GUI Users Guide

PSS®E 34.8.2

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SIEMENS

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Introduction

1.1. Overview

The Siemens PTI Power System Simulator (PSS®E) is a package of programs for studies of power system transmission network and generation performance in both steady-state and dynamic conditions. PSS®E handles power flow, fault analysis (balanced and unbalanced), network equivalent construction, and dynamic simulation. Using PSS®E, the engineer can handle a wide range of investigations for the planning and operation of modern electric power systems.

The *PSS®E Program Operation Manual* is a comprehensive working guide to PSS®E's capabilities. It documents:

- The operation and behavior of the various functional modules available in PSS®E.
- The formats of the various input data files read by PSS®E.
- The output produced by PSS®E's functional modules

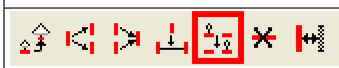
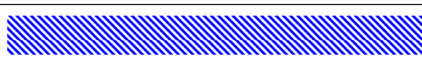
This manual, the *PSS®E GUI Users Guide*, describes the operation of PSS®E through its *Graphical User Interface* (GUI). The GUI is the primary interface to PSS®E; it is also the interface through which new users are first exposed to PSS®E. This manual is structured to help the user become familiar with the available tools and the manner in which they can be used for power system analytical investigations. It liberally references the *PSS®E Program Operation Manual* and other manuals supplied with the PSS®E package (seePSS®E Documentation).

The functions and analyses available through the interface include:

- Power flow and related network functions
- One-line diagrams
- Optimal power flow
- Fault analysis
- Dynamic simulation
- Linear network analysis
- Transmission pricing and open access
- Network equivalencing
- Program automation

1.2. Document Conventions

The following conventions are used in PSS®E manuals:

Examples	Description
Power Flow > Solution > Parameters...	Navigation path in a PSS®E GUI menu
[Solution Parameters] dialog	Interactive dialog in Graphical User Interface (GUI)
[Spreadsheet] *[Diagram]*	Interface windows and views
`SOLV,OPT` **`LIST`**	User entry the line mode in the Command Line Interface (CLI) dialog
[F10], *[Enter]*	Keys found on a standard computer keyboard
[OK], *[...]*, *[Close]*	Action buttons available on a dialog
	GUI toolbar button that starts an activity sequence
Set tap ratios to Unity	Activity option
Print outaged branches	Program option
`GENERATOR CONVERSION COMPLETED`	Message sent to *Progress* tab
`<quantity>`, `<bus number>`	Variable in message sent to *Progress* tab
`ENTER OUTPUT DEVICE CODE:`	Line mode dialog request/response
Progress tab, *Report* tab	Activity results displayed in *[Output]* view
OPEN	PSS®E activity name with hyperlink to source information
Removing Outaged Equipment in a Subsystem, Figure 12-4	Cross-reference with hyperlink to source information
Creating a Power Flow Raw Data File	Short reference with hyperlink to source information
PSS® E Program Operation Manual, Listing Saved Case or Snapshot Files	Full reference with hyperlink to source information
	Indicates report output example clipped to fit the page
PSS® E Program Application Guide	PSS®E manual reference
	Indicates additional information of interest.
	Indicates important information.
n.a.	Abbreviation meaning "not applicable".

1.3. Startup Options

Use one of the following methods to start the program:

- From the Windows® Start menu, select *Programs > PSSE 32 > PSS®E 32*.

  This is the default location as established during program installation. Other applications within suite of tools may also be initiated from the Windows® Start menu.

- From the Windows® Explorer application, double-click the psse32.exe file.

  C:\Program Files\PTI\PSSE32\PSSBIN is the default directory location of psse32.exe. An alternate directory location may be specified during program installation.

- From the Windows® Start menu, select *Programs > PSSE 32 > PSSE-32 Command Prompt* and enter *psse32.exe* (or simply *psse32*) at the DOS prompt, followed by *[Enter]*. See *PSS®E Program Operation Manual* Startup Command Options for arguments that may be used in the startup sequence.

  These arguments may be appended to the psse32.exe path name specified in the Target field of the *[Properties]* window, opened by right-clicking on the PSS®E desktop shortcut icon (see Figure 1.1, "Properties Dialog").

- Start a PSSE-32 Command Prompt and type prog params where:

  prog = name of program (e.g., IPLAN32) that is to be executed.

  params = whatever start-up parameters are appropriate for the program.

- Double-click a previously defined PSS®E shortcut icon located on the desktop.

Do not try to close the copyright window that opens during PSS®E-32 startup.

1.4. Establishing the Working Directory

PSS®E always operates out of a working *directory*. By default, this is the EXAMPLE subdirectory under its main directory. You are not restricted to this directory or, for that matter, to a single working directory. Refer to *PSS®E Program Operation Manual*, Directories and Files Overview.

A simple way to administer a variety of working directories is to create a shortcut icon for each one. Alter the properties of the shortcut to indicate the directory in which the program is to start. In Figure 1.1, "Properties Dialog" the directory path specified in the *Start in:* field may be set to an alternate location.

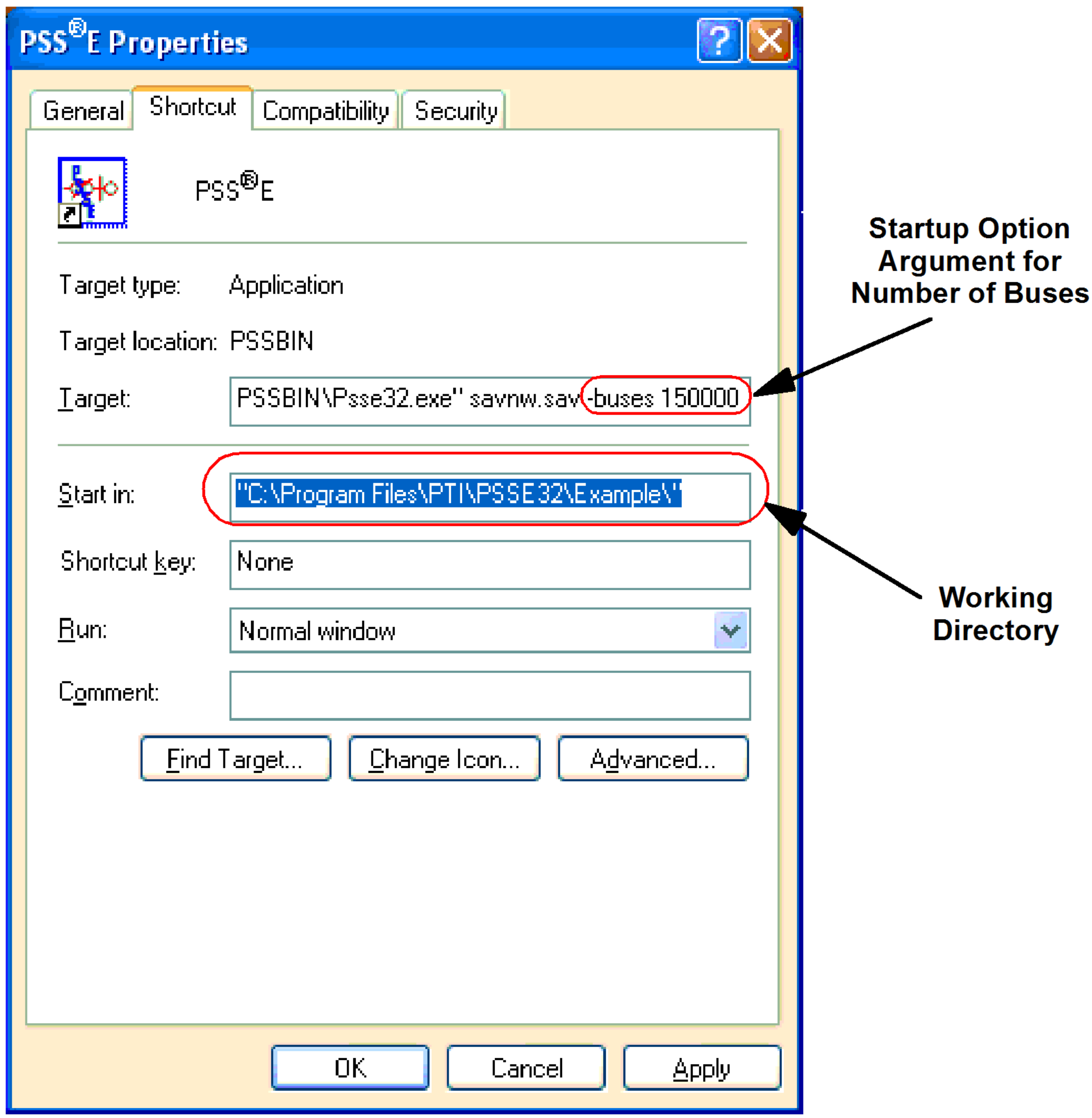


Figure 1.1. Properties Dialog

1.5. Changing Program Preferences

Edit > Preferences...

The *[Program Preferences]* dialog allows the specification of options when either *[Spreadsheet]* or *[Diagram]* is active.

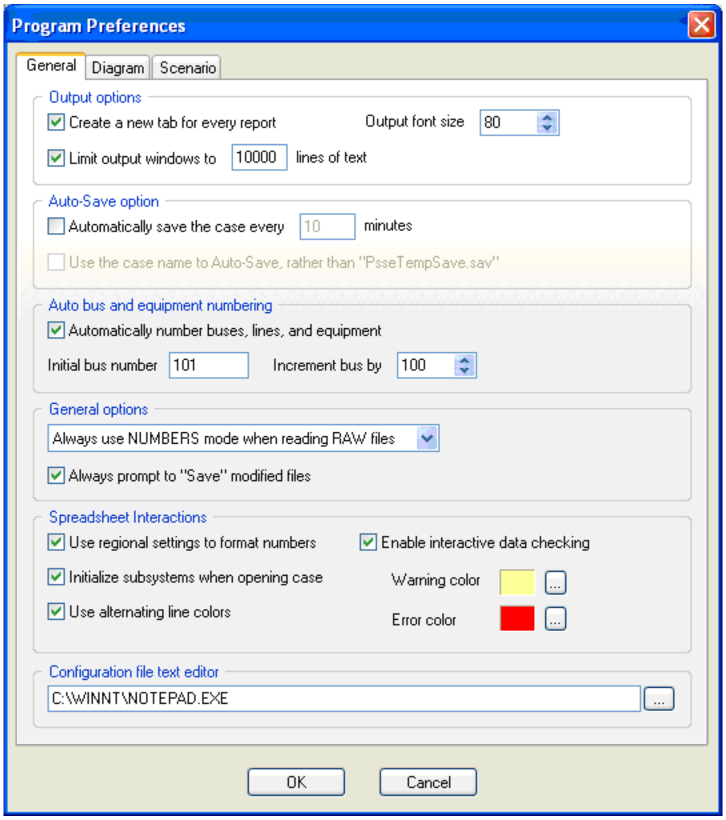


Figure 1.2. Program Preferences Dialog General Tab

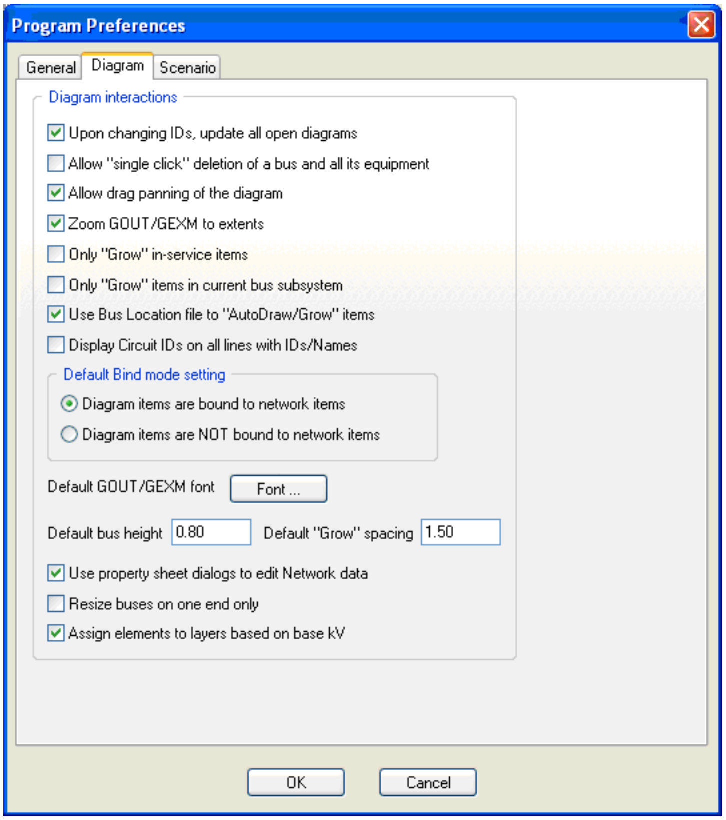


Figure 1.3. Program Preferences Dialog - Diagram Tab

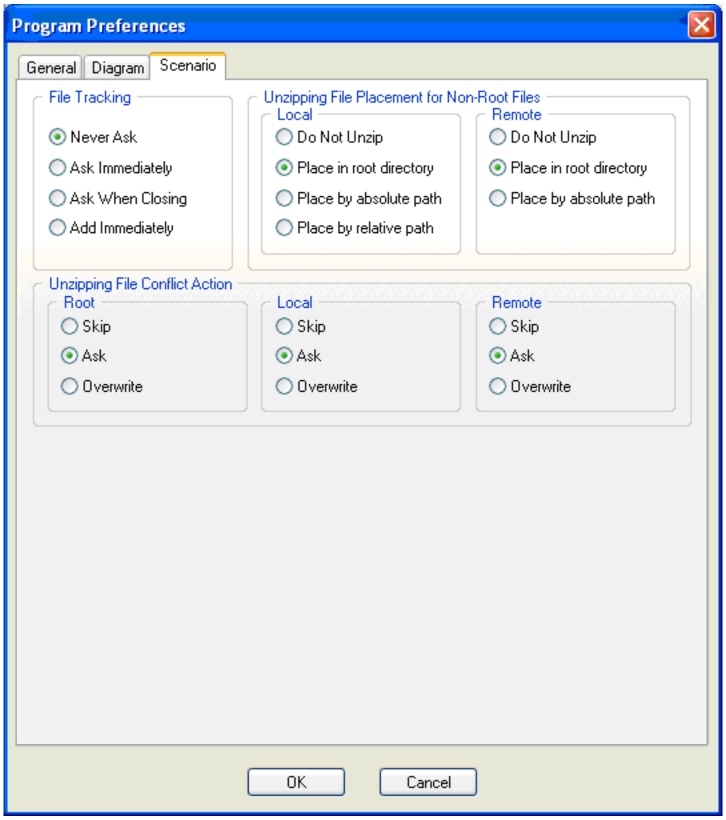


Figure 1.4. Program Preferences Dialog - Scenario Tab

The dialog (Figure 1.2, “Program Preferences Dialog General Tab”, Figure 1.3, “Program Preferences Dialog - Diagram Tab”, Figure 1.4, “Program Preferences Dialog - Scenario Tab”) contains several groups of options, as defined in the following table.

Table 1.1. Description of Program Preferences Options

Preference Type	Enabled Options
Output Options	Create a new tab for every report
	Limit output windows to <number> lines of text
Auto-Save option	Automatically save the case every <number> minutes
	Use the case name to Auto-Save, rather than PsseTempSave.sav
Auto bus and equipment numbering	Automatically number buses, lines, and equipment If you create a new case, this option automatically numbers the buses as they are added, starting with the *Initial bus number* and incrementing subsequent buses as specified.
General options	Bus data format options:

Preference Type	Enabled Options
	• Always use NUMBERS mode when reading RAW files *OR* • Always use NAMES mode when reading RAW files *OR* • Always prompt me when reading RAW files The option for manual specification of bus names or bus numbers whenever a Power Flow Raw Data File is read into the working case opens the *[Read Power Flow Raw Data]* dialog, where the For input, use bus names option may be selected when specifying the PSS®E version number that created the RAW file.
	Always prompt to save modified files
Spreadsheet interactions	Use regional settings to format numbers Initialize subsystems when opening case Use alternating line colors Enable interactive data checking Warning color Error color
Configuration file text editor	Open the directory of executable files (*.exe) to select a text editor that can be launched wherever an input configuration text file is specified. If a text file editor is specified, all the *[Edit...]* buttons used to edit configuration files in the various dialogs will be enabled.
Diagram interactions	*Upon changing IDs, update all open diagrams* Changing an ID in *[Spreadsheet]* automatically changes an ID in *[Diagram]*.
	Allow single-click deletion of a bus and all its equipment A specified bus on a diagram is deleted, along with all its equipment, either by using the *[Delete]* key or selecting *Delete* from the right-click menu.
	Allow drag panning of the diagram The mouse pointer turns to Pan mode when the left mouse button is clicked on the diagram, held down, and dragged. If disabled, a selection box is formed around that portion of the diagram.
	Zoom GOUT/GEXM to extents

Preference Type	Enabled Options
	A bus that is displayed in the diagram using the GOUT/GEXM activity will fill the entire *[Diagram]* area.
	Only Grow in-service items Only those items currently in-service will be drawn during a Grow operation.
	Only Grow items in current bus subsystem Only those items in the current bus subsystem will be drawn during a Grow operation.
	Use Bus Location file to Grow items If a Bus Location file has been opened, any Grow or Auto-Draw operations will use the Bus Location file when placing buses on the diagram.
	Display Circuit IDs on all lines with IDs/Names Circuit IDs are displayed for every line in *[Diagram]* that is bound to a line in *[Spreadsheet]*.
	Allow Grow from GOUT/GEXM A diagram generated from GOUT/GEXM can run the *Grow* operation. This method is not the same as the auto draw grow method. When the user specifies the *Grow* operation for a bus, all lines connected to it and all buses connected to those lines are drawn. In other words, *Grow* in GOUT redraws the specified bus.
Diagram interactions	*Default Bind mode setting* • Diagram items are bound to network items OR • Diagram items are NOT bound to network items When creating a one-line diagram, the addition of network items into *[Diagram]* also populate *[Spreadsheet]* with data as you build a new network. Otherwise, the new network items display only in *[Diagram]*.
	Default GOUT/GEXM font Select a font for labels created in GOUT/GEXM diagrams.
	Default Bus Height Specify length of the bus, in inches, when either *Auto-Draw* or *Grow* operations are in effect in a one-line diagram.

Preference Type	Enabled Options
	Default Grow Spacing Specify distance between buses, in inches, when either *Auto-Draw* or *Grow* operations are in effect in a one-line diagram.
	Use Dialogs to edit Diagram Items When this option is selected, double-clicking a network item in either *[Diagram]* or *[Network Tree]* will pop up a dialog to use to edit the data, rather than jumping to the appropriate spreadsheet entry.
	Resize buses on one end only When selected in the Diagram view, buses will resize from one end only, not both ends.
	Assign elements to layers based on base kV
	Make diagram element labels unelectable This option serves two purposes: 1. The initial selectability of newly created labels that are related to a diagram element (i.e. busbar, branch) will be based off of this option 2. Toggling this option will apply the chosen selectability to all applicable labels. Leaving the option in the same state it was in when opening the dialog will have no effect. N.B. This option will not apply to labels brought in from a saved diagram, only toggling the option will have an effect on current labels.
File Tracking	Specify when the Scenario prompts for adding new files
Unzipping File Placement for Non-Root Files	Select placement for files outside of the root directory
Unzipping File Conflict Action	Select action to take when a file conflict is detected when unzipping files

1.6. Defining the Program Size

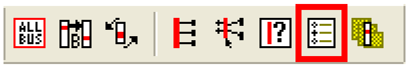
The *PSS®E Program Operation Manual*, Specifying the Maximum Number of Buses describes the dimensional capacities of the various elements at standard size levels. The default bus size level, established during program installation, is defined at startup.

An alternate size level may be specified by selecting *Misc > Change program settings (OPTN)...*, and entering the desired size level in the *Startup bus dimension* field. The new bus size level will take effect *[OK]* is clicked. An alternative is to specify the *-buses <number of buses >* argument (see Figure 1.1, "Properties Dialog").

When opening a Saved Case File, activity CASE automatically redimensions PSS®E if the Saved Case exceeds PSS®E's current capacity limits.

1.7. Changing Program Settings

OPTN



Misc > Change program settings (OPTN)...

Most PSS®E calculation and reporting functions recognize one or more program settings. When PSS®E is installed on the system, default program settings are established; see *[Program Settings]* dialog in Figure 1.5, "Program Settings Dialog". Refer to *PSS®E Program Operation Manual*, Program Run-Time Option Settings.

1.7.1. Extended Bus Names

When the *Bus input* option *Extended Name* is enabled in *[Program Settings]*, extended bus names *must* be specified in data fields designating buses on PSS®E activity dialogs. The extended bus name is formed by concatenating the 12-character bus alphanumeric name and the bus base voltage. The various selectors available by clicking *[Select...]* next to these input fields honor the *Bus input* option setting.

The requirements to specify an extended bus name are:

1. It must be enclosed in single quotes.

2. The twelve-character bus name, including any trailing blanks, must be the first twelve characters.

3. The bus base voltage in kV must immediately follow the bus name. Up to six characters may be used.

Thus, valid forms of an extended bus name include '*aaaaaaaaaaaavvvvvv*' and '*aaaaaaaaaaaavvv*'.

See *PSS®E Program Operation Manual*, Extended Bus Names for details on the use of extended bus names in Power Flow Raw Data Files. Note that the use of extended bus names in these files is governed by an option of the input activity; it is independent of the *Bus input* option setting.

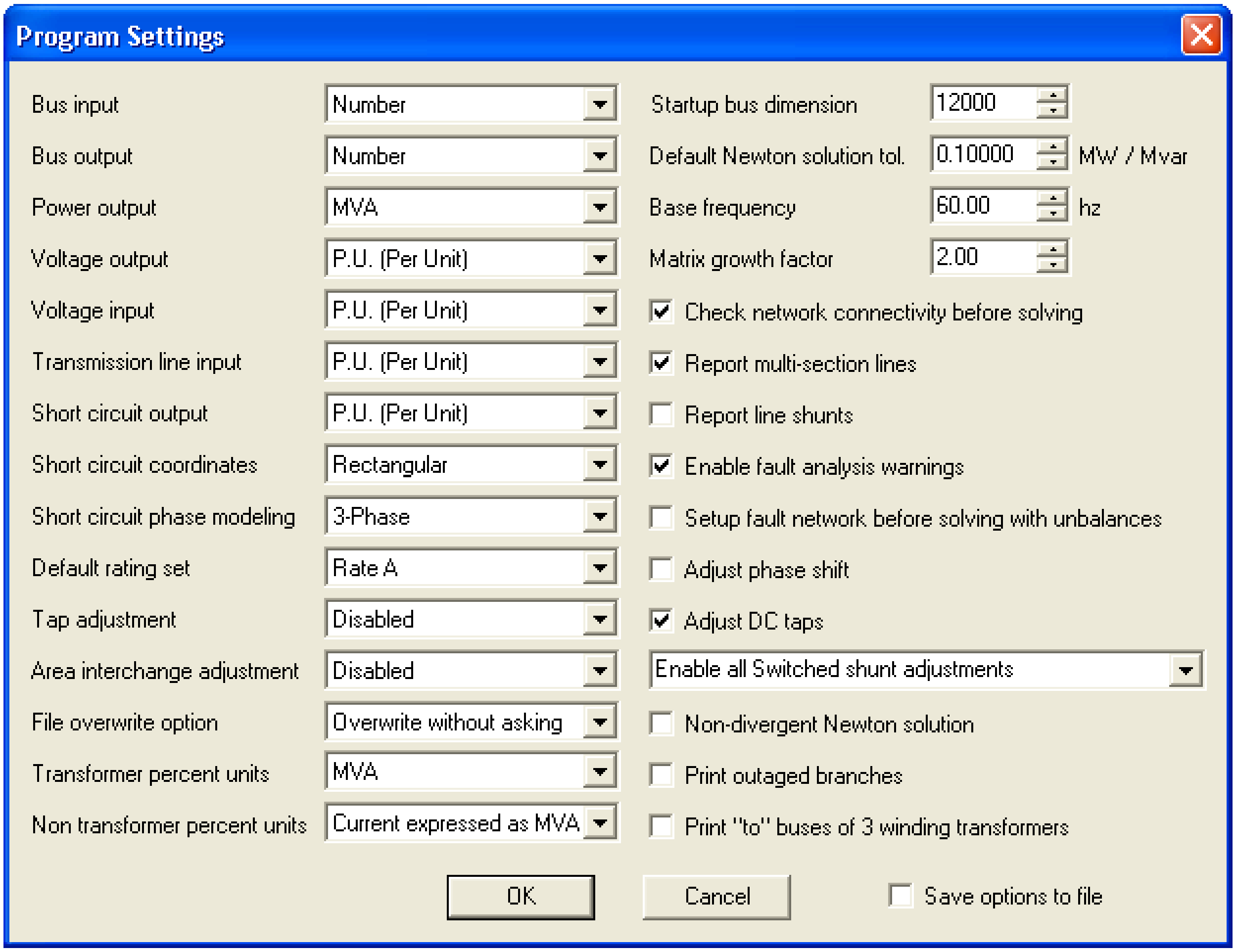


Figure 1.5. Program Settings Dialog

See *PSS®E Program Operation Manual* Changing PSS®E Program Settings for field definitions.

1.8. Displaying and Resetting Timing Statistics

TIME

Misc > Display timing statistics (TIME)

This activity obtains and displays execution time statistics during a work session. It initializes a timer and routes a message to the *Progress* tab. For example:

```
FRI, MAY 21 2004 08:36 - TIMER INITIALIZED
```

On subsequent runs of this activity, a summary of elapsed time, in seconds, since the previous run and cumulative times from the point at which the timers were last initialized are printed. In addition, two additional system statistics are printed, one of which indicates CPU utilization. The output is displayed in the following format:

```
FRI, MAY 21 2004 15:21 ELAPSE USER KERNEL SINCE LAST "TIME" XX.XXX XX.XXX XX.XXX
CUMULATIVE XX.XXX XX.XXX XX.XXX
```

The timing process is not sensitive to any interrupt control code options.

At any time during a work session in PSS®E, if *Misc > Reset timing statistics to zero (TIME,INIT)* is selected, the timers are initialized and the same initialization message is sent to the *Progress* tab.

1.9. File Search Path Rules Manipulation

File > Change File Type Properties...

When opening a file in PSSE if only a file name is given, a search procedure will be used to try to located the file. Refer to File Search path rules in the POM to learn more.

The master paths and macros can be edited though the dialog found in the above GUI selection. See Figure 1.6, "File Data Dialog"

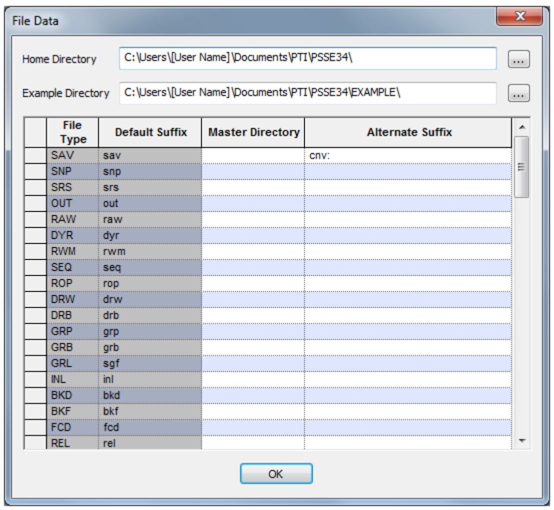


Figure 1.6. File Data Dialog

The first column shows the three letter identification to the file type, usually the is equivalent to the default suffix. The next column shows the default suffix for that file type. The last column, alternate suffix, lists all suffixes that can also be used to identify files of the type listed. The master directory column allows the user to enter in multiple paths that can be used to search for files of the listed type. Each path in the master directory string needs to be separated with a semicolon. If a path contains a semicolon it needs to be quoted.

When hovering over the cells in that column a button will appear. Clicking the button brings up another dialog for editing the entries in the master directories string for the listed type. See Figure 1.7, "Master Directory Dialog"

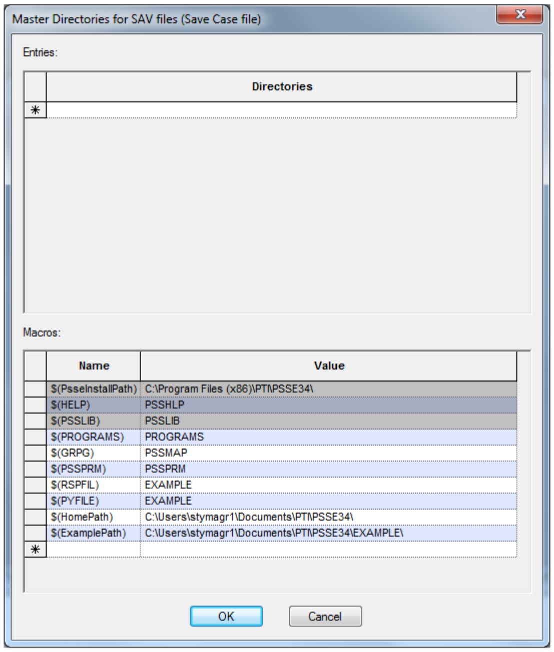


Figure 1.7. Master Directory Dialog

On the upper part of the dialog each entry in the master directory string is listed. Entries can be a path, a macro, or a combination of both.

On the lower part is a list of macros that can be used. Macros can also be made for personal use.

Master directory and macro information will be saved to the registry for preservation.

1.10. The User Interface

The interface provides the following components (see Figure 1.8, “Key Elements of the Interface”):

- *Tree View:* All network items are represented as selectable elements in a hierarchical list. Items in the list are organized by data type and are displayed in expandable/collapsible folders.
- *Spreadsheet View:* Importing a power flow case file or raw data file populates the spreadsheet with network data. Tabs along the bottom of the *[Spreadsheet]* allow specification of the various data categories.
- *Output View:* Progress, alerts/warnings, and report tabs are displayed in this expandable window. Alerts and warnings also appear in red text in the progress stream.
- *Diagram View:* Creates one-line diagrams in Slider format. In addition to showing power flow results, *[Diagram]* facilitates the building of new diagrams and networks bus by bus. For existing power flow cases, this view enables the *growing* of one-line diagrams by automatically drawing specified buses and all their equipment and connected buses. *[Diagram]* view opens only when a diagram is opened or created.
- *Toolbars:* Allows convenient selection of analytical tools, creation of one-line diagrams, generation of reports, specification of subsystems, and view management.
- *Main Menu:* Provides access to file handling, interface views, analytical functions, automation tools, I/O formatting, toolbar organization and online help.
- *Status Bar:* Provides information related to the diagram status and operating mode.
- *Command Line Interface (CLI) Window*: Provides a field for command line input and a pull-down list for reviewing command history. Another pull-down list provides selection of the desired command language.

Each analytical activity is available directly from pull-down menus and user-customizable toolbars. With some exceptions, the functional activities of the old interface exist in the new interface. For convenience, the traditional activity names are shown on many of the menu items.

Figure 1.8. Key Elements of the Interface

All view windows can be individually re-sized and located anywhere on the interface between the *Status* bar and the toolbars. The user can open and close (hide) *[Tree]*, *[Output]*, and *[Command Line]* and the *Status* bar by toggling the *View* menu items. An alternative way to close the view is to right-click within the view and select the *Hide* option. Right-clicking in *[Tree]* or *[Output]* brings up a menu with *Allow Docking* option. Toggling this option ON and OFF allows the corresponding view to float as a window or be docked to the main window. When undocked, the two views can be moved at will and resized. *[Diagram]* and *[Spreadsheet]* cannot be undocked but can be controlled using the standard Windows® controls (i.e., Minimize, Maximize, Move, etc.).

The default view arranges *[Diagram]* and *[Spreadsheet]* views in a stack. Data changes can be made only on the active window, that is, the top view. Click the appropriate button to make the desired view active (see Figure 1.9, “View Activation Buttons”).

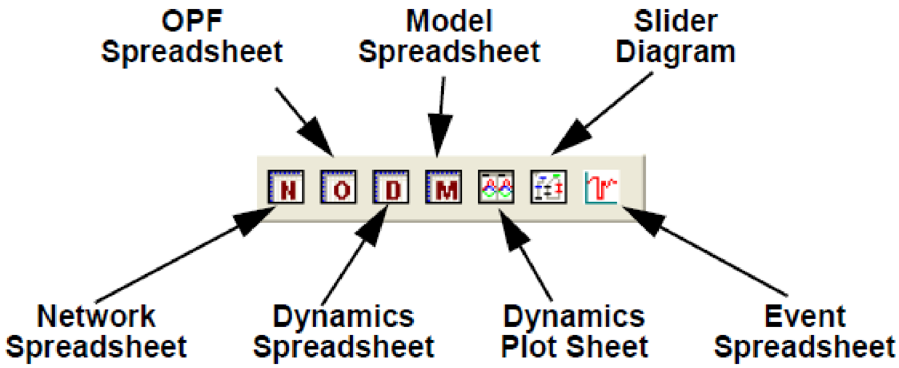


Figure 1.9. View Activation Buttons

For convenience, Appendix A of this manual provide summaries of the toolbar options. A complete description of *[Spreadsheet]* may be found in Chapter 2, *Spreadsheet View*, *[Diagram]* in Chapter 3, *Diagram View*, and *[Tree]* in Chapter 4, *Data Selection Tree View*.

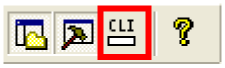
The *Status* bar displays explanatory text while you are using PSS®E. For example, when moving the mouse arrow over a toolbar button the function of that button is displayed in the left portion of the *Status* bar.

[Output] is used to display program information, dialog, errors, and warning messages. It is also used to display analysis output formatted as text reports.

Standard Microsoft Windows® capabilities for selecting and copying text to the clip board or saving it to an external file are supported in both views. This allows for easy transition between PSS®E and external applications such as Microsoft Excel® or Microsoft Word®.

The Copy/Paste functions relate to the type of window involved. Specifically, when you copy or cut from *[Diagram]*, you can only paste back into *[Diagram]*. When working from *[Spreadsheet]*, when you copy a cell or group of cells, you can paste the results into *[Spreadsheet]* or an outside application like Microsoft Excel®. Further, you can copy a piece of your network from a diagram into PSS®E's clipboard, you are allowed to copy a collection of cells from a Spreadsheet view into PSS®E clipboard at the same time; PSS®E will keep track of both copies. Afterwards, when you paste back onto the spreadsheet or an external application like Notepad, the software will know to paste the copied data from the spreadsheet. If you paste on the diagram, the software will paste the copied data from the diagram.

1.10.1. Using the Command Line



View > CLI Window

Many users remain faithful to the origins of PSS®E when the Command Line Interface (CLI) was used for all interactive dialogs with the program. Command line input continues to be available by selecting this menu option. The resulting command line input window supports the use of legacy PSS®E activity names, batch (BAT_) commands, and Python commands (see Figure 1.10, "Command Line Interface Operation").

Line Mode commands entered in the Command Line Interface (CLI) are handled by a Line Mode Interpreter (LMI); Batch Commands are handled by the Batch Command interpreter, and Python Commands are passed to the embedded Python interpreter. When using the Line Mode, prompts are provided that resemble the traditional Line Mode prompts; when an activity is completed the "Activity?" prompt is presented. When an incomplete Batch Command is entered, a prompt of the form API-name: is presented.

To enter batch commands or activity names, select *PSS®E Response* from the pull-down list.

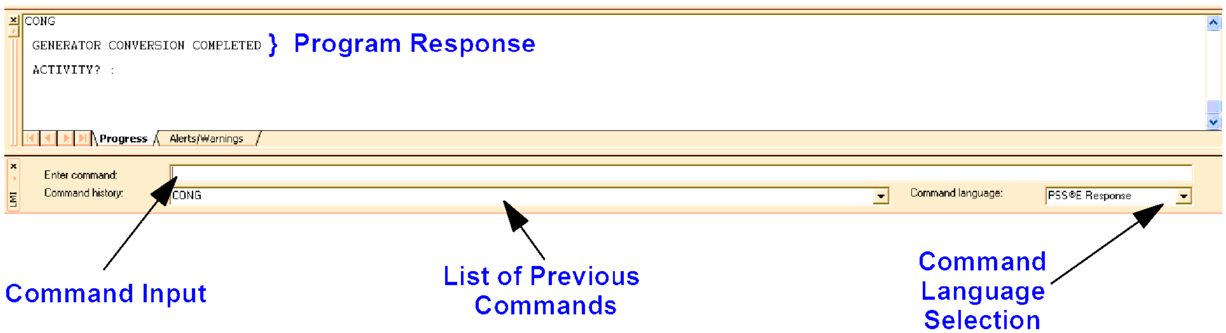


Figure 1.10. Command Line Interface Operation

An interactive session is run by typing in activity names and responding to program responses in the traditional manner. The user input must be in the *Enter command* field. Program responses are seen in the *Progress* tab.

Using the command line input field will lock out access to some aspects of the program until the current command being executed is completed. The lock out aspect depends on the API being invoked.

Re-selecting *View > CLI Window* closes *[Command Line]*. If the *Auto-Save option* has been specified in *[Program Preferences]*, the *Progress* tab displays the time saved and location of the saved case.

The manual *PSS®E Command Line Interface (CLI) Users Guide* describes the operation of PSS®E using its command line interface.

1.11. Creating a Working Case

Selecting *File* > *New* facilitates the creation of a new diagram, a new power flow case, a new diagram and power flow case, or a plot sheet. Figure 1.11, "New and Build New Case Dialogs"a shows the *[New]* dialog.

If a *Network case* option is specified, then the *[Build New Case]* dialog opens for initiation of data input (Figure 1.11, "New and Build New Case Dialogs"b). After the system *Base MVA* is entered and two (optional) *Heading* lines are input, a blank *[Spreadsheet]* view is displayed. A new case can be built entirely in *[Spreadsheet]* or jointly with *[Diagram]* (see Chapter 2, *Spreadsheet View* and Chapter 3, *Diagram View*).

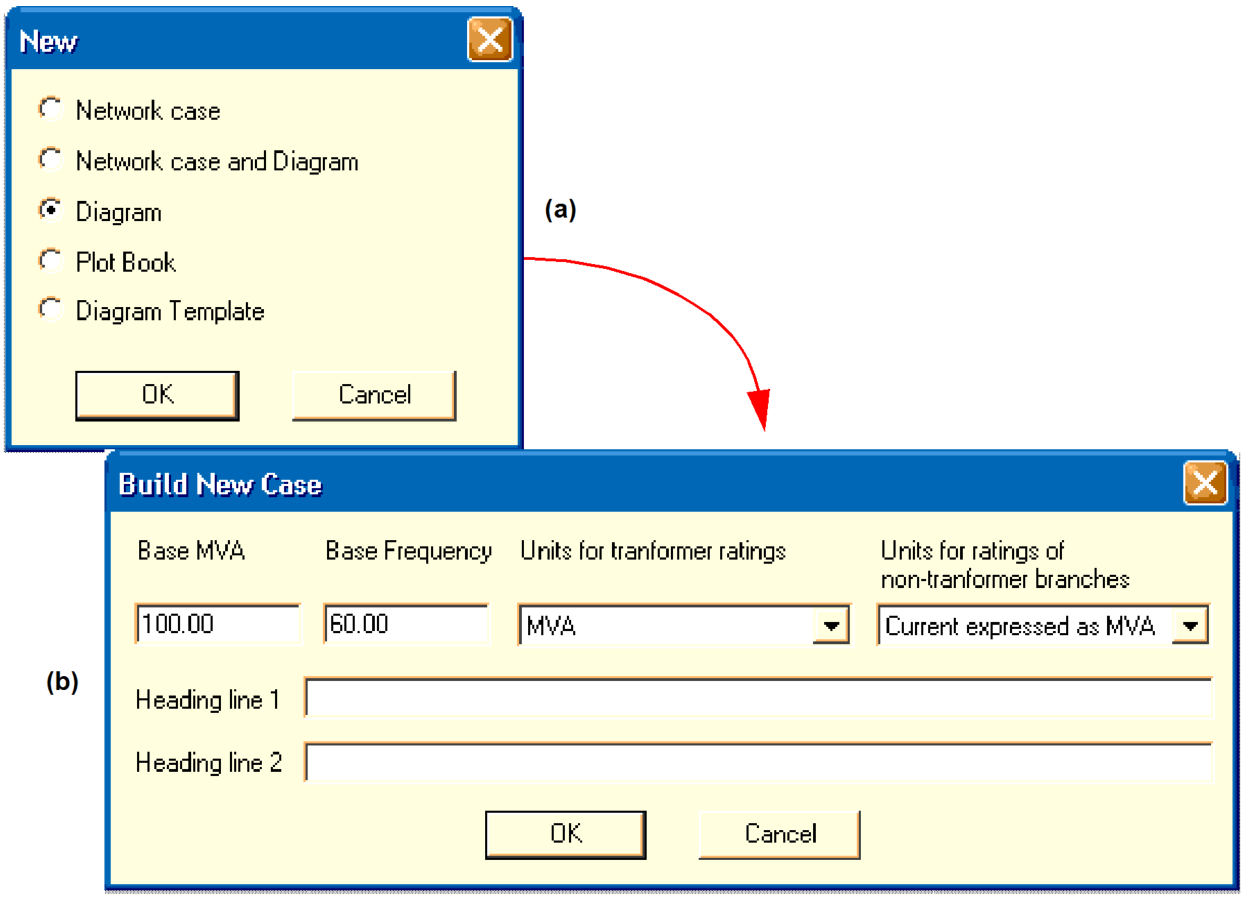


Figure 1.11. New and Build New Case Dialogs

The system stores the heading lines as comments if the case is exported. They are used to document the case.

A new working case can be created merely by typing data elements directly into a blank spreadsheet. This method would typically be limited to only small cases or to establish a small network model into which significantly more data could be pasted into or imported.

1.12. Data Input

The representation of power networks in PSS®E comprises several data categories of network and equipment elements, each of which requires a particular type of data. The data categories and the order in which they are input are described in the *PSS® E Program Operation Manual*, Power Flow Raw Data File Contents. In addition to the basic data set describing the network elements, PSS®E requires other data and control element files for specific applications. Not all the data described in Part 2: PSS®E Activities are needed for all applications, and some data can be defaulted.

The bulk power flow data input facility *File > Open...* imports hand-typed power flow source data from a correctly formatted Power Flow Raw Data File (.raw) and enters it into the power flow working case, rearranging it from its original format into a computationally oriented data structure in the process (see Section 6.3, "Reading Power Flow Raw Data into the Working Case ").

All data is read in free format with data items separated by a comma or one or more blanks. Tabbed delimited data items are not recommended. The *File > Open...* selection may also import binary saved case files (*.sav) containing power flow data as well as solution values and related options (see Section 6.1, "Retrieving a Power Flow Saved Case File").

A list of all data formats available for input into a new case follows. *[Spreadsheet]* cells are populated by each data set automatically, according to PSS®E activity requirements.

Saved Case file (*.sav)	Section 10.1, "Creating a Saved Case File"
Slider Binary file (*.sld)	Section 3.19, "Closing the Diagram View"
Power Flow Raw Data file (*.raw)	Section 10.4, "Creating a Power Flow Raw Data File "
Power Flow Data file, Options (*.raw)	Section 6.4, "Reading or Changing Power Flow Data", Section 6.3.2, "Subsystem Data Input "
Dynamics Snapshot Data file (*.snp)	Section 20.6, "Saving Dynamics Working Memory in a Binary FIle "
Dynamics Model Raw Data file (*.dyr)	Section 20.1, "Reading Dynamics Model Data"
Add Dynamics Model Data (*.dyr)	Section 20.1.1, "Adding Dynamics Data to Existing Dynamics Working Case"
Dynamics Snapshot Raw Data file (*.srs)	Section 20.3, "Restoring Dynamics Working Memory from a Binary Snapshot File Created in PSS®E-26 or Earlier "
Bus Location Data file (*.loc)	Section 3.6.8, "Specifying Bus Locations from a File"
Sequence Data file (*.seq)	Section 10.5, "Creating a Sequence Data File"
Optimal Power Flow Data file (*.rop)	Section 19.7, "Creating an Optimal Power Flow Raw Data File "
Transactions Raw Data file (*.mwm)	Section 10.6, "Creating a Transactions Raw Data File "
Machine Impedance Data file (*.rwm)	Section 10.3, "Saving Machine Impedance Data "
Slider XML file (*.sldxml)	Section 3.19, "Closing the Diagram View"
Ucte Data file (*.uct)	*UCTE Data Exchange Format Application Guide and Manual*
Event Study file (*.evs)	Section 25.1, "Creating an Event Study"
Channel Output file (*.out)	Section 20.4, "Channel Setup"

1.12.1. Resetting Dialog Options

Edit > Reset all dialog options to defaults

During operation of PSS®E, the last used options specified in each dialog are saved. However, the user may want to go back to the default dialog options but does not remember what they are. This function restores all options specified in the dialog boxes to their respective defaults.

1.12.2. Closing the Application

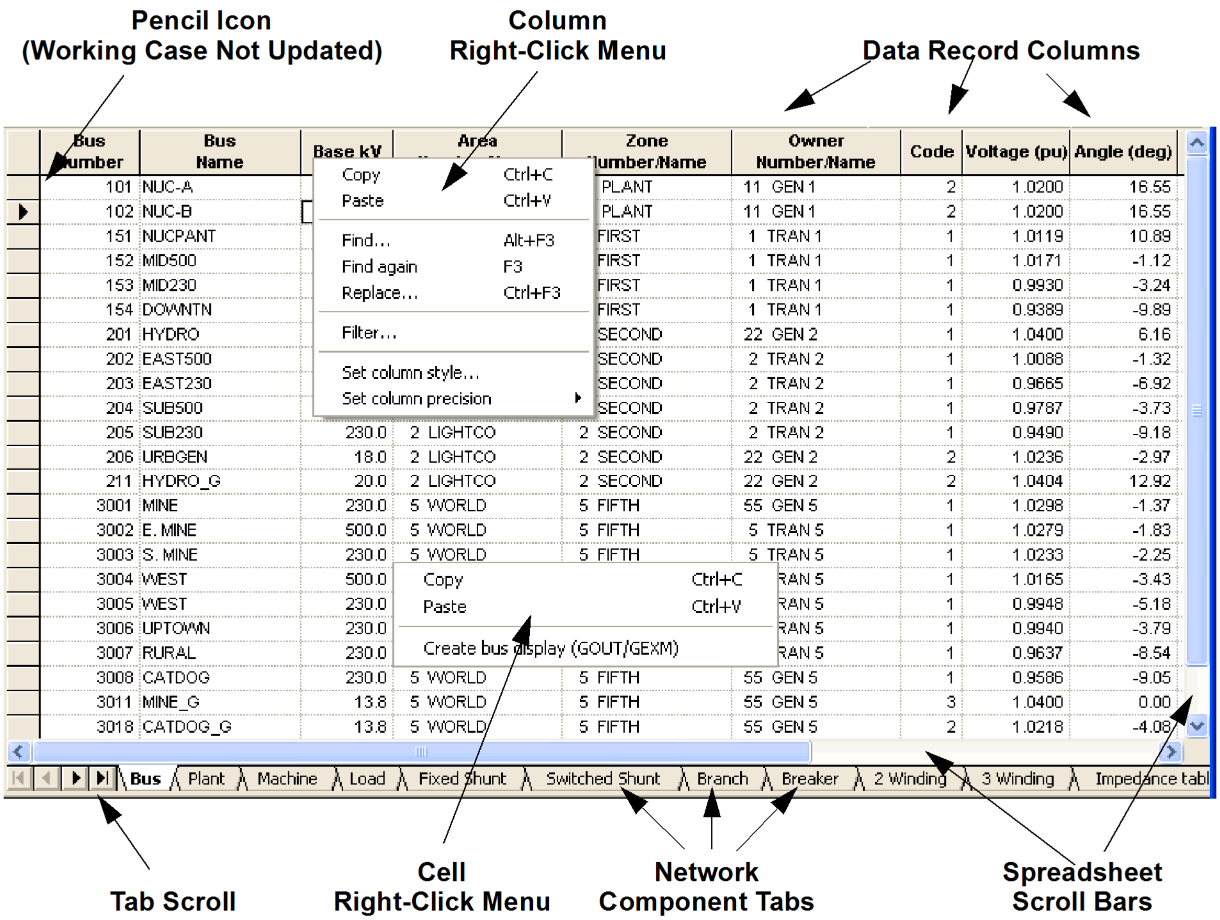
File > Exit

This function closes the application. If the default option *Always prompt to save modified files* is enabled in *[Program Preferences]*, you will see a prompt requiring confirmation to save changes to the working case. If this option is disabled, all files are closed without saving, regardless of their status, modified or un-modified. This setting is preserved between from the current work session to the next.

Chapter 2
Spreadsheet View

2.1. Introduction

All network data components (e.g., buses, lines, loads) are represented on worksheet-style tabs in *[Spreadsheet]* view. At program startup *[Spreadsheet]* is displayed only after a raw data or saved case file is opened.



Spreadsheet View

Spreadsheets are constructed to display data in arrangements that are convenient to review and modify for specific PSS®E activities. Although many of the column headings are abbreviated for easier scanning, the following lists are unabbreviated.

[Network Spreadsheet] is the default view for the interface and remains open once it is populated. Tabs are provided to review and modify data for the following network component types:

Bus	Plant	Machine	Load
Fixed Shunt	Switched Shunt	Branch	Breaker/Switch
2-Winding Transformer	3-Winding Transformer	Impedance Table	FACTS Device
2-Terminal dc Line	VSC dc Line	Multi-terminal dc Line	Area
Inter-area Transfer	Owner	Zone	Multi-section Line
Mutual Coupling			

For more information, refer to Section 2.3, “Network Spreadsheet”.

[OPF Spreadsheet] contains tabs provided to review and modify data in the following data categories:

Bus Voltage Attribute	Bus Voltage Attribute / Subsystem
Adjustable Bus Shunt	Adjustable Bus Shunt / Subsystem
Adjustable Branch Reactance	Adjustable Branch Reactance / Subsystem
Branch Flow	Branch Flow / Subsystem
Adjustable Bus Load	Adjustable Bus Load / Subsystem
Adjustable Load Table	Generator Dispatch
Generator Dispatch / Subsystem	Dispatch Table
Generation Reactive Capability	Generation Reactive Capability / Subsystem
Generation Reserve	Generation Reserve / Subsystem

For more information, refer to Section 2.4, “OPF Spreadsheet”.

[Dynamics Spreadsheet] is used to add, remove, edit and change the status of models attached to network elements, with tabs provided for the following model types:

Machine:	Wind Machine:	2-Terminal dc Line
• Generator	• Generator	VSC dc Line
• Exciter	• Electrical	N-Terminal dc Line
• Governor	• Mechanical	FACTS Device
• Stabilizer	• Pitch	Line Relay
• Minimum Exciter	• Aerodynamic	Switched Shunt
• Maximum Exciter	• Gust	Load - Bus
• Compensating	• Auxiliary Control	Load - Owner
• Turbine Load Controller		Load - Zone
		Load - Area
		Load - All

The data tab contains cells to modify CONs, VARs, ICONs, and Channels. For more information, refer to Section 2.5, “Dynamics Spreadsheet” .

[Event Spreadsheet] provides a summary of faults established for an event study (see Chapter 25, *Event Studies*) and the means to enable/disable or synchronize events for a particular dynamic simulation. For more information, refer to Section 2.7, “Event Spreadsheet”

.

2.2. Editing and Formatting the Spreadsheet

ITo record data changes made in spreadsheet cells, either point to another row or press [Enter]. The pencil symbol disappears.

If a column is grayed out on a spreadsheet tab, the cells cannot be modified from this location. For instance, a bus number can be changed using the Bus tab on the Network Spreadsheet, but it cannot be changed from the Plant, Machine, Load, etc., tabs. Read-only columns can be changed to a different color, if desired (see Set column style option below).

2.2.1. Menu Options

The right-click menu supports standard Windows® commands, such as copy and paste actions. Multiple rows can be selected by holding the *[Shift]* key to include all rows dragged or holding the *[Ctrl]* key to select row-by-row. It is possible to copy and paste data to and from another application, such as Microsoft Excel®.

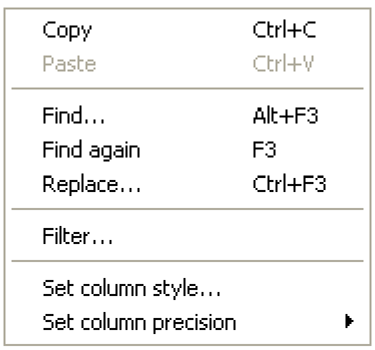


Figure 2.1. Spreadsheet Column Right-Click Menu

Bus numbers and other identifiers are not copied as this would result in duplicate data items in the network. Instead, the next available unused identifier is placed in the field. If the copied area exceeds the number of rows available, PSS®E will automatically create the extra network elements required (and generate appropriate bus numbers).

The column heading right-click menu (Figure 2.1, "Spreadsheet Column Right-Click Menu") provides access to the *[Find]* and *[Replace]* dialogs (also available through the *Edit Menu*).

Sorting and filtering capabilities are provided to increase usability, especially with large systems.

Any data edits performed within a filtered spreadsheet will automatically be reflected in the original unfiltered sheet. This allows the use of a reduced data set on which to perform edits.

Spreadsheet appearance and data entry precision can also be customized using this menu. Highlight the entire column to use these features.

Set column style opens the *[Cells]* dialog (Figure 2.2, “Cells Dialog”), with tabs to change the font, color, and border of the cells in the highlighted column. Set column precision opens an option list that permits data precision up to 6 decimal places.

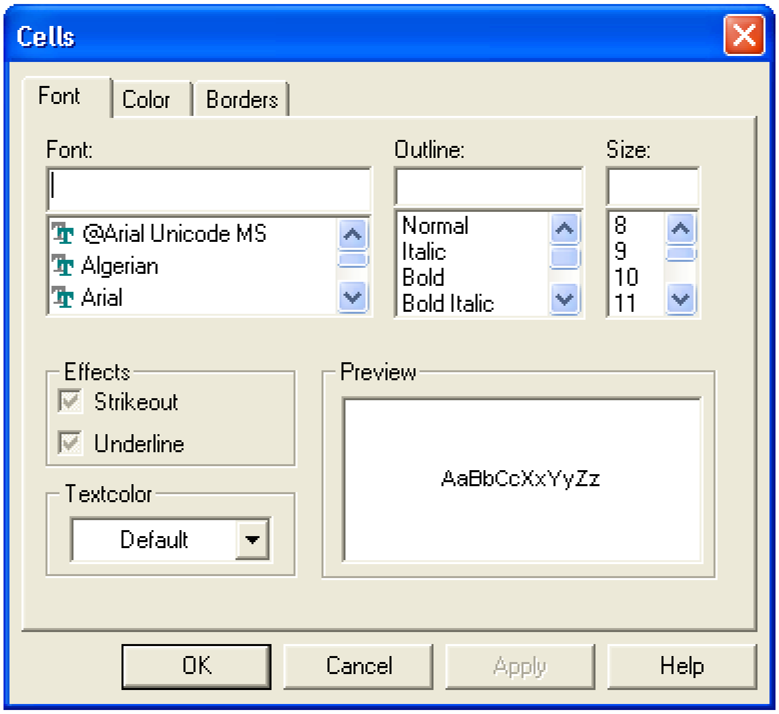


Figure 2.2. Cells Dialog

Color coding as a data visibility option is also available for those columns that are grayed out, that is, not available for edit on a particular worksheet. However, only the appearance of the column changes; the data record can be edited only from the appropriate worksheet (for example, *Bus Number* from the Bus tab; *Pgen* from the Machine tab).

The toolbar options to zoom in/out and return to 100% are active in *[Spreadsheet]*, although magnification about 150% becomes illegible unless the row height is also increased.

The right-click menu for bus data records also contains the option *Create bus display (GOUT/GEXM)*. Refer to Section 3.15, “Creating a Bus Display”.

File Menu options include options to set up printing formats for the spreadsheet data. See Section 2.2.5, “Print Setup” for details.

In order to access *File Menu* options, *[Spreadsheet]* must be the active view. Click in any cell to make it active if the desired option does not appear in the menu.

2.2.2. Managing Columns

For data spreadsheets that contain a large number of columns it may be useful to lock the identification fields in place when scrolling to view the other columns. Highlight the columns and select *Edit > Freeze Columns*. Use *Edit > Unfreeze Columns* to undo the action.

Some data columns may hold data that is of little or no importance to the analysis the user is doing. In order to help the user organize the column so they can be viewed easily,

Columns can be hidden from view if they are not important to the current analysis. Highlight the columns and select *Edit > Hide Columns*. Use *Edit > Unhide Columns* to unhide all columns that were previously hidden.

To rearrange the order of the columns, highlight the column and drag it. While the column is being dragged, a red line indicates where the column will be dropped when the mouse button is released.

To reset *[Spreadsheet]* to the default layout, select *Edit > Reset Active Spreadsheet* or *Edit > Reset All Spreadsheets*, as appropriate.

2.2.3. Header/Footer Setup

File > Spreadsheet Header/Footer Setup...

The *[Header / Footer]* dialog (Figure 2.3, “Spreadsheet Header / Footer Dialog”) provides settings for header and footer spacing, the alignment, page numbering and the style, size and other font characteristics. If the *Save settings to profile* option is enabled, then the saved profile will be activated at the next PSS®E work session.

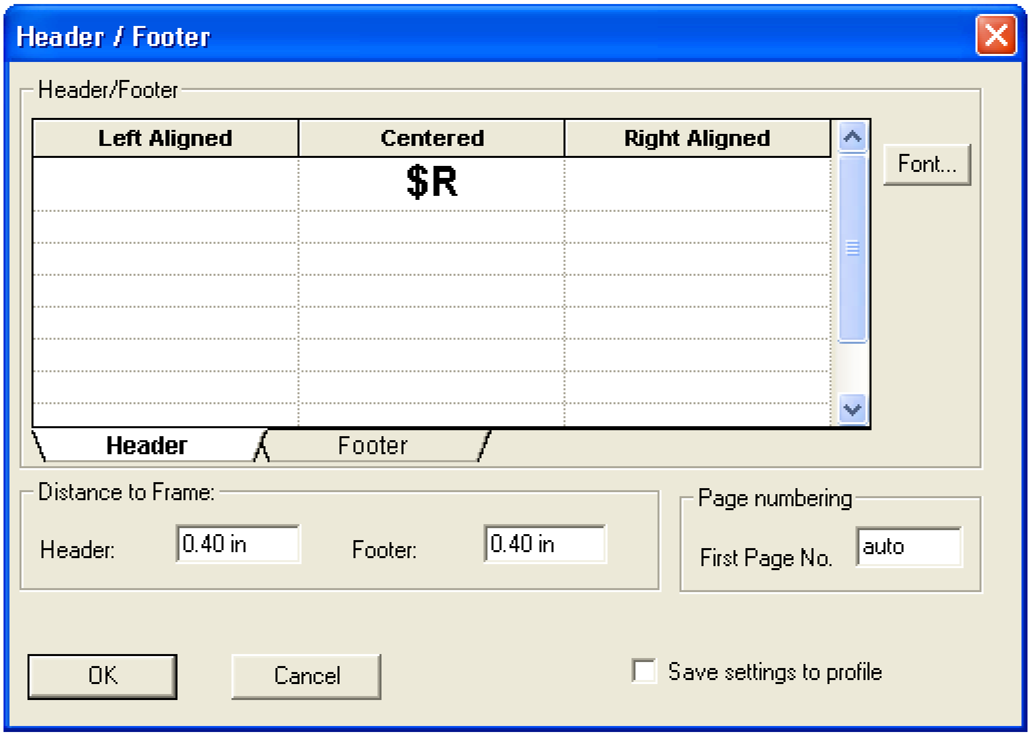


Figure 2.3. Spreadsheet Header / Footer Dialog

2.2.4. Page Setup

File > Spreadsheet Page Setup...

The *[Page Setup]* dialog (Figure 2.4, "Spreadsheet Page Setup Dialog ") provides settings for margins and grid lines. If the *Save settings to profile* option is enabled, then the saved profile will be activated at the next PSS®E work session.

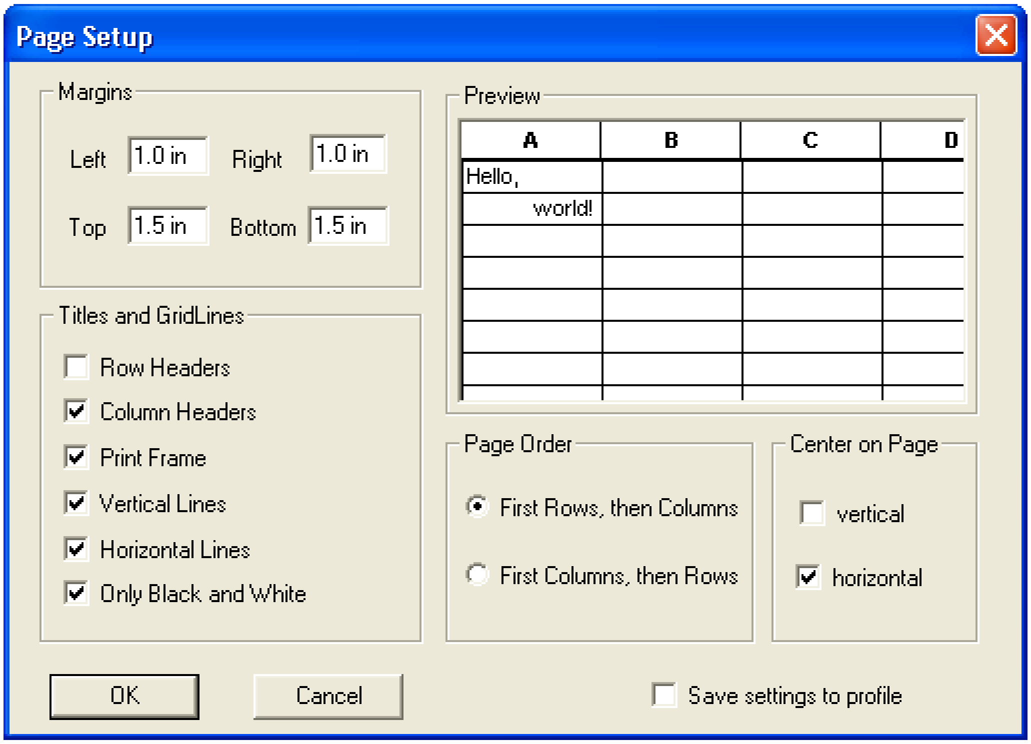


Figure 2.4. Spreadsheet Page Setup Dialog

2.2.5. Print Setup

File > Print Setup...

The *[Print Setup]* dialog (Figure 2.5, “Print Setup Dialog”) is a standard Windows® dialog.

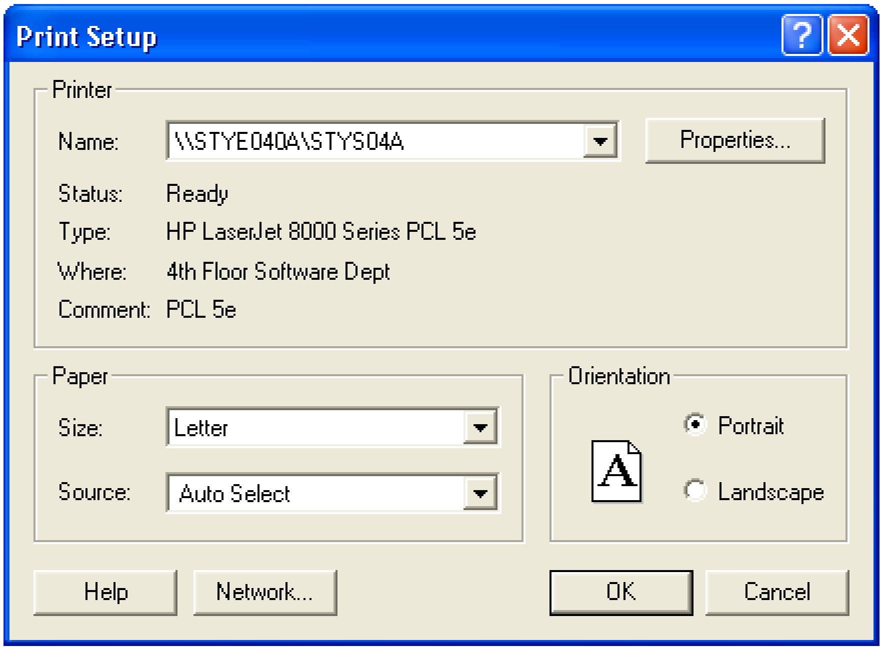


Figure 2.5. Print Setup Dialog

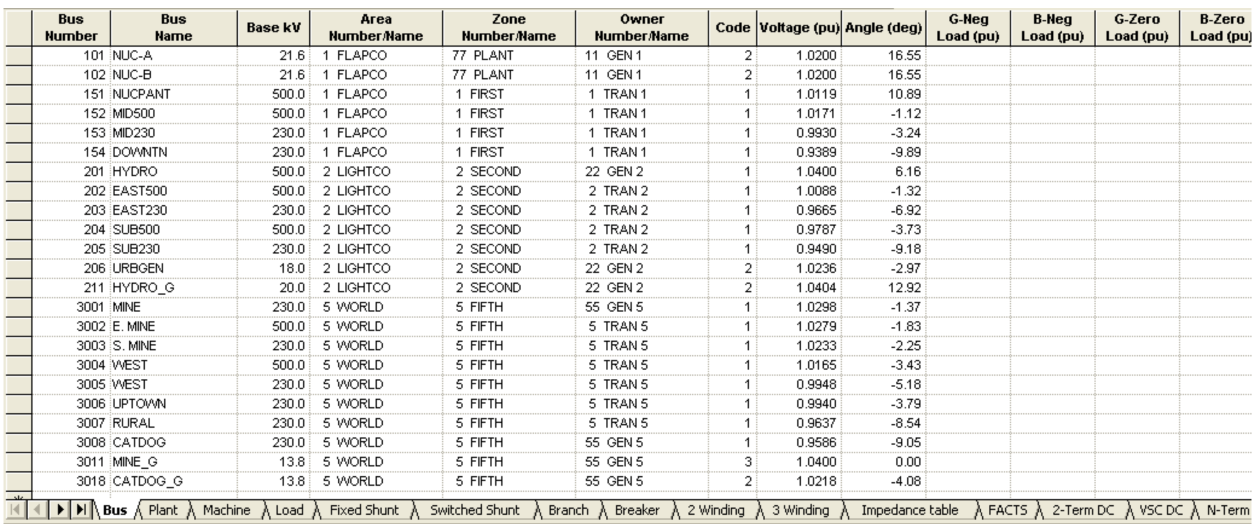
The *File > Print Preview* action provides view options of each page, using the [Next Page] button, and *[Zoom]* options from full page view to 100%. To return to *[Spreadsheet]* without printing, press the keyboard *[Esc]* key.

2.3. Network Spreadsheet

[Network Spreadsheet] is synchronized with the bus subsystem selector (see Figure 2.8, "Bus Subsystem Selector Dialog") so that a subset of the data can be viewed during a work session. It can be minimized, but you cannot close it unless you close the working case.

As shown in Figure 2.6, "Network Spreadsheet View, Bus Tab", the *Bus* tab is the default worksheet; it displays the bus data records in the working case. Data records corresponding to each instance of the following network elements are available on separate tabs for review and modification:

• Bus	• Breaker/Switch	• N-Terminal dc Line
• Plant	• 2-Winding Transformer	• Area
• Machine	• 3-Winding Transformer	• Inter-area Transfer
• Load	• Impedance Table	• Owner
• Fixed Shunt	• FACTS Device	• Zone
• Switched Shunt	• 2-Terminal dc Line	• Multi-section line
• Branch	• VSC dc Line	• Mutual Coupling



Bus Number	Bus Name	Base kV	Area Number/Name	Zone Number/Name	Owner Number/Name	Code	Voltage (pu)	Angle (deg)	G-Neg Load (pu)	B-Neg Load (pu)	G-Zero Load (pu)	B-Zero Load (pu)
101	NUC-A	21.6	1 FLAPCO	77 PLANT	11 GEN 1	2	1.0200	16.55				
102	NUC-B	21.6	1 FLAPCO	77 PLANT	11 GEN 1	2	1.0200	16.55				
151	NUCPANT	500.0	1 FLAPCO	1 FIRST	1 TRAN 1	1	1.0119	10.89				
152	MID500	500.0	1 FLAPCO	1 FIRST	1 TRAN 1	1	1.0171	-1.12				
153	MID230	230.0	1 FLAPCO	1 FIRST	1 TRAN 1	1	0.9930	-3.24				
154	DOWNTN	230.0	1 FLAPCO	1 FIRST	1 TRAN 1	1	0.9389	-9.89				
201	HYDRO	500.0	2 LIGHTCO	2 SECOND	22 GEN 2	1	1.0400	6.16				
202	EAST500	500.0	2 LIGHTCO	2 SECOND	2 TRAN 2	1	1.0088	-1.32				
203	EAST230	230.0	2 LIGHTCO	2 SECOND	2 TRAN 2	1	0.9665	-6.92				
204	SUB500	500.0	2 LIGHTCO	2 SECOND	2 TRAN 2	1	0.9787	-3.73				
205	SUB230	230.0	2 LIGHTCO	2 SECOND	2 TRAN 2	1	0.9490	-9.18				
206	URBGEN	18.0	2 LIGHTCO	2 SECOND	22 GEN 2	2	1.0236	-2.97				
211	HYDRO_G	20.0	2 LIGHTCO	2 SECOND	22 GEN 2	2	1.0404	12.92				
3001	MINE	230.0	5 WORLD	5 FIFTH	55 GEN 5	1	1.0298	-1.37				
3002	E. MINE	500.0	5 WORLD	5 FIFTH	5 TRAN 5	1	1.0279	-1.83				
3003	S. MINE	230.0	5 WORLD	5 FIFTH	5 TRAN 5	1	1.0233	-2.25				
3004	WEST	500.0	5 WORLD	5 FIFTH	5 TRAN 5	1	1.0165	-3.43				
3005	WEST	230.0	5 WORLD	5 FIFTH	5 TRAN 5	1	0.9948	-5.18				
3006	UPTOWN	230.0	5 WORLD	5 FIFTH	5 TRAN 5	1	0.9940	-3.79				
3007	RURAL	230.0	5 WORLD	5 FIFTH	5 TRAN 5	1	0.9637	-8.54				
3008	CATDOG	230.0	5 WORLD	5 FIFTH	55 GEN 5	1	0.9586	-9.05				
3011	MINE_G	13.8	5 WORLD	5 FIFTH	55 GEN 5	3	1.0400	0.00				
3018	CATDOG_G	13.8	5 WORLD	5 FIFTH	55 GEN 5	2	1.0218	-4.08				

Bus | Plant | Machine | Load | Fixed Shunt | Switched Shunt | Branch | Breaker | 2 Winding | 3 Winding | Impedance table | FACTS | 2-Term DC | VSC DC | N-Term

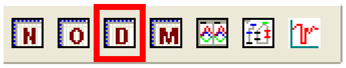
Figure 2.6. Network Spreadsheet View, Bus Tab

Network elements may be added, modified, or deleted in the appropriate worksheet. If a subsystem selector has been activated to reduce the amount of network data presented at any one time, read-only fields are colored light gray to distinguish them from editable fields. See Section 2.3.2, "Creating a Bus Subsystem" and Section 2.3.3, "Using the Subsystem Menu ".

2.3.1. Revising the Working Case

In order to revise the working case using *[Network Spreadsheet]*, it must be the active view. Choose the most convenient way to make it active from among the following options:

- Toolbar selection



- Double-clicking the item to be revised in *[Network Tree]* or *[Diagram]*

Most data fields may be edited directly by clicking in the cell and entering in the desired value. Editable area, owner, and zone cells have *[Area Selection]*, *[Owner Selection]*, and *[Zone Selection]* dialogs available by double-clicking in the cell.

Data fields that contain check boxes (for example, in-service, metered, and auto-adjust options) are considered to be enabled when checked and disabled when unchecked.

Some data cells require specification from a list of valid entries (for example, I/O code for a winding, impedance, or admittance). Clicking in the cell displays a pull-down list from which one value may be specified.

2.3.2. Creating a Bus Subsystem

A bus subsystem can be created directly from the bus data spreadsheet by highlighting the bus data records to be included and selecting the *Create bus subsystem* option from the right-click menu (Figure 2.7, "Creating a Bus Subsystem"a). *[Spreadsheet]* will then show only that bus subsystem (Figure 2.7, "Creating a Bus Subsystem"b).

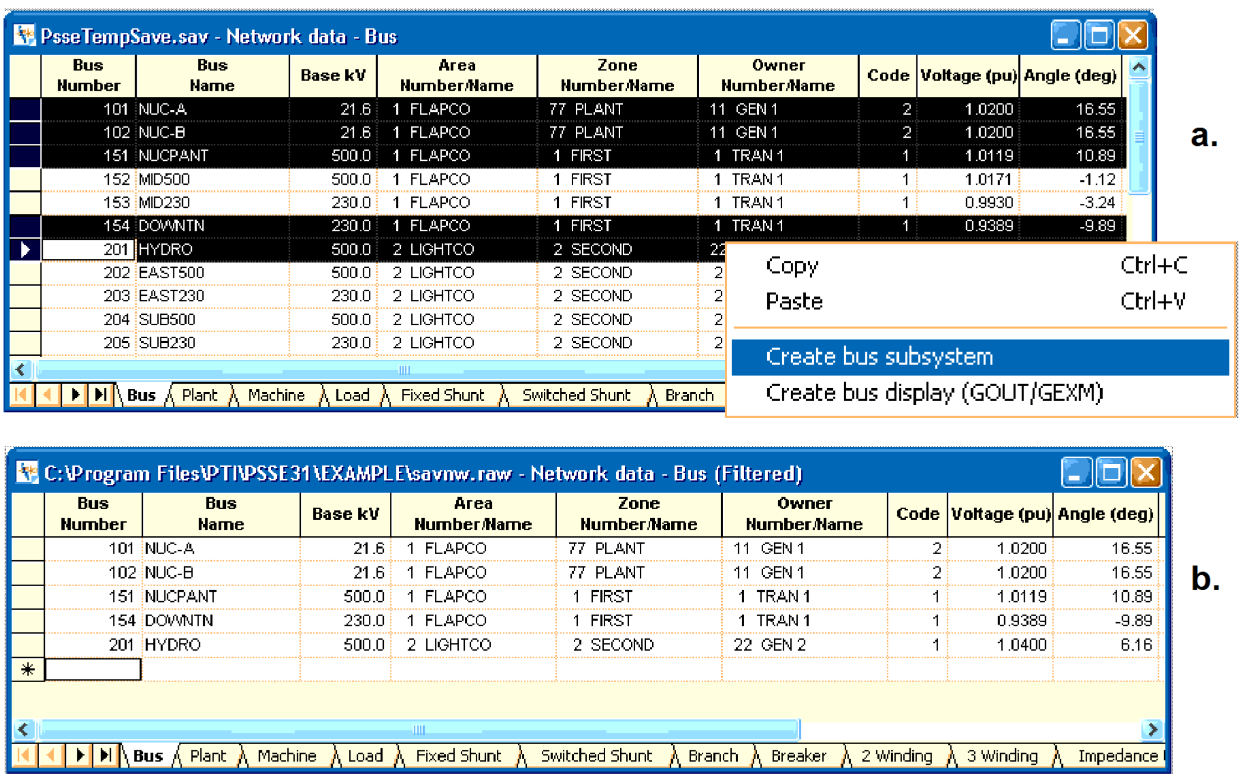
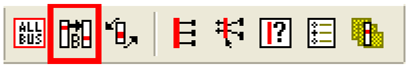


Figure 2.7. Creating a Bus Subsystem

2.3.3. Using the Subsystem Menu



Subsystem > Bus...

A bus subsystem can also be created using the *[Bus Subsystem Selector]* dialog (Figure 2.8, “Bus Subsystem Selector Dialog”). Using this method, a subsystem can be built using filters by area, owner, zone, base kV, or bus numbers. Each category is available on a separate tab. For Areas, Owners, Zones, and Buses use the appropriate lists to specify the subsystem. Click *[Reset]* to return all entries in the *Selected* list to the *Unselected* list.

The *Buses* tab provides a *[Filter]* button that opens the *[Filter Bus Subsystem Selection]* dialog (Figure 2.9, “Filter Bus Subsystem Selection Dialog”), an additional mechanism to exclude buses from the selection process in very large systems.

