
IPF BASIC User's Guide

IPF GUI User's Guide

*User Documentation
Interactive Powerflow Program*

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CHAPTER 1

INTRODUCTION

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1.1 OVERVIEW

The Interactive Powerflow (IPF) is actually a family of programs for doing power flow studies. This guide presents information about the graphical user interface (GUI) for the program. Other programs include BPF, the batch Powerflow version; IPFPLOT, a batch program for outputting printed maps; IPFCUT, a batch program that cuts out a subsystem from a solved base case file, etc. See the *IPF Batch User's Guide* for more information about the IPF family of programs.

IPF's GUI interface makes data entry and modification easy. It also simplifies the running of base case solutions and the printing of network diagrams. This guide shows how to use the major features of IPF. Users who need details about data input record formats or system models should consult the *IPF Batch User's Guide*.

The graphical user interface features the common windows, menus, and mouse interface familiar to those people who use MicroSoft Windows, Macintoshes, and workstation computers with the X Window System. IPF's GUI uses the X Window System and the OSF/Motif window manager interface.

1.2 CHAPTER SUMMARIES

- Chapter 1* Introduces IPF, summarizes the guide chapters, discusses intended audience, and defines important user interface terms and conventions.
- Chapter 2* Introduces the X Window System and the OSF/Motif GUI.
- Chapter 3* Presents task-oriented information about the major capabilities of IPF. Turn here if you need to know how to print a diagram, open a base case file, change a bus name on the display, etc.
- Chapter 4* Provides an alphabetically arranged, reference-type description of all

commands and features of IPF. Turn here if you are wondering what a particular command, window, or dialog box does or how it works.

Appendix A Gives basic directions on how to set up default file paths and names. For detailed information on customizing window parameters, colors, and fonts, see the *IPF Advanced User's Guide*.

Appendix B Describes the network diagram facility, as seen from the GUI perspective. For detailed information on plotting options, bubble diagrams, etc., see the *IPF Advanced User's Guide*.

Appendix C Shows how to calculate line impedance.

Appendix D Tells how to use the IPS2IPF data conversion program, and describes differences between IPS and IPF data.

1.3 AUDIENCE

This guide introduces IPF users to IPF's graphical user interface (GUI). You will be expected to already know the basics of power flow programs in general, but you will find that small changes in bus and branch values are now much easier to make, so you will probably be doing a lot more solutions than before. For example, users will get a feel for how changes to the input data affect the solution voltages in a network much more quickly with IPF than by using a batch style interaction.

Inexperienced users should read through the guide from front to back. Users experienced with a standard GUI, such as Microsoft Windows, the Macintosh GUI, or some non-Motif GUI, can skip right to Chapter 3, *Working with IPF*, or Chapter 4, *Concepts and Commands*.

1.4 USER INTERFACE TERMS

The X Window System and the OSF/Motif window manager use certain descriptive terms for actions performed with the mouse. These terms are defined here. In addition, some keyboard actions are also defined. See Table 1-1.

Table 1-1 User Interface Terms

Term	Meaning
Select	Perform a mouse (or keyboard) action that singles out a user interface object. Usually the object is highlighted in some fashion, such as reverse video for menu selections. Subsequent commands or operations are performed on the selected object.

Table 1-1 User Interface Terms (Continued)

Term	Meaning
Select Text	Click the left mouse button inside a text box. If the text is modifiable, the cursor will change to the text cursor (I-beam) cursor, which can be moved to edit or enter text in the box.
Press	Hold down <i>without releasing</i> a mouse button or key.
Click	Press and release a mouse button in one quick action.
Double-click	Click the same mouse button (left, middle, or right) two times rapidly <i>without</i> moving the mouse between clicks.
Drag	Press and hold a mouse button, move to a new location and release the button.
Type	Type all the keys called for <i>without</i> pressing Return at the end.
Enter	Type all the keys called for and press Return at the end.
Scroll	Drag the bar at the right of the window up or down to move through a display. Some windows also have a bar at the bottom with which you can scroll right and left.

1.4.1 Keyboard Conventions

The following conventions are used for key strokes. Generally, a hyphen (-) connects key names that should be pressed and held, starting from left to right. For example, the key sequence `Control-c Shift-E` means to press and hold the `Control` key and then press `c`. Release this combination and press and hold the `Shift` key and then the `E` key. Then release these keys. A different example: `Esc f` means to press and release the `Esc` key followed by the `f` key.

In general, the mouse operation and keyboard operation follow the conventions of the Motif interaction style guidelines. These are found in the *OSF/Motif Style Guide*. Many aftermarket books about Motif cover these conventions also.

1.4.2 Typographical Conventions

Operating system commands, parameters, file names, etc., and all information that you type or that you might see on your screen appear in the Courier plain font, for example, `ls -sF`.

CHAPTER 2

IPF AND THE X WINDOW SYSTEM

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2.1 OVERVIEW

This chapter provides a quick introduction to the X Window System and X window managers with emphasis on the OSF/Motif window manager. The treatment here is certainly not exhaustive or even complete. But it is intended to give you enough background to successfully use the Interactive Powerflow (IPF) program.

If you have not used a Graphical User Interface (GUI) before, be sure to go through this chapter for some pointers so that you'll be headed in the right direction. If you would like more information, refer to the following books about the X Window System and OSF/Motif.

- Open Software Foundation. *OSF/Motif Style Guide Revision 1.1*. Prentice Hall, 1991. This provides the official description of OSF/Motif look, feel, and behavior for OSF/Motif software developers. Though not oriented toward OSF/Motif users, this book does give precise descriptions of all OSF/Motif components and behavior.
- Quercia, Valerie and Tim O'Reilly. *X Window System User's Guide OSF/Motif Edition*. O'Reilly & Associates, Inc., 1991. This is a good, general introduction to X and OSF/Motif.

2.2 A GUI INTERFACE—THE X WINDOW SYSTEM

Many people today are familiar with the physical components of the most widely used GUI: the mouse, the menu, and the window. These components have been generally available on the Macintosh computer since 1984 and on IBM PC-compatible computers as an option since 1987. The third most popular GUI is the one associated with the X Window System, which is very similar to the other two.

For those who are not acquainted with the mouse/menu/window interface, here are some quick definitions:

- | | |
|---------|--|
| Mouse | A one, two, or three button pointing and selecting device that you operate with your hand. It allows you to move a cursor around in the display “real estate” and choose areas that you want to interact with. The left mouse button is used most often, and in the absence of direction otherwise, this is the button meant. |
| Menus | Screen components that have commands associated with them. These are commands that act on display objects that you have previously chosen with the mouse pointer. |
| Windows | The primary display organizational component, consisting of rectangular areas of the display having an inside and a perimeter. The perimeter window elements allow you to control the properties of the window, such as size, position, overlapping of other windows, movement of information inside the window, whether the window is “active”, etc. The inside of a window is controlled (in the X Window System) by a separate program — the application program. In this case, the program is IPF; other applications are text editors, drawing programs, spreadsheet programs, electronic mail programs, etc. |

2.3 AN X WINDOW SYSTEM OVERVIEW

Broadly speaking, the X Window System is designed to deliver mouse-driven menu/window user interface applications over a local area network.

In contrast to other GUIs, like the Macintosh Operating System and Microsoft Windows, the X Window System specifies that the “look and feel” of its user interface be “policy free.” Because of this, programmers are free to create their own look and feel within broad limits. Over the past few years, Sun Microsystems, AT&T, and the Open Software Foundation have all created GUIs for the X Window System with a distinct look and feel. The Open Software Foundation offers OSF/Motif, which is now the most common interface in the industry.

Like most large software systems, X and its environment have a jargon of their own. Here are a few terms you should know:

- | | |
|--------|--|
| Server | The part of X resident in your local computer (or X terminal) memory. The server has three main tasks. First, the server takes care of communicating with the mouse and keyboard. Second, it takes care of managing X resources, such as fonts and colors. Third, it communicates with X applications. |
| Client | A stand-alone X program. Clients are the X programs that you use to |

accomplish your work, such as drawing graphs, preparing text, making power flow calculations, etc. Clients usually reside in a computer across the local area network, but they can also reside in the same memory as the server itself. Clients and servers communicate through a special language ("protocol") that is especially efficient for communication over a Local Area Network (LAN).

Resources	X components that are held and managed in common for X clients by the server. X resources reside in your local computer (or X terminal) memory just like the server. X resources are things like fonts, color "pixmap," font information, etc.
Window manager	A special X client that handles the window services of other X clients. There are a number of different X window managers, not just one, but you only use one window manager at a time.
X terminal	A special purpose computer having a built-in X server, and connection hardware and software for a LAN.
LAN	A Local Area Network usually based on the hardware and low-level software standard of Ethernet. For UNIX computers, the software communication protocols are usually based on the TCP/IP standard. PC networks may use different hardware and software network communication standards.

The GUI portion of IPF is a server; the powerflow portion is a client. These two programs may reside on different computers, in which case the GUI will be running on the machine you are sitting in front of, and the powerflow will be running on a workstation somewhere else, perhaps a network server. Note that the X Window terminology for "client" and "server" is reversed from the network communication terminology. It is also possible for both client and server applications to be running on the same computer.

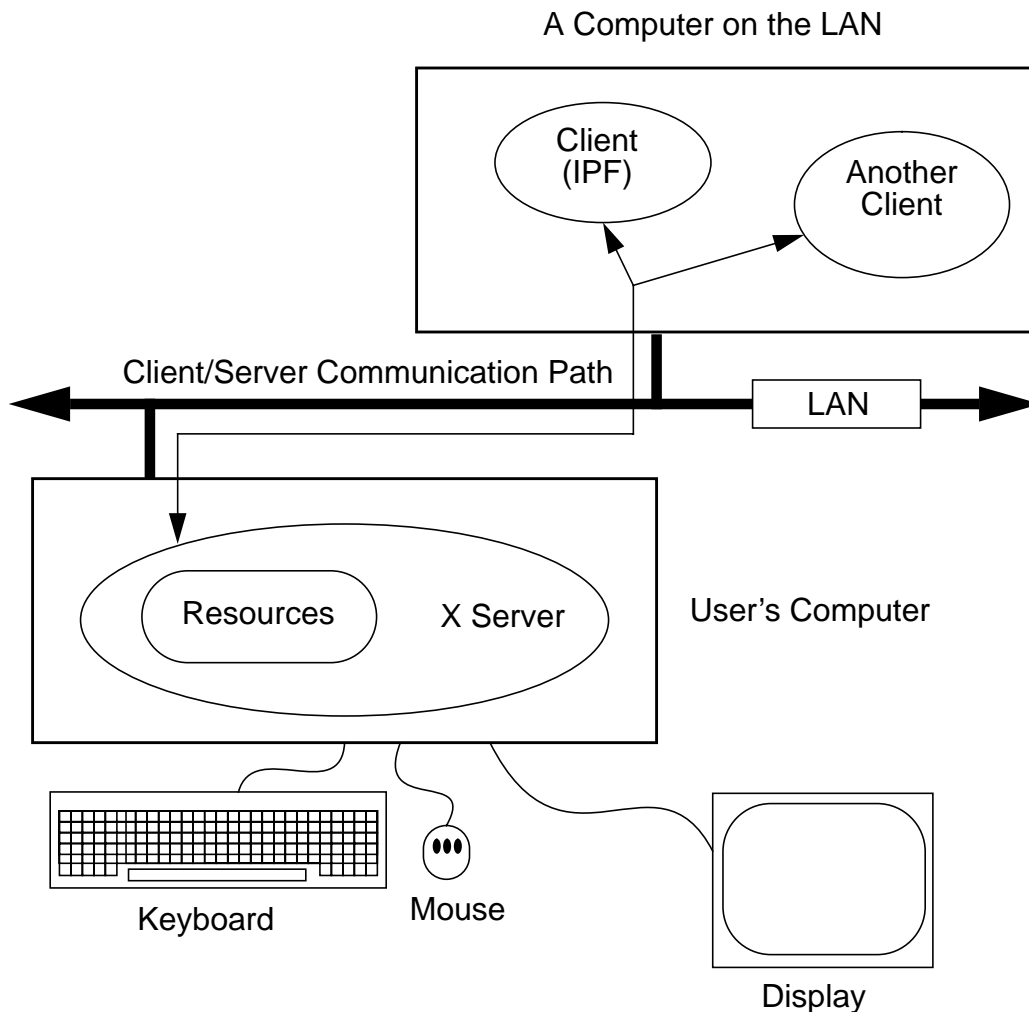


Figure 2-1 A Server, Some Clients, and a LAN

Figure 2-1 shows you the basic architecture and communication model of the X Window System. Something you should note is that the client (application) program may be physically residing on a completely different computer from the one that your keyboard, mouse, and display are attached to. To access the remote application, you only have to know the name of the computer your client is on. (You also must have permission to use the other computer, of course, and it must be connected properly to the LAN.) The X Window System was designed from the ground up to run in a distributed computing environment.

When you are running a client, such as IPF, over the network, in contrast to running it in your own

computer's local memory, you will ordinarily notice very little performance degradation due to network traffic, though there may be some depending on how busy the network is. X is designed to minimize network communication.

The server side of X resides in your own computer's (or X terminal's) memory. There is one X server for each user's keyboard, mouse, and display. The server is dedicated to you. However, your server may communicate simultaneously with many different X clients, not just IPF. And again, these other clients may be anywhere out on the LAN. Thus, in any one X session (between "login" and "logout"), you may run many X clients on many different computers. The server manages all this.

When your client requests a certain font, the server delivers it. When your client requests different colors for graphical objects, the server consults the color map for that client and delivers the correct colors. Fonts, colors, and certain other server-managed software components are termed *resources*. Some resources such as colors and fonts you can change in your own account's IPF resources file, XGUI. Turn to Appendix A if you would like to learn more about this.

2.4 A SUMMARY OF MOTIF BASICS

IPF is designed to run and look best with the Motif window manager. This section introduces you to some Motif window manager basics. However, for detailed information, turn to the books cited at the beginning of this chapter.

2.4.1 Motif Windows

Motif windows are rectangular areas of the display. Various Motif components surround a central area where text and/or pictures appear. See Figure 2-2. These components are controlled by the Motif window manager. However, the central area is controlled by an X client, *which is a completely separate program from the Motif window manager*. IPF is an X client, so it controls only the interior of Motif-managed windows. Because of this separation, you may notice that IPF's windows can still be moved, iconized, etc., even though the IPF client may not be responding.

In Figure 2-2, the Terminal Emulator client controls the central display (where the text is), the Menu Bar, and the Scroll Bar. The Motif window manager (client) controls all the rest of the window.

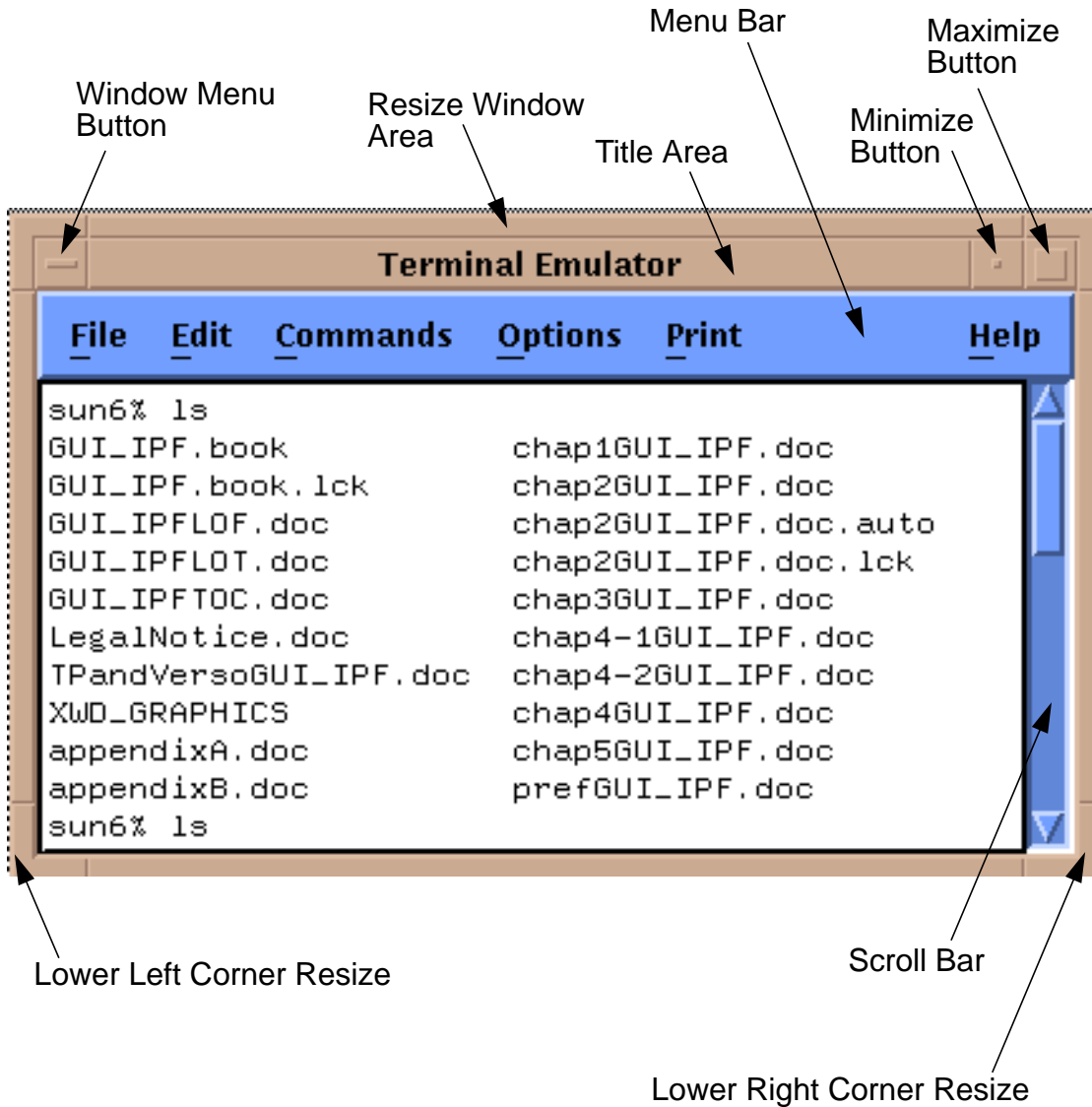


Figure 2-2 Motif Window Components

2.4.2 Motif Resources

Like the X Window System, Motif has resources that you can change. Resources are system controlled components such as fonts, colors, initial size and position of windows, etc. Many X

clients (application programs) have customizable resources. Since the Motif window manager is just another client, it has customizable resources, too.

Resources can be changed in two ways:

- Change the dedicated client resource file with an ASCII text editor. On UNIX systems, the Motif resource file is named `.mwmrc` and the X resources file is `.xdefaults`.
- Use a dedicated X application that provides a regular GUI interface for changing the resource file.

Since interpreting the meaning of the resource specifications is not always easy or straightforward, it is recommended that you look for a dedicated X client for changing resources. Your Motif system probably has this X client already available, so that all you have to do is choose the Motif resource editor as a command on a system menu. Possible names to look for are System Setup, Configuration, User Preferences, or something similar. The editing of the many resources may be broken out on your system menus as separate commands, such as Colors, Fonts, Sizes, etc.

As a second choice, use a Motif book to help you interpret the meaning of the resource specifiers in the `.mwmrc` file and edit them with an ASCII editor such as the vi ASCII editor. Nearly all UNIX systems have vi.

2.4.3 Common Windows Tasks

This section goes through a few common window and menu tasks to give you a feel for the Motif interface. Some tasks can be done through a menu command and through direct manipulation of a graphic component. And, in addition, many tasks can be accomplished through a sequence of keys without recourse to mouse movement or button clicks. The following brief descriptions concentrate on direct graphic component manipulation since this is usually the quickest way to get something done in Motif.

To move a window:

Motif windows have a title area at the top. The window shown in Figure 2-2 has “Terminal Emulator” in the title area. You move Motif windows by “grasping” the window in this area and dragging it to a new location.

1. Move the mouse cursor to any point within the title area.
2. Press and hold the left mouse button.
3. Move the window to another location of the display. You will note that an outline box of the window shows you the dimensions of the window as you are moving.
4. Release the button. The window appears at the new location.

To reduce a window to an icon:

Icons are small, rectangular graphic objects that represent the main windows of Motif applications. Icons have many, but not all of the same attributes as windows — for example, they can be moved like windows. Icons are used to organize the display and reduce clutter. You are free to put icons wherever you like on the display. Some Motif systems organize icons in a special window, which looks like the MS/Windows or MAC desktop.

1. Click the Minimize button at the top right of a window. This shrinks the window to an icon and automatically places the icon at a predetermined place on the display. (Note that this place may be obscured by other windows!)
2. Move the icon as you would a window by placing the cursor over the icon, pressing the left mouse button, moving, and releasing the button.

To change an icon into its window:

An icon can be changed back into its windows by double clicking on it. The window will “remember” where its previous position was. Sometimes the timing between clicks is important, so make sure you do it fast enough.

1. Find an icon (or create one) and move the mouse cursor over the icon. Double-click the left mouse button. Be sure to keep the mouse cursor stationary between clicks; otherwise, Motif may interpret your actions as a “move icon” operation.
2. If you find that a menu pops up, select the Restore command by moving the cursor over the word and clicking once.

To resize a window:

Motif windows have a narrow border that acts as a “handle” for resizing operations. There are eight parts to the border — four corners and four sides. The corners are used to resize simultaneously both adjacent sides, and the sides are used to resize just one side at a time. The following procedure describes a common resizing operation. See Figure 2-2.

1. Move the mouse cursor over the lower right corner. Note that this corner is demarcated by two cross cuts on the border a short distance away from the corner. The cursor may change its appearance when it is in this area, indicating that it is in the right position.
2. Press and hold the left mouse button on the lower right corner.
3. Move the mouse to the inside or outside of the current window.

The opposite (upper left corner) remains stationary while you move the mouse around. A border line for two sides shows up to give you an idea of the size of the window as you move. Also, a pixel counter of the vertical and horizontal dimensions shows up to give you feedback if you need it.

4. Release the mouse button when you are satisfied with the size.

If the corner or side the you want to grab is not visible on the screen, move the window until it is.

To enlarge a window quickly:

The Maximize button in the upper right corner is a quick way to enlarge a window to the maximum size of your display. See Figure 2-2.

1. Move the mouse cursor over the Maximize button in the upper right corner of a window.
2. Click the button. Note that the window now covers the maximum area of the display. (All other windows should be covered.) You can resize the window using the directions above.

To pop up a window's menu:

All Motif windows have a minimum set of window management functions available in the upper left corner via the Window Menu button. See Figure 2-2. Many of the functions described above are available through this menu. Some additional ones are there too, such as Close, Restore, and Lower.

1. Move the mouse cursor over the Window Menu button in the upper left corner.
2. Press and hold the left mouse button. Note that a menu pops up. Select one of the commands on the menu by moving the mouse cursor over the command and releasing. Only commands that are clearly visible are selectable. Those which are "grayed out" are not accessible or appropriate in the current context.

Closing a window causes the window to disappear from the display, so be careful because it can also quit the application. In the beginning, you may not know how to restart an application! (Look for a Motif window called the Session Manager. Your system operator has probably set up your account with a Session Manager. See if you can find the closed application on a menu in your Session Manager, so that you can re-open the application if you accidentally close it.)

Lowering a window means to cause it to go to the bottom of the windows "stack." Think of Motif windows as pieces of rectangular paper on a desk. The ones that overlap have an order from top to bottom. The Lower command causes movement of windows in the stack from top to bottom. Experiment with the command to see how it works. You bring "buried" windows to the top by pushing visible ones down with the Lower command. Note, however, that if you see any piece of a Motif window, you can just click on or inside the border to bring it immediately to the top.

2.5 IPF AS AN X CLIENT

IPF is built on top of the X Window System and uses the facilities of an X window manager of your

choice. (However, the recommended window manager is Motif.) In Figure 2-3, you can see that both the X server and the GUI part of IPF reside on the user's computer. Another client that is always present on the user's computer is the user's window manager. This is not shown in Figure 2-3, however. In most configurations, the Powerflow (`ipfsrv`) part of IPF resides on the user's computer, but may, as in Figure 2-3, reside on some other computer across the LAN.

When you start up IPF, the GUI initializes itself, initializes `ipfsrv`, and then brings up IPF's window interface.

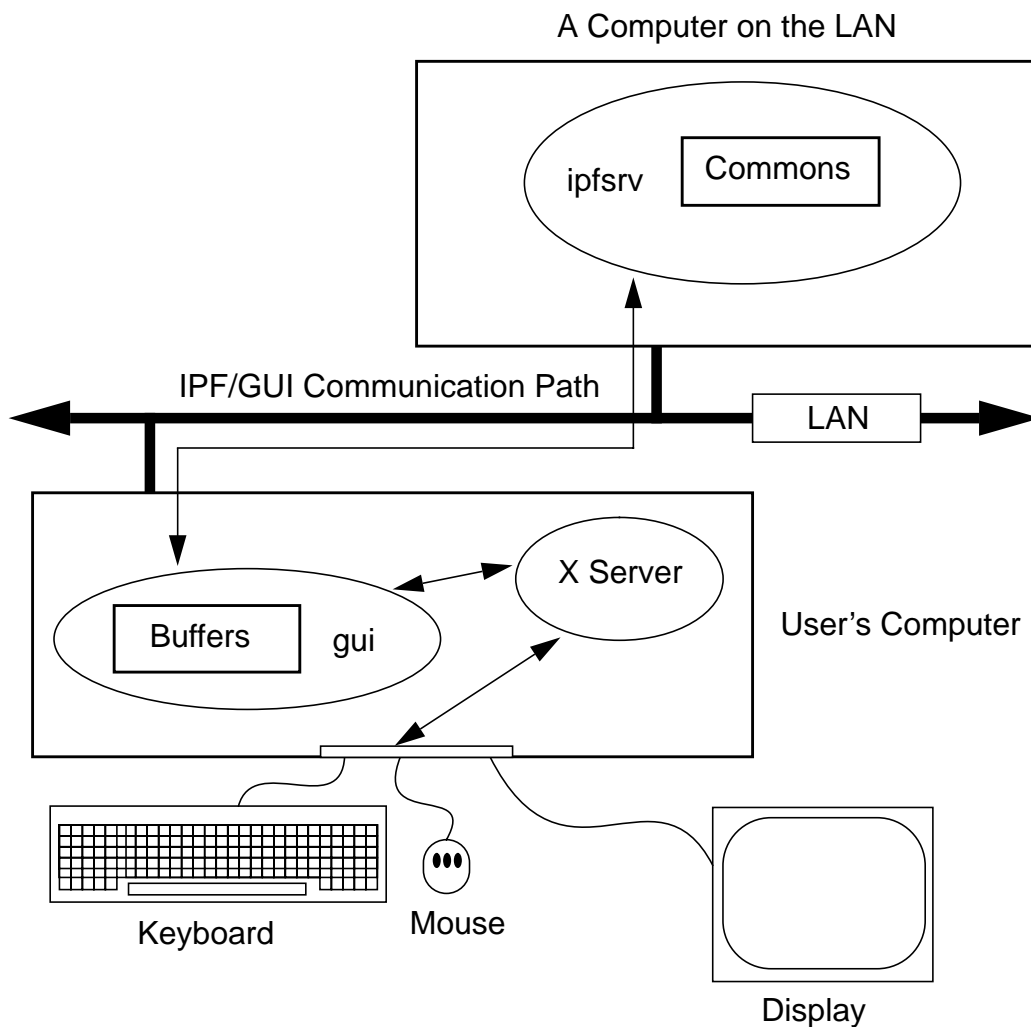


Figure 2-3 Powerflow/GUI Communication

2.6 A LOOK AT THE IPF SOFTWARE ARCHITECTURE

Figure 2-4 shows a high-level view of the IPF software and its environment. IPF is divided into the GUI code, which is written in C, and the PF code, which is written in FORTRAN. When you run the X Window System and Motif, you are using the Motif and X libraries in addition to UNIX operating system calls and IPC (Interprocess Communication) calls. The GUI part of IPF (gui) uses the Motif library and IPC calls. The PF part of IPF (ipfsrv) uses IPC calls.

Because the Motif library is used for IPF, the Motif window manager is recommended for running with IPF. You can use another window manager with IPF, but the program will not have a consistent look and feel. The functionality remains the same, but you will notice a visual style within the IPF client that is different from the window manager, which controls the display outside the IPF windows and dialog boxes.

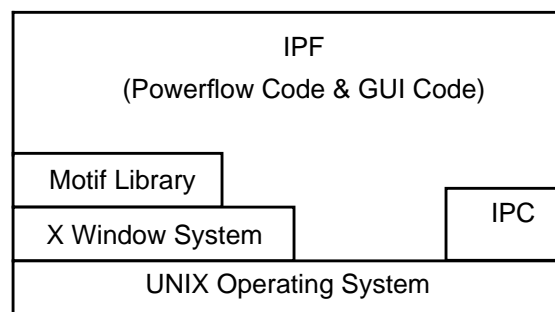


Figure 2-4 Powerflow/GUI and System Software

2.7 SOME HISTORY

Some key developments took place in the late 1970s and 1980s that made possible the X Window System and the X window managers.

- The idea of the graphical user interface (GUI) was created, implemented, and became popular.
- Personal computers became powerful enough to handle the data and processing intensive GUI.
- Efficient, fast, inter-computer communication — the local area network (LAN) — became widespread.
- A general purpose, non-proprietary operating system — the UNIX operating system — achieved wide acceptance.

All of these developments contributed materially to the possibility and, indeed, the eventual widespread acceptance of the X Window System and X window managers.

2.7.1 Graphical User Interfaces

In the late 1970s, medium-sized computers began to get powerful enough to handle information organized graphically rather than in a character-based (textual) way. They also began to get cheap enough to be dedicated to one person. It was on one of these computers that the Xerox Corporation installed the very first GUI using a mouse, menus, and windows. This GUI borrowed heavily from the Smalltalk-80 user interface, which was also invented at Xerox. (Smalltalk-80 is an object-oriented programming environment and system.)

GUI—graphical user interface—simply means using the graphics capability of a computer as the primary mode of interacting with users. A few GUIs do not, in fact, use a mouse, menus, and windows. However, GUIs using this combination of elements became common early because of their inherent ease of use.

2.7.2 Personal Computers and Workstations

Meanwhile, truly affordable *personal* computing was taking off in the late 1970s and early 1980s with the Apple and then IBM PC computers. These computer architectures were essentially graphical in nature, especially the Apple, though their interfaces were still character-based.

In 1984, Apple introduced the first personal computer with a thorough-going GUI. This was the Macintosh. This computer introduced wide numbers of people to a very easy to use graphical interface. It showed many computer manufacturers that they needed to design with GUIs in mind. A few years later, Microsoft Corporation retrofitted a windowing system onto MS DOS IBM PC-compatible computers.

Also in the late 1970s and 1980s, Sun Microsystems, Hewlett-Packard, DEC, and other companies saw the need for powerful computing “workstations” that business, research laboratories, and government could use. These workstations became common where personal computers didn’t have enough power. However, they generally lacked GUIs, which made them harder to use and less versatile than they might have been.

2.7.3 Local Area Networks

Another element in the computing picture was also developing in the 1970s and 1980s. This was widespread inter-computer communication. The idea of the local area networks (LAN), which was a room-to-room and building-to-building communication network, was created and implemented. A particularly popular LAN was, and is today, the Xerox-created Ethernet. This LAN is simply a cable connecting computers, whereby the computers can request and send just about any kind of data, often organized as files.

2.7.4 UNIX Operating System

Another computing environment element was the development and distribution of a general purpose operating system that was platform independent, the UNIX system developed in the 1970s and 1980s at AT&T's Bell Labs. This operating system was distributed freely to many college campuses, and the University of California at Berkeley developed many extensions to UNIX, among them sockets which provide efficient communication over LANs. Today, the UNIX operating system is offered commercially by AT&T as UNIX System V.

2.7.5 X Window System Origins

To complete the computer environment picture of the 1980s and 1990s, engineers at the Massachusetts Institute of Technology created the X Window System, often called just "X." This GUI and underlying software was designed for powerful workstations with graphics-oriented hardware architecture. These capabilities are now available on high-end PCs as well. It is also designed for computers that make heavy use of a LAN. Though not limited to the UNIX operating system, the X Window System was first developed on UNIX computers.

CHAPTER 3

WORKING WITH THE GUI

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3.1 OVERVIEW

This chapter describes how to accomplish basic tasks in the GUI version of IPF. After reading through this chapter, you should be able to use the *Concepts and Commands* chapter to figure out and work with the rest of IPF's features. If you want a very quick introduction to IPF capabilities, see the IPF User Tutorial.

The material in this chapter is not written as a complete, start-to-finish tutorial. Rather, the material is organized by individual task. However, the various topics are organized so that they reflect the common order of tasks in a typical session. So, you can either read the topics and do the steps within the topics in the order presented, or you can skip around and try out specific topics as they interest you.

Note: Most of the task procedures in this chapter involve using the mouse and its buttons. When you are asked to use a mouse button, the left-hand button is meant unless you are explicitly directed otherwise.

3.2 MAIN WINDOW AND TOOLBOX

Take a minute to familiarize yourself with IPF's main window and its main menus, toolbox, display modes, display area, current files area, and branch color key. You will be using them often as you work with IPF. See Figure 3-1 and Figure 3-2.

The main menus and toolbox are the keys to IPF's main functions. The main menus contain commands that allow you to open files, save files, print network diagrams, solve cases, get help, edit bus and branch data, and so forth. The toolbox contains icon buttons that move you into and out of various display modes. They allow you to create new buses, move buses, bend branches, reduce or enlarge the display, modify bus or branch data, and so forth.

The Display Mode buttons determine whether the map shows the intersection of the currently loaded base case file and the currently loaded coordinate file, or everything in the coordinated file. The current files area tells you which files you currently have loaded. The branch color key indicates the base kV rating of branches shown on the display, or their overload status.

In a prototypical session, you would generally follow this scenario:

1. Load a solved system and/or a network data file, and a coordinate file via the main menu Files - Open command.
2. Make changes to the system and/or coordinate file data using the various toolbox icon buttons, which allow direct on-screen manipulation of bus icons and branches, or bring up dialog boxes for adding data to bus and branch records.
3. Solve the new case with the main menu Process - Solve command.
4. Save your new case including its solution data with the main menu Files - Save command.
5. Print out a network diagram with the main menu Files - Print Plot command.

You might also do the following:

- Run a CFLOW program with the main menu Process - Auto CFLOW command.
- Get some help along the way with the main menu Help command.

