for Multiple Greek Letter Distribution parameters or use the up and down arrow keys to highlight an option. Press **<Enter>** to access the CCCG Level screen (Figure 73).

```
CCCG Level

Enter CCCG level for parameter conversion  4

<Esc>          <Enter>
Exit           Conversion
```

Figure 73. CCCG Level screen.

Enter the CCCG level (from 2 to 8) for parameter conversion. Press **<Enter>** to access the conversion screen (Figure 74 or Figure5).

MGL to ALPHA Conversion

CCCG Size 3

MGL INPUTS

Parameter	MLE
Beta	-----E----
Gamma	-----E----

ALPHA RESULTS

Parameter	MLE
α1	----------
α2	-----E----
α3	-----E----

Use Staggered Testing? Y

<Esc> Exit

<Enter> Calculate

Figure 74. MGL to Alpha Conversion screen.

ALPHA to MGL Conversion

CCCG Size 3

ALPHA INPUTS

Parameter	MLE
α 1	----------
α 2	-----E----
α 3	-----E----

MGL RESULTS

Parameter	MLE
1-Beta	-----E----
Beta	-----E----
Gamma	-----E----

Use Staggered Testing? Y

<Esc> Exit

<Enter> Calculate

Figure 75. Scaled Basic to Alpha Model Conversion screen.

Enter parameter values into the input field of the conversion screen, and press <Enter> to convert the initial parameters to Alpha-Factor Model parameters. Press <Esc> to return to the Select Conversion Type screen.

6.6 NPRDS Agreement

To view the NPRDS Agreement, press R or highlight NPRDS Agreement and press <Enter> The NPRDS Agreement screen (Figure 76) will be displayed. Press the <Page Down> button to view the remainder of the agreement (Figure 77). Press the <Page Up> button to view the first page of the agreement (Figure 76). Press <Esc> to return to the utility menu.

6.7 Change Password

To change your password, press P or highlight Change Password and press <Enter>. Type in your current password to proceed to the Password Changing Utility screen (Figure 78). First CCF will ask you to "Type in desired password." Then press <Enter>. Next, CCF will ask you to "Retype Password to Verify." Press <Enter> to confirm your new password. CCF will confirm if it accepted your new password.

```
                    NPRDS Conditions of Use

BY USING THE COMMON CAUSE FAILURE DATABASE, WHICH CONTINS NPRDS DATA,
YOU AGREE TO THE FOLLOWING CONDITIONS: The data contained in the
Nuclear Plant Reliability Data System (NPRDS) are the exclusive property
of the Institute of Nuclear Power Operations (INPO) and the U.S. nuclear
utility members of INPO. NPRDS may be used only to promote safety and
reliability in the operation of commercial nuclear power plants.

INPO strictly prohibits any use of NPRDS, or data obtained through NPRDS,
in marketing, advertising, solicitations, proposals, and similar activities.

Data obtained through NPRDS are confidential. Disclosure is prohibited
without the express written advance consent of INPO. In addition disclosure
of data that identify and individual nuclear power plant is prohibited
without the express, written, advance consent of the Member of INPO that has
primary authority for the operation of that plant. Any disclosure to the
U.S. Nuclear Regulatory Commission is permitted, without any consent,
provided that the disclosure is accompanied by a statement that NPRDS data

          <Esc> - Exit      <PgDwn> - Continue Reading Conditions
```

Figure 76. NPRDS Agreement screen.

NPRDS Conditions Of Use (cont.)

are confidential, commercial information and the exclusive property of INPO.

Any individual or organization that obtains access to NPRDS by means of contract with an INPO Member shall return to the Member all NPRDS data, user identification codes, passwords, documentation, and similar items at the conclusion of the contract.

<Esc>
Exit

<PgUp>
Previous Page

Figure 77. NPRDS Agreement screen (cont.).

Password Change Utility

Type in desired Password

Password:

Retype Password to Verify

Password:

Figure 78. Password Change Utility screen.

7. REFERENCES

1. U.S. Nuclear Regulatory Commission, *Common Cause Failure Database and Analysis System, Volume 3, Data Collection and Event Coding*, NUREG/CR-6268, June 1998, INEEL/EXT-97-00696.

2. U.S. Nuclear Regulatory Commission, *Common Cause Failure Database and Analysis System Volume 2, Event Definition and Classification*, NUREG/CR-6268, June 1998, INEEL/EXT-97-00696.

GLOSSARY

Application—A particular set of CCF events selected from the common cause failure database for use in a specific study.

Average Impact Vector—An average over the impact vectors for different hypotheses regarding the number of components failed in an event.

Basic Event—An event in a reliability logic model that represents the state in which a component or group of components is unavailable and does not require further development in terms of contributing causes.

Common Cause Event—A dependent failure in which two or more component fault states exist simultaneously, or within a short time interval, and are a direct result of a shared cause.

Common Cause Basic Event—In system modeling, a basic event that represents the unavailability of a specific set of components because of shared causes that are not explicitly represented in the system logic model as other basic events.

Common Cause Component Group—A group of (usually similar [in mission, manufacturer, maintenance, environment, etc.]) components that are considered to have a high potential for failure due to the same cause or causes.

Common Cause Failure Model—The basis for quantifying the frequency of common cause events. Examples include the beta factor, alpha factor, and basic parameter, and the binomial failure rate models.