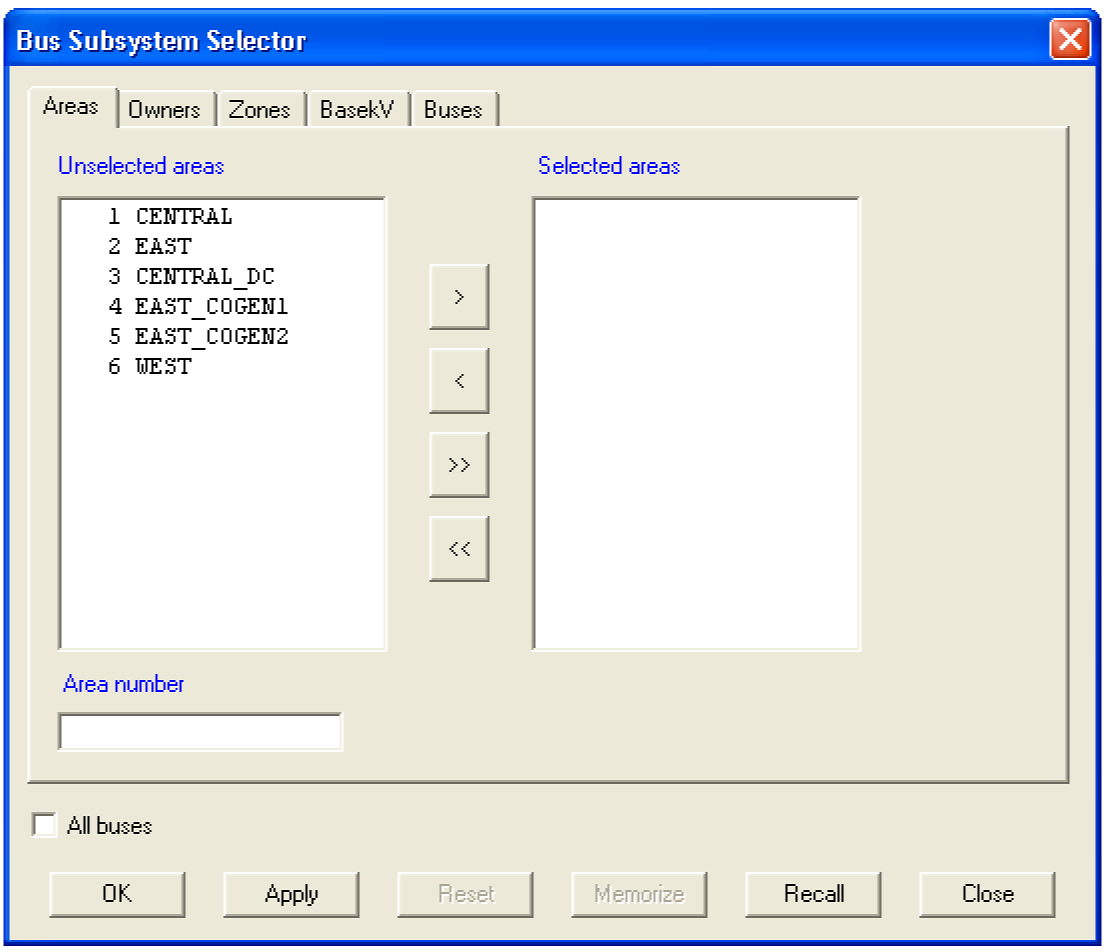


Figure 2.8. Bus Subsystem Selector Dialog

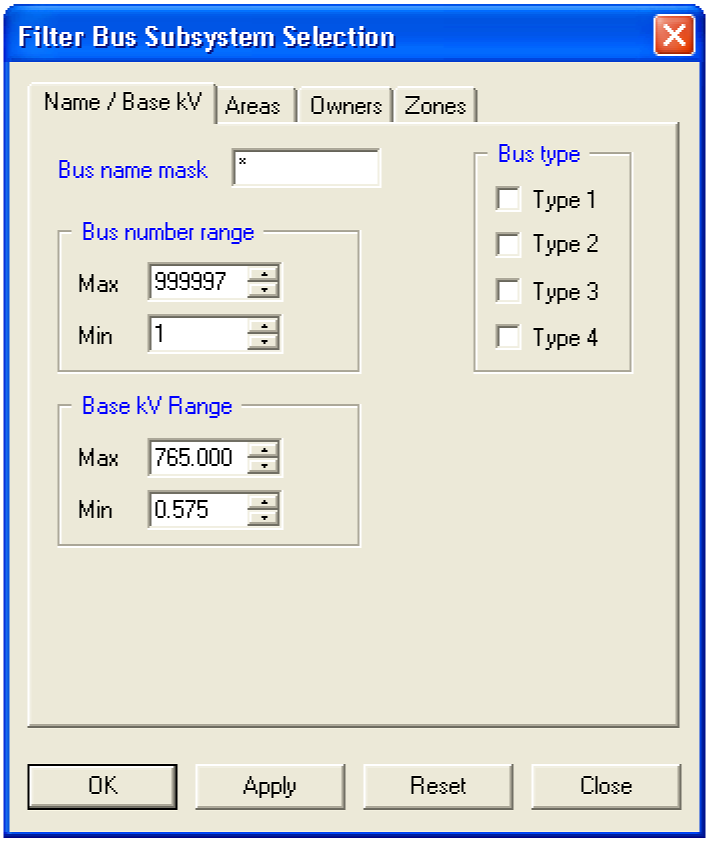


Figure 2.9. Filter Bus Subsystem Selection Dialog

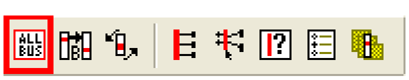
After specifying the subsystem, click *[Apply]*. The tab with a specified subsystem will be marked with an asterisk (for example *Buses* *) until the selected component is returned to the unselected list.

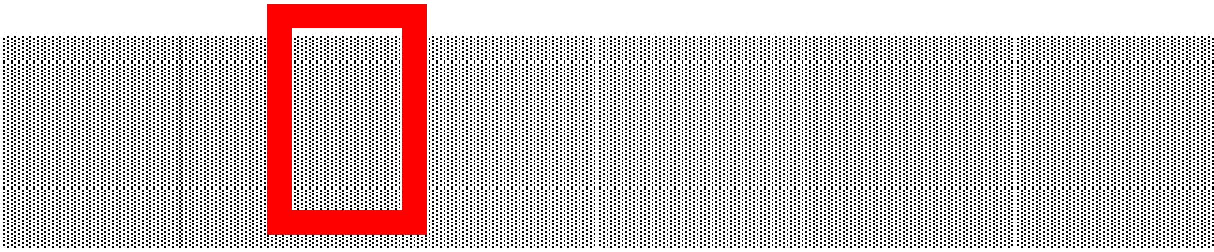
Click *[Memorize]* to preserve a specific subsystem for later recollection. The *[Save As]* dialog requires entering a filename for the Bus Subsystem file (*.sbs).

Click *[Recall]* to open a saved Bus Subsystem file (*.sbs).

Click *[OK]* to close the dialog and refresh *[Spreadsheet]*. Only data corresponding to the subsystem is displayed, until a new subsystem selection is made.

To return the entire working case to *[Spreadsheet]*, select *Subsystem > Bus...* and select the *All buses* check box from *[Bus Subsystem Selector]* or click the ALL BUS icon.





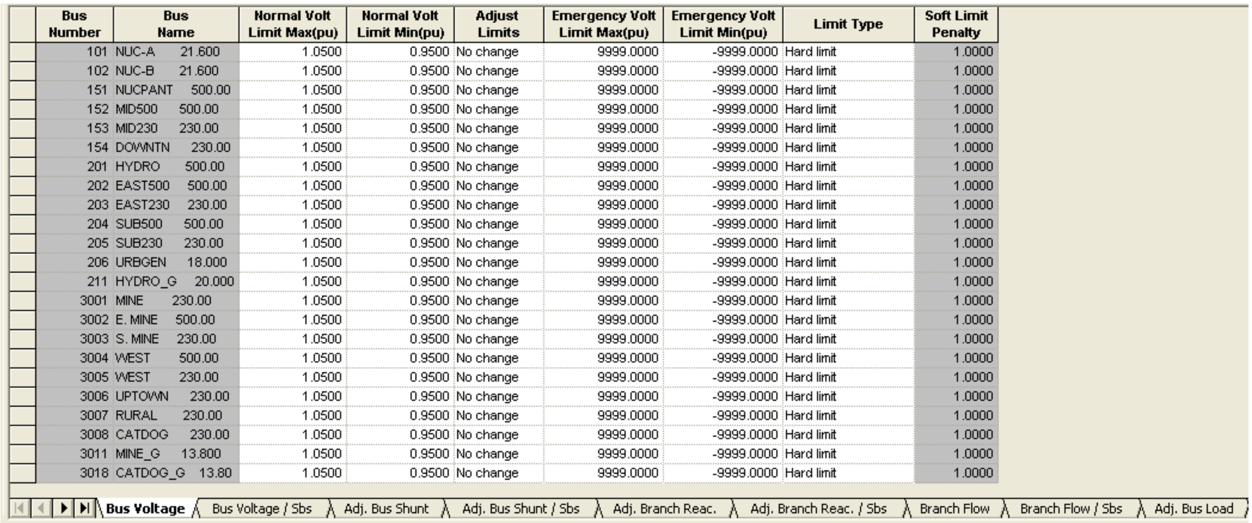
Subsystem > Primary bus subsystem

This function toggles between two subsystems. Under normal operation, only one subsystem is created at a time. However, a second subsystem will be created when, in *[Diagram]*, information is requested for an element that is not in the current subsystem. The creation of the second subsystem allows the first subsystem to be preserved.

2.4. OPF Spreadsheet

[OPF Spreadsheet] is synchronized with the bus subsystem selector (see Figure 2.8, "Bus Subsystem Selector Dialog") so that a subset of the data can be viewed during a work session. It can be minimized, but you cannot close it unless you close the working case.

As shown in Figure 2.10, "OPF Spreadsheet View", the *Bus Voltage* tab is the default worksheet; it displays the voltage limits for each bus as currently specified in the working case.



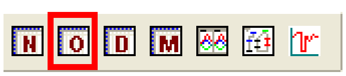
Bus Number	Bus Name	Normal Volt Limit Max(pu)	Normal Volt Limit Min(pu)	Adjust Limits	Emergency Volt Limit Max(pu)	Emergency Volt Limit Min(pu)	Limit Type	Soft Limit Penalty
101	NUC-A 21.600	1.0500	0.9500	No change	9999.0000	-9999.0000	Hard limit	1.0000
102	NUC-B 21.600	1.0500	0.9500	No change	9999.0000	-9999.0000	Hard limit	1.0000
151	NUCPANT 500.00	1.0500	0.9500	No change	9999.0000	-9999.0000	Hard limit	1.0000
152	MID500 500.00	1.0500	0.9500	No change	9999.0000	-9999.0000	Hard limit	1.0000
153	MID230 230.00	1.0500	0.9500	No change	9999.0000	-9999.0000	Hard limit	1.0000
154	DOWNTN 230.00	1.0500	0.9500	No change	9999.0000	-9999.0000	Hard limit	1.0000
201	HYDRO 500.00	1.0500	0.9500	No change	9999.0000	-9999.0000	Hard limit	1.0000
202	EAST500 500.00	1.0500	0.9500	No change	9999.0000	-9999.0000	Hard limit	1.0000
203	EAST230 230.00	1.0500	0.9500	No change	9999.0000	-9999.0000	Hard limit	1.0000
204	SUB500 500.00	1.0500	0.9500	No change	9999.0000	-9999.0000	Hard limit	1.0000
205	SUB230 230.00	1.0500	0.9500	No change	9999.0000	-9999.0000	Hard limit	1.0000
206	URBGEN 18.000	1.0500	0.9500	No change	9999.0000	-9999.0000	Hard limit	1.0000
211	HYDRO_G 20.000	1.0500	0.9500	No change	9999.0000	-9999.0000	Hard limit	1.0000
3001	MINE 230.00	1.0500	0.9500	No change	9999.0000	-9999.0000	Hard limit	1.0000
3002	E. MINE 500.00	1.0500	0.9500	No change	9999.0000	-9999.0000	Hard limit	1.0000
3003	S. MINE 230.00	1.0500	0.9500	No change	9999.0000	-9999.0000	Hard limit	1.0000
3004	WEST 500.00	1.0500	0.9500	No change	9999.0000	-9999.0000	Hard limit	1.0000
3005	WEST 230.00	1.0500	0.9500	No change	9999.0000	-9999.0000	Hard limit	1.0000
3006	UPTOWN 230.00	1.0500	0.9500	No change	9999.0000	-9999.0000	Hard limit	1.0000
3007	RURAL 230.00	1.0500	0.9500	No change	9999.0000	-9999.0000	Hard limit	1.0000
3008	CATDOG 230.00	1.0500	0.9500	No change	9999.0000	-9999.0000	Hard limit	1.0000
3011	MINE_G 13.800	1.0500	0.9500	No change	9999.0000	-9999.0000	Hard limit	1.0000
3018	CATDOG_G 13.80	1.0500	0.9500	No change	9999.0000	-9999.0000	Hard limit	1.0000

Figure 2.10. OPF Spreadsheet View

2.4.1. Revising OPF Specifications

In order to revise OPF attributes using *[OPF Spreadsheet]*, it must be the active view. Choose the most convenient way to make it active from among the following options:

- Toolbar selection



- Double-clicking the item to be revised in *[OPF Tree]*

Change numeric values by overwriting the value in the cell. Non-numeric specifications are changed using a pull-down list, available by clicking to the right of the cell contents. Table 2.1, "Choices for worksheets" summarizes the choices available from the pull-down lists. Wherever appropriate, these lists provide the same options for each worksheet in which they occur.

Table 2.1. Choices for worksheets

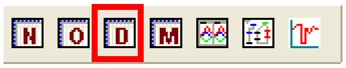
OPF Spreadsheet Data Record	Attribute	Options
Bus Voltage Bus Voltage / Subsystem	Adjust Limits	• No change • Fix

<table>
<tr><th>OPF Spreadsheet Data Record</th><th>Attribute</th><th>Options</th></tr>
<tr><td></td><td></td><td>• Open</td></tr>
<tr><td>Bus Voltage
Bus Voltage / Subsystem
Branch Flow
Branch Flow / Subsystem</td><td>Limit type</td><td>• No change
• Reporting
• Hard limit
• Soft-linear limit
• Soft-quadratic limit</td></tr>
<tr><td>Adjustable Bus Shunt / Subsystem
Branch Flow / Subsystem</td><td>Add/modify for selected buses</td><td>• Modify only
• Add/Modify</td></tr>
<tr><td>Adjustable Branch Reactance / Subsystem</td><td>In Service</td><td>• No change
• Out
• In</td></tr>
<tr><td>Branch Flow
Branch Flow / Subsystem</td><td>Initialize Rate Limits</td><td>• None
• Rate A
• Rate B
• Rate C</td></tr>
<tr><td>Branch Flow
Branch Flow / Subsystem</td><td>Flow Type</td><td>• No change
• MW
• MVAR
• MVA
• Ampere</td></tr>
<tr><td>Dispatch Table</td><td>Cost Curve Type</td><td>• Polynomial & Exponential
• Piece-wise linear
• Piece-wise quadratic</td></tr>
<tr><td>Generator Reactive Capability
Generator Reactive Capability / Subsystem</td><td>Reactive Capability Limit</td><td>• No change
• Out-of-service
• Enabled
• + Delta Efd inhibit
• - Delta Efd inhibit
• Fixed EFD</td></tr>
</table>

2.5. Dynamics Spreadsheet

The *[Dynamics Spreadsheet]* is populated from data specified in either a Snapshot (*.snp) or DYRE (*.dyr) file. In order to revise the working case using *[Dynamics Spreadsheet]*, it must be the active view. Choose the most convenient way to make it active from among the following options:

- Toolbar selection

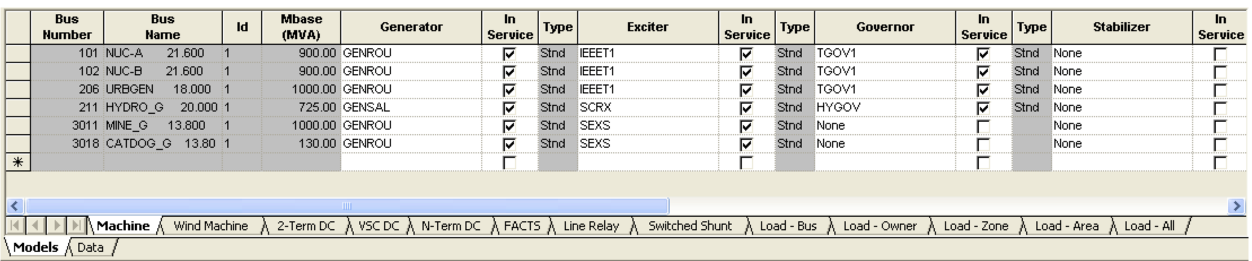


- Double-clicking the item to be revised in *[Dynamics Tree]* or *[Diagram]*

[Dynamics Spreadsheet] is synchronized with the bus subsystem selector (see Figure 2.8, “Bus Subsystem Selector Dialog”) so that a subset of the data can be viewed during a work session. It can be minimized, but you cannot close it unless you close the working case.

2.5.1. Models Tab

As shown in Figure 2.11, “Dynamics Spreadsheet View”, the *Machine* model sub-tab on the Models tab is the default worksheet; it displays the generator model types currently loaded in dynamic memory. The Models tab contains sub-tabs for all network elements to which Dynamics models can be attached.



	Bus Number	Bus Name	Id	Mbase (MVA)	Generator	In Service	Type	Exciter	In Service	Type	Governor	In Service	Type	Stabilizer	In Service
	101	NUC-A 21.600	1	900.00	GENROU	☑	Stnd	IEEET1	☑	Stnd	TGOV1	☑	Stnd	None	☐
	102	NUC-B 21.600	1	900.00	GENROU	☑	Stnd	IEEET1	☑	Stnd	TGOV1	☑	Stnd	None	☐
	206	URBGEN 18.000	1	1000.00	GENROU	☑	Stnd	IEEET1	☑	Stnd	TGOV1	☑	Stnd	None	☐
	211	HYDRO_G 20.000	1	725.00	GENSAL	☑	Stnd	SCRX	☑	Stnd	HYGOV	☑	Stnd	None	☐
	3011	MINE_G 13.800	1	1000.00	GENROU	☑	Stnd	SEXS	☑	Stnd	None	☐		None	☐
	3018	CATDOG_G 13.80	1	130.00	GENROU	☑	Stnd	SEXS	☑	Stnd	None	☐		None	☐
*						☐			☐			☐			☐

Machine | Wind Machine | 2-Term DC | VSC DC | N-Term DC | FACTS | Line Relay | Switched Shunt | Load - Bus | Load - Owner | Load - Zone | Load - Area | Load - All

Models | Data

Figure 2.11. Dynamics Spreadsheet View

Model types may be added, modified, or deleted using this spreadsheet.

Certain network elements, such as machines, must have Dynamics models defined. For these elements, the spreadsheets will contain an entry for every corresponding network element.

Other elements don’t require a Dynamics model, so these spreadsheets will be empty if no Dynamics models were defined for them in either the Snapshot or DYRE file. Models can be added for these elements either by double-clicking an editable cell to open a selector dialog or just entering the values by typing them into the spreadsheet.

If you create a new entry for a network element in one of the spreadsheets without specifying any Dynamics models, the message No models specified pops up. Dynamics models must then be defined or the entry removed using the *Edit > Undo* command.

Use the *In Service* checkbox to place a model in-service or out-of-service.

Model changes are initiated from the right-click menu (Figure 2.12, “Dynamics Spreadsheet Menu”) available in the model type cells.

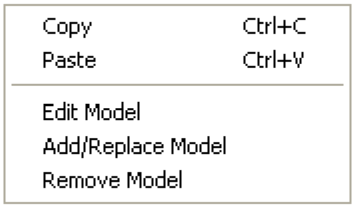


Figure 2.12. Dynamics Spreadsheet Menu

Selecting *Edit Model* from the menu opens the *[Edit Model Parameters]* dialog (Figure 2.13, "Edit Model Parameters Dialog ") where values of the parameters (CONs/ICONs/VARs) associated with that particular instance of the model at that particular network element can be changed.

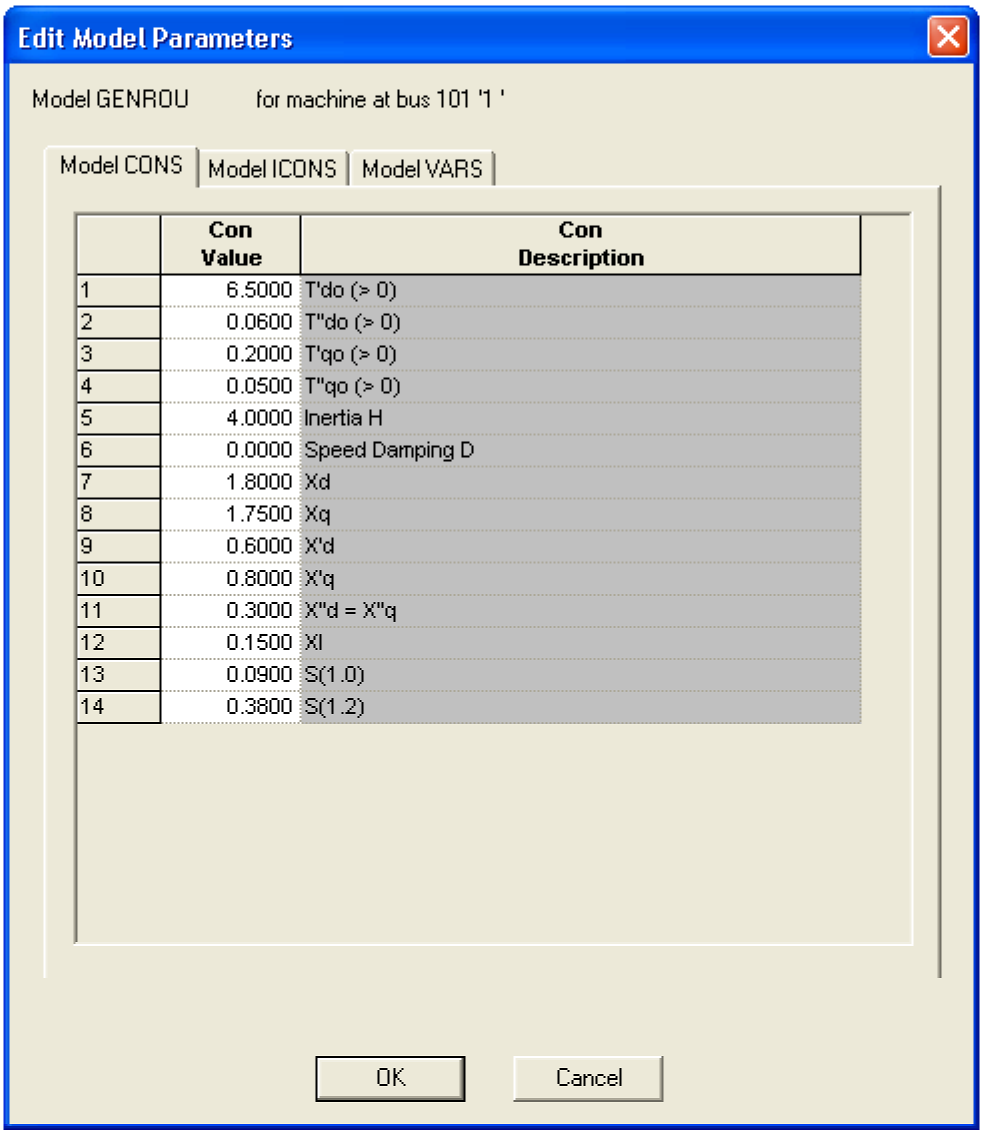


Figure 2.13. Edit Model Parameters Dialog

Selecting *Add/Replace Model* from the menu opens the *[Model Selection]* dialog (Figure 2.14, "Model Selection Dialog, Generator Models") which provides a list of available models appropriate for the type of network element being modified. When adding a model, the default status is out-of-service. Use the checkbox to place the new model in-service.

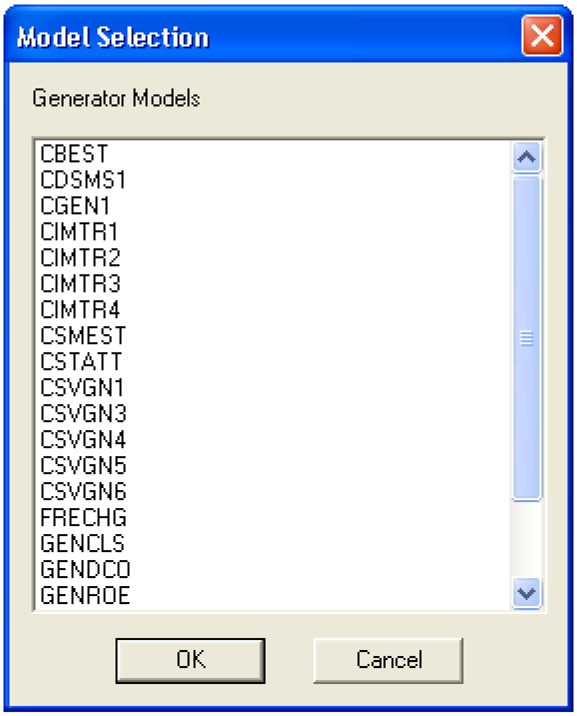


Figure 2.14. Model Selection Dialog, Generator Models

Selecting *Remove Model* from the menu deletes the model from the simulation; the in-service flag is ignored until a model is replaced.

2.5.2. Data Tab

The Dynamics Data tab contains sub-tabs for all data elements associated with CONEC and CONET called models as well as all defined channels. The CONs, ICONs, and VARs associated with CONEC and/or CONET called models, as well as those associated with model logic that are in-line code (rather than model calls) in CONEC and/or CONET will appear in these spreadsheets and are available for edit (see Figure 2.15, "Dynamics Data Tab").

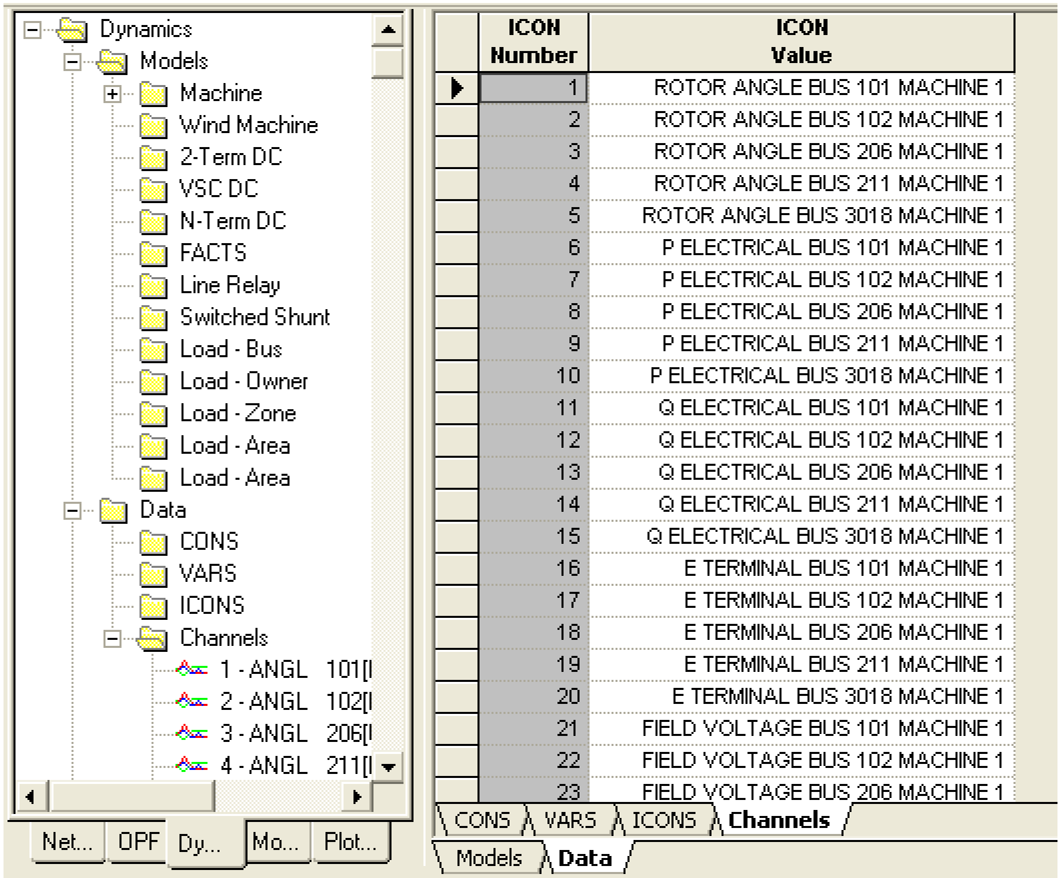
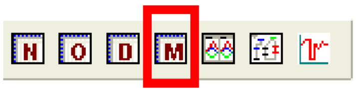


Figure 2.15. Dynamics Data Tab

2.6. Models Spreadsheet

The *[Models Spreadsheet]* is populated from data specified in either a Snapshot (*.snp) or DYRE (*.dyr) file. In order to revise these values, *[Model Spreadsheet]* must be the active view. Choose the most convenient way to make it active from among the following options:

- Toolbar selection



- Double-clicking the model to be revised in *[Models Tree]*

[Models Spreadsheet] (Figure 2.16, "Models Spreadsheet") is used to modify the CONs and ICONs associated with the individual Dynamics models attached to network elements. Using *[Models Spreadsheet]*, all the CONs and ICONS associated with all instances of a particular model in the current network can be examined at once, providing a way to make quick data value range checks or modifications.

	Model Name	Model Identifier	Type	T'do (> 0)	T"do (> 0)	T'qo (> 0)	T"qo (> 0)	Inertia H	Speed Damping D	Xd	Xq	X'd	X'q	X"d = X"q	Xl	S(1.0)	S(1.2)
	GENROU	101 [NUC-A 21.600] 1	Stnd	6.5000	0.0600	0.2000	0.0500	4.0000	0.0000	1.8000	1.7500	0.6000	0.8000	0.3000	0.1500	0.0900	0.3800
	GENROU	102 [NUC-B 21.600] 1	Stnd	6.5000	0.0600	0.2000	0.0500	4.0000	0.0000	1.8000	1.7500	0.6000	0.8000	0.3000	0.1500	0.0900	0.3800
	GENROU	206 [URBGEN 18.000] 1	Stnd	4.5000	0.0700	0.1500	0.0500	2.5000	0.0000	1.4000	1.3500	0.5000	0.7000	0.2500	0.1000	0.0900	0.3800
	GENROU	3011 [MINE_G 13.800] 1	Stnd	5.0000	0.0600	0.2000	0.0600	3.0000	0.0000	1.6000	1.5500	0.7000	0.8500	0.3500	0.2000	0.0900	0.3800
	GENROU	3018 [CATDOG_G 13.800] 1	Stnd	5.0000	0.0600	0.2000	0.0600	3.0000	0.0000	1.6000	1.5500	0.7000	0.8500	0.3500	0.2000	0.0900	0.3800
*																	

CONS ICONS VARS

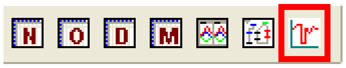
Figure 2.16. Models Spreadsheet

The columns containing a particular CON, ICON, or VAR can be sorted by double-clicking the column header, just as in *[Network Spreadsheet]*. Copy/Paste operations work the same as described for *[Network Spreadsheet]*.

2.7. Event Spreadsheet

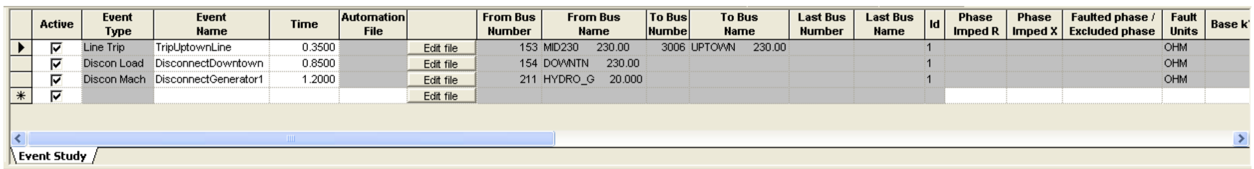
[Event Spreadsheet] (Figure 2.17, "Event Spreadsheet") is populated with data saved in an Event Study file (*.evs). Choose the most convenient way to make it active from among the following options:

- Toolbar selection



- Double-clicking the event study to be revised in *[Dynamics Tree]*

Individual faults/events may be de-activated from a particular simulation without removing the fault from the event study. The event name may be edited for clarity, as the default names are created in numeric sequence, which may not correspond to the synchronization of the study. Timing of the event within the simulation period may also be edited from this spreadsheet.

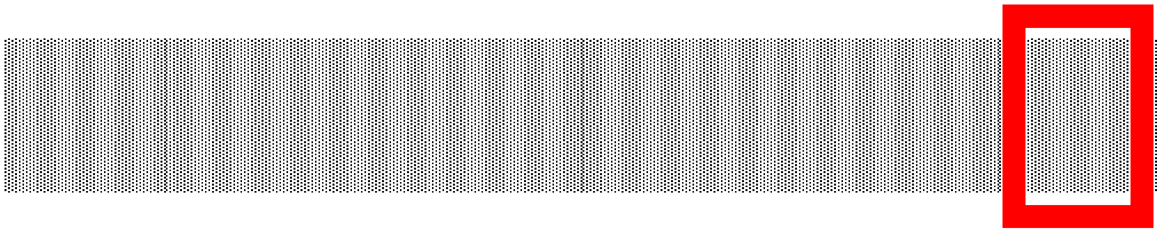


Active	Event Type	Event Name	Time	Automation File		From Bus Number	From Bus Name	To Bus Numbe	To Bus Name	Last Bus Number	Last Bus Name	Id	Phase Imped R	Phase Imped X	Faulted phase / Excluded phase	Fault Units	Base k'
☑	Line Trip	TripUptownLine	0.3500		Edit file	153	MID230 230.00	3006	UPTOWN 230.00			1				OHM	
☑	Discon Load	DisconnectDowntown	0.8500		Edit file	154	DOWNTN 230.00					1				OHM	
☑	Discon Mach	DisconnectGenerator1	1.2000		Edit file	211	HYDRO_G 20.000					1				OHM	
☑					Edit file												

Event Study

Figure 2.17. Event Spreadsheet

2.8. Exporting Spreadsheet Data



File > Export > Spreadsheet Tab to text file...

This activity exports all data from an open spreadsheet to a tab-delimited file. The file selection window in the *[Save As]* dialog lists only Text Files (*.txt). Specify the filename; this can be a new file or a previously-built file to be over-written.

2.9. Undoing an Action

Edit > Undo Record

This action returns a PSS®E operation to its state previous to the run of an automation file (see Section 23.3, "Executing Automation Files"). It is necessary when adding a new record to any of the spreadsheets and the application generates an error message about missing information. At certain points, this can lead to application lockup. The Add operation cannot continue until the missing data is provided and the missing data cannot be provided because the application keeps notifying the user of the problem. At this point, *Edit > Undo Record* will reset the application back to the state before the Add operation was begun. The missing data can then be added in other spreadsheets and the item added again. Once the data has been entered, however, the *Undo Record* operation will have no effect.

Chapter 3
Diagram View

3.1. Introduction

[Diagram] view (Figure 3.1, "Diagram View with Slider Diagram") is used to create and modify one-line diagrams and to display a variety of results, such as:

- Power flow results (Section 3.8, "Displaying Power Flow Results")
- Network impedances (Section 3.9, "Displaying Impedance Data")
- Graphical differences between power flow cases (Section 3.10, "Displaying Graphical Difference Data ")
- Fault analysis results (Section 3.11, "Displaying ASCC Fault Analysis Results")
- IEC fault calculations results (Section 3.12, "Displaying IEC Fault Analysis Results")
- Reliability analysis results (Section 3.13, "Displaying Reliability Analysis Results")
- Dynamic simulation results (Section 3.14, "Displaying Dynamics Analysis Results")

To open *[Diagram]*, open an existing diagram (*File > Open > Slider Binary file (*.sld)*), or begin a new diagram (*File > New > Diagram*).

As you add new elements to a diagram, *[Network Spreadsheet]* (Chapter 2, *Spreadsheet View*) and *[Network Tree]* (Chapter 4, *Data Selection Tree View*) are automatically updated to reflect the addition. To move from *[Diagram]* to *[Network Spreadsheet]*, double-click the desired diagram component. *[Network Spreadsheet]* opens to the specified data tab and highlights the row of data for that component.

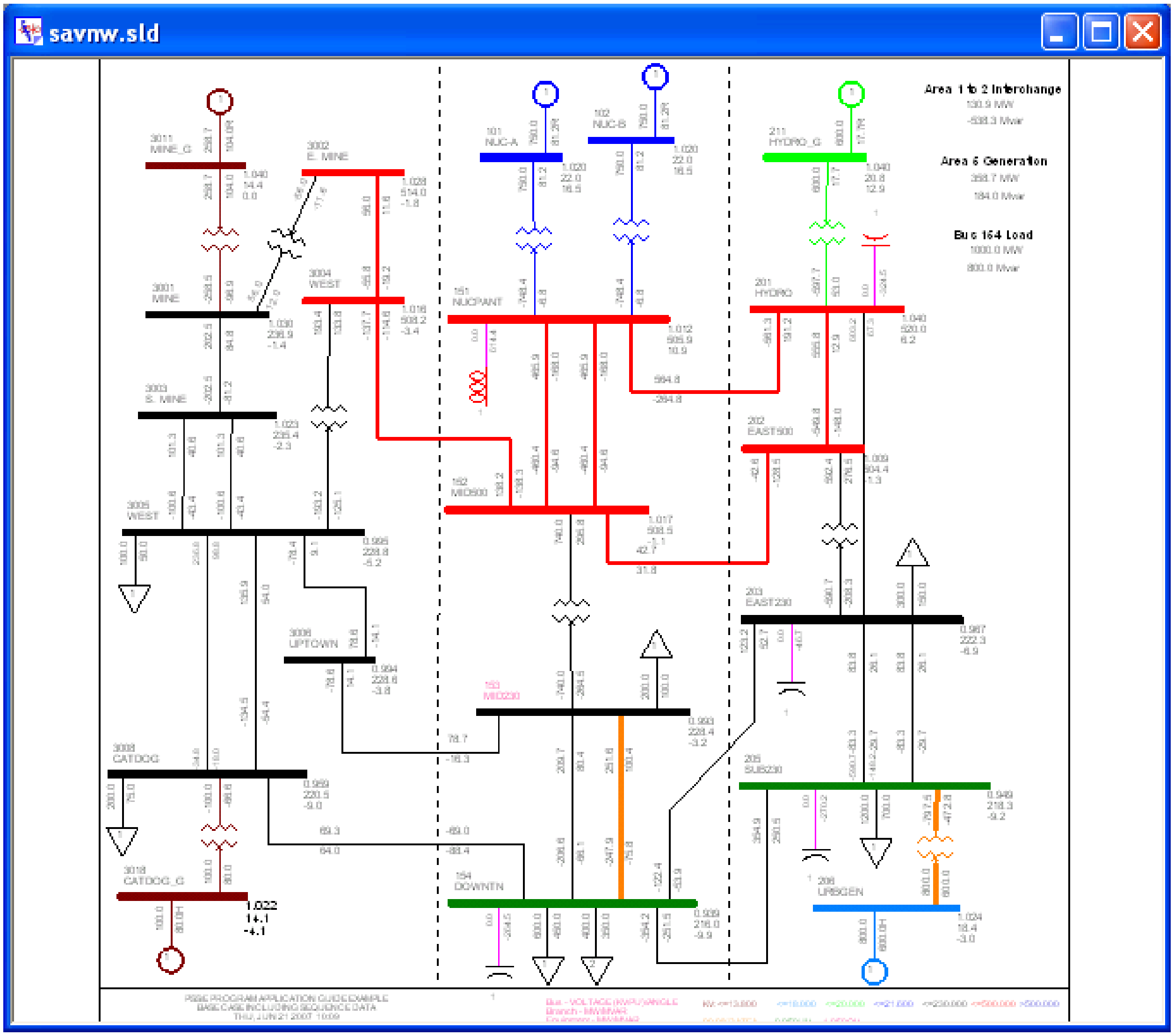


Figure 3.1. Diagram View with Slider Diagram

3.2. Specifying Diagram Properties

Diagram > Properties...

The *[Diagram Properties]* dialog (Figure 3.2, "Diagram Properties Dialog "), available only when *[Diagram]* is the active view, supports user-configurable settings, such as units, background colors, grid spacing, and zoom / pan thresholds.

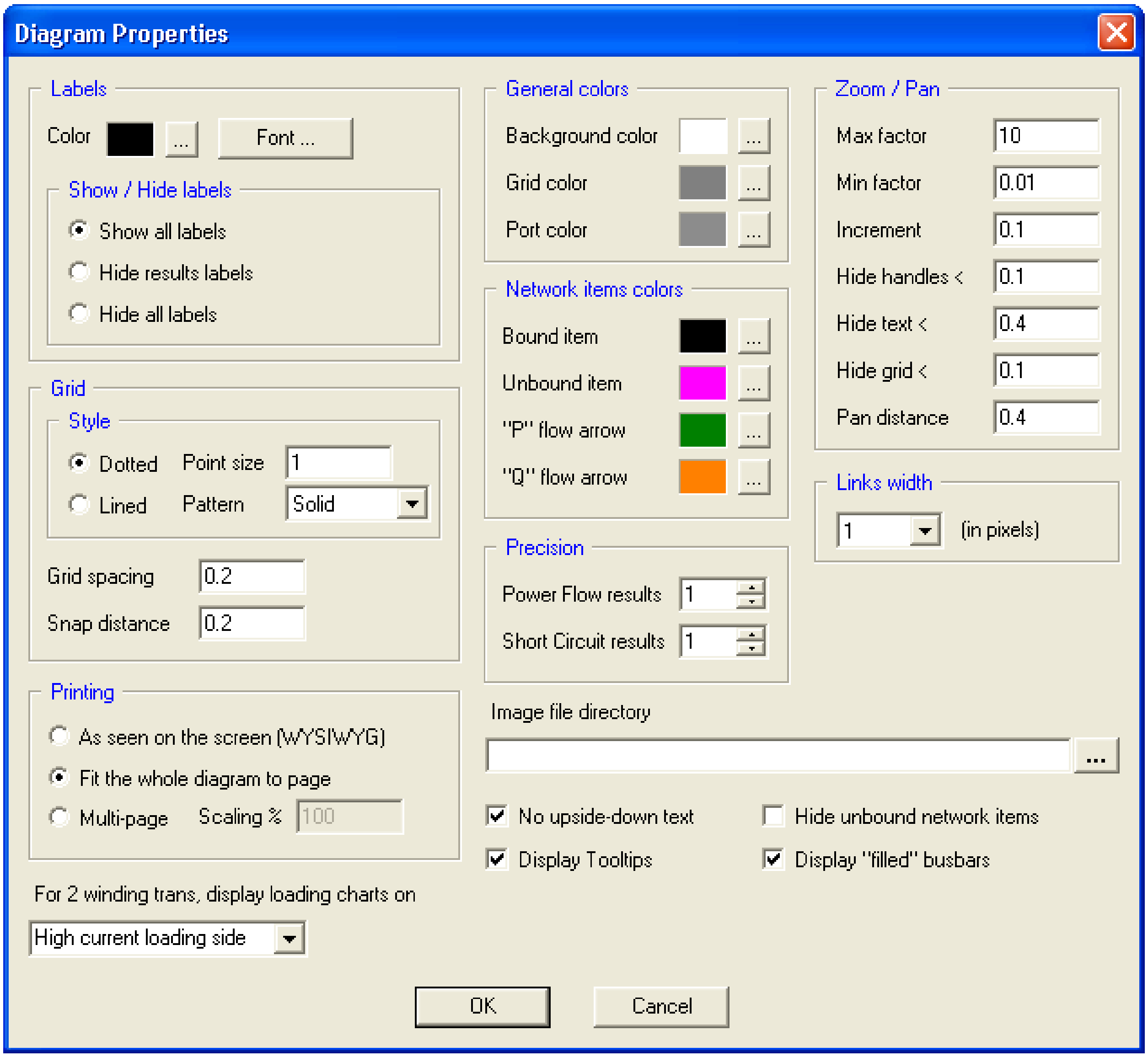


Figure 3.2. Diagram Properties Dialog

Labels: Select from a variety of font styles, sizes and colors for labels. Options for hiding or showing all labels and hiding results labels are also available. Click *[...]* to open the *[Color]* dialog (Figure 3.3, "Color Dialog") or click *[Font]* to open the *[Font]* dialog (Figure 3.4, "Font Dialog") to change label color or font.

Figure 3.3. Color Dialog

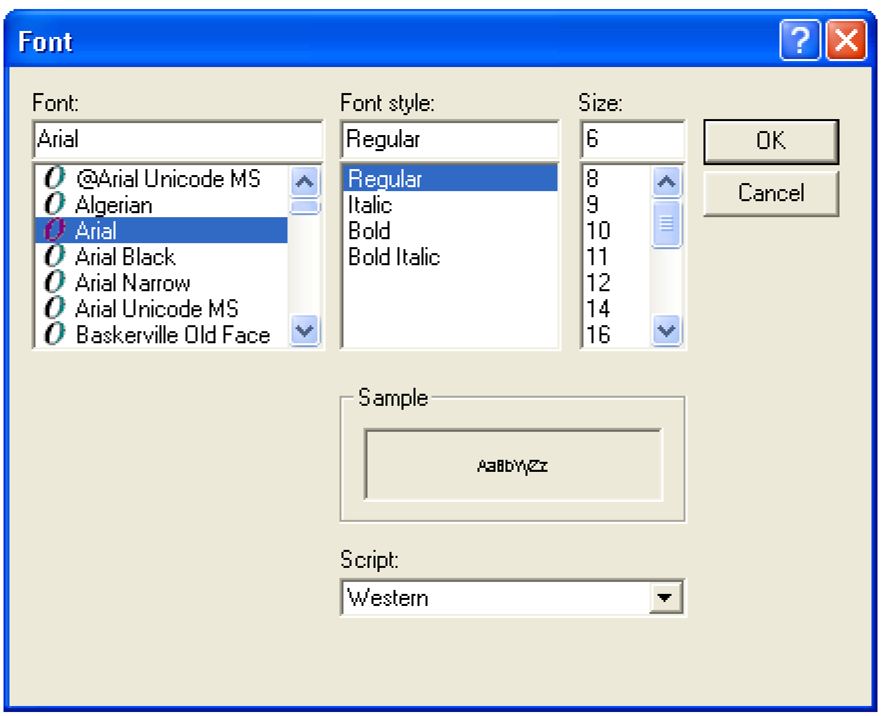


Figure 3.4. Font Dialog

Grid: An underlying grid pattern may be made visible. Line style and width, grid spacing, and snap distance, may be specified. For very dense diagrams the snap distance must be small enough to ensure that items snap to the desired grid point instead of one further away.

General Colors: Defines background, grid, and port colors. Click *[...]* to open the *[Color]* dialog (Figure 3.3, "Color Dialog").

The port symbol is a small circle that appears at a location where a line or equipment connects to a bus. Ports appear as connection points when selecting lines or equipment and move to the new bus location when changes are made from *[Diagram]*.

Network Items Colors: Defines colors for bound and unbound diagram items and power flow direction. Click *[...]* to open the *[Color]* dialog (Figure 3.3, "Color Dialog").

All network items in *[Diagram]* that represent real network data are drawn in the bound color (Section 3.6.4, "Binding Data"), unless the color has been over-ridden by range checking coloration (Figure 3.46, "Diagram Range Checking Tab"). All network items added to a diagram that do not represent data in the network are drawn in the unbound color.

The P flow arrow and the Q flow arrow display animated flow directions for real and reactive power for power flow results (Figure 3.46, "Diagram Range Checking Tab").

Precision: Defines the number of decimal places to be used in representing power flow and short circuit results on a diagram.

Zoom/Pan: Enter values for zoom factors directly in the fields provided. In addition, it is possible to hide some diagram items when the zoom factor is small and the diagram becomes crowded, including the handles that appear at each end of a bus when it is selected.

These values set limits. The diagram can be expanded, reduced and panned using the Zoom Toolbar buttons. Computers equipped with a mouse-wheel can pan vertically using just the mouse-wheel. Holding down the *[Shift]* key while moving the mouse-wheel will pan horizontally. Holding down the *[Ctrl]* key while moving the mouse-wheel will zoom. Keyboard arrow keys may also be used to pan the image.

Image File Directory: Click *[...]* to open the dialog specifying a default path for commonly used images. These images may be imported to the background layer of *[Diagram]*.

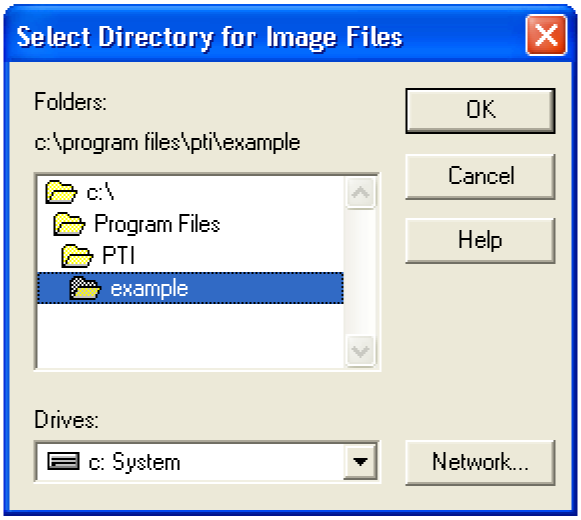


Figure 3.5. Select Directory for Image Files Dialog

Printing: Three options are available for printing a diagram:

- *As seen on the screen*: *WYSIWYG* (What you see is what you get.) prints only the visible portion of the one-line diagram. If you have zoomed in to see greater detail, this might be only a portion of a bus. Verify the desired print area by selecting *File* > *Print Preview*.

- *Fit the whole diagram to page*: The entire one-line diagram is printed on one page, independent of whether or not the entire diagram is shown in *[Diagram]*.

- *Multi-page*: The entire diagram is printed on multiple pages, independent of whether or not the entire diagram is visible in *[Diagram]*. In addition, a muiltiple-page diagram may be scaled. This is useful when the one-line diagram is large.

The user must specify loading chart placement for 2-winding transformers from the following options:

- High current loading side

- Low current loading side

- Both sides

Other diagram options may be enabled using checkboxes. If *Display Tooltips* is enabled, moving the mouse cursor over a diagram item opens a pop-up note that provides basic information, such as bus number, name, and base kV.

3.3. Creating a New Power Flow Case using Diagram View

After starting a new case and creating a blank *[Spreadsheet]* (see Creating a Working Case), select *File* > *New* and the *Diagram* option. Click *[OK]* to create a blank *[Diagram]*. Then network elements can be added graphically instead of typing data into the spreadsheet.

The first task is to specify whether to number the buses automatically; see Changing Program Preferences. For example, select *Edit* > *Preferences* to open *[Program Preferences]*, partially shown in Figure 3.6, “Example: Automatic Bus Numbering”. Here the buses are numbered starting at 1 in increments of 100.

The example built in this section will have:

- A generator at bus 1 and bus 201.
- A non transformer branch between bus 1 and 101.
- A non transformer branch between bus 101 and 102.
- A load at bus 101.

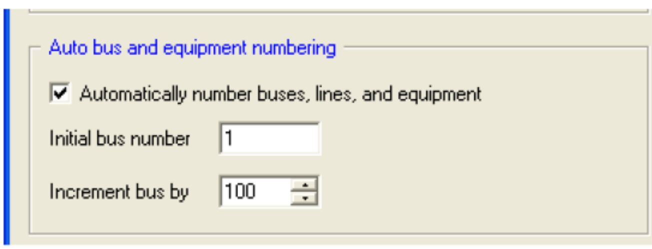
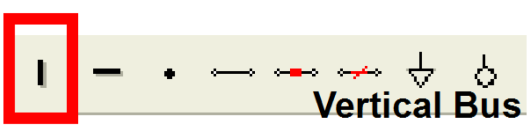
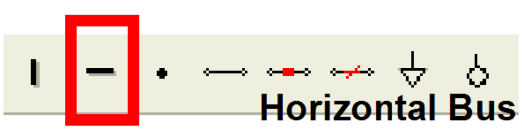


Figure 3.6. Example: Automatic Bus Numbering

3.3.1. Adding Buses





To add buses to the diagram, and consequently the database, select a *Bus* toolbar button (vertical or horizontal) in the Diagram toolbar. Click *[Diagram]* in those locations where the buses are to be placed. They can be moved and otherwise adjusted later. If *Bind Items* is enabled for the Diagram (Section 3.6.4, “Binding Data”) then, as buses are added to the diagram, they will also be added to the spreadsheet with default values; in other words, they are bound to the spreadsheet. If *Use property sheet dialogs to edit Network data* is selected under *Program Preferences* (Changing Program Preferences) then the *Datasheet Dialog* for the placed bus will come up so that the default values may be modified, however this behavior can be suppressed by holding down the *[Shift]* key while placing buses. Default values can be subsequently modified by editing in *[Spreadsheet]* as well.

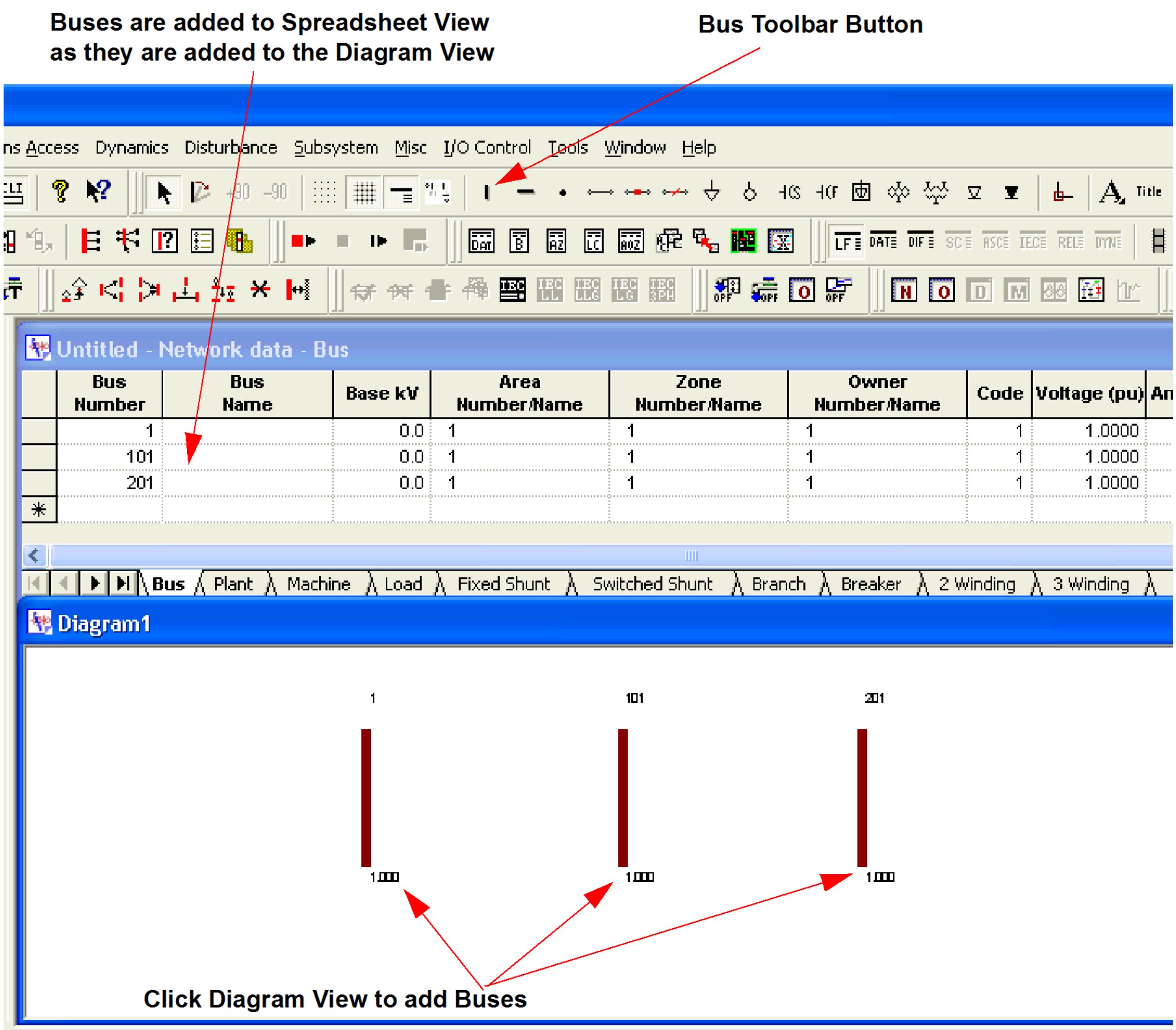
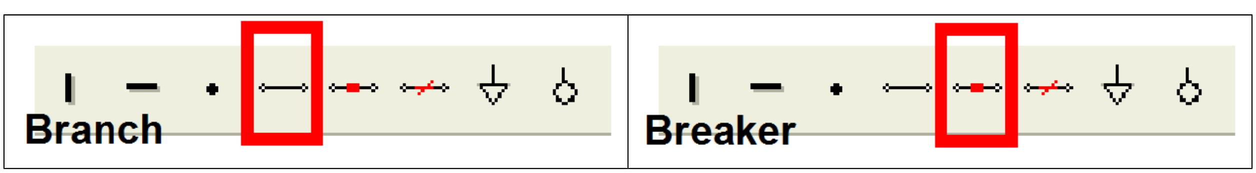
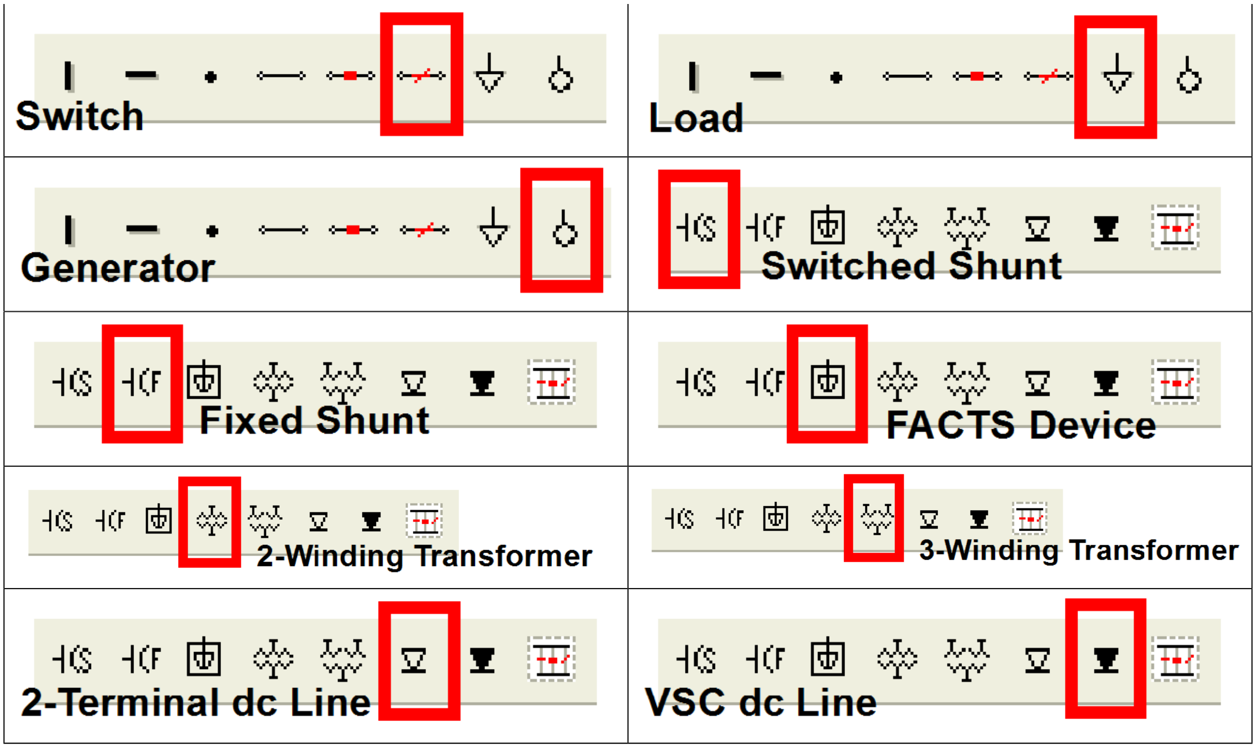


Figure 3.7. Adding Buses to the Database Using the Diagram View

3.3.2. Adding Network Elements





With the buses roughly positioned, select the *Branch* button and drag the mouse between two buses to represent branch connections. Select the Breaker button or the Switch button and drag the mouse to a branch to represent these connections. Select the *Load* button and drag the mouse from a bus to an adjacent empty area. Select the *Generator* button and drag the mouse between two buses. If *Bind Items* is enabled for the Diagram (Section 3.6.4, "Binding Data") then, as items are added to the diagram, they will also be added to the spreadsheet with default values. If *Use property sheet dialogs to edit Network data* is selected under *Program Preferences* (Section 1.5, "Changing Program Preferences") then the Datasheet Dialog for the placed bus will come up so that the default values may be modified, however this behavior can be suppressed by holding down the *[Shift]* key while placing items. The data can also be edited in *[Spreadsheet]* to change default values. Figure 3.8, "Adding Network Elements to the Diagram" summarizes an example.

As each element is added, a summary of the case building activity is displayed in the Progress tab.

See Section 3.19, "Closing the Diagram View" for options to save the diagram.

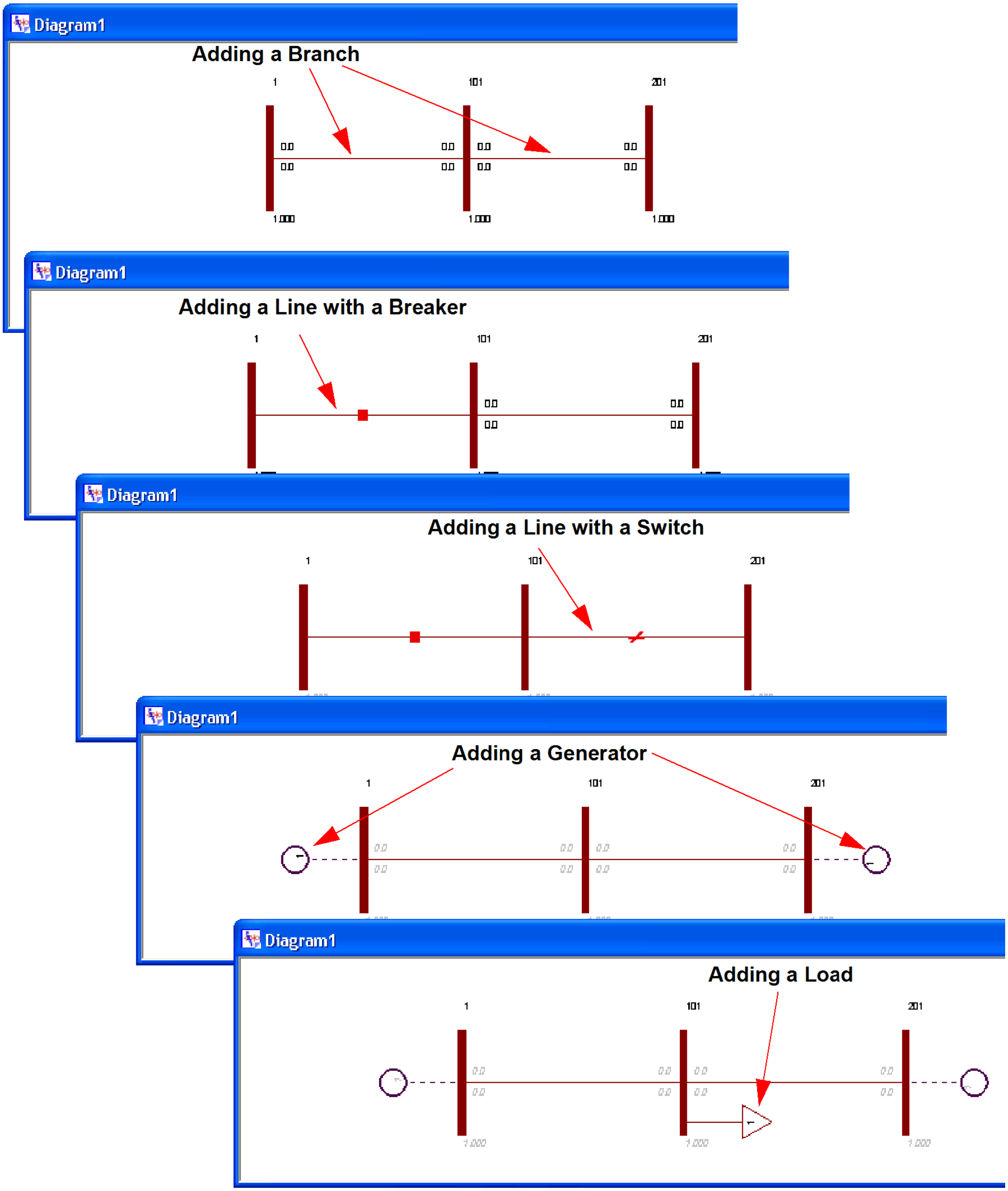


Figure 3.8. Adding Network Elements to the Diagram

3.4. Opening or Importing Existing Diagram Files

Diagram data may be supplied in one of two formats: the old PSS®E DRAW format or the new Slider file format created by the current version of PSS®E, the file type that will be used for future versions.

3.4.1. Slider Diagram File

File > Open...

From the *[Open]* file selector window, select *Slider Binary File (*.sld)*. Highlight the desired file and click *[Open]*. The resulting diagram will be displayed in a new diagram window.

3.4.2. Importing a DRAW File

DRAW

Requirements / Prerequisites
If bus voltages and/or line flows are to be printed, validly specified power flow case solved to an acceptable mismatch tolerance. Draw Data file (*.drw)

File > New...

From the *[New]* dialog, select the *Diagram* option to create a blank *[Diagram]*. Then select *File > Import > DRAW file...*. A list of available *.drw files will be provided. Highlight the desired file and click *[Open]*.

DRAW coordinate data files *cannot* be opened using *File > Open* from the Main Menu.

The open DRAW file can be saved as a Slider Binary file (*.sld). Select *File > Save As* and rename the file as a slider file.

Although existing PSS®E DRAW files can be imported, diagrams can be saved only in the slider format (*.sld). The new diagrams are *not* backward compatible with the PSS®E DRAW/DRED activities used to display and edit one-line diagrams in earlier versions of PSS®E.

3.4.3. Importing an Image File

File > Import > Image file...

Image files may be imported into a diagram if they are formatted as *.bmp, *.jpg, *.gif, or *.png files. From the *[Import Image File]* selector window, select the desired file type. Highlight the desired file and click *[Open]*. The image will be displayed in the active diagram layer.

To assign image attributes, right-click the image and select *Image Properties...*. The *[Image Properties]* dialog permits layer reassignment (see Section 3.17.3, "Diagram Layers "), scaling, and options to select and move the image in the diagram as if it were a network element. However, there is no network data associated with the image.

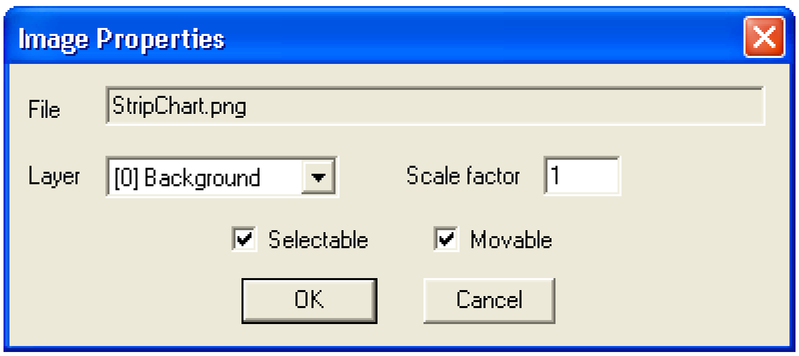


Figure 3.9. Image Properties Dialog

3.5. Diagram Templates

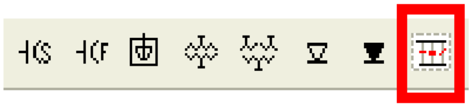


Diagram templates can be used to build a library of common network configurations to be used over and over when creating new network elements. The diagram template function was initially created for use with the Substation Reliability Assessment (SRA) option.

As engineers add detailed bus/breaker/switch substation configurations to their networks for evaluation, the same configurations repeat over and over. The diagram template allows you to create the basic substation configuration once and then use it to reproduce the substation repeatedly in the network.

Diagram templates can be created using buses, branches, switches, breakers, loads etc. The diagram template is created and saved without network data associated, only the topology of the network elements is maintained (see Figure 3.10, "Diagram Template, Double Bus and Single Breaker, 4 Circuits" for an example). When a diagram template is inserted in a slider diagram, the network topology is created in the network and default data is assigned to each new element.

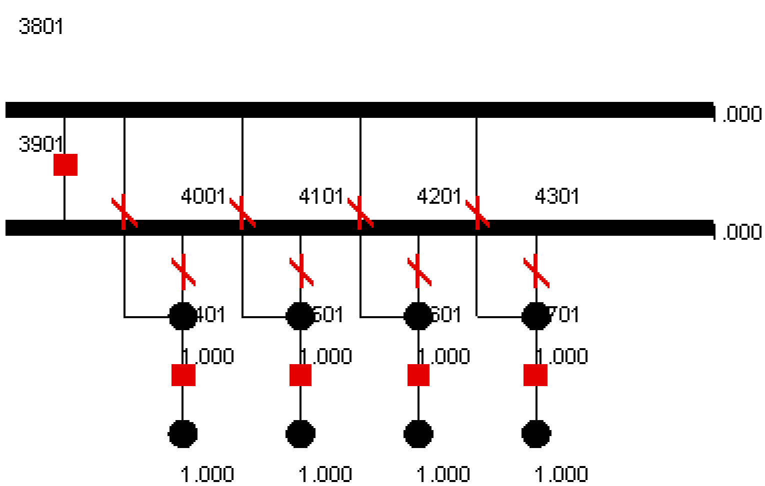


Figure 3.10. Diagram Template, Double Bus and Single Breaker, 4 Circuits

3.6. Revising a Diagram

3.6.1. Using Data Records

Data record dialogs for individual network components may be used to revise the working case. To activate the data record option, select *Edit > Preferences...*, select Use Dialogs to edit Diagram Items on the *[Program Preferences]* dialog, and click [OK] to update preferences. Thereafter, data records are activated whenever a diagram component is double-clicked.

When all changes have been entered in the data record, click [OK] to update the data record in the diagram and the network spreadsheet. When the working case is saved, the component data record is permanently updated.

Data records are available for bus, machine, load, and branch data records starting with PSS®E-32. An inventory of currently available data records is provided in Appendix B.

3.6.2. Using Diagram Menus

Various menus are available by right-clicking in *[Diagram]*, with or without a network item selected. Selecting a network item and right-clicking opens a menu that is specific to the type of network element selected. For example, selecting a bus and right-clicking opens the following menu (Figure 3.11, "Example of Diagram View Right-click Menu").

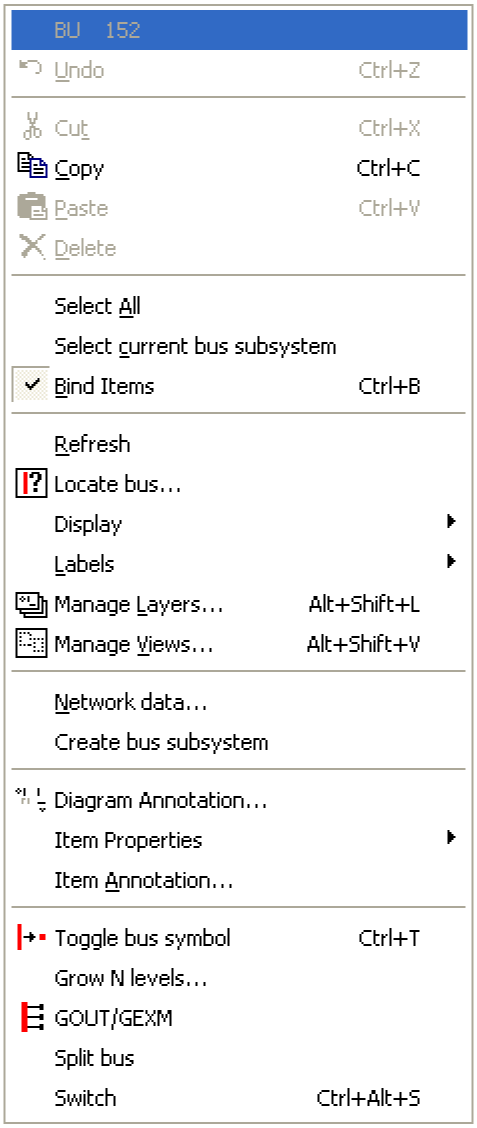


Figure 3.11. Example of Diagram View Right-click Menu

3.6.3. Editing Functions

All cutting, copying and pasting actions in *[Diagram]* use the application diagram clipboard. Diagram items placed on the application diagram clipboard may only be used in another *[Diagram]* within the same instance of PSS®E.

If the bind option is enabled (Section 3.6.4, "Binding Data"), all changes made in in *[Diagram]* are reflected in *[Network Spreadsheet]*.

Two options are available from the right-click menu:

- *Select All*: Selects all items in the diagram.
- *Select current bus subsystem*: Select a network item to specify. This option selects all items that are in that bus subsystem. If no bus subsystem has been specified, *Select All* occurs.

The remaining right-click menu functions are sensitive to the bind option.

If the bind option has been enabled for *Cut* and *Copy* functions, both the graphic representation and the corresponding model information are available from the diagram clipboard. If it has not been enabled, only the graphic representation is available from the diagram clipboard.

If the bind option has been enabled for the *Paste* function, and the copied area exceeds the number of existing elements, PSS®E will automatically create the extra network elements required (and generate appropriate bus numbers).

If the bind option has been enabled for the *Delete* function, all network elements removed from the diagram are also removed from the working case.

Unless the edited diagram has been saved, *Edit > Undo* will reverse the last 30 actions, undoing both *[Diagram]* and network changes.

To copy a diagram from PSS®E to another application, such as Microsoft® Word, the system clipboard is used. Select *Edit > Copy to clipboard*. This action copies everything visible in *[Diagram]* to the clipboard; the user cannot select specific elements. To paste the clipboard contents to another application, use the paste function in that application. Note that the system copy is a screen capture of the *[Diagram]* view; and if components have been highlighted, the handles will be visible in the pasted copy.

3.6.4. Binding Data

Selecting *Bind Items* toggles the binding mode, where all selected diagram items are synchronized with their associated network data.

When *Bind Items* is enabled, a check mark is displayed in the menu. If a network item is deleted in the diagram, it will be deleted from the working case. Consequently, there will be no data displayed in either *[Network Tree]* or *[Network Spreadsheet]*; and the item symbol will disappear from the diagram. Similarly, if network items are pasted into *[Diagram]*, then a corresponding network item will be added to the working case and will appear in both *[Network Tree]* and *[Network Spreadsheet]*.

The *Bind Items* option also affects diagram elements deleted from *[Network Tree]*. The delete action removes the network item from the working case and, consequently, from *[Network Spreadsheet]*. However, in *[Diagram]* the symbol representing the network item remains in view, but its color changes to the previously specified unbound color, indicating that the item is no longer part of the working case.

Conversely, if the Bind Items option is not selected when a diagram item is deleted, it is deleted only from the diagram but remains part of the power flow case. It will thus still be available in both *[Network Tree]* and *[Diagram]*.

Network components drawn in *[Diagram]* that *do not* correspond to existing items in the network will be displayed in an unbound item color. Network components drawn in *[Diagram]* that *do* correspond to existing items in the network will be displayed in bound item colors, unless over-ridden by range checking coloration. Both the bound and unbound colors can be set by the user in the *[Diagram Properties]* dialog (Section 3.2, "Specifying Diagram Properties").

3.6.5. Displaying and Modifying Network Elements

Refresh: This right-click menu function redraws all items in the diagram.

Locate bus: The *[Select Bus]* dialog initiates a search for the location of a specified bus. If the bus exists in the diagram, it is centered in *[Diagram]* and highlighted. If a requested bus is not in the diagram, a pop-up message is displayed.

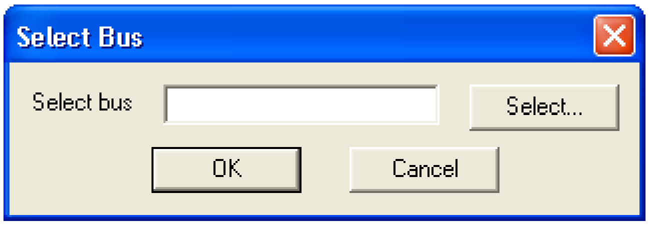


Figure 3.12. Select Bus Dialog

Display: Diagrams may be comprised of multiple layers, where each layer has an associated display list, a list of graphical objects. Individual network items are drawn in display-list order. If it is desirable to have a particular item drawn after or before another, for example, where two diagram items occupy the same general area in *[Diagram]* and one needs to be drawn over the other, layers become necessary. For each of the following functions, a network element must be highlighted.

Selecting *Display* > *Bring to Front* moves the specified item to the end of the display list. This object is drawn last, on top of the other graphical objects in the same layer.

Selecting *Display* > *Send to Back* moves the selected item to the beginning of the display list. This object is drawn first, and other items in the same layer should be drawn on top of this network item.

Selecting *Display* > *Center* moves the specified item to the center of *[Diagram]*.

Selecting *Display* > *Assign to Layer* opens the *[Select Layer]* dialog to move the selected item to a predefined layer (see Figure 3.76, “Setting the Active Layer”).