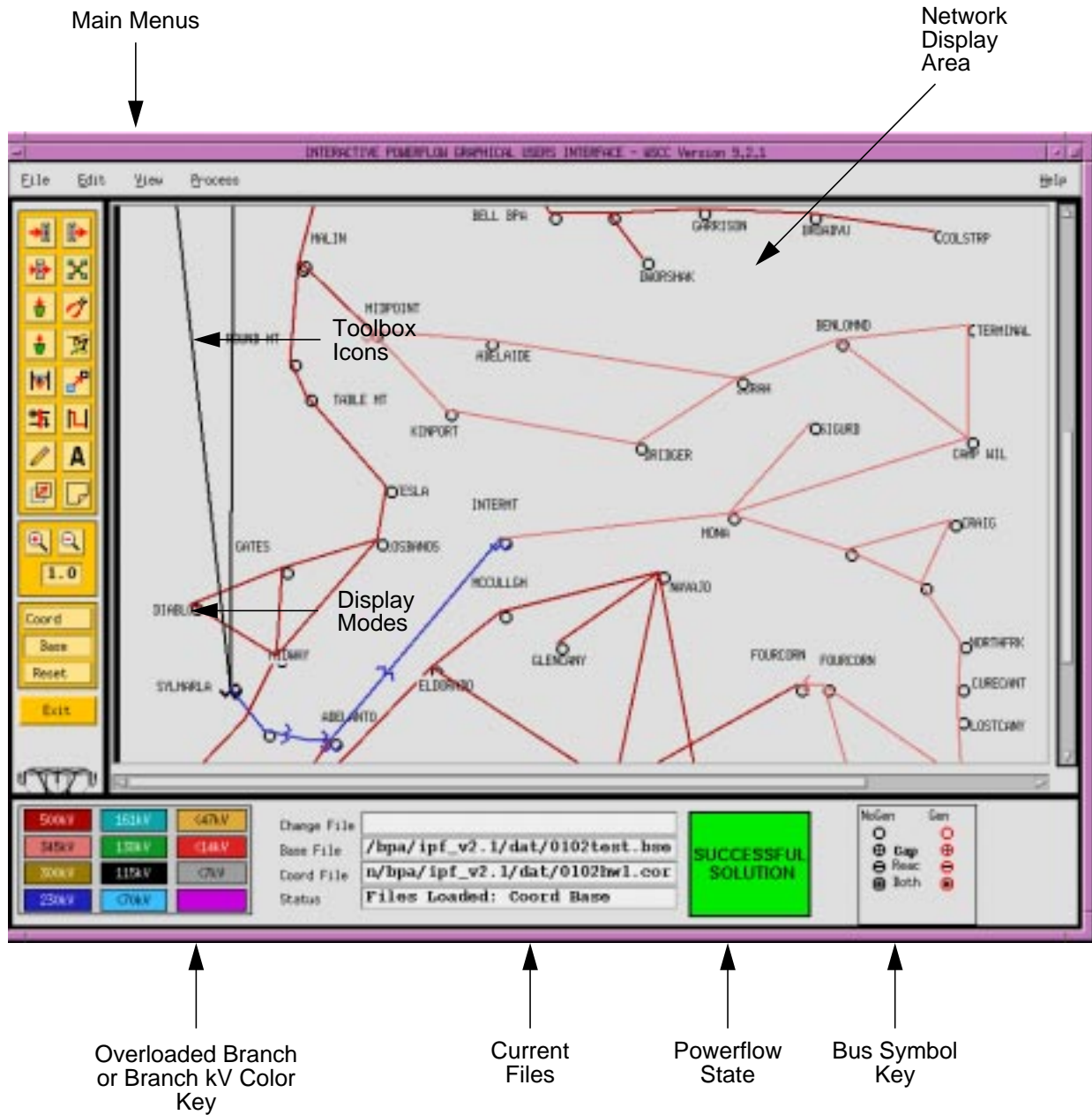


Figure 3-1 Main Window

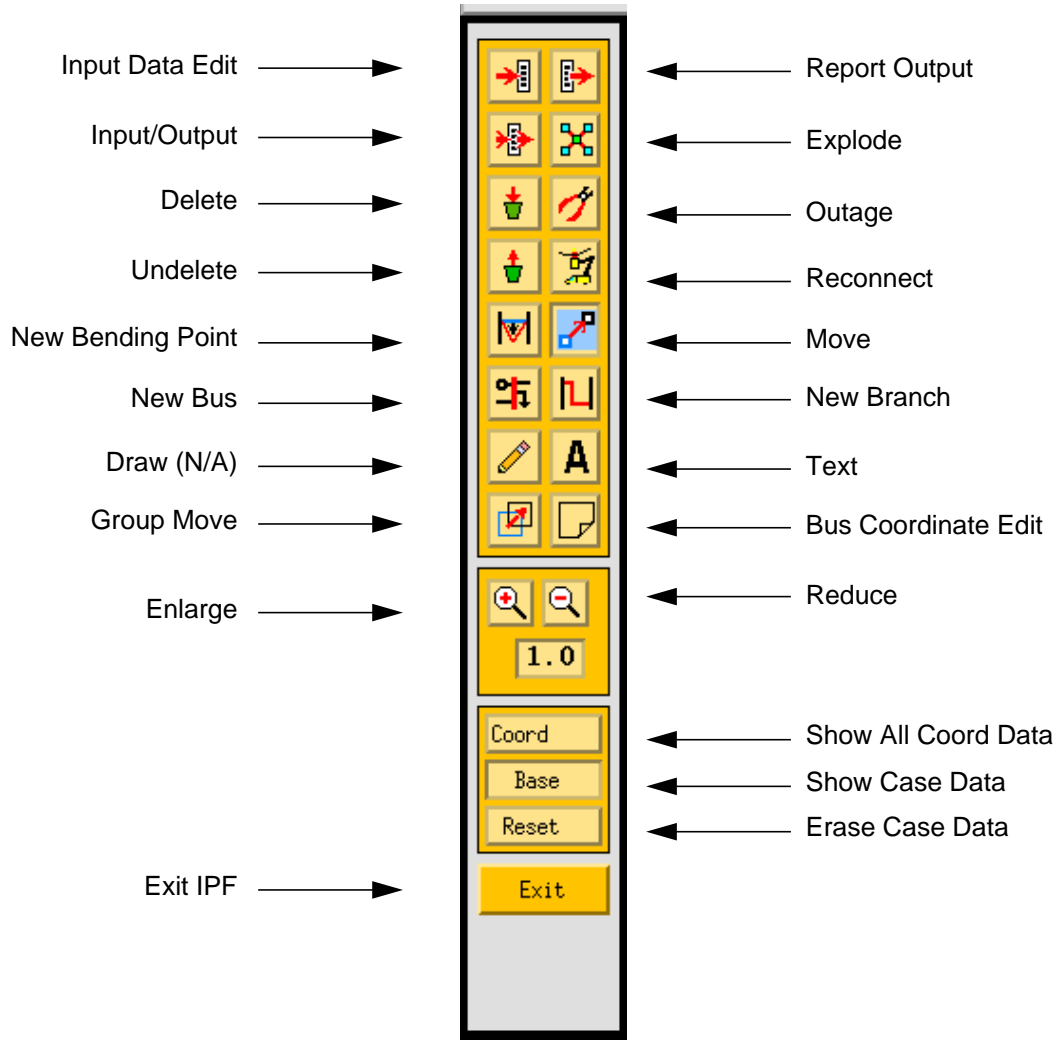


Figure 3-2 Toolbox Icons

3.3 STARTING IPF

IPF is an X Window System application and is started like any other X application. However, your underlying operating system and the window manager you are running offer some ways to simplify how you start up IPF. Essentially, there are three ways you can start up IPF:

- You type the IPF command name `gui` in a terminal emulation window.
- You select IPF on your window manager's "run applications" menu. Generally, this involves clicking a mouse button on the background to bring up the "run applications" menu.
- You find that IPF is started automatically when you log in to your account. This means the

system administrator has already set up your account to do this. You should see IPF as an icon or open window after the login process is complete.

To start IPF from an X terminal emulator window:

1. Make sure the X Window System and your window manager are running. Consult with your system administrator if you don't have X running.
2. Find a terminal emulator window or open one from a window manager menu.
3. In the terminal emulator window, enter `gui`. Within a minute or less, depending on the performance of your computer system, you should see the IPF main window appear.

3.4 EXITING IPF

When you are through editing the currently loaded base case or coordinate files, running a solution, etc., and have saved your work, choose the Exit command from the File menu.

To exit IPF:

1. Click the File menu and select the Exit command. You will see the Exit dialog box come up. *Do not use the window menu button* (upper left) to close the IPF window.
2. Click OK if you are sure you want to exit IPF. Click Cancel if you have changed your mind and want to keep IPF running. If you select OK, IPF closes all its windows and removes them from the screen. You will still be in the X Window System, and you can proceed to any icon or open window to continue working with other X clients. If, after exiting IPF, you decide to run IPF again, see *Starting IPF*, above.

3.5 OPENING FILES

The Open dialog box shows you the five kinds of files you can open in IPF: the command, change, base case, network data, and coordinate files. See Figure 3-3. For detailed information about these files, see Chapter 4, *IPF Commands and Reference* in this manual and the *IPF Batch User's Guide*.

3.5.1 About IPF Files

For most power flow studies, the base case (binary) coordinate files are used. However, network data files must be used to initially create a binary base case file. Change files are used to make changes to a base case file; this case is called a change case, and the results are typically saved as a new base case file. Command files are IPF Powerflow Command Language files. See the *IPF Batch User's Guide* for a detailed discussion.

Unlike the command, change, network data, and coordinate files, which are ASCII text files, the base case file is a binary memory image file. The base case file contains only power system data, which is edited within IPF, whereas the command, change, and network data files may be edited

outside IPF using any ASCII text editor.

The coordinate file is a combination of bus position and branch bending point data in addition to plotting data. The coordinate file bus position and branch bending point locations can be altered by moving them in the GUI display, and a new coordinate file saved if desired. The plotting data can also be edited outside of IPF with an ASCII text editor.



Figure 3-3 Open Dialog Box

3.5.2 Displaying a Network File

Normally, you will want to load a coordinate file in addition to the network data or base case file you intend to work on. If you do not, you will not be able to display the system graphically in the IPF main window. A system data file needs coordinate position information to display itself in IPF. It must get this information from a coordinate file since it does not have this information within itself. However, if all you want to do is edit a coordinate file, you can load just that file, and it will display properly in the main window.

If you load only a system data file, you can use only the textual editing and report capabilities of IPF to see your data, but you can still solve, make changes, save cases, etc. Also, you can generate a network diagram on the fly from which you can graphically navigate or display results. See *Exploring Base Case Connectivity* in this chapter.

To open a network file:

1. Choose Open from the file menu in the IPF main window. You will see the Open dialog box as shown in Figure 3-3.
2. Find Network Data File at the left of the dialog box. The button, information box, and file text boxes under the heading allow you to select a network data file. The file text box under the Select button holds a file selection string. The string displayed when you first open the Open dialog box comes from a default that you can set in your XGUI file. See Appendix A, *Customizing IPF*.
3. Click the Select button. Notice that the file selection string is transferred to the Filter file text box at the right. Also, the Files list changed to reflect the Filter criteria.
4. Scroll the Files list to find the file you want to load.
5. Select the file by clicking it. This action puts the selected file in the Selection file text box below the Files list.
6. Click the Apply button to put the file name you have selected in the Network Data File file text box at the left side of the Open dialog box.
7. Click the Load Selections button at the bottom of the left side of the Open box. This final action actually loads the selected file into IPF's memory.

Since step 7 causes the open files dialog to close, it is best to perform steps 1 to 6 for each of the different kinds of files you want to load, and then click Load Selections at the end to load all files at one time. Note that you cannot open a network and a base file. Only the last one you picked will be loaded.

To open a command, change, base case, or coordinate file:

To open these files, perform the steps above. All of the essentials are similar; only the file type is different.

3.6 SAVING FILES

You can save five kinds of files in IPF: change files, base case files, network files, coordinate, and stability interface files. Ordinarily, you save files after you are done with a work session, but you can save a file at any time. Change, network, and coordinate files are saved in ASCII text format. Base case files are saved in binary format. Stability interface files can be saved in either binary or ASCII format. In a binary file, a memory image of base case data is written out to a file. See the *IPF Batch User's Guide* for more information about these files.

To save a file:

1. Choose Save from the File menu in the main IPF window. You will see the Save dialog box as shown in Figure 3-4.

2. Change the name of the file you are saving if you do not want to overwrite an existing file.
3. Click the appropriate Save button to save the desired file.
4. If the file you are trying to save has the same name as an existing file, you are presented with the Overwrite warning dialog box. You can choose Overwrite to complete the save or Cancel to cancel the save. Note only one base per file is allowed.

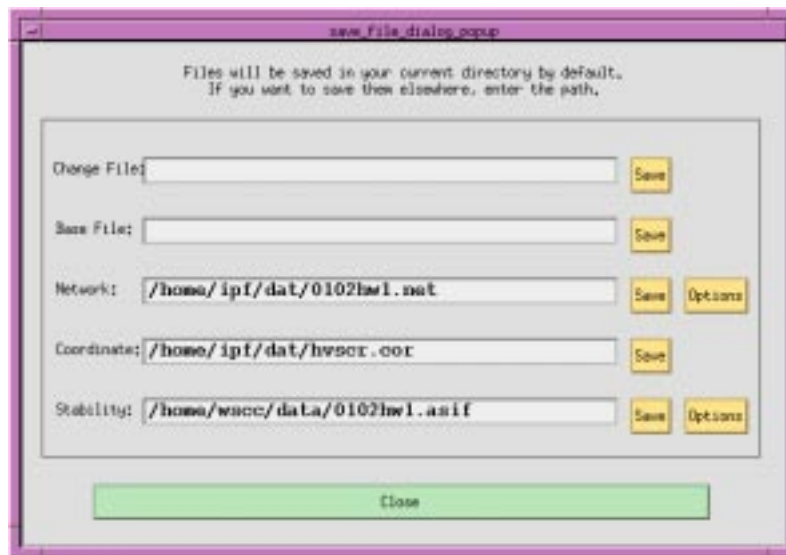


Figure 3-4 Saving a File

3.7 CHANGING THE DISPLAYED NETWORK SIZE

You can use the X Window scroll bars on the right and bottom edges of the network display window to see a different chunk of the network diagram. IPF also includes an enlarge (and reduce) displayed network feature. Two buttons in the toolbox control this. IPF has three displayed network size options. When you first load a base case or coordinate file, the middle size is chosen by IPF. If you find you would like to see more detail in a network diagram, you choose the Enlarge button. If, on the other hand, you would like to see the overall picture, you choose the Reduce button. The Enlarge button doubles the displayed network size, and the Reduce button halves the image size.

All other toolbox operations work no matter what the network size is, so you are free to work with the size that best suits the task at hand.

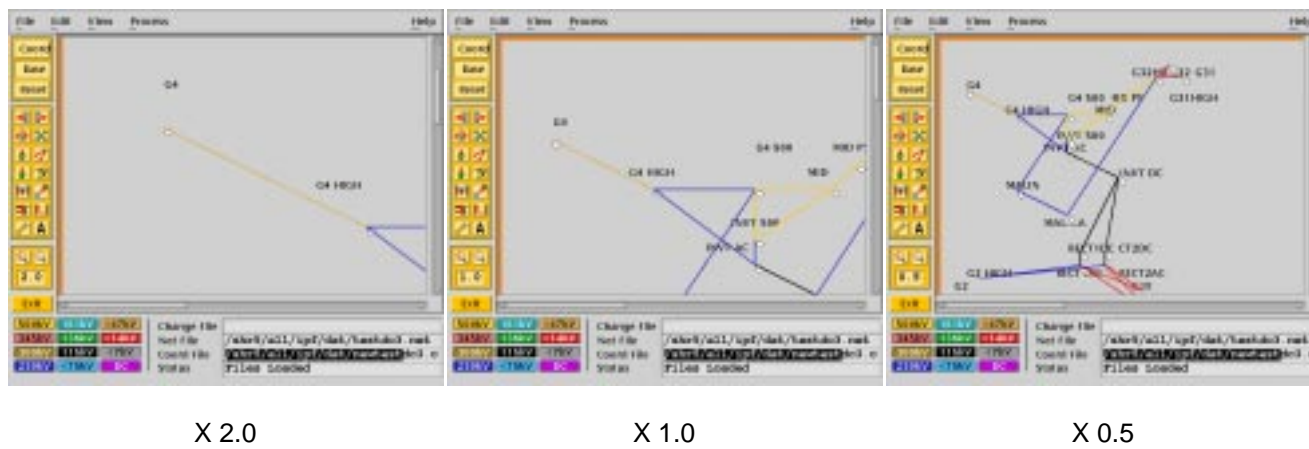


Figure 3-5 Displayed Network Sizes

To alter the displayed network size:

1. Make sure you have a coordinate file loaded. See *Opening Files* to find out how to do this.
2. Click the Enlarge button in the toolbox in the main window. This magnifies the displayed network by two times. Note that you are now at the top magnification, 2.0.
3. Click the Reduce button. The displayed network returns to its original size (1.0), which is the size created by an Open operation. Click the Reduce button again. The displayed network size decreases by half. This is the smallest size, 0.5.

3.8 EDITING BASE CASE DATA

Editing a base case file is one of the primary activities in IPF. This involves a number of tasks: adding new buses or branches, modifying existing bus or branch values, and deleting existing buses or branches. These tasks are all accomplished in the main window toolbox and display area.

3.8.1 Adding a Bus and Related Components

You can add a bus to a resident base case or to IPF itself with no base case loaded. The procedure is the same for both. Adding a bus means in effect to create a new bus record within IPF's memory. You can add as many as you want up to IPF's maximum limit. Bus-related components are such items as continuation, transformer, line, and Q records. The method of adding these components is very similar to adding a bus record.

To add a bus:

1. Make sure you have a base case loaded if you want to add a bus to an existing base case

file. See *Opening Files* to find out how to do this.

2. Click the New Bus icon in the toolbox in the main window. This puts you in the Add Bus mode and brings up the Bus Input Data dialog with a dummy bus name. Change this to whatever you want, and add data.
3. Move into the display area where you will note that the cursor changes to a box to remind you that you are in New Bus mode. Click anywhere in the display area. Note that a bus icon with an the new name appears at the point where you clicked.

3.8.2 Modifying a Bus

Modifying a bus means to alter any of its associated values as they exist in the currently loaded base case data. This is done through the Input Data Edit Box. Refer to Bus and Branch Editing in Chapter 4 to find out more about the Input Data Edit Box.

To modify a bus:

1. Make sure you have system data loaded. See *Opening Files* to find out how to do this.
2. Click the Input Data Edit button in the toolbox. You are now in Input Data Edit mode.
3. Find a bus you want to modify, move the cursor over the bus, and click the left mouse button. The Input Data Edit Box appears with data text boxes filled with the values associated with the bus you clicked.
4. Change any of the values to new ones or type new values in blank text boxes. See the *IPF Batch Users Guide* for information on models and values. When you have values correctly typed (there is some data entry checking), click the Apply button at the bottom of the box to modify the bus data in the resident base case data.

3.8.3 Adding a Branch

You can add a branch to a resident base case. Adding a branch means to create a new connection between existing buses, which adds a new branch record within IPF's data structure. You can add as many as you want up to IPF's maximum limit. Branches are always associated with their terminating buses, so you access branches through buses.

To add a branch:

1. Make sure you have system data loaded. See *Opening Files* to find out how to do this.
2. Click the New Branch icon in the toolbox in the main window. This puts you in the Add Branch mode.
3. Move into the display area where you will note that the cursor changes to a right pointing arrow. Click the first bus that you want to connect the branch to. Move to the second bus

that you want the branch to connect to and click on it. A line appears on the display connecting the two bus icons. Also, the Input Data Edit Box appears.

4. Fill in the values for the new branch as appropriate. See the *IPF Batch User's Guide* for more information.
5. Click the Add button to add the new branch record to the currently resident base case data.

3.8.4 Modifying a Branch

Modifying a branch means to alter any of its associated values as they exist in the currently loaded base case data. This is done through the Input Data Edit Box. Refer to Bus and Branch Editing in Chapter 4 to find out more about the Input Data Edit Box.

To modify a branch:

1. Make sure you have system data loaded. See *Opening Files* to find out how to do this.
2. Click the Input Data Edit button in the toolbox. You are now in Input Data Edit mode.
3. Find a *bus* that is connected to the branch you want to modify, move the cursor over the *bus*, and click the left mouse button. The Input Data Edit Box appears with data text boxes filled with the values associated with the bus you clicked. But you want a branch.
4. Find the option menu button (labeled "Bus") at the upper right of the dialog box. This menu contains records associated with the currently selected bus. You will find continuation, transformer, branch, and other records on this menu.
5. Press this option button to show the associated items. Drag down to the branch record of your choice and release the mouse button. Note that the Input Data Edit Box now reflects data associated with the branch you chose.
6. Change any of the text box data to new values. When you have values correctly typed (there is some data entry checking), click the Apply button at the bottom of the box to modify the branch data in the resident base case data.

3.8.5 Adding, Modifying, or Deleting an Area or Intertie

For area or intertie studies, you can add, modify, or delete areas or interties, by using the main window Edit - Area/Interchange command. You can do this at any time. See Figure 3-6, Figure 3-7, and Figure 3-8.

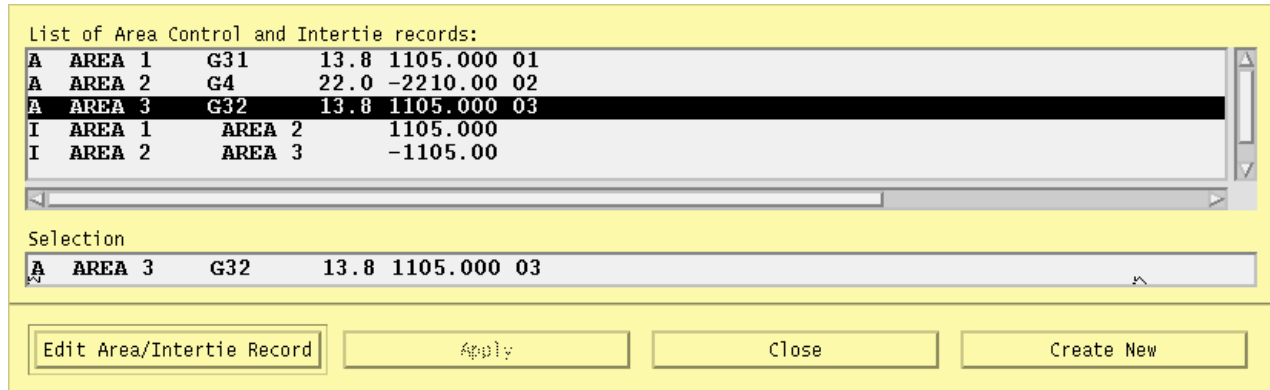
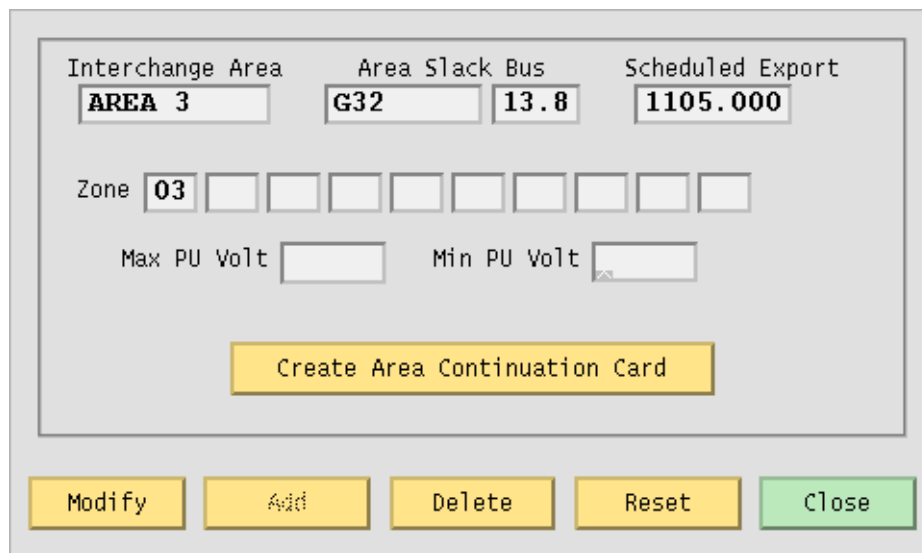


Figure 3-6 Area Intertie Selection Dialog Box

To add an area:

1. Click Area/Interchange on the Edit menu in main window. The Area/Intertie Selection dialog box appears.
2. Click the Create New button. A small box appears, asking whether you want to create an Area Control (A) record or an Intertie (I) record. Click Area Control.
3. The Area/Interchange dialog box appears. Fill in the required text boxes.
4. Click the Add button at the bottom. The Area/Interchange dialog box closes and the new data you typed into the Area/Intertie dialog box now appears in the Area/Intertie Selection dialog box.



The dialog box is titled "Area/Interchange Dialog Box" and contains the following fields and buttons:

- Interchange Area:** Text box containing "AREA 3".
- Area Slack Bus:** Text box containing "G32".
- Scheduled Export:** Text box containing "13.8".
- Scheduled Export:** Text box containing "1105.000".
- Zone:** A row of ten text boxes, the first containing "03".
- Max PU Volt:** Text box.
- Min PU Volt:** Text box.
- Create Area Continuation Card:** A yellow button.
- Modify:** A yellow button.
- Add:** A yellow button.
- Delete:** A yellow button.
- Reset:** A yellow button.
- Close:** A green button.

Figure 3-7 Area/Interchange Dialog Box

To modify an area intertie:

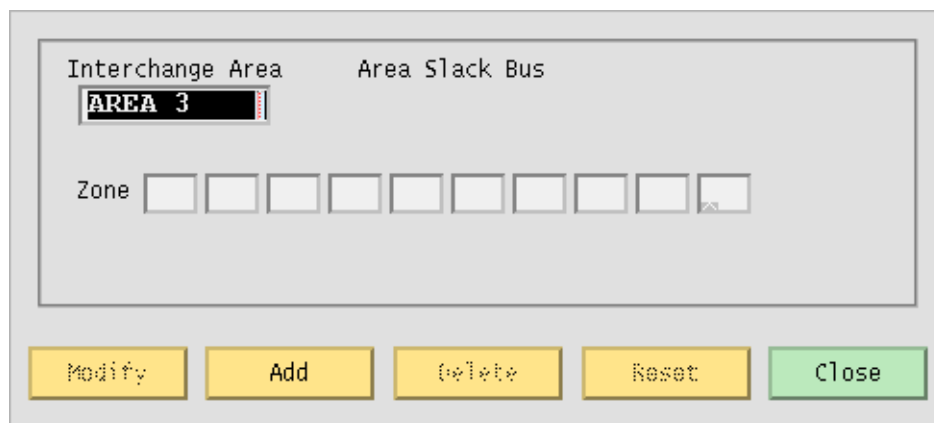
1. Click Area/Interchange on the Edit menu in the main window. The Area/Intertie Selection dialog box appears.
2. Select an item in the list window by clicking it. This action puts the selected item in the Selection text box.
3. Click the Edit Area/Intertie button. The Area/Interchange dialog box appears.
4. Change the data in the text boxes.
5. Click the Modify button. The Area/Interchange dialog box closes and the new data you typed into the Area/Intertie dialog box now appears in the Area/Intertie Selection dialog box.

To delete an area:

1. Click Area/Interchange on the Edit menu in main window. The Area/Intertie Selection dialog box appears.
2. Select an item in the list window by clicking it. This action puts the selected item in the Selection text box.
3. Click the Edit Area/Intertie button. The Area/Interchange dialog box appears.
4. Click the Delete button.

To create an area continuation record:

1. Click Area/Interchange on the Edit menu in the main window. The Area/Intertie Selection dialog box appears.
2. Select an item in the list window by clicking it. This action puts the selected item in the Selection text box.
3. Click the Edit Area/Intertie button. The Area/Interchange dialog box appears.
4. Change the data in the text boxes if you need to.
5. Click the Create Area Continuation Card button. The dialog box appears.
6. Add zone data to the Zone text boxes.
7. Click the Add button. The Area/Interchange dialog box closes and the new data you typed into the Area/Intertie dialog box now appears in the Area/Intertie Selection dialog box.

**Figure 3-8 Area Continuation Card Dialog Box****3.8.6 Exploring Base Case Connectivity**

Sometimes you may want to explode a portion of a large network to see how buses are locally interconnected. The idea is that you start with one bus on the display and find out what other buses are connected to it. Then, with each of these buses, you find out what buses are connected to these, and so on.

The Explode icon in the toolbox allows you to explore base case connectivity.

To explore a base case:

1. Load just a base case file to demonstrate this function. See *Opening Files* to find out how to do this.
2. Click the New Bus icon in the toolbox to enter Add Bus mode. The Input Data Edit box will come up; just close it without entering any data.
3. Select Alpha Search on the View menu. In the Alpha Search dialog box, type the first few letters of a bus name. The alphabetical list automatically scrolls to find the bus of interest in the list. See the Alpha Search command entry in Chapter 4 for more information.
4. Click the bus name of interest. It may already be highlighted, but you must click on it to make it the currently selected bus.
5. Move to the blank display area. (You should still be in Add Bus mode.) Click once to make the bus icon and name appear.
6. Move back to the toolbox and click the Explode icon. You previously established a bus that you can now explore bus connectivity with.
7. Click the bus. You will note that any buses that are connected to your bus of interest are now shown on the display with connecting lines representing branches. You can continue exploring the network by clicking any new buses that show up. You can reveal the entire network in this way if you like (although it will probably look like a mess!)

The buses and branches are positioned by an internal algorithm since you have not loaded any underlying coordinate data. You can click the Move icon and then move the buses around the screen if you want to clean things up.

3.8.7 Sectionalizing a Bus

Sectionalizing a bus separates a bus into two buses and rearranges its branches between the two buses. You can also optionally create a tie line between the two buses. See Figure 3-9.

To sectionalize a bus:

1. Make sure you have system data loaded. See *Opening Files* to find out how to do this.
2. Click the Input Data Edit mode button in the toolbox. You are now in Input Data Edit mode.
3. Select a bus by clicking it. This brings up the Input Data Edit Box. At the center bottom of the dialog box is the Sectionalize button. Click it to cause the Bus Sectionalize dialog box to appear. Note that the bus name of the currently selected bus appears in *two* places.
4. Type a new bus name over the existing Bus 2 name to create a new bus.
5. Click any branch, transformer, etc., record in the left-hand scrolling text box to transfer it to the right-hand scrolling text box. Note that you can go back and forth by clicking the appropriate records till branches, transformers, etc., are all associated with the bus you want.

- Click the OK button to send the sectionalized bus data to the resident base case data. If IPF detects any errors or inconsistencies, it puts up the Error dialog box. Examination of the message helps you figure out the problem.

Note: If the name you type is not accepted, IPF has found it to be a duplicate name and rejects it. If, at any point, you would like to start from the beginning, just press Reset at any time. This returns all values to the state they were at the time the dialog box first opened.

- Sometimes you may want to connect the old and new buses making up the sectionalized bus. Click on the Bus Tie button to create a line with impedance of 0.0 + j0.00001. You may modify this line later, if you wish.

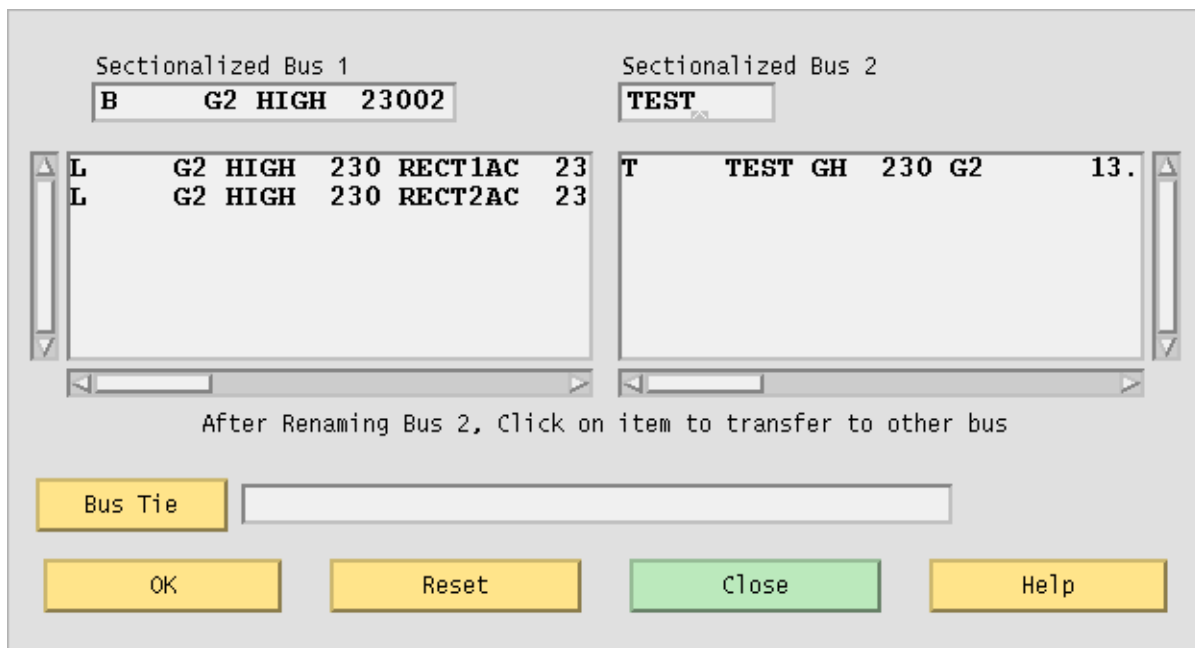


Figure 3-9 Sectionalize Operation Completed

3.8.8 Tapping a Line (Not yet available)

Tapping a line means to service a new load by creating a new tap point bus on an existing line. The tapped line is effectively segmented into two lines, separated with a newly created bus. If the load is remote from the tapped point, an additional line and bus will be necessary. The new load and the new bus are connected by a new line. As with many line operations, you access line tapping through a bus that the line is connected to.

To tap a line:

1. Make sure you have system data loaded. See *Opening Files* to find out how to do this.
2. Click the Input Data Edit mode button in the toolbox.
3. Click a bus icon that is connected to the line you want to tap. This brings up the Input Data Edit Box which is loaded with input data pertaining to the selected bus. Click and hold the option button opposite the bus name at the top of the Input Data Edit Box. The cascading menu lists all branches connected to the current bus. Drag down to the line you are interested in tapping. Be sure that this is a line and not a transformer. Selecting this item brings up the Input Data Edit Box for your line of interest. Near the center bottom of *this* dialog box is the Tap Line button. Click it to cause the Tap Line dialog box to appear.
4. Initially the dialog box displays data from a previous invocation. If this is the first time it is displayed, all fields are blank. Enter the name of the bus you want to create in the dialog field Tapped Bus Name and press the Apply button. The selected line is tapped at the point depicting 50% of the total line's reactance. You can horizontally scroll the line data within the Bus 1 side and the Bus 2 side to verify that the line resistance and reactance is split according to the sliding scale selected. Pressing the Apply button recomputes the line impedance on each side of the tapped bus without affecting any data in the Powerflow base case.
5. Change the units (Percentage, Miles, Kilometers, or Section) to reflect your tapping criteria. Adjust the horizontal slider as necessary. Move the slider by moving the mouse cursor over it, pressing the left mouse button, and moving left or right till you find the point of the line you want to tap. Release the mouse button. The line tapping slider just above the Reverse Scale button shows the tap point according to the tapping criteria (length of the line in kilometers or miles, or percent of reactance). The line tapping slider also shows any sections the line may be divided into. Again press Apply to update the line's impedance to reflect the slider's current value.
6. If the values are acceptable, click OK to export these changes to Powerflow.
7. Click Close to cause the dialog box to disappear.

3.9 SOLVING A NETWORK CASE

Solving a network case (or base case) causes IPF to calculate bus voltages that satisfy the network constraints as they exist within the currently resident base case data. This is usually done after you have loaded a base case and made some modifications to reflect the conditions of the system you want to study. However, you may solve as soon as you have loaded any system data. You do not need to load a coordinate or change file to solve a case. See Figure 3-11 for a typical display after a case solution.

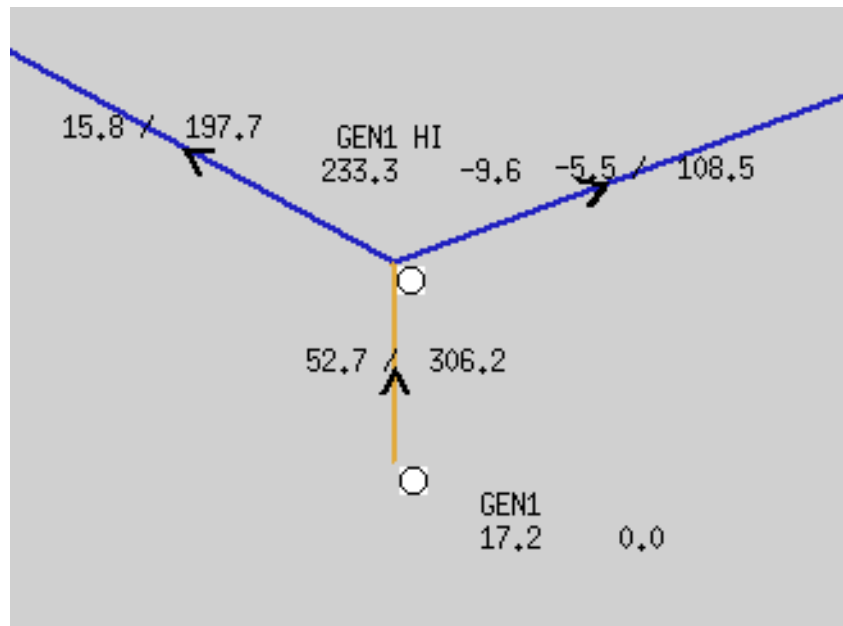


Figure 3-10 Network Display After Solution

To solve a base case:

1. Make sure that you have previously loaded a base case or netdata file. See *Opening Files* if you have not.
2. Choose Solve Case from the Process menu in the IPF main window. The Solve dialog box opens and you are presented with a number of options. See Figure 3-12. Note that default values are set for you. If these suit your case, click the Solve button. If the defaults are not appropriate for your case, change them. Then solve the case. See Chapter 4 for a discussion of the options.