Complete Common Cause Failure—A common cause failure in which all redundant components are failed simultaneously as a direct result of a shared cause; i.e., the component degradation value equals 1.0 for all components, and both the timing factor and the shared cause factor are equal to 1.0.

Component—An element of plant hardware designed to provide a particular function.

Component Boundary—The component boundary encompasses the set of piece parts that are considered to form the component.

Component Degradation Value (p)—The assessed probability ($0.0 \leq p \leq 1.0$) that a functionally or physically degraded component would fail to complete the mission.

Component State—Component state defines the component status in regard to its intended function. Two general categories of component states are defined, *available* and *unavailable*.

- *Available*—The component is available if it is capable of performing its function according to a specified success criterion. (N.B., available is not the same as availability.)

- *Unavailable*—The component is unavailable if the component is unable to perform its intended function according to a stated success criterion. Two subsets of unavailable states are *failure* and *functionally unavailable*.

  - *Failure*—The component is not capable of performing its specified operation according to a success criterion.

  - *Functionally unavailable*—The component is capable of operation, but the function normally provided by the component is unavailable due to lack of proper input, lack of support function from a source outside the component (i.e., motive power, actuation signal), maintenance, testing, the improper interference of a person, etc.

- *Potentially unavailable*—The component is capable of performing its function according to a success criterion, but an incipient or degraded condition exists. (N.B., potentially unavailable is not synonymous with hypothetical.)

  - *Degraded*—The component is in such a state that it exhibits reduced performance but insufficient degradation to declare the component unavailable according to the specified success criterion.

  - *Incipient*—The component is in a condition that, if left unremedied, could ultimately lead to a degraded or unavailable state.

Coupling Factor/Mechanism—A set of causes and factors characterizing why and how a failure is systematically induced in several components.

Date—The date of the failure event, or date the failure was discovered.

Defense—Any operational, maintenance, and design measures taken to diminish the frequency and/or consequences of common cause failures.

Dependent Basic Events—Two or more basic events, A and B, are statistically dependent if, and only if,

$$P[A \cap B] = P[B|A]P[A] = P[A|B]P[B] \neq P[A]P[B],$$

where P[X] denotes the probability of event X.

Event—An event is the occurrence of a component state or a group of component states.

Exposed Population—The set of components within the plant that are potentially affected by the common cause failure event under consideration.

Failure Mechanism—The history describing the events and influences leading to a given failure.

Failure Mode—A description of component failure in terms of the component function that was actually or potentially unavailable.

Failure Mode Applicability—The analyst's probability that the specified component failure mode for a given event is appropriate to the particular application.

Impact Vector—An assessment of the impact an event would have on a common cause component group. The impact is usually measured as the number of failed components out of a set of similar components in the common cause component group.

Independent Basic Events—Two basic events, A and B, are statistically independent if, and only if,

$$P[A \cap B] = P[A]P[B],$$

where P[X] denotes the probability of event X.

Mapping—The impact vector of an event must be "mapped up" or "mapped down" when the exposed population of the target plant is higher or lower than that of the original plant that experienced the common cause failure. The end result of mapping an impact vector is an adjusted impact vector applicable to the target plant.

Mapping Up Factor—A factor used to adjust the impact vector of an event when the exposed population of the target plan is higher than that of the original plant that experienced the common cause failure.

Potential Common Cause Failure—Any common cause event in which at least one component degradation value is less than 1.0.

Proximate Cause—A characterization of the condition that is readily identified as leading to failure of the component. It might alternatively be characterized as a symptom.

Reliability Logic Model—A logical representation of the combinations of component states that could lead to system failure. A fault tree is an example of a system logic model.

Root Cause—The most basic reason for a component failure which, if corrected, could prevent recurrence. The identified root cause may vary depending on the particular defensive strategy adopted against the failure mechanism.

Shared-Cause Factor (c)—A number that reflects the analyst's uncertainty ($0.0 \leq c \leq 1.0$) about the existence of coupling among the failures of two or more components, i.e., whether a shared cause of failure can be clearly identified.

Shock—A shock is an event that occurs at a random point in time and acts on the system; i.e., all the components in the system simultaneously. There are two kinds of shocks distinguished by the potential impact of the shock event, i.e., *lethal* and *nonlethal*.

System—The entity that encompasses an interacting collection of components to provide a particular function or functions.

Timing Factor (q) —The probability ($0.0 \leq q \leq 1.0$) that two or more component failures (or degraded states) separated in time represent a common cause failure. This can be viewed as an indication of the strength-of-coupling in synchronizing failure times.

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10. SUPPLEMENTARY NOTES

11. ABSTRACT (200 words or less)

This volume of the Common-Cause Failure Database and Analysis System report provides an overview of common cause failure methods for use in the U.S. commercial nuclear power industry. It summarizes how data (on common cause failure events) are gathered, evaluated, and coded. It then describes the process for estimating probabilistic risk assessment (PRA) common cause failure parameters. It also references other volumes of this report for specific details.

Equipment failures that contribute to common cause failure events are identified through searches of Licensee Event Reports (LERs) and Nuclear Plant Reliability Data System (NPRDS) failure reports. Once common cause failure events are identified by reviewing reports of equipment failures, INEEL staff enters the event information into a personal computer data analysis system (CCF system) using the method presented in this and companion volumes. The events stored in the CCF system are utilized for common cause failure PRA parameter estimations using common cause failure quantification methods.

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