Grouping: Diagram items may be grouped into logical units. These units can then be modified as a single entity. Grouping items together is particularly helpful when moving a collection of diagram elements. A group cannot consist of only one item.

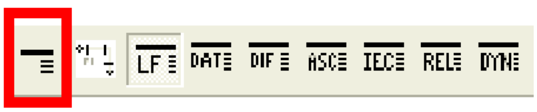
Diagram items can belong to only one group at a time. If you attempt to reassign an item to another group, it is removed from the existing group before being added to the new group. Define a block to be grouped by dragging the mouse on a portion of the diagram. Or define the group one item at a time by using *[Ctrl]*+ left-mouse-click to selectively add items to the group. Select *Grouping* > *Group* to build a group out of all the specified diagram items.

To return a group to its individual items, highlight the group by clicking any item. Then select *Grouping* > *Ungroup*.

The system manages annotations (labels) associated with a given device as if it were grouped with the device. If the device is deleted, the related annotation is also deleted. If the selected device is moved, the related annotation is also moved. Therefore, adding a device to a larger group, in effect, adds all the related annotation to the larger group as well. This grouping behavior automatically moves annotations when the device is moved (called autopositioning), but can be disabled by selecting *Item Properties > Auto Position*. When autopositioning is disabled, the annotation must be explicitly selected to be added to the group during the grouping operation.

Labels: The user can *show* or *hide* diagram labels (also called annotations). In order to be activated, the *Labels > Toggle label selectability* option is used to open the following dialog.

Figure 3.13. Make Labels Selectable Dialog



After selectability is activated, use the toggle button in the toolbar to show/hide the labels.

Manage Layers: The *[Layers]* dialog (Figure 3.74, "Layers Dialog") provides the means to create layers for a specified diagram. Each layer has its own *Visibility* options, as well as an option to turn selectability on and off. See Section 3.17.3, "Diagram Layers ".

Manage Views: The *[Saved Views]* dialog (Figure 3.14, "Saved Views Dialog") provides provides the means to create and retrieve a variety of one-line diagram presentations. These may be desirable for re-displaying unique views of the data, for example, results at different zoom levels from different parts of the network. If specific views are needed on a regular basis, then those views can be stored for rapid retrieval.

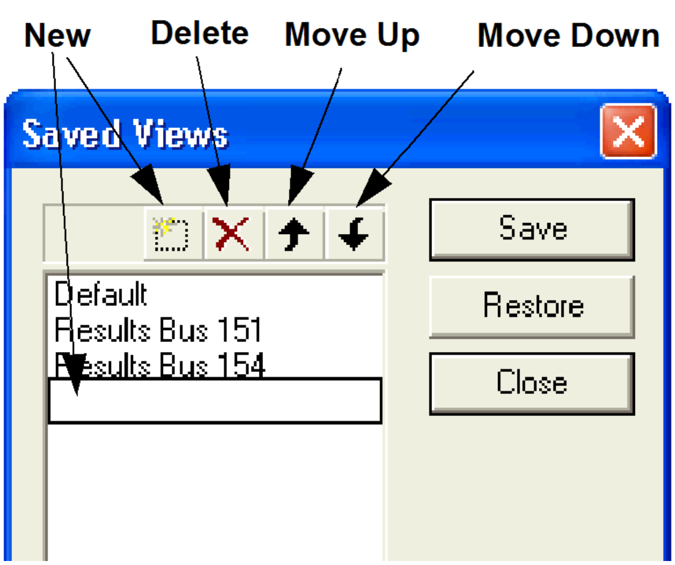


Figure 3.14. Saved Views Dialog

Click the new view icon, enter a name for the current view, and click *[Save]*. The title of the view appears in the dialog list. Double-click the title to edit the view. Highlight the desired view and click *[Restore]* to reposition the diagram to the saved view. Highlight the desired view and use the up and down arrows to reorder the list. Any view except *Default* may be deleted.

Network Data: Highlight the desired network item and select this function to activate *[Network Spreadsheet]*, which displays the appropriate data tab and highlights the appropriate row. The data can then be examined and manipulated as desired. Only one network item at a time may be selected. See also Section 3.6.1, “Using Data Records ”.

Create bus subsystem: Define a block to be defined by dragging the mouse on a portion of the diagram and select this function to define a bus subsystem. Both *[Spreadsheet]* and *[Network Tree]* will be updated to reflect the new subsystem selection.

Diagram Annotation: This function opens the *[Powerflow Data Annotation]* dialog (Figure 3.44, “Power Flow Data Annotation Dialog”) where diagram annotations (that is, branch, bus, equipment labels and diagram title) and diagram range checking options can be set. These are described in Section 3.8.1, “Power Flow Annotation ” and Section 3.8.2, “Range Checking ”.

Item Properties > Auto Position: If no network item is specified, this function opens the *[Enable Auto Position]* dialog, where the auto-position mode for the entire diagram may be set. If only one equipment item or annotation is specified (i.e. machine, load, capacitor), then the *Auto Position* option can be toggled ON or OFF for the selected element.

If auto-positioning is enabled, the equipment or annotation connected to a bus will orient itself perpendicular to the bus. Toggling this property OFF allows the diagram item to be positioned in any orientation (see Figure 3.15, “Impact of Auto-Positioning”).

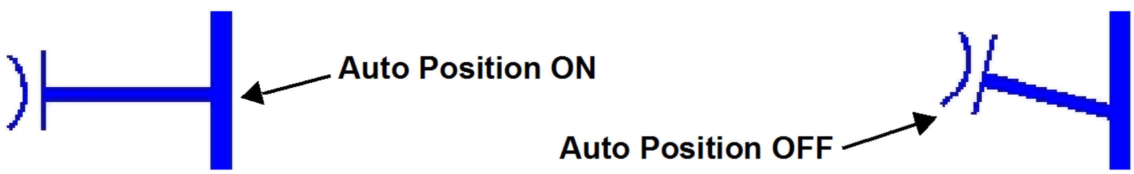


Figure 3.15. Impact of Auto-Positioning

Item Properties > Auto Relink: If no bus is specified, this function opens the *[Enable Auto Relink]* dialog, where the auto-relink mode for all buses in the diagram may be set. If only one busbar/bus node is specified, then the *Auto Relink* option can be toggled ON or OFF for the selected bus.

If auto-relinking is enabled, moving or re-sizing a busbar causes the attached branches and transformers to re-attach themselves for a perceived optimal representation. Toggling this property OFF allows the busbar to be moved or re-sized without affecting the attachment of branches and transformers.

Item Properties > Auto Rotate: When a non-bus item is specified, this function opens the *[Enable Auto Rotate]* dialog, which allows equipment connected to the bus to rotate when the bus is rotated. Toggling this property OFF keeps the original position of the equipment when the bus is rotated.

Item Properties > Font: When a label (annotation) is specified, this function opens the *[Font]* dialog (Figure 3.4, “Font Dialog”) from which a new text font, style, and point size for the selected item and its result labels can be applied.

Item Properties > Line Style / Color: When a line is specified, this function opens the *[Line Style]* dialog (Figure 3.16, "Line Style Dialog") from which the line type (solid or dotted), width, and color may be changed. This function may also be used to change the color of annotations or primitive shapes. Primitive shapes include straight lines, arcs, circles, polygons, etc., available on the Diagram Toolbar with the other network diagram elements.

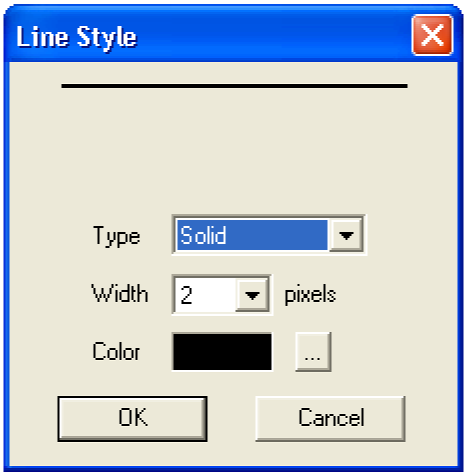


Figure 3.16. Line Style Dialog

Item Properties > Visible: When a network item is specified, it may be made invisible using this function. The item is still available, as its handles appear when the location of the item is clicked. Thus, an invisible network item may be made visible using this function.

Item Properties > Unbind: When one or more diagram elements are specified, they may be disassociated from the corresponding network item, overriding the previously enabled binding. In order to re-establish binding, the network model item in *[Network Tree]* and the diagram element must be reselected. Then select the *Bind* option from the *[Network Tree]* right-click menu.

Item Properties > Location: Certain diagram elements allow the specification of GIS coordinates. This is useful for providing locations for network elements for use with Google Maps.

Item Properties > Map String: This is used to edit the mapping string used to associate a diagram item with a specific network element. Most users will have no need to alter this field, but certain Python APIs can be used to set and query these map strings and perform operations based on results.

Item Annotation: When a network item is specified, an item-specific dialog provides the means to change the way its annotation is displayed. For example, the *[Bus Annotation Properties]* dialog (Figure 3.29, "Bus Annotation Properties Dialog") is displayed when the specified item is a bus. You may choose to apply the changes to the specified bus or to all buses. See also Section 3.8.1, "Power Flow Annotation ", Section 3.9.1, "Impedance Annotation ", Section 3.10.1, "Comparison Annotation", Section 3.11.1, "Fault Analysis Data Annotation ", Section 3.12.1, "IEC Fault Analysis Annotation ", Section 3.13.1, "Reliability Annotation ", and Section 3.14.1, "Dynamics Annotation ".

The items at the bottom of the *[Diagram]* right-click menu are customized to the element(s) selected. Figure 3.17, "Customized Right-Click Menu" shows the difference between specifying one or two buses and lines. Other functions are available when another type of equipment is selected (i.e., load, machine, etc). This sections provides a description of all possible functions.

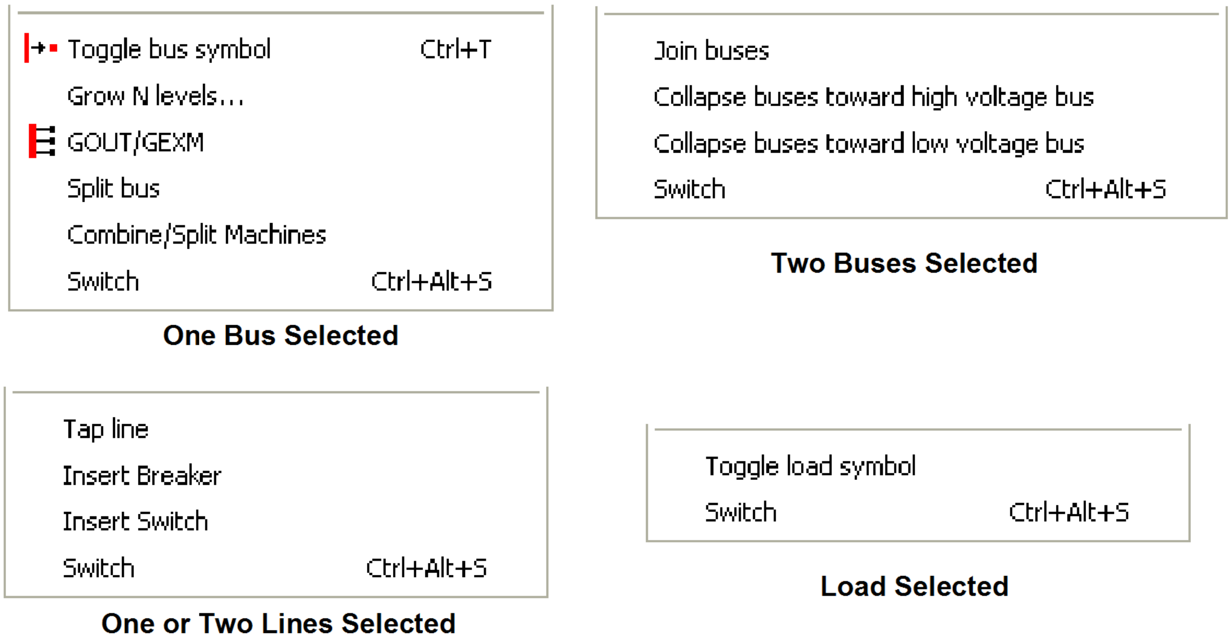


Figure 3.17. Customized Right-Click Menu

Toggle bus symbol: This function toggles the specified bus between the busbar and busnode representations (see Figure 3.18, “Alternative Bus Symbols”).

Figure 3.18. Alternative Bus Symbols

Grow N Levels: The *[Specify Grow Levels]* dialog specifies a method for drawing elements connected to the bus (see Section 3.7, “Using Auto-Draw”).

Split bus: The *[Split Bus]* dialog requires a new bus number, name and base kV for the additional bus. Click *[OK]* to split the bus, preserving the existing one and adding the new one to the diagram. Equipment and lines can then be dragged to the new bus. See also Section 7.4, “Splitting Buses”.

Join buses: This function is available when two buses have been specified. The *[Join Buses]* dialog requires specification of an option to handle *Line shunts of deleted in-service branches*. Click *[OK]* to join the two buses into a single retained bus. See also Section 7.3, “Joining Buses”.

Switch: This function changes the status of a network component. Visual representation of out-of-service equipment is specified using *[Powerflow Data Annotation]* (see Section 3.8.2, “Range Checking ”). A summary of the change is routed to the *Progress* tab (Figure 3.19, “Example of Switch Function to Out-of-Service”). When using this function to disconnnect a bus, its type code is set to 4 and all ac branches, dc lines, and series FACTS devices connected to the bus are represented as out-of-service.

Toggle load symbol: This function toggles the specified load symbol size.

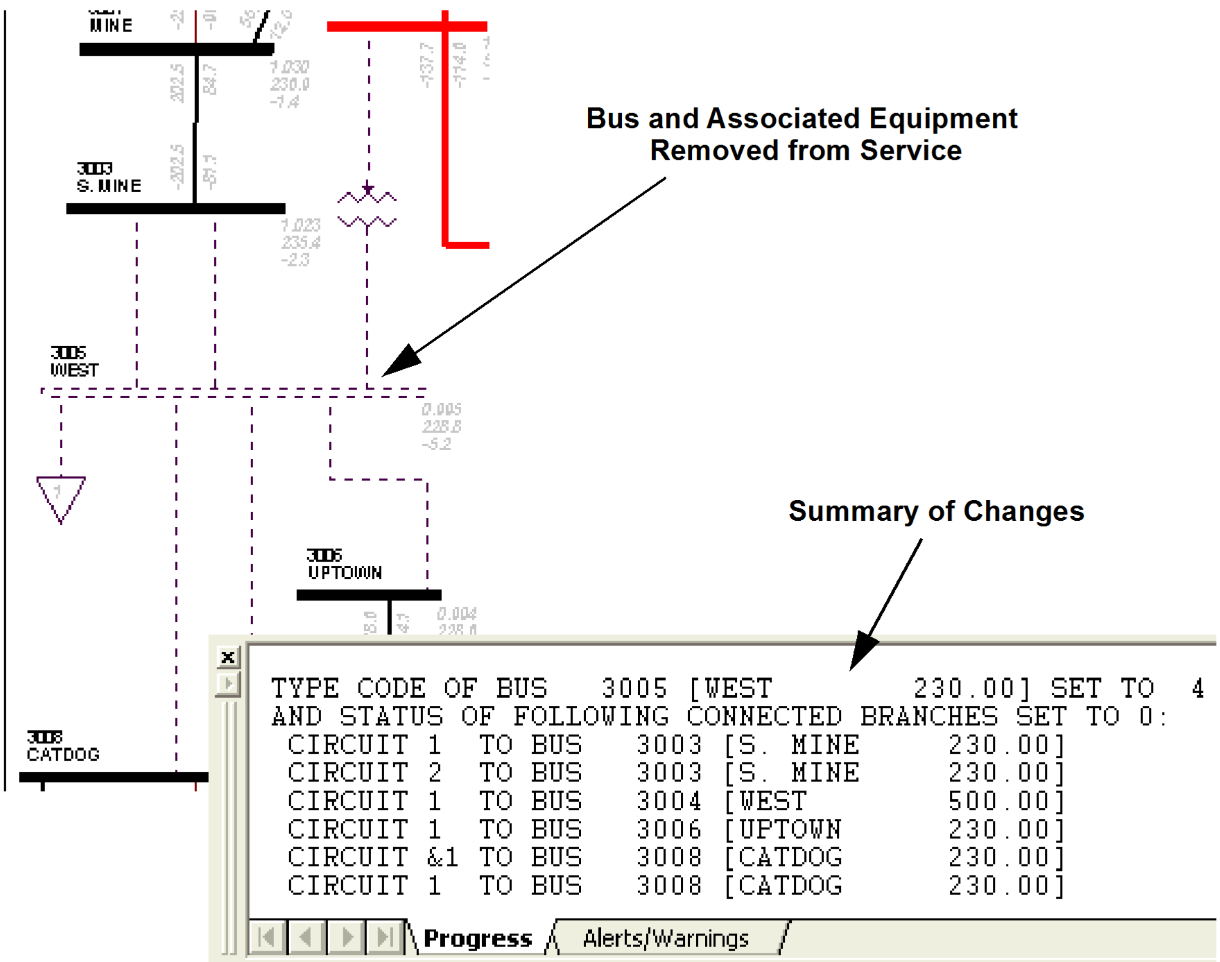


Figure 3.19. Example of Switch Function to Out-of-Service

For bus connected capacitors and reactors the *Switch* option is not available. To switch the status of capacitors and reactors, double-click the network item (or right-click and select *Network data...*) to edit the status field of the corresponding data record in *[Spreadsheet]*.

Combine/Split Machines: This function is available when a single bus with at least one connected machine is selected. When performed, it combines multiple machine diagram items at the bus into a single summing machine symbol, where results are summed for total generation at the bus. A summing machine symbol has no machine ID in the center of the symbol, whereas a machine diagram item representing a single machine has a machine ID in the center of the symbol.

If only a summing machine symbol exists on the bus, selecting the bus and the *Combine/Split Machines* function will remove the summing machine symbol and replace it with one or more machine diagram items representing the individual machines at the bus.

Combine/Split Loads: This function is available when a single bus with at least one load is selected. Its action is comparable to *Combine/Split Machines*, affecting the bus load.

Combine/Split Fixed Shunts: This function is available when a single bus with at least one fixed shunt is selected. Its action is comparable to *Combine/Split Machines*, affecting the fixed shunt.

Collapse buses towards high voltage bus: This function is available when two buses are selected. It is used to visually change the layout in *[Diagram]*, and has no effect on the actual network. When performed, all components on the lower voltage bus appear to be connected to the high voltage bus, and the lower voltage bus is removed, as well as any connections between the two buses. Only *[Diagram]* is affected; these components are not removed from the actual network. If an analysis is performed, all components of the two buses are included in the calculations.

Collapse buses towards low voltage bus: This function is available when two buses are selected. It is used to visually change the layout in *[Diagram]*, and has no effect on the actual network. When performed, all components on the lower voltage bus appear to be connected to the low voltage bus, and the higher voltage bus is removed, as well as any connections between the two buses. Only *[Diagram]* is affected; these components are not removed from the actual network. If an analysis is performed, all components of the two buses are included in the calculations.

Tap Line: This function is available when a line is selected. The *[Tap Line]* dialog requires specification of the tap location and identification of the new bus. Any nontransformer branch may be tapped. Click *[OK]* to tap the line. See also Section 7.5, “Tapping a Line”.

Insert Breaker: This function is available when a line is selected. This is used to insert a dummy bus node and a specially identified zero impedance line that is used to model a breaker in substation reliability analysis. The *[Insert a Breaker]* dialog (Figure 3.20, “Insert a Breaker Dialog”) requires specification of the dummy bus created to build the breaker. Click *[OK]* to add the breaker.

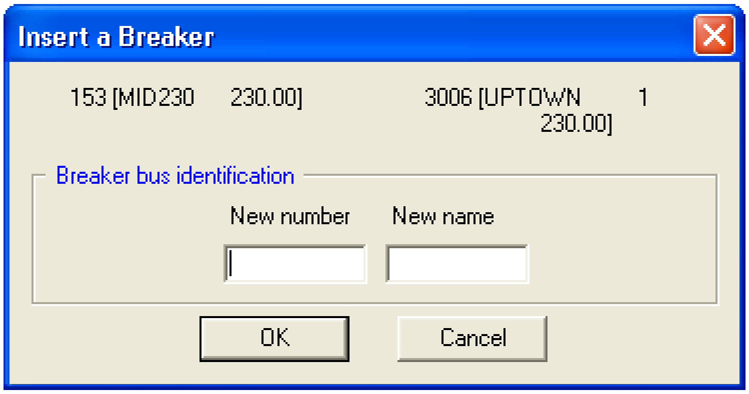


Figure 3.20. Insert a Breaker Dialog

Insert Switch: This function is available when a line is selected. This is used to insert a dummy bus node and a specially identified zero impedance line that is used to model a switch in substation reliability analysis. The *[Insert a Switch]* dialog (Figure 3.21, "Insert a Switch Dialog") requires specification of the dummy bus created to build the switch.

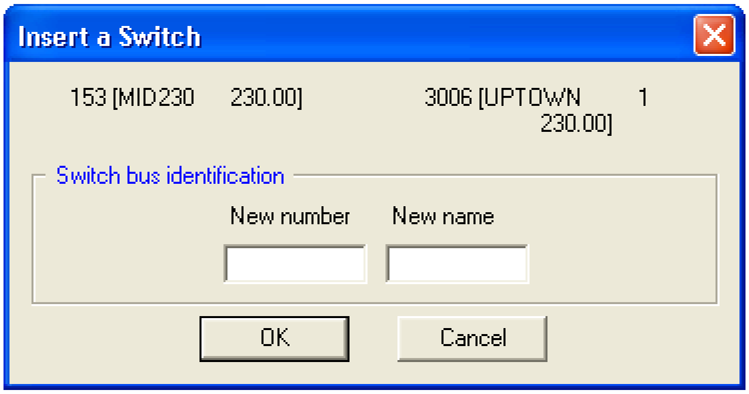


Figure 3.21. Insert a Switch Dialog

3.6.6. Drawing a Missing Bus

If a bus is present in the working case but is not drawn in the active diagram, it is indicated in the expanded *[Network Tree]* without the busbar symbol (see Figure 4-2). Right-clicking the missing bus activates a *Draw* option. Selecting Draw from the pop-up menu draws the bus and all its equipment in the active *[Diagram]*.

3.6.7. Renumbering Buses in the Diagram

File > Renumber Buses in Diagram (RNFI)...

The *Renumber Buses in Diagram* option is available only when working in *[Diagram]*. It opens the *[Bus number translation file]* selection window for the required Bus Number Translation file (*.trn). The creation of this file is described in Section 7.16, "Renumbering Buses". The file contains records of old bus numbers and the corresponding new numbers.

3.6.8. Specifying Bus Locations from a File

File > Open...

Loading a Bus Location Data File (*.loc) from the *[Open]* dialog allows the bus locations in the diagram to be specified from the same Cartesian or GIS coordinates across repeated analyses or different working case subsystem configurations.

File data is used to position any buses drawn or *Grown* for which an entry exists in the file. Those buses in the working case that are not defined in the file are assigned default locations in the diagram.

The same file is used to reposition buses in an existing diagram; select *Diagram > Update bus locations* after the file is loaded. If no Bus Location file has been loaded, this function is disabled. Buses may be specified for repositioning. If buses are selected, only those buses will be evaluated for update. If no buses are selected, all buses in the diagram will be evaluated for update.

Bus Location Data File Contents

Bus positions on a diagram may be specified in a Bus Location file that can be accessed whenever a bus is created. These positions can be specified as x/y coordinates or as GIS coordinates in an hour, minutes, seconds format. The format of the file is as follows:

[BUSES | BRANCHES | NODES]

The first record of a block specifies what kinds of network items are being given locations. This can be left out of the first block as the default assumption is BUSES.

[CARTESIAN [SCALE] | GEOPHYSICAL [LATLON]]

The first record in the file describes the format of all bus position records. CARTESIAN specifies that bus positions are provided as x/y locations on the diagram. GEOPHYSICAL specifies that bus positions are provided in GIS form as two pairs of hour, minute, seconds inputs.

If CARTESIAN is specified, a scale can be specified to give more detail on how the CARTESIAN units translate to physical units. By default the positions will translate into logical inches on the diagram.

If GEOPHYSICAL is specified, the optional keyword LATLON may be added to specify that LATITUDE will be specified before LONGITUDE for each position record.

If this line is left out, GEOPHYSICAL will be assumed.

Degrees are specified as a set of 1 to 3 real numbers (degrees, minutes, seconds) followed by a direction (E, W, N, S) (the direction can be omitted if all three numbers are specified). Positive values are interpreted as E or N, negative values as W or S. The degree parts can be separated by spaces, commas, apostrophes, or by the specific unit markers for degree, minutes, or seconds (in which case they must be used in order).

For example, the following all represent the same value:

79°30'36W

-79 -30 -36

79.51W

-79.51,,,

The Bus Location file *does not* require an entry for every component in the case. If a position record is not found in the file when positioning a component on the diagram, default component positioning is used. If a component is specified that does not exist in the case, that component's record will be ignored.

If BUSES has been specified, then the next N lines will use the following format to specify bus positions.

The format of a bus position record is as follows:

```
BusId, X location, Y location, Rotation, Length
```

where:

BusId	A bus number.
X location	The bus X location on the diagram.
Y location	The bus Y location on the diagram.
Rotation	The optional bus rotation, in degrees.
Length	The optional length of the busbar, in inches. A point bus will be used if Length is zero.

If BRANCHES has been specified, then the next N lines will use the following format to specify branch, two winding transformer, or system switching device positions. The first and last coordinate pair can be used to specify where on a bus the branch should connect. However, automatic re-linking should make this unnecessary, so only knee point positions should be specified.

The format of a branch position record is as follows:

```
FromBusId, ToBusId, CircuitId, [X From loc, Y From loc], X KP1 loc, Y KP1 loc,
X KPn, Y KPn, [X To loc, Y To Loc]
```

where:

FromBusId	Either a bus number or a quoted extended bus name of the from bus.
ToBusId	Either a bus number or a quoted extended bus name of the to bus.
CircuitId	Circuit Id of branch.
X From loc	The from bus connection X location on the diagram.
Y From loc	The from bus connection Y location on the diagram.
X KP1 loc	The first knee point X location on the diagram.
Y KP1 loc	The first knee point Y location on the diagram.
X KPn loc	The nth knee point X location on the diagram.
Y KPn loc	The nth knee point Y location on the diagram.
X To loc	The to bus connection X location on the diagram.
Y To loc	The to bus connection Y location on the diagram.

If NODES has been specified, the next N lines will be use the following format to specify station node offsets from the station location.

The format of a node offset record is as follows:

```
StationId, NodeId, X location, Y location, Rotation, Length
```

where:

StationId	A station number
NodeId	A node number.
X location	The node X offset on the diagram.
Y location	The node Y offset on the diagram.

Rotation	The optional node rotation, in degrees.
Length	The optional length of the node bar, in inches. A point node will be used if Length is zero.

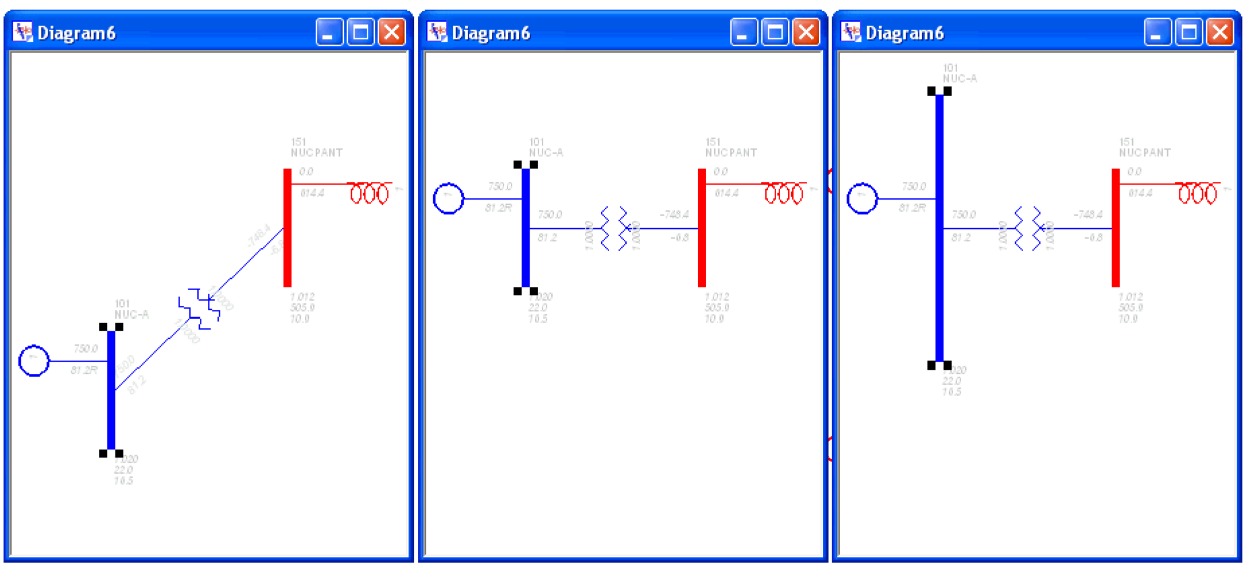
3.6.9. Moving Diagram Elements

Existing diagram items can be moved with mouse actions. Buses can be moved and their length changed. Equipment and lines can be repositioned on a bus or moved to another bus. If the *Bind Items* option is selected, then moving equipment and lines to another bus in *[Diagram]* will also move the equipment and lines within the network data.

To move or resize a bus, select the bus in the diagram with a mouse click, (see Figure 3.22, “Moving and Resizing Buses”a). If the *[Program Preferences]* dialog has been specified to Resize buses on one end only, the double-arrow mouse pointer will indicate this.

To move the bus to a different location, select the desired bus and position the mouse over the busbar. The mouse pointer will change to a four-arrow cursor. Drag the bus to the desired position (Figure 3.22, “Moving and Resizing Buses”b).

To make the bus longer or shorter, select the desired bus and position the mouse over one end of the bus. The pointer will change to a double sided arrow. Drag the bus end handle to the desired length (Figure 3.22, “Moving and Resizing Buses”c).



(a) Select Bus to Move **(b) New Position** **(c) Grab Bus End to Re-size**

Figure 3.22. Moving and Resizing Buses

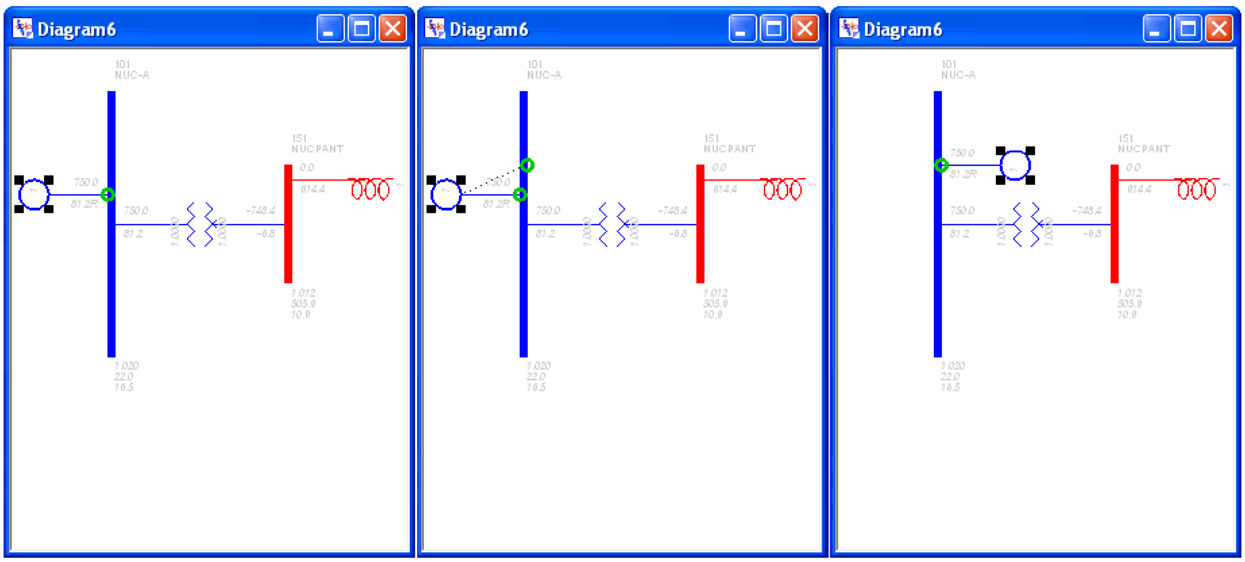
To move existing equipment and lines:

1. Click the diagram component you wish to move; a bus end connection is illuminated with a circle (Figure 3.23, “Moving Equipment”a).

2. Drag the end to the new attachment point. Valid attachment points will be illuminated with circles as the mouse passes over them (Figure 3.23, “Moving Equipment”b).

3. When the end illuminates the desired attachment point, release the mouse to connect the diagram component (Figure 3.23, “Moving Equipment”c).

The capacitor symbol direction from the bus can be controlled. Drag the connection circle to the desired edge of the busbar; the crosshairs in the circle will guide you.



(a) Selecting (b) Dragging to New Position (c) New position

Figure 3.23. Moving Equipment

Not only can equipment and lines be moved to another location on a bus but they can also be moved to another bus, using the same technique. If *Bind Items* is selected, (see Section 3.6.4, “Binding Data”) moving equipment and lines to another bus in *[Diagram]* will also move the equipment and lines in *[Network Tree]*. The change will also be reflected in *[Spreadsheet]*. Consequently, this is another form of modifying not only the power flow topology but also the location of equipment.

3.6.10. Changing Status

In addition to using the right-click *Switch* function (Section 3.6.5, “Displaying and Modifying Network Elements”), to toggle equipment to and from in-service status, the connection between *[Diagram]* and *[Spreadsheet]* may be useful. As shown in the following example, double-clicking a component in the diagram opens the spreadsheet tab and highlights the row containing that component’s data. In-service status may be enabled or disabled, as desired.

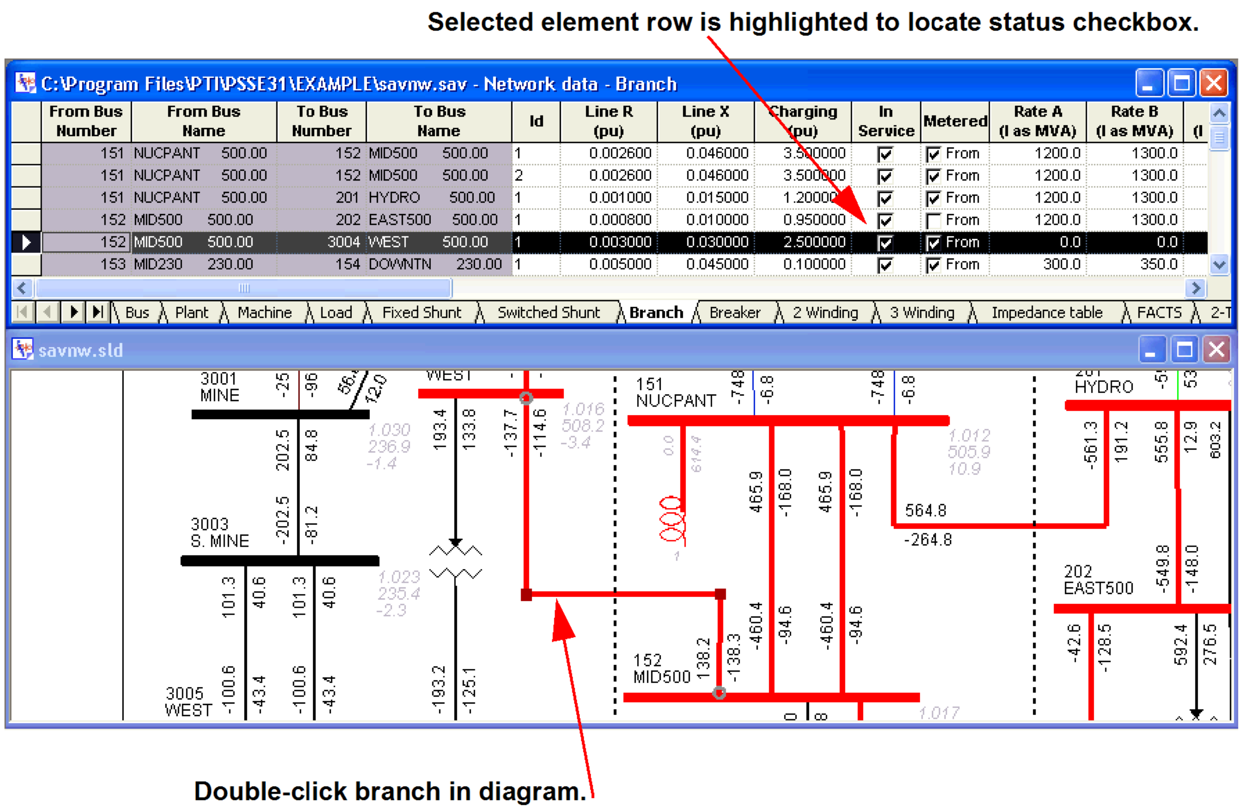


Figure 3.24. Changing Line Status from Diagram View

3.6.11. Displaying ISO Symbols

Diagram > Display ISO Symbols

This option modifies the images of network components, replacing PSS®E symbols with standard ISO symbols. Figure 3.25, "Examples of Transformer Symbols" shows the standard PSS®E transformer symbol, compared with the ISO symbol.

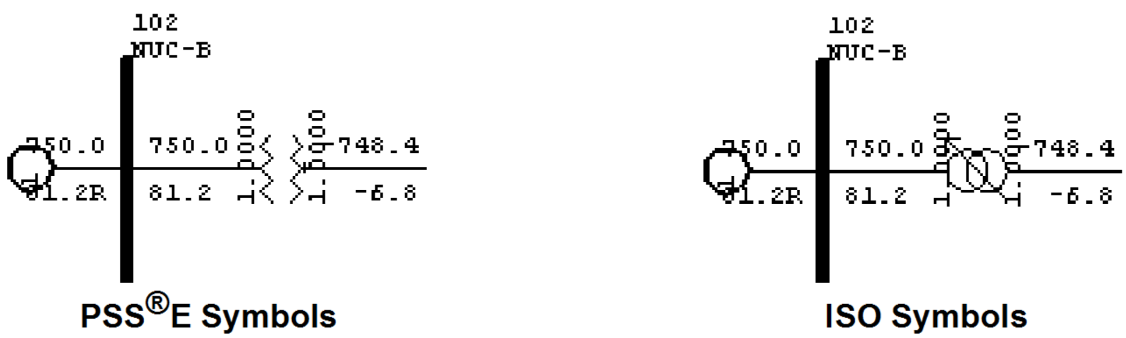
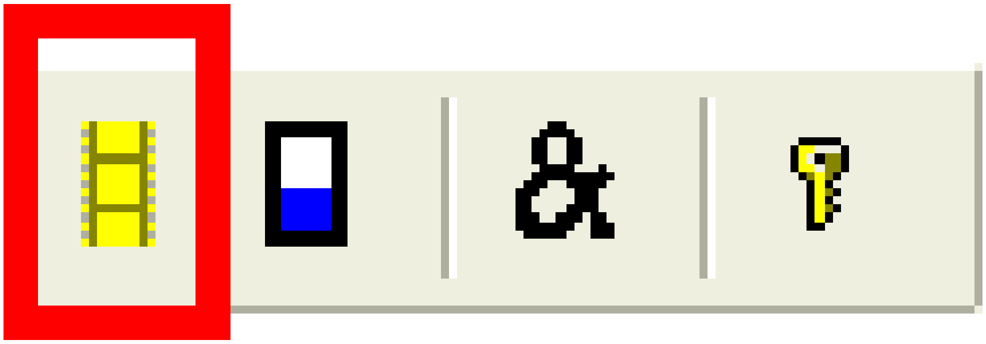


Figure 3.25. Examples of Transformer Symbols

3.6.12. Animating Flows



This function animates branch flows on the active *[Diagram]* using the flows from the last power flow solution (Figure 3.26, “Animated Flow”).

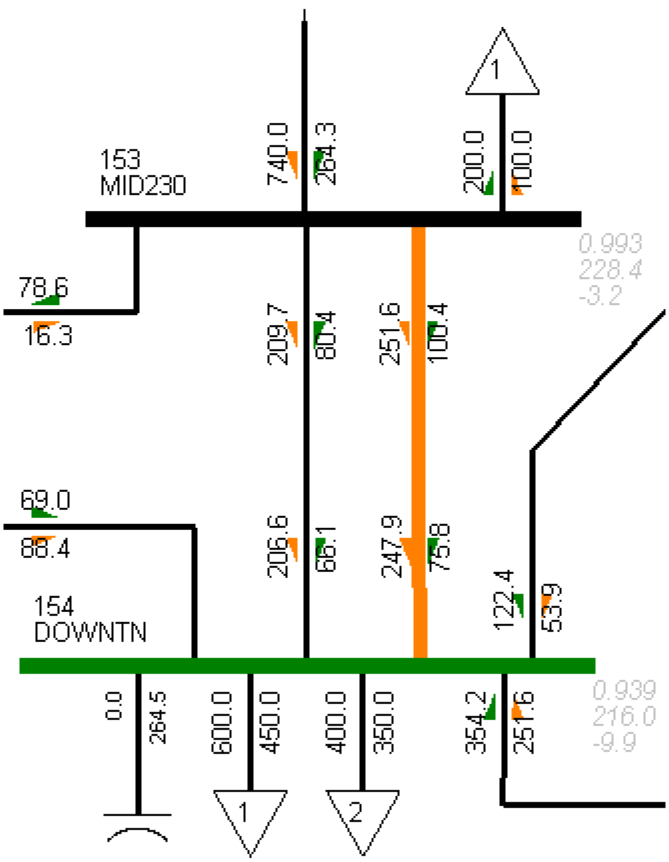
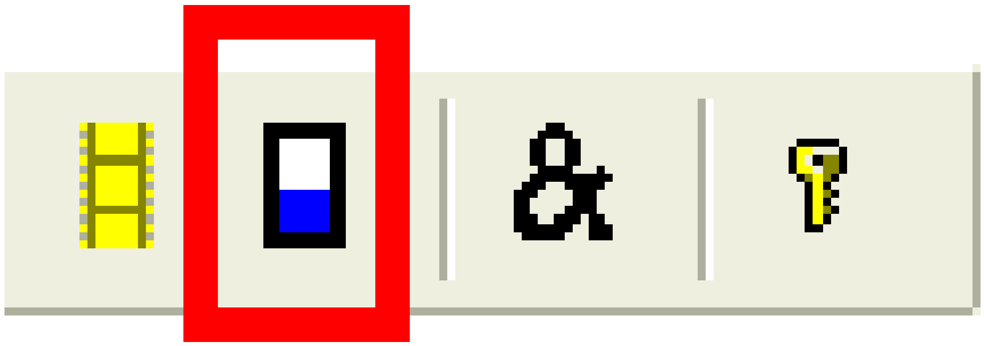


Figure 3.26. Animated Flow

3.6.13. Viewing Current Loadings



This function displays line loading graphs using values from the last solution (Figure 3.27, "Current Loading Blocks Indicating Flow Levels").

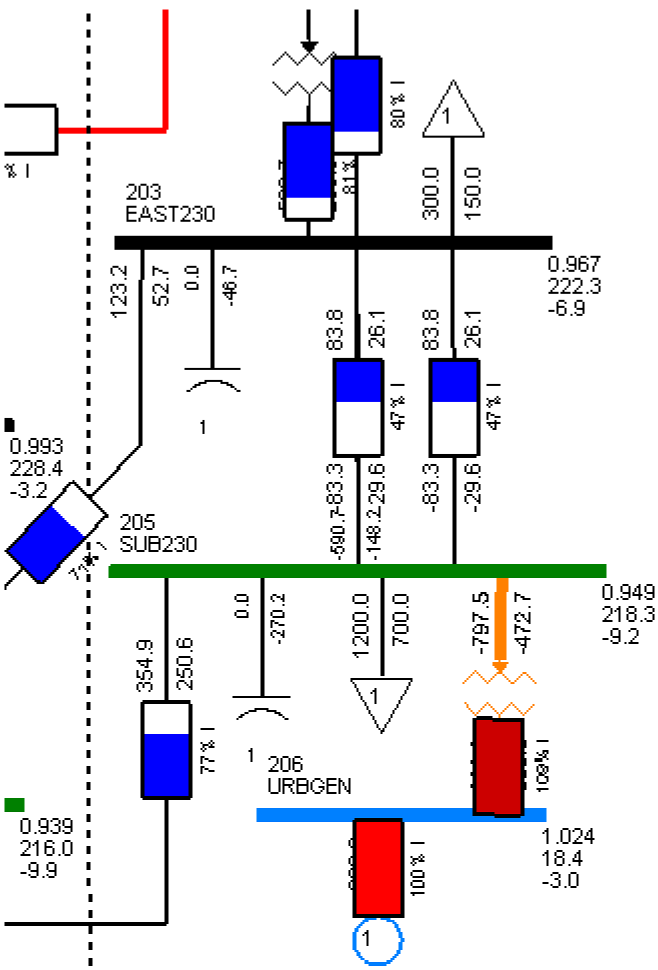
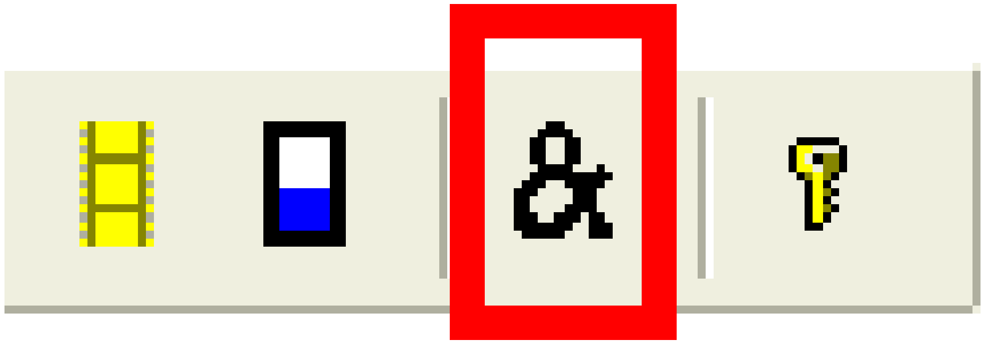


Figure 3.27. Current Loading Blocks Indicating Flow Levels

3.6.14. Multi-Section Line Reporting



This function displays or hides the dummy buses that constitute the terminals of multiple sections that make up a single line between buses.

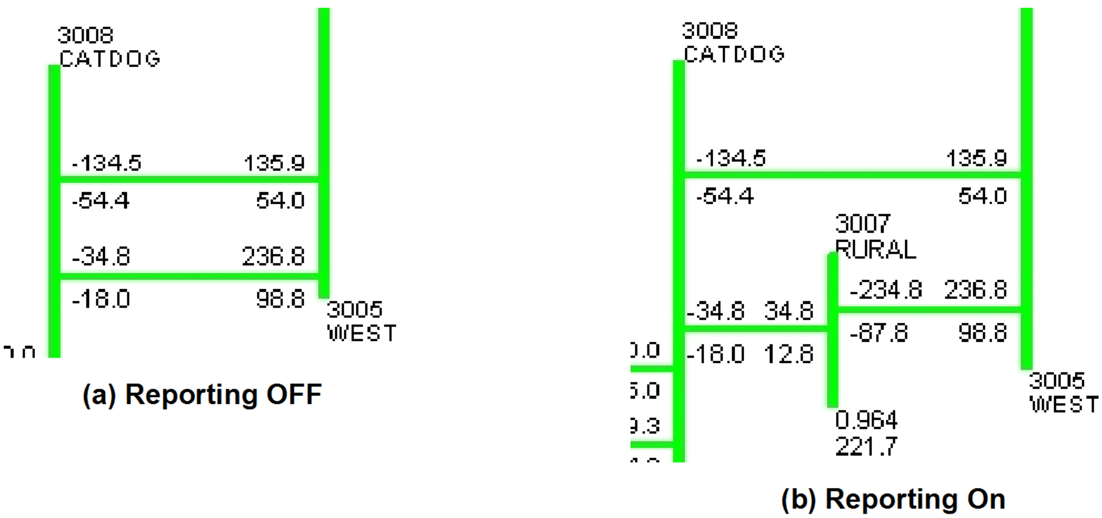


Figure 3.28. Multi-Line Section Reporting ON and OFF

3.6.15. Item Annotation

Right-clicking on a bus in *[Diagram]* opens the *[Bus Annotation Properties]* dialog (Figure 3.29, "Bus Annotation Properties Dialog"). The label displayed, as well as its positioning, can be specified. Furthermore, you can choose to suppress all annotation at the selected bus or to apply the annotation properties specified for the single bus to all buses by selecting the *Apply the selection option to all buses* checkbox.

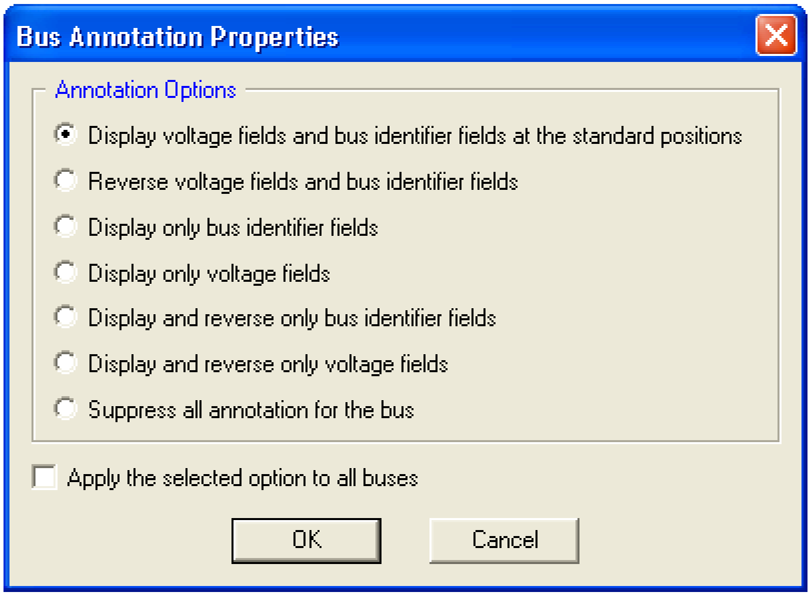


Figure 3.29. Bus Annotation Properties Dialog

Right-clicking on a load or a shunt capacitor/reactor opens the appropriate annotation properties dialog (see Figure 3.30, "Annotation Properties Options for Shunts and Loads"). You can choose the type of image or annotation, suppression of annotationy, and application of the properties to all shunt or load items.

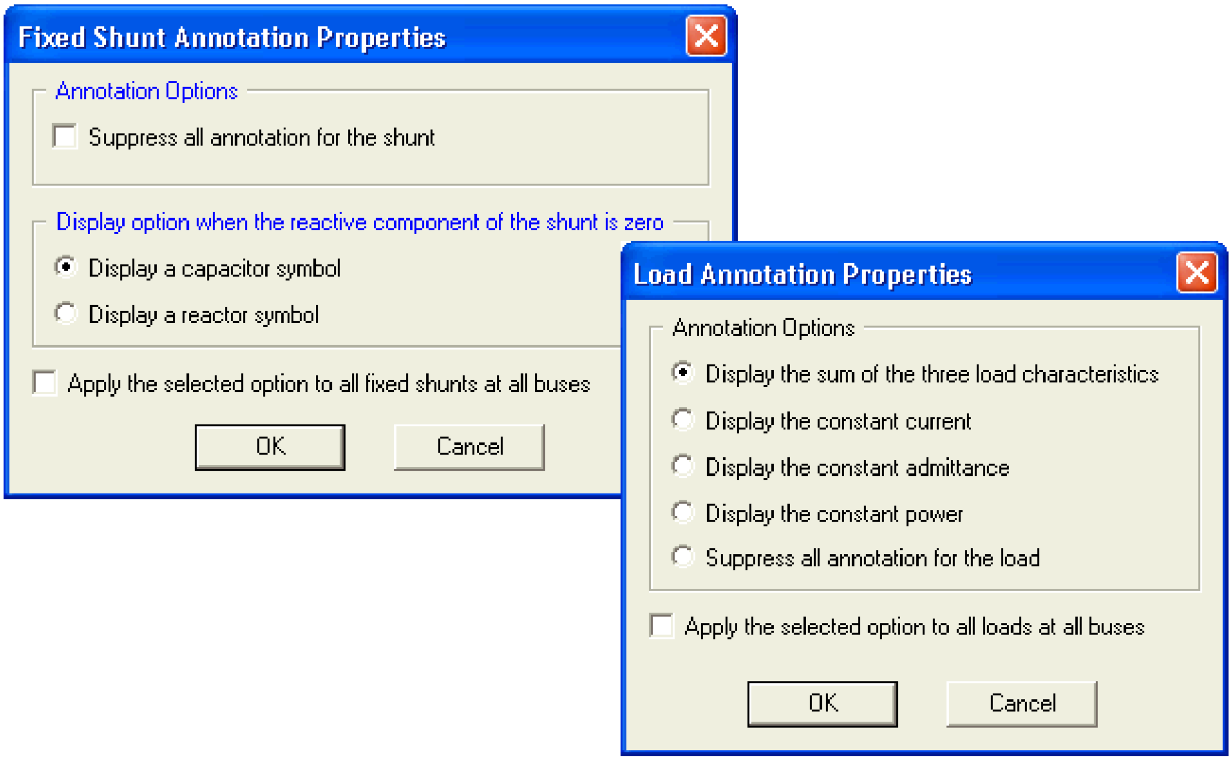


Figure 3.30. Annotation Properties Options for Shunts and Loads

Right-clicking on a branch or 2-winding transformer transformer (the transformer symbol itself, not the transformer line) and selecting *Item Annotation...* opens the *[Branch Annotation Properties]* or *[Two-Winding Transformer Annotation Properties]* (Figure 3.31, "Branch / Two Winding Transformer Annotation Properties Dialogs") dialogs, respectively. These dialogs are similar, except that when selecting a nontransformer branch, only the *Flow Annotation Options* are available, with the option to draw a series capacitor symbol or circuit ID.

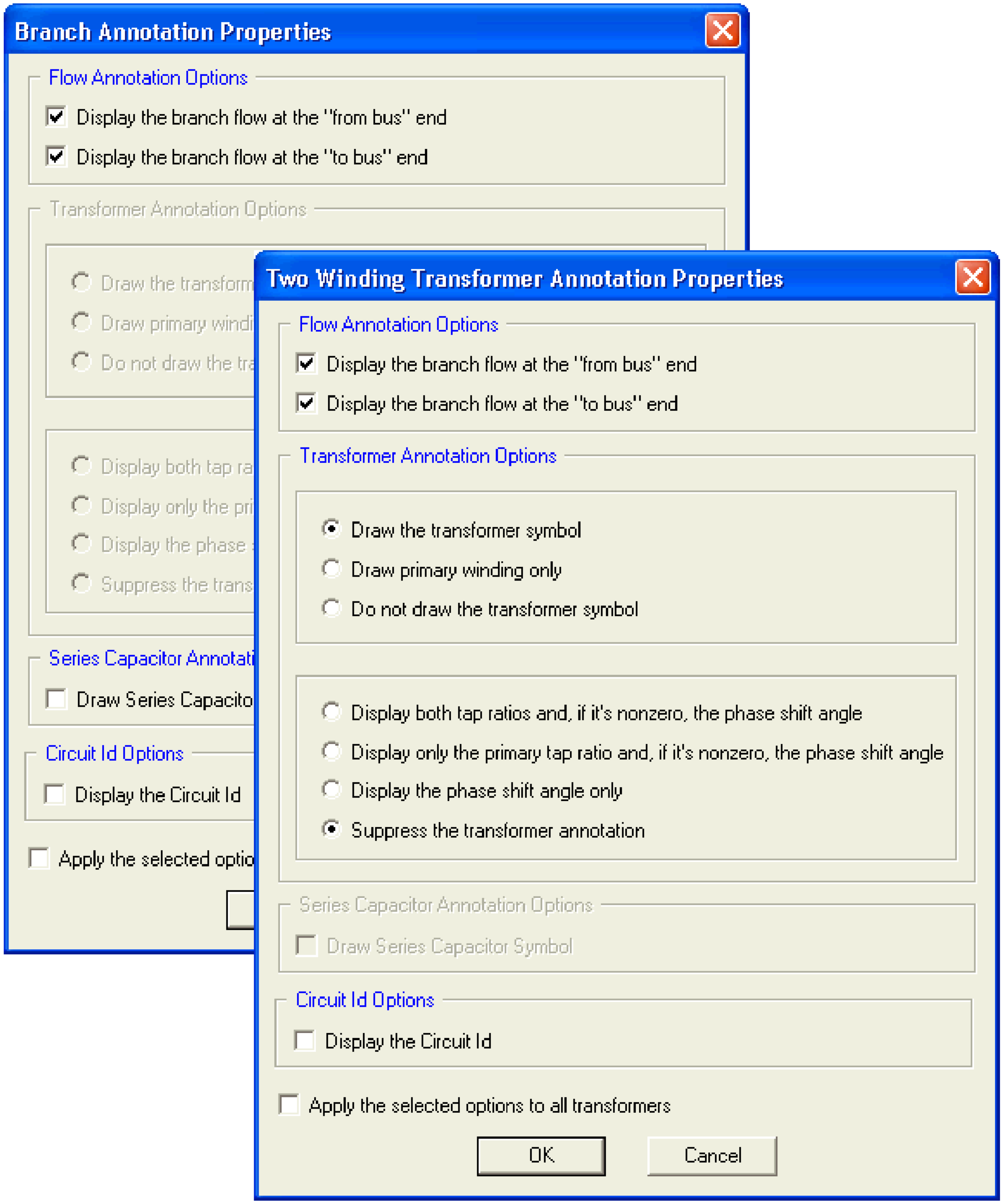


Figure 3.31. Branch / Two Winding Transformer Annotation Properties Dialogs

A separate dialog is provided for three-winding transformers, *[Three-Winding Transformer Annotation Properties]* (Figure 3.32, "Three-Winding Transformer Annotation Properties Dialog").

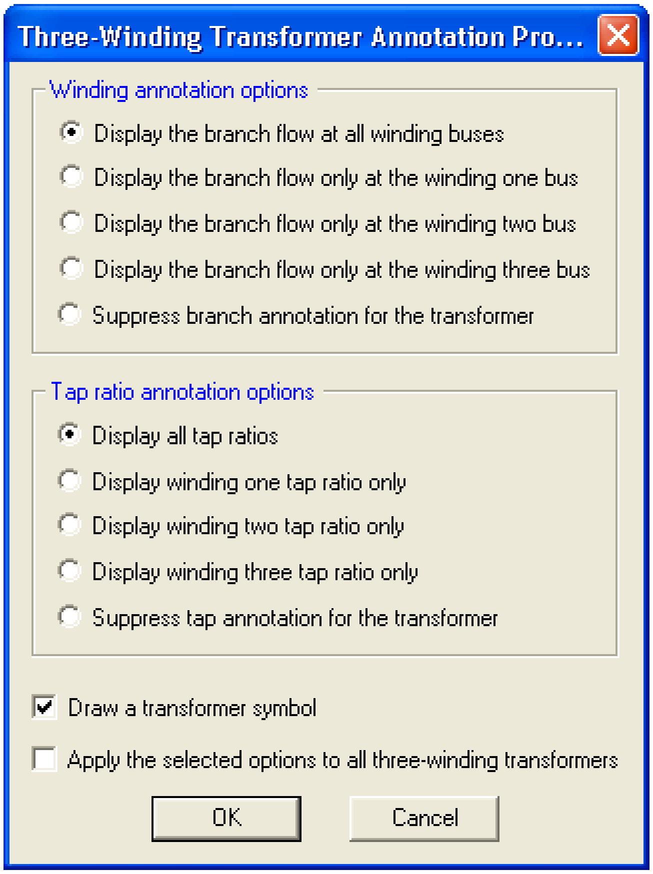


Figure 3.32. Three-Winding Transformer Annotation Properties Dialog

Dialogs are also available for annotating generators and multi-terminal dc lines (Figure 3.33, "Other Annotation Properties Dialogs") and FACTS devices (Figure 3.34, "FACTS Device Annotation Properties Dialog").

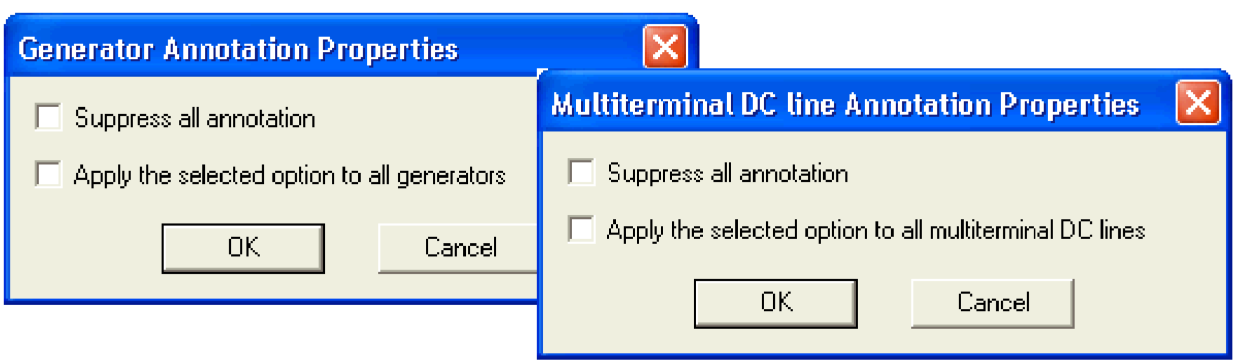


Figure 3.33. Other Annotation Properties Dialogs

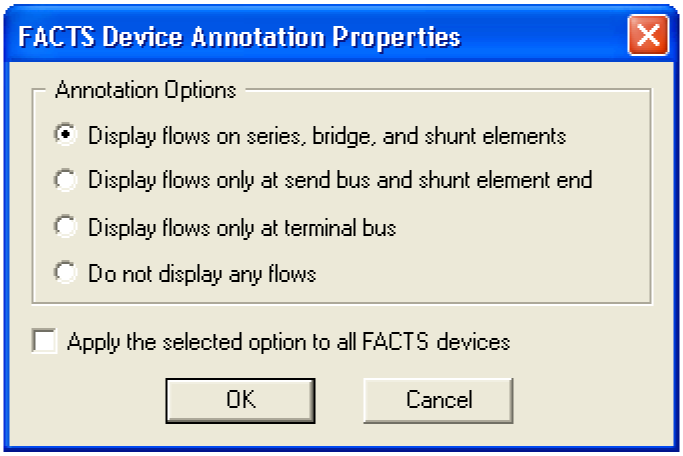


Figure 3.34. FACTS Device Annotation Properties Dialog

3.6.16. Contouring

Figure 3.35. Diagram > Contouring > Enable Contouring

The *[Contour Settings]* dialog provides the means to control contouring used to visualize voltage violations and magnitude for bus, line or machine elements.

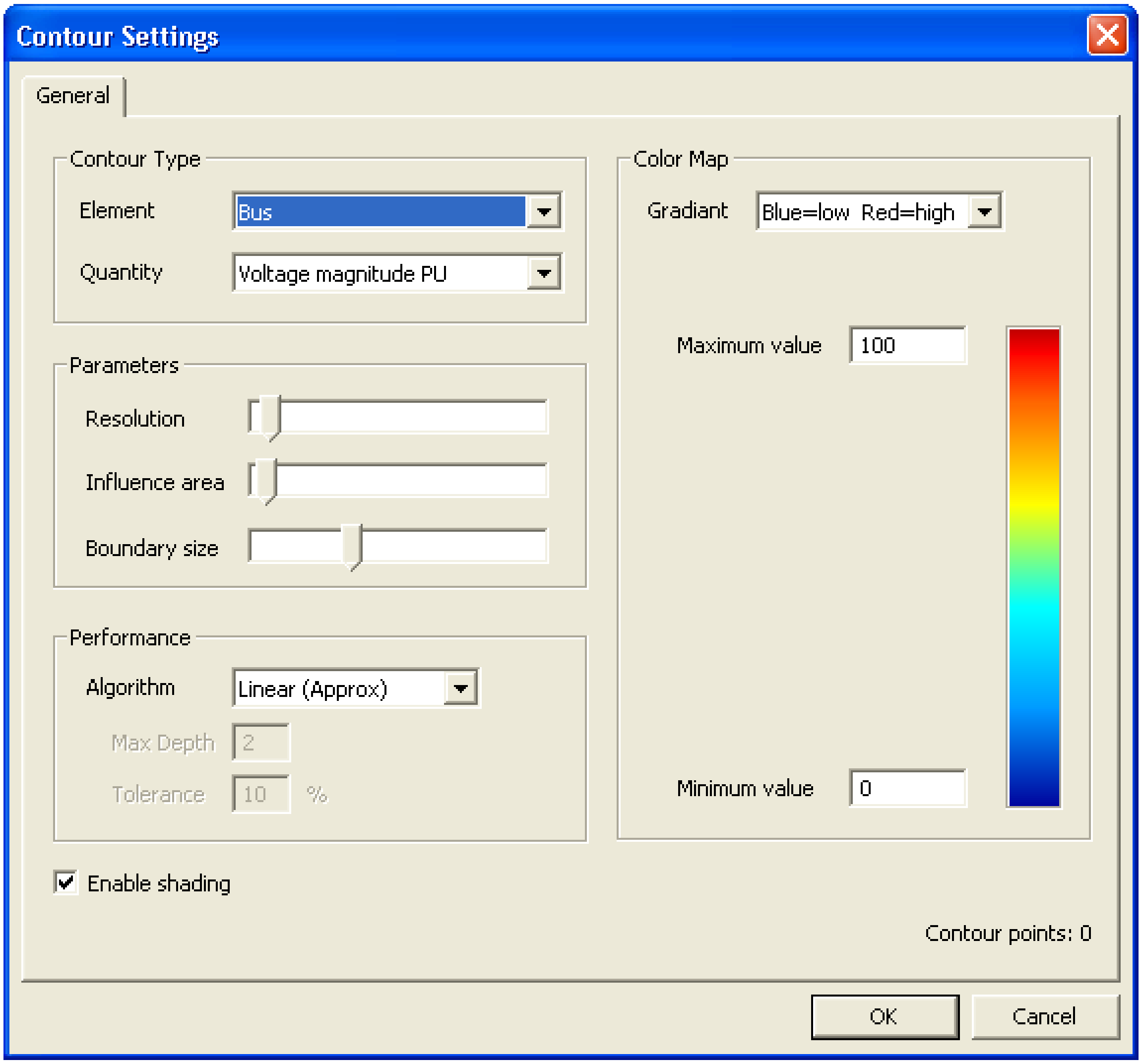


Figure 3.36. Contour Settings Dialog

One of the following quantities must be specified along with the contour type:

Bus Element			
• Voltage Magnitude, pu	• Angle rad	• Load MVA	• Zone
• Voltage Magnitude, kV	• Load P	• Area	• Scheduled Voltage
• Angle deg	• Load Q	• Owner	
Line Element			
• MW Flow	• MVA Flow	• Ampe	
• MVar Flow	• % Rating	• pu Current	
Machine Element			
• QGen	• QMax	• QMin	

The three contour parameters are selected from a sliding scale.

Resolution

Range 10 - 2000. To compute values across the entire contouring region, a virtual grid is super-imposed on the contour points. The value at each grid point is interpolated using actual values at the contour points. The weights are inversely proportional to the square of the distance from each contour point. Values at the grid points are then mapped to a color using the selected colormap before rendering is performed. A larger resolution results in a finer grid and more accurate results but also increases processing time.

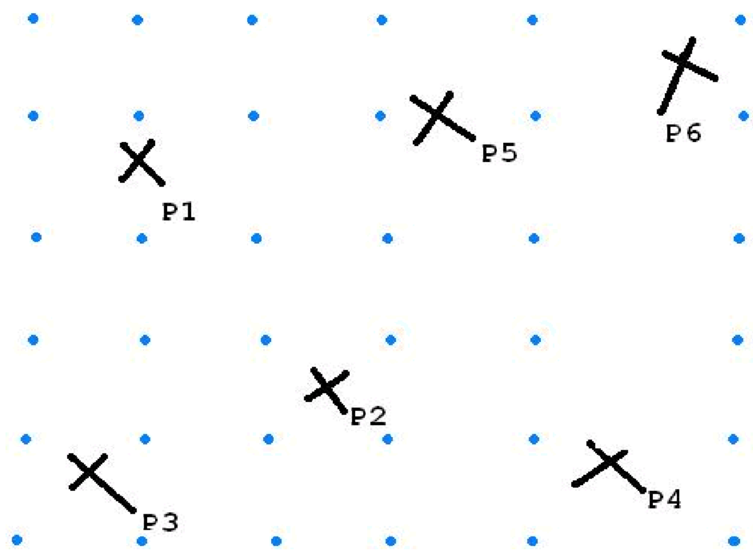


Figure 3.37. 6 X 6 Virtual Grid Superimposed on Contour Points P1 – P6

Influence Area

Range 1 - 100. Each contour point impacts a circular region, centered at the point with radius proportional to the influence setting. In the current implementation, the radius is equal to the square of the influence. A larger influence results in more blending and can be used for general overviews. Smaller settings are applied to highlight variations as each grid point is affected by fewer contour points. By decreasing influence, each grid point will be affected less by contour points farther away.

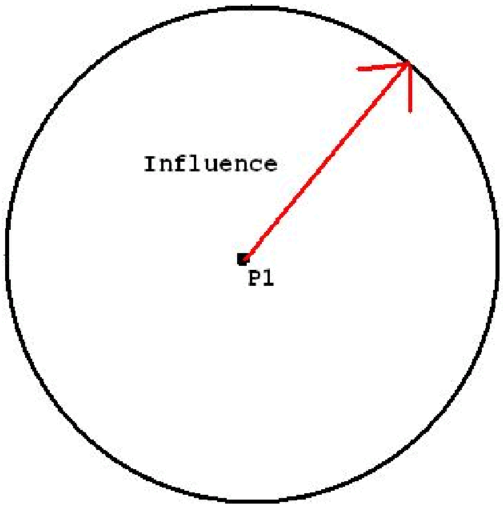


Figure 3.38. Circle of Influence around Contour Point P1

Boundary Size

Range 0 - 3. The typical setting is 0 or 1.

The user must specify one of the following interpolation methods.

Linear Approximation

The Linear Approximation method iterates over all contour points. A given contour point contributes to each grid point that lies within its circle of influence. Larger circles take longer to process therefore processing time is sensitive to changes in influence rather than resolution. This algorithm is faster than the Linear method while providing accuracy and is the current default. The order of the algorithm is O(m) where m is the number of contour points.

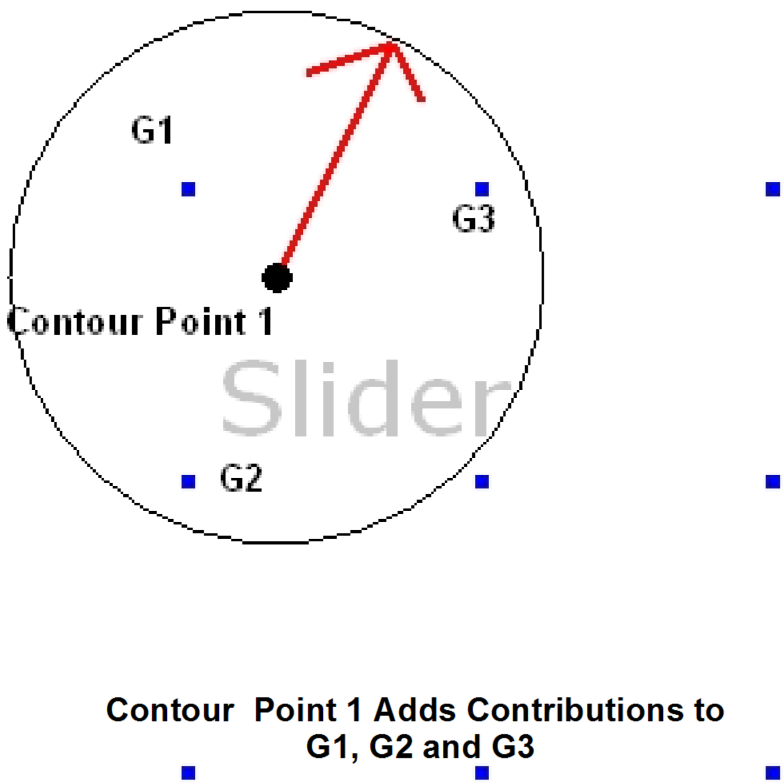


Figure 3.39. Linear Approximation Method

Linear

The Linear Method is the most accurate. Processing speed depends on the resolution of the grid. Values at each grid point are interpolated using all contour points within a certain distance. The contribution from each contour point is the value of the physical quantity being plotted weighted (inversely) by the square of its distance from the grid point. Thus the speed of the algorithm is O(n^2 * m) where n is the desired resolution and m is the number of contour points. The time taken by the Linear Method is therefore very sensitive to the resolution of the grid.

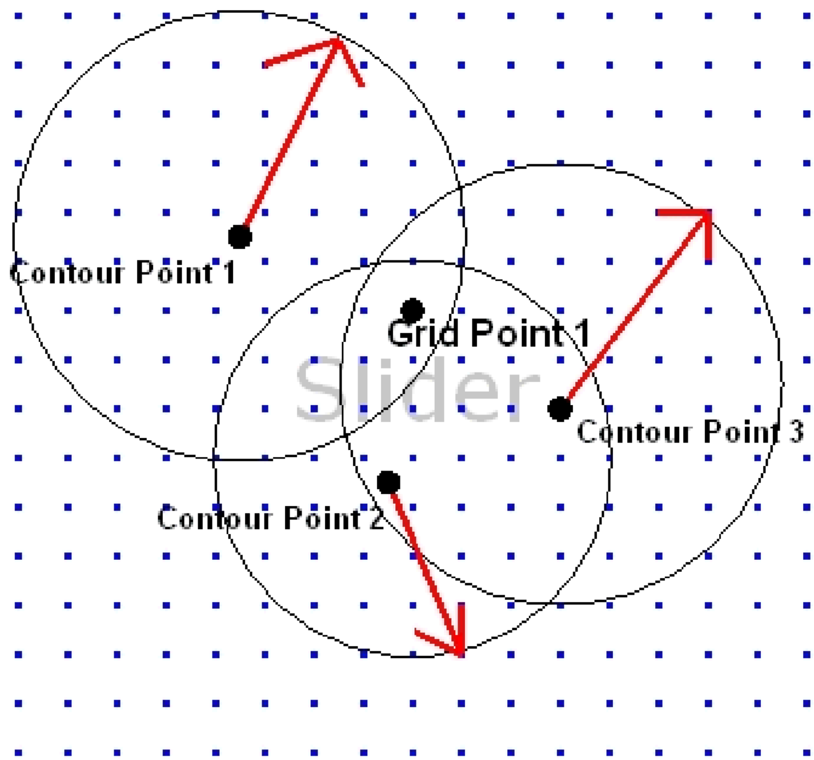


Figure 3.40. Linear Method

Quad Tree

This method subdivides the diagram into uneven sized grid cells with finer subdivision occurring in areas that exhibit greater variation. Processing efforts are focused on regions that show signs of larger differences in the physical quantity being plotted. This occurs at the expense of other areas that have more uniform values. The QuadTree method generally results in a more blended diagram. For small values of depth, contours are generated very quickly.

Non-Uniform Partitioning using the QuadTree Method

The Depth and Tolerance settings are required for the quad tree interpolation method.

Depth

The *Depth* setting determines the maximum level of subdivision that will occur. Further partitioning of grid cells will not occur even if the current difference is greater than the user selected tolerance value.

Tolerance Value

The *Tolerance Value* is needed to end subdivision. For a given grid cell, the difference between the maximum and minimum at the corners is calculated. If it is less than the specified tolerance, no further splitting occurs. Otherwise, the grid cell is recursively subdivided further.

The *Enable Shading* option can be disabled to create a non-shaded image. This is useful when viewing regions of finer subdivision resulting from the QuadTree partitioning.

The Color Map options determine which values are to be displayed and the colors assigned to them. the *Maximum* and *Minimum* values are used as a filter. Any points that lie outside this range will be removed. The discarded quantities don't contribute to interpolated values at the grid points. This feature can be used to see variations within a desired range. The *Gradient* options translate interpolated values at grid points into colors. The maximum value is mapped to the topmost color and the minimum is gets assigned to the bottom color. The user selects from the following color options:

• Red (dark to light)	• GrayScale (dark to light)
• Green (dark to light)	• Blue=low Red=high (default)
• Blue (dark to light)	• Red=low Blue=high

Helpful Hints

- The Linear Approximation method is recommended unless extreme accuracy is needed or only a generalized picture is desired.
- When using the Linear Approximation, start with the default influence setting. Smaller values highlight detailed variations better. Increase influence slowly and only as necessary.
- Larger influence values result in more blending and tell a more generalized story.
- When using the Linear method start with the default value for resolution, increase it slowly if any square-like artifacts appear. Once the artifacts are gone, a further increase in resolution can be tried if desired but after a certain point the law of diminishing returns goes into effect.
- Both Linear and Linear Approximation are sensitive to the number of contour points.
- For diagrams with large extents, larger influence values are needed. If at first no contours appear, try increasing the influence while keeping the resolution constant. If the contours appear but exhibit square-like grid cells, increase the resolution till you see a better picture.
- Use a Bounding Box of 0 or 1, especially for diagrams with large extents.
- To get a generalized view of a large area, use larger values for influence.
- As a general recommendation, start with defaults for influence and resolution. Increase each parameter only as needed while keeping the other constant to see the difference in the picture.
- Use the QuadTree method to get quick generalized pictures.
- Processing time is a combination of several factors in all cases. However the speed of the Linear Approximation method is affected mostly by the influence setting while that of the Linear method is determined by the resolution.
- Busbars and Branches are represented by several contour points, placed equally along the length. When plotting quantities for Busbars or Branches and using a minimum influence (value of 1) an oval effect is seen around the element being plotted. This is the union of all the circles centered at the contour points.