The solution may take anywhere from a few seconds to minutes depending on the number of buses in the base case. After the solution is complete, the display shows some of the calculated data.

Near each bus icon are two numbers. The one on the left is the calculated voltage for the bus in kV; the one on the right is the voltage angle in degrees. Two other numbers also appear. These are the branch real and reactive power. The one on the left of the slash is the real power in MWs, and the one on the right is the reactive power in MVARs. Note also that the direction of positive power flow is shown by an arrow in the middle of the branch.

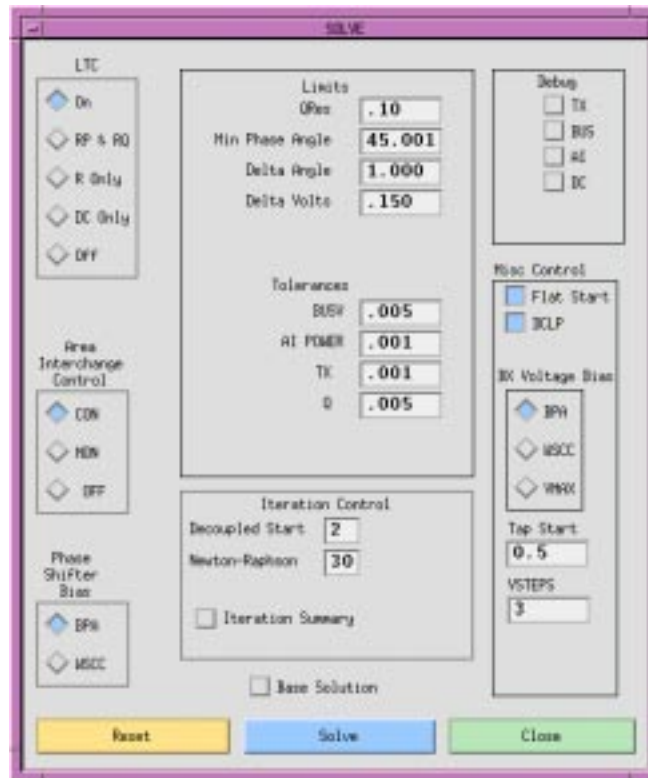


Figure 3-11 Solve Dialog Box

3.10 EDITING COORDINATE DATA

An IPF coordinate file specifies where to place buses and branch bending points on the IPF display and on a hard copy plot. Thus, when you edit coordinate data, it is important to keep in mind that you are not affecting the base case in any way. But, of course, for the base case file and the coordinate file to work together, they must have bus identification data — the bus name and base kV — and bus connectivity and branch specification between buses “in synch.” If bus names are not the same between the files and if the bus connectivity and branch specification does not match up, then errors may arise. IPF helps find some of these errors, but cannot protect you from all possible errors.

Note that when you edit coordinate data on the display, it does not affect the coordinate file that you loaded. If you want to save your changes, you must coordinate file using the Save File dialog.

You can edit certain coordinate file values through the Bus Coordinate Edit dialog box. Be sure to read through the description of this at the end of this section.

3.10.1 Moving a Bus

Each bus in the coordinate file is represented on the display by a bus icon. Bus icons also have associated bus names. When you move a bus icon, the icon and the bus name both move, along with the connected lines representing network branches. Bus icons are usually moved to make the diagram more readable or more pleasing to look at. See Figure 3-13.

To move a bus:

1. Click the Coord button in the main window toolbox. This action displays the loaded coordinate data, including that for buses which do not appear in the base case. If there is no display, you need to load a coordinate file. See *Opening Files*.
2. Click the Move button in the main window toolbox.
3. Move the cursor over into the display area of the main window. You will notice that the cursor changes shape. This shape always means you are in Move mode.
4. Find a bus icon you want to move and put the cursor directly over the icon, covering it.
5. Press the mouse button, hold it, and move the cursor to a new location. You will see that an outline of the bus icon and name appears and moves with the cursor to the new location. The attached branches also move in outline along with the bus.
6. Release the mouse button. The bus and name are now in the new location, and branches are properly moved along with the bus.

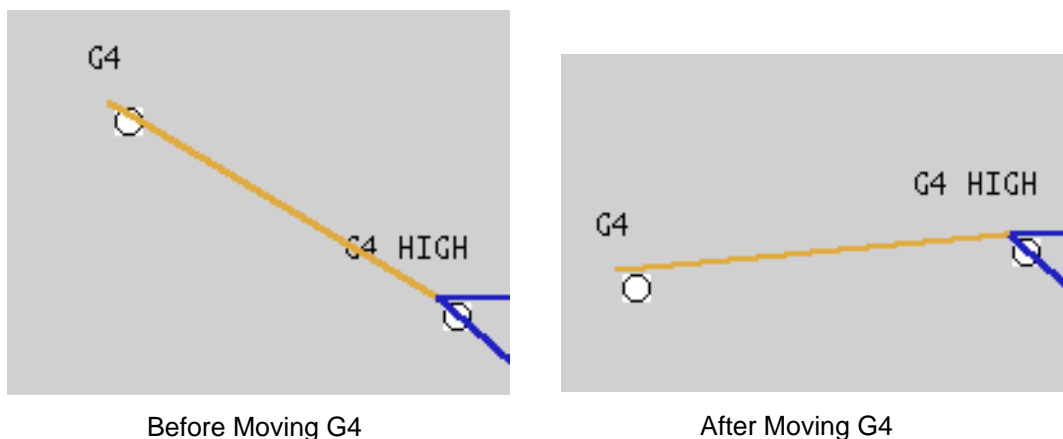


Figure 3-12 Moving a Bus

3.10.2 Moving a Group of Buses

You can do a group move of buses. The group move is no different in result from moving each bus by itself. The only difference is that all buses are moved at the same time and, perhaps more important, all buses in the group maintain their relative distances from each other. (Mathematically, the buses are “translated” from one place to another as a unit.) See Figure 3-14.

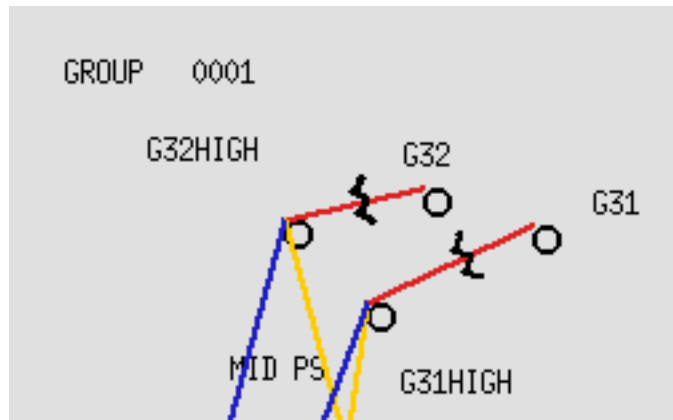


Figure 3-13 After a Group Selection of Buses

To group move some buses:

1. Click the Coord button in the main window toolbox. This action displays the loaded coordinate data. If there is no display, you need to load a coordinate file. See *Opening Files*.
2. Click the Group Move button in the main window toolbox.
3. Move the cursor over into the display area of the main window. You will notice that the cursor changes shape. This shape always means you are in Group Move mode.
4. Find a group of buses you would like to move. Move the cursor to the upper left of the farthest up and to the left of all the buses. Press and hold the left mouse button and drag the cursor to the lower right. You will see a selection box form as you move to the lower right. Make sure that all of your intended buses are clearly within this selection box. Release the mouse button.
5. In the area where you first pressed the mouse button, you will see a name appear, such as GROUP 0001. This name becomes the “handle” by which you grab the group and move it. If you do further group moving, the group names increment and become GROUP 0002, GROUP 0003, etc.
6. Move the cursor over the name GROUP 0001. Press and drag to a new location, then release. The selected group of buses is now moved all together to the new location.

3.10.3 Moving a Bus Name

The bus name accompanying a bus icon “knows” where its associated icon is. Thus, when you move a bus icon, the associated bus name always moves with the icon and keeps its position relative to the bus icon. However, in addition to moving a bus icon, you can move a bus name independently of its associated icon. This helps you make the network diagram more readable if names, icons, or branches happen to overlies one another. See Figure 3-15.

To move a bus name:

1. Click the Coord button in the main window toolbox. This action displays the loaded coordinate data. If there is no display, you need to load a coordinate file. See *Opening Files*.
2. Click the Move button in the main window toolbox.
3. Move the cursor over into the display area of the main window. You will notice that the cursor changes shape. This shape always means you are in Move mode.
4. Find a bus name you want to move and put the cursor directly over the name, covering it.
5. Press the left mouse button, hold it, and move the cursor to a new location. You will see that an outline box of the bus name forms and moves with the cursor to the new location. Just the outline box moves. The bus icon and branches stay put.
6. Release the left mouse button. The bus name is now in the new location.

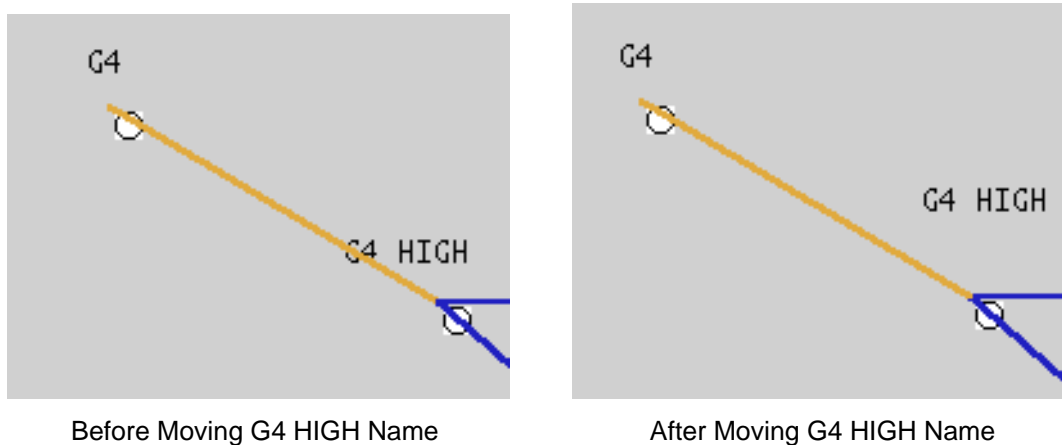


Figure 3-14 Moving a Bus Name

3.10.4 Deleting a Bus

The coordinate file has bus position data and possibly line bending points. So, when you delete a bus from the display, you remove the bus coordinates from the coordinate file *and* you delete any line bending points in any of the branches connected to the deleted bus. See Figure 3-16. This does not delete anything from the base case, if you have one loaded. It only removes the bus from the display.

To delete a bus:

1. Click the Coord button in the main window toolbox. This action displays the loaded coordinate data. If there is no display, you need to load a coordinate file. See *Opening Files*.
2. Click the Delete button in the main window toolbox.
3. Move the cursor over into the display area of the main window. You will notice that the cursor changes shape. This shape always means you are in Delete mode.
4. Find a bus you want to delete and put the cursor directly over the bus icon.
5. Click the left mouse button. You will see that both the bus icon and any connected branches disappear from the display.

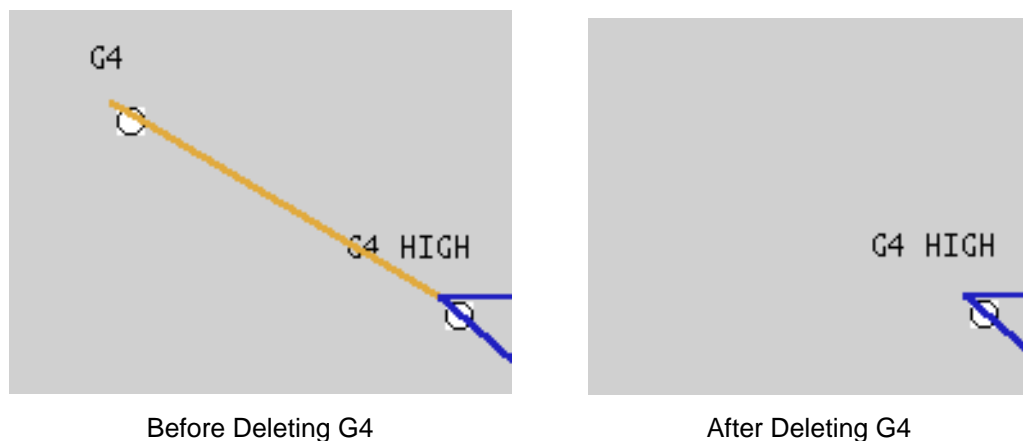


Figure 3-15 Deleting a Bus

3.10.5 Adding and Moving a Branch Bending Point

Bending points in branches allow you to arrange a network diagram in a neater or more pleasing way than without bending points. With bending points, you can avoid branches that intersect bus icons, bus names, other branches, etc.

Bending point coordinates are stored only in the coordinate file. They are not stored or referred to in the base case file. You can have up to four bending points in a branch. However, if a branch is very short on the display, the limitations of the graphics algorithms may not allow you to add all four bending points. On the other hand, you can put in as many bending points as the displayed branch will take, though only the first four will be recorded in the coordinate file data for hardcopy plotting. See Figure 3-17.

To add a branch bending point:

1. Click the Coord button in the main window toolbox. This action displays the loaded coordinate data. If there is no display, you need to load a coordinate file. See *Opening Files*.
2. Click the New Bending Point button in the main window toolbox.
3. Move the cursor over into the display area of the main window. You will notice that the cursor changes shape. This shape always means you are in Bending Point mode.
4. Find a point along any branch and press the left mouse button. A small outline box appears next to the cursor.
5. Move the cursor to a point that creates a suitable bend in the branch. Release the button. Note that it is quite possible to have one or more bending points along a branch with no on-screen physical bends in the branch. Because of this, there may be hidden bending points in a branch. If you suspect hidden bending points, you can find them by moving one of the bus icons.

To move a branch bending point:

This is the same except you want to click on an existing bend.

Note: You must place the cursor over the Bending Point Hot Spot Box to select a bending point. Note that the upper left hand corner of the Box is attached to the actual bending *point*. The point of the blue cursor arrow indicates this corner. If the point is *above* or *to the left of* the bending point, you may very well miss selecting it.

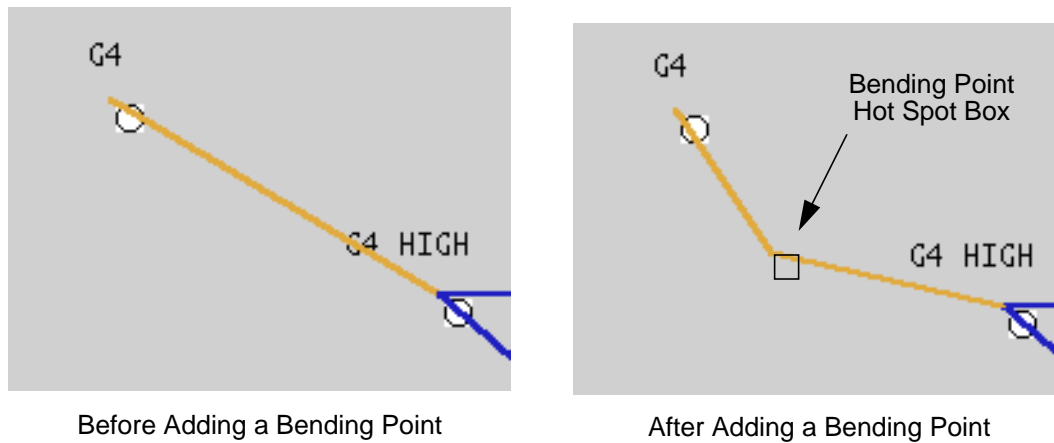


Figure 3-16 Adding and Moving a Branch Bending Point

3.10.6 Deleting a Branch Bending Point

Deleting a bending point means to remove the bending point from the display and to also remove it from the coordinate data if it was a stored bending point. See Figure 3-18.

To delete a branch bending point:

1. Click the Coord button in the main window toolbox. This action displays the loaded coordinate data. If there is no display, you need to load a coordinate file. See *Opening Files*.
2. Click the Delete button in the main window toolbox. Move the cursor over into the display area of the main window. You will notice that the cursor changes shape. This shape always means you are in Delete mode.
3. Find the point in a branch where there is a bend. Move the cursor right over the bending point or to the lower left of the bending point. Click the left mouse button. The bend in the branch disappears and the branch straightens out.

Note: Branches may have hidden bending points that are actually there but do not show because of the placement of the buses at either end of a branch. To find hidden branch bending points, while in Move mode, select and move a bus icon. This should reveal hidden bending points.

3.10.7 Bus Coordinate Edit Dialog Box (Incomplete)

You can edit certain coordinate file values via the Bus Coordinate Edit dialog box. If you want to

change the position of a bus on a plot, for example, or create a special plot-only name for a bus, you can do so through the Bus Coordinate Edit dialog box. See Figure 3-19.

Note: This dialog box changes values only for a coordinate file that is then plotted as a paper hard copy. The values do not change on the display itself.

Figure 3-17 Bus Coordinate Edit Dialog Box

To edit with the Bus Coordinate dialog box:

1. Click the Coord button in the main window toolbox. This action displays the loaded coordinate data. If there is no display, you need to load a coordinate file. See *Opening Files*.
2. Click the Bus Coordinate Edit button in the main window toolbox.
3. Move the cursor over into the display area of the main window. You will notice that the cursor changes shape. This shape always means you are in Bus Coordinate Edit mode.
4. Click any bus. The Bus Coordinate Edit dialog box opens. Note the text boxes for Bus Name, kV, Plot Name, Bus X and Y Position, Generator and Reactance Angle, Name X and Y Position. You can fill in or change any of these values except for Bus Name and kV
5. Move the cursor over the Bus Name text box. Try to change the name. You cannot. The same is true of the kV. These two values are the base case identifiers of the bus you have chosen. You cannot change these because they are base case and not coordinate file values.

6. Type a plot name in the Plot Name box. Note that this works. You can type any name you like. Type bus x and y position values. Remember that the x,y values are with respect to the lower left-hand corner of the plot as are the x,y values for the name. The generator and reactance angles are 360 degrees centered on the bus position with 0 degrees being on the right of the bus position. For example, 180 degrees would put the generator symbol on the left-hand side of the bus symbol.
7. Click the radio buttons to show or hide the bus itself or the bus name.
8. Pop up the Voltage Location menu to put the voltage value in one of the following positions: Above Name, Right of Name, Below Name, or Left of Name. Do Not Print Voltage and Print Voltage Without Name are also possibilities on this menu.
9. Click Apply if you want to see the values on a new plot. Click Reset to delete all the values you just entered. Close closes the dialog box without making any changes to the values.
10. Print a new plot with the new values for the selected bus by going to the main window menus and selecting Print Plot on the File menu. (If you want to see the effect of your changes, you will have to compare it to a previously printed plot.)

3.11 GETTING REPORTS

Reports allow you to get a concise look at IPF data — input, output, solution, and calculated. These reports involve bus input data, overloaded lines and transformers, lines that are overvoltage or undervoltage, line comparisons, area interchanges, tie lines, etc. See Figure 3-20.

Additional reports can be obtained from IPF by writing programs that use the IPF CFLOW library. See the *IPF CFLOW User's Guide* for instructions on how to write these programs.

Batch-style reports can be obtained by saving a new base case file from IPF and then running the batch program, BPF. See the *IPF Batch Users Guide* for instructions.

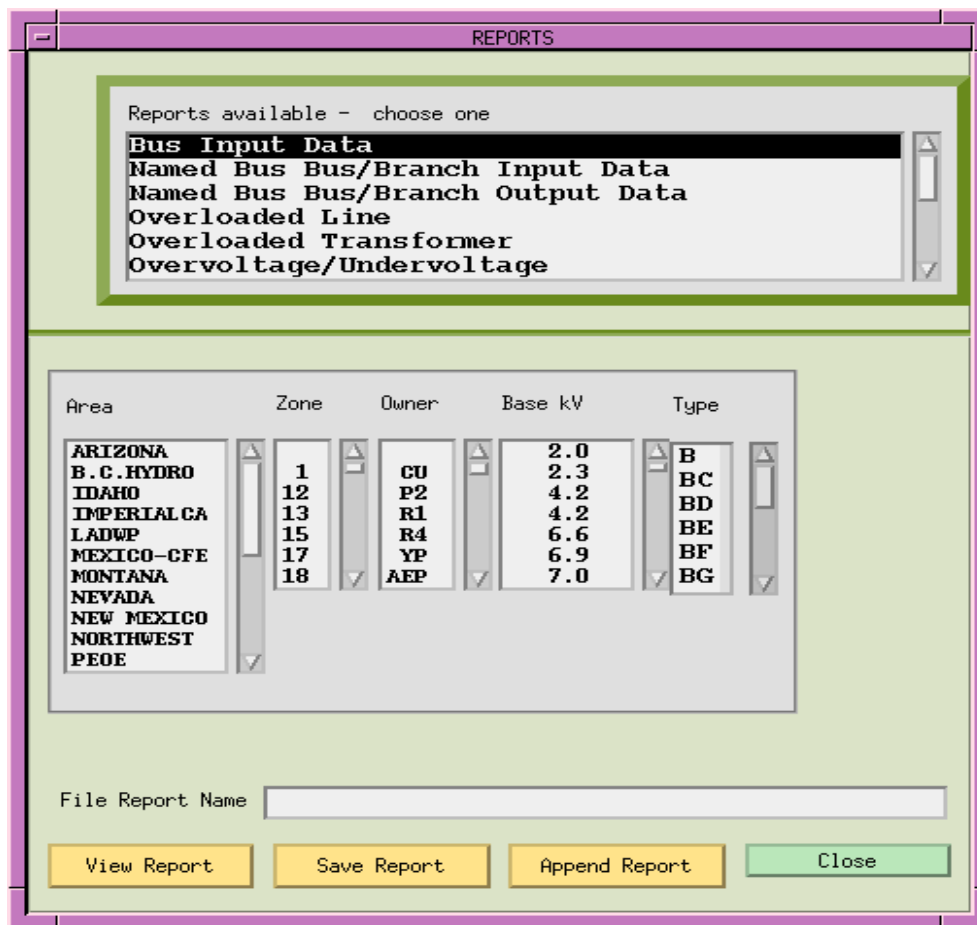


Figure 3-18 Reports Dialog Box

To get a report:

1. Most reports require you to have a solved case in residence. If you have only loaded a network file and have not yet run a solution, then there is no output solution data in residence for you to get a report on.
2. Click the View main window menu and select Reports. The Reports dialog box appears.
3. Scroll down the list to see what reports are available. Choose one by clicking it.
4. Click the View Report button. A report appears in a separate, scrolling list window. Note that there are heading labels at the top to help you interpret the data. Use the scroll bar to find data of interest.
5. If you would like to save the report in a file, click the Save Report button. If you do not specify a file name in the File Report Name text box, the output will be saved in a file names REPORTS.DAT. To append to an existing report file, type the name in the text box and

click on the Append Report button.

6. For reports that consist of a large amount of data, you may want to trim the amount to a more manageable size. The filters in the center of the box help you do this. Here's an example. To select overloaded lines owned by BPA in zone 03 at a nominal 230 kV, you would first select Overloaded Line. Then, select filters 03, BPA, and 230. These selections are effectively "anded" together. This limits the report to bus records with just those attributes.

3.12 PRINTING A NETWORK DIAGRAM

Besides printing a report, you can get a permanent copy of IPF data by printing a network diagram. A coordinate file provides position data for buses (and sometimes branch bending point data) to which you can add various kinds of base case data to create a hard copy map (network diagram) of a base case study. The Print Plot command on the File menu prints the current, memory-resident base case and coordinate data, using the settings specified in the Plot Options command. See the Plot Options entry in the *Concepts and Commands* section for how to specify the printing device and many other printing options. See also Appendix B for more information about how network diagrams are created.

To print a network diagram:

1. Click the File menu in the main window and select Print Plot. This sends the currently resident data off to the printing device that you have previously specified either as a default in your XGUI file, or by selection on the Plot Options menu.

CHAPTER 4

CONCEPTS AND COMMANDS

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4.1 OVERVIEW

This chapter provides detailed explanations and discussions of all IPF menu commands and dialog boxes. It also describes the function of each toolbox button found in the main IPF window. The menu commands are arranged alphabetically. The dialog boxes are arranged as you encounter them in the program. The toolbox is discussed along with the main window at the beginning of this chapter.

The menu that each command is found on is noted in parentheses after the command name. General information about the command or dialog box is presented first. Then each named item in the dialog box(es) is described.

4.2 THE MAIN WINDOW

The IPF main window provides graphical display of bus and branch record data and access to the primary commands and modes of IPF. The window is partitioned into six areas. See Figure 4-1. The largest area is a scrollable window that displays power system record data in graphical format. The buses are represented by icons with bus names nearby. The branches between buses are represented by multi-colored lines connecting the buses. The various colors signify branches of different voltage ratings or overload condition. Clicking on the displayed buses and branches brings up record data organized in the Input Data Edit Box. See the Input Data Edit Box entry later in this chapter.

Below the graphical display area are the branch voltage (or overload) key and the current file text boxes. The current file boxes show you which data files are currently loaded. A Power flow State box and a Bus Symbol key are also found below the graphical display area.

At the top of the graphical display area is a standard window manager menu bar. The commands in the pull down menus supplement the functions available directly in the toolbox at the left side of the graphical display area. See Table 4-1.

Below the toolbox are the display mode buttons. These buttons give you a somewhat different graphical look at the underlying bus and branch record and coordinate data. Sometimes you may want to see how a corresponding coordinate file looks without regard to base case file data. The Coord button gives you this view. You see how the intersection of the base case data and a corresponding coordinate data file look on the display by clicking the Base button. The Reset button clears the graphical display area of all solution data. (It leaves the underlying base case and

coordinate data intact.)

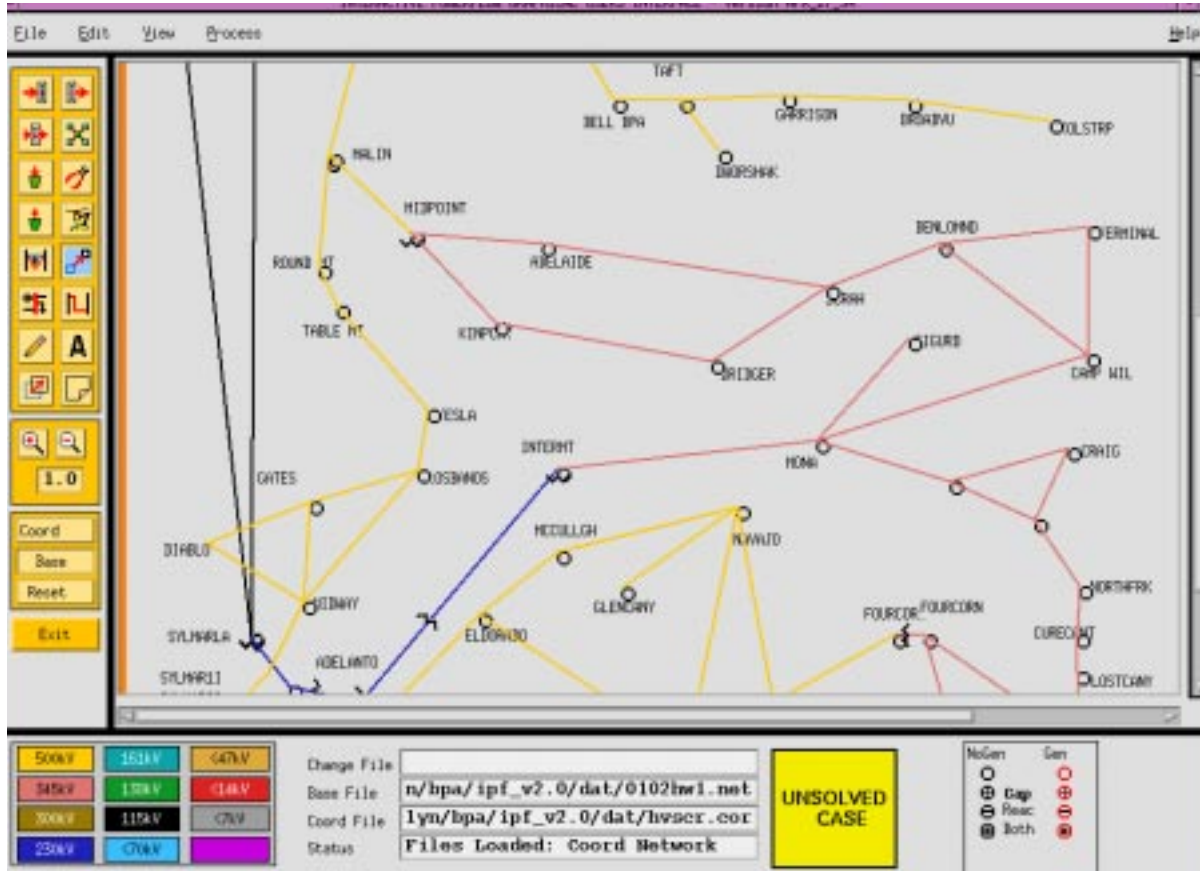


Figure 4-1 IPF Main Window with Loaded Files

Table 4-1 Main Window Toolbox Buttons



















Tool	Description
	The Input Data Edit Box tool brings up the Input Data Edit Box.
	The Report Output Box tool brings up the Report Output Box.
	The Input/Output tool brings up both the Input Data Edit Box and the Report Output Box.
	The Explode tool allows you to explore network connectivity, bus by bus.
	The Delete tool allows you to delete buses and branches.
	The Reconnect tool allows you to outage buses or branches.
	The Undelete tool undeletes buses and branches. <i>(Not yet implemented.)</i>
	The Reconnect tool allows you to restore buses and branches to the display.
	The New Bending Point tool allows you to create new branch bending points.
	The Move tool allows you to move bus icons and bus names and existing line bends.
	The New Bus tool allows you to create new buses.

Table 4-1 Main Window Toolbox Buttons (Continued)

Tool	Description
	The New Branch tool allows you to create new branches.
	The Draw tool allows you to draw lines on the display. <i>(Not yet implemented.)</i>
	The Text tool allows you to type text on the display. <i>(Not yet implemented.)</i>
	The Group Move tool allows you to move more than one bus at a time.
	The Bus Coordinate Edit tool allows you to edit certain coordinate file values. <i>(Not completely implemented.)</i>
	The Enlarge tool magnifies the bus and branch network display by two times.
	The Reduce tool reduces the bus and branch network display by two times.

4.3 BASIC CONCEPTS

This section presents certain basic concepts which underlie the interface and behavior of IPF. Understanding these concepts will help you work effectively with IPF.

4.3.1 Current Bus

The first time you perform an action on a bus in a loaded case, IPF turns that bus into the currently selected bus. This bus changes, of course, as you select and work with different buses in the current base case data. There are a number of ways to choose the currently selected bus, but the most common way is to click a bus icon in the graphical display. The other common way is to select a bus from the Alpha Search main window menu.

4.3.2 Branch Bending Points

A branch bending point is a point along a branch where the graphically displayed or hard copy diagram shows a corner. A bending point is purely “cosmetic” and contains no associated electrical information. Specifically, no bus is located at a bending point.

You can use bending points to reroute a branch so that it does not obscure bus names, bus icons, and other information on a network diagram.

4.3.3 IPF Data Files

IPF needs certain power system data to work on. The following three files are used most often: the base case file, the network data file, and the coordinate file.

Base Case and Network Data Files

IPF obtains base case data from two basic sources: a new network data file or a previously existing base case file. When you create new data for a power system network, you usually create an ASCII text network data file. When IPF reads this file, it creates a memory-resident “image” of the data. When you save this memory-resident image, it becomes a base case data file, and it is written out to a disk as a binary file. (This file is not ordinarily readable by editing or word processing programs.) See Figure 4-2.

Network data and base case files contain data about buses, bus connectivity, and branches. (This data is fully defined in the *IPF Batch User's Guide*.) As soon as you run a solution on a new network data file, you produce electrical solution data. This solution data and other information, such as final tap position and switched reactance values, is added to a base case file when it is written to disk.

Using IPF, you can add new bus and branch data, or alter an existing base case in a number of ways.

- You can use the IPF Input Data Edit Box.
- You can specify a new network data file.
- You can specify new and altered bus and/or branch data in a change file.

However, most users will use IPF's Input Data Edit Box for small changes to a base case file.

Coordinate Files

Coordinate files are ASCII text files that contain bus identification, bus position, branch bending point, and plotting data. The bus identification, position, and bending points are used by IPF's GUI component to create graphical displays of networks. See Figure 4-2.

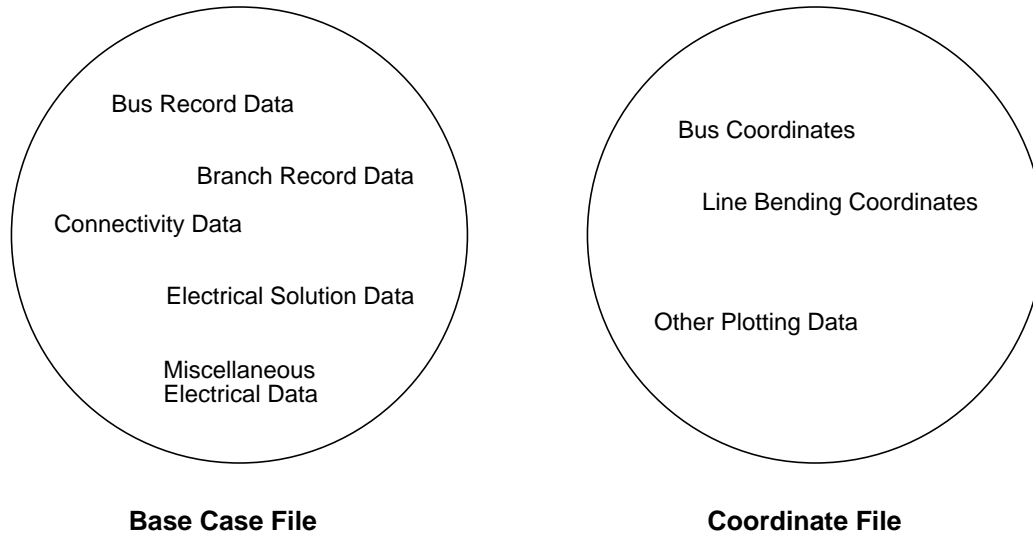


Figure 4-2 Base Case and Coordinate File Contents

4.3.4 The IPF Internal Processing Model

IPF works primarily with two data files — the base case file and the coordinate file. The base case file contains bus, branch, connectivity, and electrical solution data. The coordinate file contains position data for buses (and line bending points). Base case files and coordinate files work together to provide graphical display information for the GUI component of IPF. See Figure 4-2 for a quick idea of the contents of the base case and coordinate files.

Note that the base case file has data about buses and how buses are connected, but no actual position (or coordinate) data, whereas the coordinate file has data about the position of buses. The essential common data in both files is the bus identification data — the bus name and base kV. The bus identification data allows the two files to be used to provide the GUI's graphical display of a network.

Coordinate File Display Operation

When you press the Coord button in the main window, IPF reads the currently loaded coordinate file data and displays all the buses it finds in the file. IPF also examines the file for any bending points that may be specified along lines between buses. No base case file data is examined, read, taken account of, etc., for this operation. You simply see a graphical representation of the coordinate file data by itself with no reference to the currently loaded base case file data. In fact,

you can load a coordinate file, and display and edit that file without ever loading a base case file.

Base Case File Display Operation

When you click on the Base button in the main window, IPF reads the currently loaded base case file data and the currently loaded coordinate file data. The GUI goes through the following steps to create the Base graphical display.

1. The GUI reads all the bus identification data from the currently loaded coordinate file.
2. The GUI locates all the bus identification data common to the currently loaded base case and coordinate file data.
3. For these common buses, the GUI finds all the branch connectivity in the base case data.
4. For all the branch data, it checks in the coordinate file data to see which branches have bending points.
5. This extracted data set of buses, branches, and bending points is then turned over to the GUI display operations to create the Base graphical display.

This Base display operation has certain important consequences. If you have loaded only a base case or netdata file without a coordinate file, *you will have no base case graphical display* when you click the Base button. The display will be blank. Furthermore, if you happen to have loaded a coordinate file that has no buses in common with the currently loaded base case file, you will also have no base case graphical display when you click the Base button. You must be certain that all buses that you want to display are specified correctly in the currently loaded coordinate file.