3.6.17. Customizing Tooltips

Diagram > Customize Tooltips > Show item ID only

Diagram > Customize Tooltips > Show item current results

Diagram > Customize Tooltips > Show item expanded parameters

Tooltips are the pop-up informational boxes that appear when the mouse cursor is held over a component in the diagram. The *Display Tooltips* option in the *[Diagram Properties]* dialog must be enabled for tooltips to function (see Section 3.2, “Specifying Diagram Properties”). If the option to display tooltips is enabled, one of the three types of information can be displayed in the tooltip (see Figure 3.41, “Alternative Tooltip Presentations for a Bus”). The example shows possible tooltips for a bus.

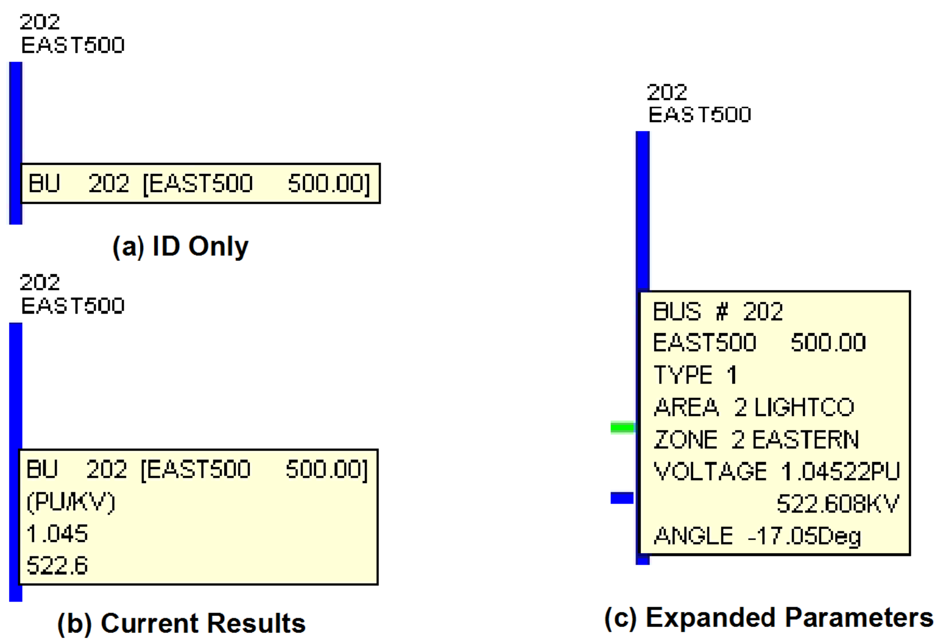
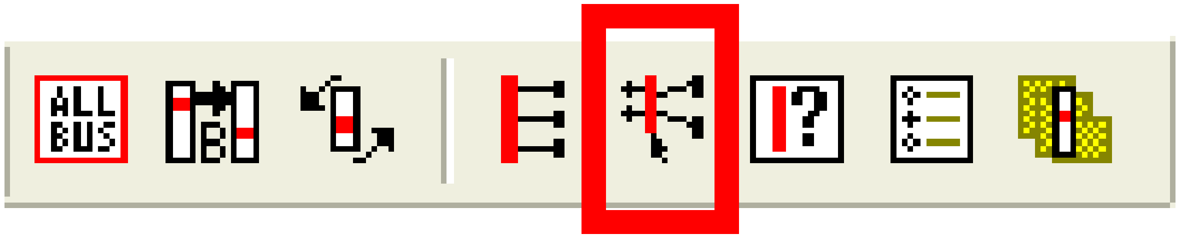


Figure 3.41. Alternative Tooltip Presentations for a Bus

3.7. Using Auto-Draw



One of the features of *[Diagram]* is the ability to automatically build or expand one-line diagrams of power flow cases bus-by-bus or by groups of buses. This facilitates the rapid population of a blank *[Diagram]* with a one-line diagram of the open power flow case.

Using the *Auto Draw* function will place a selected bus on the diagram graphically, and automatically draw adjacent equipment, including adjacent buses. The Auto Draw feature also allows the specification of the number of bus levels to extend out of the first bus. Auto Draw will draw and connect these buses and neighboring facilities of all of these buses.

The user has two options to draw a diagram quickly. The first approach involves the following steps:

1. Open a blank diagram (see Section 3.3, "Creating a New Power Flow Case using Diagram View").

2. Select the *Auto Draw* button and click in *[Diagram]* to set the bus position.

   The *[Select Bus for Auto-Draw]* dialog (Figure 3.42, "Drawing Bus 101 and Buses Two Levels Out, using the Auto Draw Toolbar Button") opens.

3. Select or specify the bus to grow and the number of levels to grow out from this bus.

   For example, using the *savnw.sav* power flow case, bus 101 has been selected and *grown* two levels (see Figure 3.42, "Drawing Bus 101 and Buses Two Levels Out, using the Auto Draw Toolbar Button").

The bus, all its equipment, all lines, transformers, and attached buses are then laid out in *[Diagram]*. In the example, Bus 101 bus and its one neighboring bus are drawn, along with their attached equipment and connecting transformer branch.

If a Bus Location file has been opened and the *Use Bus Location file to AutoDraw/Grow items* option on the *[Program Preferences]* dialog has been selected (see Section 3.6.8, "Specifying Bus Locations from a File"), the buses will be placed at the locations specified in the Bus Location file. If the bus location data for the bus does not exist or the option is disabled, then the bus will be placed at the default location.

The process could be continued by selecting locations on the diagram and bus numbers from the *[Select Bus for Auto-Draw]* dialog. If, in this example, bus 152 were the next one selected and one level was grown out of this bus, the diagram would grow to include the other attached buses to bus 152, which are buses 153, 202, and 3004, their connected equipment, and the branches from these buses back to bus 152.

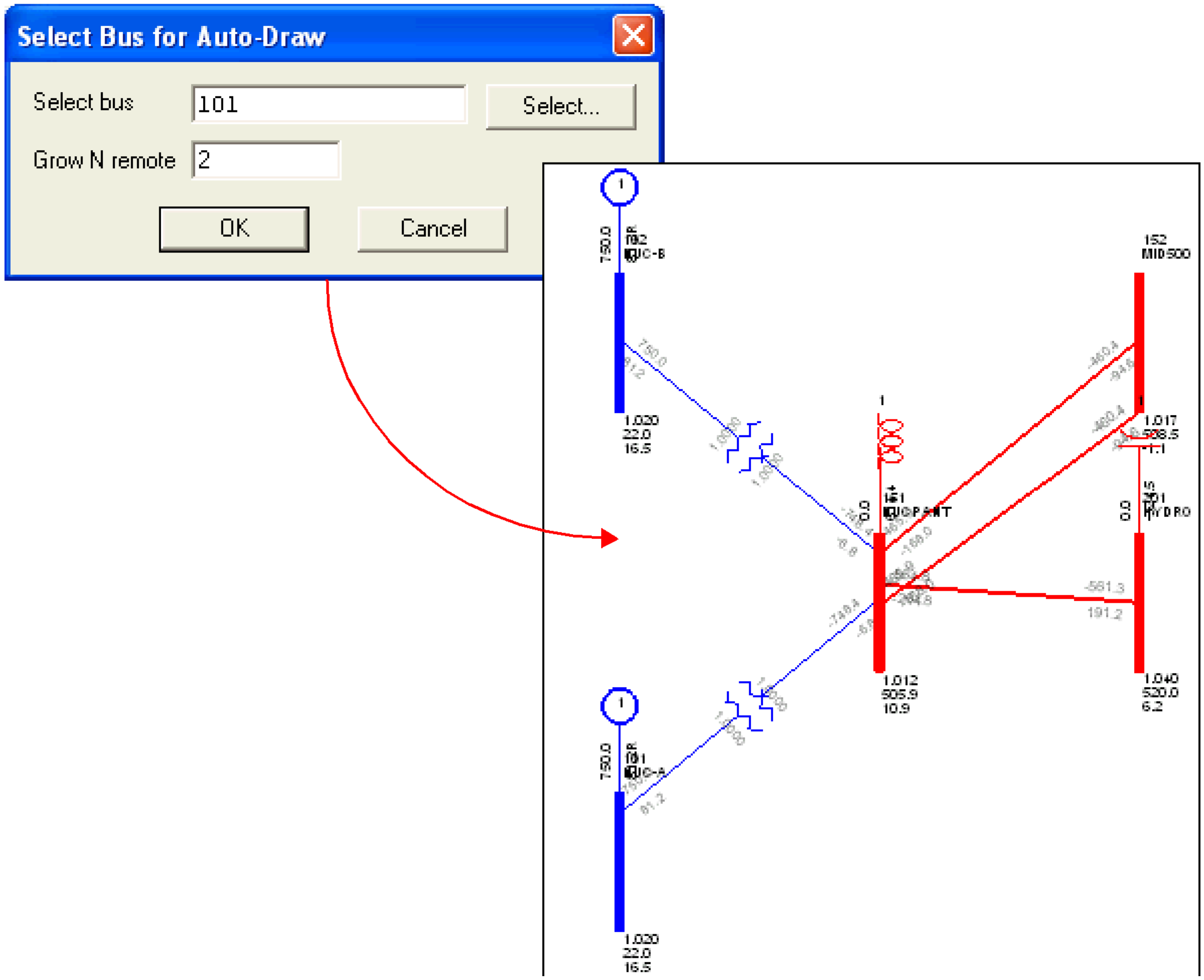


Figure 3.42. Drawing Bus 101 and Buses Two Levels Out, using the Auto Draw Toolbar Button

The second approach to start drawing a diagram is to reverse the order of actions, as follows:

1. Select (highlight) the desired starting bus in *[Network Tree]*.
2. Click the *Auto Draw* button from the Diagram Toolbar.
3. Click in *[Diagram]* to place the bus.

If the first bus selected in *[Network Tree]* was bus 101, the result would be bus 101 and 151 plus all equipment attached to either bus. The process could be continued by selecting other buses from *[Network Tree]*.

If there is a bus or buses already drawn on the one-line diagram it is possible to use the *Grow* option from *[Network Tree]* to add more one more level of buses. Also, the *Grow N Levels...* option can be used to add multiple levels of buses to the diagram. Right-click the bus in *[Diagram]* (see Figure 3.11, “Example of Diagram View Right-click Menu”).

Selecting *Grow N Levels...* on either of these menus will initiate the drawing of all buses attached to the bus selected, along with the connected equipment and the branches back to the selected bus N levels out from the bus. This method assists in rapidly creating a one-line diagram of the open power flow case.

If a connecting bus or branch already exists on the diagram when a Grow is performed, any new connections will be made to the existing equipment.

3.7.1. Bus Orientation

Diagram > Auto Draw style > Vertical buses

Diagram > Auto Draw style > Horizontal buses

When buses are added to *[Diagram]* using *Auto Draw* or by selecting the *Grow* option described in Section 3.6, "Revising a Diagram", the buses will be drawn either horizontally or vertically. This function permits shifting between vertical and horizontal bus representations as the one-line diagram is being developed

3.8. Displaying Power Flow Results

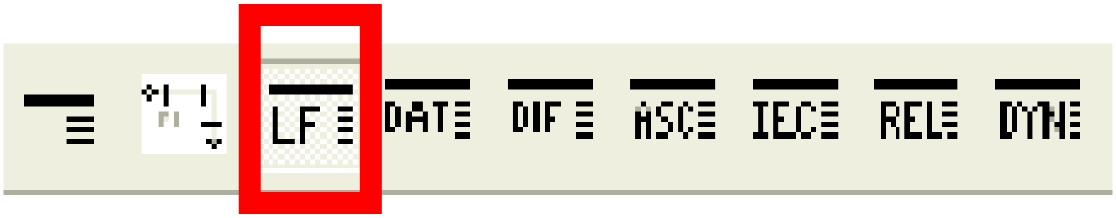


Diagram > Results > Powerflow results

Superimposing power flow results on a one-line diagram is an effective means of presentation. This section will highlight some of those features on the assumption that a slider diagram (**.sld)* has been created. The following examples use the *savnw.sav* and *savnw.sld* files provided in the Example folder of the PSS®E installation.

A portion of the network power flow results can be seen in Figure 3.43, "Power Flow Results in Diagram View". Here the annotation is selected to show:

- Bus name and number with voltages shown in pu and kV
- Branch flows at to and from ends
- Transformer taps on both sides
- MW and Mvar flows on branches and in equipment
- Signs as opposed to arrows to show flow directions. Plus signs indicate flows out of a bus and minus signs indicate flows into a bus.

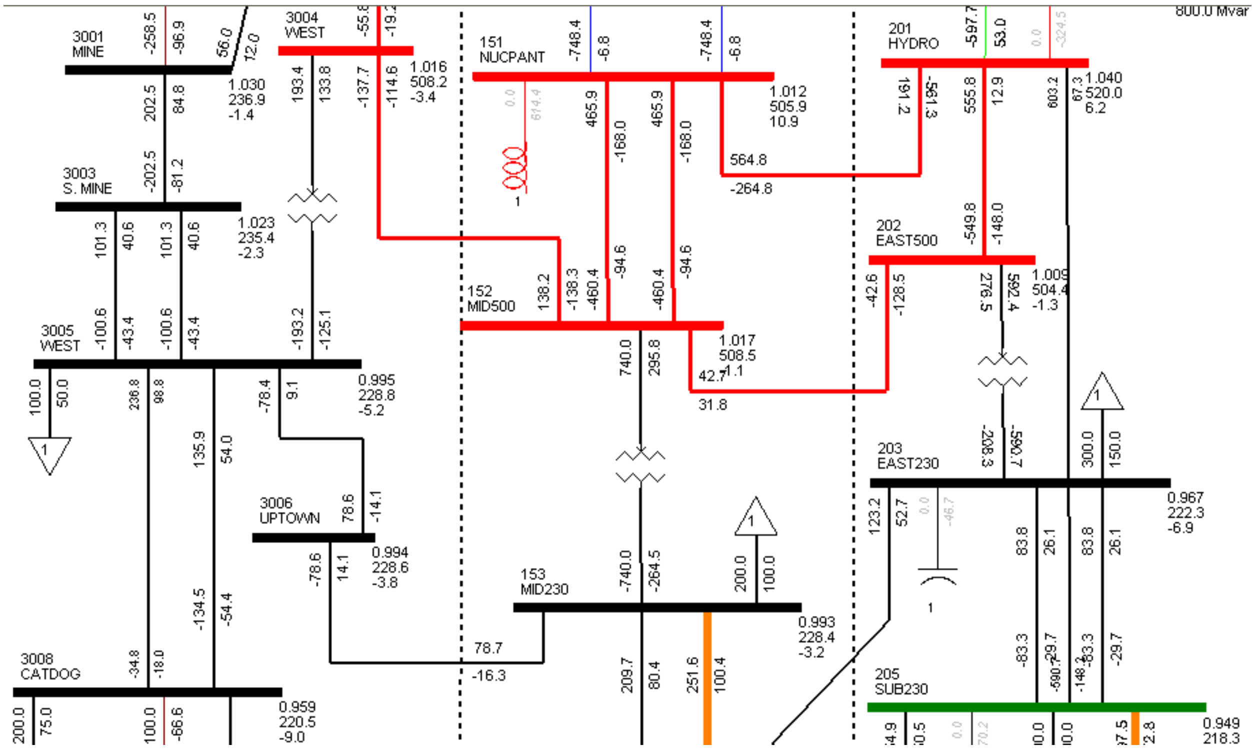
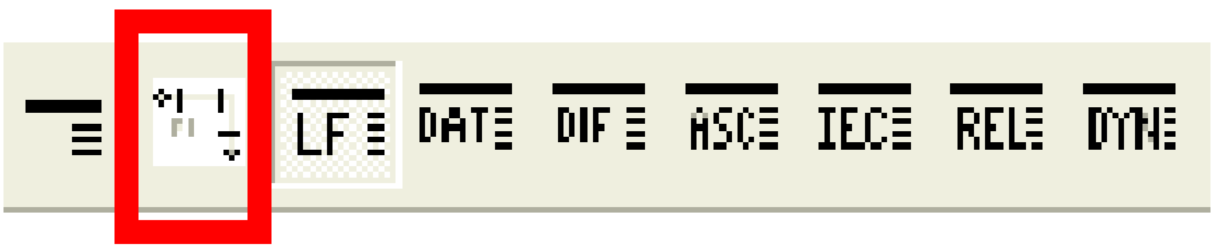


Figure 3.43. Power Flow Results in Diagram View

3.8.1. Power Flow Annotation

Diagram > Annotation...



Results of a power flow analysis may be modified as a whole for presentation using a set of annotation dialogs. For example, the user can choose to show all the information in Figure 3.43, "Power Flow Results in Diagram View" for all buses, branches and equipment, including generation, or to globally prevent showing of particular types of information (such as no branch flows on all branches) or to select particular buses, lines and equipment to have their annotation suppressed.

The right-click menu applied to a selected diagram item opens a specific annotation dialog for that item (see also Section 3.6.5, "Displaying and Modifying Network Elements " and Section 3.6.15, "Item Annotation ").

When power flow results are shown, the *[Powerflow Data Annotation]* dialog provides a *Diagram Annotations* tab Figure 3.44, “Power Flow Data Annotation Dialog”) to modify the presentation for printing or to save to a file.

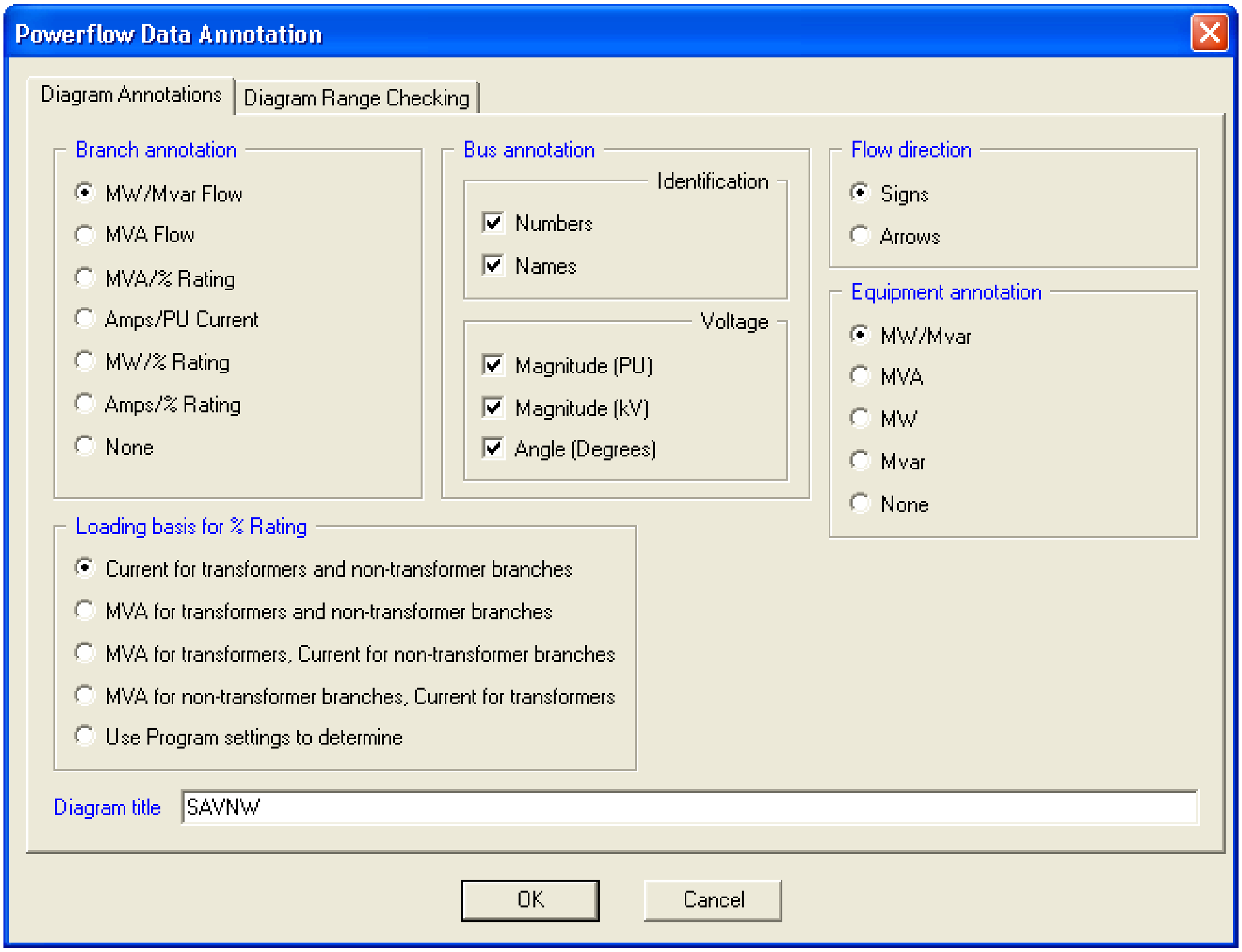


Figure 3.44. Power Flow Data Annotation Dialog

Options include the type of results annotation information to be displayed for branches, buses and equipment. The user can represent flows on the branches with either signs or arrows (see Figure 3.45, “Signs and Arrows to Display Flow”). The real power, in each case is shown above the branch.

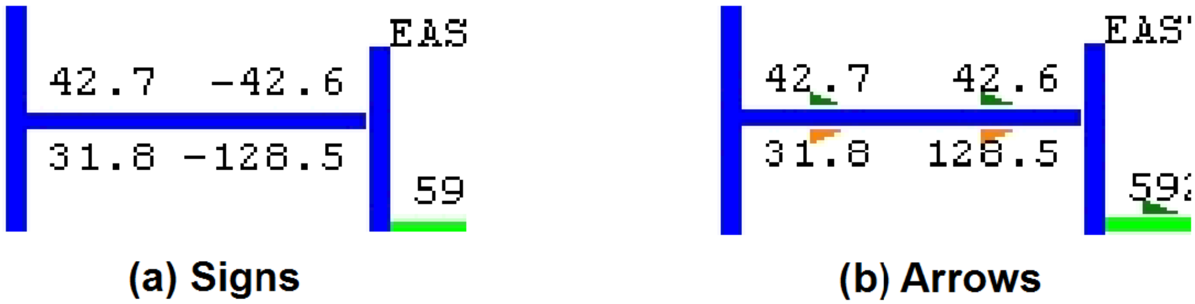


Figure 3.45. Signs and Arrows to Display Flow

3.8.2. Range Checking

The *[Powerflow Data Annotation]* dialog also provides a *Diagram Range Checking* tab (Figure 3.46, "Diagram Range Checking Tab"), which is a very useful tool. Not only can *[Diagram]* show numerical results for bus voltage, line flow and equipment loading, but color-coding can be set up to provide rapid identification of problems. It is possible to highlight branches that are overloaded and bus voltages that are either higher than a selected high limit or lower than a selected low limit.

In addition, the user can choose to over-ride the color selected for bound items and select colors for each voltage level in the network. This makes it easy to identify networks at different voltage levels.

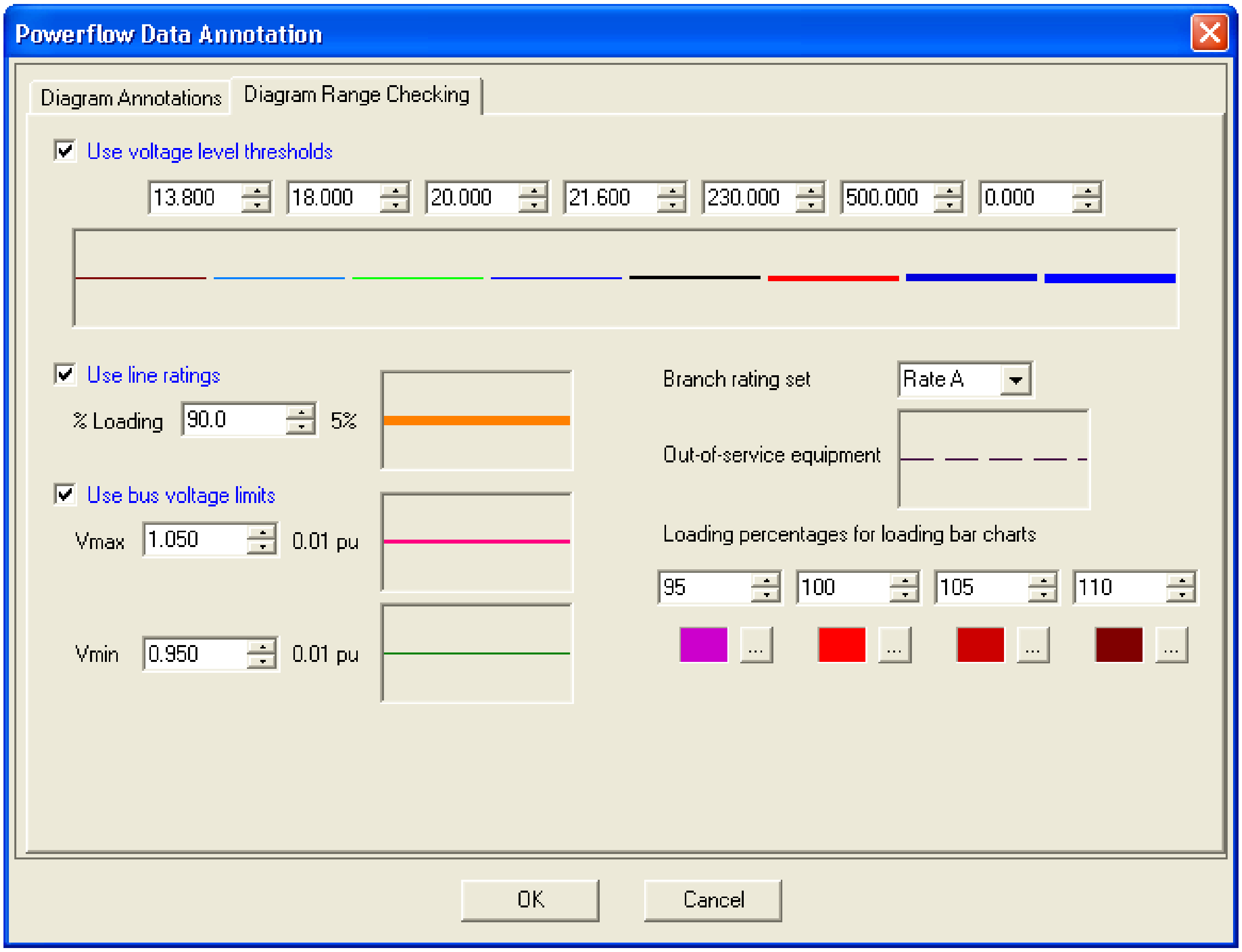


Figure 3.46. Diagram Range Checking Tab

Use voltage level thresholds: When enabled, this option indicates equipment and lines based on voltage level. Threshold levels may be specified by entering a value directly in the input field or using the scroll buttons. Click the sample line corresponding to each threshold to open a *[Voltage level]* dialog for each threshold (Figure 3.47, “Voltage Level Dialog”) to change line styles and colors. Click the palette button to open the *[Color]* dialog (Figure 3.3, “Color Dialog”).

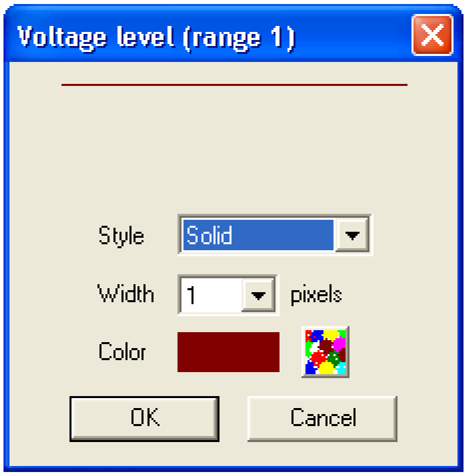


Figure 3.47. Voltage Level Dialog

Use line ratings: When enabled, this option indicates lines that are loaded above the specified percent loading value. Click the sample line to open a *[Line ratings appearance]* dialog (Figure 3.48, "Line Ratings Appearance Dialog") to change line style and color. Click the palette button to open the *[Color]* dialog (Figure 3.3, "Color Dialog").

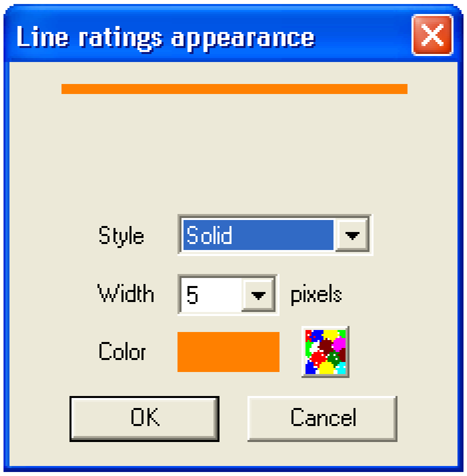


Figure 3.48. Line Ratings Appearance Dialog

Branch Rating Set: This option provides a pull-down list of branch ratings to which the % loading value is to be applied. Rate A is typically used for normal power flow conditions while Rate B or C would be used to examine contingency conditions where loadings are often allowed to be higher.

Use bus voltage limits: When enabled, this option indicates buses with voltages above or below specified maximum and minimum voltage levels. Click the sample line to open the *[Bus voltage limit appearance]* dialog (Figure 3.49, "Bus Voltage Limit Appearance Dialog") to change line style and color. Click the palette button to open the *[Color]* dialog (Figure 3.3, "Color Dialog").

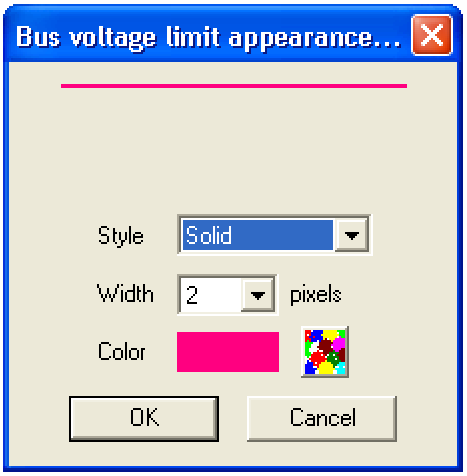


Figure 3.49. Bus Voltage Limit Appearance Dialog

Out-of-service equipment: This setting indicates status of out-of-service equipment. Click the sample line to open the *[Out-of-service equipment appearance]* dialog (Figure 3.50, "Out-of-Service Equipment Appearance Dialog") to change line style and color. Click the palette button to open the *[Color]* dialog (Figure 3.3, "Color Dialog").

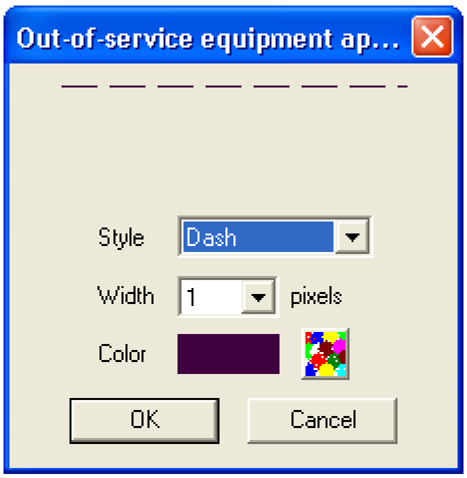


Figure 3.50. Out-of-Service Equipment Appearance Dialog

Loading percentages for loading bar charts: These fields are used to control the percentage at which overload colors are applied to the loading bar charts. Overload colors by default progress from purple to red to deeper shades of red. Click *[...]* to open the *[Color]* dialog to modify these colors.

The following example shows that that buses 206 and 3018 (and others) are highlighted for having voltages in excess of the high limit, specified at 1.02 pu. Bus 203 and 205 are highlighted for having voltages below the low limit, 0.97 pu.

The circuit one between buses 153 and 154 (and others) are highlighted to show their loading is in excess of 90% of their Rate A.

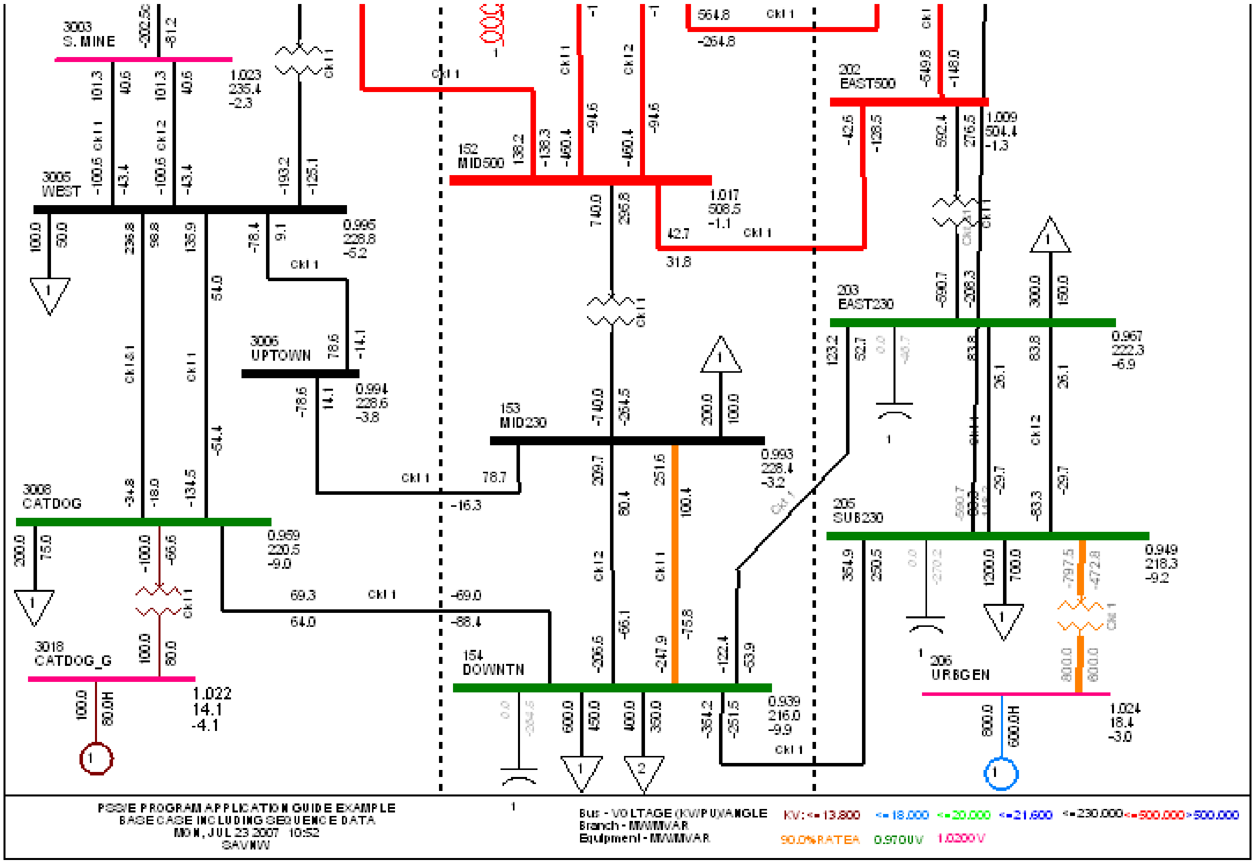
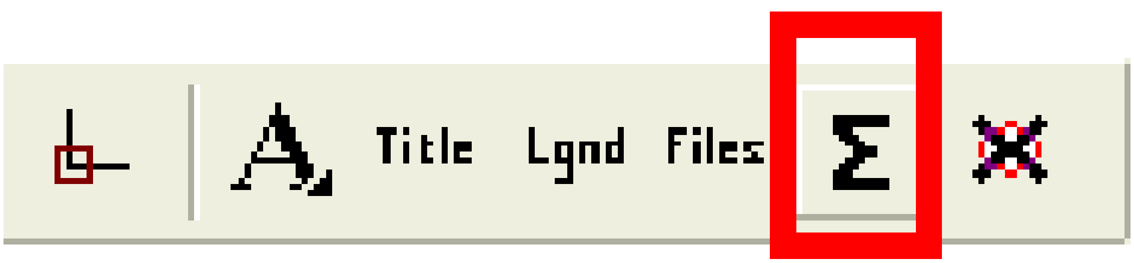


Figure 3.51. Power Flow Diagram showing Effect of Range Checking

3.8.3. Adding a Summation Record



The user can clarify the power flow results visualization by including a summation block for flow information. This could be useful to report current results when testing a variety of network conditions. The *[Edit Summation]* dialog provides fields for a title line for the summation and a variety of system results to sum. For example, these can be generator output and line flows. The example in Figure 3.52, "Edit Summation Dialog" sums the difference between generator output at bus 101 and the flow on circuit 1 of the line from bus 151 to 201.

The summation block is placed in *[Diagram]* at the point selected by the user. Subsequently, it can be edited and/or moved to a different location.

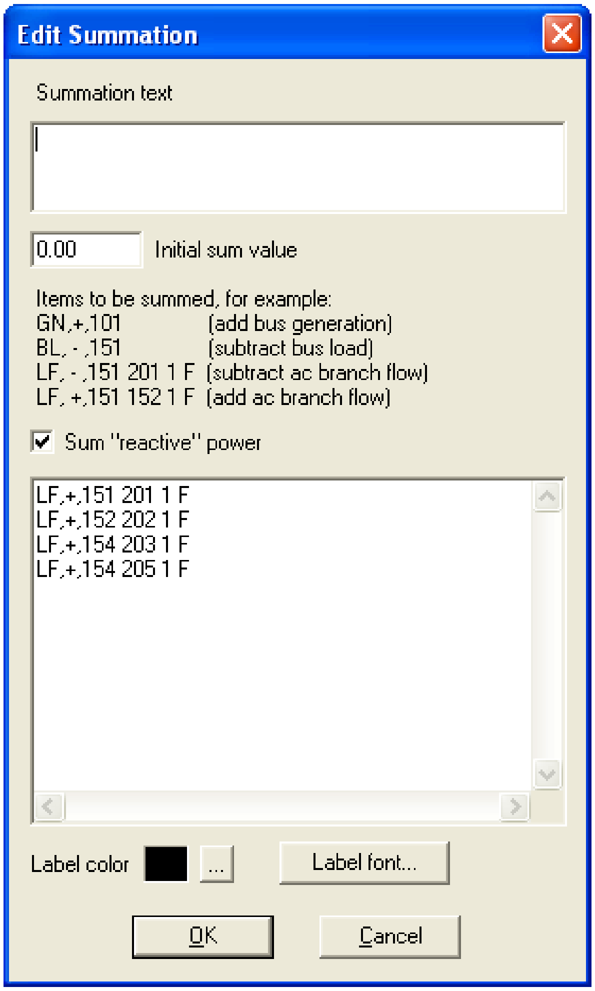
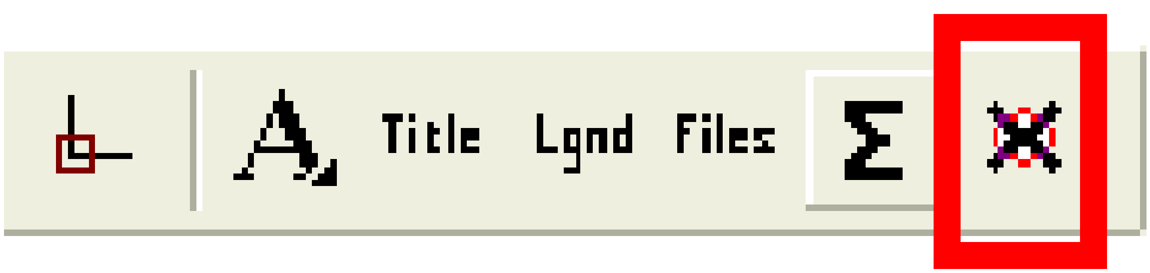


Figure 3.52. Edit Summation Dialog

To cancel the summation activity, press the *[Esc]* key. Refer to *PSS®E Program Operation Manual*, Summation Block Structure for additional information.

3.8.4. Adding a Report Node



The user can clarify the power flow results visualization by including a report node to display any type of information that may be of importance. This could be useful to report current results when testing a variety of network conditions.

The report node is Python based. Python code can be written to calculate and return any value, using existing Python APIs, that may be of interest to the user.

The *[Edit Report Node]* dialog provides fields for a title line for the report node, passing arguments to Python, defining the Python function, and defining the Python module that contains the Python function. The example in Figure 3.53, "Example of Report Node" shows the definition of a report node called Area Summary:, using the Python function area_summary, in the Python module pssgrpg, passing 1 as an argument.

The report node is placed in *[Diagram]* at the point selected by the user. Subsequently, it can be edited and/or moved to a different location.

To cancel the report node activity, press the *[Esc]* key.

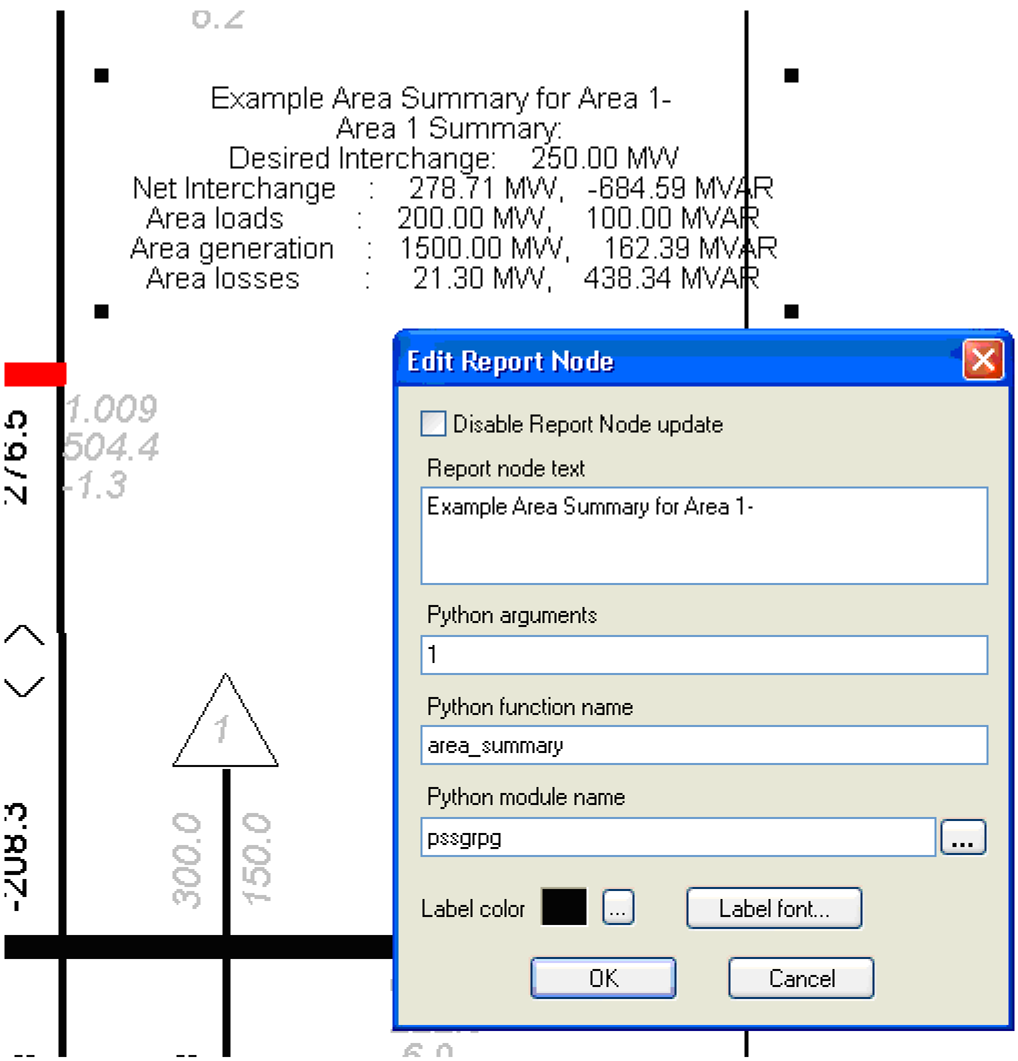


Figure 3.53. Example of Report Node

3.9. Displaying Impedance Data

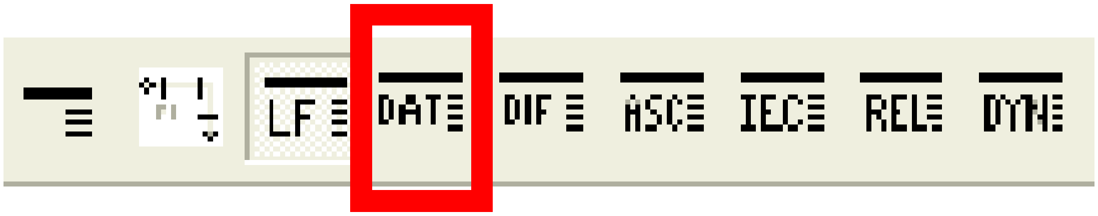


Diagram > Results > Impedance Data

This function displays impedance and equipment rating data. By default the diagram displays the generator scheduled power and the reactive power limits. Bus information includes the bus number, name and base kV. Line and transformer information shows the R, X and B values, as appropriate, and the transformer tap information is included.

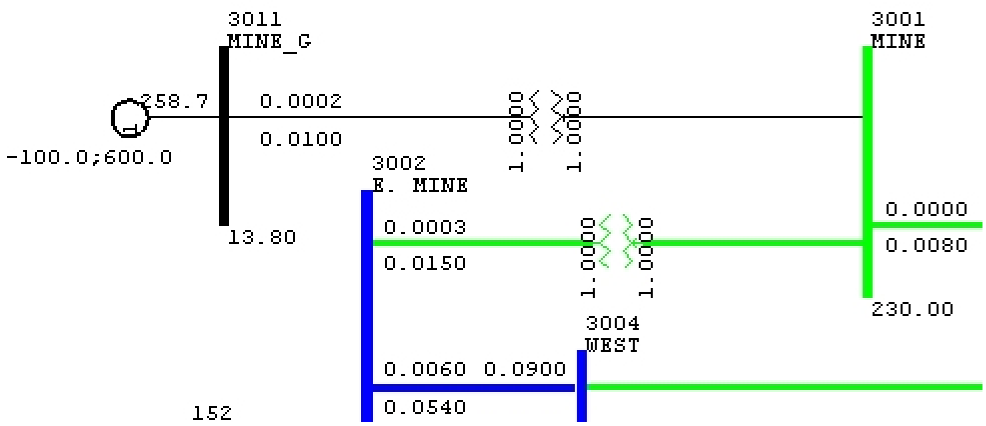


Figure 3.54. Example of Impedance Data in a One-Line Diagram

3.9.1. Impedance Annotation

Diagram > Annotation... opens the *[Impedance Data Annotation]* dialog (Figure 3.55, “Impedance Data Annotation Dialog”).

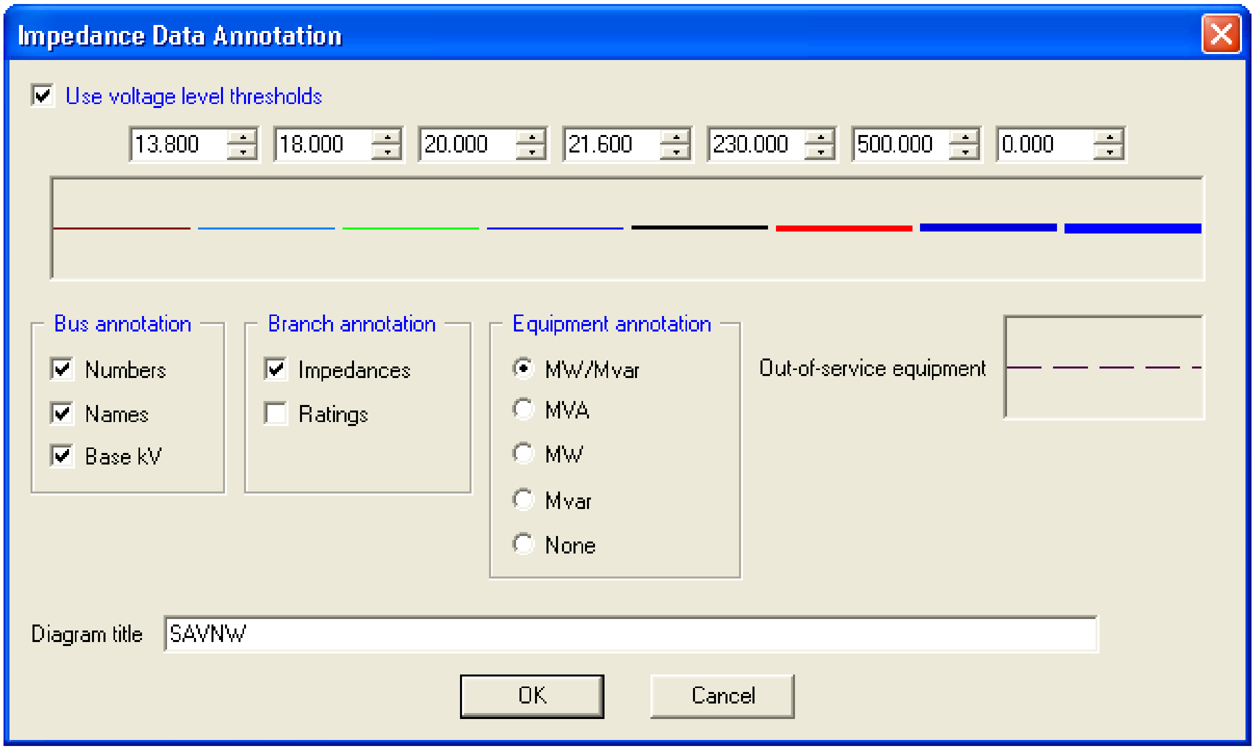


Figure 3.55. Impedance Data Annotation Dialog

Bus, branch, and equipment annotations, as well as voltage level thresholds are available in the impedance data annotation.

3.10. Displaying Graphical Difference Data

GDIF

Requirements / Prerequisites
Validly specified power flow case. Saved Case file (*.sav) Both cases solved to an acceptable mismatch level.

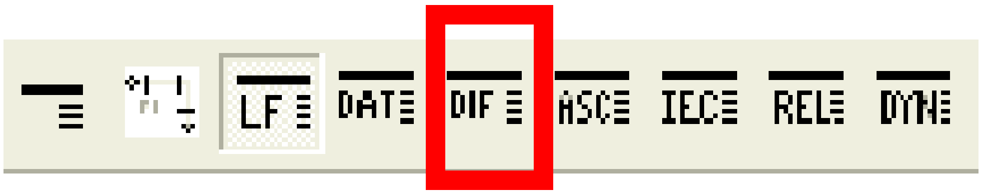


Diagram > Results > Graphical Difference Data...

The *[Compare Cases on a Diagram]* dialog (Figure 3.56, “Compare Cases on a Diagram Dialog”) requires the specification of a saved case against which to the working case. Click *[...]* to open the selection window for the required *Saved Case file* (*.sav). Click *[OK]* to perform the activity. A summary of the comparison is routed to the *Report* tab.

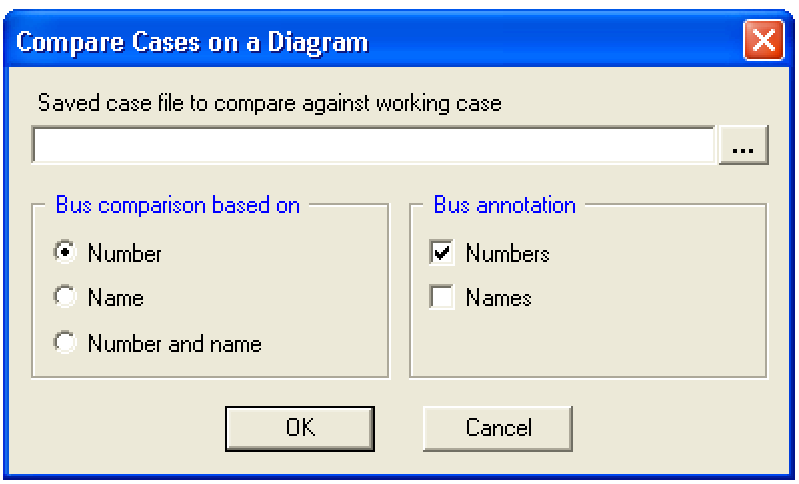


Figure 3.56. Compare Cases on a Diagram Dialog

Differences in solution results and bus boundary conditions between the current power flow case and the selected saved case are displayed. Differences are always calculated as comparison case values minus power flow case values. At each bus in the bus comparison list, voltage differences in per unit and phase angle differences in degrees are shown. All other difference values are shown in MW and Mvar. An example diagram is shown in (Figure 3.57, “Example of Case Comparison Differences”).

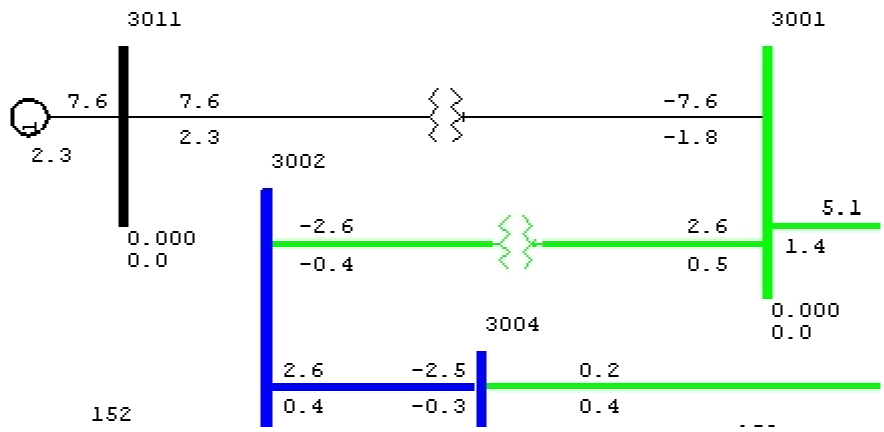


Figure 3.57. Example of Case Comparison Differences

The difference fields are left blank for equipment items present in the power flow case, but not in the comparison case. Those items present in the comparison case that are not included in the power flow case are omitted from the diagram.

Load and shunt differences include voltage sensitivity effects.

Differences in flow into a converter bus of DC line n are shown if all of the following conditions apply:

- DC line n is present in both cases.
- The converter bus is in the bus compare list.
- The same converter bus is specified in both cases.

Two-terminal dc lines are annotated according to the annotation properties currently set in the diagram.

Differences in the sending end bus shunt element of FACTS device n are shown if all of the following conditions apply:

- FACTS device n is present in both cases.
- The sending end bus is in the bus compare list.
- The same sending end bus is specified in both cases.

If the above conditions are satisfied and FACTS device n has a series element in the power flow case, differences in series flow at the sending end bus are also shown.

Differences in series flow at the terminal end bus are shown if all of the following conditions apply:

- FACTS device n is present and has a series element in both cases.
- The terminal end bus is in the bus compare list.
- The same terminal end bus is specified in both cases.

3.10.1. Comparison Annotation

Diagram > Annotation... opens the *[Graphical Case Comparison Data Annotation]* dialog (Figure 3.58, "Graphical Case Comparison Data Annotation Dialog").

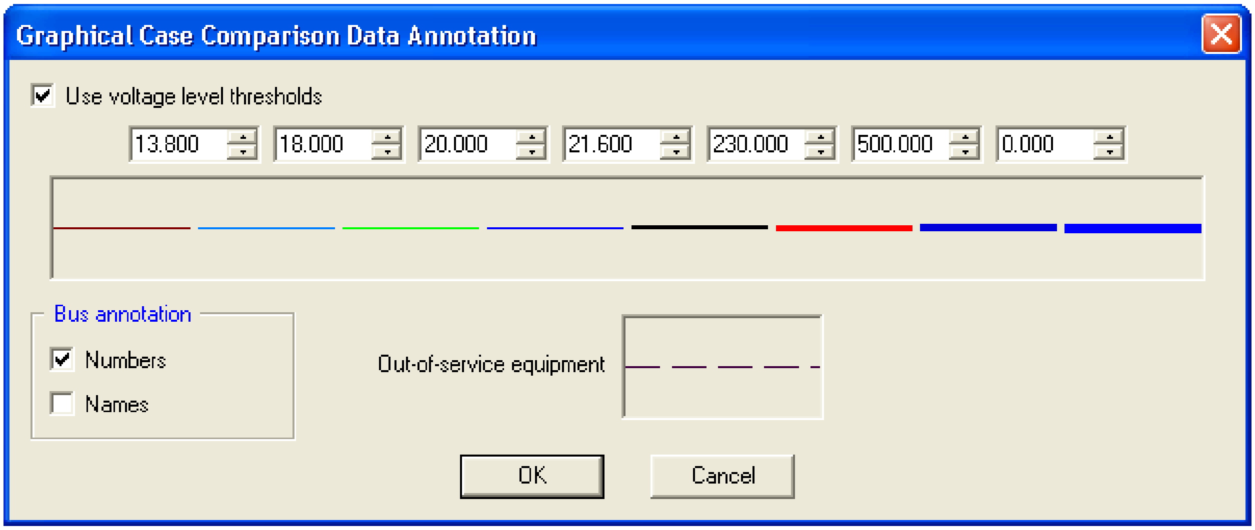


Figure 3.58. Graphical Case Comparison Data Annotation Dialog

Only bus annotation and voltage thresholds are available in the case comparison annotation.

3.11. Displaying ASCC Fault Analysis Results

Requirements / Prerequisites
Validly specified power flow case with sequence data appended to it. Reading Sequence Data for Fault Analysis Calculating Automatic Sequencing Fault

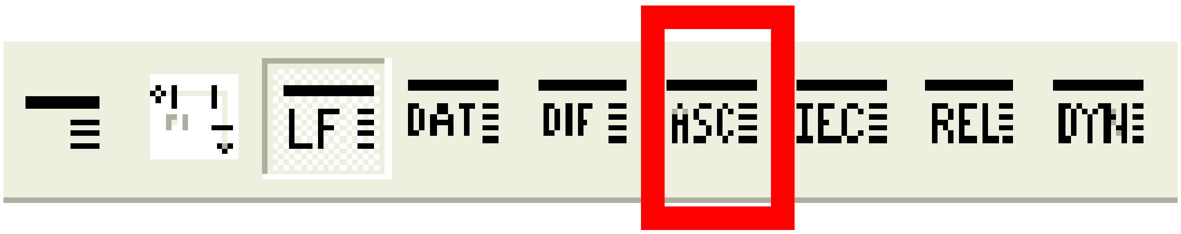


Diagram > Results > ASCC Fault Analysis Results...

If the calculation has been performed, the results may be displayed in *[Diagram]*.

3.11.1. Fault Analysis Data Annotation

Diagram > Annotation... opens the *[ASCC Fault Analysis Data Annotation]* dialog (Figure 3.59, "ASCC Fault Analysis Annotation Dialog"). Only the voltage thresholds are available in the fault analysis annotation.

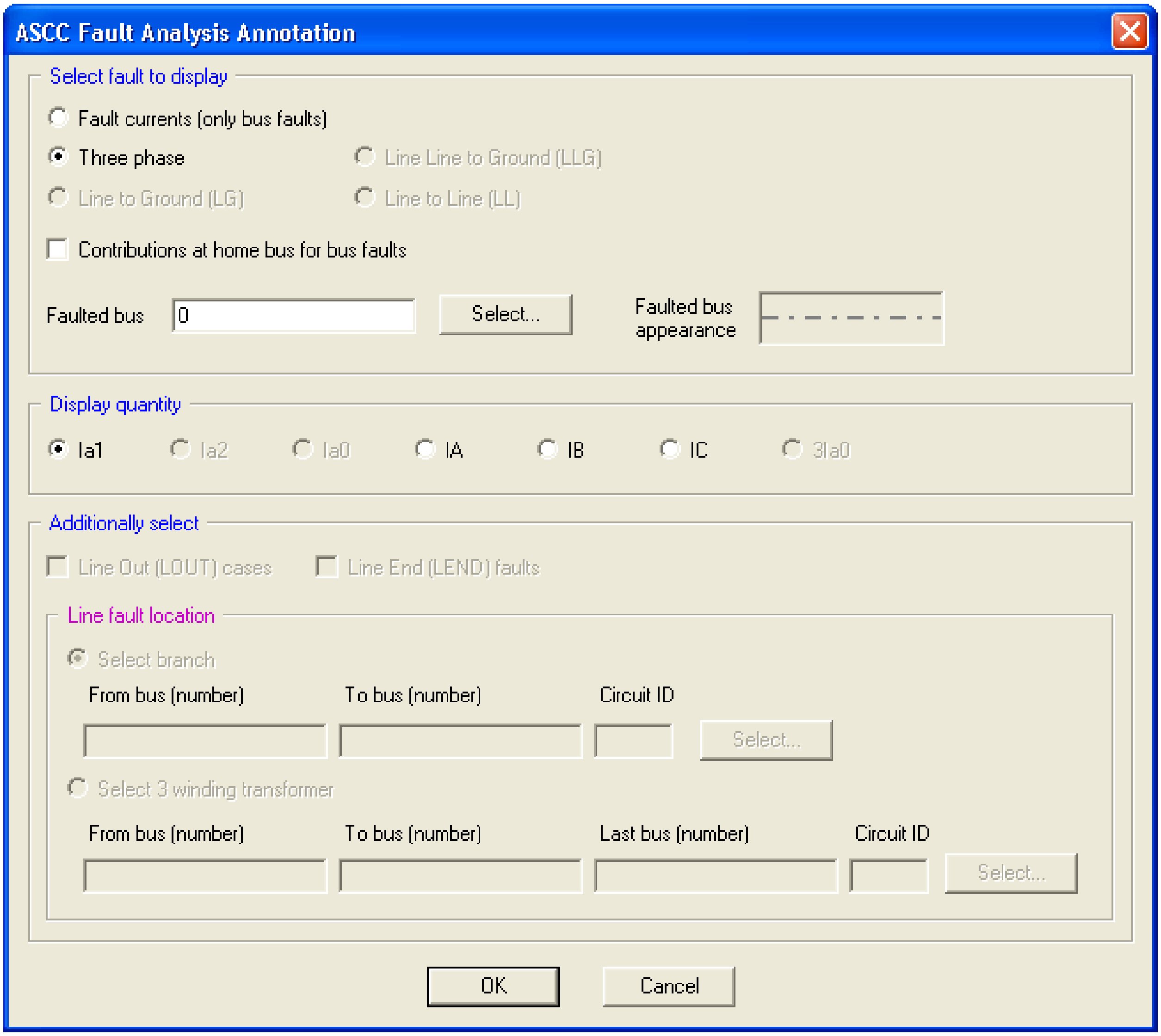


Figure 3.59. ASCC Fault Analysis Annotation Dialog

3.12. Displaying IEC Fault Analysis Results

Requirements / Prerequisites
Validly specified specified power flow case with sequence data appended to it. Reading Sequence Data for Fault Analysis Calculating Short Circuit Currents According to IEC 60909 Standard

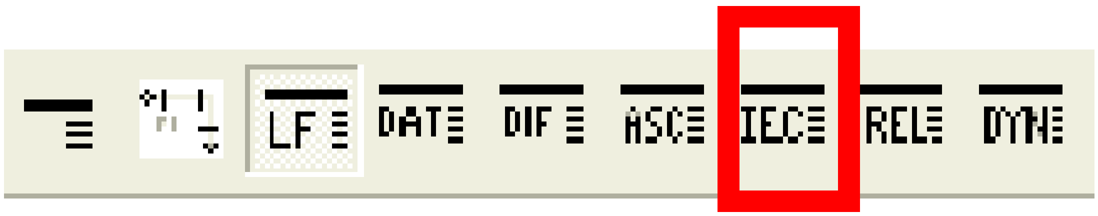


Diagram > Results > IEC Fault Analysis Results...

If the calculation has been performed, the results may be displayed in *[Diagram]*.

3.12.1. IEC Fault Analysis Annotation

Diagram > Annotation... opens the *[IEC Fault Analysis Annotation]* dialog (Figure 3.60, "IEC Fault Analysis Annotation Dialog").

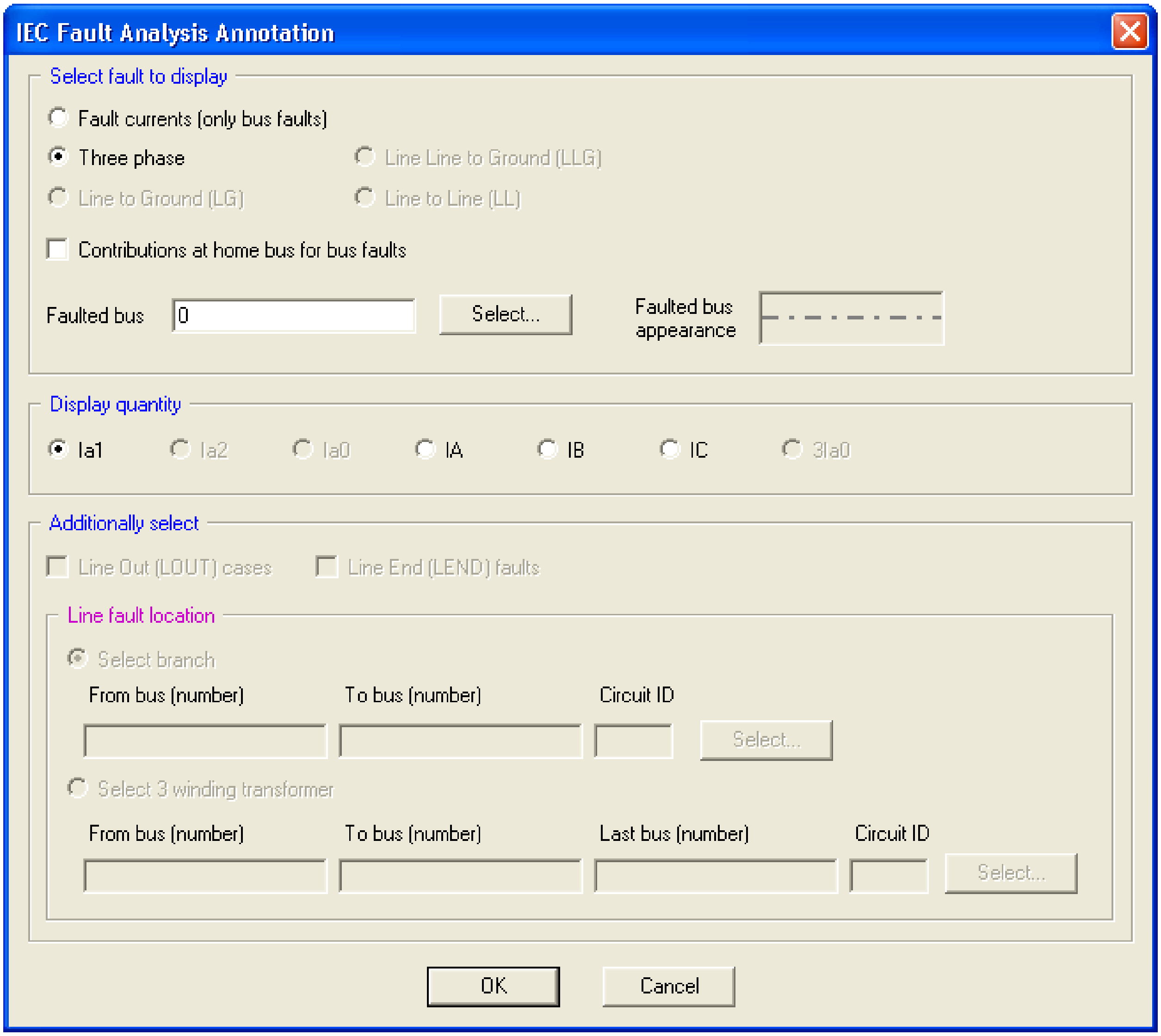


Figure 3.60. IEC Fault Analysis Annotation Dialog

3.13. Displaying Reliability Analysis Results

Requirements / Prerequisites
Validly specified power flow case solved to an acceptable mismatch tolerance. Valid contingency analysis. Running AC Contingency Analysis Running Probabilistic Reliability Assessment

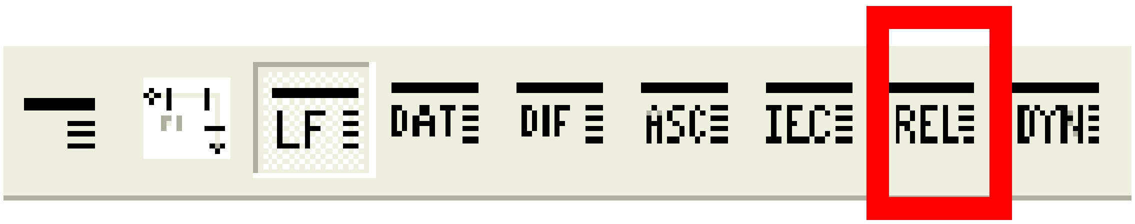


Diagram > Results > Reliability Analysis Results...

If the calculations have been performed, the results may be displayed in *[Diagram]*.

3.13.1. Reliability Annotation

Diagram > Annotation... opens the *[Reliability Annotation]* dialog (Figure 3.61, “Reliability Analysis Annotation Dialog”).

One of three data categories can be displayed one a time on the reliability diagram; they are contingency solution, deterministic reliability results, and probabilistic reliability results. Under each data category, several data quantities are available. When a data category does not exist in the reliability assessment analysis, the corresponding option is disabled.

To display bus voltage violations, a voltage limit record and either its lower or upper limit must be specified. *[Diagram]* displays voltage violations for only one monitored voltage limit record at a time.

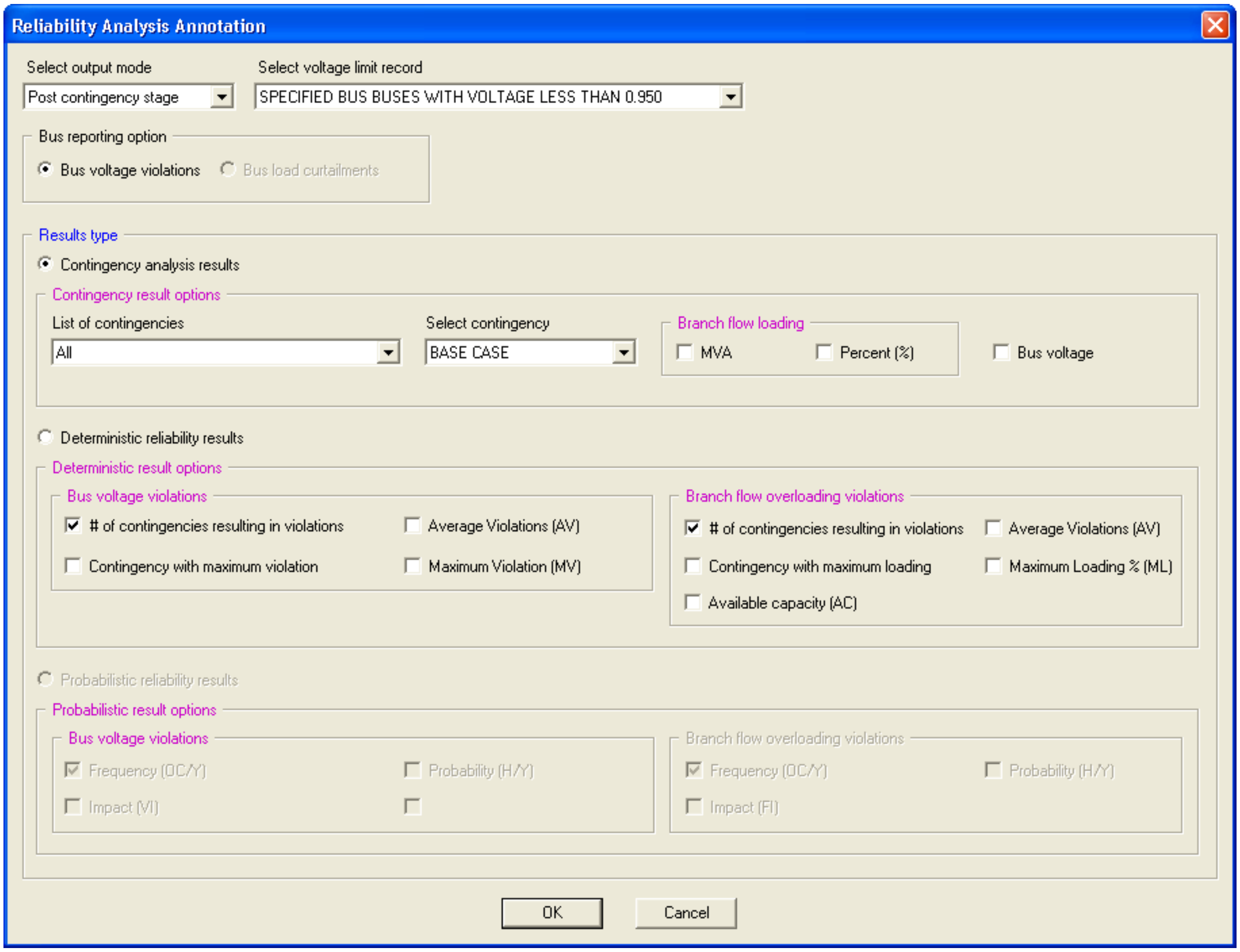


Figure 3.61. Reliability Analysis Annotation Dialog

Figure 3.62, “Example of Branch Flow Overloading Probabilistic Reliability Results” shows branch flow overloads. Only monitored branches have values and are shown in the diagram. Overloaded circuits are branches from bus 154 to bus 203 and from bus 154 to bus 205. Note that the results shown in the diagram are calculated on the basis of contingency analysis results and specified options in reliability assessment. (e.g rating set, percent loading, cutoff values of frequency and probability). In this example, branch flow overloading probabilistic indices are on the basis of 100% of rating A. Modifying the rating of any of the following parameters requires redoing reliability assessment to refresh the diagram view.

- Normalizing probability option
- Rating set
- Cutoff values of frequency and probability
- Outage statistic data

Similarly, for voltage violations and load curtailment results, reliability assessment should be performed again if any of following parameters are changed:

- Normalizing probability option
- Cutoff values of frequency and probability
- Outage statistic data

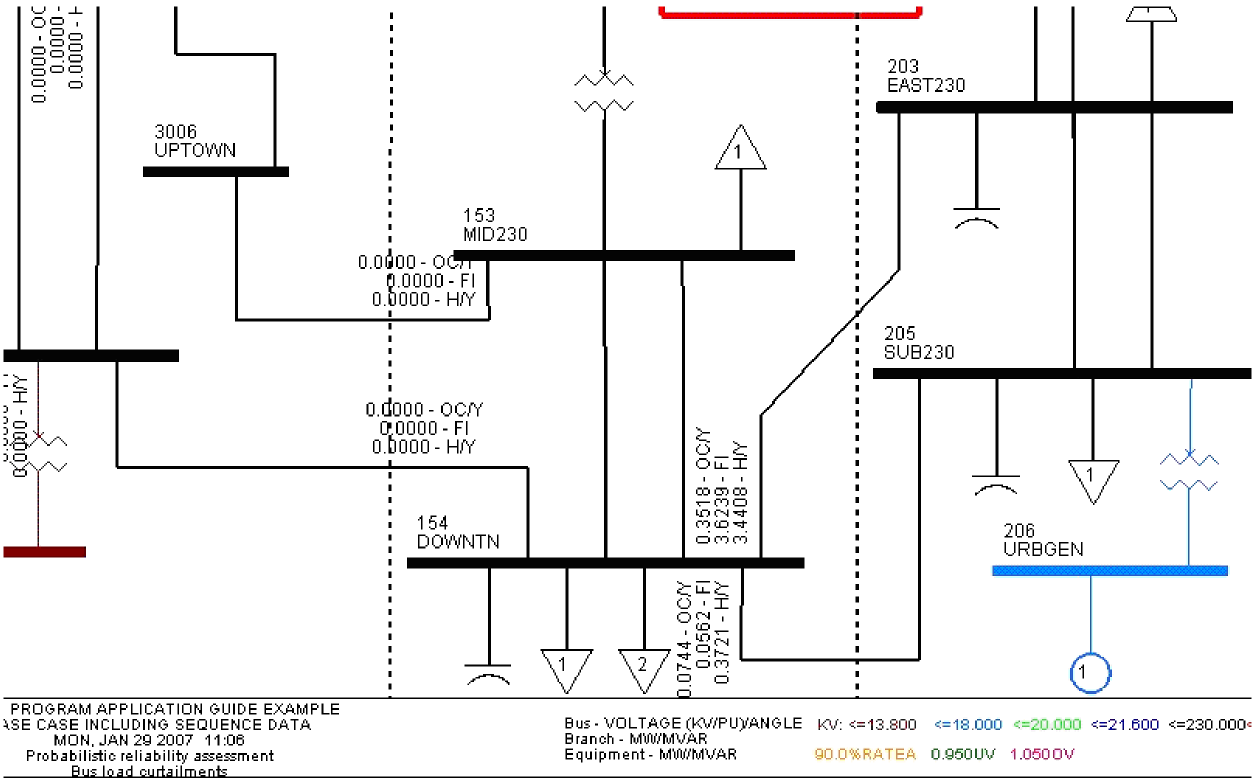


Figure 3.62. Example of Branch Flow Overloading Probabilistic Reliability Results

Figure 3.63, "Example of Bus Load Curtailment Results" shows bus load curtailment probabilistic results. Expected unserved energy at buses 153 and 154 are 5546.6 MWH/Y and 8480.8MWH/Y respectively.