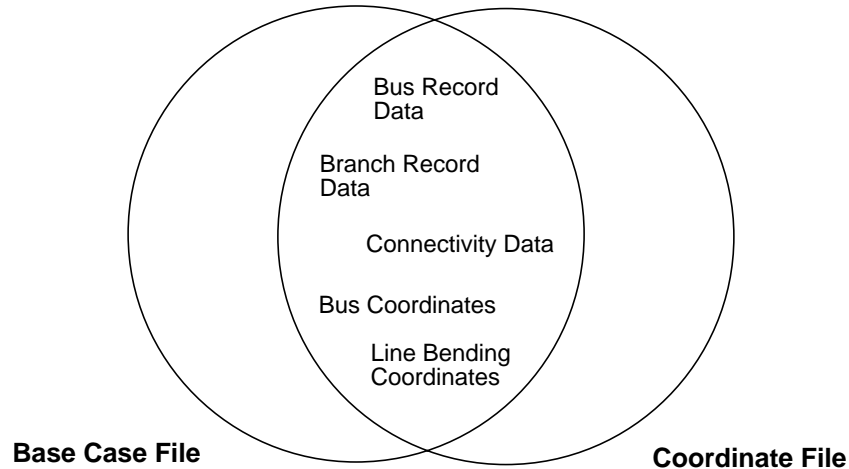


Figure 4-3 Base Mode Displayed Data

A more detailed look at how IPF displays base case and coordinate file data is given in Table 4-2. In the table, B1 and B2 are any two buses. L12 is a branch between B1 and B2. BEND12 is a bending point along branch L12. Each row of the table shows what is displayed when the corresponding combinations of data exist in the base case and coordinate files. Note that the only way a branch can be included in the coordinate file is by having a bending point defined for it. This bend may, however, be invisible on the display

Table 4-2 Display Operation Condition Table

Coordinate File	Base Case File	Displayed
B1, B2, L12, BEND12	B1, B2, L12	B1, B2, L12, BEND12
B1, B2	B1, B2, L12	B1, B2, L12
B1, B2, BEND12	B1, B2	B1, B2
B1, BEND12	B1, B2, L12	B1
B1, B2, BEND12	B1	B1
B1, B2	B1, B2	B1, B2

4.4 BUS AND BRANCH EDITING

Bus and branch data editing are most often accomplished through the Input Data Edit Box. This dialog box is brought up on the display whenever you click a bus displayed in the main window. The specific data associated with the bus you click fills the text boxes of the Input Data Edit Box. You can change any of the values to new values. You can then store the changed data in the memory-resident bus and branch database, solve the case with the new data values, and optionally save the changes permanently in a file.

Note: See the Network Data Edit menu item entry in this chapter for another way to edit bus and branch data.

Each of the text box fields in a given instance of the Input Data Edit Box corresponds to a record field for a bus, line, or transformer type as documented in the *IPF Batch User's Guide*. If you are unsure of the meaning of the fields for a particular bus, line, or transformer type, look it up in the *IPF Batch User's Guide*.

In the *IPF Batch User's Guide*, field width, decimal point placement, and sign are specified for each field. Real number fields have a position where a decimal point is implied, i.e. as long as you correctly position your digits, you need not enter a decimal point on your card-image record. In the Input Data Edit Box you should always enter a decimal point. Sufficient room has been allowed for this in each field. IPF will format your data correctly so it fits the Fortran field on a standard input record.

When you enter data into the Input Data Edit Box text boxes, IPF checks to see whether you have entered values correctly. Specifically, it checks for all characters being numeric, having a minus sign (in the proper place), or having a decimal point (period). All other characters are rejected and a warning bell sounds. Other basic checks for valid data are also operating in IPF during data entry. However, it may still be possible to enter invalid data that only shows up when a power flow solution is attempted.

4.4.1 Bus Editing

Bus input data dialogs are accessed directly by clicking on a bus icon in the display, or by selecting a bus name on the Alpha List. Their appearance varies according to the type of the bus. To change the bus type of a bus, click the button labeled Type, near the Owner and Zone fields. This option button pops up a menu showing all the bus types accepted by IPF. If you click on a different type than was originally displayed, the dialog will change into one appropriate to that bus type. If you click the Modify button, the bus will be changed to a different type. You may have to supply more (or different) data in other fields in order for the change to be legal.

4.4.2 Branch and Other Component Editing

You cannot select a branch directly. Branch data is accessed by selecting a bus that is connected to the line or transformer you want to edit. Then, once the Input Data Edit Box shows a bus connected to your line of interest, you pick the line by using the option button labeled **Bus**, in the upper right corner of the box. Press and drag down to select the one you want. The dialog box changes to reflect the fields and parameters characteristic of lines.

The Bus option menu also contains other bus-related components, or records, such as X data, bus continuation data, PQ curves, etc. Drag down and release to select any of these you want to edit.

4.4.3 Adding New Components

New buses are added by using the New Bus tool in the main menu toolbox. See Chapter 3 for details on this process. New branches can be added only if both terminal buses exist. You can add branches graphically by using the New Branch tool, or by going through the Input Data Edit Box for one of the terminal buses. Other bus-related components can only be added through the dialog box. To add components to a bus, press the option button labeled **New Component** and drag down to the desired item. Items which are grayed out are not appropriate for this type of bus. For example, X data can only be added to a BX type bus.

When you release the mouse button, the data dialog for the selected item will appear. You fill in the desired data fields, and click the **Add** button at the bottom to add it to the currently resident base case data. Notice that the **Modify** button is grayed out on this dialog.

4.5 INPUT DATA EDIT DIALOG BOXES

The following dialog boxes are all accessed from the Input Data Edit Dialog Box. The dialog boxes are arranged with buses first and branch components last. .

Table 4-3 Input Data Edit Dialog Boxes

Page	Dialog Box	Description
4-16	B-BLANK BUS	Adds bus data for modeling load bus.
4-16	BC BUS	Adds bus data for a bus controlled by a BG bus.
4-20	BD BUS	Supplies data for a two terminal dc bus.
4-17	BE BUS	Adds bus data for a bus that holds its voltage to a specified value.
4-17	BF BUS	Supplies data for a special-purpose bus for the Newton-Raphson solution method.
4-17	BG BUS	Adds bus data for a bus that controls the voltage of a remote BC bus.
4-22	BM BUS	Supplies data for a multi-terminal dc bus.
4-18	BQ BUS	Adds bus data for a bus that holds its voltage to a specified value within reactive limits.
4-18	BS BUS	Adds bus data for the slack (or swing) bus.
4-18	BT BUS	Adds bus data for a bus that maintains its voltage with an LTC transformer.
4-19	BV BUS	Adds bus data for a bus that holds its net reactive power within a user-specified voltage range.
4-19	BX BUS	Adds bus data for a bus that controls its local voltage by switching capacitors/reactors in and out.
4-24	CONTINUATION BUS	Adds additional data to an existing bus record.
4-26	SWITCHED REACTANCE	Adds data for voltage controlled shunt device installations.
4-28	PQ CURVE	Adds PQ curve data for calculation of Q limits.
4-30	SECTIONALIZATION	Provides for the sectionalization of a bus.
4-32	LINE TAPPING (Not yet available)	Provides for tapping of lines.
4-34	TRANSMISSION LINE	Adds data for a balanced transmission line.
4-37	PHASE SHIFTER	Adds data for phase shifting transformers.

Table 4-3 Input Data Edit Dialog Boxes (Continued)

Page	Dialog Box	Description
4-40	TRANSFORMER	Adds data for two-winding transformers.
4-43	REGULATING TRANSFORMER	Adds data to give fixed transformers or phase shifters automatic regulating or control status.
4-45	EQUIVALENT NETWORK	Adds data for an asymmetrical pi type line.

4.6 AC BUS INPUT DATA BOXES

This box will look slightly different, depending on the bus type. All of the ac bus data fields are described below; specific differences are covered under the various bus types. You must click separately in each field that you want to alter. Text entry is always in Insert mode, meaning that you cannot type over a character or number; you must delete it first. Note that when a field is described as a "real number," you should *always* enter a decimal point. See Figure 4-4 for an example of a typical bus input data dialog box.

The screenshot shows a dialog box for editing bus data. At the top, the 'Name' field contains 'G4 500' and '500.', and a dropdown menu is set to 'Bus'. Below this is a section with a bus icon, 'Owner' (empty), 'Zone' (02), and 'Type' (B). To the right is a graph with 'Q' on the y-axis and 'Constant Q' on the x-axis. The main area contains several input fields: 'Load P', 'Load Q', 'Shunt P', 'Shunt Q', 'P Max', 'P Gen', 'Q Sched', 'Q Min', 'V Max', and 'V Min'. A yellow 'Sectionalize' button is at the bottom of this section. Below the graph is a 'New Component' dropdown set to 'Continuation Bus...'. At the very bottom are buttons for 'Add', 'Modify', 'Reset', 'Delete', 'Cutage', and 'Close'.

Figure 4-4 Input Data Edit Box Showing B-blank Bus Data

Name. An eight character maximum, alphanumeric string designating a bus name. The string must start with an alpha character. The name should be unique. This name is placed in the first text box from the left. The right text box should have a five character maximum numeric string representing the bus's base kV rating.

Bus. An option button that allows you access to other records that are associated with the currently displayed bus. Press on this button and drag down to select an existing branch or other component. The dialog box transforms into the dialog for the selected component.

Owner. Three character maximum, alphanumeric string designating a bus owner.

Zone. Two character maximum, alphanumeric string designating the zone the bus is in.

Type. An option button that changes the dialog box to reflect different bus types. The types are: B-blank, BC, BE, BF, BG, BQ, BS, BT, BV, and BX. You cannot change an ac bus into a dc bus using this button.

Load P. Five character maximum, real number designating real load in megawatts (MW).

Load Q. Five character maximum, real number designating reactive load in megavoltamperes reactive (Mvar).

Shunt P. Four character maximum, real number designating the shunt admittance load in megawatts (MW) at the base kV of the bus.

Shunt Q. Four character maximum, real number designating shunt admittance in megavolt-ampere reactive (Mvar). A positive value is capacitive; a negative value is inductive. The minus sign goes in front of the number.

P Max. Four character maximum, real number designating the maximum real power generation in megawatts (MW).

P Gen. Five character maximum, real number designating scheduled real power generation in megawatts (MW).

Q Sched. Five character maximum, real number designating scheduled reactive power in megavoltamperes reactive (Mvar). May be positive or negative.

Q Max. Five character maximum, real number designating maximum reactive power in megavoltamperes reactive (Mvar). Generally positive.

Q Min. Five character maximum, real number designating minimum reactive power in megavoltamperes reactive (Mvar). Generally negative. The minus sign goes in front of the number.

V Hold. Four character maximum, real number designating a voltage to hold for the bus, in per unit.

V Max. Four character maximum, real number designating a maximum voltage limit in per unit.

V Min. Four character maximum, real number designating a minimum voltage limit in per unit.

Sectionalize. A button that brings up the Sectionalize dialog box. See *Sectionalize Dialog Box* in this chapter.

New Component. A tag for the option button that allows you to add a new bus-related component such as a branch, X data, etc.

Add. A button that adds a new record to the database.

Modify. A button that modifies the record.

Reset. A button that restores text box displays to their original values (before any changes were made).

Delete. A button that deletes (removes) a record from the database.

Outage. (Not yet implemented.)

Close. A button that causes the dialog box to close and disappear from the display without making any modifications to the record.

4.6.1 B-BLANK BUS

The B-blank dialog box supplies data for modeling the typical load bus. See the B-blank record in the *IPF Batch User's Guide*.

V Max. Four character maximum, real number designating a maximum voltage limit in per unit.

V Min. Four character maximum, real number designating a minimum voltage limit in per unit

The voltage limit fields take effect only if the voltage of the B-blank bus is being controlled by a remote device.

4.6.2 BC BUS

The BC dialog box supplies data for a bus controlled by one or more BG type buses. See the BC record in the *IPF Batch User's Guide*.

V Hold. Four character maximum, real number designating a voltage to hold for the bus, in per

unit.

4.6.3 BE BUS

The BE dialog box supplies data for a bus that holds its voltage to a specified value. See the BE record in the *IPF Batch User's Guide*.

Q Max. Five character maximum, real number designating maximum reactive power in megavoltamperes reactive (Mvar). Generally positive.

Q Min. Five character maximum, real number designating minimum reactive power in megavoltamperes reactive (Mvar). Generally negative. The minus sign goes in front of the number.

V Hold. Four character maximum, real number designating a voltage to hold for the bus, in per unit.

4.6.4 BF BUS

The BF dialog box supplies data for a special-purpose bus for the Newton-Raphson solution method. It holds the specified voltage until the P-solution has converged, then acts like an ordinary load bus (B-blank). See the BF record in the *IPF Batch User's Guide*.

Q Max. Five character maximum, real number designating maximum reactive power in megavoltamperes reactive (Mvar). Generally positive.

Q Min. Five character maximum, real number designating minimum reactive power in megavoltamperes reactive (Mvar). Generally negative. The minus sign goes in front of the number.

V Hold. Four character maximum, real number designating a voltage to hold for the bus, in per unit.

4.6.5 BG BUS

The BG dialog box supplies data for a bus that controls the voltage of a remote BC bus. See the BG record in the *IPF Batch User's Guide*.

Q Max. Five character maximum, real number designating maximum reactive power in megavoltamperes reactive (Mvar). Generally positive.

Q Min. Five character maximum, real number designating minimum reactive power in megavoltamperes reactive (Mvar). Generally negative. The minus sign goes in front of the number.

V Max. Four character maximum, real number designating a maximum voltage limit in per unit.

V Min. Four character maximum, real number designating a minimum voltage limit in per unit

Remote Bus. An eight character maximum, alphanumeric string designating the remote bus to be voltage controlled (a BC type bus).

PCS. A three character maximum, numeric string designating the percentage of VARS supplied by this bus to control the remote bus voltage.

4.6.6 BQ BUS

The BQ dialog box supplies data for a bus that holds its voltage to a specified value within reactive limits. See the BQ record in the *IPF Batch User's Guide*.

Q Max. Five character maximum, real number designating maximum reactive power in megavoltamperes reactive (Mvar). Generally positive.

Q Min. Five character maximum, real number designating minimum reactive power in megavoltamperes reactive (Mvar). Generally negative. The minus sign goes in front of the number.

V Hold. Four character maximum, real number designating a voltage to hold for the bus, in per unit.

4.6.7 BS BUS

The BS dialog box supplies data for the system slack (or swing) bus. See the BS record in the *IPF Batch User's Guide*.

Q Sched. Five character maximum, real number designating scheduled reactive power in megavoltamperes reactive (Mvar). May be positive or negative.

V Hold. Four character maximum, real number designating a voltage to hold for the bus, in per unit.

Angle. Four character maximum, real number designating a voltage phase angle in degrees. Blank is translated to an angle of zero.

4.6.8 BT BUS

The BT dialog box supplies data for a bus that maintains its voltage with an LTC transformer. See the BT record in the *IPF Batch User's Guide*.

Q Sched. Five character maximum, real number designating scheduled reactive power in

megavoltamperes reactive (Mvar). May be positive or negative.

V Hold. Four character maximum, real number designating a voltage to hold for the bus, in per unit.

4.6.9 BV BUS

The BV dialog box supplies data for a bus that holds its net reactive power within a user-specified voltage range. See the BV record in the *IPF Batch User's Guide*.

Q Sched. Five character maximum, real number designating scheduled reactive power in megavoltamperes reactive (Mvar). May be positive or negative.

V Max. Four character maximum, real number designating a maximum voltage limit in per unit.

V Min. Four character maximum, real number designating a minimum voltage limit in per unit

4.6.10 BX BUS

The BX dialog box supplies data for a bus that controls its own or a remote bus's voltage by switching capacitors or reactors in and out. See the BX record in the *IPF Batch User's Guide*.

Q Max. Five character maximum, real number designating maximum reactive power in megavoltamperes reactive (Mvar). Generally positive.

Q Min. Five character maximum, real number designating minimum reactive power in megavoltamperes reactive (Mvar). Generally negative. The minus sign goes in front of the number.

V Max. Four character maximum, real number designating a maximum voltage limit in per unit.

V Min. Four character maximum, real number designating a minimum voltage limit in per unit

Remote Bus. An eight character maximum, alphanumeric string designating the remote bus to be voltage controlled.

4.7 BD BUS

The BD dialog box supplies data for a two-terminal dc bus. See the BD record in the *IPF Batch User's Guide*. See Figure 4-5.

Name

Owner Zone Type D

Number of Bridges

Smoothing Reactor mh

Min Firing Angle Degrees

Max Firing Angle Degrees

Value Drop Volts

Bridge Rating Amps

Commutating Bus

Figure 4-5 Input Data Edit Box Showing BD Bus

Number of Bridges. Two digit integer designating the number of bridges per dc circuit (number of valves serially connected).

Smoothing Reactor. Five character maximum, real number designating smoothing inductance in millihenries.

Min Firing Angle. Five character maximum, real number designating minimum firing angle (α_{\min}) in degrees, for rectifier operation.

Max Firing Angle. Five character maximum, real number designating maximum firing angle (α_{stop}) in degrees, for inverter operation.

Valve Drop. Five character maximum, real number designating valve voltage drop per bridge, in volts.

Bridge Rating. Five character maximum, real number designating maximum bridge current rating in amps.

Commutating Bus. Eight character maximum, alphanumeric string designating the commutating bus name. This is the bus on the ac system side of the commutating transformer bank.

4.8 BM BUS

The BM dialog box supplies data for a multi-terminal dc bus. See the BM record in the *IPF Batch User's Guide*.

Figure 4-6 Input Data Edit Box Showing BM Bus

Number of Bridges. Two digit integer designating the number of bridges per dc circuit (number of converters serially connected).

Smoothing Reactor. Five character maximum, real number designating smoothing inductance

in millihenries.

Min Firing Angle. Five character maximum, real number designating minimum ignition delay angle (α_{\min}) in degrees.

Max Firing Angle. Five character maximum, real number designating maximum ignition delay angle (α_{stop}) in degrees.

Valve Drop. Five character maximum, real number designating converter valve drop per bridge, in volts.

Bridge Rating. Five character maximum, real number designating bridge current rating (maximum converter current) in amps.

Commutating Bus. Eight character maximum, alphanumeric string designating the commutating bus name.

Converter Type. Single character alpha string designating the converter code. R indicates normal operation as a rectifier; I is normal operation as an inverter. M indicates an inverter with current margin, and blank indicates a passive dc tap.

Ignition Delay Angle. Three character maximum, real number designating the normal ignition delay angle (α_N) for a rectifier, or normal extinction angle (γ_N) for an inverter, in degrees.

Min Extinction Angle. Three character maximum, real number designating the minimum ignition angle (α_{\min}) for a rectifier, or minimum extinction angle (γ_0) for an inverter, in degrees.

Converter DC Power. Six character maximum, real number designating the scheduled dc bus load (net converter dc output power) in megawatts (MW) at the base kV of the bus.

Converter DC Voltage. Five character maximum, real number designating the scheduled dc bus kV (converter dc voltage).

4.9 CONTINUATION BUS

The continuation bus dialog box is used for extending the data for a given bus record. You can specify additional generation, load, and shunt admittance. A typical use is the case where several owners have load at the same bus. Also, shunt specified on this record is considered to be fixed, rather than variable. See the + (plus) record in the *IPF Batch User's Guide*. See Figure 4-7.

The dialog box is titled 'Continuation Bus Dialog Box'. At the top, there is a 'Name' field containing 'G4 500' and '500.'. Below this, the dialog is organized into several sections:

- Code Type:** A section with a '+' button and a '-' button.
- Owner:** A text input field.
- Code Year:** A text input field.
- Load P:** A text input field.
- Load Q:** A text input field.
- Shunt P:** A text input field.
- Shunt Q:** A text input field.
- Gen P:** A text input field.
- Gen Qmax:** A text input field.
- Gen Qmin:** A text input field.

At the bottom of the dialog, there are six buttons arranged in two rows:

- Row 1: Add (yellow), Modify (yellow), Reset (yellow).
- Row 2: Delete (yellow), Outage (yellow), Close (green).

Figure 4-7 Continuation Bus Dialog Box

Name. An eight character maximum, alphanumeric string, plus a five character maximum real number, designating the name of the bus that this continuation data is associated with.

Code Type. An option button that specifies the type of continuation record: +blank, +A, +C, +F,

+I, +N, +P, or +S. See the *IPF Batch User's Guide* for an explanation of these codes.

Owner. Three character maximum, alphanumeric string designating the owner of this particular load, shunt, etc. This will usually be different from the owner of the bus itself.

Code Year. Two character maximum, alphanumeric string. See the *IPF Batch User's Guide* for the meanings of the codes.

Load P. Five character maximum, real number designating real load in megawatts (MW).

Load Q. Five character maximum, real number designating reactive load in megavoltamperes reactive (Mvar).

Shunt P. Four character maximum, real number designating the shunt admittance load in megawatts (MW) at the base kV of the bus.

Shunt Q. Four character maximum, real number designating the shunt reactance load in megavoltamperes reactive (Mvar) at the base kV of the bus.

Gen P. Five character maximum, real number designating scheduled real power in megawatts (MW) as a real number.

Gen Qmax. Five character maximum, real number designating maximum reactive power in megawatts (MW).

Gen Qmin. Five character maximum, real number designating minimum reactive power in megawatts (MW).

4.10 SWITCHED REACTANCE

The switched reactance bus dialog box is used for specifying steps in a switched reactance BX bus. See the X record in the *IPF Batch User's Guide*. See Figure 4-8.

Name **G4 HIGH 230.** Bus

Remote Bus Owner

	Steps	MVAR
Increment 1	<input type="checkbox"/>	<input type="text"/>
Increment 2	<input type="checkbox"/>	<input type="text"/>
Increment 3	<input type="checkbox"/>	<input type="text"/>
Increment 4	<input type="checkbox"/>	<input type="text"/>
Increment 5	<input type="checkbox"/>	<input type="text"/>
Increment 6	<input type="checkbox"/>	<input type="text"/>
Increment 7	<input type="checkbox"/>	<input type="text"/>
Increment 8	<input type="checkbox"/>	<input type="text"/>

Add Modify Reset

Delete Outage Close

Figure 4-8 Switched Reactance Dialog Box

Name. An eight character maximum, alphanumeric string, plus a five character maximum real number, designating the name of the BX bus that this data is associated with.

Remote Bus. An eight character maximum, alphanumeric string, plus a five character maximum real number, designating the name of the remote bus to be voltage controlled.

Owner. A three character maximum, alphanumeric string designating the bus owner.

Steps. An integer from 1 to 9, designating the number of increments of shunt of this magnitude.

MVAR. A five character maximum, real number designating a block of switchable reactive shunt in megavoltamperes reactive (Mvar).

4.11 PQ CURVE

The PQ Curve dialog box allows you to specify points for a generator reactive capability curve for a type BE, BG, BQ, BX, or BS bus. See the QP record in the *IPF Batch User's Guide* for detailed information. See Figure 4-9.

To specify P Gen, Q Max, and Q Min values, type the values in the bottom text entry boxes. Click the Insert button to transfer the values from the text entry boxes to the list boxes above. Rows of values are associated across. Six rows of values are sufficient for most curves. Once you have values typed in and entered, you can replace or delete them, a row at a time.

P Gen	Q Max	Q Min
140.00	130.00	-100.0
165.00	120.00	-80.00
180.00	5.0000	-6.000

Figure 4-9 P-Q Generation Dialog Box

P Gen. Five character maximum, real number designating a particular level of real power generation in megawatts (MW) which is to be associated with certain Q limits. Values may be specified in per unit on Pmax, or in MVA. All values for a curve must be specified the same way.

Q Max. Five character maximum, real number designating maximum reactive power (positive) in megavoltamperes reactive (Mvar) that can be produced by the generator when operating at this level of real power output. Values may be specified in per unit on Pmax, or in MVA. All values for a curve must be specified the same way.

Q Min. Five character maximum, real number designating minimum reactive power (negative) in megavoltamperes reactive (Mvar) that can be absorbed by the generator when operating at this level of real power output. Values may be specified in per unit on Pmax, or in MVA. All values for a curve must be specified the same way.

Insert. A button that inserts the values in the bottom text entry boxes into the text lists above.

Replace. A button that replaces the selected row of values in the list above with the current values in the bottom text entry boxes.

Delete. A button that deletes the selected text list row of values.

Active. A radio button that makes the curve defined by the values in the text list rows active, that is, IPF uses the curve to determine what the Q limits will be, based on the current level of Pgen specified in the bus record.

Inactive. A radio button that makes the curve inactive, that is, IPF does *not* calculate new Q limits whenever Pgen is changed, but uses whatever it currently has stored.

MVA. The values for the PQ curves may be specified in MVA or per unit. Clicking the MVA radio button tells the program to expect values in MVA.

Per Unit. The values for the PQ curves may be specified in MVA or per unit. Clicking the Per Unit radio button tells the program to expect values in per unit on Pmax.

Add. A button that adds a new three-record point set to the current curve data for this bus.

Modify. A button that modifies the curve data. (Not available.)

Reset. A button that restores text box values to their original values (before any changes were made).

Delete. A button that deletes (removes) the curve data from the database.

Outage. (Not applicable.)

Close. A button that causes the dialog box to close and disappear from the display without making any modifications.

4.12 SECTIONALIZATION

The Sectionalize Bus dialog box allows you to split a bus to create two buses, with existing branches divided between them. See Figure 4-10. You can sectionalize a bus at any time. You get to this dialog box from the Sectionalize button in the Input Data Edit dialog box for the bus you want to split.

When the Sectionalize Bus dialog box first comes up, it assumes the current bus name and information from the Input Data Edit dialog box. Note that the name of the current bus appears in *both* text boxes found at the top of the dialog box. You change the name in the right-hand box to create a new bus record, which will inherit the bus type and voltage of the old bus.

Once you have changed the bus name to a new one, you can arrange the branch information in the list boxes to define the new connections. The list box under the left-hand text box applies to the bus name on the left side, and the list on the right to the right-hand bus name. If you click on a record in either box, it will be transferred to the other. Use the horizontal and vertical scroll bars to see information that is hidden.

After the two buses and their associated branches are satisfactory, you can optionally press the Bus Tie button to create a “bus tie” record, which is a line with impedance 0.0 + j0.00001 between the new bus and the old one. The bus tie record will appear in the text box.

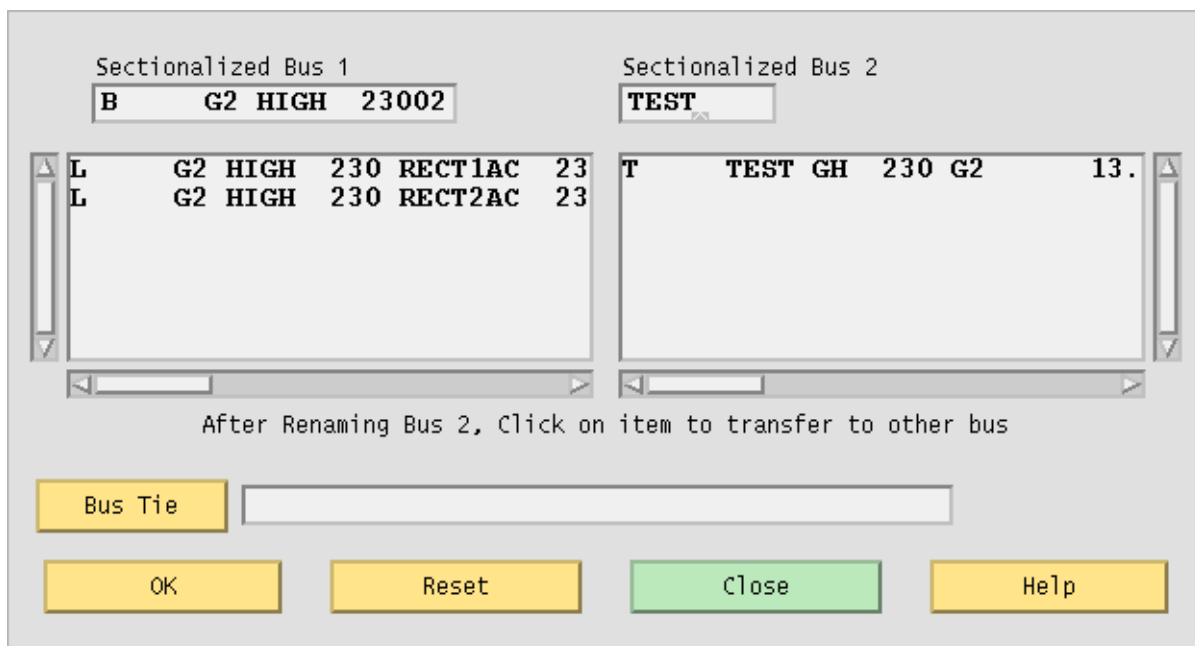


Figure 4-10 Sectionalize Bus Dialog Box

Sectionalize Bus 1. This text box contains the bus type, name, and base kV of the current bus you are working with in the Input Data Edit Box.

Sectionalize Bus 2. This text box initially contains the name of the current bus. You can change this to be any new bus name. The new bus inherits the base kV, ownership, and bus type of Bus 1.

Bus Tie. Click this button if you want to tie the two buses with a low impedance tie line. This creates a bus tie record. The branch record shows up in the text box.

OK. Click this button to cause the new data to be saved in the memory-resident bus and branch database. No changing action occurs until you click OK. The dialog box closes and returns you to the Input Data Edit Box.

Reset. Click this button if you want to return to the initial state of a just opened dialog box. All changes that you have made are erased and returned to initial conditions.

Close. Click this button if you have decided that *no* save action is necessary, that is, you do not want to make any sectionalization changes to the memory-resident bus and branch database. Clicking this button closes the dialog box and returns you to the Input Data Edit Box.

4.13 LINE TAPPING (Not yet available)

Tapping a line means to service a new load by creating a new tap point bus on an existing line. The tapped line is effectively segmented into two lines, separated with a newly created bus. If the load is remote from the tapped point, an additional line and bus will be necessary. The new load and the new bus are connected by a new line. As with many line operations, you access line tapping through a bus that the line is connected to. See Figure 4-11.



Figure 4-11 Line Tapping Dialog Box

Bus 1 Line Data. This text box displays the lines between bus 1 and the tapped bus. Initially, it contains all the lines between bus 1 and bus 2.

Bus 2 Line Data. This text box displays the lines between bus 1 and the tapped bus. Initially, it is empty.

Scale Value Radio Buttons. These radio buttons identify the line tap point in terms of three different criteria: (1) percent of reactance from bus 1, (2) the distance from bus 1, (3) the section number. Note that transformers and series capacitors ($X < 0$) have zero (0) length and cannot be tapped.

Scale Slide. A dynamic, moveable slider that shows the proportion of the selected scale on the line between Bus 1 and Bus2. The slider value changes according to what scale value radio button

is currently active.

Base 1 Name. A bus name and base kV bus identifier specifying the terminal 1 bus of the line to be tapped.

Base 2 Name. A bus name and base kV bus identifier specifying the terminal 2 bus of the line to be tapped.

Reverse Scale. A button that flips the scale values from one end to the other.

Tapped Bus Name. The name and base kV of the new bus created at the tap point.

Send. Click this button to cause the line tapping operation data to be saved in the memory-resident bus and branch database. The dialog box closes and returns you to the Input Data Edit Box.

Calculate. Click this button to see the effects of the slider operation. This action does *not* send any data to Powerflow.

Cancel. A button that closes the dialog box and causes no further action.

Close. Click this button if you have decided that *no* save action is necessary, that is, you do not want to make any sectionalization changes to the memory-resident bus and branch database. Clicking this button closes the dialog box and returns you to the Input Data Edit Box.

Help. (Not yet implemented.)

4.14 TRANSMISSION LINE

The transmission line dialog box specifies the identification and electrical characteristics of a balanced pi line, section of a line, or series capacitor. See the L record in the *IPF Batch User's Guide*. See Figure 4-12.

The dialog box is titled "INPUT WITH EDIT BOX". It features a "Name" field with the text "FOURCORN 345." and a secondary field "L. SHOPROCK: 345 1". Below the name fields are "Metering" (set to 1) and "Owner" (set to MAP). There are also "Circuit ID" (set to 1) and "Section" (empty) fields. A "PER UNIT" section contains parameters for $Z_{pi} = R + jX$ (R: 0.00028, X: 0.00417) and $Y_{pi} = G + jB/2$ (G/2: empty, B/2: 0.03214). There are also fields for "Number of Parallels" (0) and "Miles" (0). A "CURRENT RATINGS" section has three empty fields for "Nominal", "Thermal", and "Bolt-torque". At the bottom of the dialog are several buttons: "Calculate Impedance", "Tap Line", "OK", "Modify", "Reset", "Delete", "Help", and "Close".

Figure 4-12 Transmission Line Dialog Box

Name. Two eight character maximum, alphanumeric strings designating the buses. The strings must start with an alpha character. The first name is placed in the first text box from the left. The next text box should have a four character maximum numeric string representing the bus's base kV rating. The second bus name and its base kV are to the right of the first.

Metering. An integer (or blank) flag having three possible values: 1 means to meter at the bus 1 end; 2 means to meter at the bus 2 end; and blank means to let the program decide on the following criteria — (1) when bus ownership differs from bus ownership, meter at the point where line ownership differs from bus ownership, or (2) when both buses have the same ownership, meter at bus 1 location.

Owner. A three character alphanumeric code representing ownership of the branch.

Circuit ID. A single alphanumeric character representing the circuit identification.

Section. An integer (1-9) representing the section number for making an equivalent for series elements. The elements are assembled in ascending numeric order. This may be blank or zero if the line has only one section.

Resistance (R). A six digit real number representing the per unit impedance R. See *IPF Batch User's Guide* for more information.

Reactance (X). A six digit real number representing the per unit impedance X. See *IPF Batch User's Guide* for more information.

Admittance (G/2). A six digit real number representing the per unit admittance G. See *IPF Batch User's Guide* for more information.

Susceptance (B/2). A six digit real number representing the per unit susceptance B. See *IPF Batch User's Guide* for more information..

Number of Parallels. An integer representing the number of parallel circuits represented by this record.

Miles. A real number indicating the line length. Note: if a branch is composed of individual sections, then the total line length is the sum of mileage of each section. Also, note that series capacitors ($X < 0$) have no mileage.

Current Ratings. Real numbers that are conductor current ratings in amps. Nominal is the normal rating based on the line construction and conductor size. Thermal takes into account the effect of ambient temperature and other environmental factors upon the maximum permissible temperature of the conductor, usually for short time periods. Bottleneck is the minimum rating of the line including other series connected components, such as circuit breakers, fuses, or disconnect switches.

Calculate Impedance. A button that allows you to compute the electrical parameters given the conductor size and type, and tower geometry and length.

Tap Line. A button that allows you to tap a line with a newly added bus.

Add. A button that adds a new record to the database.

Modify. A button that modifies the record.

Reset. A button that restores text box values to their original values (before any changes were made).

Delete. A button that deletes (removes) a record from the database.

Outage. (Not yet implemented.)

Close. A button that causes the dialog box to close and disappear from the display without making any modifications to the record.

4.15 PHASE SHIFTER

The Phase Shifter dialog box allows you to add data for phase shifting transformers. See the T and R records in the *IPF Batch User's Guide*. See Figure 4-13.

The screenshot shows a dialog box titled "INPUT WITH EXIT BOX". At the top, there are two text boxes: "Name" containing "BILINGS 161." and "TP BUS PHA 381 1". Below these are several checkboxes: "Metering", "Section", "Circuit" (set to "1"), "Dener", and "Parallels". A section titled "PER UNIT" contains input fields for "R" (value "0.06670"), "X", "G", and "B". There are also fields for "Phase Shift" and "Tap 2 kV". A larger section titled "RVA RATINGS" contains fields for "Nominal" (value "100"), "Thermal", "Bottleneck", and "Emergency". At the bottom of the dialog are six buttons: "Add", "Modify", "Reset", "Delete", "Output", and "Close".

Figure 4-13 Phase Shifter Dialog Box

Name. Two eight character maximum, alphanumeric strings designating the buses. The strings must start with an alpha character. The first name is placed in the first text box from the left. The next text box should have a four character maximum numeric string representing the bus's base kV rating. The second bus name and its base kV are to the right of the first.