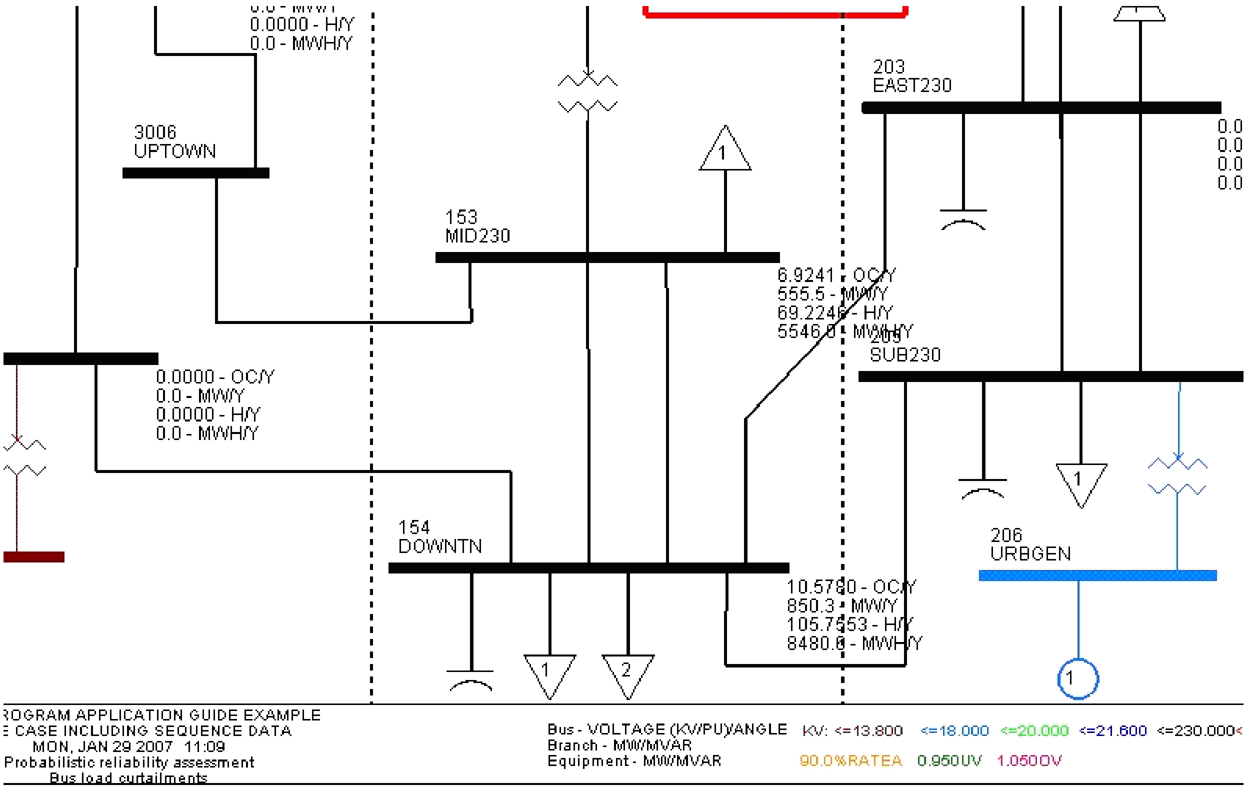


Figure 3.63. Example of Bus Load Curtailment Results

3.14. Displaying Dynamics Analysis Results

Diagram > Results > Dynamics Analysis Results...

After the calculations have been performed, the results may be displayed in *[Diagram]*.

In the following example (Figure 3.64, “Example of Diagram View Showing Difference between Bus Display and Bus Display with Dynamic Analysis Results”), Bus 206 is displayed before and after analysis.

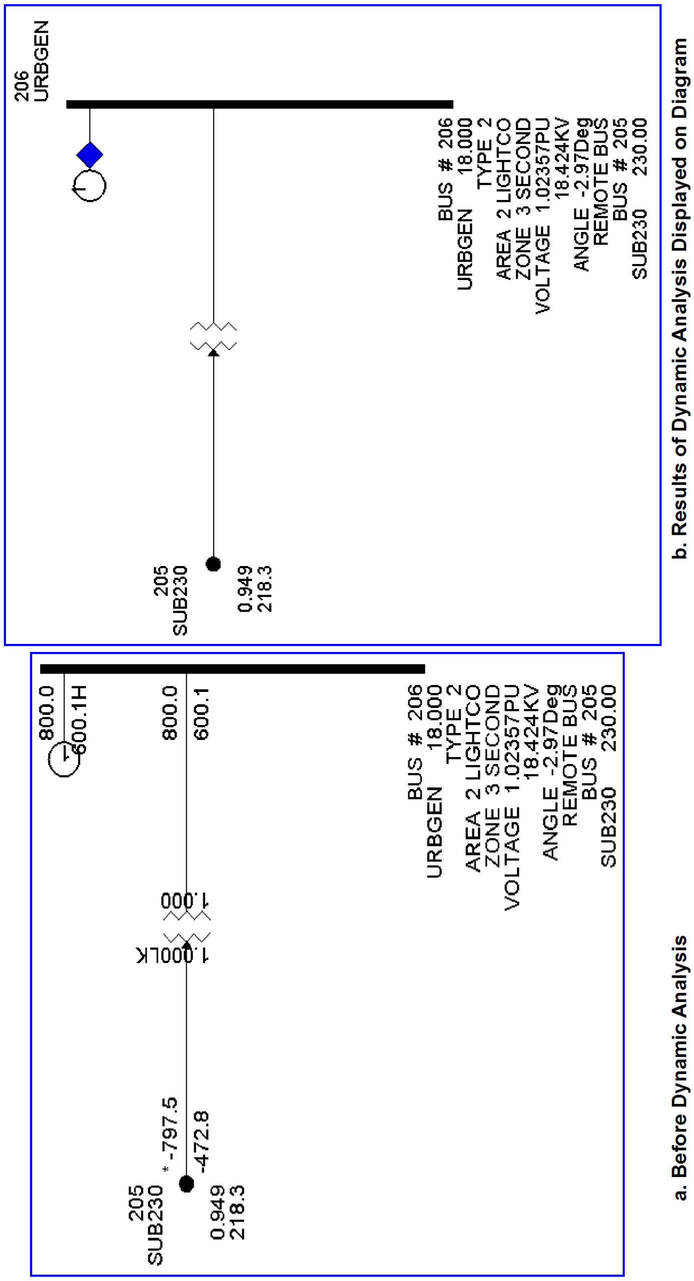


Figure 3.64. Example of Diagram View Showing Difference between Bus Display and Bus Display with Dynamic Analysis Results

3.14.1. Dynamics Annotation

When dynamics data is shown, selecting *Diagram > Annotation...* opens the *[Dynamics Simulation Annotation]* dialog (Figure 3.65, “Dynamics Simulation Annotation Dialog”).

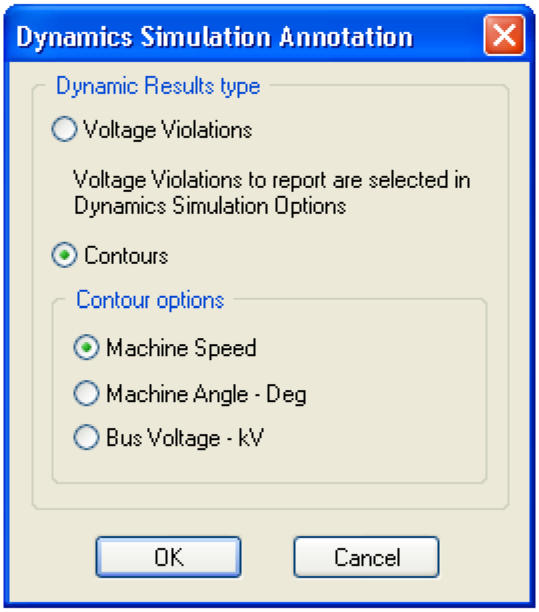


Figure 3.65. Dynamics Simulation Annotation Dialog

Annotation options may be selected for either Voltage Violations or Contours.

3.15. Creating a Bus Display

GOUT/GEXM

Requirements / Prerequisites
Validly specified power flow case solved to an acceptable mismatch level.

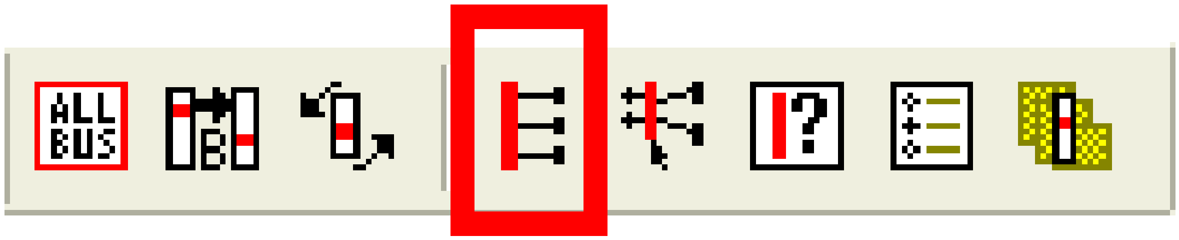


Diagram > Generate a graphical power flow bus display

This function provides the means to create a one-line drawing starting with a single bus. Enter the desired bus number in the *[Select Bus]* dialog (Figure 3.66, "Select Bus Dialog") and click *[OK]*. A diagram of power flow results is generated for the selected bus, showing associated lines and equipment and distant to buses. All distant buses are represented as nodes (Figure 3.67, "Example of Single Bus Display, Power Flow Results").

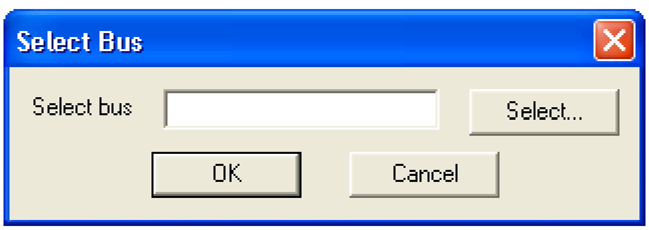


Figure 3.66. Select Bus Dialog

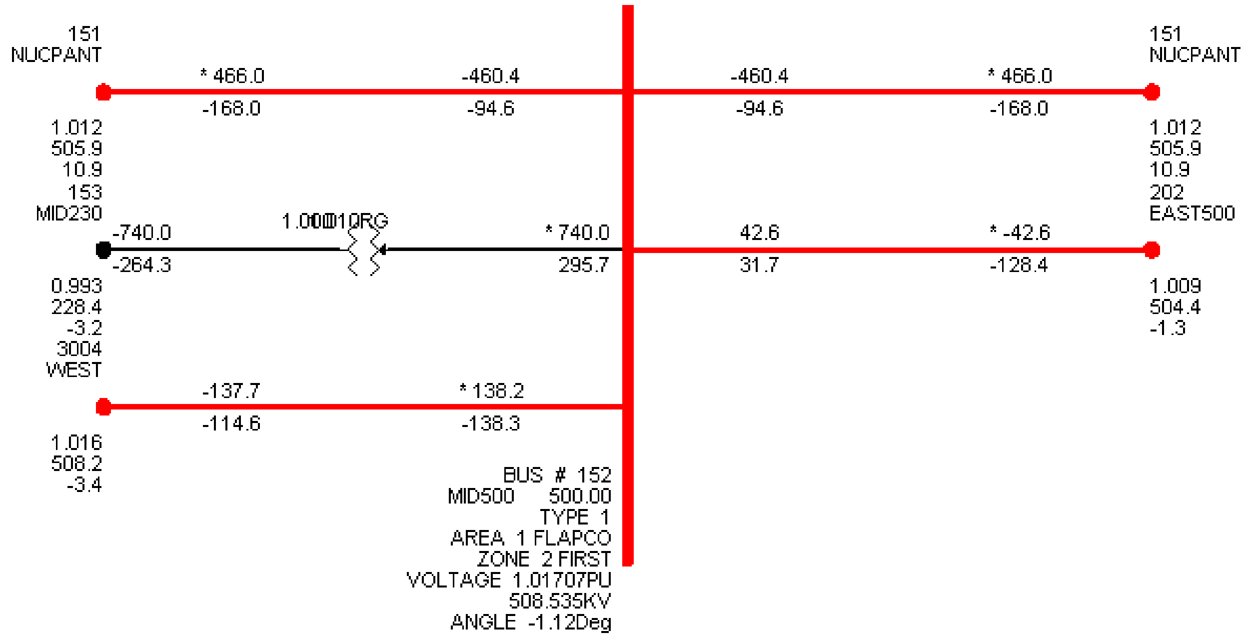


Figure 3.67. Example of Single Bus Display, Power Flow Results

All *[Diagram]* functions are available using the single bus display. Thus, selecting *Diagram > Results > Impedance data* and the *Current loadings* icon from the active diagram in Figure 3.67, “Example of Single Bus Display, Power Flow Results” produces the example shown in Figure 3.68, “Example of Single Bus Display, Impedance Data”. Switching and data changing functions are available for any data display.

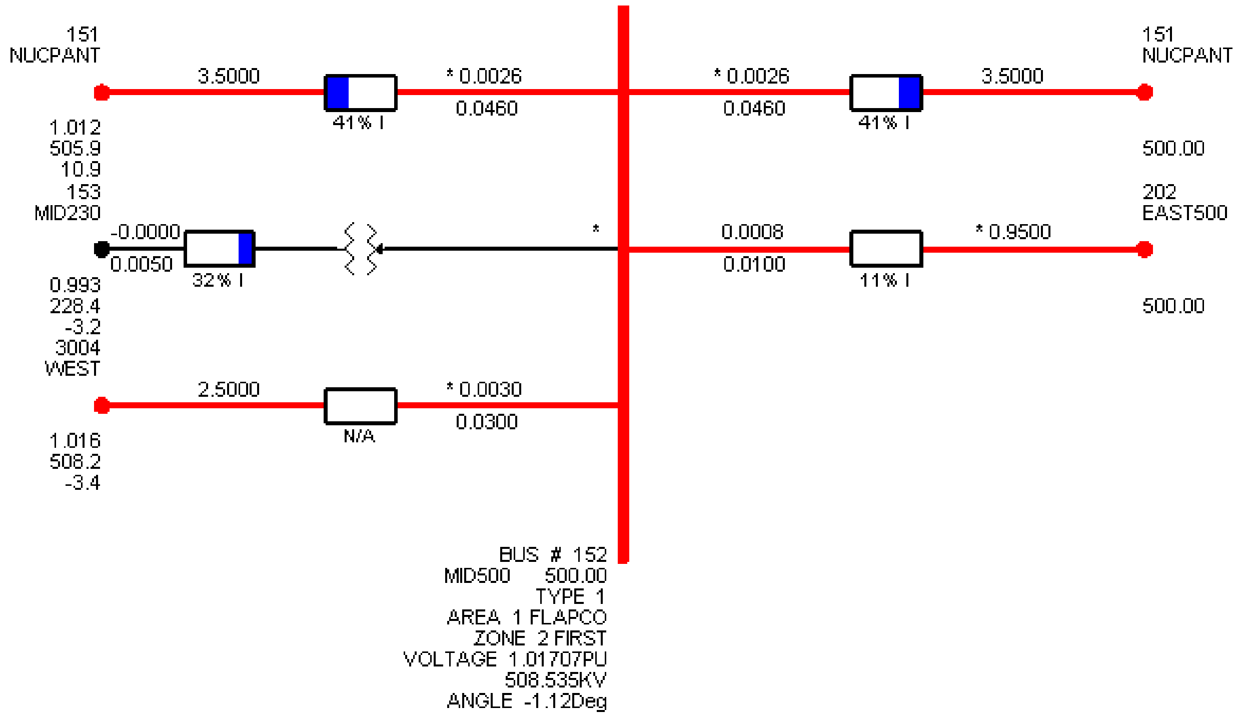


Figure 3.68. Example of Single Bus Display, Impedance Data

The single bus display is also available from *[Network Spreadsheet]*. Select the desired *Bus Number* on the *Buses* tab, right-click, and select *Create bus display (GOUT/GEXM)*. The default view (*Power Flow Results*) is displayed.

3.15.1. Single Bus Display Labels and Symbols

Default labels for the single bus display depend upon the type of bus specified.

If the selected bus is a generator bus controlling the voltage at a remote bus, the remote bus number, name, and base voltage will be tabulated with the other selected bus information. Further, if the active and reactive power mismatch at the bus exceed 0.5 MVA or kVA, according to the power output option in effect, the mismatch information will be listed.

Each machine at a selected bus is separately displayed with the machine identifier printed inside of the generator symbol. In the *Power Flow Results* view, the machine loading is shown along with one of the H, L and R flags indicating the current reactive loading condition. In the *Impedance Data* view, the machine's defined power setting and reactive limits are shown.

Load and shunt elements are represented with actual loadings when shown in the *Power Flow Results* view view and ratings when shown in the *Impedance Data* view. Load identifiers are shown within the symbol.

Branches are drawn from the top of the page in ascending to bus order (numeric or alphabetic according to the bus output option in effect). The to bus number and name are drawn on the extreme right of the branch line adjacent to the to bus busbar. Placing the cursor on the branch will pop up the line from and to bus numbers/names and the circuit identifier. In the *Power Flow Results* view flows are shown as active and reactive power leaving the from bus (the selected bus) and as active and reactive power arriving at the to bus end. In the *Impedance Data* view, the R, X and B data quantities are shown.

For two-winding transformer branches, two transformer symbols are drawn between the flow and the to bus. Off-nominal turns ratio and any nonzero phase shift angle are displayed between the flow and the first transformer symbol and between transformer symbols.

Any three-winding transformer connected to the bus is drawn similar to the two-winding transformer except one more branch and bus are displayed, and off-nominal turns ratio and any nonzero phase shift angle are shown only for the winding connected to the bus box.

When the multisection line reporting option is enabled (see Changing Program Settings), the far end to bus (rather than the closest dummy bus) of each multisection line connected to the bus being displayed is shown as its to bus.

An asterisk (*) is drawn at the metered end of each branch. If a branch is a member of a multisection line grouping and the multisection line reporting option is enabled, the asterisk indicates the metered end of the line section adjacent to the bus being displayed and a plus sign (+) designates the metered end of the multisection line grouping.

Any dc lines connected to the bus are drawn before any AC branches in ascending DC line number order, with two-terminal lines listed first, followed by any multi-terminal lines. Power flow conventions for dc lines are as in the Bus based report output format. Alpha, gamma, and the converter transformer off-nominal turns ratios are displayed and tagged as in the Bus based reports. For multi-terminal lines, no to bus end conditions are listed.

Any FACTS device with no series element which is connected to the selected bus is drawn to the left of the bus. It is illustrated with a straight line drawn from the displayed bus and connects to a rectangular box, which is attached to a shunt symbol. The rectangular box contains a power flow direction arrow pointing in the direction of the shunt. The FACTS device number is displayed above the device.

Any series FACTS device connected to the selected bus is drawn to the right of the bus with a line connecting that bus and its associated terminal/send bus. The series element is illustrated by a circle containing an embedded arrow and is located midway on the connecting line. The arrow indicates the power flow direction (sending end bus to terminal end bus direction). The FACTS device number is displayed to the right of the connected bus.

For series FACTS devices with non-zero shunt current and/or bridge active power transfer limits, when the selected bus is the sending end bus, two additional lines are drawn to represent the shunt and bridge element connections. The first line is drawn to the right of the sending end bus underneath the series element connecting line and stops at a point midway between the sending end bus and the terminal end bus. Another line is drawn from that point upward to the series element circle.

3.15.2. Navigating the Network Using the Single Bus Display

It is possible to proceed through the network graphically to examine power flow conditions and data or to check topology.

To go from the initially selected bus to one of its to buses, double click the to bus node. The diagram will then feature that bus and its connections. Figure 3.69, “Scrolling through the Network ” shows the result of double-clicking from bus to bus.

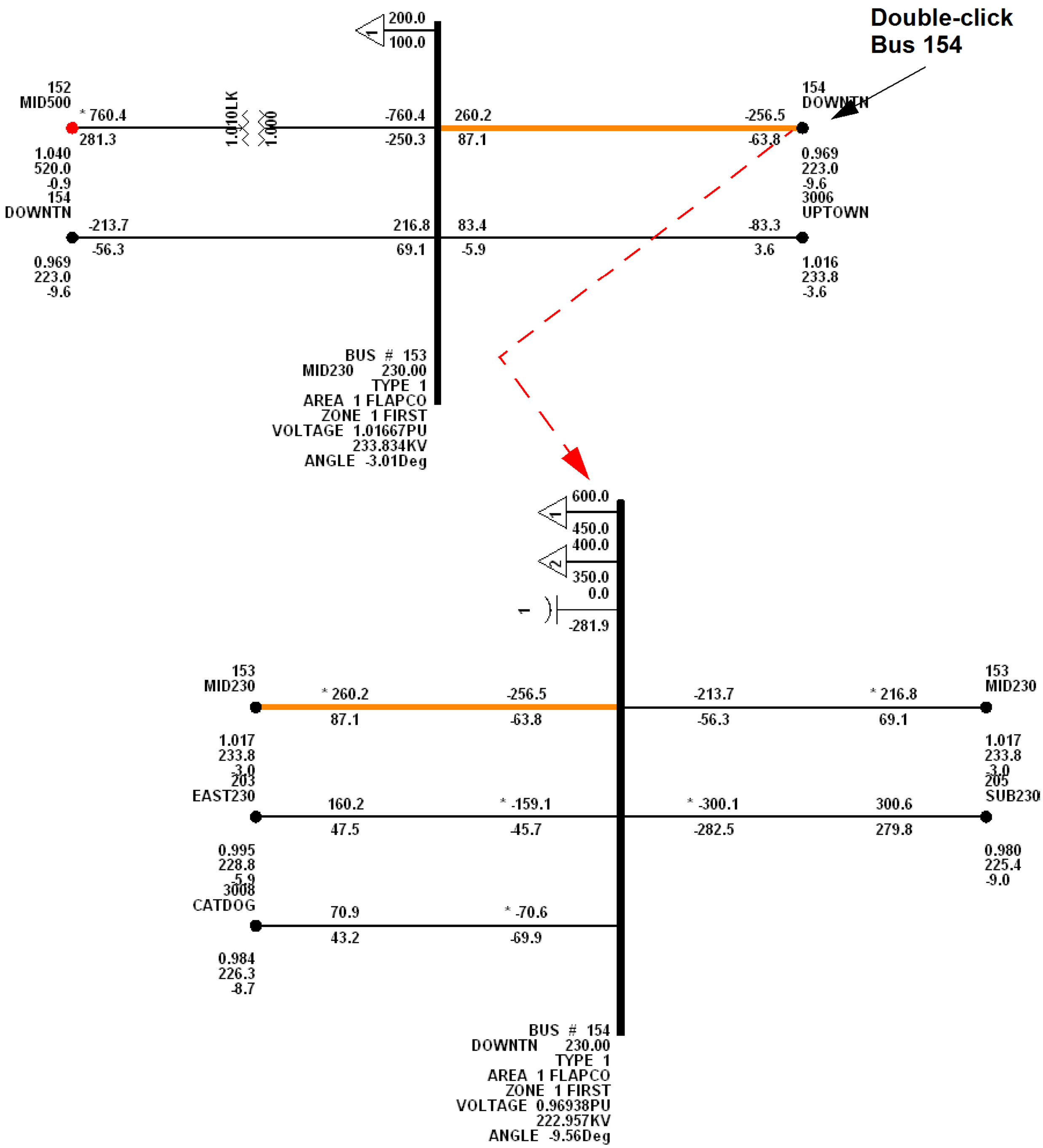


Figure 3.69. Scrolling through the Network

3.15.3. Converting Grow Mode

Convert Grow mode from GOUT to Auto-Draw

Single bus display diagrams are used for quickly traversing the network. A diagram originally created with GOUT/GEXM will respond to *growing* elements differently from a diagram created using Auto-Draw or Grow (see Section 3.7, "Using Auto-Draw"). During a Grow operation they simply display everything connected to the bus. The Grow operations pays no attention to whether or not the element exists in *[Diagram]*; the item is simply created again to lend clarity to the layout.

This function can be used to convert the *grow* behavior of a diagram from GOUT/GEXM to an Auto-Draw style *grow* where each specific element only is created once.

This option is available only when a *[Diagram]* is the active view.

Additional Information
PSS®E Program Operation Manual, Displaying Power Flow Solution on the Diagram Displaying Power Flow Data on the Diagram

3.16. Generating a Graphical Report

GRPG

Requirements / Prerequisites
Validly specified power flow case solved to an acceptable mis-match level if network data is to be included on the drawing.

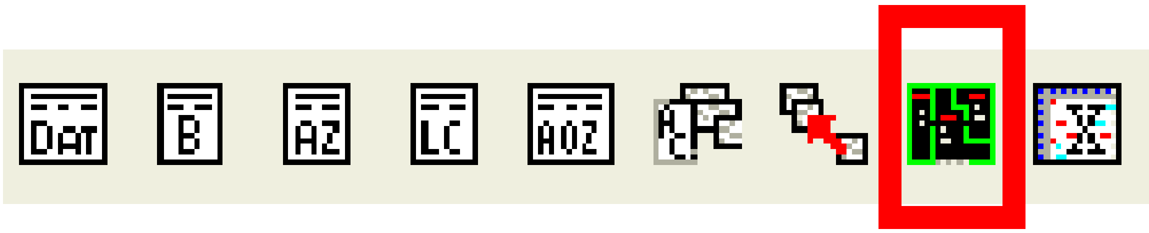


Diagram > Generate a graphical report (GRPG)...

This activity generates the old GRPG-style report. The *[Graphical Report Data file]* selection window requires entering the filename of an existing Graphical Report Data file (*.grp). The *[Terminal Read]* dialog (Figure 3.70, "Terminal Read Dialog") then requires a code for the output device. The most common response is 26, directing the output to the screen. Future releases will provide support for GPRG style reporting directly from *[Diagram]*.

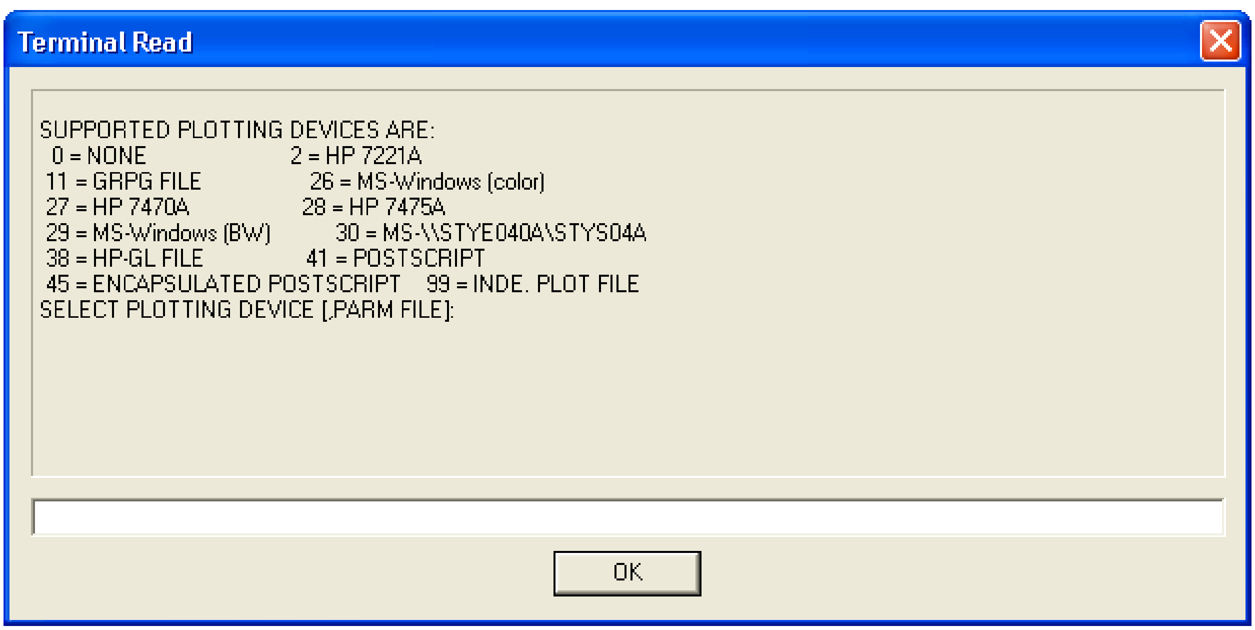


Figure 3.70. Terminal Read Dialog

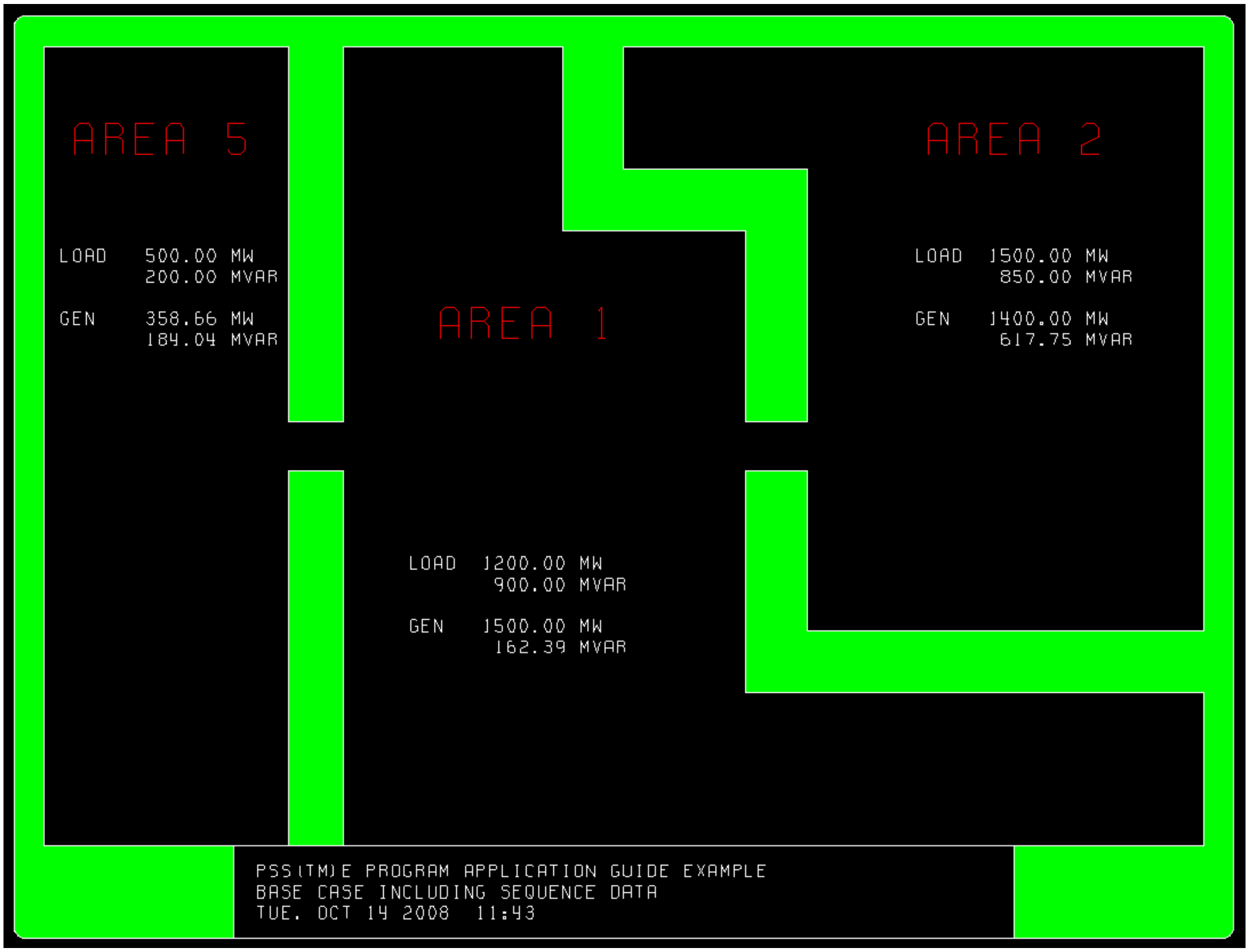


Figure 3.71. GRPG-Style Graphical Report

Additional Information
PSS® E Program Operation Manual, Generating a Graphical Report

3.17. Diagram Management

3.17.1. Diagram Contents

Diagram > Contents

The *[Diagram Contents]* screen presents an itemized list of the number of components in the entire diagram, including diagram items, annotations, images, and text annotations added by the user (Figure 3.72, "Diagram Contents").

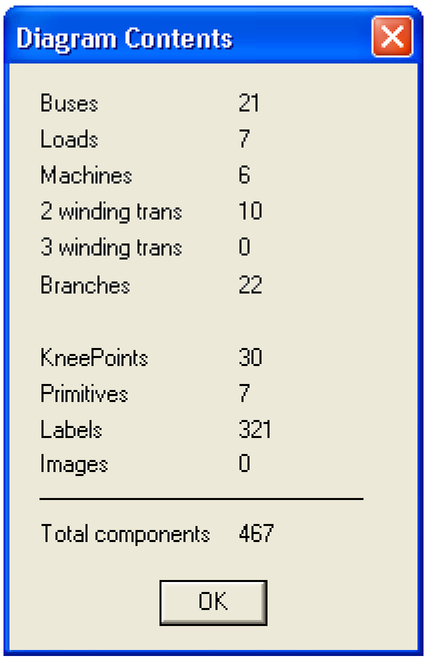


Figure 3.72. Diagram Contents

3.17.2. Errors/Missing Items

Diagram > Check

This function examines the entire network and diagram for apparent errors and missing items. The results are displayed in the *Progress* tab (Figure 3.73, "Results Generated by the Check Menu Option").

To examine the network by subsystem, select *Diagram > Check by Subsystem*.

```
           Missing Network Items

           ---------- None ----------

           Missing Diagram Items

Bus #      152 [MID500      500.00]
    Branch 152 3004 1  not found in current diagram

Bus #      204 [SUB500      500.00]
    Bus 204 not found in current diagram
```

Figure 3.73. Results Generated by the Check Menu Option

3.17.3. Diagram Layers

Diagram > Manage Layers...

A simple way to visualize layers is to imagine *[Diagram]* as an infinite number of sheets of clear mylar, stacked on top of another. Diagram items are drawn on a single sheet of mylar, that is, they belong to a particular layer. When all sheets are laid down, *[Diagram]* is seen in its entirety.

This function opens the *[Layers]* dialog (Figure 3.74, “Layers Dialog”).

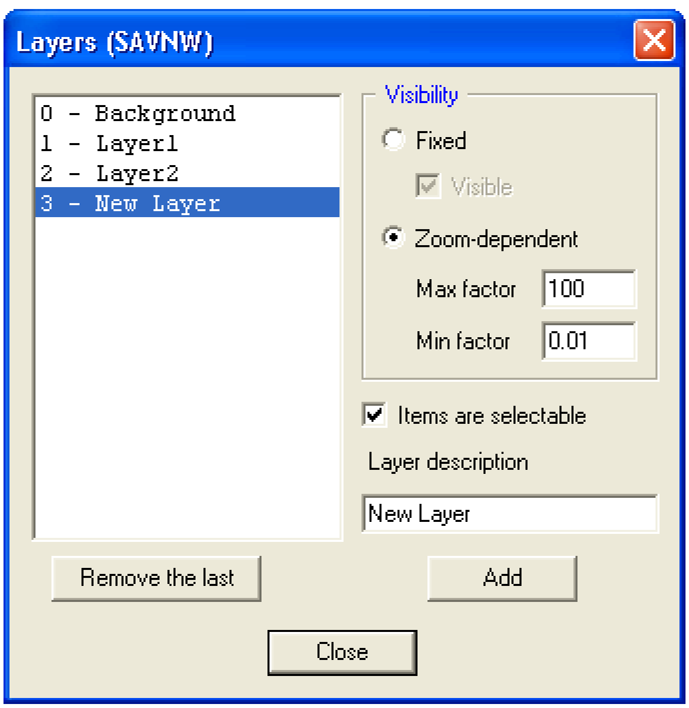


Figure 3.74. Layers Dialog

PSS®E provides the capability to view selected layers. For example, layers could be defined for base voltages of 110 kV, 200 kV, and 300 kV. The diagram items that correspond to these base voltages could then be created on the appropriate layer. To view the entire network, all layers would be made visible. To view only the 200 kV elements, the 100 kV and 300 kV layers would be made invisible, leaving only the 200 kV layer visible.

At a minimum, *[Diagram]* contains two layers:

- *Layer 0:* The background layer with any imported images.
- *Layer 1:* The default layer.

You can change attributes in these layers, but they cannot be removed from *[Diagram]*. All new diagram items added to *[Diagram]* are created on the active layer, which is the single layer specified.

Even if all layers are visible, only one is considered the active layer. It is displayed in the *Status* bar at the bottom of the PSS®E interface when *[Layers]* is closed (Figure 3.75, "Status Bar Showing Active Layer").

Figure 3.75. Status Bar Showing Active Layer

Click *[Add]* to specify a new layer. You may create a unique title by modifying the *Layer description* field. Clicking another layer or *[Close]* saves the layer attributes, which may be modified. Highlight a layer and click *[Remove the last]* to delete it.

The visibility of the layers depends on the options selected in *[Layers]*.

Fixed: The layer is in the diagram file. It is visible if the *Visible* checkbox is selected.

Zoom-dependent: The current zooming factor determines layer visibility. If the current zooming factor is within the minimum and maximum zooming factors specified, then the layer is visible. If the zooming factor is outside the range, then the layer is invisible.

The *Items are selectable* checkbox enables the ability to highlight specific components of a layer. To avoid the inadvertent manipulation of certain diagram components, place them on a separate layer and deselect the checkbox.

To set the active layer, go to *Diagram > Set Active Layer...* and select the desired layer from the pull-down list in the *[Select Layer]* dialog (Figure 3.76, "Setting the Active Layer").

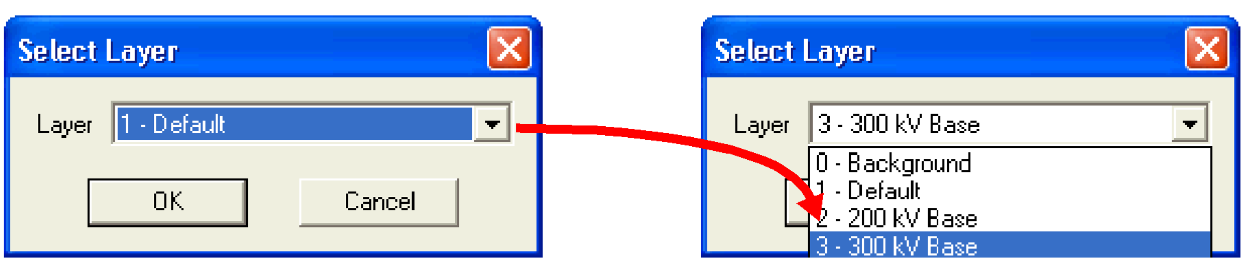


Figure 3.76. Setting the Active Layer

To assign network components to a layer, select the component and right-click to display the menu. Select *Display > Assign to Layer...* and select the desired layer from the pull-down list in *[Select Layer]*.

This method can be used to assign diagram items to a layer one at a time, or a group of items can be selected and all be assigned to a layer. In the following example, all diagram items from Area 1 of the savnw.sav power flow case have been selected and assigned to a layer with the name Area 1

To see the entire one-line diagram, select all layers to be visible (see Figure 3.77, "All Layers Visible from Layers Dialog"). If the Area 1 layer is selected to be *not* visible, the one-line diagram will show only the diagram items belonging to the *Default* layer (see Figure 3.78, "Only Default Visible").

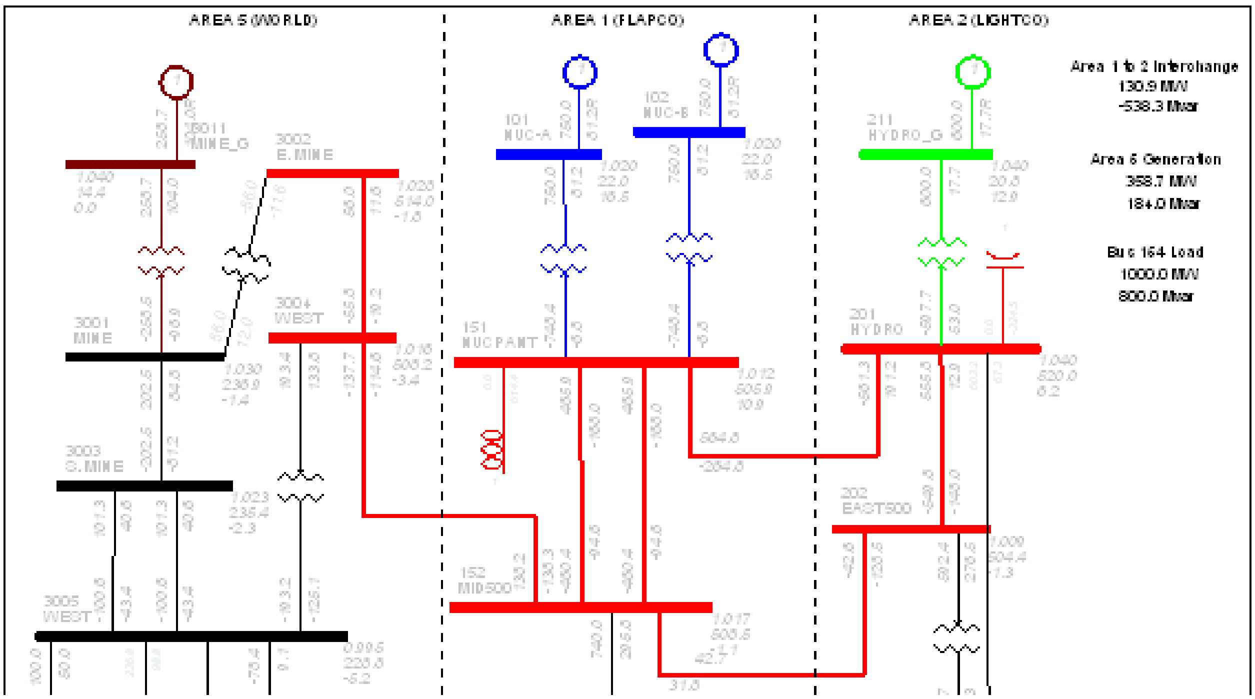


Figure 3.77. All Layers Visible from Layers Dialog

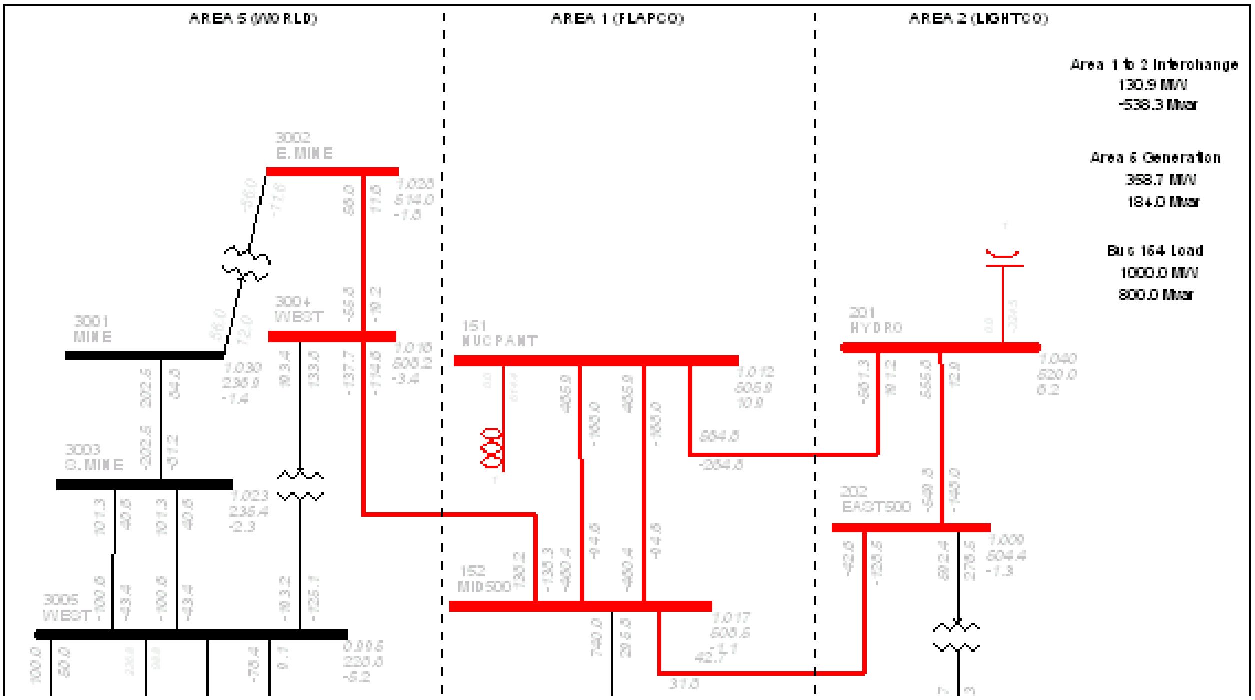


Figure 3.78. Only Default Visible

Layer assignment may also be made from *[Network Tree]*. Right-clicking the network folder opened to an expanded list will display a pop-up menu with an *Assign all items to Layer* option. This function opens *[Select Layer]*. When the layer is selected, all drawn items in the expanded list are re-assigned and *[Diagram]* is refreshed. This tool can be useful for assigning network items to layers for an existing or imported diagram.

3.17.4. Property Overrides

Diagram > Select all items with property overrides

This function selects all items in the diagram that have had color, line style, or line width established in Specifying Diagram Properties or Range Checking replaced by *[Color]* or *[Line Style]* dialogs (Figure 3.3, "Color Dialog" and Figure 3.16, "Line Style Dialog").

Diagram > Remove property overrides from selected items

This function removes any property overrides from selected items in the diagram. The line style, width and color will return to those specified by Specifying Diagram Properties or Range Checking.

3.17.5. Cleaning the Diagram

Diagram > Clean

This function performs a general diagram cleanup. As bugs are discovered in existing diagrams, new cleaning modes are added to this function and released in program patches so that users will be able to repair their diagrams. Repeatedly executing this activity will have no effect on a diagram, it addresses only specific diagram issues. The current issues addressed are:

1. Makes sure any name extension is separated by a ' ' from the end of the internally generated name.
2. Removes any unattached Branch or Radial symbols.
3. Checks for Summations that have lost their Identity strings.
4. Fixes any bad annotation tags found on branches and two winding transformers.

3.18. Exporting Data

3.18.1. Image File

File > Export > Diagram Image...

You may export the visible area of an active diagram to either a Bitmap or a JPEG file. The *[Export Image As]* dialog requires the name of the file in which to save the image and navigation to the desired directory for file storage.

When the JPEG file type is selected, the export process requires the specification of the *JPEG quality* level on a scale of 1 to 100 (see Figure 3.79, "JPEG Quality Dialog"). Some experimentation may be necessary to find the desired level of quality, balanced with file size.

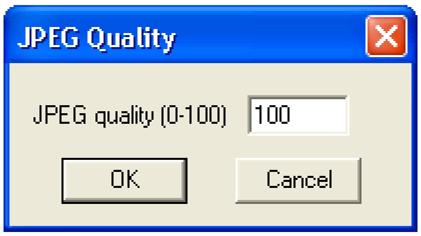


Figure 3.79. JPEG Quality Dialog

3.18.2. Bus Location File

File > Export > Bus Locations...

You may export the x/y coordinates from all buses, branches, and two winding transformers in the active diagram to a text file. Bus, branch and two winding transformer locations are recorded as Cartesian coordinates. The *[Select bus location output file]* dialog requires the name of the file (*.loc) in which to save the data and navigation to the desired directory for file storage.

3.18.3. Google Earth Locations File

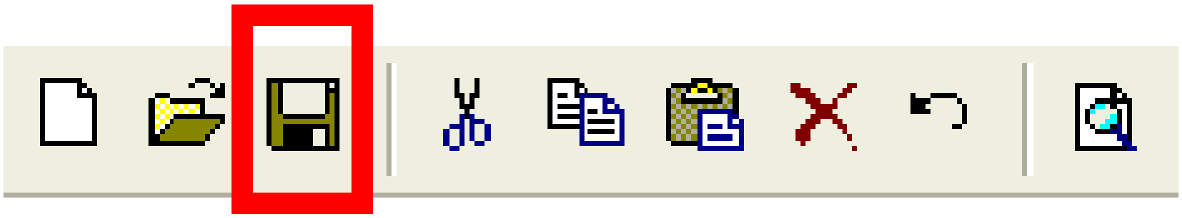
File > Export > Google Earth Locations...

You may export slider diagrams to KML (Keyhole Markup Language) format. Geographic Coordinate information in the WGS-84 (World Geodetic System) is required for graphical elements that will be exported. The KML file can then be opened and manipulated in Google Earth. This feature allows a power network to be viewed against the backdrop of location specific, geographic data. The *[Select Google Earth data output file]* dialog requires the name of the file (*.kml) in which to save the data and navigation to the desired directory for file storage.

3.19. Closing the Diagram View

File > Close

The *Close* option provides the opportunity to save any changes made to the diagram since it was last opened.



File > Save

The *Save* option over-writes a previous version of the file. If a new diagram is to be saved, the *[Save As]* dialog requires a filename and the specification of file type: either Slider Binary file (*.sld), the standard format, or Slider XML file (*.sldxml), an XML text file.

Chapter 4
Data Selection Tree View

4.1. Introduction

The *[Tree]* view provides a hierarchical, expandable and collapsible list view of the network, OPF, dynamics, model, and plot data in the working case (see Figure 4.1, “Network Tree View”). Folders can be expanded or collapsed to control the amount of data visible. Only one folder may be expanded at a time.

A right-click in a blank area of *[Tree]* (without selecting a data category) will display a menu from which hiding/exposing and docking/undocking the view can be selected.

Hide: Closes the view. The user must select *View > Tree View* to reopen it.

Allow Docking: Toggles between docking the view and making it a free-floating window.

4.2. Network Tree

[Network Tree] provides a quick glance at all network data in the system. It is synchronized with the bus subsystem selector to enable the user to reduce the amount of data presented at any one time. *[Network Tree]* is also synchronized with *[Network Spreadsheet]* and *[Diagram]*, reflecting their current contents.

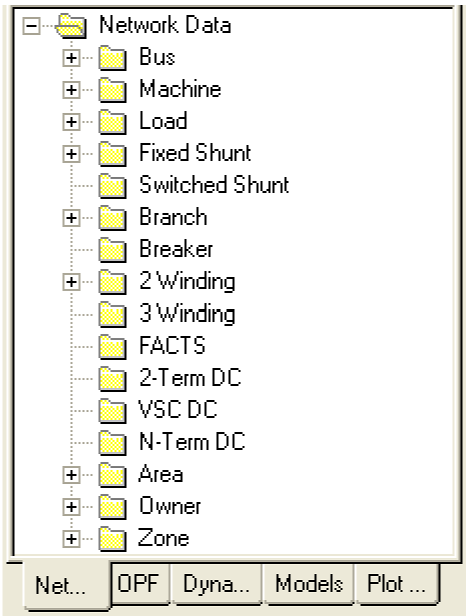


Figure 4.1. Network Tree View

When *[Diagram]* is active, the data items in *[Network Tree]* are updated to reflect whether a particular item is drawn in the diagram. If the item is not drawn, then the symbol to the left of the item is blank. If the item is drawn, the symbol to the left of the item is filled with the symbol belonging to the data category (i.e., busbar, load symbol, etc.).

When *[Diagram]* is active, data record property sheets can be opened by double-clicking a data items in *[Network Tree]*. See Section 3.6.1, "Using Data Records ".

The symbols in *[Network Tree]* are refreshed whenever *[Diagram]* is made active. A network item can be drawn in one diagram and not another, so the symbols provide a visual cue indicating whether the network item is drawn in the active diagram (see Figure 4.2, "Tree View, Buses in Active Diagram"). When *[Spreadsheet]* is active, all symbols are replaced with blanks.

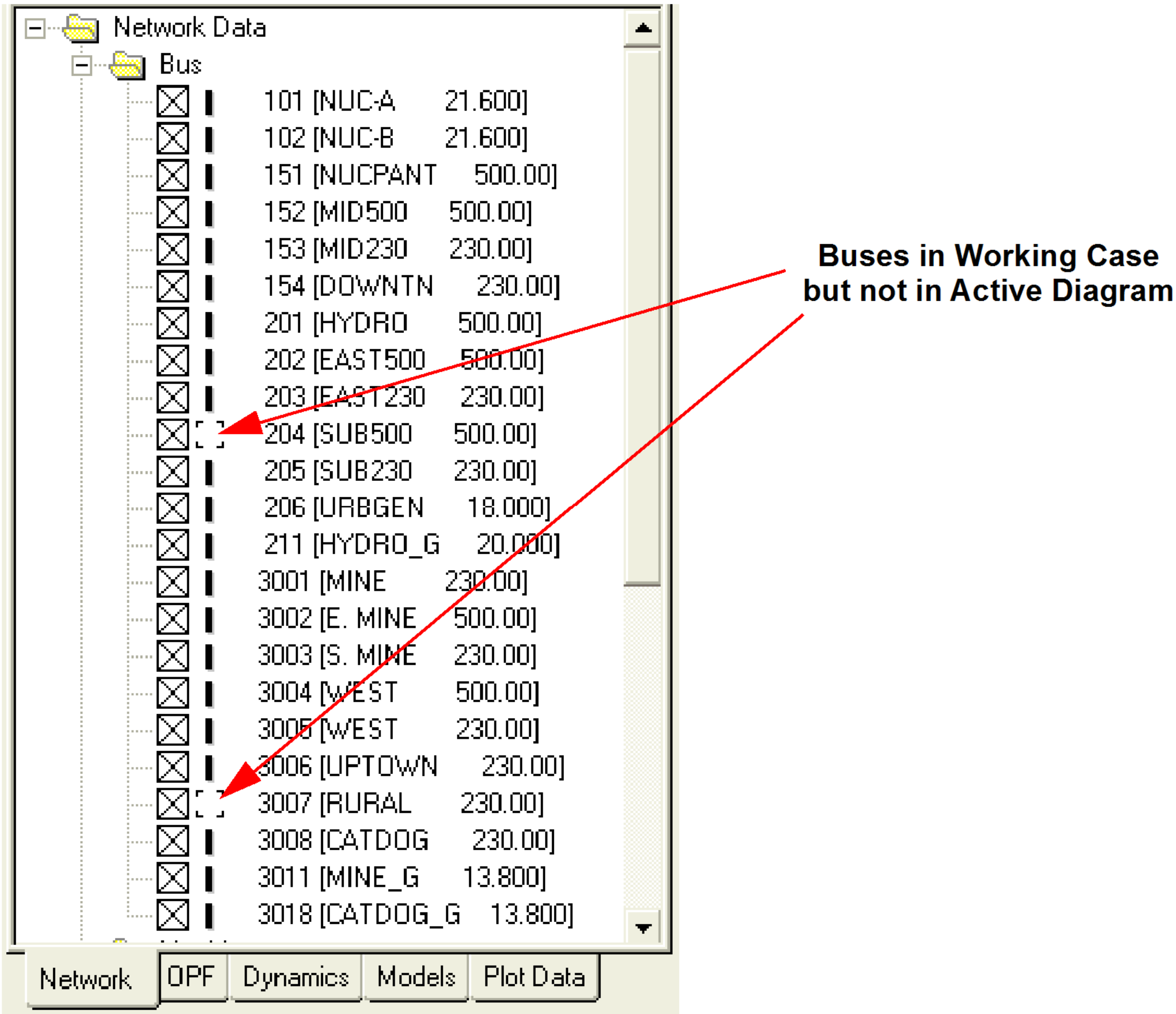
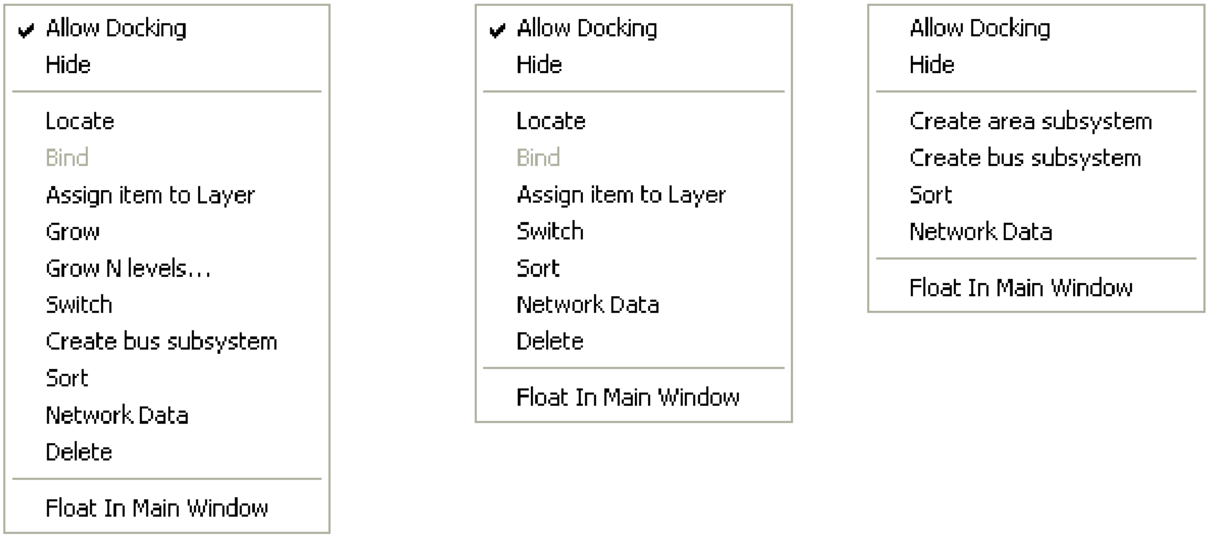


Figure 4.2. Tree View, Buses in Active Diagram

Various menus are available by selecting and right-clicking a network component. Menus are specific to the type of network element selected (see Figure 4.3, “Some Tree View Menu Options”).



Bus Right-Click Menu **Machine Right-Click Menu** **Area Right-Click Menu**

Figure 4.3. Some Tree View Menu Options

Switch: Toggles in-service status; that is, disconnects the device.

Sort: All items in the selected data category are sorted in ascending alphanumeric order.

Network Data: Points to the selected network component in *[Network Spreadsheet]* on the relevant data tab, and highlights its data row.

Dynamics Data: Points to the selected network component in *[Dynamics Spreadsheet]* on the relevant data tab, and highlights its data row.

Delete: Deletes the network component from the model.

Create bus subsystem: Filter the model by a set of selected buses.

Create area subsystem: Filter the model by a set of selected areas.

Create zone subsystem: Filter the model by a set of selected zones.

Create owner subsystem: Filter the model by a set of selected owners.

If *[Diagram]* is the active view, then the right-click menu for the selected element provides additional options. These are described in detail in Section 3.6.4, “Binding Data”, Section 3.6.5, “Displaying and Modifying Network Elements ”, Section 3.6.6, “Drawing a Missing Bus”, Section 3.7, “Using Auto-Draw”, and Section 3.17.3, “Diagram Layers ”.

Double-clicking a component activates *[Network Spreadsheet]*, opens the correct data tab, and highlights its data row.

4.3. OPF Tree

The OPF tab in the Tree View (Figure 4.4, "OPF Tree View") provides a quick glance at all OPF data in the working case.

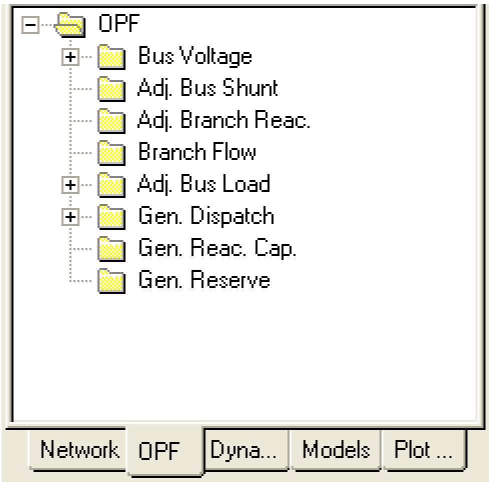


Figure 4.4. OPF Tree View

All network elements that have OPF data associated with them will have an entry in the appropriate folder in the OPF tab.

Double-clicking a data element (i.e., a particular bus) activates *[OPF Spreadsheet]*, opens the correct data tab, and highlights the spreadsheet data row for the selected item.

[OPF Tree] displays only network elements for which OPF data has been defined, either through opening an Optimal Power Flow data file or by initializing OPF data in the current working case (see Section 19.2, "Data Initialization for OPF").

4.4. Dynamics Tree

The Dynamics tab in the Tree View (Figure 4.5, "Dynamics Tree View") provides a quick glance at all Dynamics data in the working case. The Dynamics Tab is synchronized with the bus subsystem selector to enable the user to reduce the amount of Dynamics data presented at any one time.

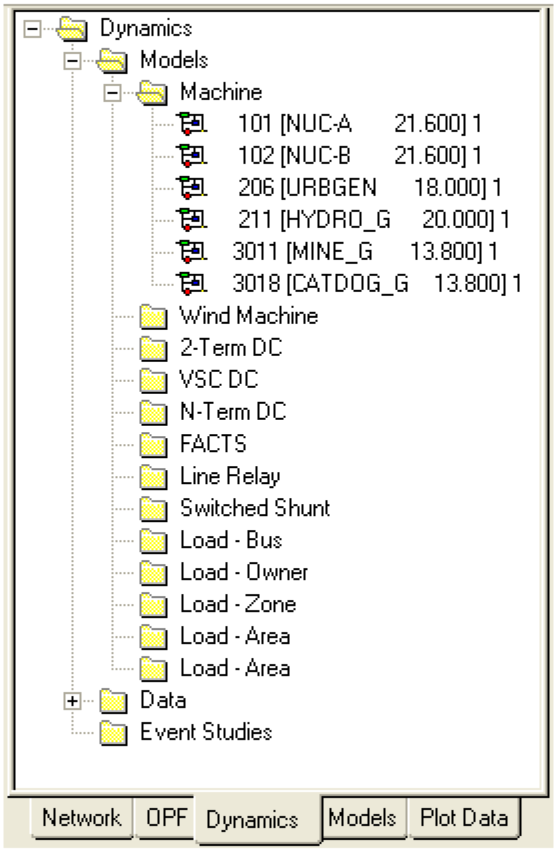


Figure 4.5. Dynamics Tree View

All network elements that have Dynamics models associated with them will have an entry in the appropriate folder in the Dynamics tab.

Double-clicking a data element (i.e., a particular machine) activates *[Dynamics Spreadsheet]*, opens the correct data tab, and highlights the spreadsheet data row for the selected item.

[Dynamics Tree] only displays network elements for which Dynamics models have been defined, either through opening a Snapshot or DYRE file or through *[Dynamics Spreadsheet]*.

4.5. Models Tree

The Models tab in the Tree View provides a quick glance at all Dynamics models present in the current network (see Figure 4.6, "Models Tree View").

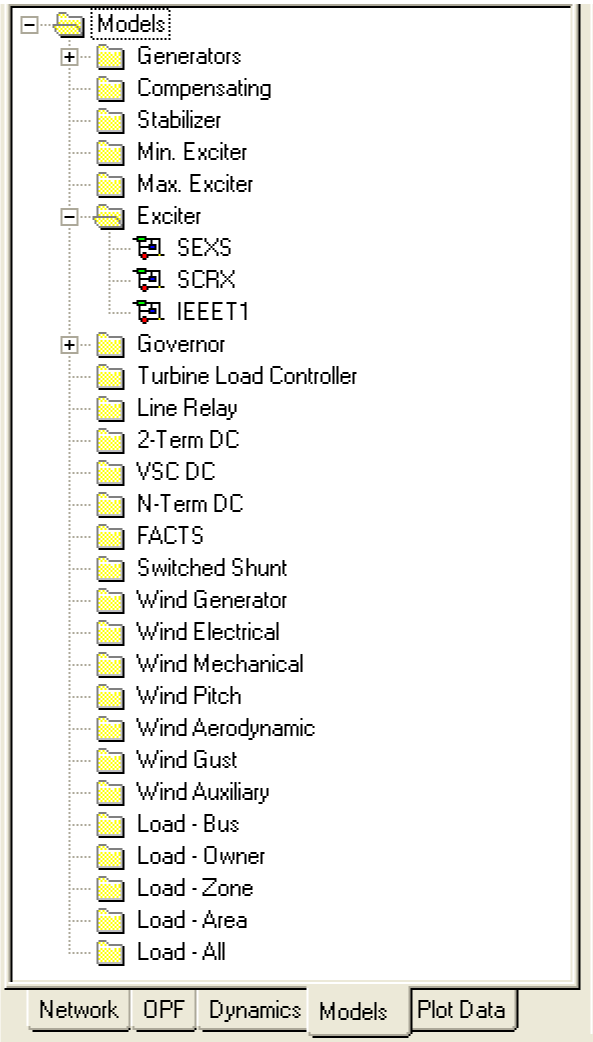


Figure 4.6. Models Tree View

The Models tab is organized by Dynamics model types e.g. Generators, Stabilizers etc. Each model type contains a list of all models of that type present in the current network. The example in Figure 4.6, "Models Tree View" shows that there are three types of exciter models present in the current network, SEXS, SCRX and IEEET1.

Double-clicking a model activates *[Models Spreadsheet]* opened to the CONS tab of the selected model.

4.6. Plot Tree

The Plot tab in the Tree View provides a quick glance at all channels defined in a channel output file (see Figure 4.7, "Plot Tree"). Folders can be expanded or collapsed to control the amount of data visible.

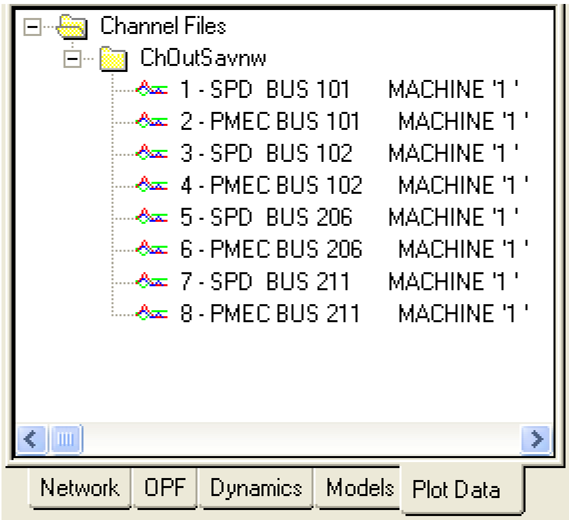


Figure 4.7. Plot Tree

Further details on using the integrated plot package can be found in Chapter 22, *Dynamic Simulation Plot-Package*.

Chapter 5
Tools

The *Tools Menu* allows the user to designate active toolbars, to select the icons (activity commands) that are to be shown on each toolbar, to define Custom Toolbar buttons, to assign model search paths, and to create the User Dynamics DLL. Toolbar icons are indexed in Chapter 29, *Appendix A - Summary of Toolbar Selections*.

5.1. Customizing Toolbars

Tools > Customize Toolbars...

The *[Customize]* dialog Toolbars tab (Figure 5.1, "Customize Dialog, Toolbars Tab") allows arrangement of the toolbars to suit your modeling requirements. Toolbars can be turned on or off, and icons can be added or removed from them. Custom toolbars can also be created.

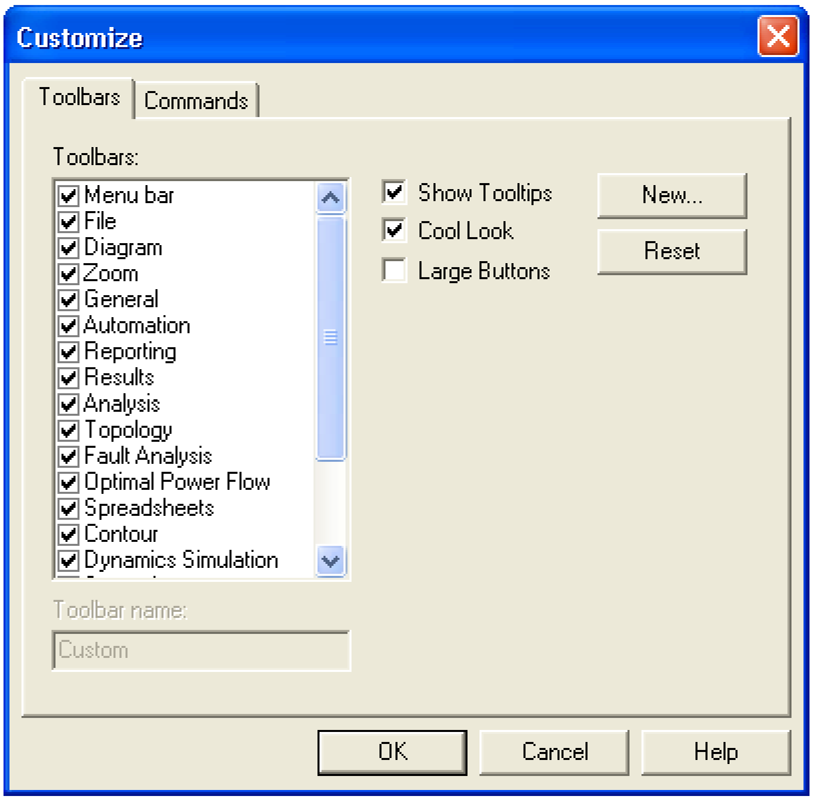


Figure 5.1. Customize Dialog, Toolbars Tab

Use the checkboxes to enable/disable displays of the default toolbar arrangements. You may choose whether or not to show tooltip messages identifying each button's function when the mouse pointer is held over it.

Toolbars can be rearranged in any position on the interface. They can also be dragged off the toolbar location and converted into floating windows.

Many of the toolbar buttons (or toolbar commands) are duplicates of menu options and will open the same dialog.

The Commands tab (Figure 5.2, "Customize Dialog: Commands Tab") displays the individual toolbar categories and shows the buttons currently assigned to each toolbar. Click an icon to provide a description of its command function. The example displays *Show or hide the output bar*.

To remove a button from an active toolbar, drag the icon from the toolbar to the *Buttons* area on the Commands tab. To add a button to an active toolbar, by drag the icon from the the *Buttons* area on the Commands tab to the desired location on the toolbar.

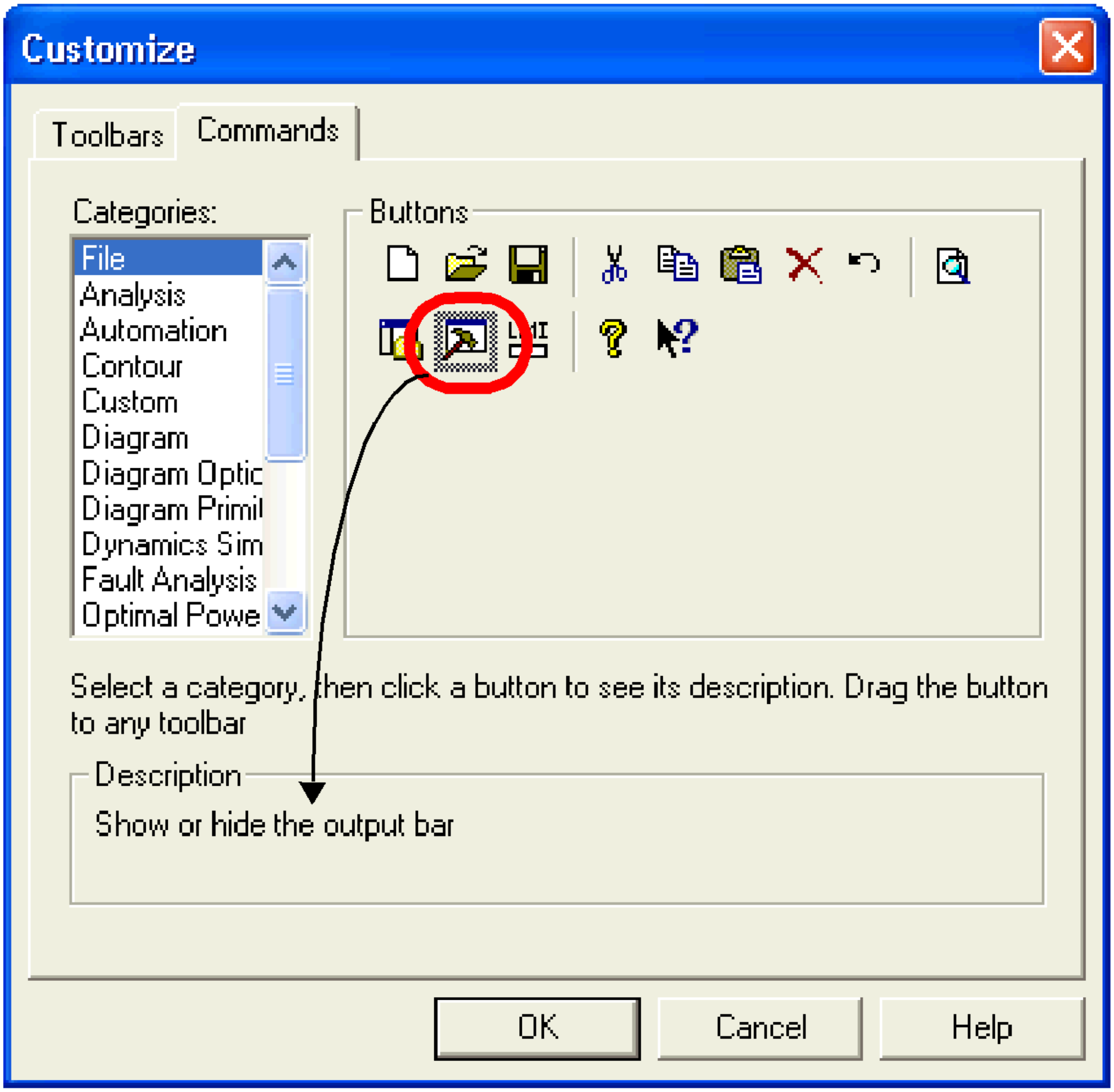


Figure 5.2. Customize Dialog: Commands Tab

5.2. Configuring Custom Toolbar Buttons

Tools > Configure Custom Toolbar Buttons...

The *[Customize Toolbar Buttons]* dialog lists available custom toolbar buttons and active toolbar buttons (see Figure 5.3, "Customize Toolbar Buttons Dialog"). These can be defined to execute user-specified commands.

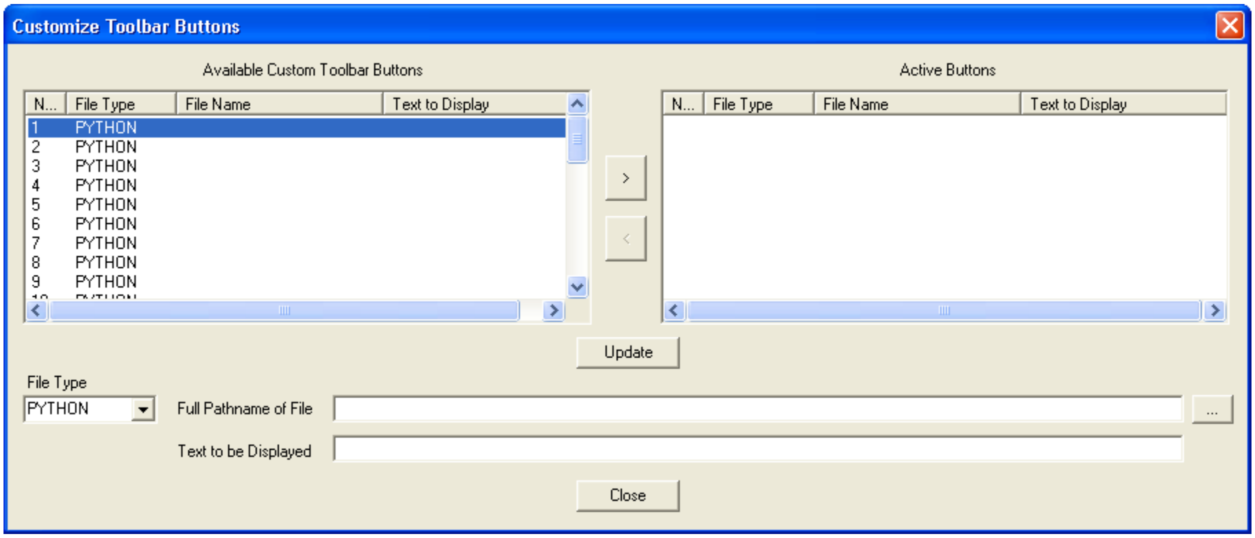


Figure 5.3. Customize Toolbar Buttons Dialog

Thirty custom toolbar buttons are available. Each button requires a file type and a file name.