Metering. An integer (or blank) flag having three possible values: 1 means to meter at the bus 1

end; 2 means to meter at the bus 2 end; and blank means to let the program decide on the following criteria — (1) when bus ownership differs from bus ownership, meter at the point where line ownership differs from bus ownership, or (2) when both buses have the same ownership, meter at bus 1 location.

Section. An integer (1-9) representing the section number for making an equivalent for series elements. The elements are assembled in ascending numeric order.

Circuit ID. A single alphanumeric character representing the circuit identification.

Owner. A three character alphanumeric code representing ownership.

Parallels. An integer representing the number of parallel transformers in this record.

Resistance (R). A six digit real number representing per unit equivalent resistance R due to copper loss. See *IPF Batch User's Guide* for more information.

Reactance (X). A six digit real number representing per unit leakage reactance X. See *IPF Batch User's Guide* for more information.

Admittance (G). A six digit real number representing per unit shunt equivalent core loss conductance G (iron losses). See *IPF Batch User's Guide* for more information.

Susceptance (B). A six digit real number representing per unit shunt magnetizing susceptance B. This is always converted to a negative number by the program. See *IPF Batch User's Guide* for more information.

Phase Shift. A five digit real number representing the fixed phase shift in degrees that describes bus 1 relative to bus 2. See *IPF Batch User's Guide* for more information.

Tap 2 kV. A five digit real number representing the fixed bus 2 tap. It is possible for a transformer to have both a phase shift and a tap. See *IPF Batch User's Guide* for more information.

MVA Ratings. All MVA ratings (Nominal, Thermal, Bottleneck, and Emergency) are represented by four digit real numbers. See Transmission Line section in this chapter for details.

Add. A button that adds a new record to the database.

Modify. A button that modifies the record.

Reset. A button that restores text box values to their original values.

Delete. A button that deletes (removes) a record from the database.

Outage. (Not yet implemented.)

Close. A button that causes the dialog box to close and disappear from the display without making any modifications to the record.

4.16 TRANSFORMER

The transformer dialog box allows you to add data for fixed tap transformers. See the T record in the *IPF Batch User's Guide*. See Figure 4-14.

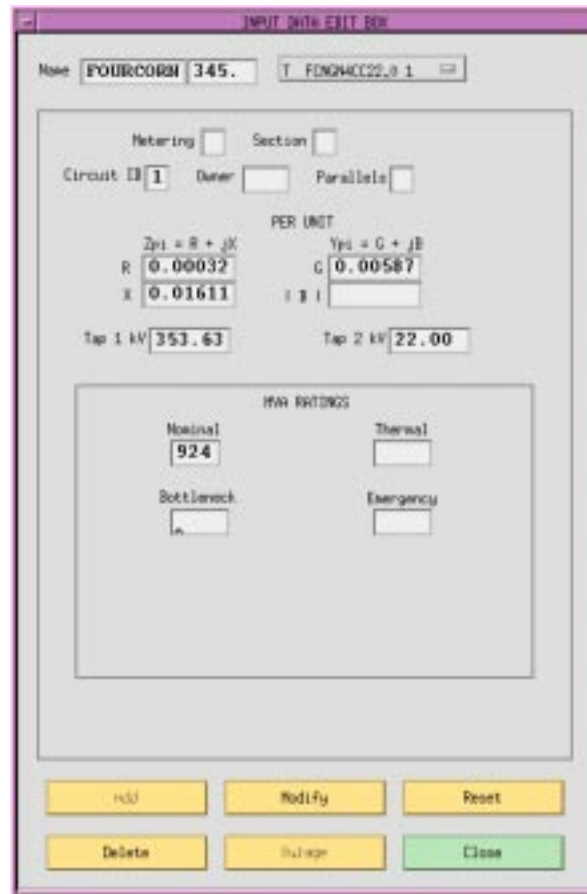


Figure 4-14 Transformer Dialog Box

Name. Two eight character maximum, alphanumeric strings designating connected buses. The strings must start with an alpha character. The first name is placed in the first text box from the left. The next text box should have a four character maximum numeric string representing the bus's base kV rating. The second bus name and its base kV are to the right of the first.

Metering. An integer (or blank) flag having three possible values: 1 means to meter at the bus 1 end; 2 means to meter at the bus 2 end; and blank means to let the program decide on the following criteria — (1) when bus ownership differs from bus ownership, meter at the point where line ownership differs from bus ownership, or (2) when both buses have the same ownership, meter at bus 1 location.

Section. An integer (1-9) representing the section number for making an equivalent for series elements. This may be zero or blank if the branch has only one section.

Circuit ID. An alphanumeric character representing the circuit identification.

Owner. A three character alphanumeric code representing ownership.

Parallels. An integer representing the number of parallel transformer banks in this record.

Resistance (R). A six digit real number representing per unit equivalent resistance R due to copper loss. See *IPF Batch User's Guide* for more information.

Reactance (X). A six digit real number representing per unit leakage reactance X. See *IPF Batch User's Guide* for more information.

Admittance (G). A six digit real number representing per unit shunt equivalent core loss conductance G (iron losses). See *IPF Batch User's Guide* for more information.

Susceptance (B). A six digit real number representing per unit shunt magnetizing susceptance B. This is always converted to a negative number by the program. See *IPF Batch User's Guide* for more information.

Tap 1 kV. A five digit real number representing the fixed bus 1 tap. See *IPF Batch User's Guide* for more information.

Tap 2 kV. A five digit real number representing the fixed bus 2 tap. See *IPF Batch User's Guide* for more information.

MVA Ratings. All MVA ratings (Nominal, Thermal, Bottleneck, and Emergency) are represented by four digit real numbers. See Transmission Line section in this chapter for details.

Add. A button that adds a new record to the database.

Modify. A button that modifies the record.

Reset. A button that restores text box values to their original values (before any changes were made).

Delete. A button that deletes (removes) a record from the database.

Outage. (Not yet implemented.)

Close. A button that causes the dialog box to close and disappear from the display without making any modifications to the record.

4.17 REGULATING TRANSFORMER

The regulating transformer dialog box allows you to add data for regulating transformers. See the R record in the *IPF Batch User's Guide*. See Figure 4-15.



Figure 4-15 Regulating Transformer Dialog Box

Name. Two eight character maximum, alphanumeric strings designating connected buses. The strings must start with an alpha character. The first name is placed in the first text box from the left. The next text box should have a four character maximum numeric string representing the bus's base kV rating. The second bus name and its base kV are to the right of the first.

Owner. A three character alphanumeric code representing ownership.

R (subtypes). An option button allowing you to choose types R-blank, RV, RQ,RP, RN, or RM. See the R record in the *IPF Batch User's Guide* for a description of these types.

Low Alpha Fixed. A radio button that identifies the fixed tap side as at the low alpha order bus name terminal. Note that this field is necessary only to resolve ambiguity if Min Tap and Max Tap cannot establish the variable tap side. Low Alpha Fixed is the default.

Bus 1 Variable. A radio button that identifies the variable tap side as at the bus 1 terminal. Note that this field is necessary only to resolve ambiguity if Min Tap and Max Tap cannot establish the variable tap side.

Bus 2 Variable. A radio button that identifies the variable tap side as at the bus 2 terminal. Note that this field is necessary only to resolve ambiguity if Min Tap and Max Tap cannot establish the variable tap side.

Remote Bus. An eight character maximum, alphanumeric string designating the remote bus to be voltage-controlled.

Min Tap. A real number in kV that specifies the minimum tap on the variable tap side.

Max Tap. A real number in kV that specifies the maximum tap on the variable tap side.

Number of Taps. An integer specifying the number of taps on the variable tap side. This must be greater than one for discrete taps; zero (0) indicates continuous taps. Zero is the default.

Add. A button that adds a new record to the database.

Modify. A button that modifies the record.

Reset. A button that restores text box values to their original values (before any changes were made).

Delete. A button that deletes (removes) a record from the database.

Outage. (Not yet implemented.)

Close. A button that causes the dialog box to close and disappear from the display without making any modifications to the record.

4.18 EQUIVALENT NETWORK

The equivalent network dialog box allows you to add data for an equivalent, unbalanced pi transmission line branch. See the E record in the *IPF Batch User's Guide*. See Figure 4-16.

INPUT WITH EXIT BOX

Name: FOURCORN 345. E CHILLA 345 1 1

Metering Owner

Circuit ID: 1 Section: 1

PER UNIT

$Z_{pi} = R + jK$

R: 0.00836
X: 0.08117

$Y_{pi1} = G1 + jB1$ $Y_{pi2} = G2 + jB2$

G1: 0.00060 G2: 0.00060
B1: 0.64422 B2: 0.64422

Number of Parallels:

CURRENT RATINGS

Nominal: Thermal: Bolt/neck:

Add Modify Reset

Delete Help Close

Figure 4-16 Equivalent Network Dialog Box

Name. Two eight character maximum, alphanumeric strings designating connecting buses. The strings must start with an alpha character. The first name is placed in the first text box from the left. The next text box should have a four character maximum numeric string representing the bus's base kV rating. The second bus name and its base kV are to the right of the first.

Metering. An integer (or blank) flag having three possible values: 1 means to meter at the bus 1 end; 2 means to meter at the bus 2 end; and blank means to let the program decide on the following criteria — (1) when bus ownership differs from bus ownership, meter at the point where line ownership differs from bus ownership, or (2) when both buses have the same ownership, meter at bus 1 location.

Owner. A three character alphanumeric code representing ownership.

Circuit ID. An alphanumeric character representing the circuit identification.

Section. An integer (1-9) representing the section number for making an equivalent for series elements. The elements are assembled in ascending numeric order. This may be blank or zero if the line has only one section.

Resistance (R). A six digit real number representing the per unit impedance R through the branch from bus 1 to bus2. See *IPF Batch User's Guide* for more information.

Reactance (X). A six digit real number representing the per unit impedance X through the branch from bus 1 to bus 2. See the *IPF Batch User's Guide* for more information.

Admittance (G1). A six digit real number representing the line's per unit shunt conductance G at the bus 1 terminal.

Susceptance (B1). A six digit real number representing the line's per unit shunt susceptance B at the bus 1 terminal.

Admittance (G2). A six digit real number representing the line's per unit shunt conductance G at the bus 2 terminal.

Susceptance (B2). A six digit real number representing the line's per unit shunt susceptance B at the bus 2 terminal.

Number of Parallels. An integer representing the number of parallel transformer banks in this record.

Current Ratings. Real numbers that are conductor current ratings in amps. Nominal is the normal rating based on the line construction and conductor size. Thermal takes into account the ambient temperature and other environmental factors upon the maximum permissible temperature of the conductor, usually for short time periods. Bottleneck is the minimum rating of the line including other series connected components, such as circuit breakers, fuses, or disconnect switches.

Add. A button that adds a new record to the database.

Modify. A button that modifies the record.

Reset. A button that restores text box values to their original values (before any changes were made).

Delete. A button that deletes (removes) a record from the database.

Outage. (Not yet implemented.)

Close. A button that causes the dialog box to close and disappear from the display without making any modifications to the record.

4.19 MENU COMMANDS

The commands in the remainder of this chapter are all accessible from the menu bar in the main window. The commands are arranged alphabetically. Each command entry is found at the top of a page and shows you which menu it is on by including the menu name in parentheses. For example, the entry Alpha Search (View) means that the Alpha Search command is found on the View menu. See Table 4-4 for a quick look at the main window menu commands.

Some dialog boxes cannot be reached through the commands in this section of the chapter. These dialog boxes are described earlier in this chapter.

Table 4-4 Main Window Menu Commands

Page	Command	Description
4-50	ALPHA SEARCH (View)	Finds a specific bus by name.
4-51	AREA/INTERCHANGE (Edit)	Allows editing of area/interchange records.
4-54	AUTO CFLOW (Process)	Allows execution of CFLOW programs by users.
4-57	BENDING POINTS (View)	Turns on (and off) display of the capital B denoting a bending point.
4-58	COLOR SCHEME (View)	Switches between line display by overload or by nominal kV.
4-59	COMMAND DIALOG (View)	Allows typing of PCL commands for PF.
4-61	ERROR MESSAGES (Help)	Displays IPF error messages.
4-62	EXIT (File)	Exits IPF. Same as Exit button.
4-63	GENERAL (Help)	Displays on-line help text.
4-65	NETWORK DATA EDIT (Edit)	Allows editing of network data.
4-70	OPEN (File)	Allows loading of IPF files.
4-74	PF ID/DESCRIPTION (Edit)	Allows creating and saving of user case description.
4-76	PLOT OPTIONS (File)	Allows changing of printer and diagram attributes and the printer device itself.
4-83	PRINT PLOT (File)	Prints a case diagram to the currently set printer.

Table 4-4 Main Window Menu Commands (Continued)

Page	Command	Description
4-84	REPORTS (View)	Creates some standard PF reports and allows display viewing, hard copy printing, and writing to files.
4-91	RUN CFLOW (Process)	Allows the running of CFLOW C programs from IPF. (Intended for CFLOW programmers.)
4-92	SAVE (File)	Saves change, base case, and coordinate files.
4-96	SOLUTION DATA OFF (View)	Rewrites the display without rewriting the current solution data.
4-97	SOLUTION DATA ON (View)	Rewrites the display with the current solution data.
4-98	SOLVE CASE (Process)	Initiates the solution of a resident base case.

4.20 ALPHA SEARCH (View)

The Alpha Search dialog box allows you to find any bus within the currently loaded base case data. Any bus selected when you close this dialog box becomes the currently selected bus until some other selection process changes it. See Figure 4-17.

When you open the dialog box from the View menu, you see a text box below Search Bus Name kV. Type in this box any character or string of characters matching the first part of the name of the bus you are looking for. Thus, if you are looking for CASCADTP, you type in C, CA, or CAS to take you to the part of the bus list starting with C, CA, or CAS. Note that the search function is case sensitive; that is, c and C are not the same. The search function immediately begins searching as soon as you enter a character in the text box.

You can also use the scroll bar to go up or down the list to visually identify the bus you are looking for, and then select the desired bus by clicking it.

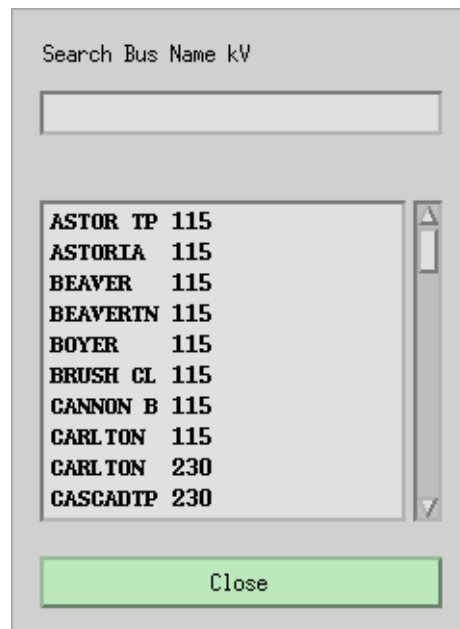


Figure 4-17 Alpha Search Dialog Box

Search Bus Name KV. Use this text box to type a string of letters at the beginning of the bus name you are looking for.

Close. Clicking this button makes the last selected bus name into the currently selected bus. The dialog box then closes.

4.21 AREA/INTERCHANGE (Edit)

For area or intertie studies, you can add, modify, or delete areas or interties. You do this through the main window Area/Interchange command.

The Area/Interchange dialog box includes all the area and intertie records from the currently resident base case — one record per line in a list box. Selecting a line puts the line in the Selection text box. Then press the Edit Area/Intertie Record button to bring up a dialog box with the data in it. See Figure 4-18, Figure 4-19, and Figure 4-20.

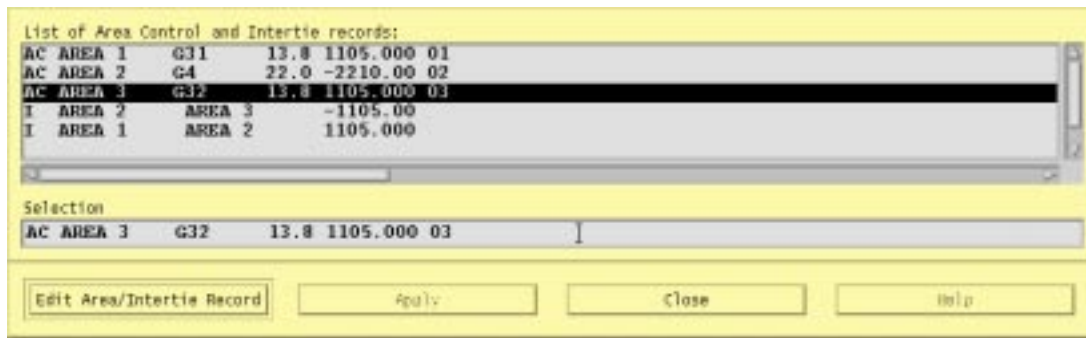


Figure 4-18 Area/Interchange Dialog Box

List of Area Control and Intertie records. This scrolling list contains all the area and intertie records from the currently resident base case. Area records are listed first followed by intertie records. Scroll through the list to find the one you want. Select it by clicking on it.

Selection. This text box contains the currently selected record from the list of records above. This text *will not change* when you edit a record, so you can compare the new record with the old.

Edit Area/Intertie Record. Clicking this button opens a dialog box where you can edit the currently selected area or intertie record (line).

Apply. Not available.

Close. Clicking this button causes the Area/Interchange dialog box to close and disappear from the display.

Create New. Clicking this button brings up the a blank dialog box so you can create a new area or intertie record.

The dialog box is titled 'Area/Interchange Record Dialog Box'. It contains the following fields and buttons:

- Interchange Area: AREA 3
- Area Slack Bus: G32
- Bus: 13.8
- Scheduled Export: 1105.000
- Zone: 03
- Max PU Volt: []
- Min PU Volt: []
- Buttons: Modify, Add, Delete, Reset, Close

Figure 4-19 Area/Interchange Record Dialog Box

Interchange Area. A ten character maximum name designating an interchange area of a network.

Area Slack Bus. An eight character maximum name designating the area slack bus plus a four character maximum real number representing the base kV rating of the slack bus.

Scheduled Export. An eight character maximum real number designating the scheduled export in MW. Negative denotes inflow.

Zone. A two character alphanumeric designating zone. The zone at the extreme left must be filled in; others may be blank or filled.

Max PU Volt. A four character maximum real number designating maximum per unit voltage for this area.

Min PU Volt. A four character maximum real number designating minimum per unit voltage for this area.

Modify. A button that modifies and updates in place a record (line) in the Area/Interchange dialog box. The data in the selection box is not changed.

Add. A button that adds a new record (line) to the list in the Area/Interchange dialog box.

Delete. A button that deletes (removes) a record (line) from the list in the Area/Interchange dialog box.

Reset. A button that restores text box values to their original values (before any changes were made).

Close. Clicking this button causes the Area/Interchange dialog box to close and disappear from the display without making any changes to the Area/Interchange records.

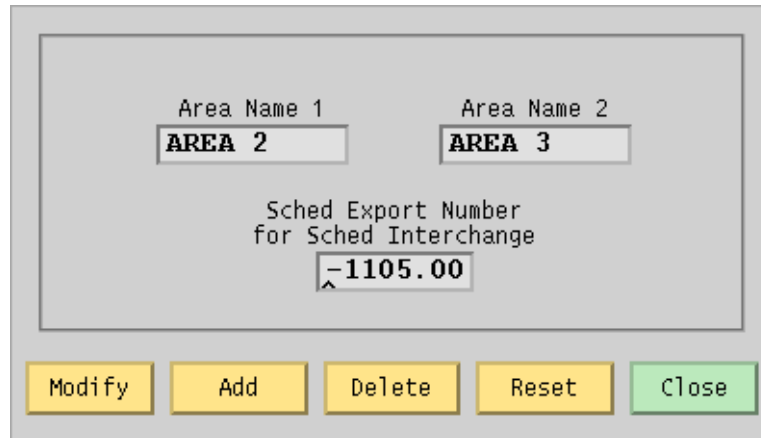


Figure 4-20 Intertie Record Dialog Box

Area Name 1. A ten character name designating an area of a network.

Area Name 2. A ten character name designating an area of a network.

Sched Export Number for Sched Interchange. An eight character maximum real number representing scheduled power transfer from Area Name 1 to Area Name 2.

Modify. A button that modifies and updates in place a record (line) in the Area/Intertie Selection dialog box.

Add. A button that adds a new record (line) to the list in the Area/Intertie Selection dialog box.

Delete. A button that deletes (removes) a record (line) from the list in the Area/Intertie Selection dialog box.

Reset. A button that returns text box values to their original values (before any changes were made).

Close. Clicking this button causes the Intertie Record dialog box to close without making any changes to the Area/Interchange dialog box records.

4.22 AUTO CFLOW (Process)

CFLOW files are C programs using the IPF CFLOW library of routines. These routines enable you to access the base case memory-resident data in IPF. Many CFLOW programs are designed to collect information for specialized reports that are not built into IPF in the Reports command. See the *CFLOW User's Guide* for more information.

There are two ways to execute a CFLOW program: Auto CFLOW is one; Run CFLOW is the other. Refer also to *Run CFLOW* later in this section so that you choose the appropriate CFLOW execution command.

The Auto CFLOW command is used primarily by CFLOW program users (rather than programmers) for CFLOW programs that are fully debugged and "production-grade." These CFLOW programs create windows for I/O themselves or are embedded in script or command file utilities that do. Thus, any I/O to or from the screen is program I/O only and not potentially confusing for a user. Alternatively, the CFLOW program may have no screen I/O and simply produce file output for a report. See Figure 4-21.

Programs that read/write to `stdin` or `stdout` would have their I/O intermixed in the same terminal window as the GUI and IPF server. Such programs should be run with the Run CFLOW command not with the Auto CFLOW command.

To use the Auto CFLOW command:

1. Start up IPF and load a base case file.
2. Select the Auto CFLOW command and (if necessary) specify a socket id number (any integer between 1024 and 4096). Generally the default socket number will be OK.
3. Use the file selection dialog box to find and select a CFLOW program. Double click the program name or click Launch CFLOW to run the program.

Note: When you have launched a CFLOW program, you cannot do anything else in the GUI until the program is finished running.

Note: If the CFLOW program fails, control is returned to IPF. However, if the CFLOW program hangs (as in an infinite loop), you need to kill the CFLOW process through operating system resources. (For example, in UNIX, this can be done with the `kill` command.) See your computer system documentation or your system administrator for help.

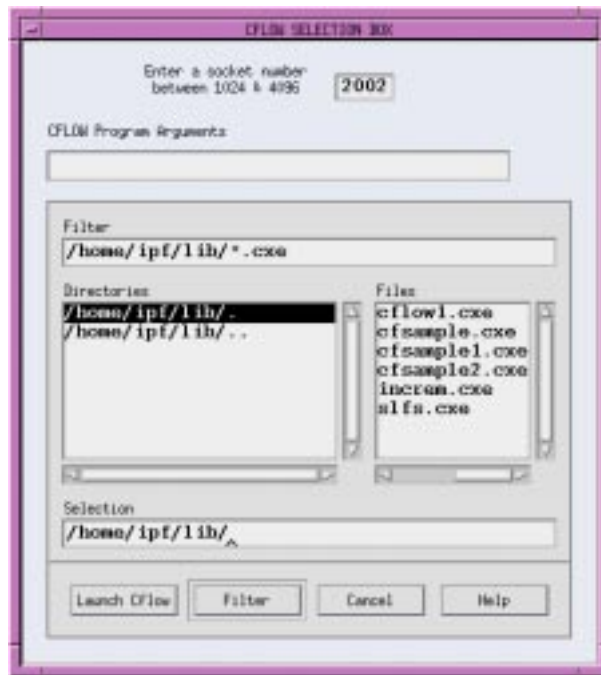


Figure 4-21 Auto CFLOW File Dialog Box

Socket Number. This is the number of the TCP/IP socket which CFLOW will use to connect to IPFSRV. Normally, you should not have to change it.

CLFOW Program Arguments. If the particular program you want to run requires input arguments, enter them here. You cannot, however, use this to redirect input or output.

Filter. The file name text box contains a “filter” that selects categories of file names. You can directly modify the file name text by clicking in the Filter box and then typing in new text. Then click the Filter button below to apply the new filter.

Directories. This list component contains directory names. You cannot modify these directory names by selecting them and typing. Use the scroll bars at the side and bottom to move the list up and down or back and forth. The UNIX operating system arranges directories in a “hierarchical” way. You move up this hierarchical tree structure by double clicking the directory name ending with a period-period (..). You move down by selecting the name of the directory you want to move into.

Files. This list component contains file names that are within the directory named at the left that ends with a period (.) and that satisfy the filter criterion specified above in Filter. You cannot

modify these file names by selecting them and typing. Use the scroll bars at the side and bottom to move the file names up and down or back and forth.

You select a file name by clicking once on the file name. This puts the selected file name in the Selection file name text box below.

Selection. This file name text box contains the file name selected by clicking a file name in the Files file list. Or, since it is a text box, you can directly modify the file name by selecting text and typing replacement text. Be sure to type an exact file name and not a wildcard character such as the asterisk (*) as part of the file name.

Launch C Flow. This button causes whatever file name is in the Selection text box to be passed to the operating system as an executable file. The file is then run.

Filter. Clicking this button causes all file names satisfying the filter file name text in Filter to appear in the Files file list. It also puts the currently selected directory name *without the file name* in the Selection text box. You must select a file name from the Files file list to select a specific file name.

Cancel. Clicking this button causes the Auto CFLOW File dialog box to close and disappear from the display. No directories or file names are changed with a Cancel action. Thus, if you immediately open the dialog box after a Cancel action, you return to the state you just left. The directories and files names are *not* returned to some default state.

Help. (Not yet implemented).

4.23 BENDING POINTS (View)

This command toggles on or off the display of a capital B at line bending points. The display of the capital B is simply to make line bending points completely apparent at a quick glance. See Figure 4-22.

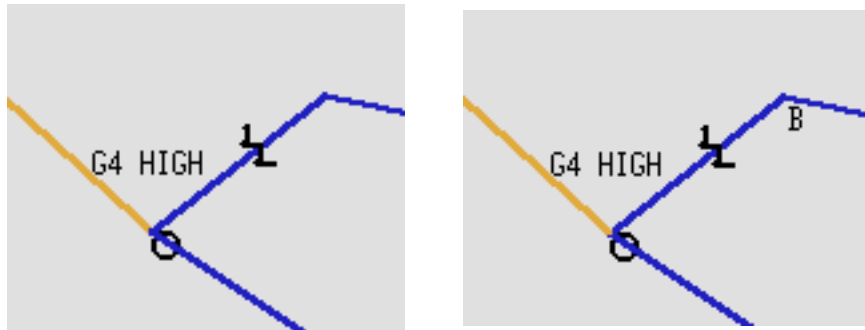


Figure 4-22 Bending Points On and Off

4.24 COLOR SCHEME (View)

This command causes the display of lines to switch between two modes: Color by kV or Color by Overload. Color by kV causes the display of lines to match the ranges that are keyed in the lower left-hand corner Branch Color Key. Color by Overload causes the display of lines to match the ranges that are keyed in the Overloaded Branch Key. These two keys are found in the same location in the main window and change when you change the command. See Figure 4-23 and Figure 4-24.

In the Color by Overload mode, you can type in percentages of overload. Figure 4-24 shows 90% for Mild Overload, 100% for Moderate Overload, and 110% for Extreme Overload.

500kV	161kV	<47kV
345kV	138kV	<14kV
300kV	115kV	<7kV
230kV	<70kV	

Figure 4-23 Branch Color Key

Extreme Overload	110
Moderate Overload	100
Mild Overload	90
Normal	

Figure 4-24 Overloaded Branch Key

After you change the overload percentages, you will have to go back to the KV color scheme and then back again to the overload color scheme in order to redisplay the map with the new percentages implemented.

4.25 COMMAND DIALOG (View)

Note: This command is intended for advanced users. It was created for program development and may be useful for users wanting to observe the interprocess communication channel traffic.

The Command Dialog box allows you to type Powerflow Command Language commands and send them to IPF. It also allows you to see the communication that passes between the GUI and PF components of IPF as IPF runs. See Figure 4-25.

The top box is a scrolling text box that stores PCL commands you type in the text box labeled Command Entry. The PCL commands list can be double-clicked to put the command into the Command Entry box. The third box down shows you what IPF's GUI component sends across the IPC channel to the PF component. The fourth box down shows what PF sends back to the GUI in response to the previously passed command. The third and fourth boxes are output only and are not responsive to any mouse clicks. Note that you can vary the vertical size of both output-only boxes by pressing on the sash controls and moving them up or down.

Note: Be sure to terminate the command set with *`[EOM]` or ^`[EOM]`. The former issues a synchronous command; the latter, an asynchronous command.

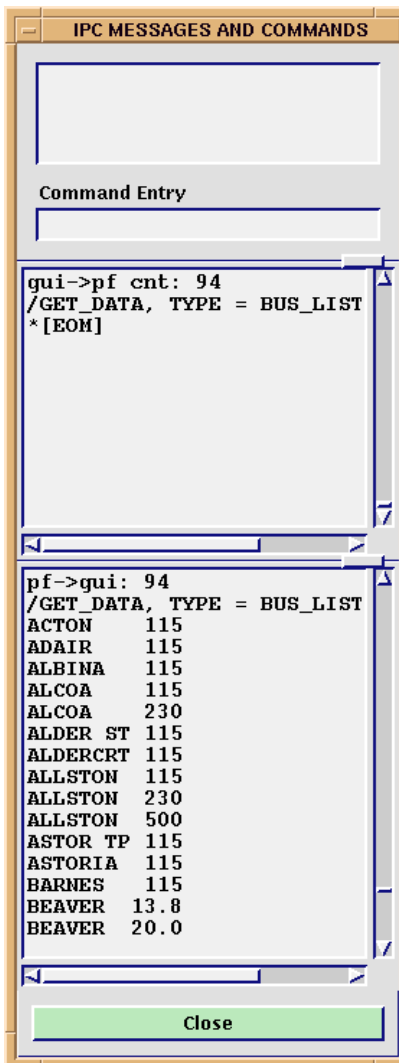


Figure 4-25 Command Dialog Box

Command Entry. This text entry box is intended for valid PCL commands that you want to send to the PF component of IPF. There is no syntax checking at data entry time. PF does all the checking once a command is sent. The command is sent to PF when you press the Return key. See the *IPF Advanced User's Guide* for information on valid commands.

Close. Clicking this button causes the dialog box to disappear from the screen. No other action is performed.

4.26 ERROR MESSAGES (Help)

When an error condition occurs, such as when IPF detects bad data, the Error Messages dialog box contains messages to help you determine what caused the error. See Figure 4-26.

These messages, along with many others, also appear in the terminal window where you started IPF. The other messages are usually not of any interest to a user. However, if you want to view the interaction report, you will have to look at the terminal window. This information is not displayed anywhere in the GUI.

Note: This dialog box pops up on its own only when the error message is a fatal one.

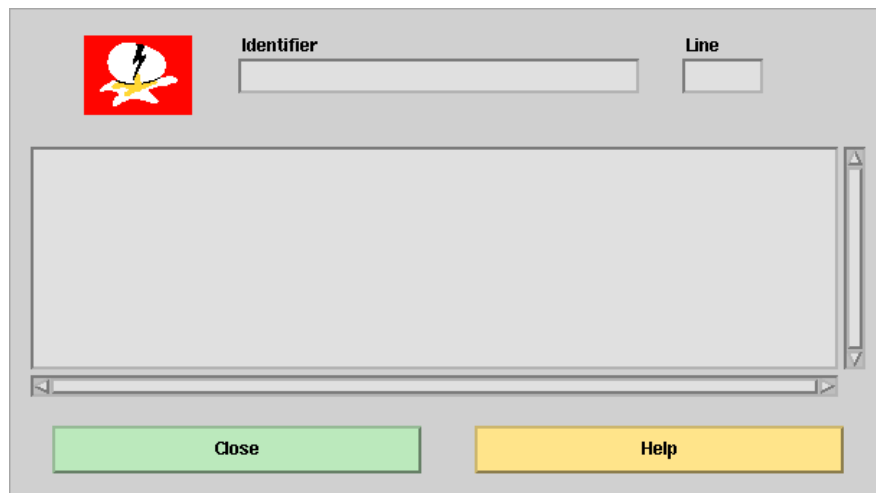


Figure 4-26 Error Box Dialog Box

Identifier. This text box specifies the identifier (source code file) where an error condition occurred. This message assists the programming staff to locate the source message.

Line. This text box gives the source code line number associated with the identifier where an error condition occurred.

Close. This button closes the Error Messages dialog box.

Help. This button brings up the IPF help system window.

4.27 EXIT (File)

This command exits you from IPF. You can exit at any time. The exit command is also available on a button below the toolbox in the main window. Although you can also click on the X Windows menu button at the upper right of the window to close, this is not the recommended method of exiting from IPF. It should be used only as a last resort.

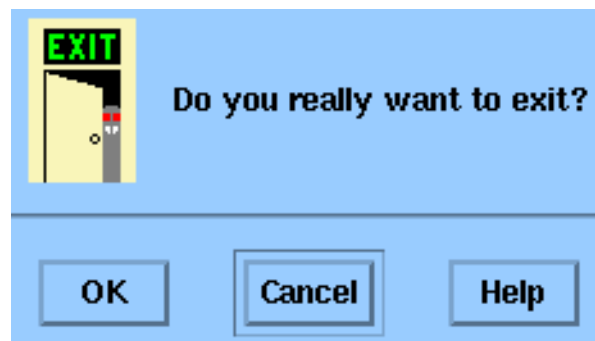


Figure 4-27 Exit Dialog Box

OK. Clicking this button exits you to the operating system.

Cancel. This closes the Exit dialog box without any action.

4.28 GENERAL (Help)

The IPF help system provides a condensation of Chapter 3 of this manual. See Figure 4-28.

In addition to the Page Up and Page Down window buttons and scroll bar, the Help system text itself has a feature to help you navigate. The text incorporates “hypertext” links. These allow you to jump immediately to a desired spot in the help text.

At the top of the Help text is a list of topics. You can click on a topic to go to the text explaining that topic. To read the topic text on a page, use the scroll bar. Use the Page Up and Page Down buttons at any time to go to different pages, one page at a time.

The Annotate button allows you to attach your own notes to a particular page. See Figure 4-29. A red paper clip shows up in the left margin after you save a note, indicating that a note exists. To read an existing note, just click the Annotate button when you see a red paper clip.



Figure 4-28 General Help Dialog Box

Page Up. The Page Up button finds the next page marker toward the beginning of the IPF Help file. Page Up does *not* go to the top of the next page up. Use the scroll bar to scroll to the top of the page if necessary.

Page Down. The Page Down button finds the next page marker toward the end of the IPF Help file. Page Down does *not* go to the top of the next page down. Use the scroll bar to scroll to the top of the page if necessary.

Annotate. The Annotate button opens a text window that you can type text into. If you want to save the text, click the Save button; if you want to clear or remove the text, click the Remove button; Close closes the Annotation dialog box without making further changes.

Close. The Close button closes the Help system window.

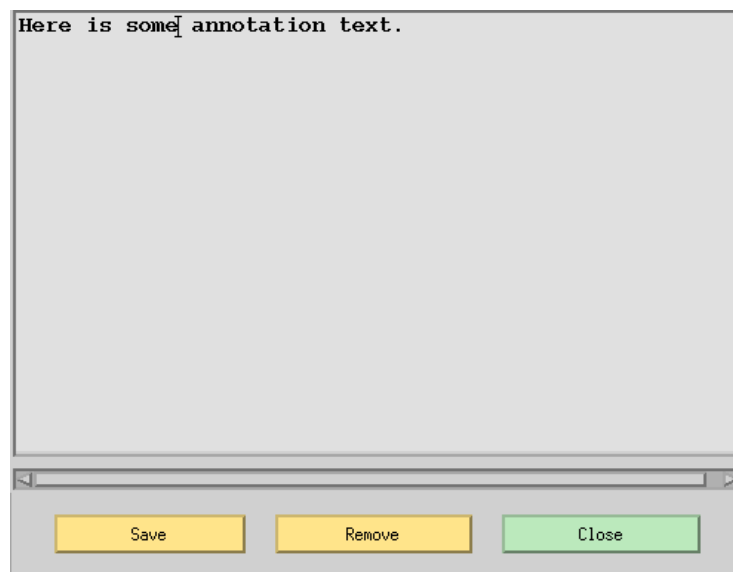


Figure 4-29 Annotate Dialog Box

4.29 NETWORK DATA EDIT (Edit)

There are two ways to edit bus and branch data in IPF. Editing via the Network Data Edit dialog box is just one. See Figure 4-30. The other one is the Input Data Edit Box. Each of the ways offers its own benefits. See the Input Data Edit Box for more information.