To define a toolbar button, highlight a button and assign a *File Type*, one of the following Automation file types to be run when the button is clicked:

- PYTHON - A Python script file (*.py) (default)
- RESPONSE - A Response file (*.idv)
- IPLAN - An IPLAN program (*.irf)

Click *[...]* to open the *[Open]* selection window to specify the filename of the Automation file to be executed when clicking the corresponding custom toolbar button. Make sure the *Full Pathname of File* appears in the field.

You may specify a description (tooltip) of the operation to be performed when the corresponding custom toolbar button is clicked in the optional *Text To Display* field. This description pops up when the mouse cursor is held over the custom toolbar button. If a tooltip is not specified, the filename associated with the button is displayed as a tooltip.

Click *[Update]* to apply the changes that you've made.

The arrows in the center of the dialog move buttons from being available to being active. Figure Figure 5.4, "Defined Toolbar Buttons" shows the results of several defined buttons, two of which are in the active list.

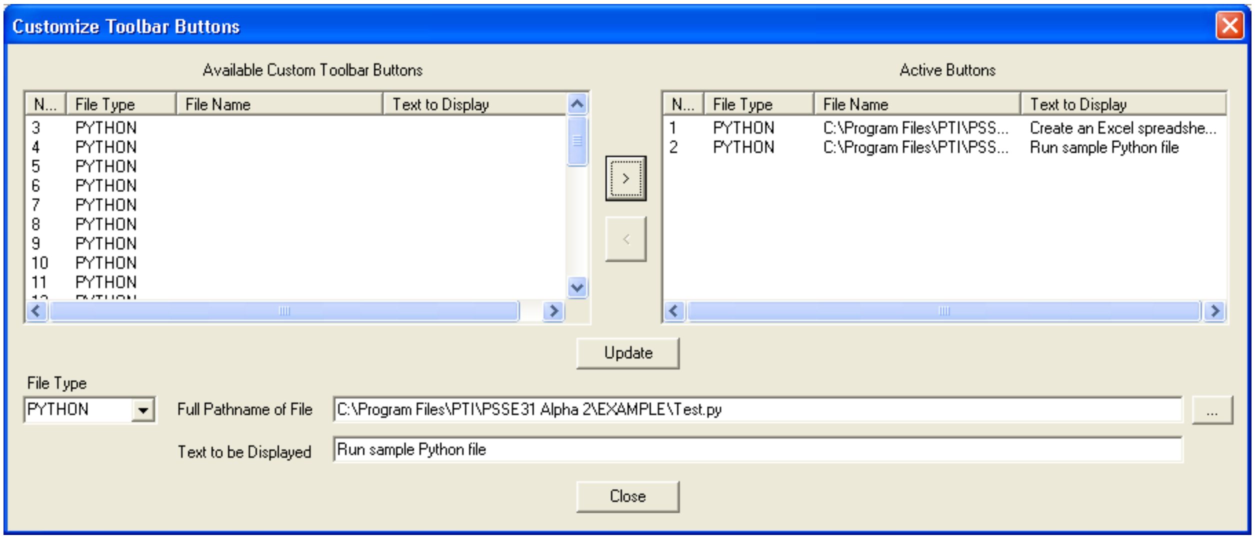


Figure 5.4. Defined Toolbar Buttons

The button must be in the *Active Buttons* list to be available on the toolbar. The others will be grayed out (Figure 5.5, "Custom Toolbar Showing Defined Buttons").

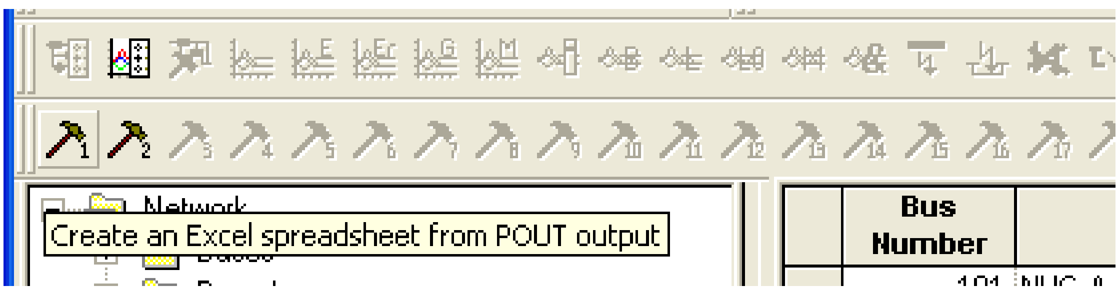


Figure 5.5. Custom Toolbar Showing Defined Buttons

These custom toolbar button definitions are preserved in a file named "Toolbar.prm" found in the Windows® Document and Settings directory for the active user.

5.3. Creating Custom Toolbars

A custom designed toolbar can be created by selecting the *[New]* button in the Toolbars tab of the *[Customize]* dialog (see Figure 5.1, “Customize Dialog, Toolbars Tab”). A new New Toolbar dialog window (Figure 5.6, “New Toolbar Dialog”) will be displayed into which a name for the new toolbar may be entered. Click *[OK]* to display the new toolbar in the list of toolbars and in the PSS®E interface as a small, free-floating toolbar.

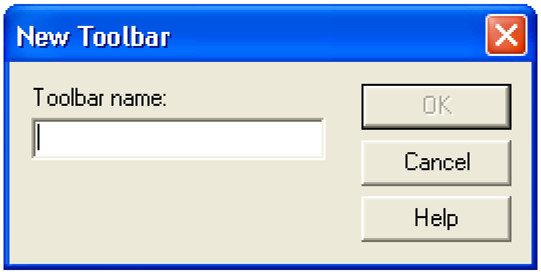


Figure 5.6. New Toolbar Dialog

To add command buttons to the new toolbar, click the Commands tab and drag the desired toolbar buttons to the new toolbar window. The new toolbar window can be docked to the toolbar area by dragging the window to the desired location on the toolbar and releasing the mouse.

To remove a user-defined toolbar from the list of toolbars on the Toolbars tab, highlight the desired toolbar to be deleted and click *[Delete]*. The standard toolbars can be reset only to their default settings.

Chapter 6
Power Flow Data Entry

6.1. Retrieving a Power Flow Saved Case File

CASE

Requirements / Prerequisites
Saved Case file (*.sav) Section 10.1, “Creating a Saved Case File”

File > Open...

The case retrieval activity CASE restores the contents of a previously saved power flow Saved Case File into the working case. The contents of the working case are overwritten while the contents of the specified Saved Case File are unchanged.

The file selection window in the *[Open]* dialog lists only those files available when the *Files of type:* field has been scrolled to the desired file type.

For this activity, scroll to *Save Case file (*.sav)*. Highlight the desired file and click *[Open]*. After the data is read into the working case, *[Spreadsheet]* is updated to include the new working case data.

Additional Information
PSS®E Program Operation Manual, Retrieving a Power Flow Saved Case File *PSS ® E Application Program Interface (API)*, CASE Section 6.2, “Listing Saved Case Filenames”

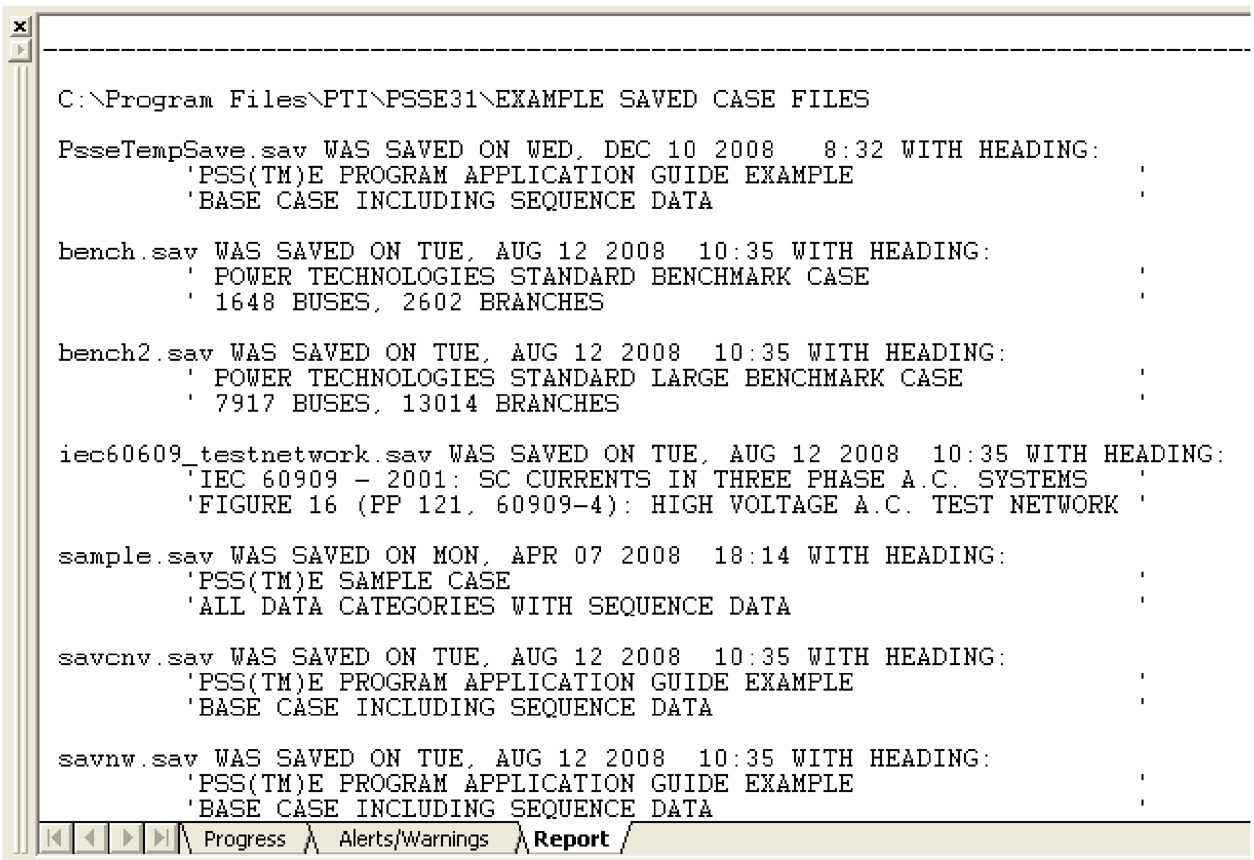
6.2. Listing Saved Case Filenames

SHOW

Requirements / Prerequisites
none

File > File information (SIZE/SHOW/BUSN)...

Selecting the *Powerflow Save cases* option from *[File Information]* produces a report of power flow case filenames in the current working directory.



```
---------------------------------------------------------------------------

C:\Program Files\PTI\PSSE31\EXAMPLE SAVED CASE FILES

PsseTempSave.sav WAS SAVED ON WED, DEC 10 2008   8:32 WITH HEADING:
        'PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE                    '
        'BASE CASE INCLUDING SEQUENCE DATA                             '

bench.sav WAS SAVED ON TUE, AUG 12 2008  10:35 WITH HEADING:
        ' POWER TECHNOLOGIES STANDARD BENCHMARK CASE                   '
        ' 1648 BUSES, 2602 BRANCHES                                    '

bench2.sav WAS SAVED ON TUE, AUG 12 2008  10:35 WITH HEADING:
        ' POWER TECHNOLOGIES STANDARD LARGE BENCHMARK CASE             '
        ' 7917 BUSES, 13014 BRANCHES                                   '

iec60609_testnetwork.sav WAS SAVED ON TUE, AUG 12 2008  10:35 WITH HEADING:
        'IEC 60909 - 2001: SC CURRENTS IN THREE PHASE A.C. SYSTEMS     '
        'FIGURE 16 (PP 121, 60909-4): HIGH VOLTAGE A.C. TEST NETWORK   '

sample.sav WAS SAVED ON MON, APR 07 2008  18:14 WITH HEADING:
        'PSS(TM)E SAMPLE CASE                                          '
        'ALL DATA CATEGORIES WITH SEQUENCE DATA                        '

savcnv.sav WAS SAVED ON TUE, AUG 12 2008  10:35 WITH HEADING:
        'PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE                    '
        'BASE CASE INCLUDING SEQUENCE DATA                             '

savnw.sav WAS SAVED ON TUE, AUG 12 2008  10:35 WITH HEADING:
        'PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE                    '
        'BASE CASE INCLUDING SEQUENCE DATA                             '
```


Figure 6.1. Example of Power Flow Saved Case File Report

6.3. Reading Power Flow Raw Data into the Working Case

The bulk power flow data input activity READ picks up hand-typed power flow source data and enters it into the power flow working case, rearranging it from its original format into a computationally oriented data structure in the process. The source data records are input from a Power Flow Raw Data file.

After the data is read into the working case, *[Spreadsheet]* is updated to include the new working case data.

6.3.1. Standard Data Input

READ

Requirements / Prerequisites
If reading change data, the working case must contain a validly specified power flow case. A Power Flow Raw Data File is available.

File > Open...

The file selection window in the *[Open]* dialog lists only those files available when the *Files of type:* field has been scrolled to the desired file type.

For a standard READ of a Power Flow Raw Data File in the format of the PSS®E release indicated in the file, scroll to *Power Flow Raw Data file (*.raw)*, highlight the desired file, and then click *[Open]*. In the specified Power Flow Raw Data file, fields designating ac buses on load, generator, fixed shunt, branch, transformer, area, two-terminal dc line, VSC dc line, multi-terminal dc line, multi-section line, FACTS device, and switched shunt data records *must* be specified as bus numbers.

A standard READ may also be initiated by using the *Power Flow Raw Data file, Options (*.raw)* entry in the *Files of type:* list. Highlight the desired file and then click *[Open]*. In the resulting *[Read Power Flow Raw Data]* dialog, select *Standard (READ)* as the *Power flow data input application*. In the *RAW file version* fields, the current or a prior PSS®E release corresponding to the format of the Power Flow Raw Data File must be indicated. When the revision number is specified in the file, specify the current version; if some other version is specified, it will take precedence over that specified as REV on the first record of the Power Flow Raw Data File. The *For input, use bus names* check box *must* be checked if the selected Power Flow Raw Data File contains any bus data fields specified as extended bus names. Then click *[OK]*.

Additional Information
PSS®E Program Operation Manual, Reading Power Flow Raw Data into the Working Case *PSS® E Application Program Interface (API)* READ READRAWVERSION

Additional Information
See also: Section 10.4, "Creating a Power Flow Raw Data File "

6.3.2. Subsystem Data Input

READ

Requirements / Prerequisites
If adding data, the working case must contain a validly specified power flow case. A Power Flow Raw Data File is available.

File > Open...

The file selection window in the *[Open]* dialog lists only those files available when the *Files of type:* field has been scrolled to the desired file type.

For a subsystem READ of a Power Flow Raw Data File, scroll to *Power Flow Data file, Options (*.raw)*, highlight the desired file, and click *[Open]*.

In the resulting *[Read Power Flow Raw Data]* dialog (Figure 6.2, "Read Power Flow Raw Data Dialog, Subsystem"), select *Stubsystem (READ,OPT)* as the *Power flow data input application*. In the *RAW file version* fields, the current or a prior PSS®E release corresponding to the format of the Power Flow Raw Data File must be indicated. When the revision number is specified in the file, specify the current version; if some other version is specified, it will take precedence over that specified as REV on the first record of the Power Flow Raw Data File. The *For input, use bus names* check box *must* be checked if the selected Power Flow Raw Data File contains any bus data fields specified as extended bus names.

The *Input by Subsystem* fields allow the selection of the options described in Section Subsystem READ of the *PSS®E Program Operation Manual*. Data input may be limited to any of the following options:

- Add only data within subsystem
- Add only tie lines from subsystem
- Add subsystem data + tie lines

The various subsystem selection checkboxes enable the specification of the subsystem by base voltage, area, owner, and/or zone. Clicking *[Select]* for an active option opens the *[Area Subsystem Selector]*, *[Owner Subsystem Selector]*, or *[Zone Subsystem Selector]* dialog, as appropriate.

With all options selected, click *[OK]* to begin reading the data into the working case.

Additional Information
PSS®E Program Operation Manual, Reading Power Flow Raw Data into the Working Case

Additional Information
PSS® E Application Program Interface (API) READSUB READSUBRAWVERSION See also: Section 10.4, "Creating a Power Flow Raw Data File "

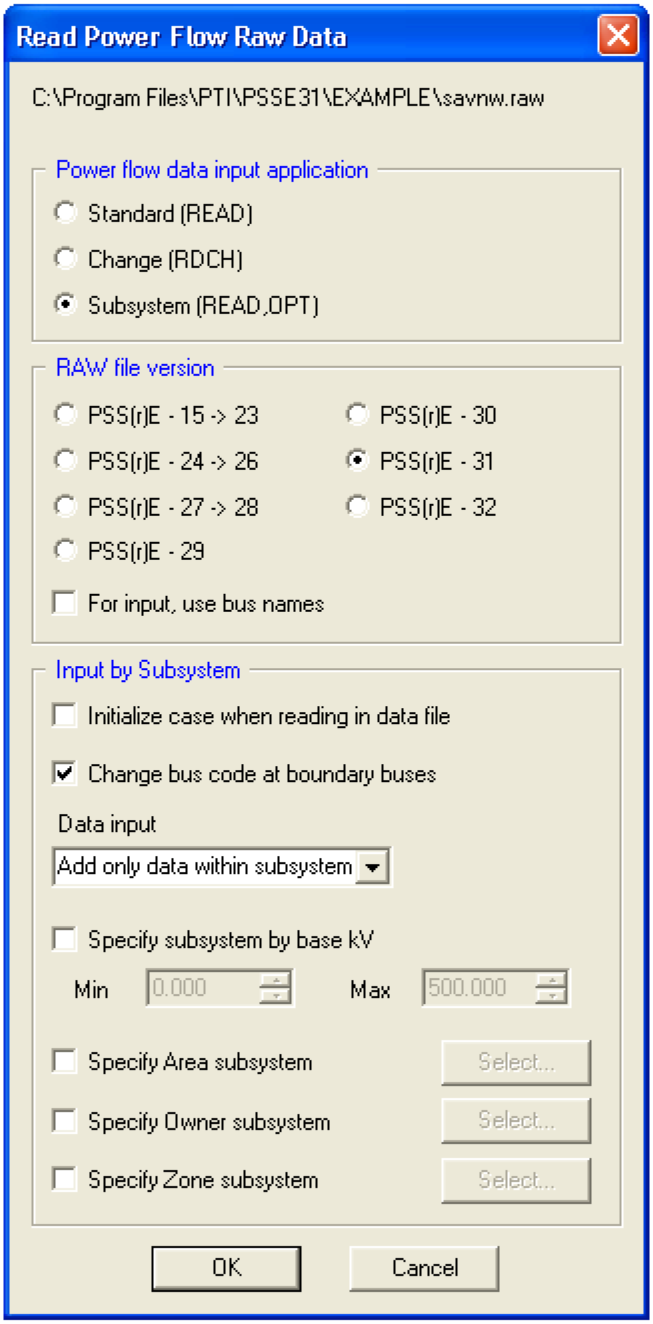


Figure 6.2. Read Power Flow Raw Data Dialog, Subsystem

6.4. Reading or Changing Power Flow Data

RDCH

Requirements / Prerequisites
The working case must contain a validly specified power flow case. A Power Flow Raw Data File is available.

File > Open...

The bulk power flow data input and modification activity RDCH picks up manually-entered power flow source data and enters it into the power flow working case. The source data records are in the form of a Power Flow Raw Data File *except* that the Case Identification Data records are omitted; that is, the first data record is expected to be a bus data record.

The file selection window in the *[Open]* dialog lists only those files available when the *Files of type:* field has been scrolled to the desired file type.

For activity RDCH, scroll to *Power Flow Data file, Options (*.raw)*, highlight the desired file, and click *[Open]*.

In the resulting *[Read Power Flow Raw Data]* dialog (Figure 6.3, "Read Power Flow Raw Data Dialog, RDCH"), select *Change (RDCH)* as the *Power flow data input application*. In the *RAW file version* fields, the current or a prior PSS®E release corresponding to the format of the Power Flow Raw Data File must be indicated. The *For input, use bus names* check box *must* be checked if the selected Power Flow Raw Data File contains any bus data fields specified as extended bus names. Then click *[OK]*.

After the data is read into the working case, *[Spreadsheet]* is updated to include the new working case data.

Additional Information
PSS®E Program Operation Manual, Reading / Changing Power Flow Data *PSS® E Application Program Interface (API)* RAWD_2 RDCHRAWVERSION See also: Section 10.4, "Creating a Power Flow Raw Data File "

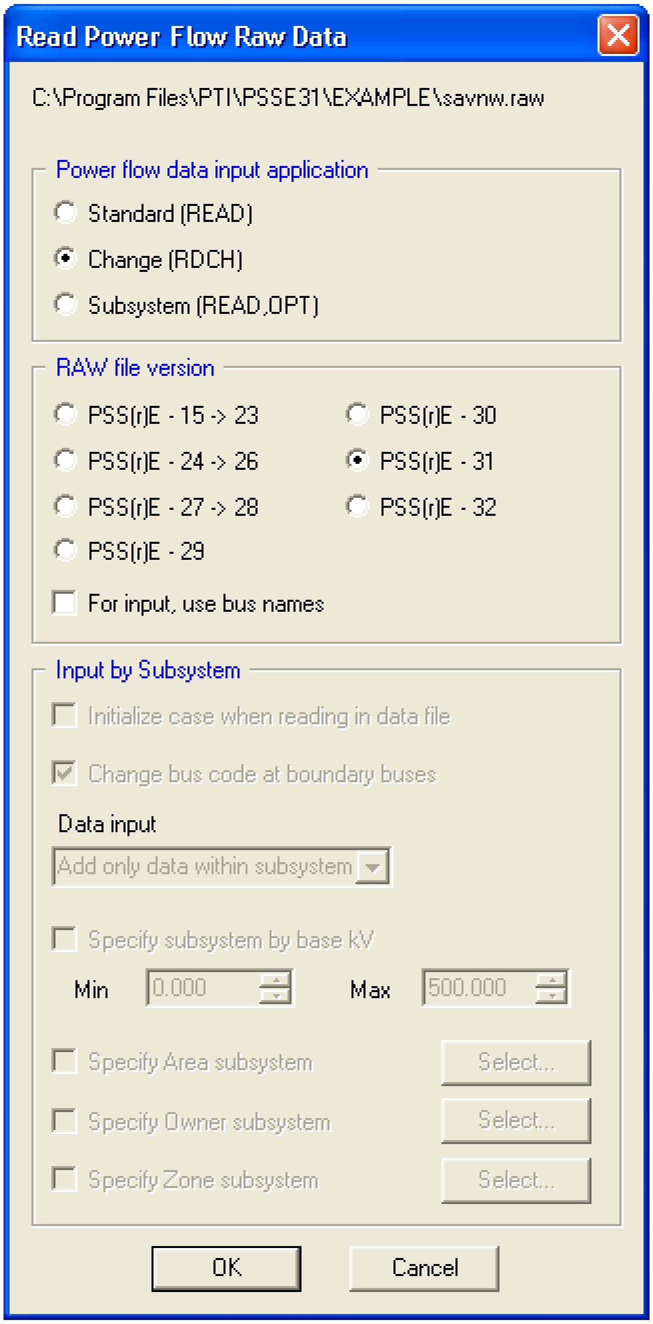


Figure 6.3. Read Power Flow Raw Data Dialog, RDCH

6.5. Selecting Extended Bus Name Input Format

Misc > Select extended bus name input format

The extended bus name format was changed at PSS®E Version 30 to accommodate longer bus names. This activity allows the user to select the input format for older versions of PSS®E. All application functions that process buses based on the extended bus name will use the selected format for processing. This setting is not preserved between runs of the application.

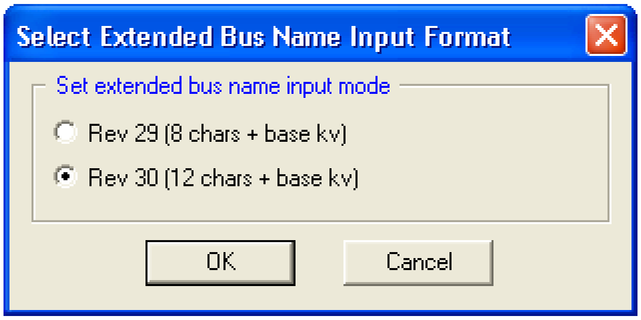


Figure 6.4. Select Extended Bus Name Input Format Dialog

6.6. Adding Machine Impedance Data

MCRE

Requirements / Prerequisites
The working case must contain a validly specified power flow case. Machine Impedance Data file (*.rwm)

File > Open...

The machine impedance data input activity MCRE enters source data records from a Machine Impedance Data File into the power flow working case.

The file selection window in the *[Open]* dialog lists only those files available when the *Files of type:* field has been scrolled to the desired file type.

For activity MCRE, scroll to *Machine Impedance Data file (*.rwm)*. Highlight the desired file and click *[Open]*.

In the resulting *[Machine Impedance Data]* dialog, select the options for the setting of the status of each new machine and for the treatment of existing machines with no input record. Then click *[OK]*.

After the data is read into the working case, *[Spreadsheet]* is updated to include the new working case data.

Additional Information
PSS®E Program Operation Manual, Adding Machine Impedance Data *PSS ® E Application Program Interface (API)*, MCRE See also: Section 10.3, "Saving Machine Impedance Data "

6.7. Reading Sequence Data for Fault Analysis

RESQ

Requirements / Prerequisites
The positive sequence network must be in the working case. Sequence Data file (*.seq)

File > Open...

The sequence data input activity RESQ appends positive, negative, and zero sequence generator data and zero sequence network data to the working case in preparation for unbalanced network solutions (i.e., fault analysis). The source data records are read from a Sequence Data File for the system whose positive sequence representation is contained in the working case.

The file selection window in the *[Open]* dialog lists only those files available when the *Files of type:* field has been scrolled to the desired file type.

For activity RESQ, scroll to *Sequence Data file (*.seq)*. Highlight the desired file and click *[Open]*.

After the data is read into the working case, *[Spreadsheet]* is updated to include the new working case data.

Additional Information
PSS®E Program Operation Manual, Reading Sequence Data *PSS ® E Application Program Interface (API)*, RESQ See also: Section 10.5, “Creating a Sequence Data File”

6.8. Reading Transactions Raw Data

REMM

Requirements / Prerequisites
Validly specified power flow case. Transactions Raw Data File (*.mwm)

File > Open...

Transaction data is introduced into working memory using activity REMM. This information consists of data records presented in a Transactions Raw Data File.

The file selection window in the *[Open]* dialog lists only those files available when the *Files of type:* field has been scrolled to the desired file type.

For activity REMM, scroll to *Transactions Raw Data file (*.mwm)*. Highlight the desired file and click *[Open]*. The data is read into the working case.

Additional Information
PSS®E Program Operation Manual, Reading Transactions Raw Data See also: Section 10.6, "Creating a Transactions Raw Data File "

6.9. Managing Case Titles

6.9.1. Importing a Long Title

RETI

Requirements / Prerequisites
The working case must contain a non-null case.

File > Import > Long Title (RETI)...

The long title data input activity RETI reads a data file containing up to 16 lines of alphanumeric data and places them into the long title. The previous content of the long title is overwritten.

Activity RETI opens a file selection dialog with the title *[Select file containing long case title]*. The file selector contains all entries in your working directory (see Establishing the Working Directory). Select the desired file and click *[Open]* to import the long title into the working case.

Additional Information
PSS® E Program Operation Manual, TREA *PSS® E Application Program Interface (API)*, RETI

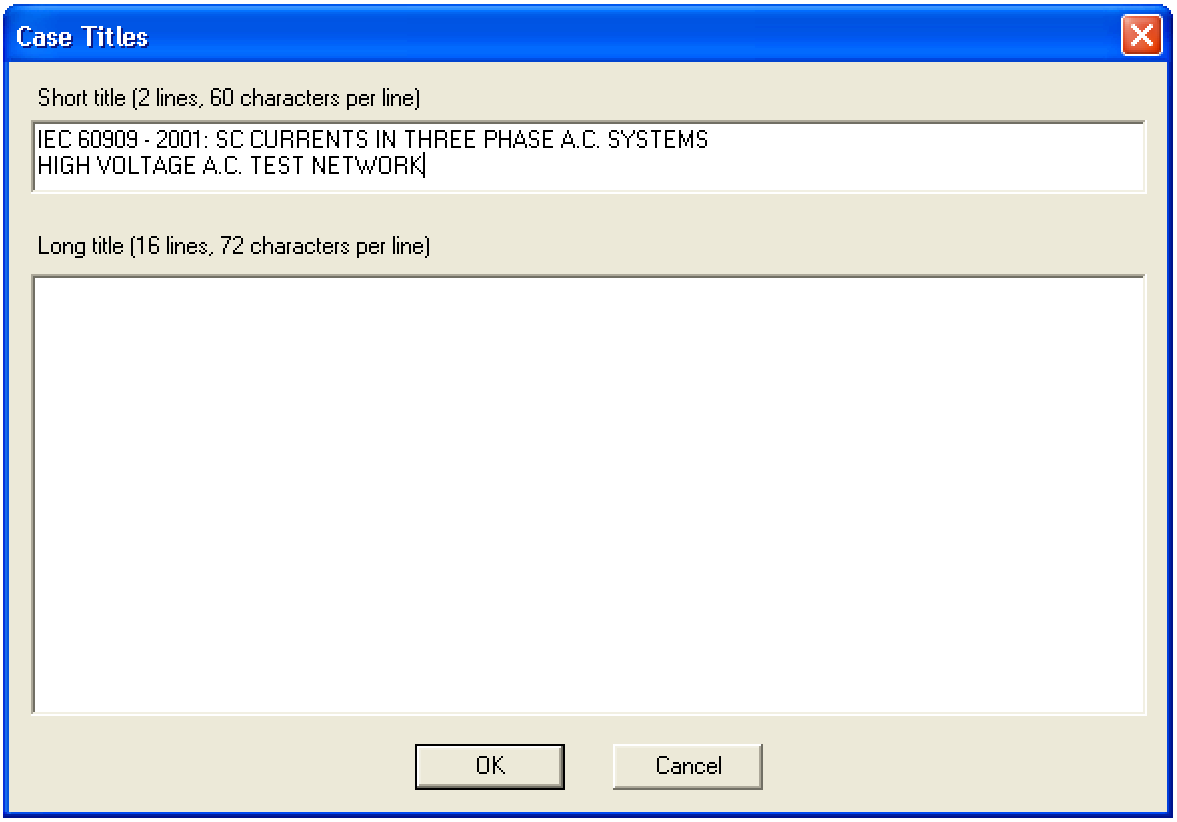
6.9.2. Changing the Case Title and the Long Title

CHTI

Requirements / Prerequisites
The working case must contain a non-null case.

File > Case titles, short & long (CHTI)...

The *[Case Titles]* dialog provides fields where the two-line case title and the 16-line long title may be edited using standard windows techniques.



Case Titles Dialog

Additional Information
PSS® E Program Operation Manual, Changing the Long Title *PSS® E Application Program Interface (API)* CASE_TITLE_DATA LONG_TITLE_DATA

Chapter 7
Power Flow Data Modification

PSS®E allows the user to modify the original network model in a variety of ways. Network elements can be added and removed either on an individual basis or in bulk. Network buses can be renumbered. Transmission resistance elements can be updated. Separate power flow files can be merged. Generation dispatch can be based on economic data. Existing network topology can be modified.

7.1. Changing Service Status and Power Flow Parametric Data

Requirements / Prerequisites
The working case must contain a validly specified power flow case.

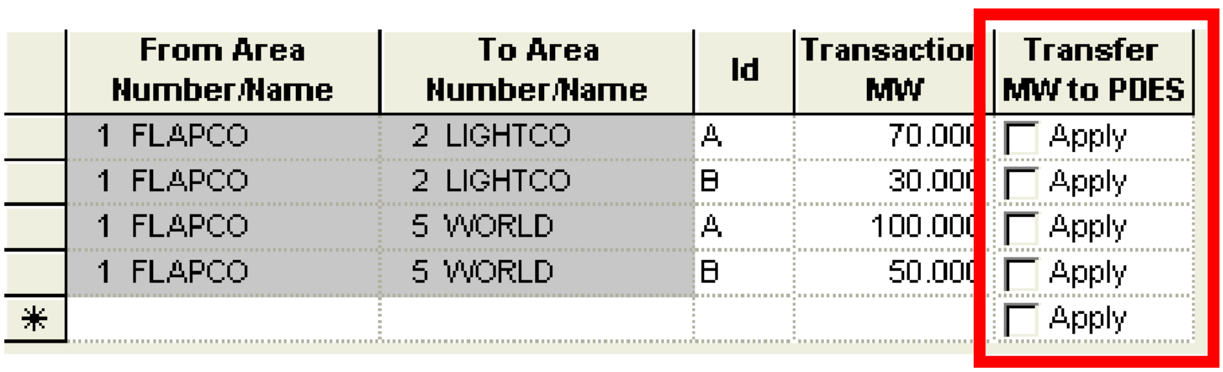
PSS®E permits the user to change all service status, control mode, and other parametric data associated with equipment represented in the working case. In the GUI, the primary means of changing individual data items is the *[Spreadsheet]* (refer to Spreadsheet View).

7.1.1. Inter-area Transfer Data Changes

On the *Inter-area Transfer* tab, the *Apply* check box provides the ability to apply changes in the transfer MW to the desired interchanges of the from and to areas (refer to *PSS ® E Program Operation Manual*,Interarea Transfer Data Changes).

If this box is checked for the row of an inter-area transfer, a change to the *Transaction MW* of that inter-area transfer results in a corresponding change to the desired area net interchange values of the from and to areas.

If this box is unchecked, desired area net interchange values are not updated to reflect any interarea transfer change.



	From Area Number/Name	To Area Number/Name	Id	Transaction MW	Transfer MW to PDES
	1 FLAPCO	2 LIGHTCO	A	70.000	Apply
	1 FLAPCO	2 LIGHTCO	B	30.000	Apply
	1 FLAPCO	5 WORLD	A	100.000	Apply
	1 FLAPCO	5 WORLD	B	50.000	Apply
*					Apply

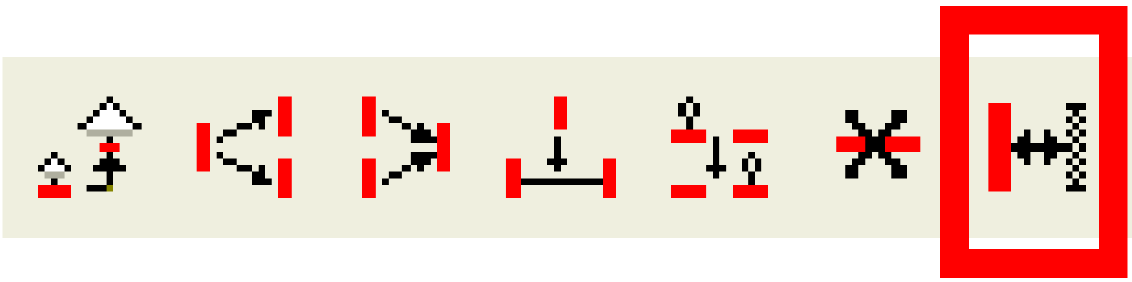
Figure 7.1. Inter-area Transfer Spreadsheet, Transfer MW

Additional Information
PSS ® E Program Operation Manual, Changing Service Status and Power Flow Parametric Data

7.2. Electrically Disconnecting or Reconnecting a Bus

DSCN/RECN

Requirements / Prerequisites
The working case must contain a validly specified power flow case.



Power Flow > Changing > Disconnect / Reconnect bus (DSCN/RECN)...

The bus disconnection activity DSCN automates the data changes required to electrically isolate a bus. The bus reconnection activity RECN automates the data changes required to electrically reconnect a bus.

The *[Disconnect / Reconnect Bus]* dialog (Figure 7.2, "Disconnect/Reconnect Bus Dialog") requires specification of the desired action and the bus to be connected. The bus number or extended bus name, as established by the bus input program option setting (refer to Saved Case Specific Option Settings of the *PSS ® E Program Operation Manual*), may be entered in the input field. Alternatively, *[Select...]* may be used to open the *[Bus Selection]* dialog (Figure 7.3, "Bus Selection Dialog") where the desired bus may be specified by double-clicking on an entry in the selection list; click *[Filter]* to open a *[Bus Filter]* dialog (Figure 7.4, "Bus Filter Dialog") to apply filtering criteria to limit the number of buses in the selection list.

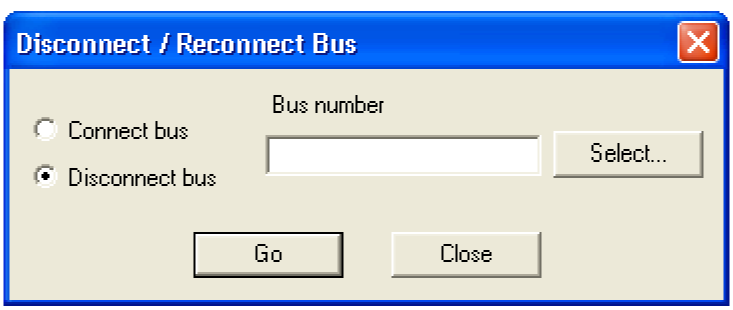


Figure 7.2. Disconnect/Reconnect Bus Dialog

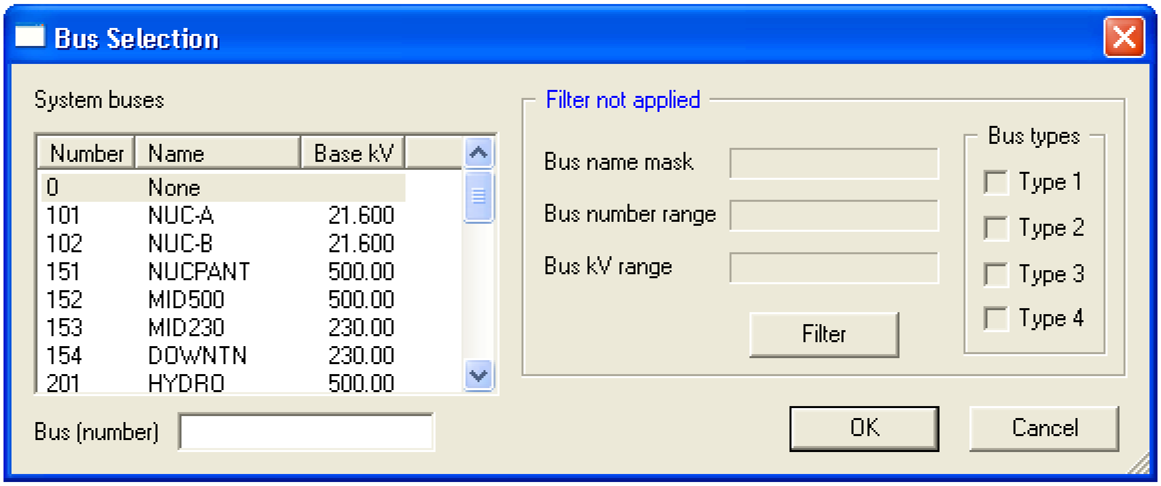


Figure 7.3. Bus Selection Dialog

Click *[Filter]* to open the *[Bus Filter]* dialog (Figure 7.4, "Bus Filter Dialog").

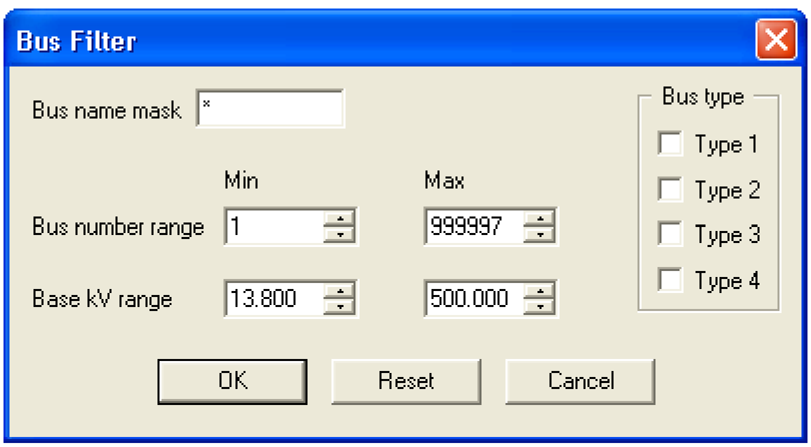


Figure 7.4. Bus Filter Dialog

Select one or more of the filtering criteria from among:

- bus name mask
- bus number range
- base voltage range
- bus type code

Click *[OK]* to go back to *[Bus Selection]* with the selected filtering options enforced.

Click *[Go]* on *[Disconnect / Reconnect Bus]* to implement the selected action.

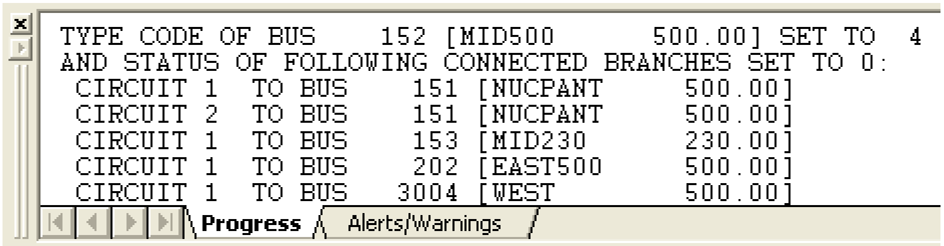


Figure 7.5. Example of Disconnect Bus Output

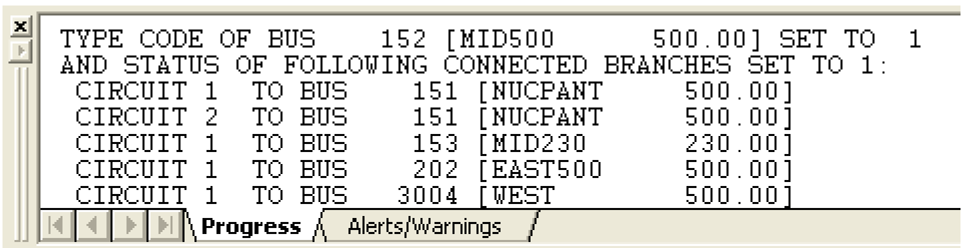


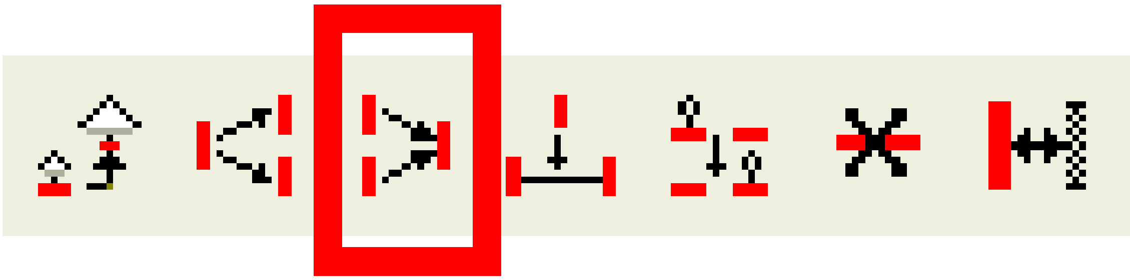
Figure 7.6. Example of Reconnect Bus Output

Additional Information
PSS ® E Program Operation Manual, Electrically Disconnecting a Bus Electrically Reconnecting a Bus *PSS ® E Application Program Interface (API)* DSCN RECN

7.3. Joining Buses

JOIN

Requirements / Prerequisites
The working case must contain a validly specified power flow case.



Power Flow > Changing > Join buses (JOIN)...

The bus joining activity JOIN enables the user to combine pairs of buses, retaining the identity of one of the two buses.

The *[Join Buses]* dialog (Figure 7.7, "Join Buses Dialog") requires identification of the two buses to be joined and the specification of the line shunt treatment option. Either bus numbers or extended bus names, as established by the bus input program option setting (refer to Saved Case Specific Option Settings of the *PSS ® E Program Operation Manual*), are required and may be entered directly in the input fields. Alternatively, *[Select...]* adjacent to each input field may be used to open the *[Bus Selection]* dialog (Figure 7.3, "Bus Selection Dialog") where the desired bus may be specified by double-clicking on an entry in the selection list; click *[Filter]* to open a *[Bus Filter]* dialog (Figure 7.4, "Bus Filter Dialog") to apply filtering criteria to limit the number of buses in the selection list.

Click *[Go]* to complete the joining process.

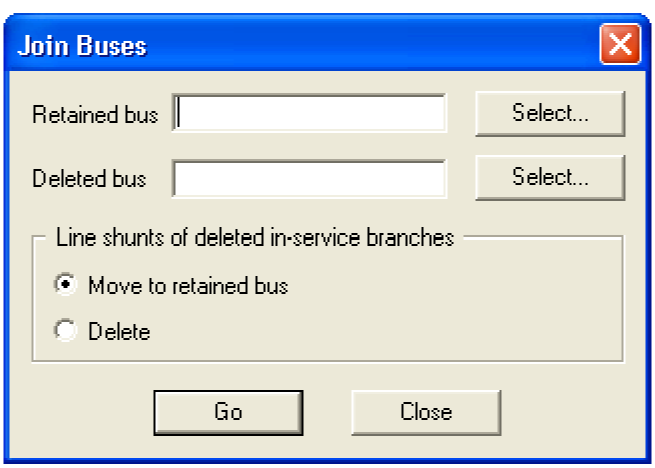


Figure 7.7. Join Buses Dialog

7.3.1. JOIN Example

As an example, using the *savnw.sav* power flow case, the buses '154 DOWNTN' and '3008 CATDOG' will be joined. In Figure 7.9, "Original Topology" it can be seen that bus 154 has two loads (600+j450 MVA and 400+j350 MVA) and bus 3008 has one load (200 + j75 MVA) at nominal voltage. The buses are joined by one 230 kV line without line shunts.

If bus 154 is the retained bus, the following topological changes are implemented as a result of joining buses 154 and 3008:

- The load at bus 3008 is moved to bus 154 and its identifier is changed from '1' to '3'.
- The branch connecting buses 154 and 3008 is removed.
- The transformer from bus 3008 to bus 3018 is rerouted so that it now connects buses 154 and 3018.
- The non-transformer branch from bus 3008 to bus 3005 is rerouted so that it now connects buses 154 and 3005.
- The mullti-section line from bus 3008 to bus 3005 is rerouted so that it now connects buses 154 and 3005, and its multi-section line member from bus 3008 to 3007 is rerouted so that it now connects buses 154 and 3007.

The summary output shown in Figure 7.8, "Example of Join Buses Output" reports the load identifier change. Figure 7.10, "Revised Topology After Joining Buses 154 and 3008" shows the *[Diagram]* view of the retained bus 154 after bus 3008 is joined with it. The topological changes are shown on the diagram.

```
JOINING BUSES. RETAINING BUS 154 [DOWNTN      230.00], ELIMINATING BUS 3008 [CATDOG      230.00]

DUPLICATE LOAD IDENTIFIER "1 "
IDENTIFIER OF TRANSFERRED LOAD CHANGED TO "3 "
```

Progress | Alerts/Warnings

Figure 7.8. Example of Join Buses Output

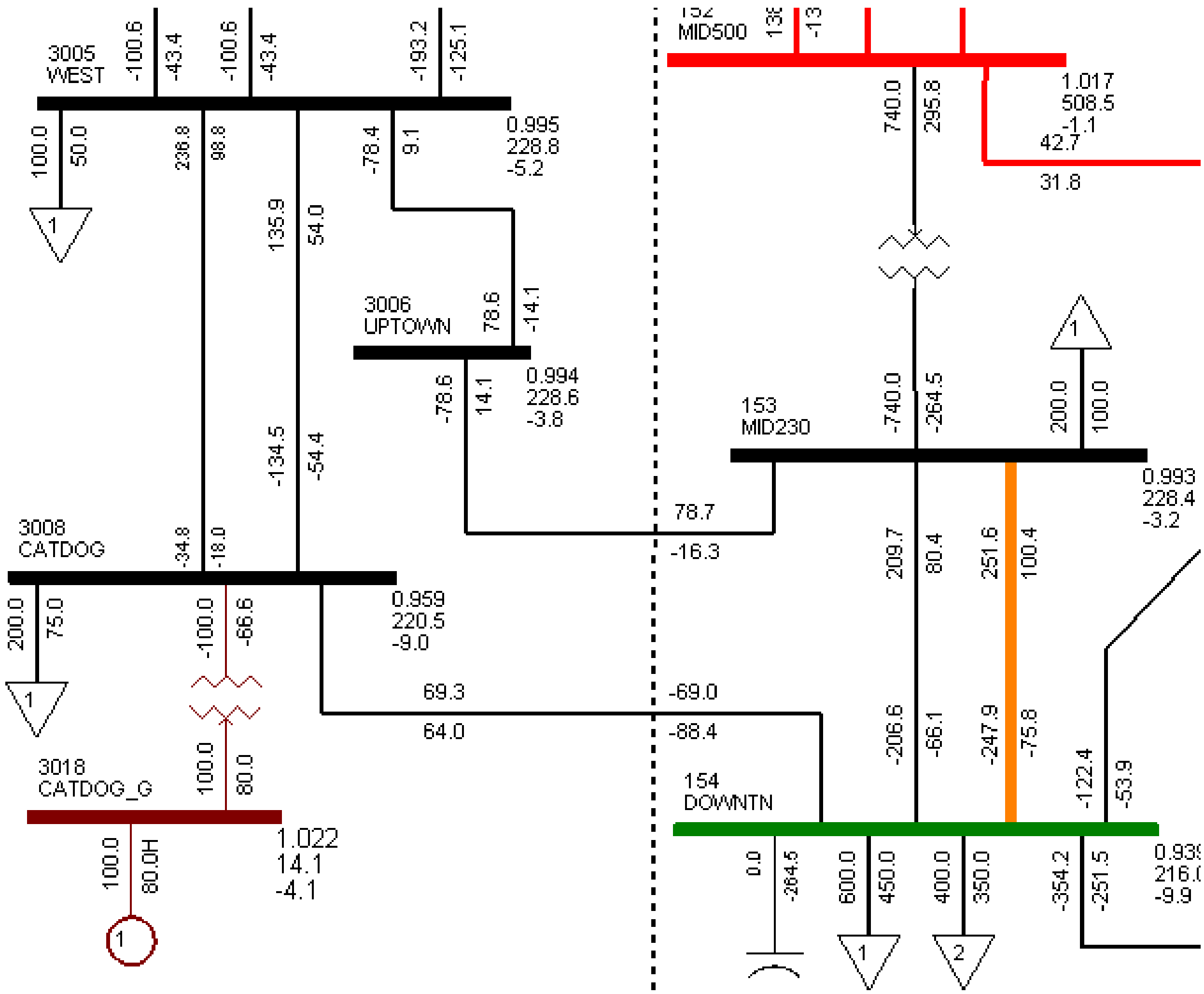


Figure 7.9. Original Topology

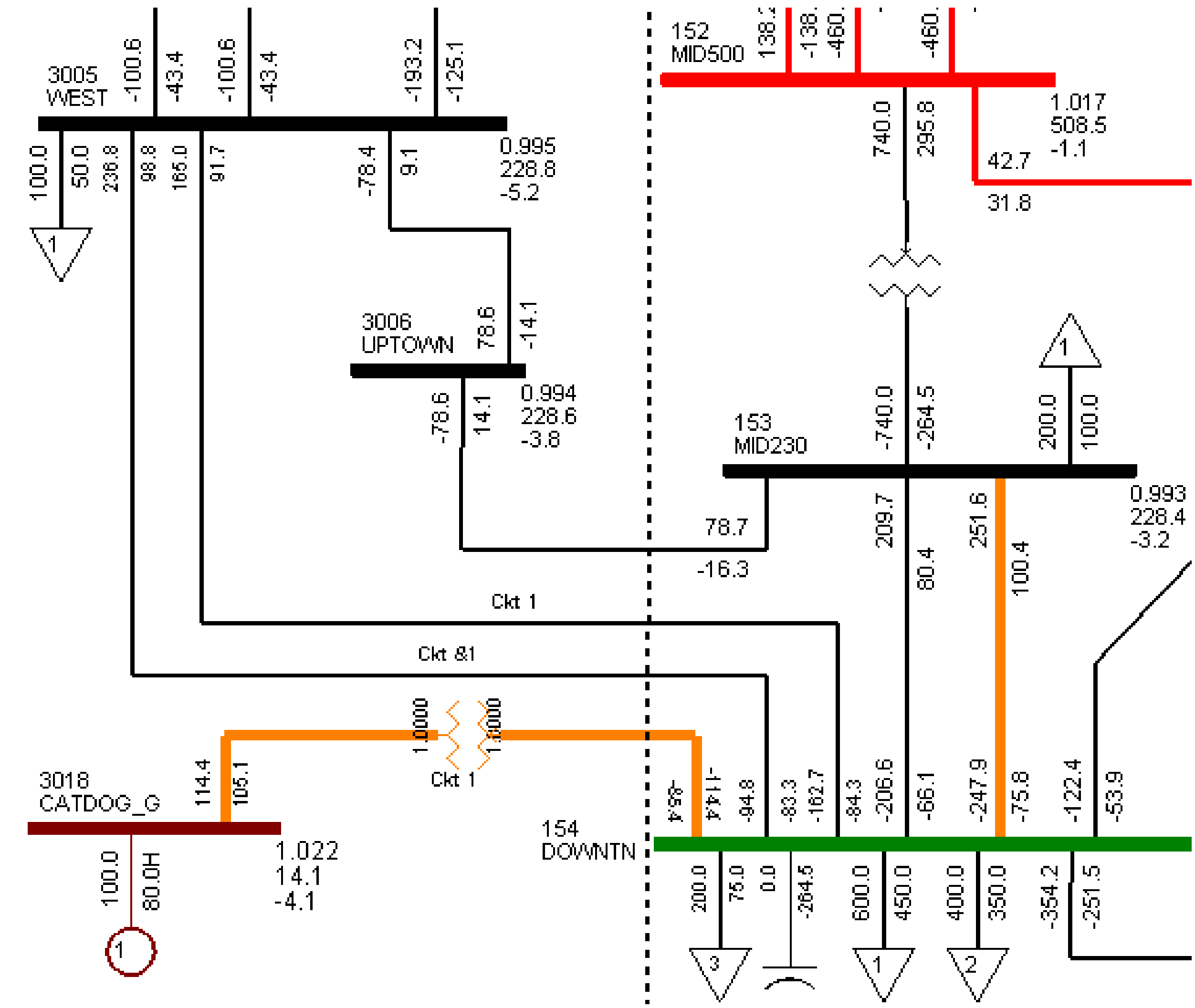


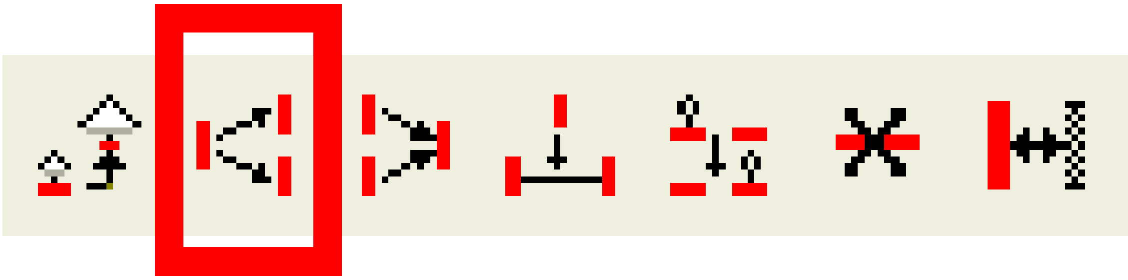
Figure 7.10. Revised Topology After Joining Buses 154 and 3008

Additional Information
PSS ® E Program Operation Manual, Joining Buses *PSS ® E Application Program Interface (API)*,JOIN

7.4. Splitting Buses

SPLT

Requirements / Prerequisites
The working case must contain a validly specified power flow case.



Power Flow > Changing > Split buses (SPLT)...

The bus sectionalizing activity SPLT enables the user to split a bus into two buses connected by a branch.

The *[Split Buses]* dialog (Figure 7.11, "Split Buses Dialog") requires identification of the bus to be split and the number of the new bus. The bus name and base voltage to be assigned to the new bus may also be specified. If omitted, the base voltage of the bus being split and a blank name are assigned to the new bus.

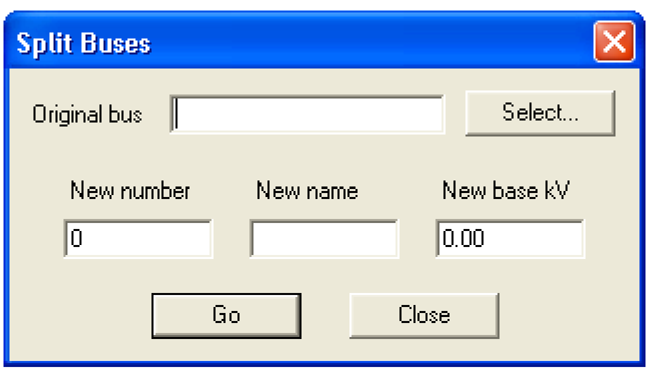


Figure 7.11. Split Buses Dialog

The bus number or extended bus name, as established by the bus input program option setting (refer to Saved Case Specific Option Settings of the *PSS ® E Program Operation Manual*), may be entered in the input field. Alternatively, *[Select...]* may be used to open the *[Bus Selection]* dialog (Figure 7.3, "Bus Selection Dialog") where the desired bus may be specified by double-clicking on an entry in the selection list; click *[Filter]* to open a *[Bus Filter]* dialog (Figure 7.4, "Bus Filter Dialog") to apply filtering criteria to limit the number of buses in the selection list.

Click *[Go]* to initiate the splitting process. The new bus is created along with a new jumper branch connecting the original and new buses. The *[Reassign Branches and Equipment]* dialog then opens and any displayed equipment items connected to the bus being split may be specified to be moved to the new bus. Figure 7.12, "Reassign Branches and Equipment Dialog" shows the display if bus 154 were selected to be split in the *savnw.sav* power flow case.

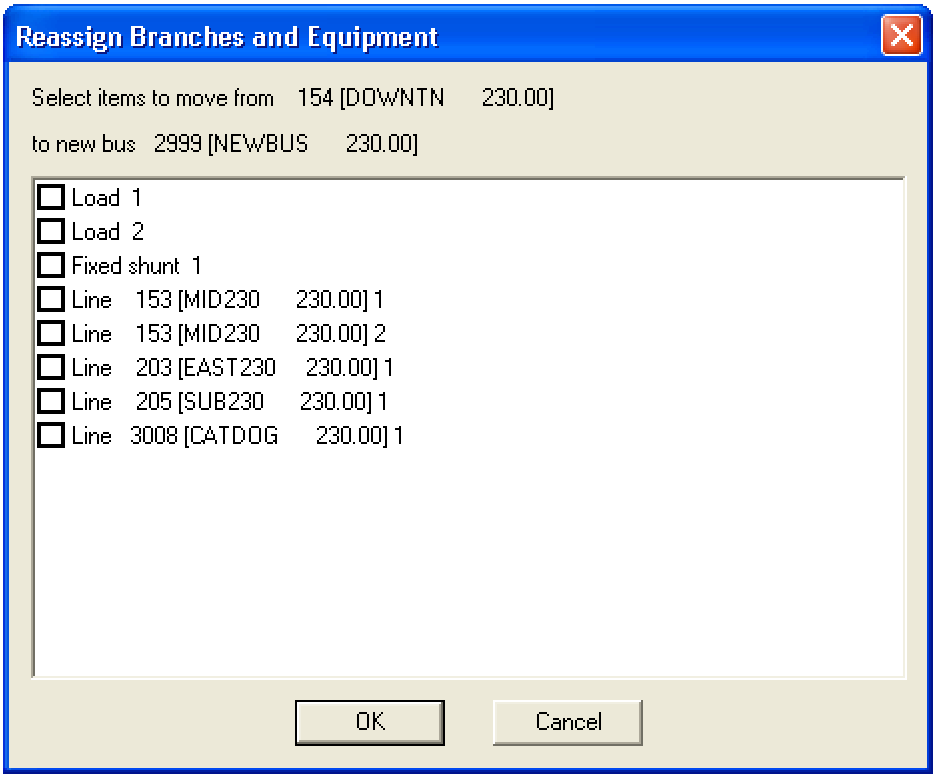


Figure 7.12. Reassign Branches and Equipment Dialog

Using the *savnw.sav* power flow case, (see Figure 7.13, "Bus 3003 to be Split") bus 3003 can be split and circuit 2 from bus 3005 reassigned to the new bus 3020.

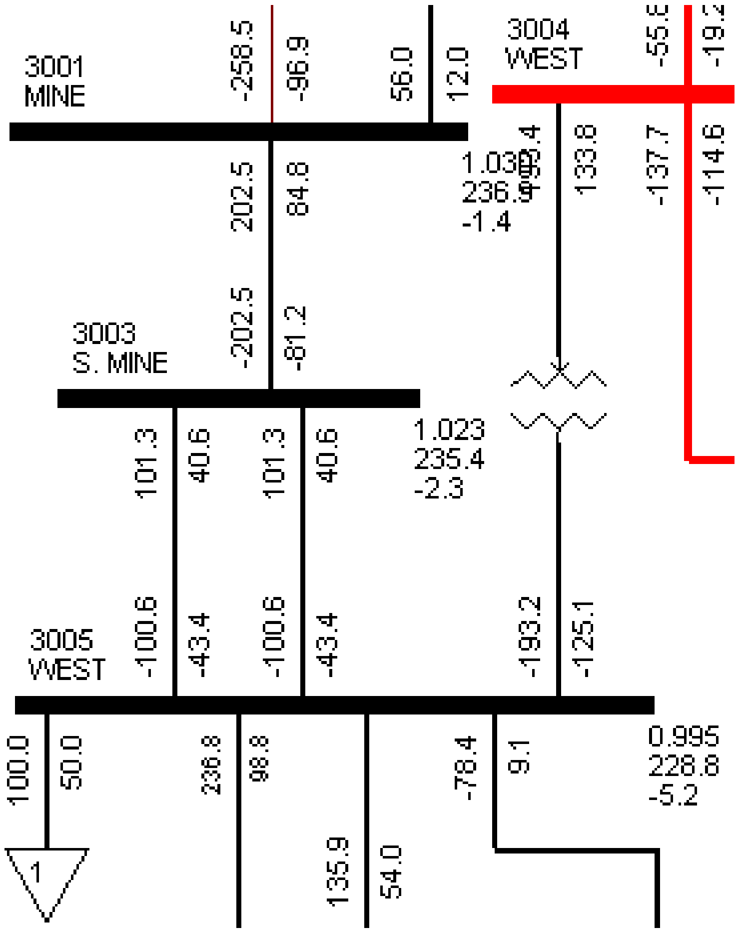


Figure 7.13. Bus 3003 to be Split

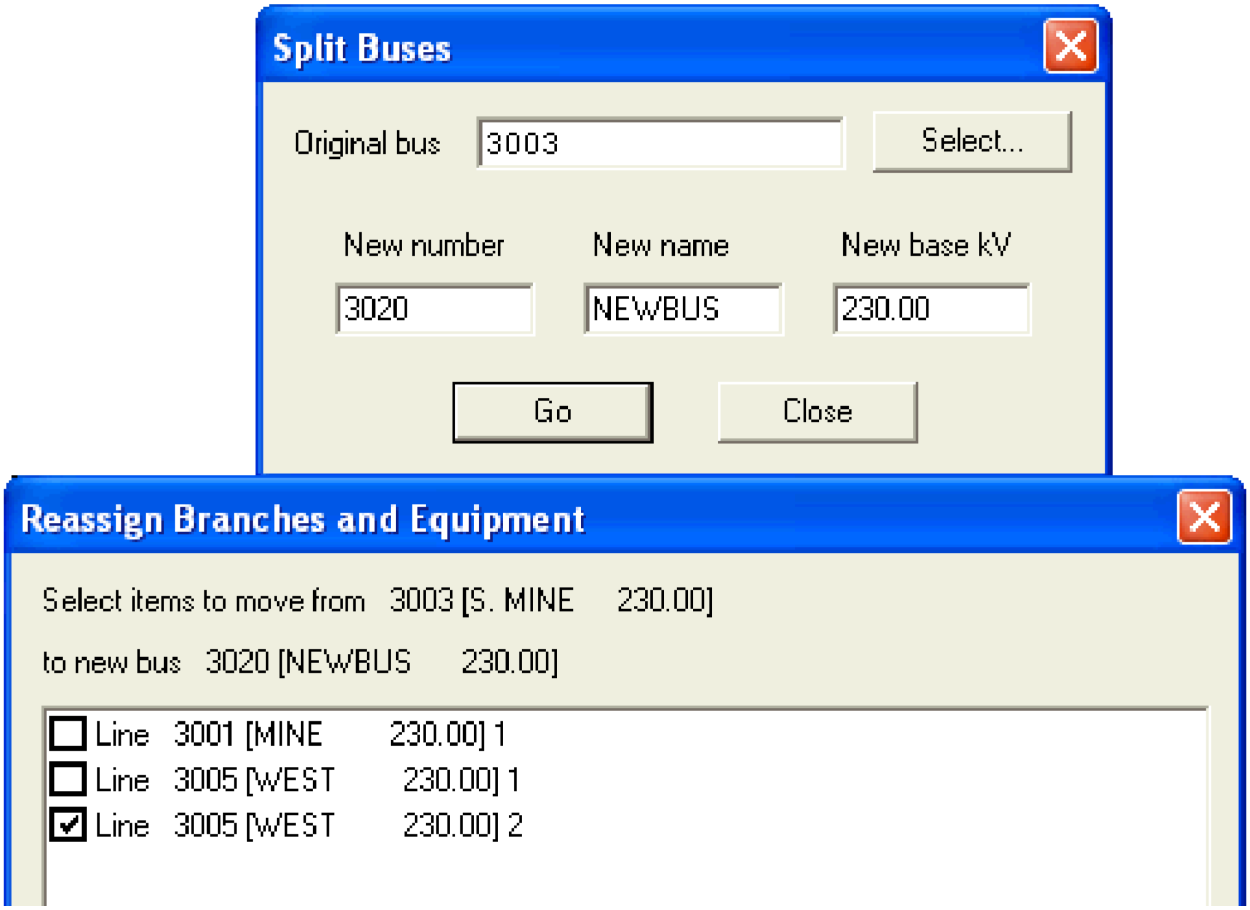


Figure 7.14. Bus Selection and Reassignment for Bus Split

Selection of the bus to be split, and the specification of the number, name and base voltage to be assigned to the new bus, is done in *[Split Buses*] (see Figure 7.14, "Bus Selection and Reassignment for Bus Split"). After clicking *[Go]*, *[Reassign Branches and Equipment]* displays the elements that can be selected to be moved to the new bus 3020. In the example, the option to move circuit 2 from bus 3005 to the new bus has been selected. Clicking *[OK]* completes the process and generates a summary of the action in the *Progress* tab (Figure 7.15, "Example of Split Buses Output").

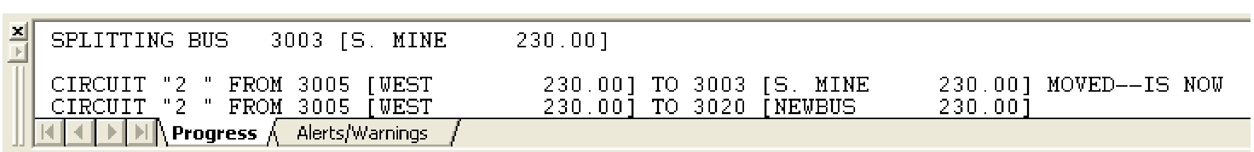


Figure 7.15. Example of Split Buses Output

The result of the splitting process can be seen in *[Diagram]* (see Figure 7.16, "Diagram View of New Topology following Bus Split"). The diagram shows the new bus, 3020, the new branch from the new bus to the original bus and the new routing of circuit 2 from bus 3005 to the new bus.

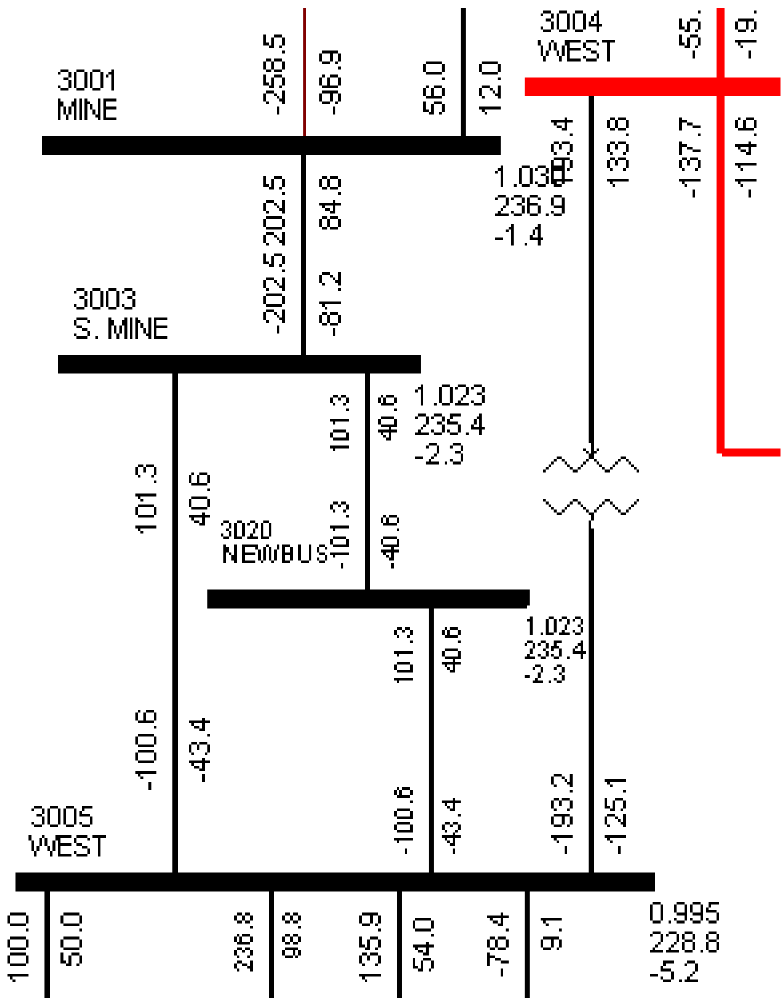


Figure 7.16. Diagram View of New Topology following Bus Split

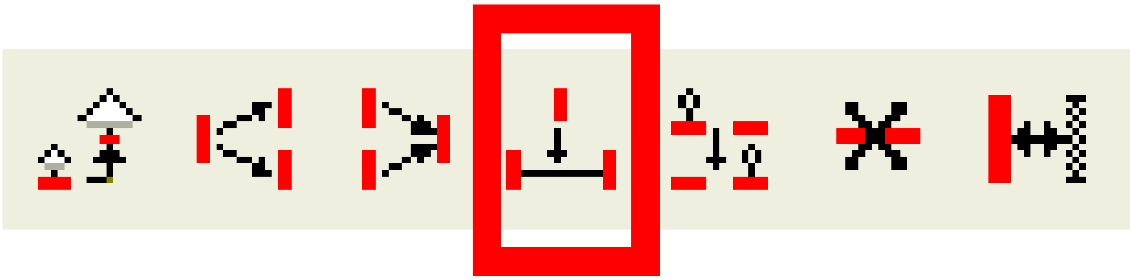
A one-line Slider file conforming to the original topology will now show circuit 2 out-of-service. A modified Slider file would have to be generated to display the new topology.

Additional Information
PSS ® E Program Operation Manual, Splitting Buses *PSS ® E Application Program Interface (API)* SPLT MOVE3WND MOVEBRN MOVELOAD MOVELOADS MOVEMAC MOVEPLNT MOVESHUNT MOVESHUNTS MOVESWS

7.5. Tapping a Line

LTAP

Requirements / Prerequisites
The working case must contain a validly specified power flow case.



Power Flow > Changing > Tap line (LTAP)...

The line tapping activity LTAP enables the user to introduce a new bus into the working case at a designated location along a specified ac branch. Any non-transformer branch may be tapped with activity LTAP.

The *[Tap Line]* dialog (Figure 7.17, "Tap Line Dialog") requires the user to specify the line to be tapped, the location of the new bus, and the identifying number, name, and base voltage of the new bus.

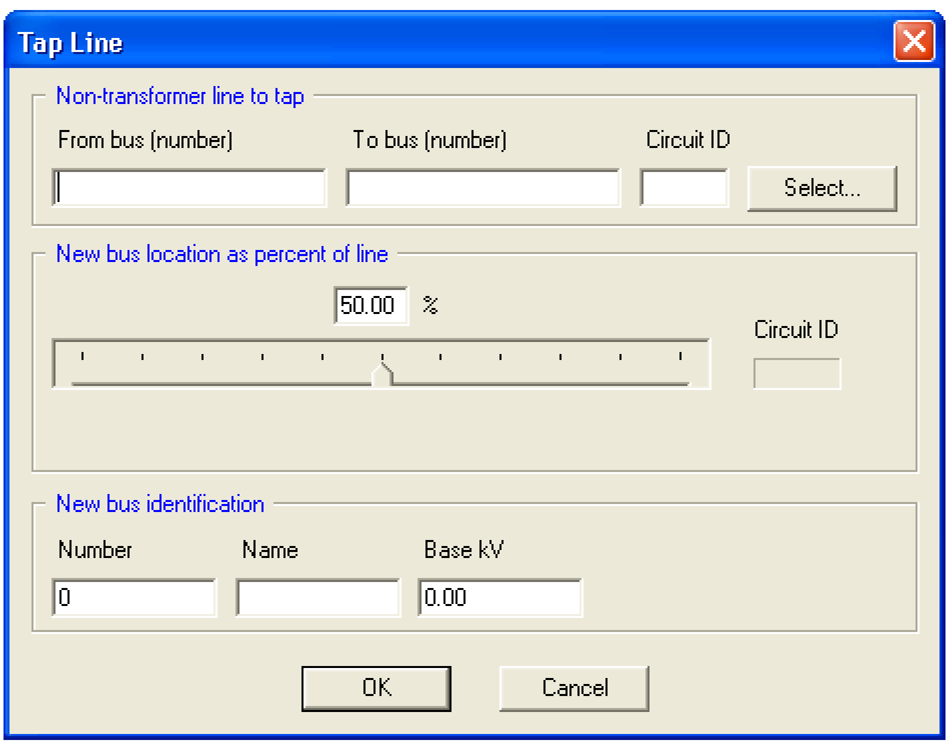


Figure 7.17. Tap Line Dialog

As an example, the branch from bus 3003 to 3005 circuit 1 in the *savnw.sav* power flow case will be tapped at a point 40% of the distance from bus 3003. A new bus will be created with the number 3020, a name NEWBUS and a base voltage of 230 kV. Figure 7.18, "Line Selected to be Tapped" shows the original topology as *[Diagram]*.

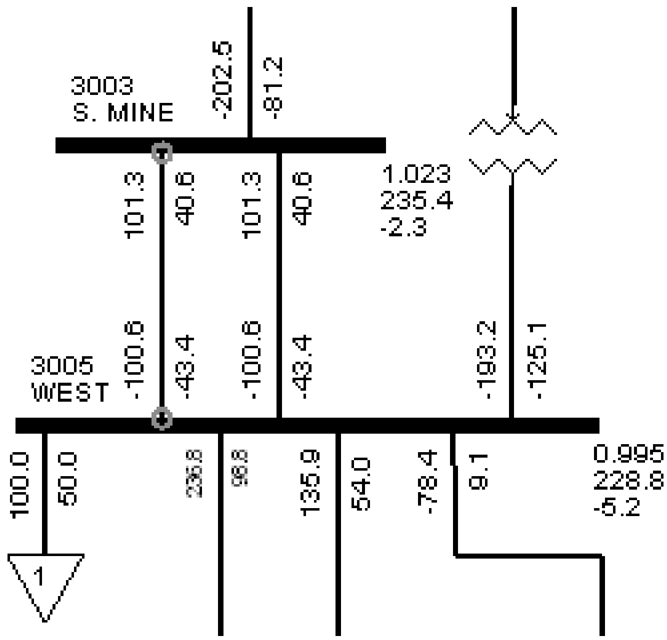


Figure 7.18. Line Selected to be Tapped

Click *[Select]* in *[Tap Line]* to open the *[Branch Selection]* dialog (see Figure 7.19, "Specification of a Branch for the Tap Line"). Specifying a bus in the *From bus* list will create a list of the to buses and circiut identifiers of the non-transformer branches connected to that bus. Then specify an entry in the *To bus* list. If required, the *[Filter]* can be used to reduce the listed buses to those in a specified subsystem.