The advantage of Network Data Edit over the other two methods of editing is that you can access the entire network data base using filters. The other editing methods require accessing the network data through the displayed network diagram or through the Bus List dialog box.

Note: Network Data Editing is designed for the expert user. Editing a network data record directly is intended for advanced users who already know the exact columns for specific data fields in each network record. See the *IPF Advanced User's Guide* for network record format information.

When you use the Network Data Edit dialog box, editing is performed indirectly on the resident network data using either an internal editor or an external editor. The internal editor is very basic; it permits cutting, pasting, and overtyping. The external editor can be any editor selected by the GUI setup script file. For UNIX systems, `vi` is usually the editor specified. There is no formatting or data validation support other than that provided by the user's external editor. No matter which you choose, the work is actually done on an intermediate file from which network changes may later be assimilated.

Editing of the network data is done with a screen editor. Four steps are required to successfully accomplish data editing. See Figure 4-30.

1. Select individual items within a filter. The filter list is scrollable so that you can see items outside the visible listing. When you click the left mouse button anywhere on a non-high-lighted item, the line highlights by reverse video, indicating selection. You can unselect by clicking again on the same item using the left mouse button. You can continue to select as many additional items as you like. If none are selected, the default is that all the items for the filter are selected.
2. Apply the selected filter(s) by pressing the Apply button(s).
3. Click either the Internal or External Editor button to display the data.
4. Edit the data in the display box. You can use the cursor 'arrow' keys to move around in the data and to cause it to scroll up and down.
5. Process the edited file using the Send To PF button.

The last step concludes the editing session. If it is skipped, no changes are performed upon the system. If it is applied, the edited file is automatically processed into network data changes and sent to Powerflow.

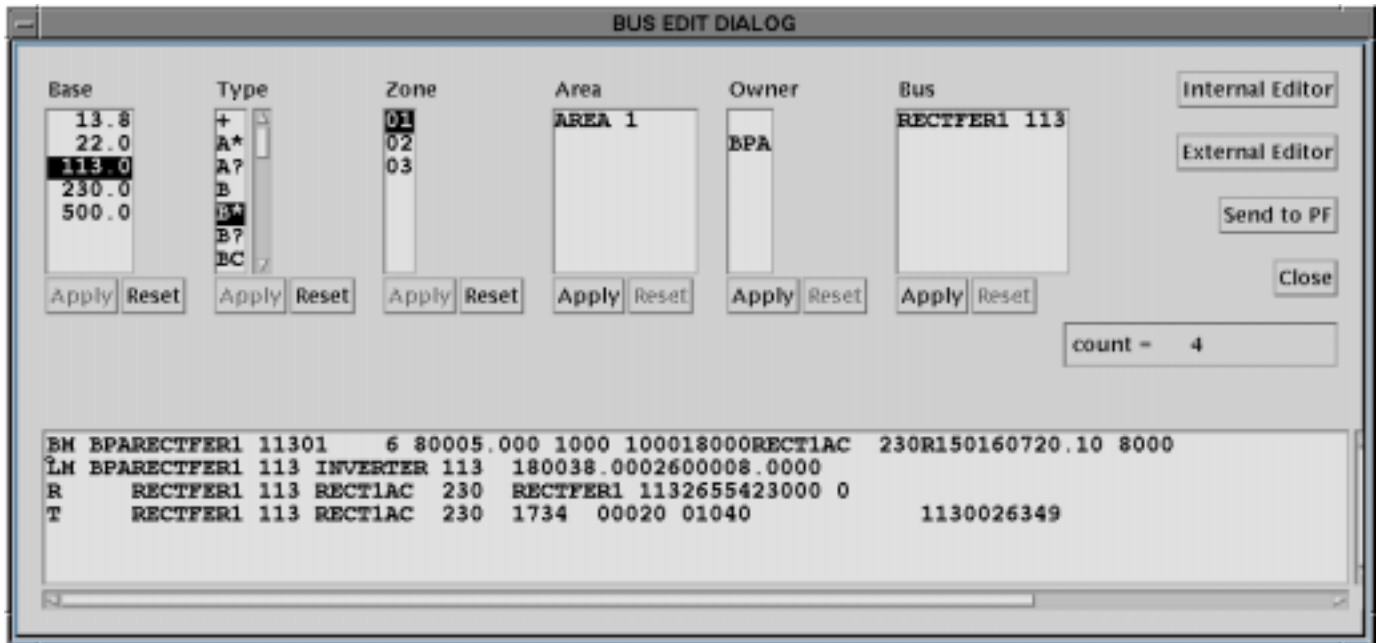


Figure 4-30 Network Data Edit Dialog Box

4.29.1 Dynamic Filters

The power of the Network Data Edit dialog box is realized in applying the dynamic filters. Six filters allow you to restrict the amount of network data displayed. The filters are Area, Base, Zone, Owner, Bus, and Type. The filters are dynamic because they propagate “downstream” (from left to right) the effects of previously defined filters upon the remaining filters.

Initially, all of the filters are primary and each filter displays the full attributes of its type. However, suppose you select one of the filters, say Owner, and highlight individual owners of interest. Then press the Apply button. Three things happen.

1. The Owner filter becomes the solitary primary filter; it is automatically repositioned to the leftmost position in the dialog box. The Apply button on this filter is ghosted, indicating that it has been applied.
2. The remaining filters are now collectively called secondary filters. They are repositioned on the dialog in an arbitrary order on the right of the primary filter. The effects of the primary filter are applied to the secondary filters through the network (downstreaming). There is a one exception, Type, whose display is always static.
3. Only the network items that collectively meet the combined filter criteria are displayed.

The effects of the primary filter can be undone by pressing the Reset button.

The procedure can be repeated for all remaining filters. The first selection, mentioned above, identifies the primary filter; the second, if selected, identifies the secondary filter; the third, the tertiary filter; etc. Select any of the remaining filters that do not have their Apply buttons ghosted. Make selections and press the Apply button. The filters will be repositioned again from left to right: primary, secondary, tertiary, etc.

The display for each filter is always current, and it shows selected network attributes (owners, zones, base kVs, etc.) that will be extracted if an Edit button is pressed.

Through judicious use of filters, you can reduce the size of the displayed network to a few hundred items. Since all of the displayed data must be encoded in Power flow and transported to the GUI process via the interprocess communication channel, the time to retrieve network data can become very long for large systems.

Table 4-5 Description of Type Filter

Code	Description
*	Retrieves all data.
A*	Retrieves A, A0, A1, A2, A3, A4, and I data.
A?	Retrieves A, A0, A1, A2, A3, A4 data.
I	Retrieves I data.
B*	Retrieves all bus and branch data.
L*	Retrieves all branch data including LTCs, transformers.
B?	Retrieves all bus types.
B, BE, BS, BC, BD, BV, BQ, BG, BT, BX, BM, BF	Retrieves specific bus type(s) named.
+	Retrieves all continuation bus data.
X	Retrieves X data.
Q	Retrieves QP, QX, and QN data.
L, LD, LM, E, T, TP, R, RZ	Retrieves specific branch type(s) named.

Apply. Clicking this button applies the selection of items within the filter to the remaining filters. It also promotes that filter to the next available downstream order: primary, secondary, tertiary, etc.

Reset. Clicking this button resets the filter in context with its status (primary, secondary, tertiary, etc.). If you wish to reset the filter to its primary state, you must first reset the original primary filter — the leftmost displayed one. Resetting a filter also unhighlights any prior selected items.

Internal Editor. Clicking this button applies the filters to the network database, and displays the retrieved data in the editing portion of the dialog box. The edit dialog box is a scrollable list; it supports only basic functions, such as cutting, pasting, and overtyping. The input data for the editor resides in the file `editbus.dat`; the output data is in the file `editbusn.dat`.

External Editor. Clicking this button applies the filters to the network database, and displays the retrieved data in a selected external editor in a new terminal window. For UNIX, the default external editor is `vi`. The input data for the editor resides in the file `editbus.dat`; the output data is in the file `editbusn.dat`.

Send To PF. Clicking this button applies a script file to the two files `editbus.dat` and `editbusn.dat`, translating the differences into a change file `editbusc.dat`. Network data changes are not made until this step is performed.

Close. Clicking this button closes the dialog box. This does not cancel any changes which have already been sent to PF.

4.29.2 Reviewing Network Changes

Once the Send To PF button is clicked, the editing changes are translated into equivalent Power flow data change records, which are sent to Powerflow. Since little or no data checking or validation is performed prior to the dispatch, the possibility of errors is high. You can check the status of your changes by viewing the Network Changes report in the View-Reports menu and the System Errors in the Help menu.

Table 4-6 Description of Type Filter

Code	Description
*	Retrieves all data.
A*	Retrieves A, A0, A1, A2, A3, A4, and I data.
A?	Retrieves A, A0, A1, A2, A3, A4 data.
I	Retrieves I data.
B*	Retrieves all bus and branch data.

Table 4-6 Description of Type Filter

Code	Description
L*	Retrieves all branch data including LTCs, transformers.
B?	Retrieves all bus types.
B, BE, BS, BC, BD, BV, BQ, BG, BT, BX, BM, BF	Retrieves specific bus type(s) named.
+	Retrieves all continuation bus data.
X	Retrieves X data.
Q	Retrieves QP, QX, and QN data.
L, LD, LM, E, T, TP, R, RZ	Retrieves specific branch type(s) named.

4.29.3 Notes

When using the internal editor, remember that you are in *overtyp*e mode only. Delete and Backspace keys may delete forward or backward depending on your X defaults. The Tab key inserts a blank character, but there is no insert mode.

The Powerflow and GUI must be launched from the same directory and reside on the same platform. The file passed in the IPF command `/CHANGES, FILE = editbusc.dat` does not contain directory or node prefixes.

The branch data is displayed double entry. If both terminal buses of a mutual branch are displayed in the edit dialog box, then the branch is displayed twice. It suffices to edit either branch entity; it is redundant to edit both branch items.

Editing an identification field amounts to deleting an old network data entity and adding a new network data item. Editing a data field amounts to modifying the data field. There is a special problem with blanks in data fields. Blanks, when applied to change modifications, designate “no changes.” You must enter a zero (0) to delete a data field within a network data record.

An external program `ipf_diff` translates differences between files `editbus.dat` and `editbusn.dat` into equivalent network data changes and puts them into the file `editbusc.dat`. The script defining this procedure must be installed in the GUI.

4.30 OPEN (File)

The Open command allows you to specify which files you want to work with. You can open files, work with them, and save them (or discard the work and not save them) as many times as you like, once IPF is executing. You do not need to exit IPF and start it up again once you are done with a given set of files. You simply load the next file(s) you want to work with. They replace (overwrite in memory only!) the previously loaded files. See *Save* and *Exit*.

When you first choose Open, you may see file names already existing in some of the text boxes. These default file names come from the X resource file for IPF, the XGUI file, in your logon directory. You can change these defaults to fit your operation. Read about the XGUI file in Appendix A.

There are three areas in the OPEN dialog box: a file type selection panel at the left, a standard Motif file selection dialog in a panel at the right, and a “load files” area at the bottom. See Figure 4-31.

The basic file specifying and loading process goes like this:

1. Select a file type in the file type area.
2. Specify the exact file to load in the file selection dialog.
3. Do steps 1 and 2 until all files you want to work with are selected.
4. Load them all with the Load Selection button at the bottom.

All text boxes where file names appear are standard Motif file name text boxes. Thus, you can modify the file names at any time simply by typing new text into the text box. If a full name is hidden at one end or the other of a text box, put the mouse cursor in the text box, press the left mouse button and drag till the hidden file name text comes into view. Press and ‘paint’ to select text; then type to replace it.

The asterisk (*) in a file name is a “wildcard” character that stands for “any string of characters of arbitrary length.” So, for example, *.BSE matches any file name that ends in .BSE.

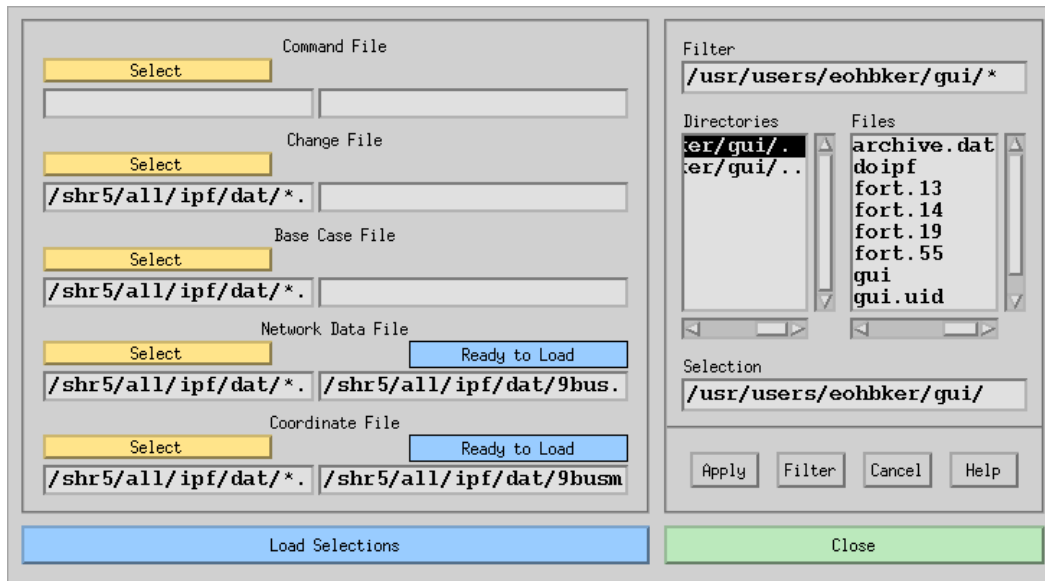


Figure 4-31 Open Dialog Box

Command File. One of five areas in the file type selection panel. The associated Select button and file text boxes apply to IPF command files. This ASCII text file is made up of standard Powerflow Command Language (PCL) commands and data. PCL files are generally used by advanced users. See the *IPF Advanced User's Guide* for more information.

Change File. One of five areas in the file type selection panel. The associated Select button and file text boxes apply to IPF change files. This ASCII text file is made up of commands and data records representing modifications intended for the current case under study. Such a file is applied automatically when it is loaded.

Base Case File. One of five areas in the file type selection panel. The associated Select button and file text boxes apply to IPF base case files. This is the main, binary format 'history' file of IPF after it has run a solution.

Network Data File. One of five areas in the file type selection panel. The associated Select button and file text boxes apply to IPF "raw" network data files. This ASCII text file consists of bus and branch data and usually represents basic data for a new network to be studied with IPF.

Coordinate File. One of five areas in the file type selection panel. The associated Select button and file text boxes apply to IPF coordinate files. This ASCII text file contains position and identification data for buses and branches in a given network. The file may be modified independently of its associated base case file or network data file.

Select. A button whose action transfers its associated file name filter with the wildcard (*) to the file name text box labeled Filter in the file selection dialog. Pressing Select causes the file selection dialog box to change to the directory specified by the wildcard file name in the file name text box associated with the Select button. The filter is specified in the left-hand text file box. The right-hand text file box contains the name of the actual file to be loaded, *not a file name filter*.

Ready to Load. Feedback information telling you the current state of the file in the associated file name text box. *This is not a button*. “Ready to Load” reminds you that IPF does not yet know about this file. You must load it with the Load Selections button below.

Loaded. Feedback information telling you that you have previously loaded the associated file. Thus, IPF is ready to operate on this file. *This is not a button*. If there was some problem loading the file, this box will say “Not Loaded”.

Filter. The file name text box contains a “filter” that selects categories of file names. You can directly modify the file name text by selecting text and typing in new text, or more commonly, you can use the Select button in the file type selection panel at the left to put a file name filter in the box. If you modify the file name filter, you must click the Filter button below to change the directory and file list displays.

Directories. This list component contains directory names associated with the filter directory. You cannot modify these directory names by selecting them and typing. Use the scroll bars at the side and bottom to move the directory names up and down or back and forth. Click the arrows or the click the bar between the arrows and drag to move the names so you can see them. You move up the directory structure by double clicking the directory name ending with a period-period (..). You move down by selecting the name of the directory you want to move into. You can also select a directory and press the Filter button.

Files. This list component contains file names that are within the directory named at the left that ends with a period (.) and that satisfy the filter criterion specified above in Filter. You cannot modify these file names by selecting them and typing. Use the scroll bars at the side and bottom to move the file names up and down or back and forth. Click the arrows or click the bar between the arrows and drag to move the names so you can see them.

You select a file name by clicking once on the file name. This puts the selected file name in the Selection file name text box below. You can then put the selected file name in the appropriate file name text box in the file type selection panel at the left by pressing Apply. You can accomplish the same thing by double clicking the file name in the Files box.

Selection. This file name text box receives the file name selected by clicking a file name in the Files file list. Or, since it is a text box, you can directly modify the file name by selecting text and typing replacement text. Be sure to type an exact file name; do not use a wildcard character such as the asterisk (*) as part of the file name.

Apply. This button causes whatever file name is in the Selection text box to be put in the

appropriate file name text box in the file type selection panel at the left. This has the same effect as double clicking the file name in the Files file list.

Filter. Clicking this button causes all file names satisfying the filter file name text in Filter to appear in the Files file list. It also puts the currently selected directory name *without the file name* in the Selection text box. You must select a file name from the Files file list to select a specific file name.

Help. (Not yet implemented).

Load Selections. Clicking this button sends a “load all the specified files” message to the PF component of IPF. The dialog box also closes and disappears. You can verify that the specified files were loaded by selecting OPEN again. Files that have been previously loaded display the “Loaded” message above the file name text box.

Close. Clicking this button closes the dialog box without changing any directory or file name values. You can close at any time.

Note: For more information about the various file types you can open, see the *IPF Batch User's Guide*.

4.31 PF ID/DESCRIPTION (Edit)

The PF ID/Description dialog box is the way you provide titling and comments for a case. These are saved with the case when you save it in a base case file with the Save command. If you loaded a case from a base case file, any titling and comments that were in the file will be displayed in this dialog. See Figure 4-32.

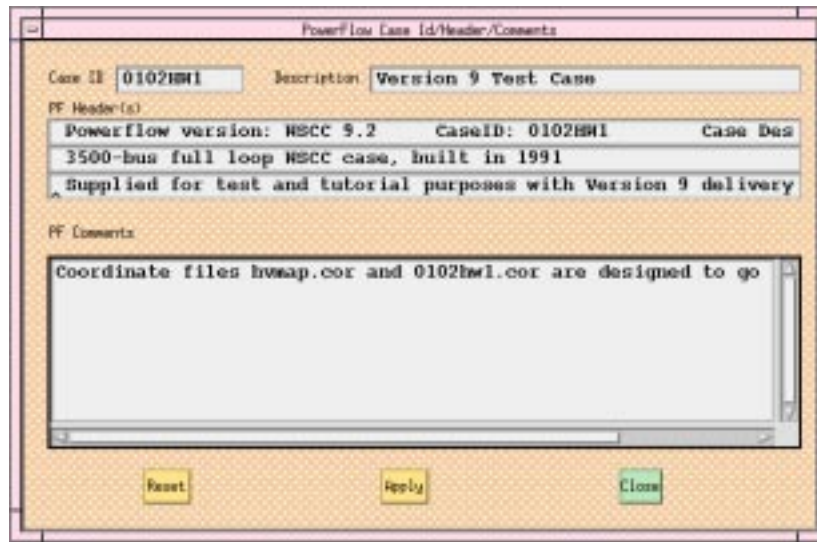


Figure 4-32 PF/ID Description Dialog Box

Case Id. Ten character maximum, alphanumeric field identifying the base case.

Description. Twenty character maximum, alphanumeric field identifying the particular study, project, etc.

PF Header(s). These three records will be printed on each batch output report page and hardcopy map. The first line is generated by the program and contains the Case ID and Description fields. The other two lines can be entered by the user.

PF Comments. Up to 20 additional lines of description and comment can be added. These are stored with the system data, so they will be visible here when you open an old base file. They are also printed in conjunction with certain batch reports, if you load the old base in BPF.

Reset. Clicking this button erases the Case, Description, and PF Comments text boxes, and closes the dialog box.

Apply. Clicking this button sends the current contents of all the text boxes to the currently resident case and closes the dialog box. If you save the case, everything you have applied will be saved with the case. The dialog will show any saved text when it is opened.

Close. Clicking this button closes the dialog box without changing any values in any of the text boxes. You can close at any time.

4.32 PLOT OPTIONS (File)

The Plot Options command allows you to create a network diagram, or map file that can be printed on a PostScript compatible printer. The plots may have insets and legends as well as the usual power system bus, branch, generator, shunt, series compensation, area bubble, intertie line, and other symbols. They are not a copy of what you see on the screen, although both the display and the hard copy are based on the coordinate file you currently have loaded.

Four dialog boxes, User Comments, Page Options, Diagram Options, and Plot Destination, allow considerable customization of the default power system plot. The basic diagram layout is selectable from the Diagram Options dialog box. In addition to the default of real and reactive power flow, current and MVA, loss, difference, and interchange diagrams are selectable.

Some computer systems provide previewing capability on your display by means of a separate PostScript viewing utility. Check with your system administrator to see if your system has this capability.

See Appendix B, *IPF Network Diagrams*, for information about how IPF produces a PostScript plot file.

4.32.1 User Comments

The User Comments menu item provides a way for you to include text comments on a plot. See Figure 4-33.

You can enter comments that will be shown in a block on the diagram. A comment beginning with an ampersand (&) identifies an auxiliary coordinate file name. Only one such file is currently allowed, and it must be identified in the last comment. The auxiliary coordinate file data will be appended to the coordinate file data edited in the GUI.

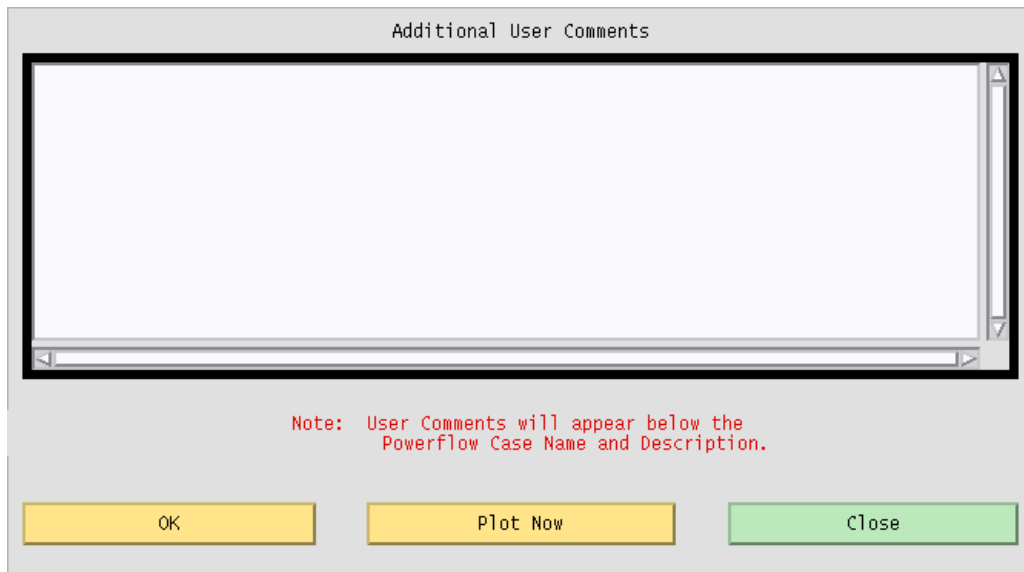


Figure 4-33 User Comments Dialog Box

OK. Clicking this button accepts all text as it is currently shown, passes this on to IPF, and closes the dialog box.

Plot Now. Clicking this button sends the currently resident plotting information to the currently selected printing device, and then closes the dialog box.

Close. Clicking this button closes the dialog box without changing any text you have entered. No text is passed on to IPF. You can close at any time.

4.32.2 Page Options

The Page Options dialog box facilitates selection of options that control the general appearance of a network diagram. The options you choose are incorporated into the network diagram file. See Figure 4-34.

Orientation. Portrait specifies that the long axis of the paper is vertical. Landscape specifies that the long axis is horizontal. Portrait is the default.

Transparency. Insets such as the legend or a detailed section of the diagram can show what is underneath them. This property is called *transparency*. Opaque specifies that objects underneath will *not* show through. Transparent specifies that objects underneath *will* show through. For insets, legends, and identification labels usually Opaque is specified. Opaque is the IPF default.

Paper Size. Width specifies the width of the paper. Height specifies the height of the paper. Make sure your printer can handle the size paper you specify. Two buttons specify 21.59 cm by 27.94 cm (8.5 by 11 inch) paper or 27.94 cm by 43.18 cm (11 by 17 inch). The IPF default is 21.59 cm by 27.94 cm (8.5 by 11 inch).

Border Top Right Corner. A border is a solid-line rectangle surrounding graphical objects. X cm and Y cm are real numbers that specify x and y values for position with respect to the top right corner of the drawing area. The lower left corner is analogous to (0,0) in the Cartesian coordinate system.

The dialog box is titled "Page Options" and contains several sections for configuring plot settings:

- Orientation:** Radio buttons for Portrait (selected) and Landscape.
- Transparency:** Radio buttons for Opaque and Transparent (selected).
- Paper Size:** Input fields for Width (21.59) and Height (27.94). Below are two buttons: "21.6 x 28 cm" and "28 x 43 cm".
- Border Top Right Corner:** Input fields for X cm (21.59) and Y cm (27.94).
- Case Name Position:** Input fields for X cm (12.7) and Y cm (4.0).
- Comments Position:** Input fields for X cm (12.7) and Y cm (3.7).
- Offset:** Input fields for X cm (0.0) and Y cm (0.0).
- Scale Factor:** Input fields for X (1.0) and Y (1.0).
- Label Box Coordinates (Centimeters):** Input fields for TOP LEFT CORNER (X: 12.0, Y: 4.5) and BOTTOM RIGHT CORNER (empty).
- Legend Position:** Input fields for X cm (5.0) and Y cm (0.5).

At the bottom are "OK" and "Close" buttons.

Figure 4-34 Page Options Dialog Box

Case Name Position. A case name is the user-specified identification associated with a particular case study and is saved in the base case file. X cm and Y cm are used to position the case name.

Comments Position. Comments are from the User Comments dialog box and the base case file.

Offset. X cm and Y cm are real numbers specifying the x and y locations of the lower left corner of an insert relative to the lower left corner of the paper. The lower left corner is analogous to (0,0) in the Cartesian coordinate system. The default values for X cm and Y cm are 0.0.

Scale Factor. X and Y are real numbers specifying whether the x and/or y axes should be enlarged or reduced. Numbers larger than 1.0 enlarge the size of diagram objects. Positive numbers smaller than 1.0 reduce the size of diagram objects. The default values for X and Y are 1.0.

Label Box Coordinates. Typically, the label box is in the lower right corner of the diagram. You may then enter just the top left corner of the box. The bottom right corner must be entered also if the box is elsewhere in the diagram.

When the label box option is selected, several default locations are established relative to the upper left corner of the box. Default options, which can be overridden by options on the Page Options menu, are

- Coordinate file name, positioned above the box.
- Powerflow case name, date, and Powerflow program version, positioned inside the box.
- Powerflow description, positioned below the Powerflow case name.
- Comments entered by the user, positioned below the Powerflow description.
- Comments from the Powerflow case, positioned below comments entered by the user.
- Border; the maximum size allowable considering the paper size and printer capabilities.

Accounting information is below the border and is fixed. This information shows the diagram type, flow options, and dates and versions of the Powerflow program used to generate the Powerflow case and diagram.

Legend Position. This locates the top left corner of the legend. The legend provides a description of branch symbols used in the diagram.

OK. Clicking this button accepts all values as they are currently set and closes the dialog box.

Close. Clicking this button closes the dialog box without changing any values. No changed values are passed on to IPF. You can close at any time.

4.32.3 Diagram Options

The Diagram Options dialog box allows for selection of power flow values that appear on a network diagram. The options you choose determine which power flow solution data is combined with coordinate data to create a PostScript network diagram file. See Figure 4-35.

The dialog box is titled "Diagram Options" and is divided into several sections:

- Bus Detail:**
 - Bus Name:** Radio buttons for "Abbreviation" (selected) and "Full Name & KV".
 - Bus Voltage:** Radio buttons for "kV" (selected) and "Per Unit".
 - Generation:** Radio buttons for "Draw Generation as Needed" (selected), "Always Draw Generation", and "Draw No Generation".
 - Shunt:** Radio buttons for "Draw Shunt as Needed" (selected), "Always Draw Shunt", and "Draw No Shunt".
 - Checkboxes: "Show Phase Angle" (checked), "Show Load", "Show Total Flow of Undrawn Branches", and "Show Outages" (checked).
- Branch Detail:**
 - Parallels:** Radio buttons for "Combined" (selected) and "Separate".
 - Checkboxes: "Transfmr Taps", "Compensation", and "Outages" (checked).
- Diagram Type:** Radio buttons for "PQ Flow" (selected), "MVA & I", "Loss", "Interchange", "Coordinates", and "Loading %".
- Values:** Radio buttons for "Normal" (selected) and "Difference".
- Flow Detail:** Checkboxes for "P Sending End" (checked), "Q Sending End" (checked), "P Receiving End", and "Q Receiving End".

At the bottom, there are "OK" and "Close" buttons.

Figure 4-35 Diagram Options Dialog Box

Bus Name. Coordinate files contain the bus record identifier consisting of bus name and base kV and an alternate coordinate diagram identifier called a bus abbreviation. The Abbreviation identifier simplifies crowded diagrams. Abbreviation is the default.

Bus Voltage. Bus Voltage allows either the actual kV or per unit voltage to be displayed. The actual kV value is the default.

Generation. Specifying Generation means that the P and Q generation values and generator graphic symbol show on the diagram.

Shunt. Specifying Shunt allows you to see shunt values and a graphic symbol.

Show Phase Angle. Specifying Show Phase Angle means that bus angle with respect to the

slack bus shows on the diagram.

Show Load. Specifying Show Load allows you to see actual load values near the bus voltage values.

Show Total Flow of Undrawn Branches. Specifying Show Total Flow of Undrawn Branches allows you to see P and Q flow values into undrawn branches.

Show Outages. Specifying Show Outages means that outaged branches show in the diagram.

Parallel Lines. Specifying Combined adds multiple circuit power flow values together. Specifying Separate allows you to see flow values for each individual branch. Combined is the default.

Transfmr Taps. Transfmr Taps shows any transformer taps.

Compensation. Compensation shows series compensation values.

Outages. Outages shows outaged branches.

Values. Specifying Normal shows the solution values of a given Powerflow case. Specifying Difference allows you to compare two power flow cases and show the differences.

Diagram Type. Diagram Type can be only one type at a time. Specifying PQ Flow shows P and Q power flow values. This is the default. Specifying MVA & I shows megavoltamperes on transformers and current flows on lines. Specifying Loss shows transmission system loss values. Specifying Interchange creates a diagram that shows net generation, load, and line flow values for area interchange studies. Specifying Coordinates creates a diagram with no solution data. This may be used for verifying that bus and branch placement is satisfactory.

Flow Detail. The options in Flow Detail allow you to fine tune how you want to show the P and Q flow values. Your choices are: P Sending End, Q Sending End, P Receiving End, and Q Receiving End. P Sending End and Q Sending End is the IPF default.

OK. Clicking this button accepts all values as they are currently set and closes the dialog box.

Close. Clicking this button closes the dialog box without changing any values. No changed values are passed on to IPF. You can close at any time.

4.32.4 Plot Destination

The Plot Destination option allows you to select the printer device most convenient or suitable to your job. You select a print command from the top list window, and the command appears in the text box below. You can edit the command in the text box. See Figure 4-36.

When you first open this dialog box, a default print command shows in the Selection text box. IPF reads the XGUI file in your home directory to find this print command. You can edit the ASCII text XGUI file to change this default print command. See Appendix A for a discussion of how to modify the XGUI file.

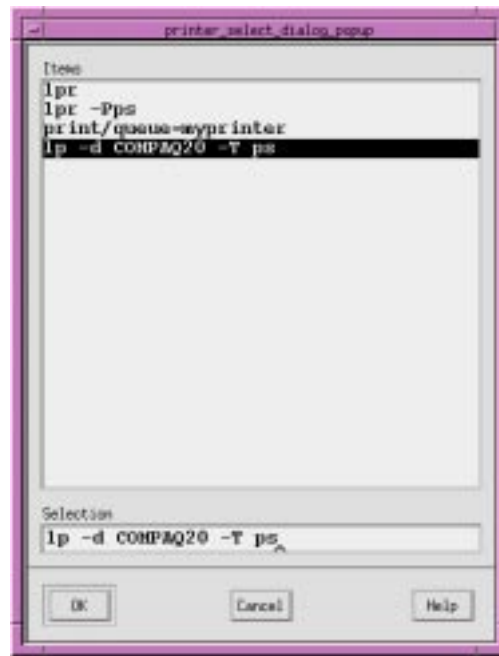


Figure 4-36 Plot Destination Dialog Box

Items. This scrolling window shows the print plot commands currently available. Selecting an item in the window makes it appear in the Selection text box below.

Selection. This text box contains the command string that IPF uses to print a diagram. You can modify the text in this box any way you like, perhaps to specify a printer or printer command option you use only occasionally. IPF uses whatever printer command is in this text box to print a diagram.

OK. Clicking this button stores the command string in the Selection text box to be used for subsequent printing. The Plot Destination dialog box then closes. Use the Print Plot command to actually send a diagram to the printer. Diagrams either printed or not printed are available for on-line viewing if you have a PostScript previewer on your system.

Cancel. Clicking this button closes the dialog box without changing any values. No values are passed on to IPF. You can cancel at any time.

Help. (Not yet implemented).

4.33 PRINT PLOT (File)

The Print Plot command sends the current, memory-resident base case/coordinate file data to the printer you have currently designated, using the settings specified in the Plot Options command. See the Plot Options entry in this chapter.

4.34 REPORTS (View)

Reports are data extracted from a memory-resident base case that is then formatted for output to the display. In a few cases, data is extracted from a base case *file* that you specify. IPF supplies the most frequently needed reports via the Reports dialog boxes. See Figure 4-37, Figure 4-38, and Figure 4-39.

The scrolling list of report possibilities appears in the upper portion of the Reports dialog boxes. You choose one of the report types by clicking on it. The dialog box itself then changes to reflect the kind of report you have chosen. Refer to the figures in this section to see a few of the possibilities. Generally, once you have chosen the kind of report you want, you then use the filter lists of Areas, Zones, Owners, etc., to narrow down the information you are looking for. Then you click View Report to see all the bus or branch records your specified list of criteria produces, or Save or Append Report to send the output to a file.

There is a limit of ten items selected on any filter. You can choose more than this, but only the first ten will be applied and reported. If you want *all* of any filter list, just *do not select anything* in the list (e.g. all areas, all zones in an area, etc.).

Note: The CFLOW library is available to C programmers so that more extensive reports can be extracted from IPF data. See the *CFLOW User's Guide*.

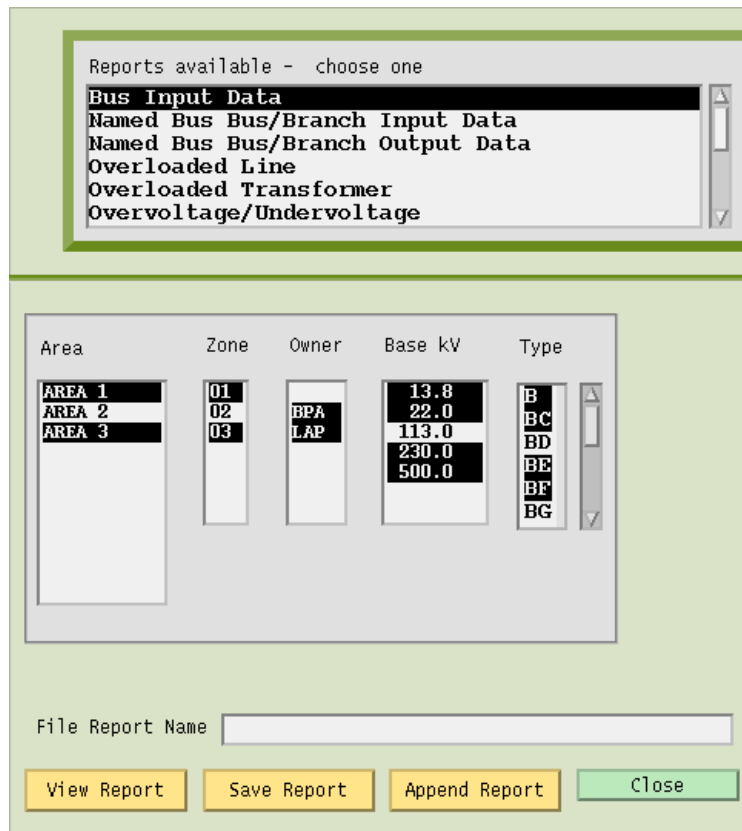


Figure 4-37 Reports Dialog Box: Bus Input Data

Reports Available. This scrolling list shows all reports available. You select a report by clicking on it. If the report needs another base case file to do a comparison, a files menu will pop up so you can select the other file names.