In the example (Figure 7.19, "Specification of a Branch for the Tap Line"), the branch from bus 3003 to bus 3005, circuit 1, has been selected. Clicking *[OK]* will return to *[Tap Line]*.

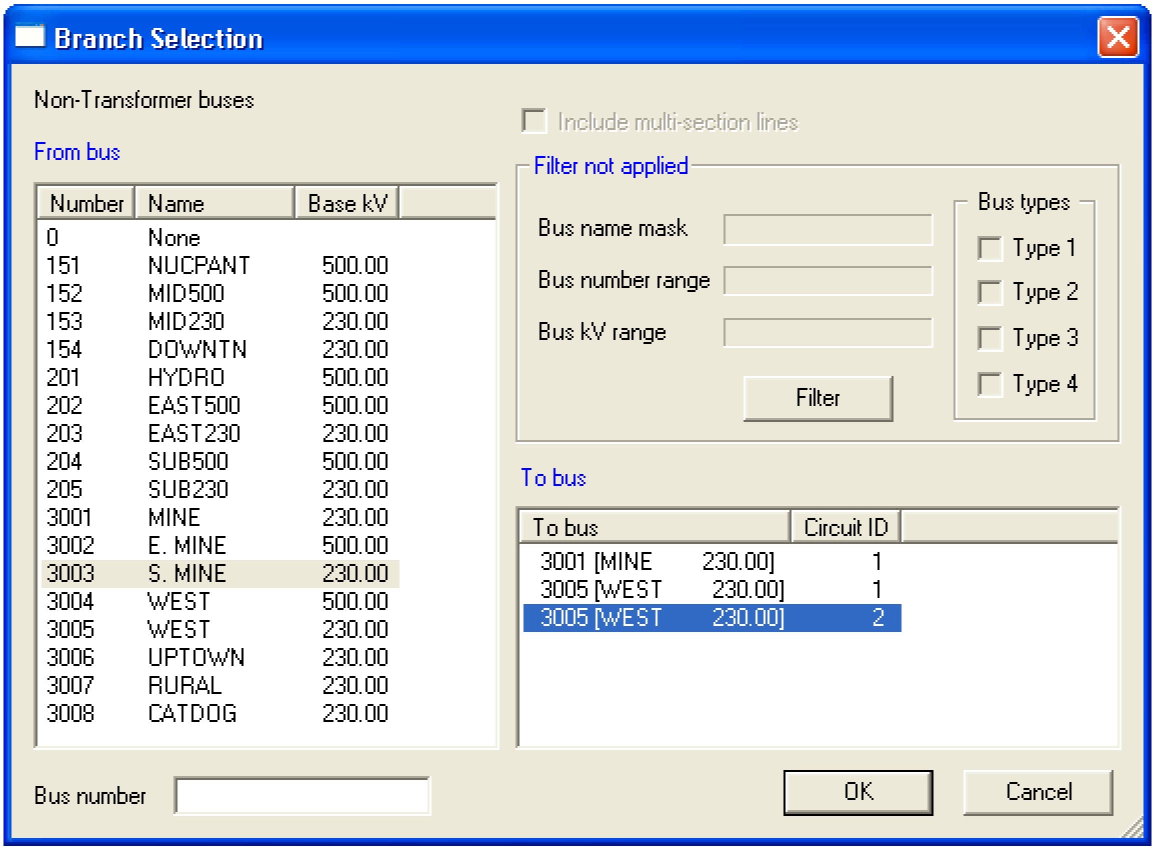


Figure 7.19. Specification of a Branch for the Tap Line

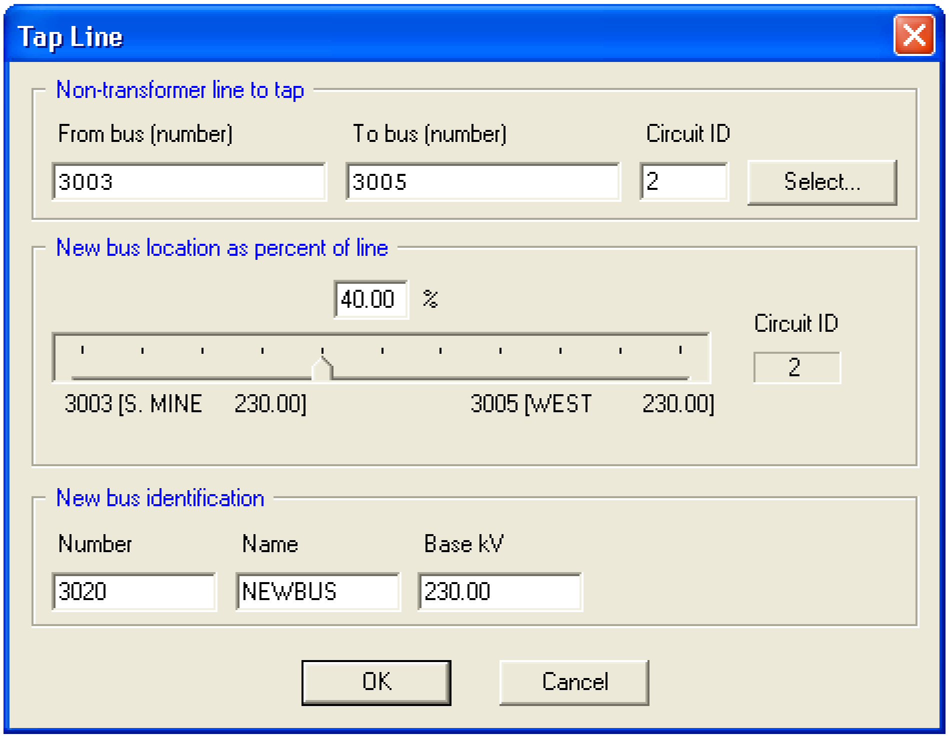


Figure 7.20. Final Stage in Tap Line Activity

In *[Tap Line]*, the tap position, 40% of the distance from bus 3003 and the new bus name, number and base voltage are specified as shown in Figure 7.20, "Final Stage in Tap Line Activity". Clicking *[OK]* completes the process and generates a summary of the action at the *Progress* device.

At this point, any Slider diagram established for the original network topology will indicate that the tapped line is out-of-service. The one-line Slider diagram will need to be modified to show the new topology with the new bus. Figure 7.21, "New Topology on Tapped Line" shows a modified *[Diagram]* of the new topology around the new bus.

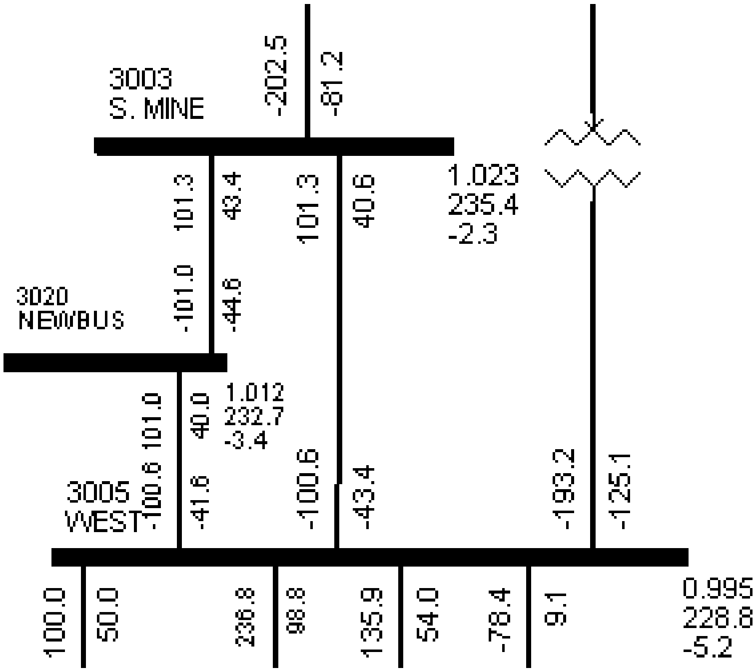


Figure 7.21. New Topology on Tapped Line

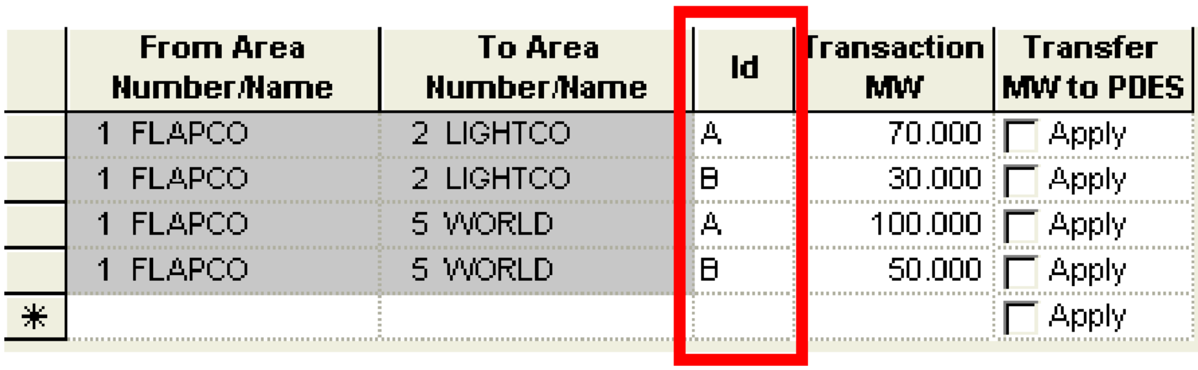
Additional Information
PSS ® E Program Operation Manual, Tapping a Line *PSS ® E Application Program Interface (API)*, LTAP

7.6. Changing Equipment Identifiers

MBID

Requirements / Prerequisites
The working case must contain a validly specified power flow case.

PSS®E permits the user to change the alphanumeric identifiers assigned to specified machines, loads, fixed bus shunts, ac branches, multi-section line groupings, dc lines, FACTS devices, and interarea transfers in the working case. In the GUI, the primary means of changing individual data items is the *[Spreadsheet]* (refer to Chapter 2, *Spreadsheet View*).



	From Area Number/Name	To Area Number/Name	Id	Transaction MW	Transfer MW to PDES
	1 FLAPCO	2 LIGHTCO	A	70.000	Apply
	1 FLAPCO	2 LIGHTCO	B	30.000	Apply
	1 FLAPCO	5 WORLD	A	100.000	Apply
	1 FLAPCO	5 WORLD	B	50.000	Apply
*					Apply

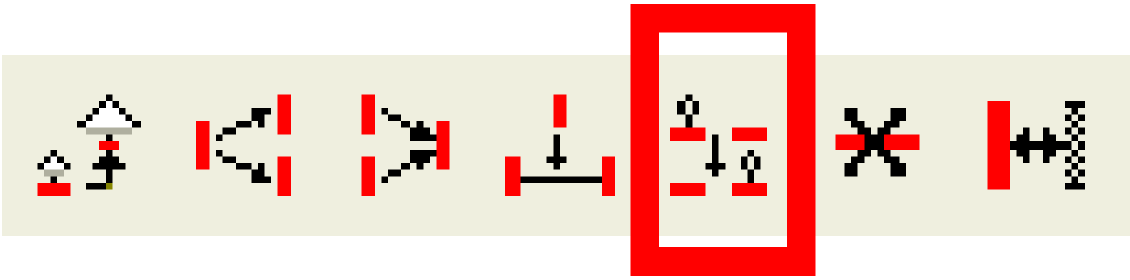
Figure 7.22. Inter-area Transfer Spreadsheet, Identifier

Additional Information
PSS ® E Program Operation Manual, Changing Equipment Identifiers *PSS ® E Application Program Interface (API)* MBID2DC MBID3WND MBIDATRN MBID-BRN MBIDFACTS MBIDLOAD MBIDMAC MBIDMDC MBIDMSL MBIDSHUNT MBIDVSC

7.7. Moving Equipment

MOVE

Requirements / Prerequisites
The working case must contain a validly specified power flow case.



Power Flow > Changing > Move network elements (MOVE)...

The equipment transfer activity MOVE allows the user to move specified fixed shunts, switched shunts, loads, machines, and plants from one bus to another. It also provides for connecting the far end of specified branches and one winding of a three-winding transformer to different to buses.

The *[Move Network Elements]* dialog (Figure 7.23, "Move Network Elements Dialog") provides tabs for each of the types of equipment that may be moved by activity MOVE.

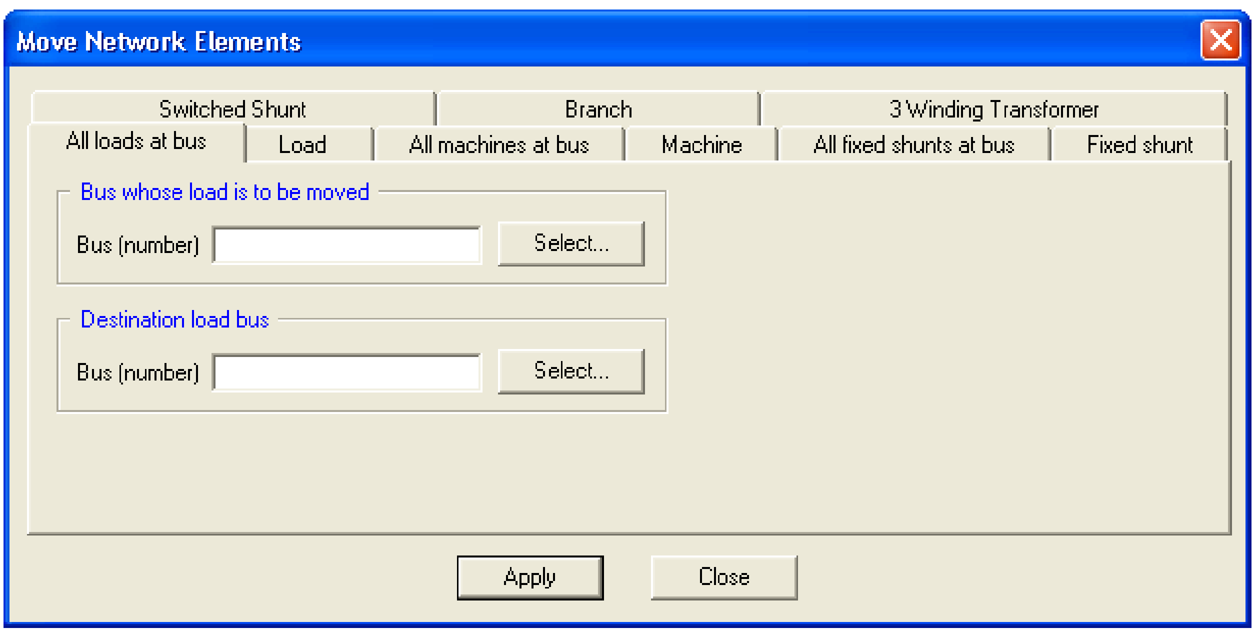


Figure 7.23. Move Network Elements Dialog

Select the equipment category tab, and then specify the individual equipment to be moved and the bus to which the equipment item is to be transferred. Clicking *[Apply]* completes the transfer.

Using the *savnw.sav* power flow case, the 500 kV line from bus 151, which terminates at bus 201 will be moved to terminate at bus 202. The original topology is shown in Figure 7.24, "Original Topology before Moving Branch 151 - 201".

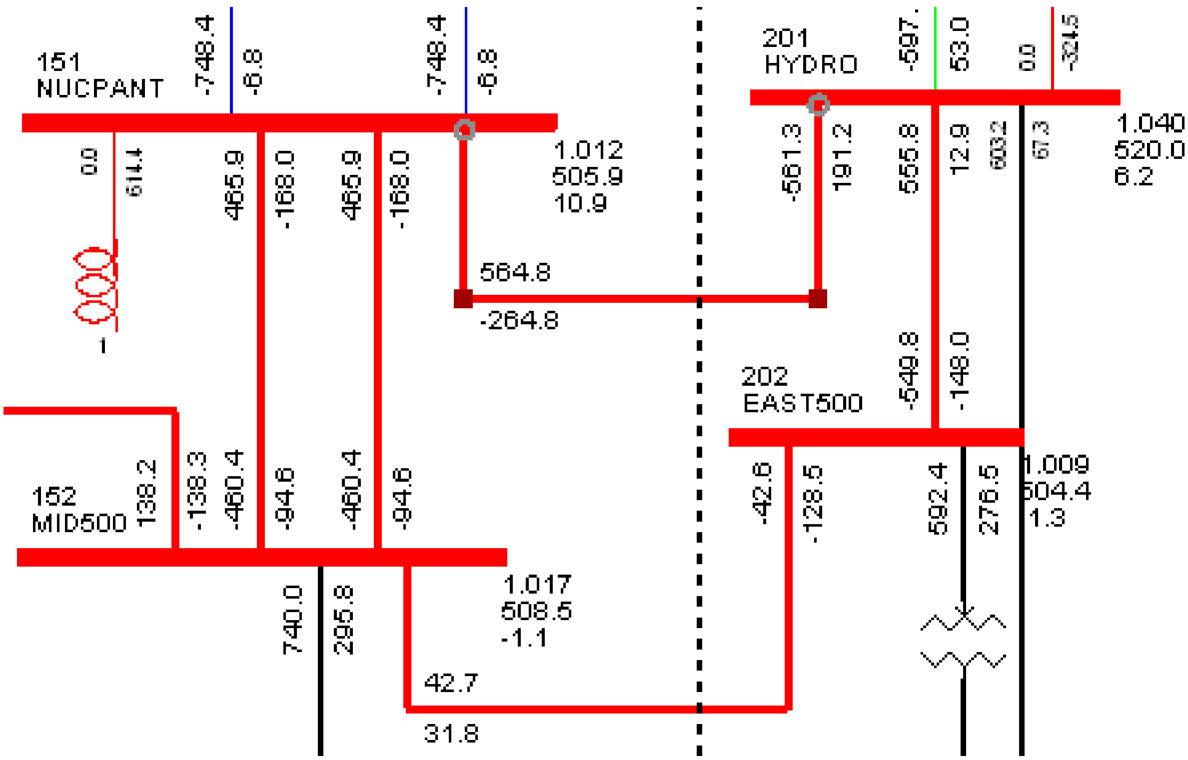


Figure 7.24. Original Topology before Moving Branch 151 - 201

From the Branch tab on *[Move Network Elements]* click *[Select...]* to open the *[Branch Selection]* dialog (Figure 7.25, "Branch Selection Dialog") and highlight the desired branch. *[Filter]* may be used to limit the number of entries in the From bus list. Clicking *[OK]* returns to *[Move Network Elements]* where the new to bus can be specified.

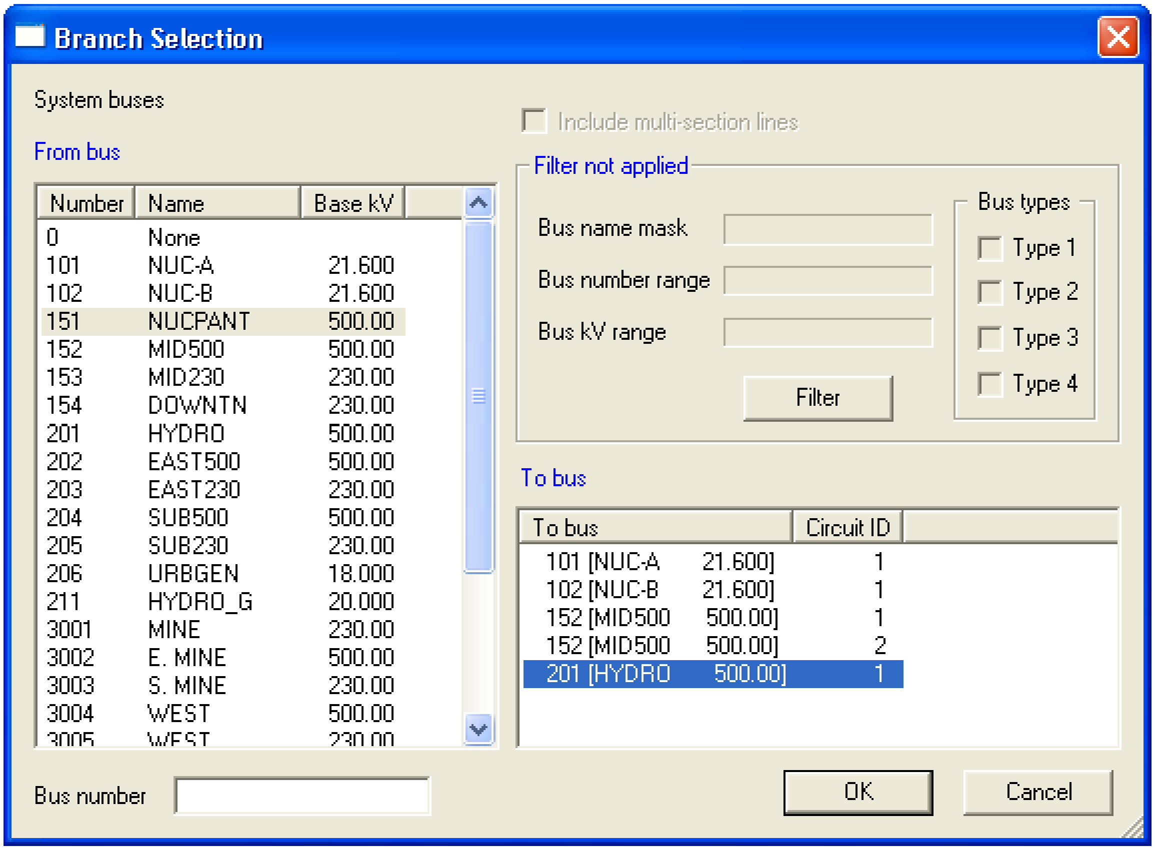


Figure 7.25. Branch Selection Dialog

From the Destination (to bus) area of the Branch tab on *[Move Network Elements]*, the bus number or extended bus name, as established by the bus input program option setting (refer to Saved Case Specific Option Settings of the *PSS®E Program Operation Manual*), may be entered in the bus input field. Alternatively, *[Select...]* may be used to open the *[Bus Selection]* dialog (Figure 7.3, "Bus Selection Dialog") where the desired bus may be specified by double-clicking on an entry in the selection list; click *[Filter]* to open a *[Bus Filter]* dialog (Figure 7.4, "Bus Filter Dialog") to apply filtering criteria to limit the number of buses in the selection list. Clicking *[OK]* in *[Bus Selection]* returns to *[Move Network Elements]* where all fields are now populated (Figure 7.27, "Example of Moving a Branch").

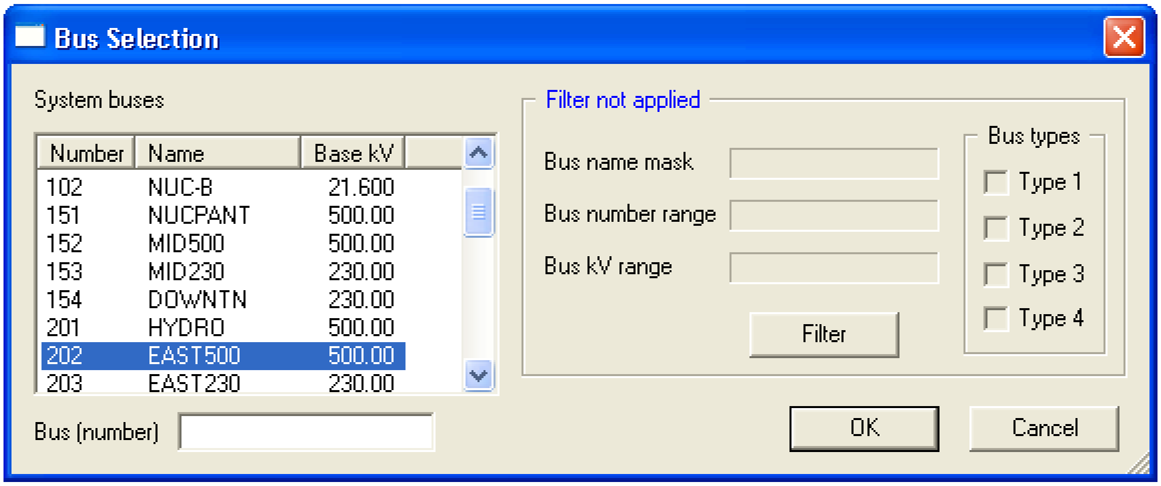


Figure 7.26. Bus Selection Dialog

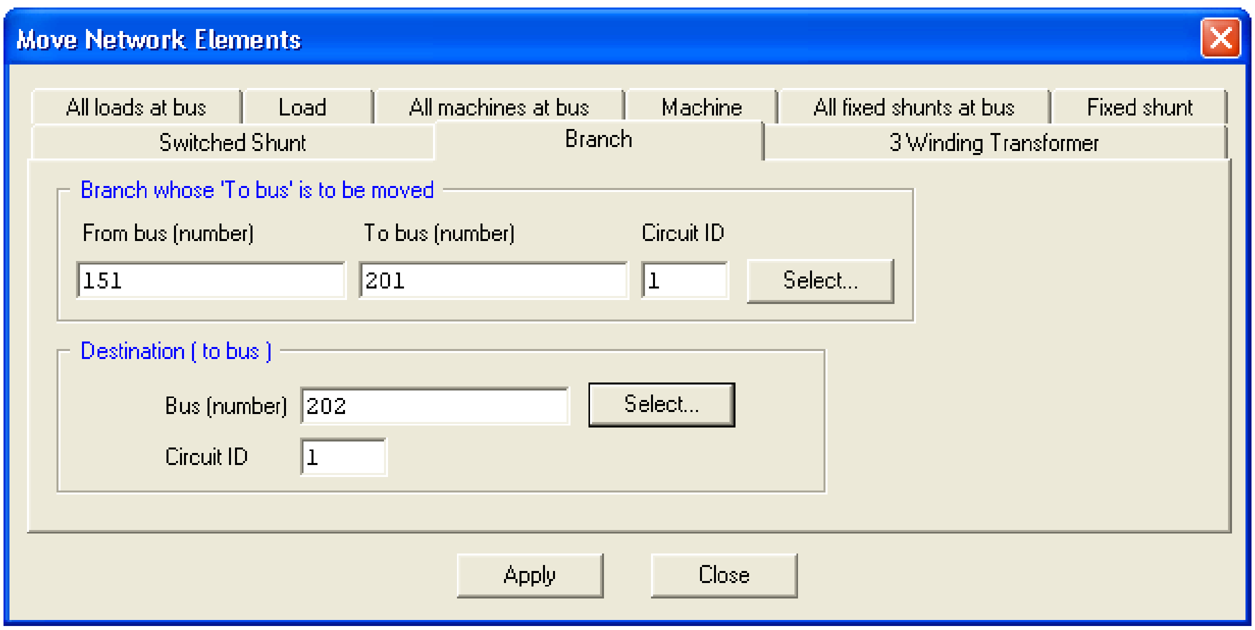


Figure 7.27. Example of Moving a Branch

Click *[Apply]* to complete the move. To end activity MOVE, click *[Close]*.

When the moving process is complete, the original one-line Slider file will not be able to display the new topology. The branch that was moved (in the case of this example, the line from bus 151 to bus 201) will be indicated as out-of-service. The Slider file will need to be modified to display the new line termination. Figure 7.28, "New Topology Following Branch Move" shows the new display with the new line location and the indicated line out-of-service from the original topology. The non-existent branch can be deleted from the Slider file. It will no longer be in the network data and will not appear in *[Spreadsheet]* or *[Network Tree]*.

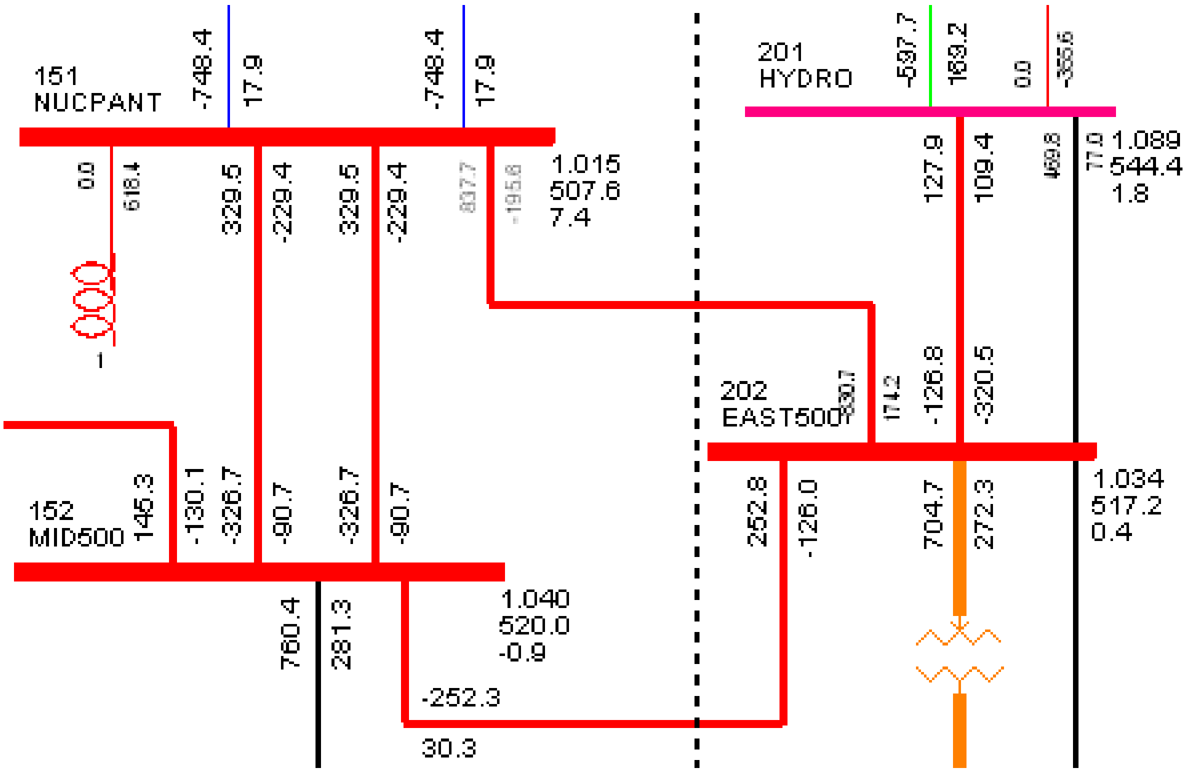


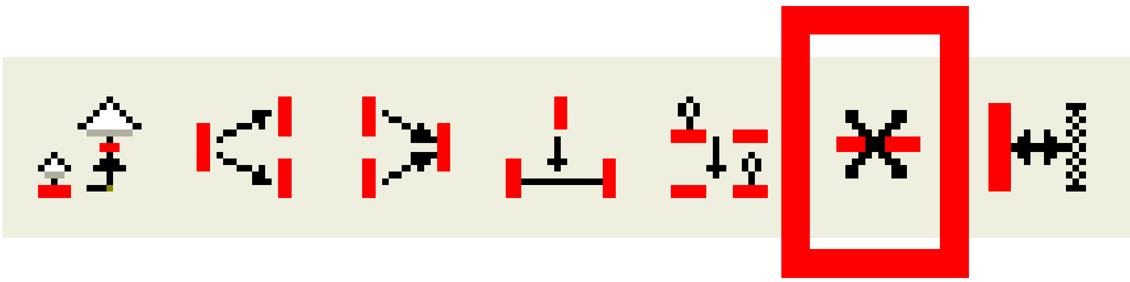
Figure 7.28. New Topology Following Branch Move

Additional Information
PSS ® E Program Operation Manual,Moving Equipment *PSS ® E Application Program Interface (API)* MOVE3WND MOVEBRN MOVELOAD MOVELOADS MOVEMAC MOVEPLNT MOVESHUNT MOVESHUNTS MOVESWS See also: Section 3.6.9, “Moving Diagram Elements”

7.8. Removing Buses and Connected Equipment

PURG/EXTR

Requirements / Prerequisites
The working case must contain a validly specified power flow case.



Power Flow > Changing > Delete network elements (PURG/EXTR)...

PSS®E facilitates the users' ability to delete equipment items from the working case. In the GUI, the primary means of deleting individual equipment items is the *[Spreadsheet]* (refer to Chapter 2, *Spreadsheet View*). In addition, the following may be removed from a specified subsystem:

- subsystem buses and all equipment connected to them.
- all outaged items of a selected equipment category in a subsystem.

The *[Delete Buses and Outaged Network Elements]* dialog (Figure 7.29, "Deleting Network Elements Dialog") enables the user to designate for processing either the entire working case or a specified bus subsystem (refer to Subsystem Selection of the *PSS ® E Program Operation Manual)*. A bus subsystem may be specified either via a *[Bus Subsystem Selector]* dialog by clicking *[Select...]*, or by entering buses directly in the *[Delete Buses and Outaged Network Elements]* dialog

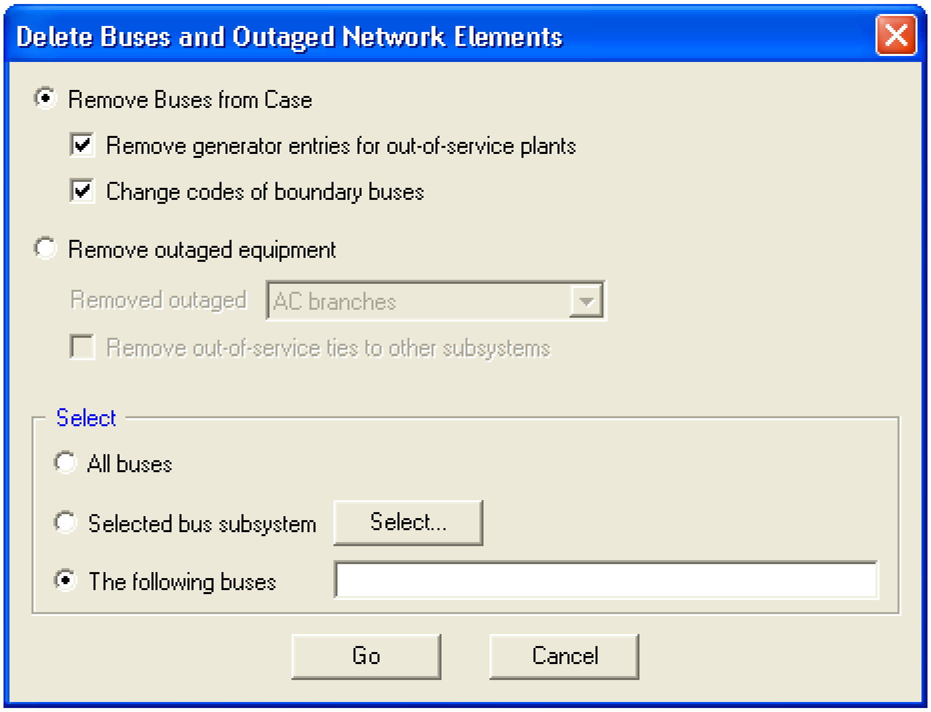


Figure 7.29. Deleting Network Elements Dialog

7.8.1. Removing Buses

The bus removal activity EXTR removes subsystem buses and all equipment connected to them from the working case.

It is possible to see buses and their associated lines and equipment that have been deleted in *[Diagram]*. The unbound items (items that exist in the diagram but not in the network data because of the deletion) are shown in color specified in *[Diagram Properties]*. Figure 7.30, "Example of Deleted Buses and the Diagram Properties Options" shows a partial view of the buses deleted from the FLAPCO area of the *savnw.sav* power flow case.

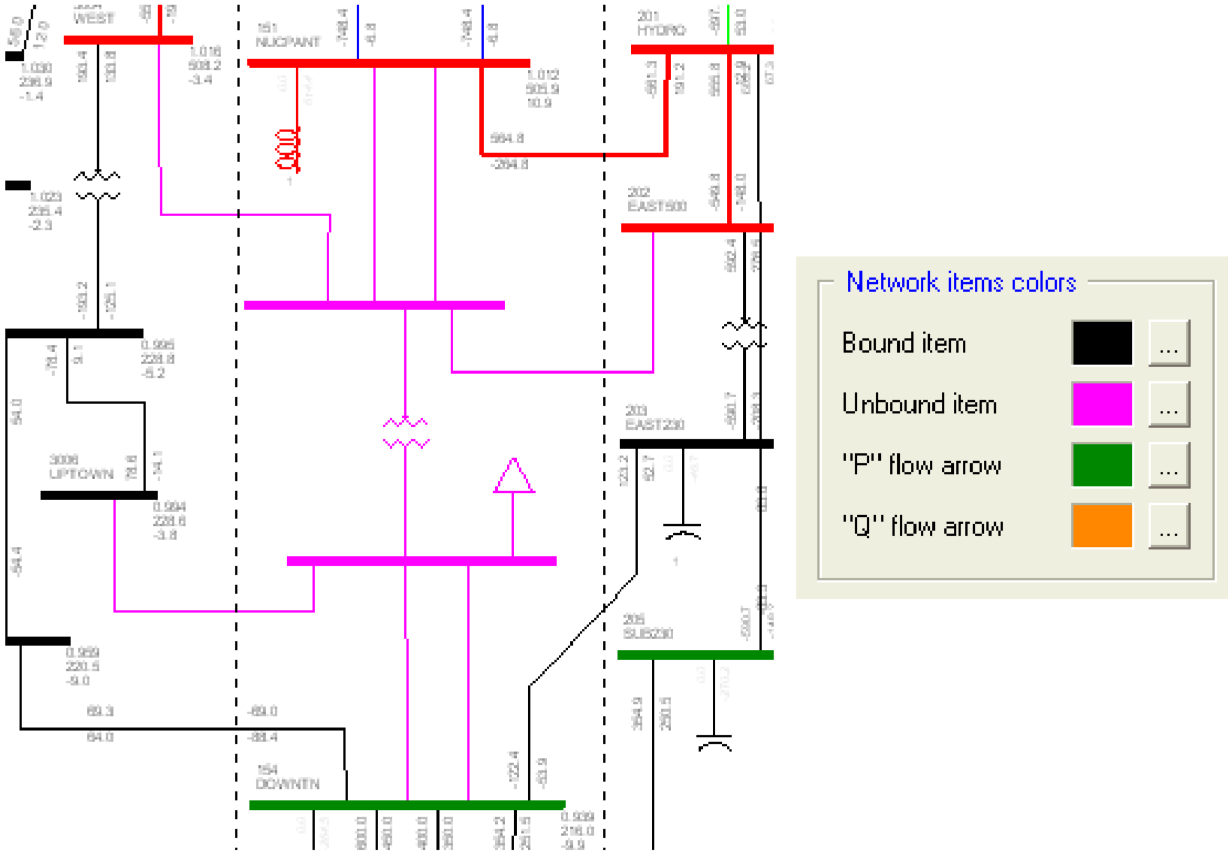


Figure 7.30. Example of Deleted Buses and the Diagram Properties Options

7.8.2. Removing Outaged Equipment

In the GUI, the equipment removal activity PURG deletes all outaged items of a specified equipment category that are contained within a specified subsystem of the working case.

The data categories that can be processed for deletion are available in a pull-down list in *[Delete Buses and Outaged Network Elements]*. In addition, a checkbox selects the option to *Remove out-of-service ties to other subsystems*.

Figure 7.31, "Example of Removing Outaged Equipment Output" shows the output following deletion of three ac lines in the *savnw.sav* case. These branches were taken out-of-service before attempting to delete them.

```
X------- FROM BUS ---------X X--------- TO BUS ----------X CKT
   151 [NUCPANT      500.00]    152 [MID500       500.00]  1
   151 [NUCPANT      500.00]    152 [MID500       500.00]  2
   151 [NUCPANT      500.00]    201 [HYDRO        500.00]  1

    3 BRANCHES DELETED
```

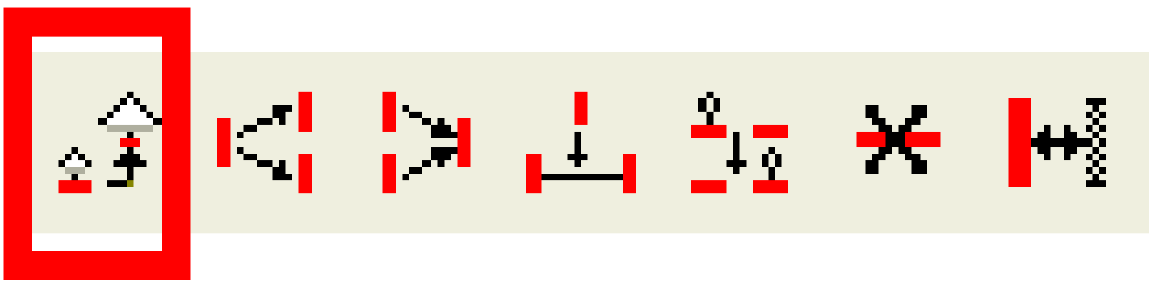
Figure 7.31. Example of Removing Outaged Equipment Output

Additional Information
PSS ® E Program Operation Manual, Removing Specified Buses and Connected Equipment Deleting Equipment *PSS ® E Application Program Interface (API)* EXTR PURG See also: Editing Functions Binding Data

7.9. Scaling Loads, Generators,and Shunts

SCAL

Requirements / Prerequisites
The working case must contain a validly specified power flow case. If generation is to be scaled, and a Type 3 bus is in the subsystem being scaled, the working case must be solved to an acceptable mismatch level.



Power Flow > Changing > Scale generation, load, shunt (SCAL)

The load, generation and shunt scaling activity SCAL enables the user to uniformly increase or decrease any or all of the following quantities for a specified grouping of loads, fixed shunts, and machines:

- Load active power.
- Load reactive power.
- Active component of fixed bus shunt admittance.
- Positive reactive component of fixed bus shunt admittance (capacitors).
- Negative reactive component of fixed bus shunt admittance (reactors).
- Generator active power output (positive generation).
- Motor active power output (negative generation).

The *[Scale Powerflow Data]* dialog (Figure 7.32, “Scale Powerflow Data Dialog to Specify Subsystem”) enables the user to designate for scaling either the entire working case or a specified bus subsystem (refer to Subsystem Selection of the *PSS®E Program Operation Manual)*. A bus subsystem may be specified either via a *[Bus Subsystem Selector]* dialog by clicking *[Select...]*, or by entering buses directly in the *[Scale Powerflow Data]* dialog.

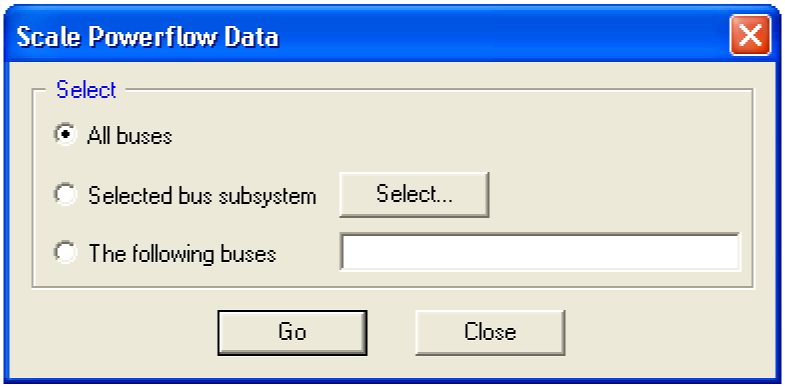


Figure 7.32. Scale Powerflow Data Dialog to Specify Subsystem

Click *[Go]* to open a second *[Scale Power Flow Data]* dialog (Figure 7.33, "Scale Powerflow Data Dialog to Enter Scaling Targets") where scaling targets for the data categories to be scaled may be specified.

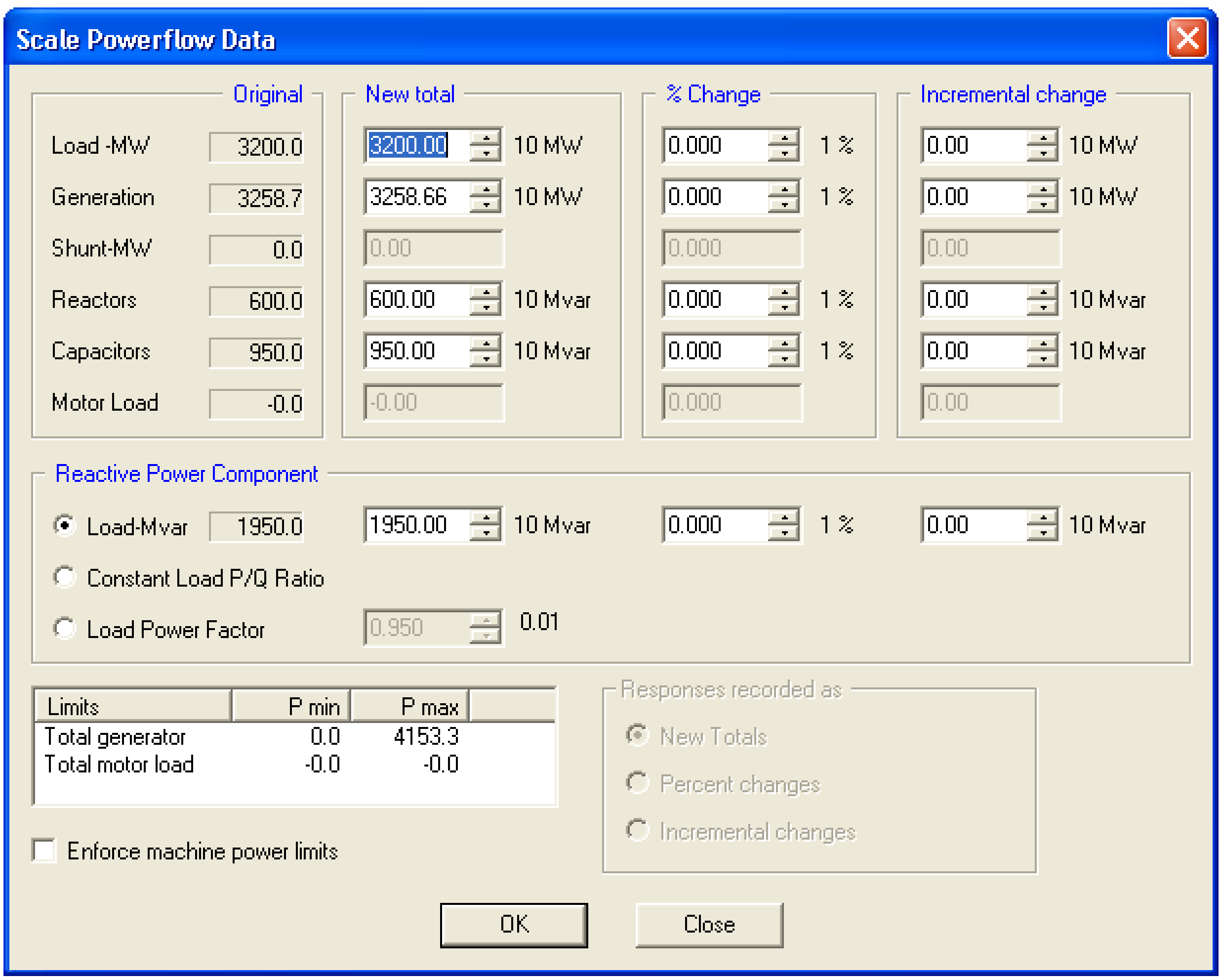


Figure 7.33. Scale Powerflow Data Dialog to Enter Scaling Targets

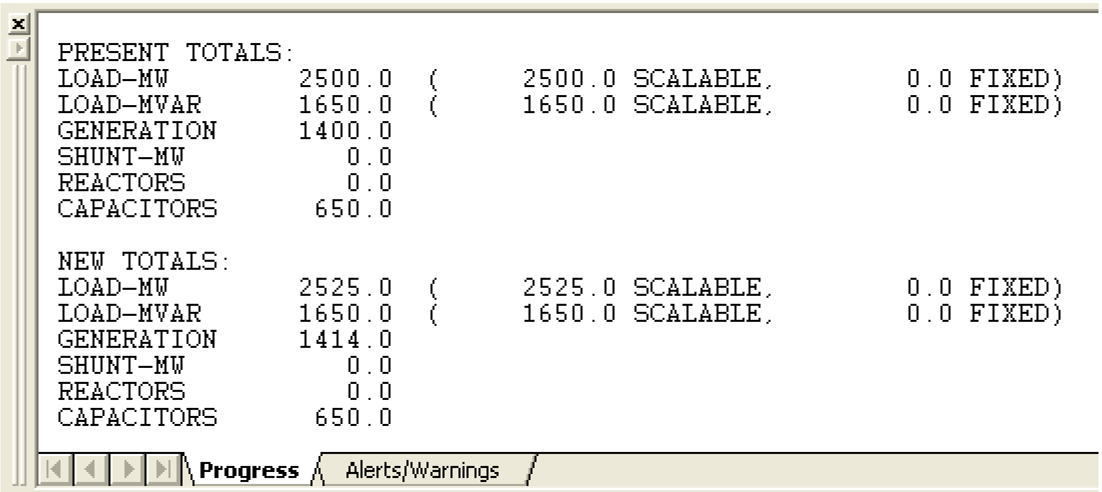


Figure 7.34. Example of Scaling Output

Additional Information
PSS ® E ProgramProgram Operation Manual, Scaling Loads, Generators, and/or Shunts *PSS ® E Application Program Interface (API)*, SCAL

7.10. Changing Adjustment Enable Flags of Transformers

TFLG

Requirements / Prerequisites
The working case must contain a validly specified power flow case.

Power Flow > Changing > Transformer adjustment flags (TFLG)...

The transformer adjustment enable flag setting activity TFLG allows the user to either enable or disable the adjustment status of all automatically adjustable transformer windings contained in the subsystem specified by the user.

The *[Transformer Adjustment Flags]* dialog (Figure 7.35, "Transformer Adjustment Flags Dialog") enables the user to designate for processing either the entire working case or a specified bus subsystem (refer to Subsystem Selection of the *PSS ® E Program Operation Manual)*. A bus subsystem may be specified either via a *[Bus Subsystem Selector]* dialog by clicking *[Select...]*, or by entering buses directly in the *[Transformer Adjustment Flags]* dialog.

The setting to be assigned to the adjustment enable flags of automatically adjustable transformer windings contained in the specified subsystem is specified via the *Allow automatic adjustment* checkbox.

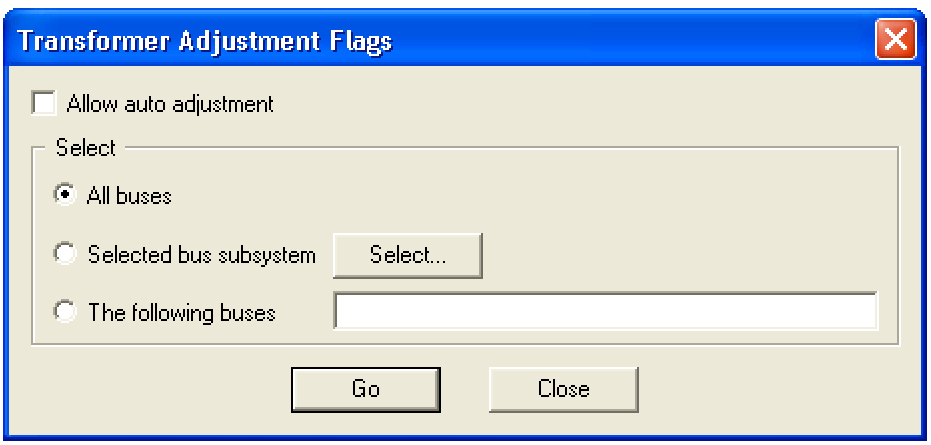


Figure 7.35. Transformer Adjustment Flags Dialog

Additional Information
PSS ® E Program Operation Manual, Changing Adjustment Enable Flags of Transformers *PSS ® E Application Program Interface (API)*, TFLG

7.11. Importing an ECDI Data File

Requirements / Prerequisites
Economic Dispatch Data File (*.ecd)

File > Import > ECDI File

The file selection window lists only *Files of type: Economic Dispatch Data file (*.ecd)*. Highlight the desired file and click *[Open]*. The economic dispatch data is read into the working case.

Additional Information
PSS ® E Program Operation Manual, Economic Dispatch Data File Contents

7.12. Performing Unit Commitment and Economic Dispatch

ECDI

Requirements / Prerequisites
The working case must contain a validly specified power flow case. Economic Dispatch Data File (*.ecd)

Power Flow > Changing > Economic dispatch (ECDI)...

The unit commitment/economic dispatch activity ECDI places machines in a specified subsystem in- or out-of-service to satisfy a given subsystem minimum capacity. The in-service machines in the subsystem are then dispatched on the basis of equal incremental cost to meet a specified total subsystem generation.

On the *[Economic Dispatch]* dialog (Figure 7.36, “Economic Dispatch Dialog”), the initial commitment option (develop a new commitment profile or start from the current commitment profile) is specified via the *New commitment profile* checkbox.

The Economic Dispatch Data file may be specified either via a file selector dialog by clicking *[...]* next to the input field, or by entering its name directly in the input field.

The *[Economic Dispatch]* dialog enables the user to designate for processing either the entire working case or a specified bus subsystem (refer to Subsystem Selection of the *PSS ® E Program Operation Manual)*. A bus subsystem may be specified either via a *[Bus Subsystem Selector]* dialog by clicking *[Select...]*, or by entering buses directly in the *[Economic Dispatch]* dialog.

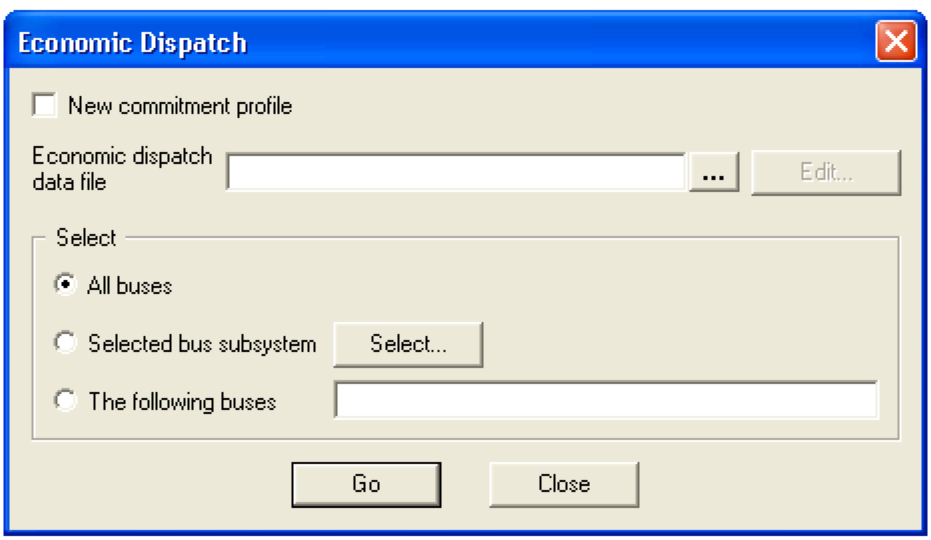


Figure 7.36. Economic Dispatch Dialog

Click *[Go]* to start activity ECDI.

When it completes its initial processing, activity ECDI summarizes the pre-dispatch conditions and brings up the *[Dispatch Parameters]* dialog (for example, Figure 7.37, "Specify Dispatch Parameters "). Ater specifying the dispatch parameters, click *[OK]* to run the unit commitment and economic dispatch calculation.

Figure 7.37. Specify Dispatch Parameters

Additional Information
PSS ® E Program Operation Manual, Performing Unit Commitment and Economic Dispatch *PSS ® E Application Program Interface (API)*, ECDI

7.13. Changing Area Assignments

ARNM

LDAR

Requirements / Prerequisites
The working case must contain a validly specified power flow case.

Power Flow > Renumbering Areas / Owners / Zones ...

The area renumbering activity ARNM reassigns buses and/or loads in the working case from their original areas to a designated area. All buses and/or loads in the working case may be reassigned to a designated area; more typically, buses and/or loads in a specified subsystem of the working case are assigned to a designated area.

To change area assignments, select the *Area assignments* tab of the *[Renumbering Areas / Owners / Zones]* dialog (Figure 7.38, "Renumbering Areas/Owners/Zones Dialog: Area Assignments Tab").

The *[Renumbering Areas / Owners / Zones]* dialog enables the user to designate for area renumbering either the entire working case or a specified bus subsystem (refer to Subsystem Selection of the *PSS ® E Program Operation Manual)*. A bus subsystem may be specified either via a *[Bus Subsystem Selector]* dialog by clicking *[Select...]*, or by entering buses directly in the *[Renumbering Areas / Owners / Zones]* dialog

Use the *Reassign* radio button to indicate if only buses, only loads, or both buses and loads in the designated subsystem are to have their area assignments changed.

Select the area to which subsystem buses and/or loads are to be assigned by highlighting an entry in either the *Used areas* scrolled list or the *Unused areas* scrolled list.

Click *[OK]* or *[Apply]* to implement the area reassignments; a summary is printed at the *Progress* device. When *[OK]* is used, the *[Renumbering Areas / Owners / Zones]* dialog is dismissed; when *[Apply]* is used, the dialog remains and additional renumbering may be implemented.

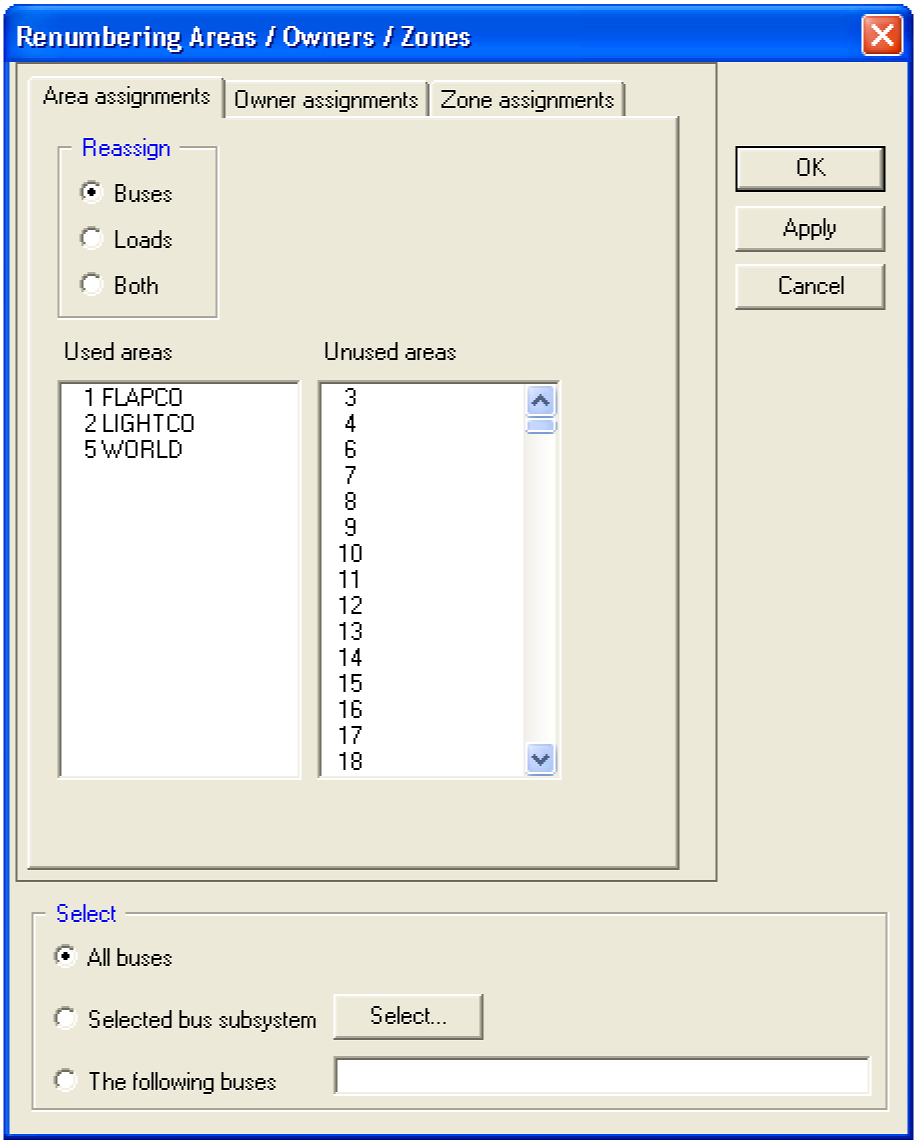


Figure 7.38. Renumbering Areas/Owners/Zones Dialog: Area Assignments Tab

Additional Information
PSS ® E Program Operation Manual: Changing Area Assignments Areas, Zones and Owners

7.14. Changing Owner Assignments

OWNM

Requirements / Prerequisites
The working case must contain a validly specified power flow case.

Power Flow > Renumbering Areas / Owners / Zones ...

The owner renumbering activity OWNM reassigns buses, loads, machines, branches, FACTS devices and/or VSC dc lines in the working case from their original owners to a designated owner. All elements of the selected equipment types in the working case may be reassigned to a designated owner; more typically, all elements of the selected equipment types in a specified subsystem of the working case are assigned to a designated owner.

To change owner assignments, select the *Owner assignments* tab of the *[Renumbering Areas / Owners / Zones]* dialog (Figure 7.39, “Renumbering Areas/Owners/Zones Dialog: Owner Assignments Tab”).

The *[Renumbering Areas / Owners / Zones]* dialog enables the user to designate for owner renumbering either the entire working case or a specified bus subsystem (refer to Subsystem Selection of the *PSS ® E Program Operation Manual)*. A bus subsystem may be specified either via a *[Bus Subsystem Selector]* dialog by clicking *[Select...]*, or by entering buses directly in the *[Renumbering Areas / Owners / Zones]* dialog.

Use the *Reassign* check boxes to indicate one or more of the following equipment types for which elements in the designated subsystem are to have their owner assignments changed:

• Buses	• Branches (non-transformers branches and transformers)
• Loads	• FACTS devices
• Machines	• VSC dc lines

When one or more of branches, FACTS devices, and VSC dc lines have been selected, the *Branch reassignment options* pull-down list is used to select for owner reassignment of series elements either:

- Subsystem branches only
- Subsystem tie lines only
- Subsystem branches and tie lines

Select the owner to which subsystem elements are to be assigned by highlighting an entry in either the *Used owners* scrolled list or the *Unused owners* scrolled list.

Click *[OK]* or *[Apply]* to implement the owner reassignments; a summary is printed at the *Progress* device. When *[OK]* is used, the *[Renumbering Areas / Owners / Zones]* dialog is dismissed; when *[Apply]* is used, the dialog remains and additional renumbering may be implemented.

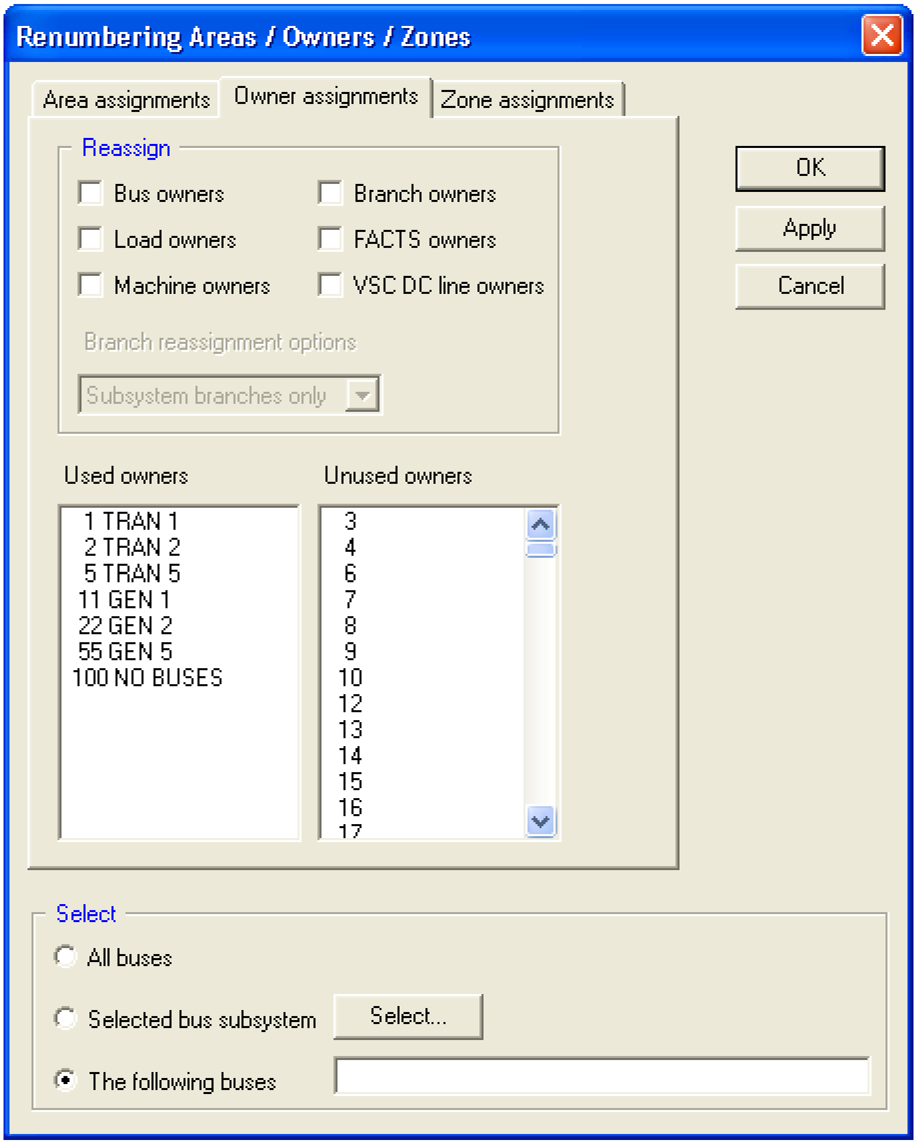


Figure 7.39. Renumbering Areas/Owners/Zones Dialog: Owner Assignments Tab

Additional Information
PSS ® E Program Operation Manual: Changing Owner Assignments Areas, Zones and Owners

7.15. Changing Zone Assignments

ZONM

LDZO

Requirements / Prerequisites
The working case must contain a validly specified power flow case.

Power Flow > Renumbering Areas / Owners / Zones ...

The zone renumbering activity ZONM reassigns buses and/or loads in the working case from their original zones to a designated zone. All buses and/or loads in the working case may be reassigned to a designated zone; more typically, buses and/or loads in a specified subsystem of the working case are assigned to a designated zone.

To change zone assignments, select the *Zone assignments* tab of the *[Renumbering Areas / Owners / Zones]* dialog (Figure 7.40, "Renumbering Areas/Owners/Zones Dialog: Zone Assignments Tab").

The *[Renumbering Areas / Owners / Zones]* dialog enables the user to designate for zone renumbering either the entire working case or a specified bus subsystem (refer to Subsystem Selection of the *PSS ® E Program Operation Manual*). A bus subsystem may be specified either via a *[Bus Subsystem Selector]* dialog by clicking *[Select...]*, or by entering buses directly in the *[Renumbering Areas / Owners / Zones]* dialog

Use the *Reassign* radio button to indicate if only buses, only loads, or both buses and loads in the designated subsystem are to have their zone assignments changed.

Select the zone to which subsystem buses and/or loads are to be assigned by highlighting an entry in either the *Used zones* scrolled list or the *Unused zones* scrolled list.

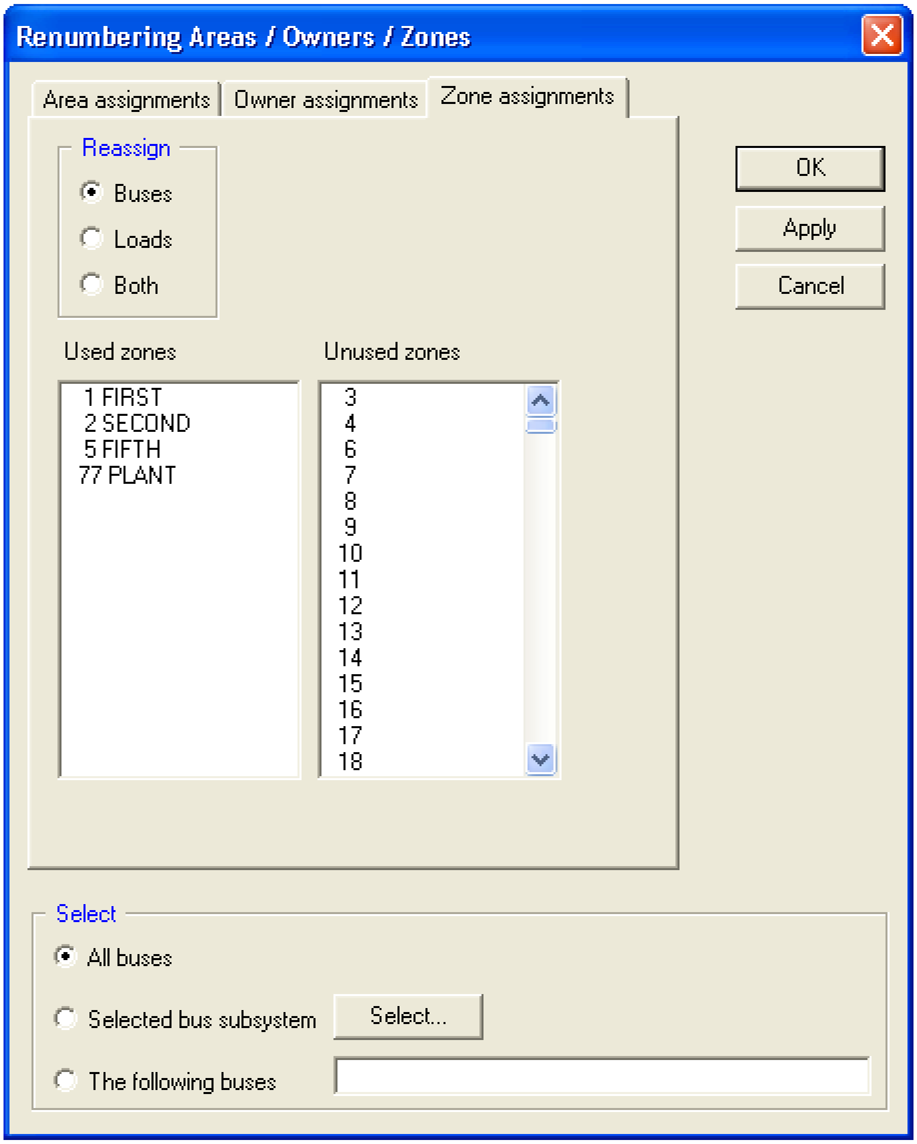


Figure 7.40. Renumbering Areas/Owners/Zones Dialog: Zone Assignments Tab

Click *[OK]* or *[Apply]* to implement the zone reassignments; a summary is printed at the *Progress* device. When *[OK]* is used, the *[Renumbering Areas / Owners / Zones]* dialog is dismissed; when *[Apply]* is used, the dialog remains and additional renumbering may be implemented.

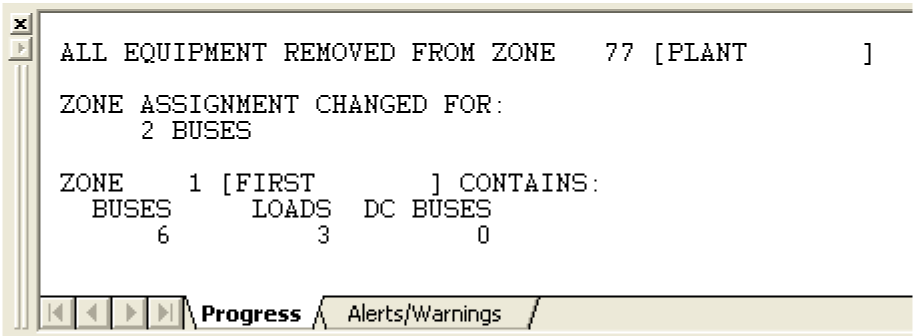


Figure 7.41. Zone Reassignment Output

Additional Information
PSS ® E Program Operation Manual: Changing Zone Assignments Areas, Zones and Owners

7.16. Renumbering Buses

BSNM

Requirements / Prerequisites
The working case must contain a validly specified power flow case.

The bus renumbering activity BSNM enables the user to change the bus numbers of specified network buses in the working case and retain a tabulation, normally in file form, of the bus number changes made.

Access to the various bus renumbering methods available in activity BSNM is supplied by four dialogs corresponding to four menu entries available in the GUI.

The option for the handling of the output tabulation records produced by activity BSNM is specified in the *Select output destination* area on each BSNM dialog. The following options are available:

- Click the *Data file* radio button on the dialog to preserve the output tabulation records in a Bus Renumbering Translation File. The name of the Bus Renumbering Translation File may be specified either via a file selector dialog by clicking *[...]* next to the input field, or by entering its name directly in the input field next to the *Data file* radio button.
- Click the *Report window* radio button on the dialog to write the output tabulation records to the *Report* device.
- Click the *No output* radio button on the dialog to suppress the writing of the output tabulation records.

7.16.1. Renumbering Buses by Bus Number

Power Flow > Renumber Buses > By Bus Number...

The *[Renumber Buses by Bus Number]* dialog (Figure 7.42, "Renumber Buses by Bus Number Dialog") is used to renumber buses using the bus number to bus number translation method. See Section 7.16, "Renumbering Buses" for a description of the *Select output destination* area.

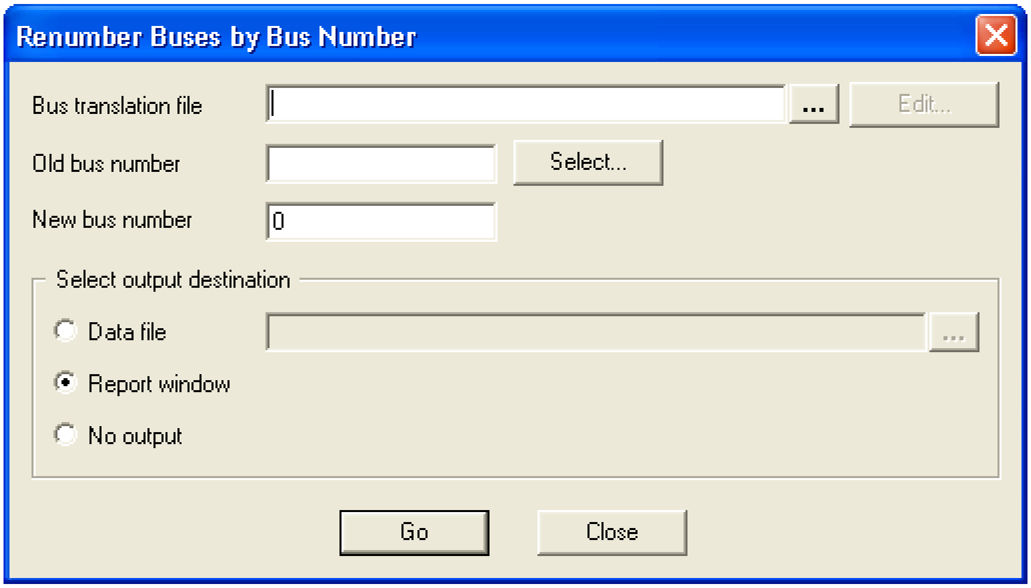


Figure 7.42. Renumber Buses by Bus Number Dialog

File Input

If bus number pairs are to be supplied in a Bus Renumbering Translation File, its name is specified in the *Bus translation file* field. The name of the file may be specified either via a file selector dialog by clicking *[...]* next to the input field, or by entering its name directly in the input field. Then click *[Go]* to complete the renumbering process and dismiss the dialog.

Dialog Input

If bus number pairs are to be specified on the dialog, the old and new bus numbers are entered in the *Old bus number* and *New bus number* fields, respectively.

The old bus number may be entered directly in the *Old bus number* input field. Alternatively, *[Select...]* adjacent to the input field may be used to open the *[Bus Selection]* dialog (Figure 7.3, “Bus Selection Dialog”) where the desired bus may be specified by double-clicking on an entry in the selection list; click *[Filter]* to open a *[Bus Filter]* dialog (Figure 7.4, “Bus Filter Dialog”) to apply filtering criteria to limit the number of buses in the selection list.

Click *[Go]* to implement the specified bus number change. The dialog remains and another bus number pair may be specified, or click *[Close]* to end activity BSNM.

7.16.2. Renumbering Buses by Name

Power Flow > Renumber Buses > By Bus Name...

The *[Renumber Buses by Bus Name]* dialog (Figure 7.43, “Renumber Buses by Bus Name Dialog”) is used to renumber buses using the bus name to bus number translation method. See Section 7.16, “Renumbering Buses” for a description of the *Select output destination* area.