Area. Click on the *areas* you want to report. Click again to unselect. Selections across Areas, Zones, Owners, Base kV, and Types are effectively “anded” and therefore narrow the reported information.

Zone. Click on the *zones* you want to report. Click again to unselect. Selections across Areas, Zones, Owners, Base kV, and Types are effectively “anded” and therefore narrow the reported information.

Owner. Click on the *owners* you want to report. Click again to unselect. Selections across Areas, Zones, Owners, Base kV, and Types are effectively “anded” and therefore narrow the reported information.

Base kV. Click on the *base kVs* you want to select. Click again to unselect. Selections across Areas, Zones, Owners, Base kV, and Types are effectively “anded” and therefore narrow the reported information.

Type. Click on the *bus types* you want to select. Click again to unselect. Selections across Areas, Zones, Owners, Base kV, and Types are effectively “anded” and therefore narrow the reported information.

File Report Name. The file name where you want report data saved. If no name is specified, the report will be saved in REPORTS.DAT.

View Report. Clicking this button brings up the View Report dialog box. The report data is in a scrolling text window. See the examples starting in Figure 4-40. The number of lines of output is limited. If you see “MORE” at the bottom of the report, you will know it was truncated.

Save Report. Clicking this button saves the specified report to a file that you name in the File Report Name box. The file will contain all lines of the report, even if there are more than can be displayed on the screen.

Append Report. Clicking this button adds the report data to an already existing file. You must supply the file name you want to append to.

Close. Clicking this button closes the dialog box without saving any settings or information.

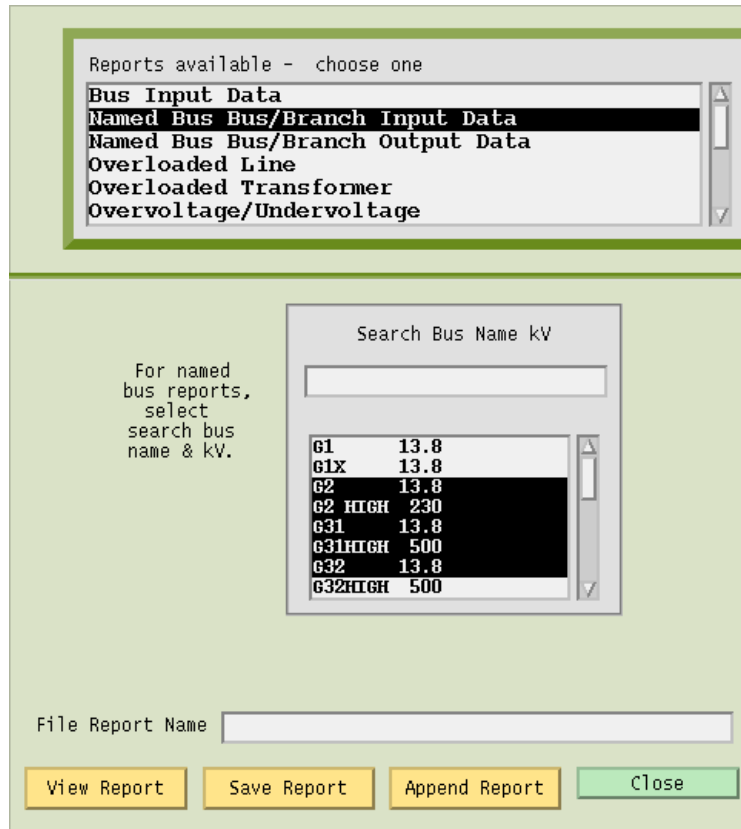


Figure 4-38 Reports Dialog Box: Branch Input Data

Search Bus Name KV. You type in this text box to go to a specific bus. The search function is case sensitive; that is, a and A are not the same. The search function begins as soon as you type a character. Begin typing the first characters of a bus name and the search function finds the alphabetically first bus matching the letters typed so far. For example, A finds ACTON, AL finds ALBINA, ALD finds ALDER ST, and ALDERC finds ALDERCART.

Clicking on a bus, or finding it with the search, causes it to be highlighted (selected). *All highlighted buses will be reported*, (up to the limit of ten). To unselect a bus that you do not want reported, just click it again.

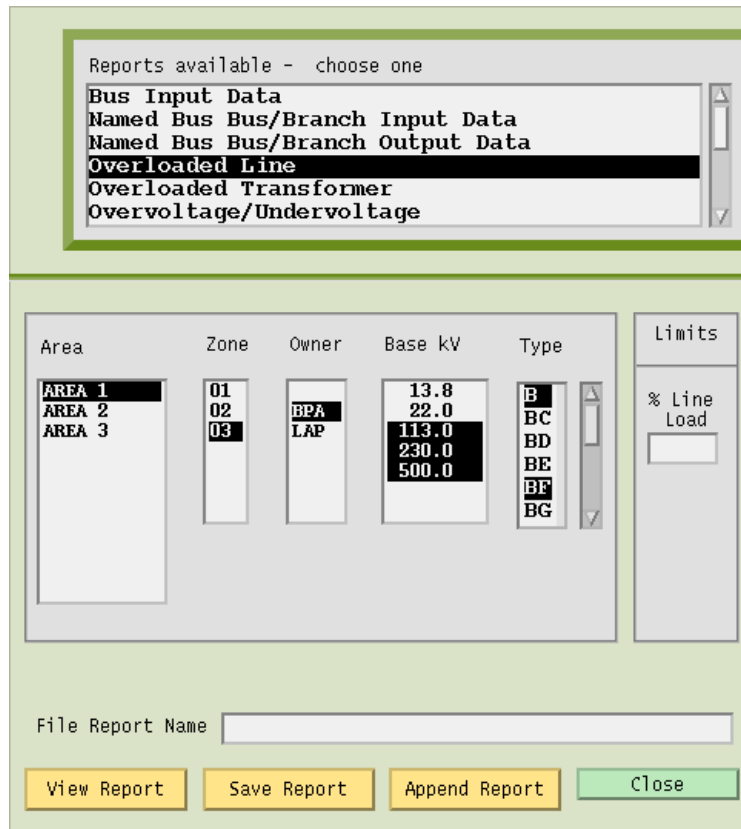


Figure 4-39 Reports Dialog Box: Overloaded Lines

Limits. Under % Line Load you can specify a minimum percentage for reporting overloads on line and transformers by typing a value in this text box.

Under PU Volt Relax you can relax the limit for over/under voltage reporting. The normal limits are either the global ones or those specified on the area record. If these give you too many buses, you can use this text box to extend the limit. For example, entering 0.02 will cause to be reported only buses whose voltage is more than 0.02 beyond the limits (you cannot lower the limit by entering a negative number.)

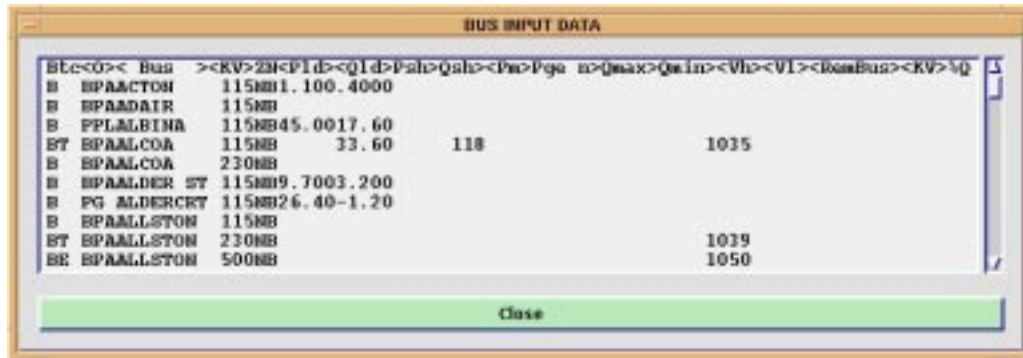


Figure 4-40 Bus Input Data Report Example



Figure 4-41 Bus/Branch Input Example

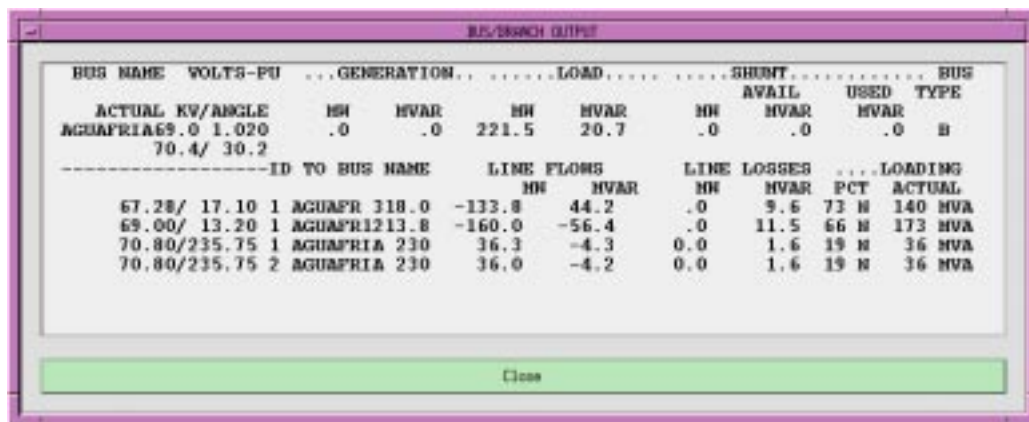


Figure 4-42 Bus/Branch Output Example

AREA INTERCHANGE SUMMARY

```

Area interchange summary case 0102HW1      date 5/20/94
Area name      Slack bus      Slack bus generation      Net
              Name         Base  Beginning  Change  Final  Maximum  Interchange
              Name         Base  MW         MW       MW     MW       MW
ARIZONA      AGUAFR 3    18.0  131.7     2.1   133.8   181.0   4685.4
B. C. HYDRO  BRIDGE R   13.8  195.8     9.6   205.4   514.0   1823.5
IDAHO        BROOKLEE   13.8  297.8     -1    297.9   450.0   1409.0
IMPERIALCA  ELSTEAMP   92.0  211.6    -1.1   211.5   265.0    352.2
LADWP       HAYNES5G   18.0  235.8    -8.1   227.7   341.0  -1935.0
MEXICO-CFE  TTD1       13.8  72.7      0.0    72.7   160.0    220.0
MONTANA     KEER       13.8  99.6     -4    99.2   180.0   1064.0
NEVADA      SUNRSHGN   13.8  47.0     -1    46.9    90.0   -1288.0
NEW MEXICO  MENHANG3   13.8  46.6      0.0    46.6   103.0   -269.5
NORTHWEST  COOLEE 2   13.8  2127.0  -10.1  2116.9  2615.0  -265.0
PEOE       MAHGT G1   18.0  136.8    -1.8   135.0   167.0  -435.6
PG AND E    PTS7SHNG   20.0  592.4     .6   593.0   710.0  -980.0
PCOLORADO  CHEROKEE   20.0  133.6     0.0   133.6   158.0   -902.7
SAN DIEGO   ENCINA 4   22.0  138.6     .3   138.9   292.0  -1417.4
SIERRA      TRACY G3   13.8  32.6     -1    32.7   115.0   -123.0
SOCALIF     ALAMT5 G   20.0  412.2     1.2   413.4   480.0  -4716.0
TRANSMATA   BRAXEAU   13.8  153.7    -1    153.6   330.0     .0
W KOOTENAY  HANETA A   14.4  179.6    -1    179.5   180.0  -323.5
WAPA L. C.  HOOVERA3   16.5  97.2      .5    97.6   130.0   1409.9
WAPA L. H.  MHPP-1     24.0  453.1    -3    452.8   550.0  -383.3
WAPA U. C.  GLENCAN6   13.8  617.2    -4    617.6   809.0  2103.0
WAPA U. H.  FT PECK1   13.8  51.0     -5    50.5    61.8   -28.0
    
```

Close

Figure 4-43 Area Interchange Report Example

TIE LINE SUMMARY

```

Tie line summary of area interchange case 0102HW1      date 5/20/94
Area 1      Area 2      /----- Intertie branch -----/
              Zone Bus 1              Zone Bus 2              line flow
IDAHO        LADWP      IP DRY LAKE 500.0 13 * MARKETPL 500.0      84.8
              IP * ROBINSON 500.0 13 DELTA 500.0     -128.8
              IP HELLSGYN 230.0 HH * ENTERPRB 230.0     194.5
O            NORTHWEST IP HINES 138.0 HF * HARNEY 115.0      7.2
              IP LADD 230.0 HH * LAGRANDE 230.0     25.8
              IP * MIDPOINT 500.0 HF * BURBS 500.0     640.5
              IP OXBOW 230.0 ?? * LOLO 230.0     -74.2
              IP * AMFLS 138.0 L1 MALAD 138.0     13.6
O            PEOE      IP BLACKFT 161.0 L1 * GOSHEN 161.0     -62.4
              IP * BORAH 345.0 L1 * BENLOMBD 345.0     -27.2
              IP BRADY 230.0 L1 * ANTILOPE 230.0     -14.7
              IP * BRADY 230.0 L1 TREASTON 230.0     19.1
              IP * BRIDGER 345.0 L1 BRIDGER 230.0     284.3
              IP BRIDGER 345.0 L1 * GOSHEN 345.0     550.7
              IP * KIMPORT 345.0 L1 GOSHEN 345.0    -110.8
              IP * MIDPOINT 345.0 27 IDAHO-NV 345.0      6.6
Area total      (MW)      (MVAR)
Generation      3834.9      443.0
Load             2275.0      987.0
Losses           150.9     -289.7
Shunt            .0       -207.4
Net Export      1409.0     -461.8
    
```

Close

Figure 4-44 Tie Line Summary Report Example

4.35 RUN CFLOW (Process)

CFLOW files are C programs using the IPF CFLOW library of routines. These routines enable you to access the base case memory-resident data in IPF. Many CFLOW programs are designed to collect information for specialized reports that are not built into IPF in the Reports command. See the *CFLOW User's Guide* for more information.

There are two ways to execute a CFLOW program from the GUI. Refer also to *Auto CFLOW* earlier in this section so that you choose the appropriate CFLOW execution command.

The Run CFLOW command is used primarily during the development and debugging of CFLOW programs. During this time, you use a terminal window outside of IPF as you work on getting the program logic to function properly.

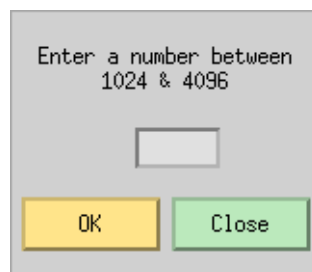


Figure 4-45 Run CFLOW Dialog Box

A second stage of CFLOW programming, after the basic program logic is correct, may involve directing input and output to a separate CFLOW-program-created terminal window. This “production-grade”, user-friendly CFLOW program may then be run by a user from within IPF with the Auto CFLOW command.

To use the Run CFLOW command:

1. In a terminal window (or other programming environment) outside of IPF, develop and debug the basic programming logic of your CFLOW program.
2. When you are ready to test it with IPF, start up IPF in a *different* terminal window.
3. Start your CFLOW program in its terminal window with a socket id number between 1024 and 4096 on the command line. Example: `cfpgm 2020`
4. Return to IPF, select the Run CFLOW command and type the *same* socket id number that you typed on the command line in the terminal window.
5. Click OK to supply the socket id number to your CLFOW program and start it executing.

4.36 SAVE (File)

The Save command permanently stores current work on a disk storage device. When you are through running a solution on a network or editing the coordinates in a network, you usually want to keep the work. You use Save to do this. The saved files remain available for continued modification within the current IPF session. You can save files at any time. See Figure 4-46, Figure 4-47, Figure 4-48, and Figure 4-49.

The Save dialog box is divided into five file save text boxes with associated Save buttons, and Options buttons for the Network and Stability files. The current files that you have loaded appear in their respective text boxes when you first open this dialog box. If you want to change the name of a file, modify the file name by selecting and typing new characters. You may also add a file path if you want to save the file in a different directory.

If you fail to change an existing file name to a new name, you get a dialog box asking you to confirm that you really want to overwrite an existing file.

When you save a file, IPF does not change the file names in the Open dialog box or any file names in the Current Files Area of the main window. These file names change only if you use the Open dialog box to load new files.



Figure 4-46 Save Dialog Box

Change File. This ASCII text file is made up of data representing modifications made in the

current session.

Base File. This is the main, binary format output file of IPF after it has run a solution.

Network. This ASCII text file contains the bus and branch record data comprising the current network, including any alterations you have made.

Coordinate. This ASCII text file contains position and identification data for buses and branches in the current case.

Stability. This ASCII text or binary file contains base case data that is readable by the WSCC Stability program.

Save. These Save buttons are dedicated to their respective files. Click the appropriate button(s) to save the file(s) you want to keep.

Options. These Options buttons are dedicated to their respective files. Click the associated button to pop up a dialog box appropriate to the Network or Stability file.

Close. Clicking this button closes the dialog box and returns you to the current IPF session.

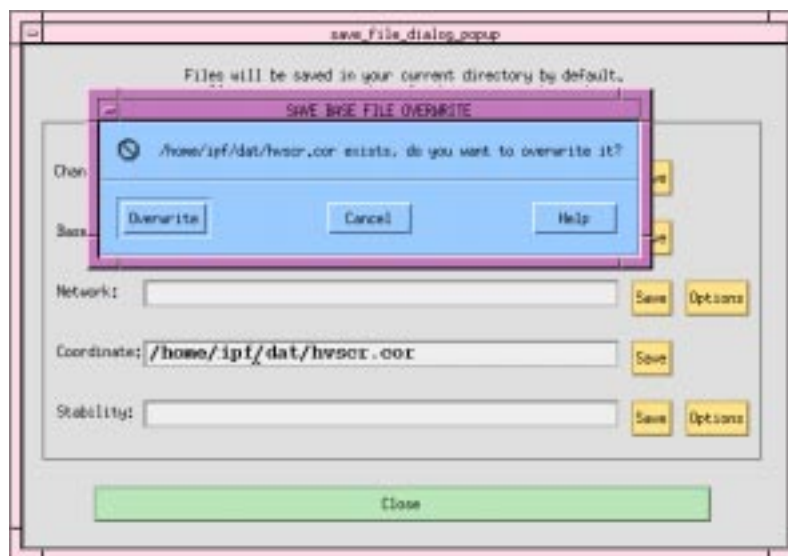


Figure 4-47 Save Overwrite Dialog Box

Overwrite. Clicking this button causes the data in the file named in the dialog box to be

overwritten. This is a replacement operation, and, thus, you may lose data if you are mistaken. Caution is urged.

Cancel. Clicking this button closes the dialog box and returns you to the main Save dialog box.

Help. (Not yet implemented.)

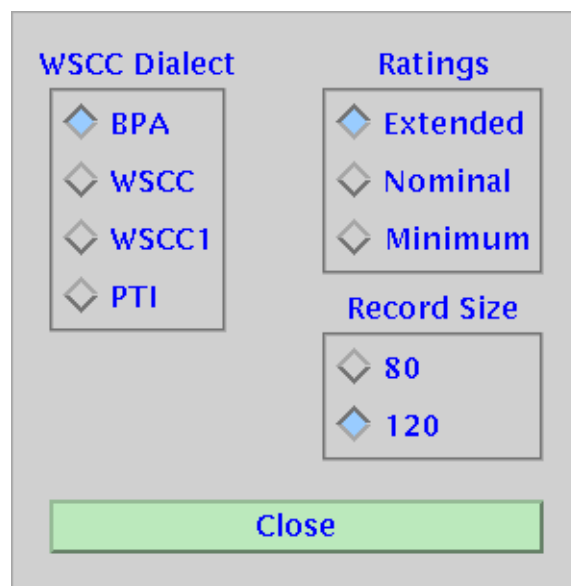


Figure 4-48 Save Network Options Dialog Box

WSCC Dialect. Dialect refers to how values in a field are interpreted and how fields are arranged. See Appendix F of the *IPF Batch User's Guide* for more information. BPA is the default.

Ratings. These refer to line voltage ratings. Extended means that more than one rating is allowed for a line. For example, thermal is another kind of rating. See the *IPF Advanced User's Guide* for more information. Nominal means there is just one rating allowed. Minimum means that the lowest of extended ratings is selected for the file. Nominal is the default.

Record Size. Eighty (80) specifies that you want to limit the record size to 80 characters. WSCC, WSCC1, and PTI dialects require this. The BPA dialect allows the 120 setting.

Close. Clicking this button closes the dialog box without writing the file to disk or changing any radio button values.

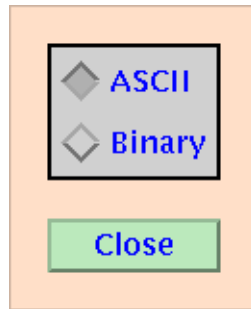


Figure 4-49 Save Stability Options Dialog Box

ASCII, Binary. The ASCII button saves the solved system data in ASCII text format, which is readable by ordinary text editors. This file can be transferred to any other platform for input to the WSCC stability program. The Binary button saves the same data in binary format. The binary file is less than half the size of the ASCII file, but can be used as stability input only on the same type of computer system.

Close. Clicking this button closes the dialog box without writing the file to disk or changing any radio button values.

4.37 SOLUTION DATA OFF (View)

The Solution Data Off command rewrites the display *without* reading and displaying the current solution data. Sometimes you may want to clear the display of extra data so that it is more readable. This command does that.

4.38 SOLUTION DATA ON (View)

The Solution Data On command rewrites solution data to the display. When you do repeated solutions, the displayed solution data does not automatically refresh in all circumstances. When you notice this, do a Solution Data On command to read and display the latest solution data.

4.39 SOLVE CASE (Process)

Solving a network case (or base case) causes IPF to calculate bus voltages that satisfy network constraints as they exist within the currently resident system data. See Figure 4-50.

In a solution scenario, the following steps are typical:

1. You make changes to the case.
2. You solve the network.
3. You examine the output.

You follow these steps repeatedly until some desired output conditions or criteria are achieved. The Error Message dialog box gives you feedback about the progress and success of a solution attempt. See Figure 4-51. However, the iteration report is visible only in the terminal window behind the GUI.

Since solution voltages are stored in all base cases, you need not solve a case after initially loading one to access solution voltage data. However, if your case is specified by a network data file, you do need to run a solution to access solution voltage data. Thereafter, solution voltages are stored in the binary base case data.

You do not need to load a coordinate or change file to solve a case — only a base case file or network file is needed.

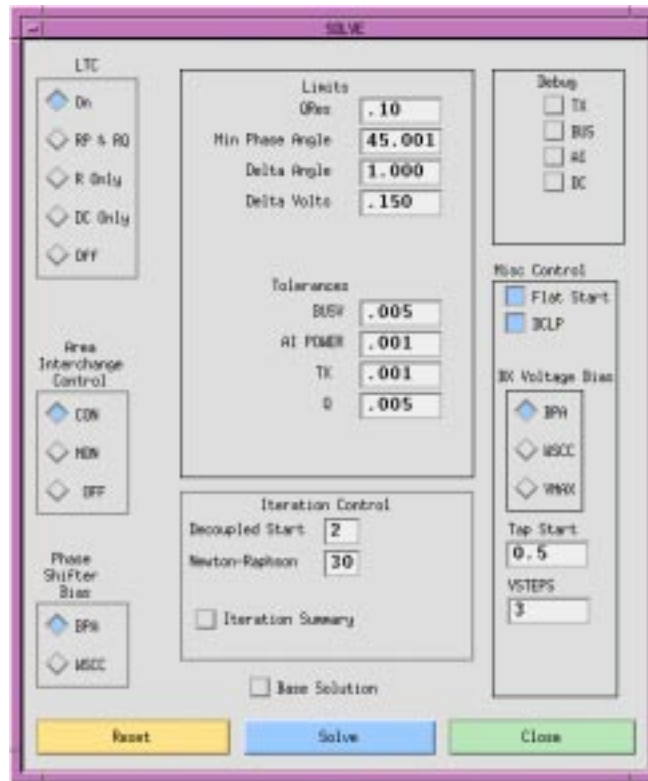


Figure 4-50 Solve Dialog Box

LTC. The radio buttons in this section select different load tap changing (LTC) transformer options. Button On enables all LTC transformer options. RP & RQ enables only LTC transformers controlling real and imaginary power. R Only enables only LTC transformers controlling voltage. DC Only enables only LTC transformers controlling DC converters. Off turns all LTC transformers off.

Area Interchange. The CON radio button causes IPF to control the area interchange according to the specified constraints. MON does not control, but will inform you of constraint violations. The OFF radio button causes IPF to ignore all area interchange constraints.

Phase Shifter Bias. There are two options for phase shifter bias: BPA and WSCC. Choose BPA to instruct IPF to try to bias voltage phase angle to zero if possible for minimum losses. Choose WSCC to instruct IPF to try to bias voltage phase angle to the initial values of the base case.

Limits. QRes is the per unit MVAR by which a bus must be perturbed to revert from a state of Qmax control to a state of V control. Min Phase Angle is the minimum angle in degrees for which fixed-tap phase shifters are modeled as ideal devices in the DC iterations. Delta Angle is the

maximum angle adjustment in radians permitted in one iteration. Delta Volts is the maximum voltage adjustment in per unit permitted in an iteration.

Tolerances. These values set the tolerances in per unit for convergence testing.

Iteration Control. This section specifies the number of iterations IPF goes through. Specifying a number for Decoupled Start means that you want IPF to calculate P and Q separately before it goes to the full Newton-Raphson solution method. Values from zero (0) to ten (10) are valid. Specifying zero means that you want to skip the decoupled start. Specifying two means that one P solution and one Q solution is done. Specifying ten means that five P and five Q solutions are done, alternating P and Q (P, Q, P, Q, P, ...) before the Newton-Raphson solution begins. It is often useful to do more DC iterations if a case has early difficulty in solving.

If a case is 'hunting', you can increase the number of Newton-Raphson iterations beyond the default of 30 to cause it to keep trying. Setting it lower (say to 10) will not cause it to stop before it finds a solution, however. Maximum is 50.

Turning the Iteration Summary button on causes several thousand lines of solution process detail to be written to your [logon].pfd file.

Base Solution. Clicking this button bypasses the solution routine, and uses the base voltages in residence to calculate line flows.

Debug. These buttons turn on various program debug switches. See the *IPF Batch User's Guide* for more information.

Miscellaneous Control. If the Flat Start radio button is on, IPF will initialize all bus voltage angle values to zero before it does a solution. This is the default. If the button is off, IPF will leave all bus voltage angles and magnitudes unchanged from their previous solution values. This option is chosen most often for base cases that have already been solved, and to which only minor changes have been made. The DCLP button should be on. It controls the type of solution used for multi-terminal DC lines.

BX Voltage Bias. There are three options for BX Voltage Bias: BPA, WSCC, and VMAX. The BPA option accepts any discrete reactance step on a BX bus when its solution voltage V lies between V_{min} and V_{max} . The VMAX option attempts to find the switched reactance step such that the solution voltage is the largest which is still less than or equal to V_{max} . The WSCC option adjusts the shunt only when the voltage violates the limits.

Tap Start. Sets the LTC transformer starting tap. See the *IPF Batch User's Guide* for a full description of how the starting tap is calculated.

VSTEPS. This controls the modeling of BQ buses which are on a Q limit.

Reset. Clicking Reset returns all radio buttons to their default values.

Solve. Clicking the Solve button causes the IPF solution algorithms to attempt a solution within the constraints of the base case data and the Solve dialog box option settings. Solution performance varies with computer system and size of the base case data set. Messages about the solution can be seen in the Error Messages dialog box. See Figure 4-51. If there are any Fatal errors, this box will pop up on its own; otherwise you must open it in order to see the messages. The iteration history can be observed in the terminal window where IPF was started. You can examine all of this in the [logon].pfd file in your current directory, after you exit IPF.

Close. Clicking Close closes the dialog box without saving any changes in the settings.

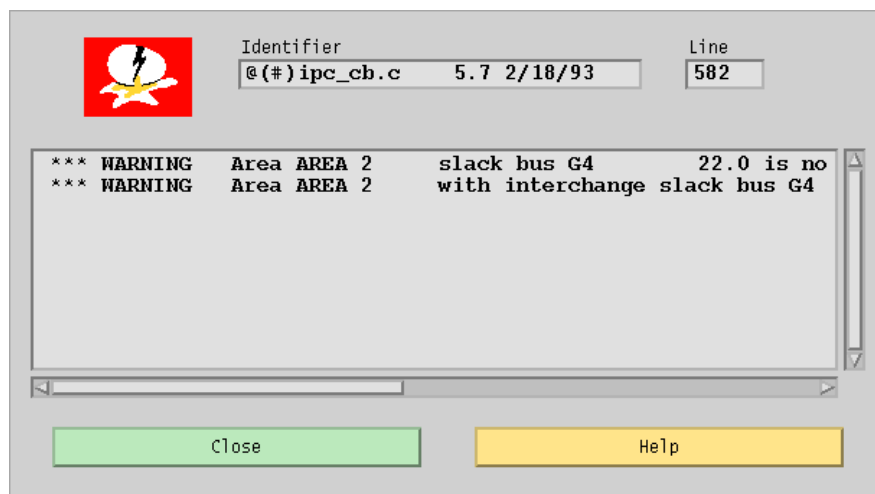


Figure 4-51 Solution Feedback

APPENDIX A

CUSTOMIZING IPF

A.1 INTRODUCTION

X resources are X system components managed in common by the X server. Examples of resources are colors, fonts and their characteristics, default size and position of windows, and default file names for dialog boxes. In IPF, you can change many of these resource values.

You customize IPF, as you do other X clients, by changing the client's X resources file. This is the XGUI file in your home (logon) directory. It is an ASCII text file, so you can alter it with any text editor. It is recommended that only advanced users edit XGUI to any extent; when making changes to X resource values it is very easy to cause problems that you won't know how to fix. For example, if you accidentally changed some branch colors to the main window's background display color, you will not be able to see those branches, even though they are still there! Caution is urged when you modify X resource values and specifications.

However, there are a few items that anybody can and will probably want to change. These are covered below. For more information, see the *IPF Advanced User's Guide*.

Note: After you make changes to the XGUI file, you may *not* see changes in your client (IPF) till you exit the X Window System itself. Exiting and restarting IPF may or may not be sufficient.

A.2 CHANGING OPEN FILE DEFAULTS

Although you can always find your way to the file you want to open by using the Files filter system, it is much nicer to have IPF come up with the paths and/or names you most commonly use. Below is the section of the XGUI file which you will want to alter in order to do this. Open XGUI with your text editor and forward search for "DEFAULT MASKS".

```
! These are the DEFAULT MASKS in the open file menu.
```

```
XGUI*open_dia_command_dir_text.value: *.pcl  
XGUI*open_dia_change_dir_text.value: *.chg  
XGUI*open_dia_base_dir_text.value: *.bse  
XGUI*open_dia_network_dir_text.value: *.net  
XGUI*open_dia_coord_dir_text.value: *.cor
```

```
! These are the default filenames in the open file menu.  
! Leave blank where you don't want a default.  
! Don't set default filenames for both base and network!!!
```

```
XGUI*file_select_dia_command_text.value:  
XGUI*file_select_dia_change_text.value:  
XGUI*file_select_dia_base_text.value:  
XGUI*file_select_dia_network_text.value:  
XGUI*file_select_dia_coord_text.value:
```

```
#####
```

When you first execute IPF and select the Open command from the main window menu, some default file selections fill the file text boxes under the Select buttons. These specify the default filters to be applied.

To change a default filter mask:

For example, the default coordinate file mask in the XGUI file for the Open dialog box is:

```
XGUI*open_dia_coord_dir_text.value: *.cor
```

This assumes that you are executing IPF from the directory where the data files reside, and that you will be selecting the coordinate file you want to load from among files in this directory that end with `.cor`. (The asterisk (*) is a UNIX wildcard character meaning "any arbitrary length string of characters.")

To make the filter default to a different directory, insert (for example) `/archive/ipf/dat/`:

```
XGUI*open_dia_coord_dir_text.value: /archive/ipf/dat/*.cor
```

Now the coordinate files selected are in the `/archive/ipf/dat` directory. The pathname you

specify can be absolute or relative; just be sure that it specifies a valid directory on your system.

To change a default filename mask:

The default base case and coordinate file masks in the XGUI file for the Open dialog box are specified with these two lines:

```
XGUI*file_select_dia_base_text.value:  
XGUI*file_select_dia_coord_text.value:
```

The filenames are currently blank, meaning that no files are loaded when IPF starts up. If during a study you are working continuously from a particular base file, say `../base/97HS4.bse`, you might want to edit XGUI to make this file, and its associated coordinate file, load automatically every time you start IPF. You then can begin work immediately, without having to go through the Open Files menu.

To add default filenames, insert them after the “:”

```
XGUI*file_select_dia_base_text.value: ../base/97HS4.bse  
XGUI*file_select_dia_coord_text.value: /archive/ipf/dat/volts.cor
```

These two files will be automatically loaded for you. If you look at the Open Files menu, you will see their names in the boxes to the right of the filter boxes.

Note: Do not specify both a base file and a network file name. These are mutually exclusive!

A.3 CHANGING PRINTER DEFAULTS

You can specify your default printer and also enter a list of others you may want to choose from. These are right at the top of the XGUI file.

```
XGUI*printer_selection_box*textstring: print
```

Change “print” to whatever string you will want to use most often.

The section just below this is where you put in the other print strings that you want to appear in the printer list.

APPENDIX B

IPF NETWORK DIAGRAMS

B.1 OVERVIEW

IPF has two different network diagram presentations. One is the display you see in the GUI graphics, and the other is the hard copy map. The display is for convenience in accessing system data graphically – it does not represent what the plotted map will look like, nor does it need to be ‘pretty’. The hard copy diagram is designed for reports, documentation, and analysis. It can be generated as a report from the graphic display or produced in a batch environment.

Both presentations use the same coordinate file format. The most important coordinate data, like bus icon and name locations, and line bending points, can be edited graphically from the GUI by moving things around and saving the altered coordinate file. However, you will have to plot out the map in order to see how your changes have affected the hard copy appearance.

The basic diagram shows power system components modeled in a power flow study. The diagram is less detailed than a Powerflow listing, but may have more (or different) information than the graphic display. It shows essential bus and branch solution data. The diagram also shows identification data. For example, it shows date, case identification, program version, and the options used to generate the diagram. The diagram can be enhanced by adding to the coordinate file such items as:

- A legend.
- A border.
- A control block for case identification, signatures, etc.
- A case title heading.
- Selected tie line flows and loss summary.
- An inset showing detail in a selected area.
- Any PostScript language objects.

These items will show up on the map plotted from the GUI, even though many of them cannot be added or edited with GUI. For details on all the hard copy diagram options and capabilities, and the usage of the IPFPLOT and IPFBAT programs, see the *IPF Advanced User's Guide*.

B.2 INPUT REQUIREMENTS, OUTPUT, AND OPERATION

When you load a coordinate file, for example `name.cor`, into the GUI, the program copies the

contents of the file into `name.tmp`. Any changes you make during your interactive session are reflected in the latter file. They will disappear when you exit IPF unless you Save the coordinate file before exiting.

When you select the Print Plot item on the File menu, IPF uses the intersection of the `name.tmp` file and the currently loaded system data to define *which data* will appear on the diagram. It then combines this with the file `pfmaster.post`, which describes *how data* will appear on the diagram. The result is a `name.ps` file, which is sent to a PostScript-capable printer using the Printer Destination string you have selected.

B.3 COORDINATE FILE

The Coordinate file consists of primary coordinate data records and supportive coordinate data records. All coordinates are first quadrant positive Cartesian coordinate values in centimeters. The lower left corner of the diagram is coordinate (0,0). The primary coordinate data records those which specify the bus and branch (bend) locations. These records are:

Bus Record	B
Line Record	L
Transformer Record	T
Area Record	A
Intertie Record	I

The Coordinate file may also include supportive record types to produce a diagram suitable for long term documentation. These records are:

File Identification Record	[ID COORD
Options Record	O
Define Record	>DEFINE_TYPE
Comment Record	C
Draw Record	D
PostScript Record	P
Trailer Record	9 OR (*EOR)

For complete details on all of the coordinate file records, see the *IPF Advanced User's Guide*.

B.3.1 File Identification Record — [ID COORD

The file identification record signifies the beginning of a set of coordinate records. Options are set to their default condition when this record is encountered.

B.3.2 Options Record — O

Options affect the general appearance of a diagram and determine which Powerflow data will be

displayed for each bus and branch on a diagram.

The option values can be set on the Diagram Options menu.

Table B-1 General Appearance Options

Option	Description
Size=XX.XX,YY.YY	DEFAULT = 21.59 by 27.94 cm (8.5 by 11 inches).
ORientation=Landscape ORientation=Portrait	DEFAULT=Portrait.
OOffset=XX.XX,YY.YY	Lower left of diagram relative to lower left of page. DEFAULT = 0.0, 0.0.
TRansparency=Transparent TRansparency=Opaque	DEFAULT for insets is Opaque. Main diagram is always opaque.
SCale_factor=X.XX,Y.YY	DEFAULT = 1.0, 1.0.
BOrder=XX.XX,YY.YY	Locates upper right corner of border. DEFAULT = no border.
BX=XX.UL,YY.UL,XX.LR,YY.LR	Locates an identification box. XX.UL and YY.UL locate the upper left corner of the box. If XX.LR and YY.LR are zero (0), the box is positioned in the lower right corner of the diagram. Default coordinates are established for CR (coordinate file), CAsE_name, and COmments. These locations can be overridden. A standard border is drawn as near the edge of the paper as most PostScript printers will allow. DEFAULT = no identification box.
CAse_name=XX.XX,YY.YY	Locates case name from Powerflow program. DEFAULT = no case name.
COmments=XX.XX,YY.YY	Locates comments from user entry and Powerflow program. DEFAULT = no Powerflow comments.
CR=XX.XX,YY.YY	Locates coordinate file name DEFAULT = relative to BX.
LG=XX.XX,YY.YY	Locates upper left corner of legend box. DEFAULT = no legend.

The options described in Table B-2 determine which Powerflow values will be displayed on a diagram.

Table B-2 Powerflow Values Options

Option	Description
DDiagram_type=Pq_flow DDiagram_type=Mva/I DDiagram_type=Loss DDiagram_type=Interchange DDiagram_type=Coordinates DDiagram_type>Loading %	See flow detail; DEFAULT Maximum values P and/or Q set via P_S, Q_S No flow data % current or % MVA rating
VAlues=Normal VAlues=Difference	DEFAULT case1 - case2
FLOW_detail=P_Sending_end FLOW_detail=Q_Sending_end FLOW_detail=P_Receiving FLOW_detail=Q_Receiving	DEFAULT DEFAULT
BUs_detail=Bus_name,Abbreviation BUs_detail=Bus_name,Powerflow_name (and kV) BUs_detail=Voltage,kV BUs_detail=Voltage,Per Unit BUs_detail=Angle BUs_detail=Generation BUs_detail=Shunt BUs_detail=Load BUs_detail=Total_flow of undrawn branches BUs_detail=Outages	DEFAULT DEFAULT DEFAULT DEFAULT DEFAULT Not yet implemented.
BRanch_detail=Trans_taps BRanch_detail=Compensation BRanch_detail=Parallels,Combined BRanch_detail=Parallels,Separate BRanch_detail=Outages	DEFAULT Not yet implemented.

B.3.3 Bus Coordinate Data

The bus coordinate data describes where and how the Powerflow bus values will be displayed on the diagram. See Table B-3 and Figure B-1 for the format of the bus coordinate data record.

Table B-3 Bus Coordinate Data Format

Column	Format	Description
1	A 1	B — Identifies the Bus coordinate record. This record type is created when you place a bus graphically.
2	I 1	Display flag: 0,Blank - Display the bus symbol. 1 - Do not display the bus symbol, but print the name. This is accessed by the Hide Bus and Show Bus buttons in the Bus Coord Edit menu.
3-10	A 8	Bus name to match Powerflow data. Used for identification.
11-14	F 4.0	Bus kv to match Powerflow data. Used for identification.
15-22	A 8	Name abbreviation to print on diagram. This can be edited from the Bus Coord Edit menu.
23	I 1	Print bus voltage relative to bus name: 1 - over name 2 - right of name 3 - below name - this is the GUI-generated default 4 - left of name 5 - do not print the voltage 6 - print the voltage, but no name
24-35	2F 6.2	X, Y of center of bus symbol. This changes whenever you move a bus in the GUI display.
36-47	2F 6.2	X, Y of the lower left corner of the bus name (if other than default). This changes whenever you move a bus name.
48-50	F 3.0	Angle (in degrees) of generator symbol (0 degrees assigns X > 0, Y = 0 position Angle > 0 moves counter clockwise). An angle of 0 is a flag to not display the generator. GUI-generated default is 150 degrees.
51-53	F 3.0	Angle of reactance symbol. An angle of 0 is a flag to not display the reactor. GUI-generated default is 120 degrees.
54-55	A 2	Bus symbol shape identifier: Blank - round symbol - this is the default from GUI. HB - horizontal bar, length = radius x 2 VB - Vertical bar User may add other symbols corresponding to symbols added in master PostScript file.

Table B-3 Bus Coordinate Data Format (Continued)

Column	Format	Description
56-59	F 4.2	Bus symbol radius in centimeters.

Column	Field	Description
1-2	FLAG	Vertical flag
3-10	BUS NAME	Bus name (8 characters)
11-12	BASE kV	Base voltage in kilovolts
13-20	ABBREVIATION	Abbreviation (8 characters)
21-22	FLAG	Vertical flag
23-28	X-BUS	X-coordinate bus (6 characters)
29-34	Y-BUS	Y-coordinate bus (6 characters)
35-42	X NAME	X-coordinate name (8 characters)
43-50	Y NAME	Y-coordinate name (8 characters)
51-52	ANGLE	Angle
53-54	ANGLE	Angle
55-56	ANGLE	Angle
57-58	ANGLE	Angle
59-60	ANGLE	Angle
61-62	ANGLE	Angle
63-64	ANGLE	Angle
65-66	ANGLE	Angle
67-68	ANGLE	Angle
69-70	ANGLE	Angle
71-72	ANGLE	Angle
73-74	ANGLE	Angle
75-76	ANGLE	Angle
77-78	ANGLE	Angle
79-80	ANGLE	Angle
81-82	ANGLE	Angle
83-84	ANGLE	Angle
85-86	ANGLE	Angle
87-88	ANGLE	Angle
89-90	ANGLE	Angle
91-92	ANGLE	Angle
93-94	ANGLE	Angle
95-96	ANGLE	Angle
97-98	ANGLE	Angle
99-100	ANGLE	Angle

- = Required; blanks or zero are unacceptable
- = Optional; blanks or zeros are acceptable
- = Not Applicable

Figure B-1 Bus Coordinate Data Record

B.3.4 Branch Coordinate Data

The branch coordinate data describes the bending points in a branch and identifies which segment will show the flow and transformer symbol or compensation symbol. See Table B-4 and Figure B-2 for the format of the branch coordinate data record.

Column 27 requires additional explanation. Several alternative routes may be established for printing parallel circuits separately. The most preferred path is 1, next 2, etc. When the option to display parallel circuits separately is on and there are as many or more routings as circuits, the circuits are shown separately.

Table B-4 Branch Coordinate Data Format

Column	Format	Description
1	A 1	L or T identifies a Line or Transformer. This record type is generated when you place a bending point in a line or transformer.
2		Not used.
3-10	A 8	Bus1 name.
11-14	F 4.0	Bus1 kV.
15-22	A 8	Bus2 name.
23-26	F 4.0	Bus2 kV.
27	I 1	Circuit number for routing parallel circuits separately. Not available from GUI.
28		Not used.
29-30	I 2	Segment for annotation with flow. A negative number means do not show arrow and flow. Not available from GUI.
31-42	2F 6.2	X, Y coordinates for 1st bending point.
43-54	2F 6.2	X, Y coordinates for 2nd bending point.
55-66	2F 6.2	X, Y coordinates for 3rd bending point.
67-78	2F 6.2	X, Y coordinates for 4th bending point.
79-90	2F 6.2	X, Y coordinates for 5th bending point.

ampersand (&). This comment instructs the program to read additional coordinate data from the file `aberdeeninset.cor`. Blocks of text such as `LOSSES` on the bus/branch diagram and `INTERTIE SCHEDULED ACTUAL` on the area interchange diagram are the product of `>DEFINE` and `C` records in the coordinate file. The `LG` (LeGend) option selects and locates the legend shown on the bus/branch diagram.

In example 2, an IPS-like three line title appears above the map. The first line is composed of the case name, description, date, and program version. The other two lines were entered as headers in the PF ID/Description menu (corresponds to command `/HEADER` in BPF).

B.4.2 Primary Diagram Components

The bus symbol group and values consists of the following:

- Bus symbol — Circle, bar, etc.
- Identification — Powerflow name and kV or abbreviation.
- Voltage and angle — Printed above, below, or to the left or right of identification.
- Bus load — Printed above, below, or to the left or right of voltage and angle.
- Total flow on branches to buses not shown on diagram — printed above, below, or to the left or right of load.
- Generator symbol — Circle connected to bus with a short line segment.
Power generation in MW is printed above the line and reactive generation is printed below the line.
- Shunt Reactive — Capacitor or inductor symbol connected to a bus with a short line segment.
Maximum reactance available at the bus is printed above the line, and actual reactance used is printed below the line.

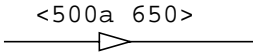
The branch symbol group and values consist of the following:

- Line segment symbol — Voltage-coded line segment representing a line or transformer connection between buses.
- Arrow symbol — Indicates direction of real power flow through the branch.
- Overload indicator — Flags circuits that are approaching an overload condition.
Branches that are approaching a nominal, thermal, bottleneck, or emergency loading are flagged with an N, T, B, or E under the arrow. The actual current or Mva flow in the line or transformer is before the numeric flag and the rating follows the flag.
- Branch flow— Real and reactive power (MW and Mvar).

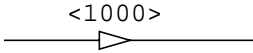
Branch flow is shown above the arrow. Real and reactive sending and receiving end flows are differentiated as follows. MW values are simply shown as numbers. Mvar values are shown within parentheses. Receiving end values are shown within square brackets. Negative values indicate a flow opposite the arrow direction.

- Branch flow — MVA and current.

An alternative to showing MW and Mvar is to show MVA for transformers and current for lines. The value shown is the maximum for any section of the circuit. If the maximum is at a point other than the sending end, an \mathbb{R} is appended to the flow. If a circuit is composed of both line sections and transformer sections, the maximum current for the line section and maximum MVA for the transformer section will be shown. The receiving or sending/receiving end flag is eliminated.

Example: 

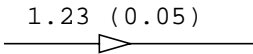
This example indicates 500 amps in a line section and 650 MVA in a transformer.

Example: 

This example indicates a flow of 1000 amps in the line.

- Branch flow — Real and reactive power loss.

Real and reactive losses in MW and Mvar are shown above the arrow.

Example: 

This example indicates a loss of 1.23 MW and 0.05 Mvar in the branch.

- Parallel circuits — Show number of parallel circuits represented by branch (default).
 The number of parallel circuits carrying the flow on the diagram is shown in brackets below the line.
- Parallel circuits — Show flow on each circuit represented (option).
 The flow on each of the parallel circuits can be shown separately.
- Transformer symbol (shown at tip of arrow).

- Transformer taps (shown below transformer).
- Series compensation symbol (shown at tip of arrow).
- Series compensation value — Percent of line compensation shown below capacitor symbol.

APPENDIX C

CALCULATING LINE IMPEDANCE

C.1 INTRODUCTION

This line impedance subroutine has been extracted from BPA's EMTP (Electromagnetic Transients Program) and modified for computing a balanced pi-equivalent line section.

The line impedance calculation feature is invoked from the branch data dialog. See Table C-1 and . It calculates the pi-equivalent quantities from the conductor type, conductor bundling, and tower geometry. The following applies to all calculations:

- There is continuous transposition of phases.
- Resistivity is calculated at 25 degrees Celsius.
- Earth resistivity is constant at 100 ohm-meters.

The Line Impedance dialog box consists of three panels for data.

- Conductor Values. This is the scrollable list of conductor data, which is usually imported from a line constants data file.
- Edit Conductor. This is the only means to edit data.
- Calculate Impedance. This output panel displays the pi-equivalent data.

Line Impedance Calculation Dialog Box

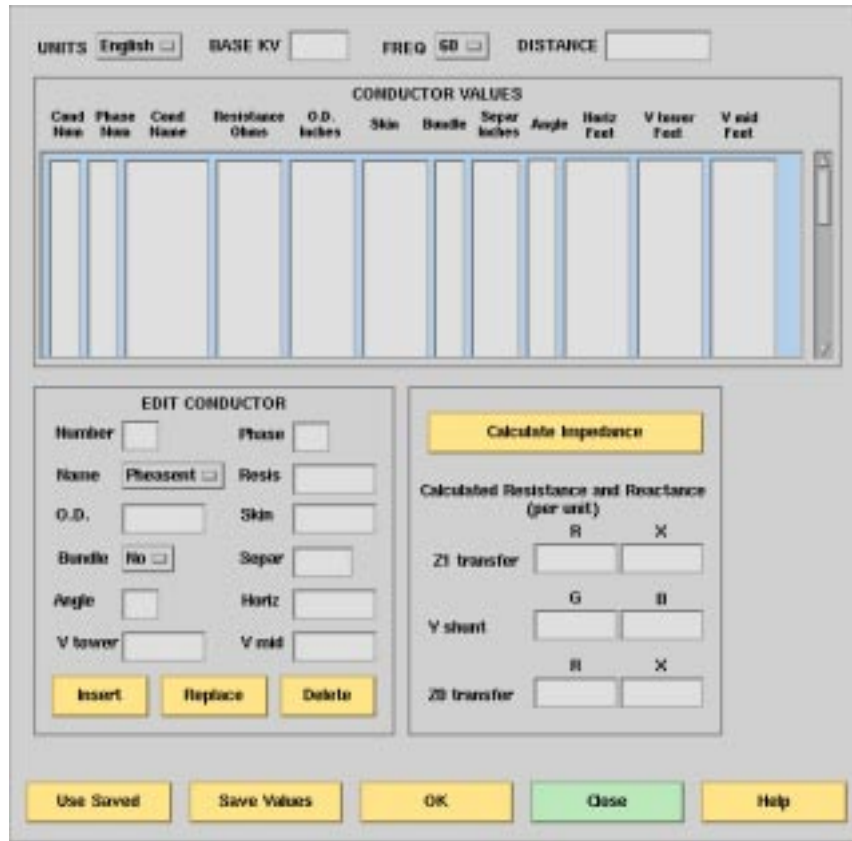


Table C-1 Line Impedance Values For BPA Transmission System

Typical KV installation	Conductor Name	O.D. (in)	SKIN	R _{d-c} (ohms)	Bundle
115	Pheasant	1.382	0.333	0.0722	no
115	Bittern	1.345	0.345	0.0738	no
115	Mallard	1.140	0.286	0.1183	no
115	Drake	1.108	0.316	0.1180	no
115	Dove	0.927	0.333	0.1687	no
115	Ibis	0.783	0.316	0.2363	no
230	Chukar	1.602	0.364	0.0516	no

Table C-1 Line Impedance Values For BPA Transmission System (Continued)

Typical KV installation	Conductor Name	O.D. (in)	SKIN	R _{d-c} (ohms)	Bundle
500 (d-c)	Thrasher	1.802	0.387	0.397	2-Thrasher
500	Chukar	1.602	0.364	0.0516	3-Chukar 2-Chukar
500	Seahawk (trapezoidal stranding)	1.603	0.4138	0.0497	3-Seahawk
500	Bunting	1.302	0.375	0.0787	3-Bunting

C.2 DESCRIPTION OF CONDUCTOR DATA FIELDS

Each physical conductor is characterized by a number of items that you need to specify. The following list describes these items:

- UNITS** Allows you to specify either metric or English units.
- BASEKV** The base value for the voltage in kV.
- BASE MVA** The base value for the power in MVA. (Default is 100.0.)
- NAME** Common conductor bird names are hard-coded. In Edit mode, selecting a name from the button menu automatically transfers O. D. (outside diameter), SKIN, and RESIS data to the pertinent field. If any of these fields are modified, the conductor name becomes "other."
- IPHASE** The phase number (an integer) to which this conductor belongs. Specify as zero for a ground wire (ground is phase number zero by definition). If more than one conductor is specified with the same phase number, this means that those conductors are to be bundled (electrically connected in parallel). Use numbers 1, 2, etc., without any missing (unused) entries, when you number the phases. In general, 1, 2, 3 pertain to circuit1, phases a, b, c, respectively; 4, 5, 6 pertain to circuit2, phases A, B, C, respectively.
- SKIN** A field that is specified with the ratio T/D , where:
- T is the thickness of the tubular conductor.
 - D is the outside diameter of the tubular conductor.

For a solid conductor, use 0.5.

RESIS The dc resistance of the conductor in ohms/kilometer if metric or ohms/mile if English.

DIAM Outside diameter of the a tubular conductor in centimeters if metric or inches if English.

HORIZ Horizontal separation of the center of the conductor from some reference line in meters if metric or feet if English.

The location of the horizontal reference line is arbitrary. Distances to the right of the center line are positive, while those to the left are negative.

VTOWER Vertical height of the conductor above the ground at the tower in meters if metric or feet if English.

VMID Vertical height of the conductor above the ground at mid-span (midway between two towers) in meters if metric or feet if English.

Note: The average height of the line is calculated by the following equation if both the **VTOWER** and **VMID** fields are specified non-zero.

$$VMID + \left[\frac{VTOWER - VMID}{3} \right] = \frac{2}{3} \times VMID + \frac{1}{3} \times VTOWER$$

If either data field is left blank, the blank field defaults to the other field. In effect, the user specifies the average height.

SEPAR ALPHA Leave this blank unless the automatic bundling option is desired.

FREQ The frequency, f , of the line impedance calculation in units of Hertz.

DIST The length of the transmission line under consideration in kilometers if metric or miles if English.

NBUND Leave this blank unless the following automatic bundling option is desired.

AUTOMATIC BUNDLING OPTION

Rather than specifying each conductor of a bundle individually, there is an automatic bundling option that allows a single conductor data to suffice for specifying the entire bundle. This can be used for a “regular” bundle, where by

definition all component conductors are identical, and such conductors are also assumed to be uniformly spaced around the circumference of a circle.

Automatic bundling uses the data fields `SEPAR`, `ALPHA`, and `NBUND`, which are otherwise left blank. The “conductor” data then becomes “bundle” data according to the following specifications:

- SEPAR** The separation between adjacent conductors in the bundle in centimeters if metric or inches if English.
- ALPHA** The angular position of the first conductor (or any conductor) of the bundle in units of degrees. Positive angles are measured counter-clockwise as shown in Figure C-1.
- NBUND** The number of conductors that make up the bundle. Or, if you specify by name, `separ`, and `alpha`, `nbund` will be supplied by the program. (For names, see Table C-1 under Bundle at the 500 kV lines.)

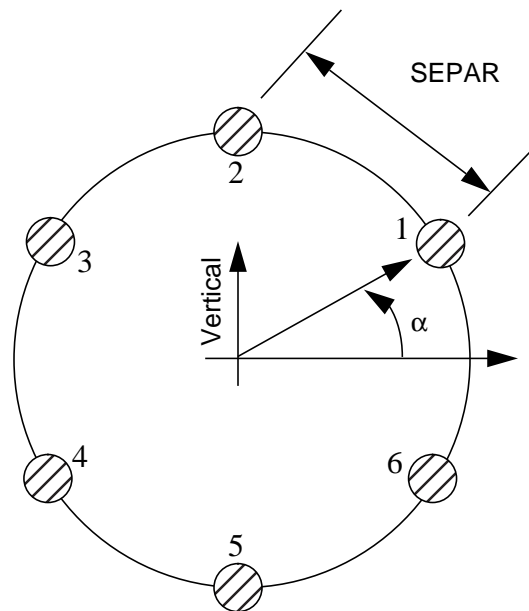


Figure C-1 A Six Bundle Conductor

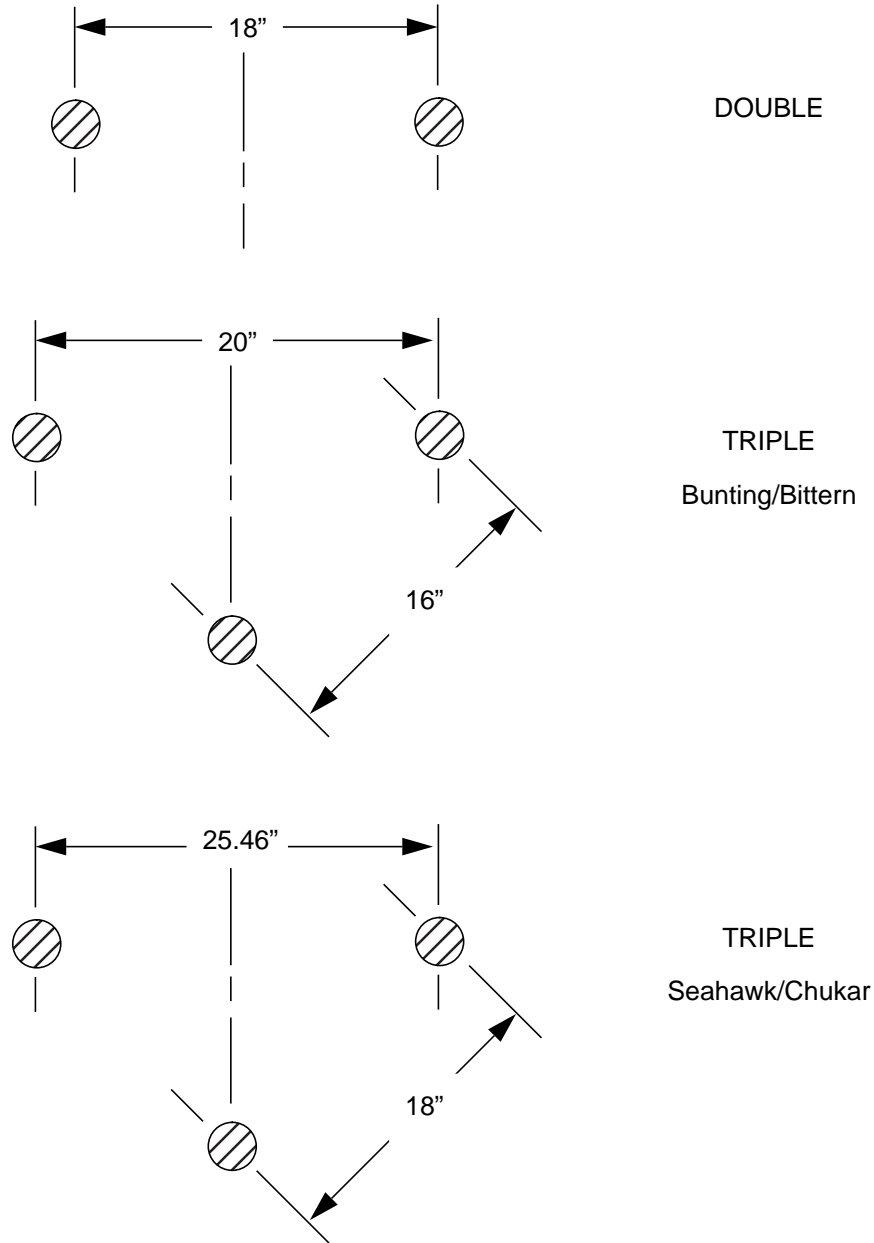


Figure C-2 BPA Conductor Bundles

C.3 OUTPUT VALUES

Considerable data is required to compute the pi-equivalent for a single segment. The line impedance dialog is most effective when importing files containing line impedance data.

A typical file contains ASCII data in free-field format. The file types are .lcd for "line conductor data." The following is an example.

```
/GET_DATA, TYPE = LINE_IMPEDANCE_CALCULATION
UNITS = < ENGLISH | METRIC >, DISTANCE = < miles | km >
BASEKV = <basekv>, BASEMVA = <basemva>, FREQUENCY = <freq>
CONDUCTOR = 1 .3636 .05215 1.602 -20.75 50. 50. 0.0 0.0 0
CONDUCTOR = 1 .3636 .05215 1.602 -19.25 50. 50. 0.0 0.0 0
CONDUCTOR = 2 .3636 .05215 1.602 -0.75 77.5 77.5 0.0 0.0 0
CONDUCTOR = 2 .3636 .05215 1.602 0.75 77.5 77.5 0.0 0.0 0
CONDUCTOR = 3 .3636 .05215 1.602 19.25 50. 50. 0.0 0.0 0
CONDUCTOR = 3 .3636 .05215 1.602 20.75 50. 50. 0.0 0.0 0
CONDUCTOR = 0 .5 2.61 0.386 -12.9 98.5 98.5 0.0 0.0 0
CONDUCTOR = 0 .5 2.61 0.386 12.9 98.5 98.5 0.0 0.0 0
```

The usual scenario involves the following steps.

1. Import a relevant .lcd file using the Use Saved button.
2. Edit the file to reflect the geometric and physical attributes of the line under consideration.
3. Calculate the pi-equivalent data. Steps 2 and 3 may be iterated as long as necessary to eliminate errors.
4. Export the modified .lcd file using the Save Values button.
5. If the results are acceptable, automatically transfer the positive sequence values back to the line dialog by pressing the OK button. (The zero sequence values are for inspection only.)
6. If the results are not acceptable, press the Close button. No values are transmitted back to the line dialog by a Close action.

C.4 CALCULATING THE IMPEDANCE

After you have supplied all the necessary values for the line impedance calculations, you can click on the Calculate Impedance button in the Line Impedance Calculation dialog box. The program fills in six numbers in per unit values having the following meanings:

- | | |
|---------------|---|
| R/Z1 transfer | Real part of the positive sequence transfer impedance per unit. |
| X/Z1 transfer | Imaginary part of the positive sequence transfer impedance per unit. |
| R/Z1 shunt | Half value of the real part of the positive sequence shunt admittance per unit. |

X/Z1 shunt	Half value of the imaginary part of the positive sequence shunt admittance per unit.
R/Z0 transfer	Real part of the zero sequence transfer impedance per unit.
X/Z0 transfer	Imaginary part of the zero sequence transfer impedance per unit.

APPENDIX D

CONVERSION FROM IPS

D.1 IPS2IPF Program

The IPS2IPF conversion program is designed to ease the burden of converting an IPS data deck into one which can be input to the IPF program with the expectation of getting the same solution results, within normal engineering tolerances. However, the conversion is not 100% automatic. See the IPF-IPS Data Differences section for more detail on the data input and internal modeling differences between the two programs.

Before running IPS2IPF on an IPS data file, you should remove from the file all COPE commands (TITLE, NEW, ATTACH, etc.) The program will handle the standard 'control cards' HDG, BAS, and ZZ. Title records may be retained by putting an HDG in front of them, or by putting a period (.) in column 1 of each. An unlimited number of (.) comments are allowed, but these only annotate the data; they are not printed anywhere in the output.

IPS2IPF performs the following tasks:

1. Renames duplicate buses.

IPS uses a 12-character bus name, which includes the base kV. IPF uses only 8 characters, plus the real value of the base kV. To IPS, SAMPLE 230. and SAMPLE 230 are two different buses; to IPF they are the same bus.

IPS2IPF identifies duplicate names and generates a different name for one of them. It reports any changed names; if you don't like the name it generated, you can change it after the fact.

2. Makes the system swing bus a BS bus, if given its name.
3. Transfers non-zero shunt vars from BE and BQ records to +A records.

In IPS, the shunt vars value entered for a bus which has variable var output is considered to be a fixed component of the total vars. In order to retain this philosophy in IPF, it is necessary to put the shunt on a +A (continuation bus) record. Shunt vars entered on the BE or BQ record are considered by IPF to be continuously variable.

4. Converts non-zero 'steps' on R records to 'taps' (by adding one).

IPS uses the number of steps available between TCUL taps; IPF uses the number of actual taps. If you run the conversion on an already converted file, another one will be added, which is probably not desirable.

5. Converts IPS comments (C in column 1) to IPF comments (. in column 1).

Unlike IPS, which prints the comments in the input data listing, IPF does not print

them at all. But they can remain in the data file itself for information as long as they have a period in column 1 instead of a 'C'.

6. Copies the controlled bus name from each X record to the corresponding BX record, to ensure that the proper bus is being controlled.
7. Copies the voltage limits from a BX record controlling a remote bus, to the remote bus record.
8. Corrects blank section id's in multi-section lines.

Blank is acceptable to IPF as a section identification only on single-section lines. IPS2IPF identifies multi-section lines, and changes blank to '1', '1' to '2', etc. If there are actually 10 sections (IPS limit), then sections '8' and '9' will be combined and labeled '9'.

9. Gives bus ties a small impedance.

IPF does not allow bus ties (0.0 impedance produces a fatal error.) IPS2IPF changes this to $(0.0 + j0.00001)$, the same impedance IPF gives you when you sectionalize a bus and create a "bus tie" between the new bus and the old one. However, you should note that this may cause difficulties in getting a solution. (There are no zero impedance lines in standard WSCC study cases.)

10. IPF has no RF model. Any RF records in your deck will be ignored.

Items which are not handled by IPS2IPF, which you need to look out for, are the following:

11. In IPS, line and bridge current ratings on DC are not processed, but only passed on to the Stability program. IPF actually uses them. You may find that the bridge current rating on the Intermountain DC line is too low.

D.2 IPS - IPF Differences

1. Powerflow Command Differences:

All IPF commands are different from those in IPS. When you are using the GUI, you will not have to worry about any of these, but there are some things you will need to do to your input data deck, such as deleting all the IPS control records and COPE commands (HDG, BAS, TITLE, ATTACH, \$DONE, END, etc.).

2. Terminology:

The IPF Base Case (.bse) file is a binary file equivalent to the IPS History (.HIS) file. However, the Base Case file does not contain any mapping data, and *only one case per file* is permitted.

The IPF Network (.net) file is an ASCII file equivalent to the IPS base case or base data file (.IPS). However, this file must *not* contain any modification records ('M' or 'D' in column 3). Changes go in a different file, which must be loaded separately.

All mapping data is saved (in PostScript format) in a Coordinate file (.cor). Only buses which have a match in the currently loaded system data will be displayed.

3. Case Title:

IPF builds the first line of a three-line IPS style title from the program version, date, and the 10 character Caseid and 20 character Case Description fields. The other two lines come from the two (optional) user-specified HEADER records. All of these are printed on standard BPA output listings, saved on the base case (history) file, and printed on hardcopy maps.

4. Structure:

The IPF Changes file (.chg) contains new and modification records you want to apply in bulk to your base case (e.g. your own local system representation). You will use the GUI to make individual touch-up or particular study changes.

The system slack bus must be specified as a 'BS' bus in the Network file; there is no GUI provision for selecting a slack bus (other than by changing the type of some bus to BS).

5. Data Differences:

IPF system data is very similar to that for IPS, but is *not* identical. If you try to read in a WSCC base case deck as an IPF network file, you can expect numerous data errors and no solution. If you charge ahead, fixing fatal errors as you stumble over them, you will still probably not get the answers to match, because of modeling differences. The data conversion program handles most of these.

D.3 Model and Data Differences

There are two categories of differences between BPA and WSCC power flow models: modeling differences (including BPA extensions) and input data differences.

Modeling Differences

	WSCC's IPS	BPA's IPF
1	The d-c line current rating is used only as a base by IPS. Both line current and bridge current ratings are passed to the Stability program; they are not used as limits in the powerflow solution.	The minimum of the bridge current rating and the line current rating is used as a limit by the d-c system solution.
2	Type RM phase shifters (controlling P_{km} between P_{min} and P_{max}) will bias the phase shift angle towards the original phase shift angle.	Type RM phase shifters (controlling P_{km} between P_{min} and P_{max}) will bias the phase shift angle to zero degrees to minimize circulating real power flow. WSCC bias is available as a solution option on the GUI.
3	A type BG generator may control only bus type BC.	A type BG generator may control bus types BC, B , BQ, BV, and BT.
4	An LTC may control only bus type BT.	An LTC may control bus types BC, B , BQ, BV, and BT.
5	Only one voltage control strategy per bus.	A generator and an LTC may simultaneously control a common bus. If a degree of freedom exists, the LTC will control Q_{km} directly to minimize transformer var flow between terminal buses.
6	Type BX buses will bias the solution towards the original X_{shunt} .	Type BX buses bias the solution to V_{max} . WSCC bias is available as a solution option on the GUI.
7	Infinite default limits are assigned to type BG buses	Default global voltage limits are assigned to all buses, including type BG buses, by base voltage level.
8	The bus shunt reactive on type BQ buses is fixed.	The bus shunt reactive on type BQ buses is continuously adjustable (0 to 100%). To make that quantity fixed, it must be entered on an accompanying +A continuation bus record. The conversion program automates this.
9	Inductance (G-jB) is applied to only one end of a transformer branch.	One half of G-jB is applied to each end of both transformers and balanced pi lines.

	WSSC's IPS	BPA's IPF
10	Model RF phase shifter takes several iterations to get from an initial angle to its final (fixed) phase shift angle.	No such model. Problems in solving phase shifters are handled internally.
11	Phase shifter must have same base kV at both terminals.	Step up phase shifter. Tap2 field is off-nominal tap2.
12	Phase shifter cannot be a section.	Phase shifting transformer can be a section.
13	Bus ties (zero impedance lines) receive special handling in solution and reporting.	No special bus tie model. A 'bus tie' is defined as a very low impedance line (0.0 + j0.00001).
14	Not available.	"+" continuation bus records. Except for constant current load models, these records are used mainly for accounting purposes to differentiate generation, load, and shunt with unique ownerships.
15	Not available.	"I" area intertie records. These records compute net area export on accompanying "A" records.
16	Not available.	"A" area record may be accompanied with "A1", "A2", "A3", and "A4" continuation records to accept a maximum of 50 zones per area.
17	Not available.	Branch records accept extended line current ratings: For types "L" and "E" records, thermal and bottleneck ratings. For types "T" and "TP" records, thermal, bottleneck and emergency ratings.
18	Not available.	Types "BM" and "LM" multi-terminal d-c data.
19	Not available.	Type "RZ" RANI devices.

Input Data Differences

	WSSC's IPS	BPA's IPF
1 *	Base kv field interpreted as A4 for identification purposes. SAMPLE 20.0 and SAMPLE 20 are different buses.	Base kV field interpreted as F4.0. SAMPLE 20.0 and SAMPLE 20 are the same bus.
2 *	The number of steps on R records are interpreted as steps, where STEPS = TAPS - 1	The number of steps on R records are interpreted as number of taps, where TAPS = STEPS + 1
3 *	A parallel branch consisting of sections will accept section numbers in the set [0-9]. (Blank is interpreted as a zero.)	A parallel branch consisting of sections will accept section numbers in the set [1-9]. Zero or blank can be used as a section number only in a single section line (i.e. there are no 'sections' in the line at all.) Zero or blank can also be used on delete, to remove <i>all</i> sections of one circuit .
4 *	Remotely controlled bus for a BX bus is specified on the X record.	Remotely controlled bus for a BX bus is specified on the BX record.
5 *	Voltage limits for a bus remotely controlled by a BX bus are specified on the BC record.	Voltage limits for any bus, no matter how it is controlled, are specified on the controlled bus record.
6	Voltage limits (for reporting over and under voltage buses) are specified on A records	Default voltage limits (for all purposes) are specified by a default array which establishes limits using base KV and zones.
7 *	Branches entered with both R and X equal to zero receive special handling as 'bus ties'.	Zero impedance is not allowed – no bus tie simulation.
8 *	The system slack bus can be designated as a BS type bus, but very often is specified in the SOLVE options instead.	System slack bus <i>must</i> be specified as a BS bus.
9 *	IPS accepts various types of comment records ('CB', 'CL', 'CR') which annotate the data file, and are printed in the (batch) input listing.	IPF uses a "." (period) in column 1 to designate a comment. These annotate only the data file; they are never printed.

* The conversion program will handle this item.

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