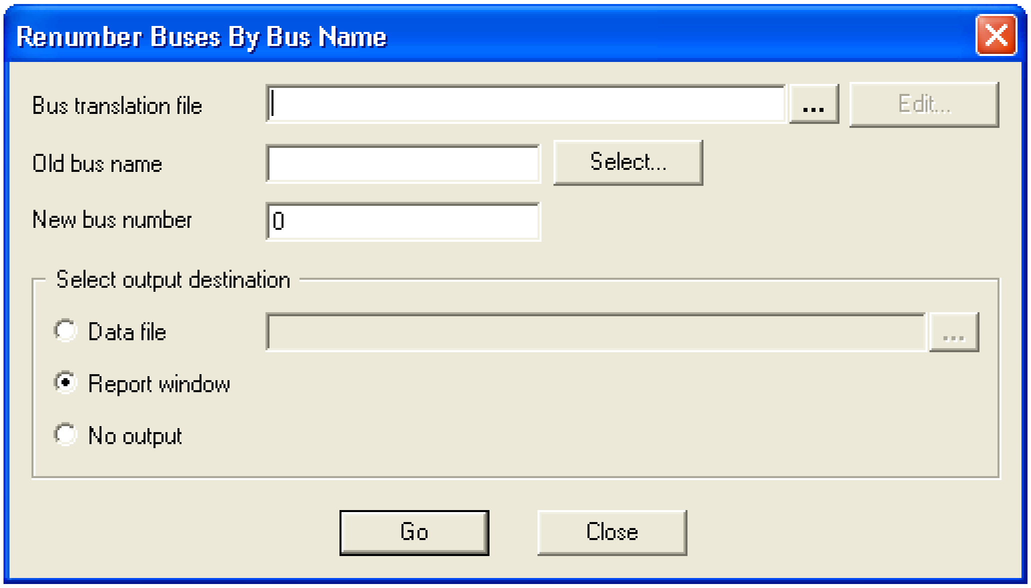


Figure 7.43. Renumber Buses by Bus Name Dialog

File Input

If bus name, number pairs are to be supplied in an input data file, its name is specified in the *Bus translation file* field. The name of the file may be specified either via a file selector dialog by clicking *[...]* next to the input field, or by entering its name directly in the input field. Then click *[Go]* to complete the renumbering process and dismiss the dialog.

Dialog Input

If bus name, number pairs are to be specified on the dialog, the extended bus name and new bus number are entered in the *Old bus name* and *New bus number* fields, respectively.

The old bus name may be entered directly in the *Old bus name* input field. Alternatively, *[Select...]* adjacent to the input field may be used to open the *[Bus Selection]* dialog (Figure 7.3, “Bus Selection Dialog”) where the desired bus may be specified by double-clicking on an entry in the selection list; click *[Filter]* to open a *[Bus Filter]* dialog (Figure 7.4, “Bus Filter Dialog”) to apply filtering criteria to limit the number of buses in the selection list.

Click *[Go]* to implement the specified bus number change. The dialog remains and another bus name, number pair may be specified, or click *[Close]* to end activity BSNM.

7.16.3. Renumbering Buses by Packing

Power Flow > Renumber Buses > By Packing...

The *[Renumber Buses by Bus Packing]* dialog (Figure 7.44, “Renumber Buses by Bus Packing Dialog”) is used to renumber buses using the bus number packing translation method. See Section 7.16, “Renumbering Buses” for a description of the *Select output destination* area.

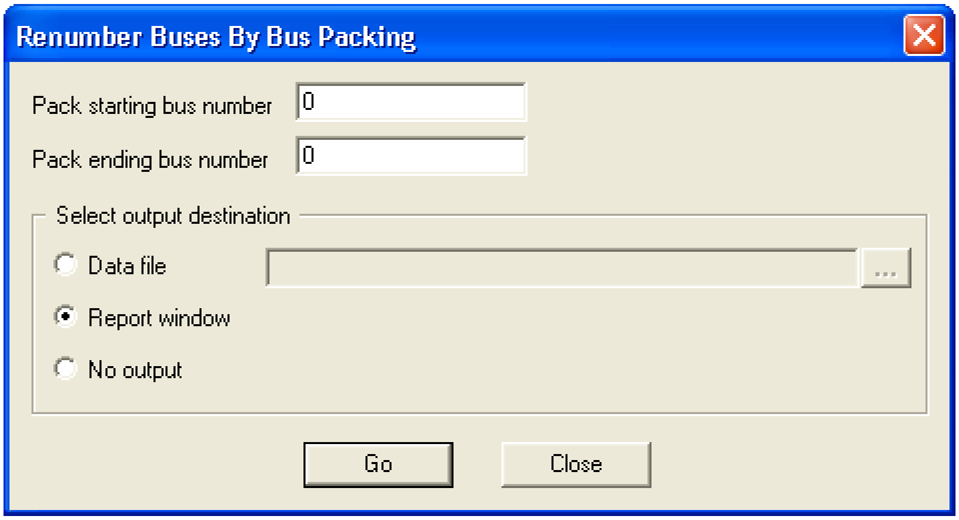


Figure 7.44. Renumber Buses by Bus Packing Dialog

The numbers defining the bus number range are entered in the *Pack starting bus number* and *Pack ending bus number* fields.

Click *[Go]* to implement the packing of bus numbers in the specified range into the low end of the range. The dialog remains and another bus range may be specified, or click *[Close]* to end activity BSNM.

7.16.4. Renumbering Buses By Subsystem

Power Flow > Renumber Buses > By Subsystem...

The *[Renumber Buses by Subsystem]* dialog (Figure 7.45, “Renumber Buses by Subsystem Dialog”) is used to renumber buses using any of the following bus renumbering methods:

- All buses without area blocking method.
- All buses with area blocking method.
- Subsystem bus number range method.
- Subsystem bus number offset method.

See Section 7.16, “Renumbering Buses” for a description of the *Select output destination* area.

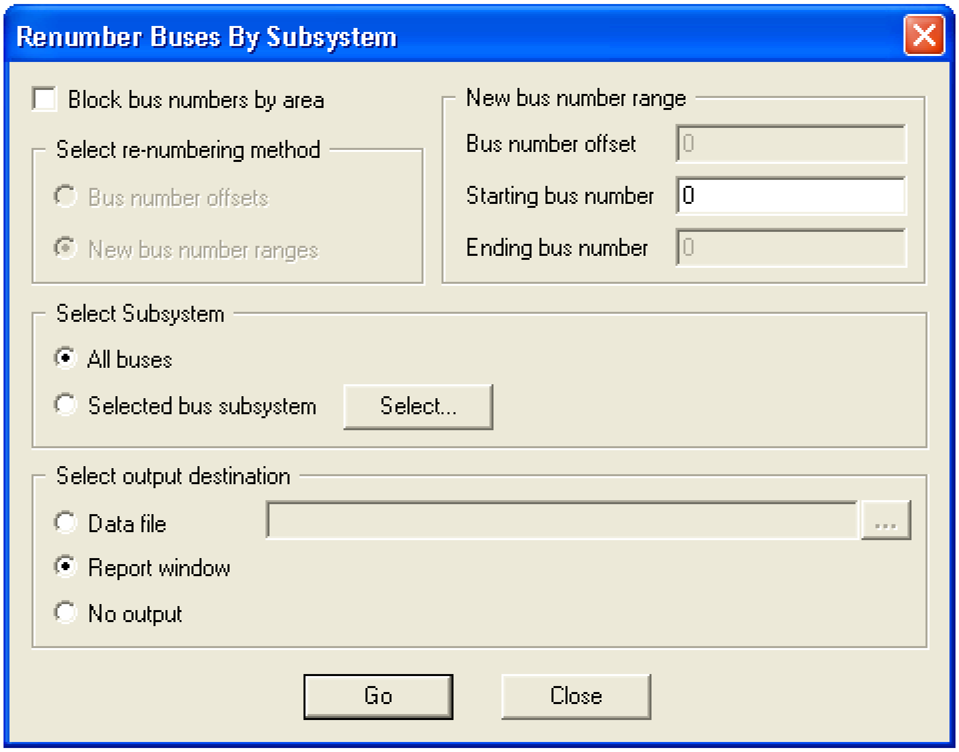


Figure 7.45. Renumber Buses by Subsystem Dialog

All Buses Without Area Blocking

To renumber buses using the all buses without area blocking renumbering method, enter the following on the dialog:

- In the *Select Subsystem* area, select the *All buses* radio button.
- Uncheck the *Block bus numbers by area* checkbox.
- In the *New bus number range* area, specify the appropriate value in the *Starting bus number* field.

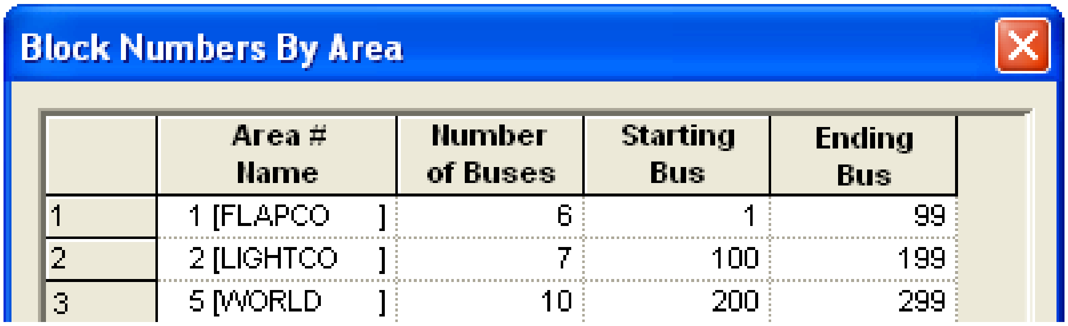
Then click *[Go]* to complete the renumbering process and dismiss the dialog.

All Buses With Area Blocking

To renumber buses using the all buses with area blocking renumbering method, enter the following on the dialog:

- In the *Select Subsystem* area, select the *All buses* radio button.
- Check the *Block bus numbers by area* checkbox.

Then click *[Go]* to open the *[Block Numbers By Area]* dialog (see Figure 7.46, "Example of Block Numbers By Area Dialog").



	Area # Name	Number of Buses	Starting Bus	Ending Bus
1	1 [FLAPCO]	6	1	99
2	2 [LIGHTCO]	7	100	199
3	5 [WORLD]	10	200	299

Figure 7.46. Example of Block Numbers By Area Dialog

The *[Block Numbers By Area]* dialog contains an entry for each area in the working case that has at least one bus assigned to it. Specify a new bus number range for *each* area on the dialog.Then click *[Go]* to complete the renumbering process and dismiss the dialog.

No bus number changes are implemented until new number ranges are specified for all areas shown on the dialog. Consequently, unless non-zero bus numbers are entered to indicate the bus number ranges for each area on the dialog, the renumbering process will not be initiated.

Subsystem Bus Number Range

To renumber buses in a bus subsystem using the bus number range method, enter the following on the dialog:

- In the *Select Subsystem* area, select the *Selected bus subsystem* radio button.
- Unless the current bus subsystem is to be processed, click *[Select...]* to specify a bus subsystem via a *[Bus Subsystem Selector]*.
- In the *Select re-numbering method* area, select the *New bus number range* radio button.
- In the *New bus number range* area, specify the appropriate values in the *Starting bus number* and *Ending bus number* fields.

Click *[Go]* to implement the specified subsystem renumbering. The dialog remains and another bus subsystem may be renumbered, or click *[Close]* to end activity BSNM.

Subsystem Bus Number Offset

To renumber buses in a bus subsystem using the bus number offset method, enter the following on the dialog:

- In the *Select Subsystem* area, select the *Selected bus subsystem* radio button.
- Unless the current bus subsystem is to be processed, click *[Select...]* to specify a bus subsystem via a *[Bus Subsystem Selector].*
- In the *Select re-numbering method* area, select the *Bus number offset* radio button.

- In the *New bus number range* area, specify the appropriate value in the *Bus number offset* field.

Click *[Go]* to implement the specified subsystem renumbering. The dialog remains and another bus subsystem may be renumbered, or click *[Close]* to end activity BSNM.

Additional Information
PSS ® E Program Operation Manual, Bus Renumbering *PSS ® E Application Program Interface (API)*, BSNM

7.17. Renumbering Buses in Auxiliary Data Files

RNFI

Requirements / Prerequisites
The working case must contain a validly specified power flow case. A Bus Renumbering Translation File must be available.

File > Renumber buses in auxiliary files (RNFI)...

The auxiliary data input file bus renumbering activity RNFI reflects changes in bus numbering in auxiliary data input files. It is used primarily in conjunction with activity BSNM to coordinate bus renumbering implemented in a Saved Case with auxiliary data input files associated with the Saved Case and read by other PSS®E activities.

The *[Renumber Buses in Auxiliary Files]* dialog (Figure 7.47, "Renumber Buses in Auxiliary Files Dialog") is available only when using *[Spreadsheet]*.

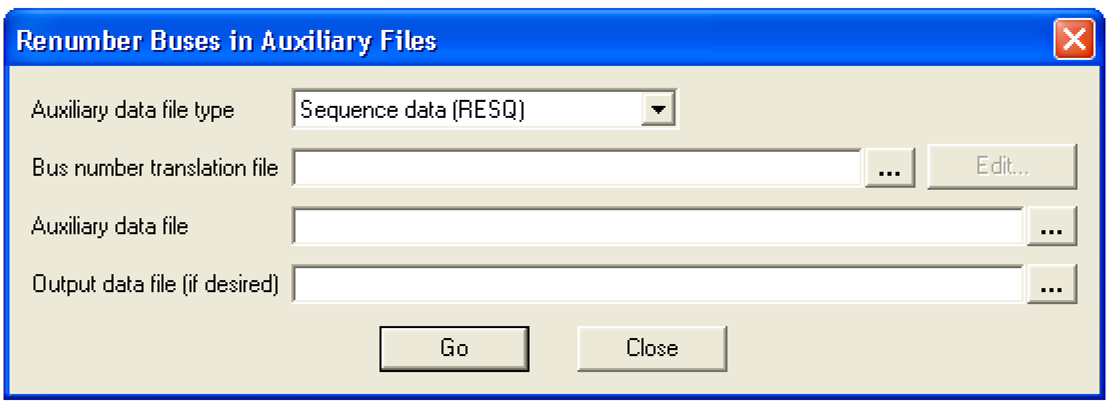


Figure 7.47. Renumber Buses in Auxiliary Files Dialog

First, select the type of file to be processed from the *Auxiliary data file type* pull-down list. An abbreviation for the activity that requires the file type appears in parentheses, as follows:

• Sequence data (RESQ)	• Capability curve data (GCAP)
• Dynamics data (DYRE)	• Load throwover data (ACCC)
• Machine impedance data (MCRE)	• Fault specification data (ANSI)
• Dispatch data (ECDI)	• Subsystem description data (ACCC)
• Dispatch data (INLF)	• Monitored element data (ACCC)
• Breaker duty data (BKDY)	• Contingency description data (ACCC)
• Fault specification data (BKDY)	• Tripping data (ACCC)
• Fault control data (ASCC)	

Then specify the files to be used by activity RNFI.

- Bus Number Translation file (*.trn)

- Auxiliary Data file (files corresponding to *Auxiliary data file type*)
- Output data file (files corresponding to *Auxiliary data file type*)

For each of these files, its name may be typed directly in its input field, or you can click *[...]* next to the input field to specify the name of the file from a file selector dialog.

Additional Information
PSS ® E Program Operation Manual, Renumbering Buses in Auxiliary Files Bus Renumbering *PSS ® E Application Program Interface (API)*, RNFI

7.18. Changing Sequence Data

SQCH

Requirements / Prerequisites
The working case must contain a validly specified power flow case. Sequence data must be present in the working case.

PSS®E permits the user to change all sequence data associated with equipment represented in the working case. In the GUI, the primary means of changing individual data items is the *[Spreadsheet]* (refer to Chapter 2, *Spreadsheet View*).

	Bus Number	Bus Name	Id	In Service	G-Shunt (MW)	B-Shunt (Mvar)	G-Zero (MW)	B-Zero (Mvar)
	151	NUCPANT 500.00	1	☑	0.00	-600.00	0.00	0.00
	154	DOWNTN 230.00	1	☑	0.00	300.00	0.00	0.00
	201	HYDRO 500.00	1	☑	0.00	300.00	0.00	0.00
	203	EAST230 230.00	1	☑	0.00	50.00	0.00	0.00
	205	SUB230 230.00	1	☑	0.00	300.00	0.00	0.00
*				☑				

Bus | Plant | Machine | Load | **Fixed Shunt** | Switched Shunt | Branch | Breaker

Sequence Data, Fixed Shunt

Additional Information
PSS ® E Program Operation Manual: Changing Sequence Data See also: Section 7.1, “Changing Service Status and Power Flow Parametric Data”

Chapter 8
Data Reports

8.1. Working Case Data Reporting

Power Flow > List Data...

PSS®E facilitates the listing of all data in the working case for viewing, problem checking, or case documentation.

Through the *[List Data]* dialog (Figure 8.1, “List Data Dialog”), the following tabulations of working case data can be produced:

- Categories of power flow data in tabular form (activity LIST).
- Power flow data grouped together on a bus-by-bus basis (activity EXAM).
- Categories of sequence data (i.e., fault analysis data) in tabular form (activity SQLI).
- Sequence data grouped together on a bus-by-bus basis (activity SQEX).
- Categories of optimal power flow data in tabular form (activity LSTO).
- Outaged network elements (activity OUTS).
- Fixed and/or switched bus shunts (activity SHNT).
- Extended bus names in alphabetic order (activity ALPH).

Click the radio button on the *[List Data]* dialog corresponding to the desired reporting function. If the selected function has provision for reporting options, the corresponding controls on the dialog are enabled.

The *[List Data]* dialog enables the user to designate for processing either the entire working case or a specified bus subsystem (refer to Subsystem Selection of the *PSS®E Program Operation Manual)*. A bus subsystem may be specified either via a *[Bus Subsystem Selector]* dialog by clicking *[Select...]*, or by entering buses directly in the *[List Data]* dialog.

Reports are routed to the *Report* device.

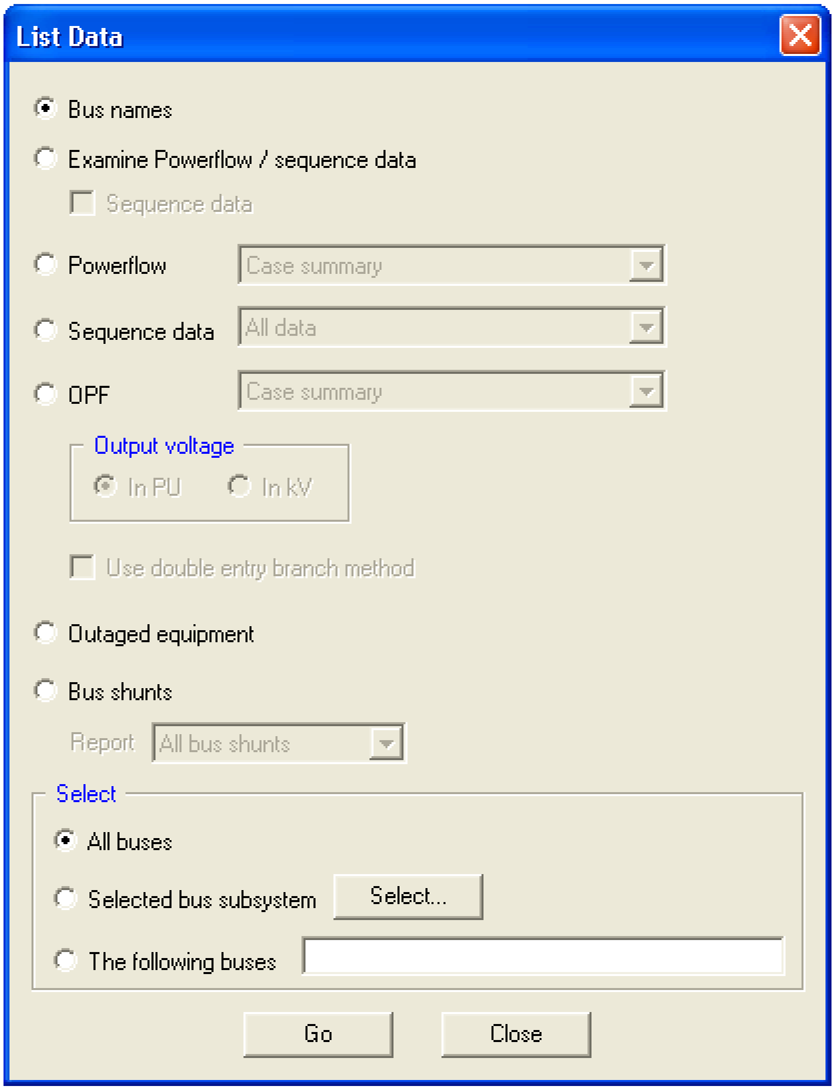


Figure 8.1. List Data Dialog

8.1.1. Power Flow Data

LIST

Requirements / Prerequisites
The working case must contain a non-null case.

Power Flow > List Data...

The data listing activity LIST tabulates the power flow working case in a form suitable for problem data documentation. The report generated by activity LIST is separated into several categories of data.

Activity LIST is accessible from the *Powerflow* radio button of the *[List Data]* dialog (Figure 8.1, “List Data Dialog”). The data category to be tabulated is selected from the drop down list next to the *Powerflow* radio button on the dialog. The *Output voltage* radio buttons provide for the tabulation of ac voltages in either per unit or kilovolts. The *Use double entry branch method* check box is used to select either single or double entry format for branch related category reports when either the *All data* or *Branches* report is specified in the drop down list.

The *[List Data]* dialog enables the user to designate for processing either the entire working case or a specified bus subsystem (refer to Subsystem Selection of the *PSS®E Program Operation Manual)*. A bus subsystem may be specified either via a *[Bus Subsystem Selector]* dialog by clicking *[Select...]*, or by entering buses directly in the *[List Data]* dialog.

Additional Information
PSS® E Program Operation Manual, Displaying Power Flow Data *PSS® E Application Program Interface (API)*, LIST

8.1.2. Listing Buses in Alphabetical Order

ALPH

Requirements / Prerequisites
Validly specified power flow case.

Power Flow > List Data...

The bus alphabetic listing activity ALPH prints an alphabetically sorted table of all buses in a specified subsystem of the working case.

Activity ALPH is accessible from the *Bus names* radio button of the *[List Data]* dialog (Figure 8.1, “List Data Dialog”).

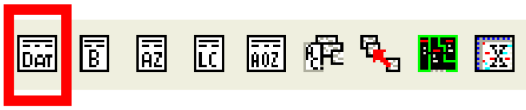
The *[List Data]* dialog enables the user to designate for processing either the entire working case or a specified bus subsystem (refer to Section 4.8, Subsystem Selection of the *PSS®E Program Operation Manual)*. A bus subsystem may be specified either via a *[Bus Subsystem Selector]* dialog by clicking *[Select...]*, or by entering buses directly in the *[List Data]* dialog.

Additional Information
PSS® E Program Operation Manual, Listing Buses in Alphabetical Order *PSS® E Application Program Interface (API)*, ALPH

8.1.3. Listing Buses and their Connected Equipment

EXAM

Requirements / Prerequisites
The working case must contain a non-null case.



Power Flow > List Data...

The data examination activity EXAM produces a tabulation of power flow data organized by bus. For each bus tabulated, its bus data is followed by the data associated with each network element that is connected to the bus.

Activity EXAM is accessible from the *Examine Powerflow / sequence data* radio button of the *[List Data]* dialog (Figure 8.1, "List Data Dialog"). The sequence data check box must be unchecked.

The *[List Data]* dialog enables the user to designate for processing either the entire working case or a specified bus subsystem (refer to Section 4.8, Subsystem Selection of the *PSS®E Program Operation Manual)*. A bus subsystem may be specified either via a *[Bus Subsystem Selector]* dialog by clicking *[Select...]*, or by entering buses directly in the *[List Data]* dialog.

Additional Information
PSS® E Program Operation Manual, Listing Components of a Bus *PSS® E Application Program Interface (API)*, EXAM

8.1.4. Listing Sequence Data

SQLI

Requirements / Prerequisites
The working case must contain a validly specified power flow case with sequence data appended to it..

Power Flow > List Data...

The sequence data listing activity SQLI tabulates the sequence data arrays in the working case in a form suitable for problem data documentation. The report generated by activity SQLI is separated into several categories of data..

Activity SQLI is accessible from the *Sequence data* radio button of the *[List Data]* dialog (Figure 8.1, "List Data Dialog"). The data category to be tabulated is selected from the drop down list next to the *Sequence data* radio button on the dialog.

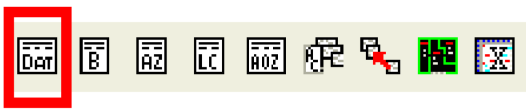
The *[List Data]* dialog enables the user to designate for processing either the entire working case or a specified bus subsystem (refer to Subsystem Selection of the *PSS®E Program Operation Manual)*. A bus subsystem may be specified either via a *[Bus Subsystem Selector]* dialog by clicking *[Select...]*, or by entering buses directly in the *[List Data]* dialog.

Additional Information
PSS® E Program Operation Manual, Listing Sequence Data *PSS® E Application Program Interface (API)*, SQLI

8.1.5. Listing Sequence Data for Buses and their Connected Equipment

SQEX

Requirements / Prerequisites
The working case must contain a validly specified power flow case with sequence data appended to it..



Power Flow > List Data...

The sequence data examination activity SQEX produces a tabulation of fault analysis data organized by bus. For each bus tabulated, its shunt load data is followed by the data associated with each network element that is connected to the bus for which sequence data is applicable.

Activity SQEX is accessible from the *Examine Powerflow / sequence data* radio button of the *[List Data]* dialog (Figure 8.1, "List Data Dialog"). The Sequence data check box must be checked.

The *[List Data]* dialog enables the user to designate for processing either the entire working case or a specified bus subsystem (refer to Subsystem Selection of the *PSS®E Program Operation Manual)*. A bus subsystem may be specified either via a *[Bus Subsystem Selector]* dialog by clicking *[Select...]*, or by entering buses directly in the *[List Data]* dialog.

Additional Information
PSS® E Program Operation Manual, Listing Sequence Data for a Bus *PSS® E Application Program Interface (API)*, SQEX

8.1.6. Outaged Equipment

OUTS

Requirements / Prerequisites
The working case must contain a validly specified power flow case.

Power Flow > List Data...

The outaged equipment reporting activity OUTS tabulates those components in the working case that are removed from service.

Activity OUTS is accessible from the *Outaged equipment* radio button of the *[List Data]* dialog (Figure 8.1, "List Data Dialog").

The *[List Data]* dialog enables the user to designate for processing either the entire working case or a specified bus subsystem (refer to Subsystem Selection of the *PSS®E Program Operation Manual)*. A bus subsystem may be specified either via a *[Bus Subsystem Selector]* dialog by clicking *[Select...]*, or by entering buses directly in the *[List Data]* dialog.

Additional Information
PSS® E Program Operation Manual, Listing Outaged Equipment *PSS® E Application Program Interface (API)*, OUTS

8.1.7. Listing Bus Shunts

SHNT

Requirements / Prerequisites
The working case must contain a validly specified power flow case.

Power Flow > List Data...

The bus shunt summary activity SHNT tabulates fixed and/or switched bus shunts contained in the working case.

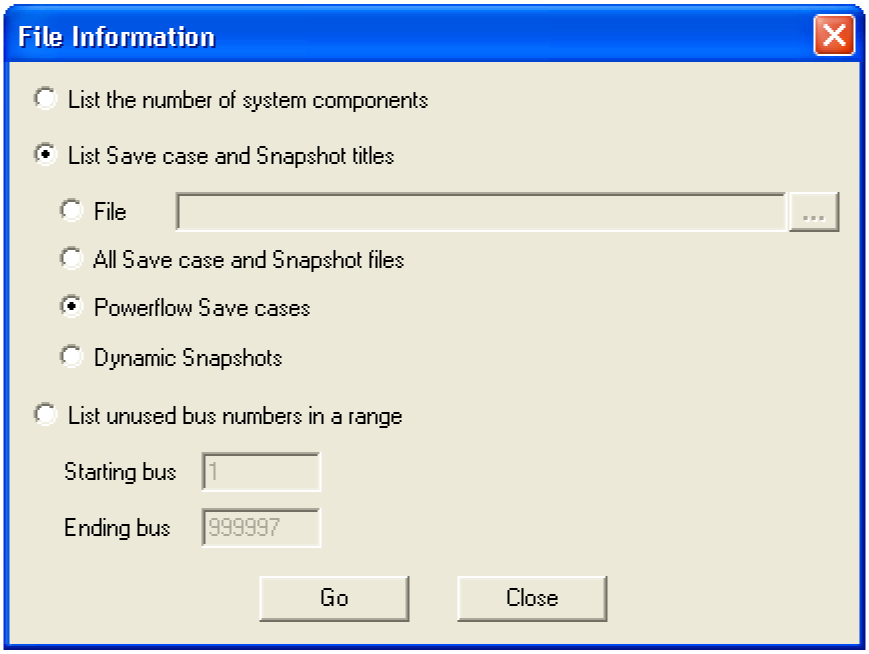
Activity SHNT is accessible from the *Bus shunts* radio button of the *[List Data]* dialog (Figure 8.1, "List Data Dialog"). The type(s) of bus shunts to be tabulated is selected from the *Report* drop down list below the *Bus shunts* radio button on the dialog.

The *[List Data]* dialog enables the user to designate for processing either the entire working case or a specified bus subsystem (refer to Subsystem Selection of the *PSS®E Program Operation Manual)*. A bus subsystem may be specified either via a *[Bus Subsystem Selector]* dialog by clicking *[Select...]*, or by entering buses directly in the *[List Data]* dialog.

Additional Information
PSS® E Program Operation Manual, Listing Bus Shunts *PSS® E Application Program Interface (API)*, SHNT

8.2. Listing File Information

File > File information (SIZE/SHOW/BUSN)...



File Information Dialog

Three reports are available from the *[File Information]* dialog:

- System Components
- Saved Case and Snapshot Filenames
- Unused Bus Numbers

8.2.1. System Components

SIZE

Requirements / Prerequisites
The working case must contain a non-null case..

The case size summary activity SIZE tabulates the number of components in the working case, along with the maximum number permitted at the current size level of PSS®E working memory.

Activity SIZE is accessible from the *List the number of system components* radio button of the *[File Information]* dialog.

Additional Information
PSS® E Program Operation Manual, Editing the Two-Line Case Title or the Long Title

Additional Information
PSS® E Application Program Interface (API), SIZE

8.2.2. Saved Case and Snapshot Filenames

SHOW

Selecting the *List Save case and Snapshot titles* option produces a report of filenames in the current working directory. The user may specify whether to open the *[Select file to display title]* dialog, only Powerflow Save cases, only Dynamics Snapshot files, or All Save cases and Snapshot files.

Specific information on this option may be found at Section 6.2, “Listing Saved Case Filenames” and Section 20.7, “Listing Snapshot Filenames”.

Additional Information
PSS® E Program Operation Manual, Listing Saved Case or Snapshot Files

8.2.3. Unused Bus Numbers

BUSN

Requirements / Prerequisites
Validly specified power flow case.

The unused bus number summary activity BUSN tabulates those numbers, from within a user specified bus number range, which are not assigned to buses in the working case.

Activity BUSN is accessible from the *List unused bus numbers in a range* radio button of the *[File Information]* dialog. The bus number range is specified in the *Starting bus* and *Ending bus* input fields on the dialog.

Additional Information
PSS® E Program Operation Manual, Listing Unused Bus Numbers *PSS® E Application Program Interface (API)*, BUSN

Chapter 9
Case Comparison

9.1. Comparing Power Flow Case Totals

CMPR

Requirements / Prerequisites
Validly specified power flow case. If losses, mismatches, or interchange are to be compared, both cases should be solved to an acceptable mismatch level. Saved Case file (*.sav)

File > Compare...

) creates a report comparing working case totals by area, owner, or zone with a specified saved case. Click *[Compare Case Totals]* dialog (*[...]* to open the selection window for the required *Saved Case file* (*.sav). Click *[Go]* to perform the activity. The comparison is routed to the *Report* tab by default (Figure 9.2, "Example of Compare Case Totals Report").

You will need to click *[Close]* to end this activity.

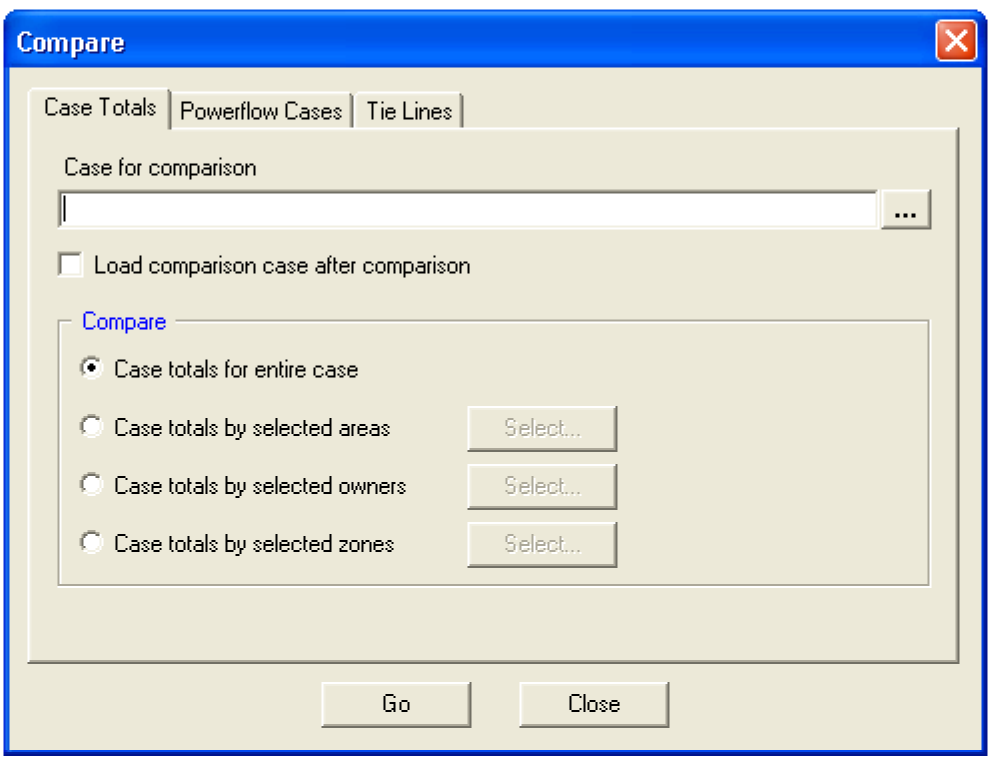
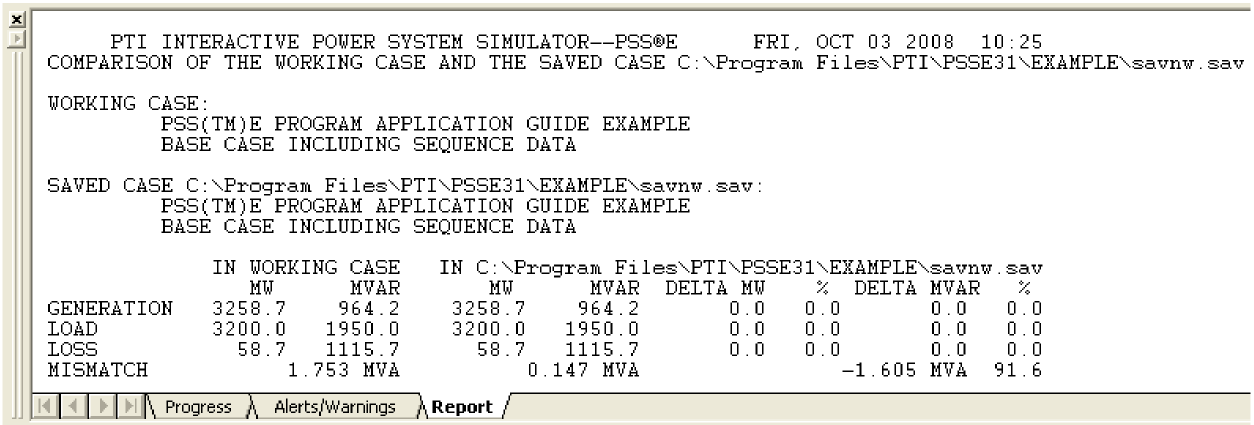


Figure 9.1. Compare Case Totals Dialog



```
     PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS®E      FRI, OCT 03 2008  10:25
COMPARISON OF THE WORKING CASE AND THE SAVED CASE C:\Program Files\PTI\PSSE31\EXAMPLE\savnw.sav

WORKING CASE:
         PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE
         BASE CASE INCLUDING SEQUENCE DATA

SAVED CASE C:\Program Files\PTI\PSSE31\EXAMPLE\savnw.sav:
         PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE
         BASE CASE INCLUDING SEQUENCE DATA

             IN WORKING CASE   IN C:\Program Files\PTI\PSSE31\EXAMPLE\savnw.sav
                MW       MVAR       MW       MVAR  DELTA MW     %  DELTA MVAR   %
GENERATION   3258.7     964.2    3258.7     964.2       0.0   0.0         0.0   0.0
LOAD         3200.0    1950.0    3200.0    1950.0       0.0   0.0         0.0   0.0
LOSS           58.7    1115.7      58.7    1115.7       0.0   0.0         0.0   0.0
MISMATCH           1.753 MVA         0.147 MVA                 -1.605 MVA  91.6
```

Progress | Alerts/Warnings | **Report**

Figure 9.2. Example of Compare Case Totals Report

Additional Information
PSS® E Program Operation Manual, Comparing Power Flow Case Totals

9.2. Comparing Power Flow Cases

DIFF

Requirements / Prerequisites
Validly specified power flow case. If bus voltages, line flows, or line losses are to be compared, both cases should be solved to an acceptable mismatch level. Saved Case file (*.sav) - - - Reading Sequence Data for Fault Analysis

File > Compare...

The *[Compare Powerflow Cases]* dialog (Figure 9.3, "Compare Power Flow Cases Dialog") creates a report comparing a specified bus subsystem quantity in the working case with a saved case. Click *[...]* to open the selection window for the required *Saved Case file* (*.sav).

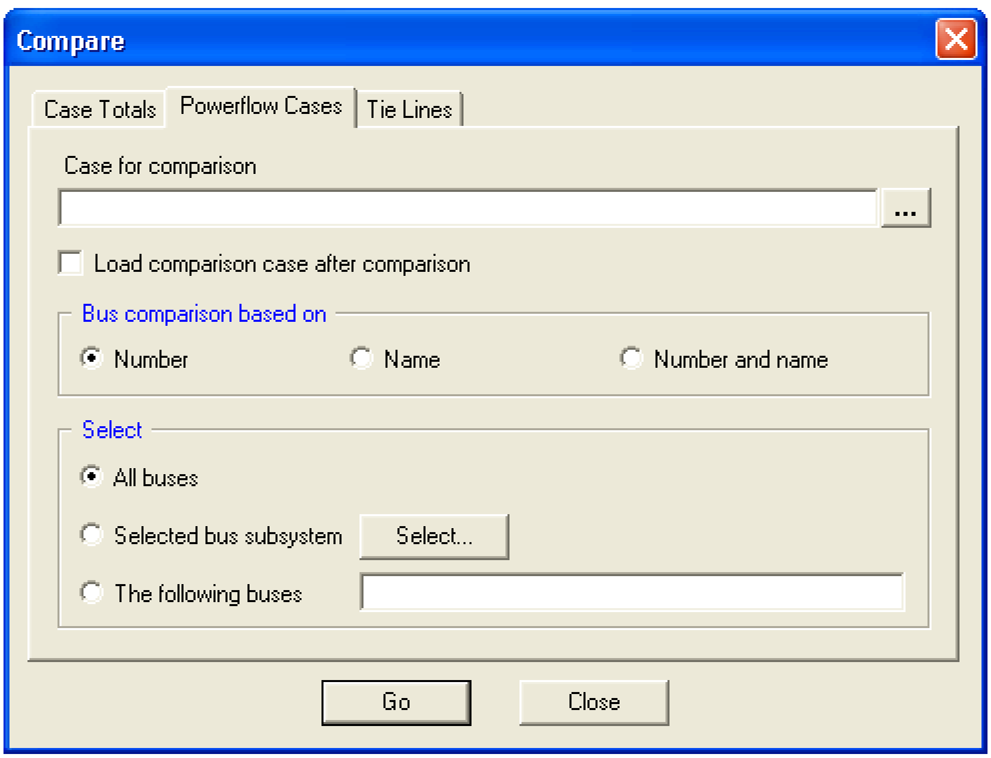


Figure 9.3. Compare Power Flow Cases Dialog

Click *[Go]* to open the *[Select Powerflow Comparison Options]* dialog (Figure 9.4, "Select Powerflow Comparison Options Dialog").

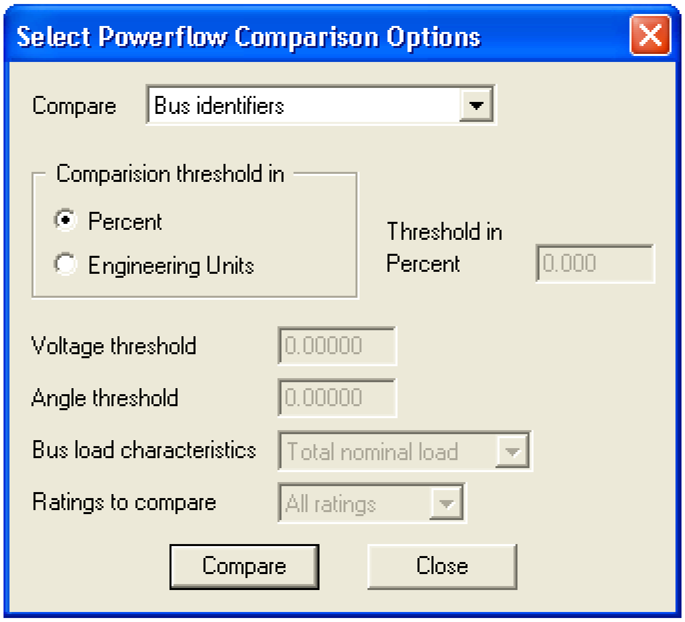


Figure 9.4. Select Powerflow Comparison Options Dialog

The dialog activates comparison threshold values, load characteristics, or ratings appropriate to the specification of one of the following quantities:

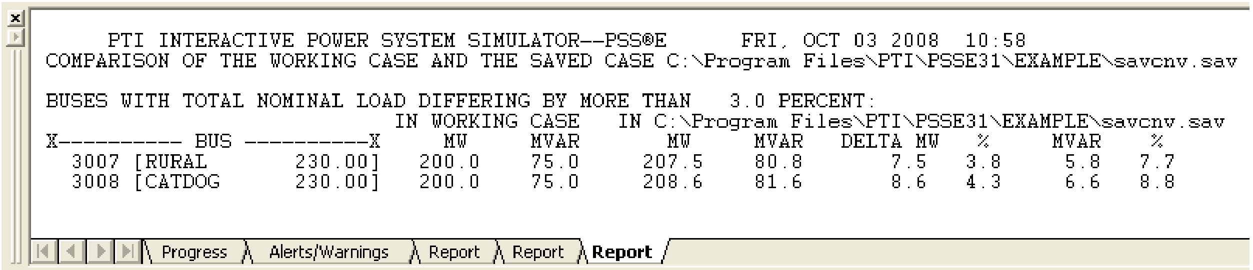
• Bus identifiers	• Negative sequence bus shunts	• Zero sequence mutuals
• Bus type codes	• Zero sequence bus shunts	• Multi-section lines
• Machine status	• Branch status	• Multi-section line metered end
• Generator MW	• Line R, X, B	• Bus load status
• Generator MW or MVAR	• Line shunts	• Line lengths
• Bus loads	• Line ratings	• Generator MVAR
• Bus shunts	• Metered end	• Flows MW (from bus)
• Switched shunts	• Transformers	• Flows MVAR (from bus)
• Voltage	• Flows MW or MVAR (from bus)	• Flows MW (from & to)
• Voltage and angle	• Flows MW or MVAR (from & to)	• Flows MVAR (from & to)
• MBASE & ZSORCE	• Line MW or MVAR losses	• Line MW losses
• MBASE & ZPOS	• Zero sequence R, X, B	• Line MVAR losses
• MBASE & ZNEG	• Zero sequence line shunts	• Fixed shunt status
• MBASE & ZZERO	• Connection codes	• Switched shunt status

Bus load characteristics that may be compared include one of the following quantities:

• Total nominal load	• Constant current
• Constant MVA	• Constant admittance

Click *[Compare]* to perform the activity. The comparison is routed to the *Report* tab by default (Figure 9.5, "Example of Compare Cases Report").

You will need to click *[Close]* to end this activity.



```
     PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS®E      FRI, OCT 03 2008  10:58
COMPARISON OF THE WORKING CASE AND THE SAVED CASE C:\Program Files\PTI\PSSE31\EXAMPLE\savcnv.sav

BUSES WITH TOTAL NOMINAL LOAD DIFFERING BY MORE THAN   3.0 PERCENT:
                            IN WORKING CASE   IN C:\Program Files\PTI\PSSE31\EXAMPLE\savcnv.sav
X---------- BUS ----------X     MW      MVAR       MW      MVAR   DELTA MW    %      MVAR    %
  3007 [RURAL        230.00]   200.0    75.0     207.5    80.8       7.5    3.8     5.8   7.7
  3008 [CATDOG       230.00]   200.0    75.0     208.6    81.6       8.6    4.3     6.6   8.8
```


Figure 9.5. Example of Compare Cases Report

Additional Information
PSS® E Program Operation Manual, Comparing Power Flow Cases

9.3. Comparing AC Tie Branches

DFTI

Requirements / Prerequisites
Validly specified power flow case. If line flows or line losses are to be compared, both cases should be solved to an acceptable mismatch level. Saved Case file (*.sav) - - - Reading Sequence Data for Fault Analysis

File > Compare...

The *[Compare Tie Lines]* dialog (Figure 9.6, "Compare Tie Lines Dialog") creates a report comparing a specified tie line quantity in the working case with a specified saved case. Click *[...]* to open the selection window for the required *Saved Case file* (*.sav).

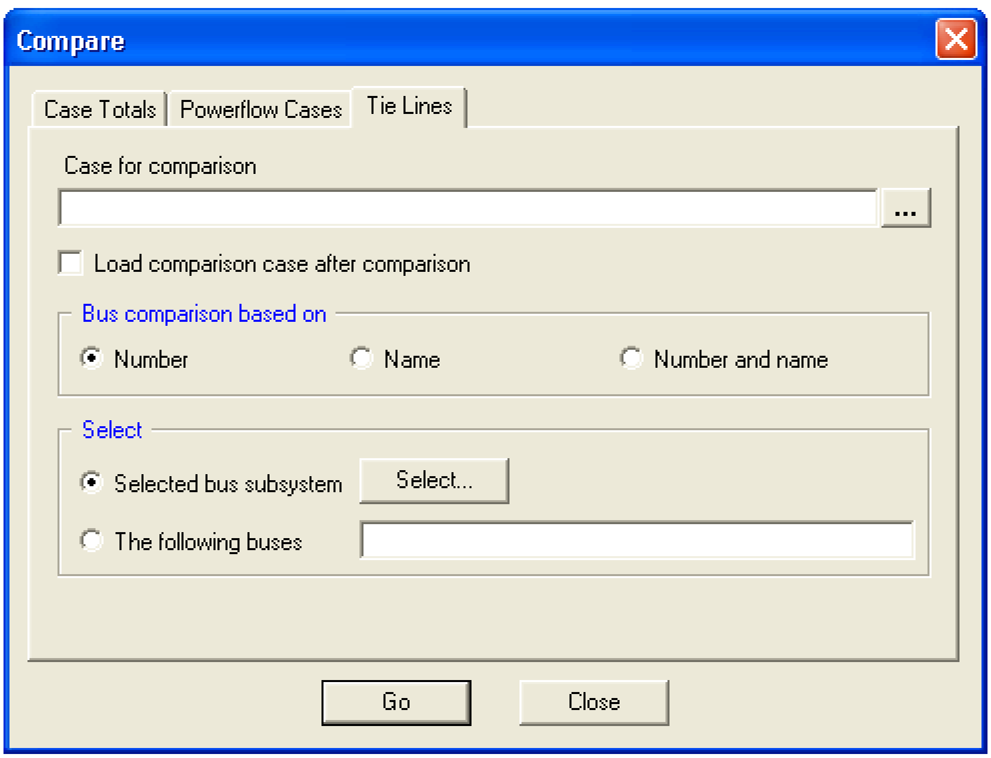


Figure 9.6. Compare Tie Lines Dialog

Click *[Go]* to open the *[Select Tie Line Comparison Options]* dialog (Figure 9.7, "Select Tie Line Comparison Options Dialog").

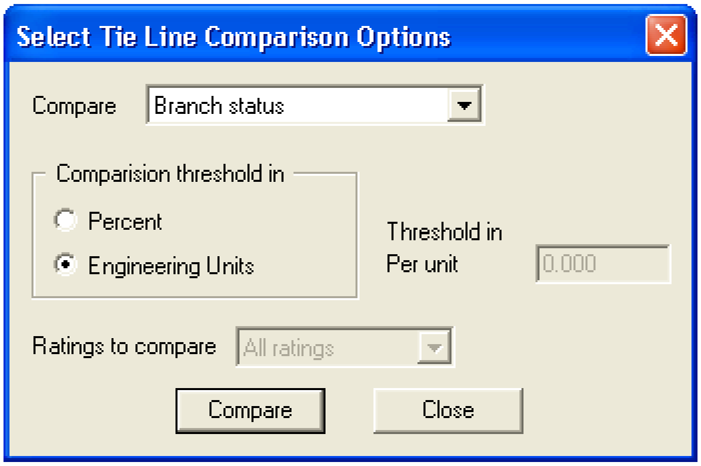


Figure 9.7. Select Tie Line Comparison Options Dialog

The dialog activates comparison threshold values or ratings appropriate to the specification of one of the following quantities:

• Branch status	• Zero sequence R, X, B
• Line R, X, B	• Zero sequence line shunts
• Line shunts	• Connection codes
• Line ratings	• Flow MW (from bus)
• Metered end	• Flow MVAR (from bus)
• Line length	• Flow MW (from & to)
• Transformers	• Flow MVAR (from & to)
• Flows MW or MVAR (from bus)	• Line MW losses
• Flows MW or MVAR (from & to)	• Line MVAR losses
• Line MW or MVAR losses	

Click *[Compare]* to perform the activity. The comparison is routed to the *Report* tab by default

You will need to click *[Close]* to end this activity.

Additional Information
PSS® E Program Operation Manual, Comparing AC Tie Branches

Chapter 10
Creating Power Flow Data Files

10.1. Creating a Saved Case File

SAVE

Requirements / Prerequisites
The working case must contain a validly specified power flow case.

File > Save...

The case saving activity SAVE stores the working case into a user-specified Saved Case file in a compressed format.

Activity SAVE is accessible from the *Case Data* tab of the *[Save Network Data]* dialog (Figure 10.1, “Save Network Data Dialog, Case Data”). The Saved Case File may be specified either via a file selector dialog by clicking *[...]* next to the input field, or by entering its name directly in the input field.

Click *[OK]* to save the working case in the designated file.

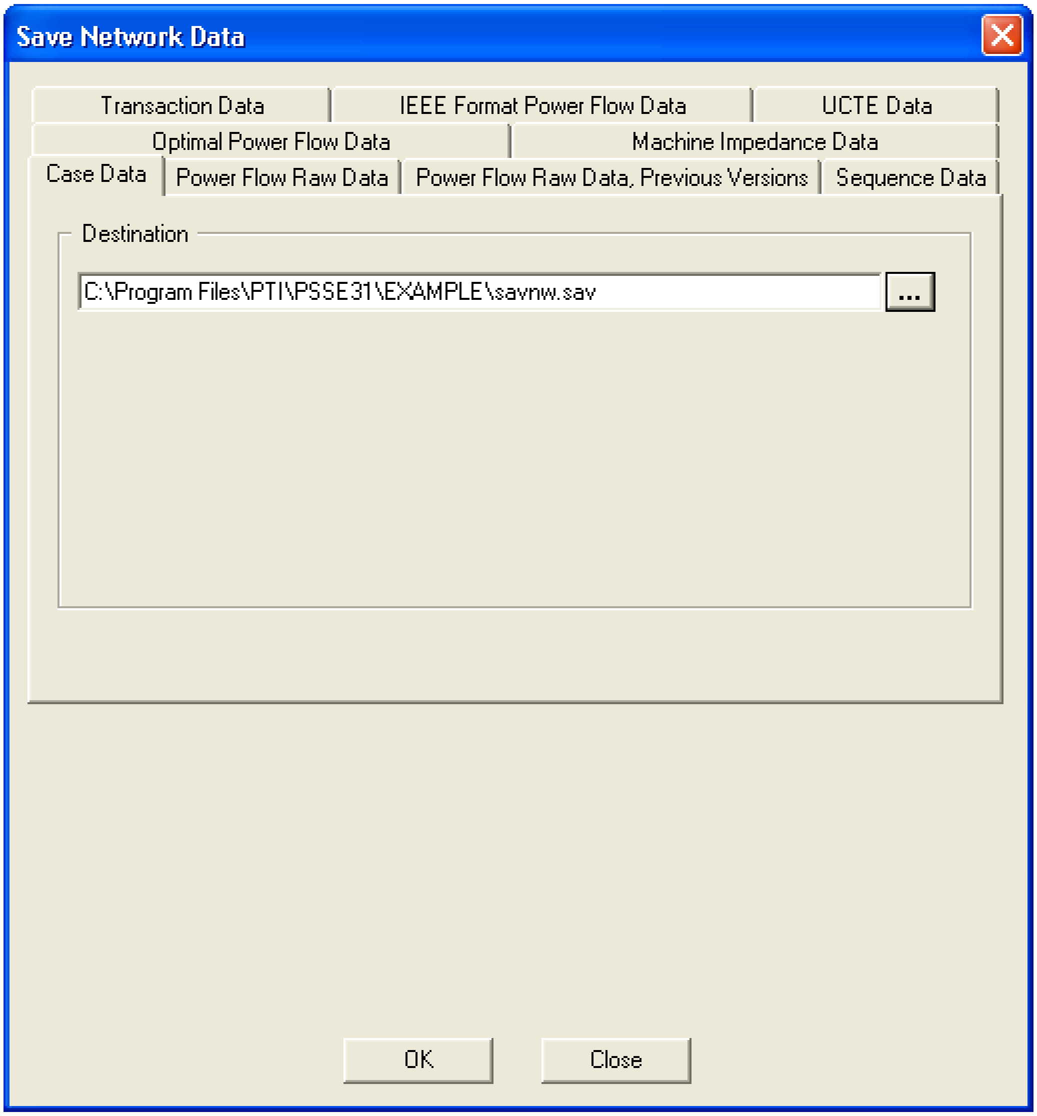


Figure 10.1. Save Network Data Dialog, Case Data

Additional Information
PSS® E Program Operation Manual, Creating a Saved Case File *PSS® E Application Program Interface (API)*, SAVE

10.2. Saving the Working Case in an IEEE Common Format File

RWCM

Requirements / Prerequisites
The working case must contain a validly specified power flow case solved to an acceptable mismatch level.

File > Save...

The IEEE Common Format output activity RWCM writes the working case as a file in IEEE common tape format data records.

Activity RWCM is accessible from the *IEEE Format Power Flow Data* tab of the *[Save Network Data]* dialog (Figure 10.2, "Save Network Data Dialog, IEEE Common Format").

To write the data records to a file, select the *Data file* radio button in the *Destination* area of the dialog. The name of the file may be specified either via a file selector dialog by clicking *[...]* next to the input field, or by entering its name directly in the input field.

To write the data records to the *Report* device, select the *Report window* radio button in the *Destination* area of the dialog.

To ignore dc lines and FACTS devices in the data records, uncheck the *Add power to loads* checkbox; to represent their power injections as load, check the *Add power to loads* checkbox.

Click *[OK]* to save the working case in the designated file in the IEEE format.

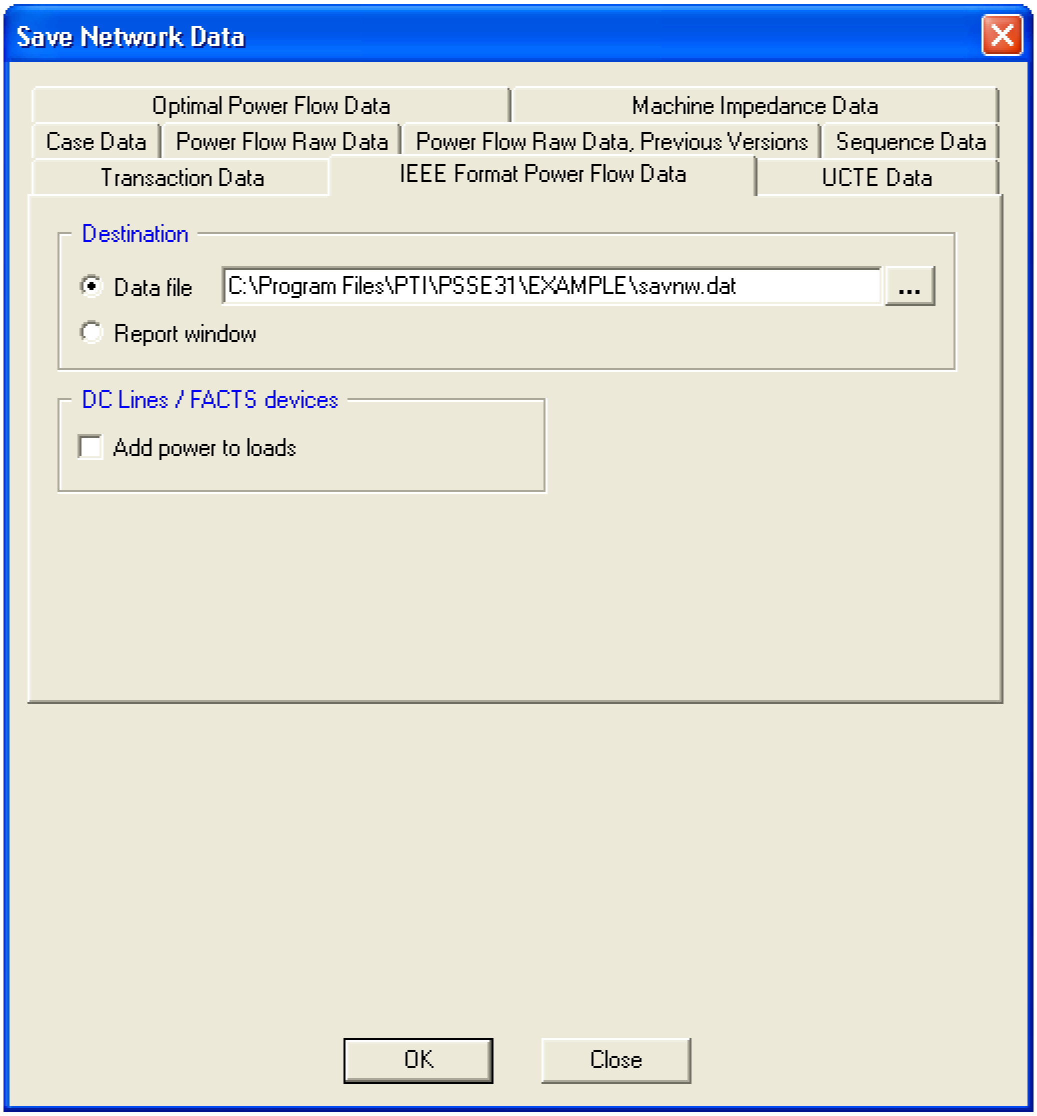


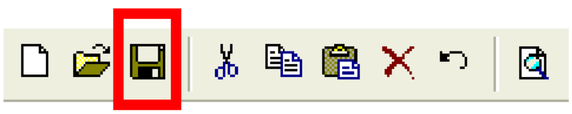
Figure 10.2. Save Network Data Dialog, IEEE Common Format

Additional Information
PSS® E Program Operation Manual, Saving the Working Case in an IEEE Common Format File *PSS® E Application Program Interface (API)*,RWCM

10.3. Saving Machine Impedance Data

RWMA

Requirements / Prerequisites
The working case must contain a validly specified power flow case. If generator reactive powers are to be used in calculating the reactive power split fractions, the case must be solved to an acceptable mismatch level. Machine impedance data (MBASE, ZSORCE, XTRAN, and GENTAP) must be correctly specified for those machines to be processed.



File > Save...

The machine impedance data output activity RWMA writes out machine parametric data from the working case in the form of a Machine Impedance Data File.

Activity RWMA is accessible from the *Machine Impedance Data* tab of the *[Save Network Data]* dialog (Figure 10.3, “Save Network Data Dialog, Machine Impedance Data”).

To write the data records to a file, select the *Data file* radio button in the *Destination* area of the dialog. The name of the file may be specified either via a file selector dialog by clicking *[...]* next to the input field, or by entering its name directly in the input field.

To write the data records to the *Report* device, select the *Report window* radio button in the *Destination* area of the dialog.

To exclude data data records for out-of-service machines, uncheck the *Include records for out-of-service machines* checkbox; to include them, check the *Include records for out-of-service machines* checkbox.

Designate the quantities to be used in calculating the active and reactive power split fractions by selecting the appropriate entries from the two drop-down lists in the *Machine Impedance* area of the dialog.

The *[Save Network Data]* dialog enables the user to designate for processing either the entire working case or a specified bus subsystem (refer to Subsystem Selection of the *PSS®E Program Operation Manual)*. A bus subsystem may be specified either via a *[Bus Subsystem Selector]* dialog by clicking *[Select...]*, or by entering buses directly in the *[Save Network Data]* dialog.

Click *[OK]* to save the machine parametric data in Machine Impedance Data File format.

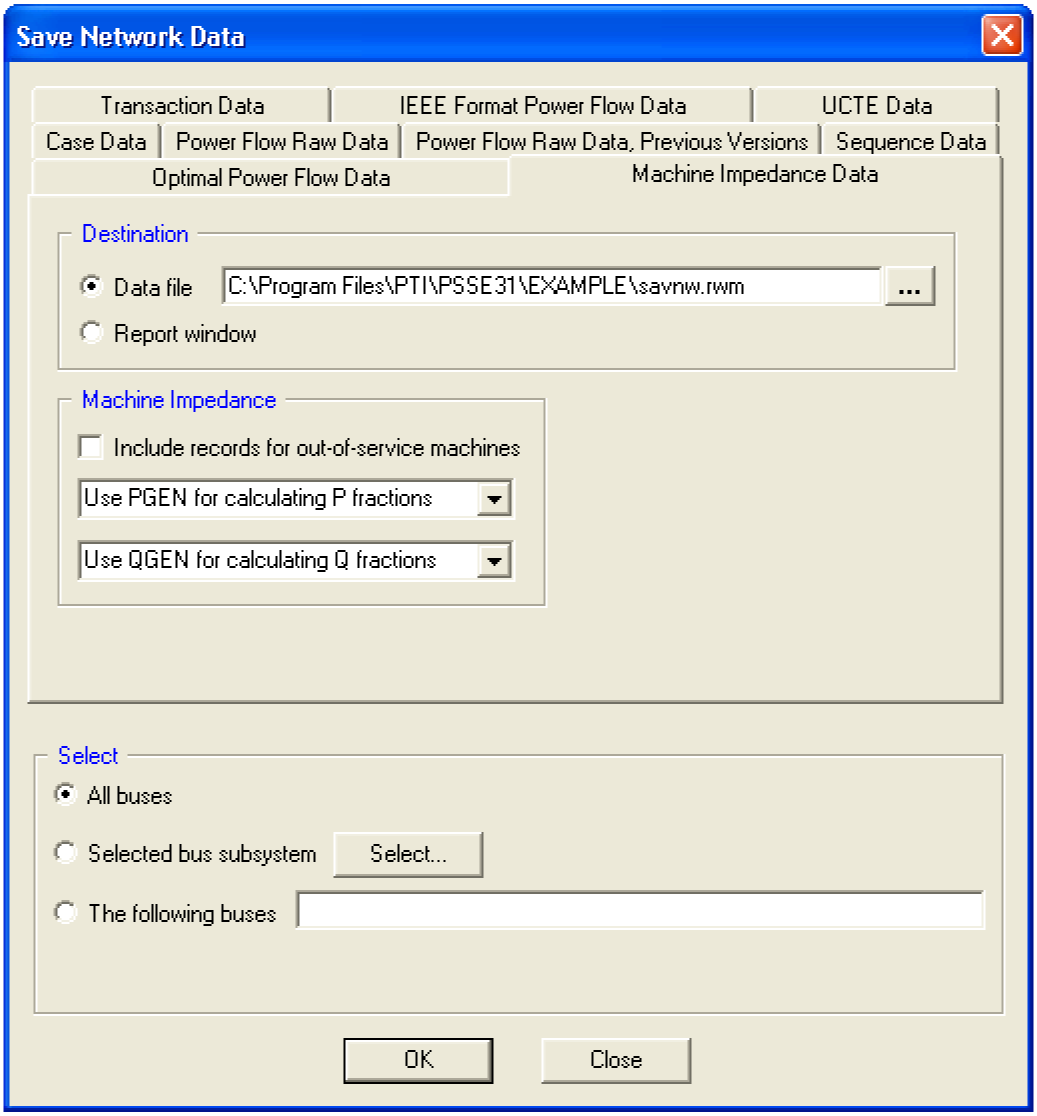


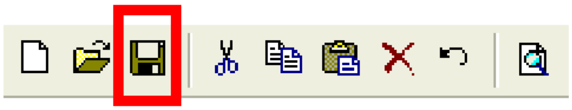
Figure 10.3. Save Network Data Dialog, Machine Impedance Data

Additional Information
PSS® E Program Operation Manual, Saving Machine Impedance Data *PSS® E Application Program Interface (API)*, RWMA

10.4. Creating a Power Flow Raw Data File

RAWD

Requirements / Prerequisites
The working case must contain a validly specified power flow case.



File > Save...

The Raw Data File output activity RAWD writes the working case in the form of a Power Flow Raw Data File. That is, when directed to a file, the data records written by activity RAWD are in a format suitable for input to activity READ.

Activity RAWD is accessible from the *Power Flow Raw Data* tab of the *[Save Network Data]* dialog (Figure 10.4, "Save Network Data Dialog, Power Flow Raw Data").

To write the data records to a file, select the *Data file* radio button in the *Destination* area of the dialog. The name of the file may be specified either via a file selector dialog by clicking *[...]* next to the input field, or by entering its name directly in the input field.

To write the data records to the *Report* device, select the *Report window* radio button in the *Destination* area of the dialog.

The user must designate the intended use of the Power Flow Raw Data File by selecting one of the following entries from the *Configure RAW file to* drop-down list:

- *Initialize working case*: suitable for use by activity READ with IC on the first data record set to 0 (default).
- *Add to working case*: suitable for use by activity READ with IC on the first data record set to 1.
- *Use with RDCH*: suitable for use by activity RDCH (i.e., the three case identification data records are omitted).

The *[Save Network Data]* dialog enables the user to designate for processing either the entire working case or a specified bus subsystem (refer to Subsystem Selection of the *PSS®E Program Operation Manual)*. A bus subsystem may be specified either via a *[Bus Subsystem Selector]* dialog by clicking *[Select...]*, or by entering buses directly in the *[Save Network Data]* dialog. If the *All area ties* radio button is selected, RAWD writes data records only for branches between areas.

Options to be used in writing Power Flow Raw Data records are specified via checkboxes and a drop-down list in the *Include* area of the dialog. The checkboxes provide options to include network components: isolated buses, out of service branches, subsystem data, subsystem tie lines, and/or bus names. The drop-down list selects of one of the following load options:

- Include all loads at subsystem buses
- Include subsystem loads at all buses

- Include all loads at subsystem buses and subsystem loads at non-subsystem buses

Click *[OK]* to save the power flow data in Power Flow Raw Data File format.

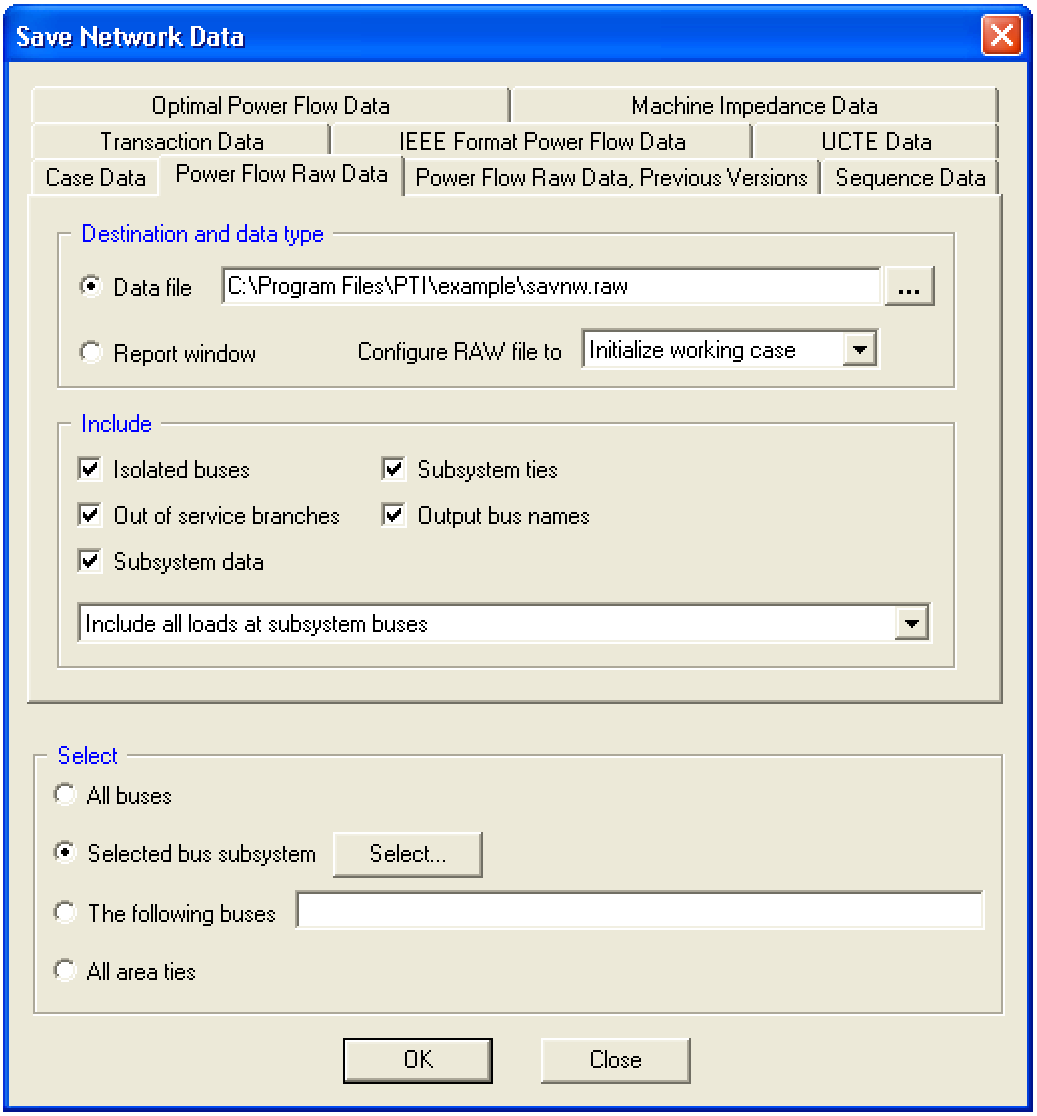


Figure 10.4. Save Network Data Dialog, Power Flow Raw Data

Additional Information
PSS®E Program Operation Manual: Creating a Power Flow Raw Data File Power Flow Raw Data File Contents *PSS®E Application Program Interface (API),* RAWD_2

10.5. Creating a Sequence Data File

RWSQ

Requirements / Prerequisites
The working case must contain a validly specified power flow case with sequence data appended to it.

File > Save...

The Sequence Data File output activity RWSQ writes the sequence data contained in the working case in the form of a Sequence Data File. That is, when directed to a file, the data records written by activity RWSQ are in a format suitable for input to activity RESQ.

Activity RWSQ is accessible from the *Sequence Data* tab of the *[Save Network Data]* dialog (Figure 10.5, "Save Network Data Dialog, Sequence Data").

To write the data records to a file, select the *Data file* radio button in the *Destination* area of the dialog. The name of the file may be specified either via a file selector dialog by clicking *[...]* next to the input field, or by entering its name directly in the input field.

To write the data records to the *Report* device, select the *Report window* radio button in the *Destination* area of the dialog.

The *[Save Network Data]* dialog enables the user to designate for processing either the entire working case or a specified bus subsystem (refer to Subsystem Selection of the *PSS®E Program Operation Manual)*. A bus subsystem may be specified either via a *[Bus Subsystem Selector]* dialog by clicking *[Select...]*, or by entering buses directly in the *[Save Network Data]* dialog. If the *All area ties* radio button is selected, RWSQ writes data records only for branches between areas.

The various options to be used in writing the Sequence Data records are specified via checkboxes in the *Include* area of the dialog.

Click *[OK]* to save the fault analysis data in Sequence Data File format.

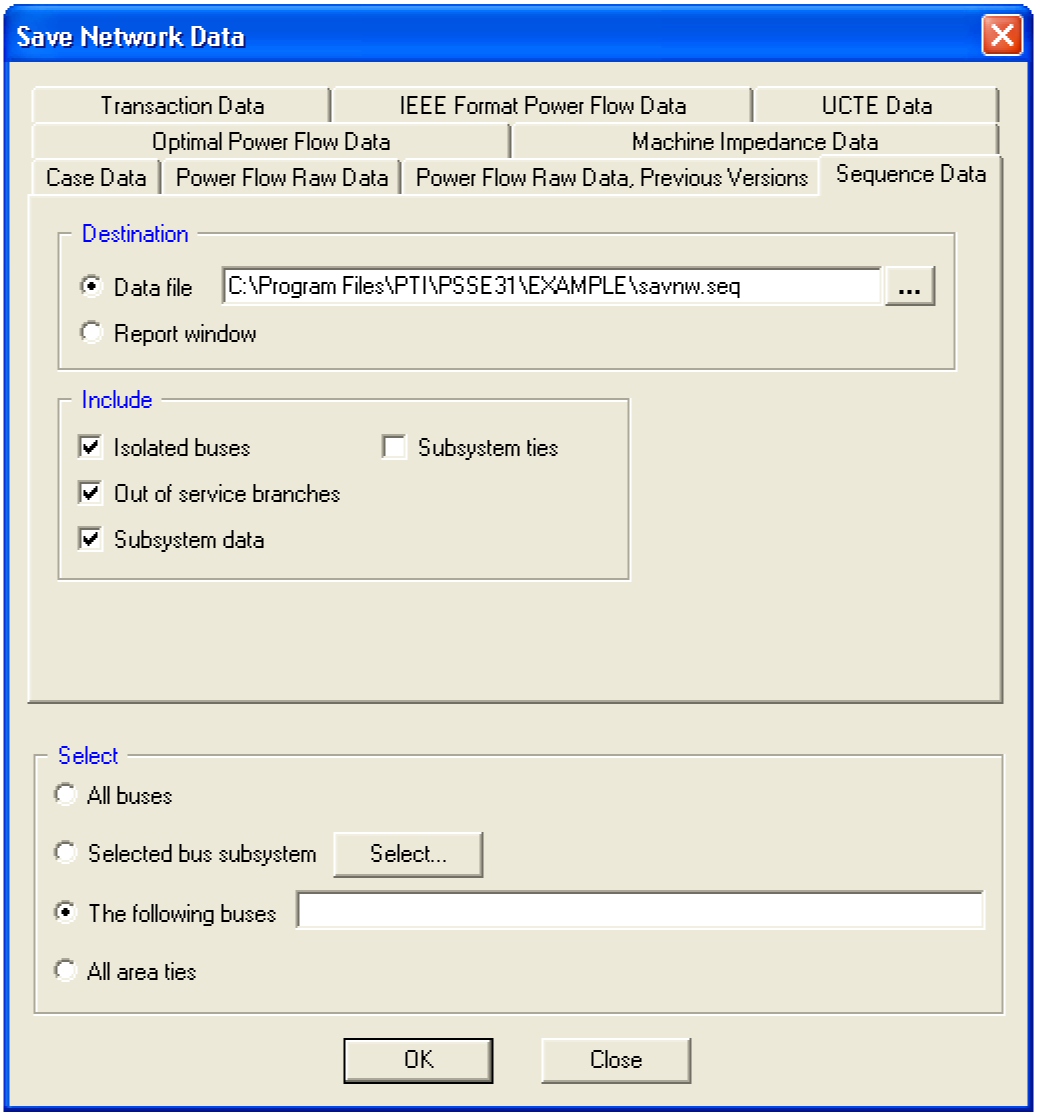


Figure 10.5. Save Network Data Dialog, Sequence Data

Additional Information
PSS®E Program Operation Manual, Creating a Sequence Data File Sequence Data File Contents *PSS®E Application Program Interface (API)*, RWSQ

10.6. Creating a Transactions Raw Data File

RWMM

Requirements / Prerequisites
The working case must contain a validly specified power flow case.

File > Save...

The Transactions Raw Data File output activity RWMM writes the transactions data contained in working memory in the form of a Transactions Raw Data File. That is, when directed to a file, the data records written by activity RWMM are in a format suitable for input to activity REMM.

Activity RWMM is accessible from the *Transaction Data* tab of the *[Save Network Data]* dialog (Figure 10.6, "Save Network Data Dialog, Transaction Data").

To write the data records to a file, select the *Data file* radio button in the *Destination* area of the dialog. The name of the file may be specified either via a file selector dialog by clicking *[...]* next to the input field, or by entering its name directly in the input field.

To write the data records to the *Report* device, select the *Report window* radio button in the *Destination* area of the dialog.

Click *[OK]* to save the transactions data in Transaction Raw Data File format.

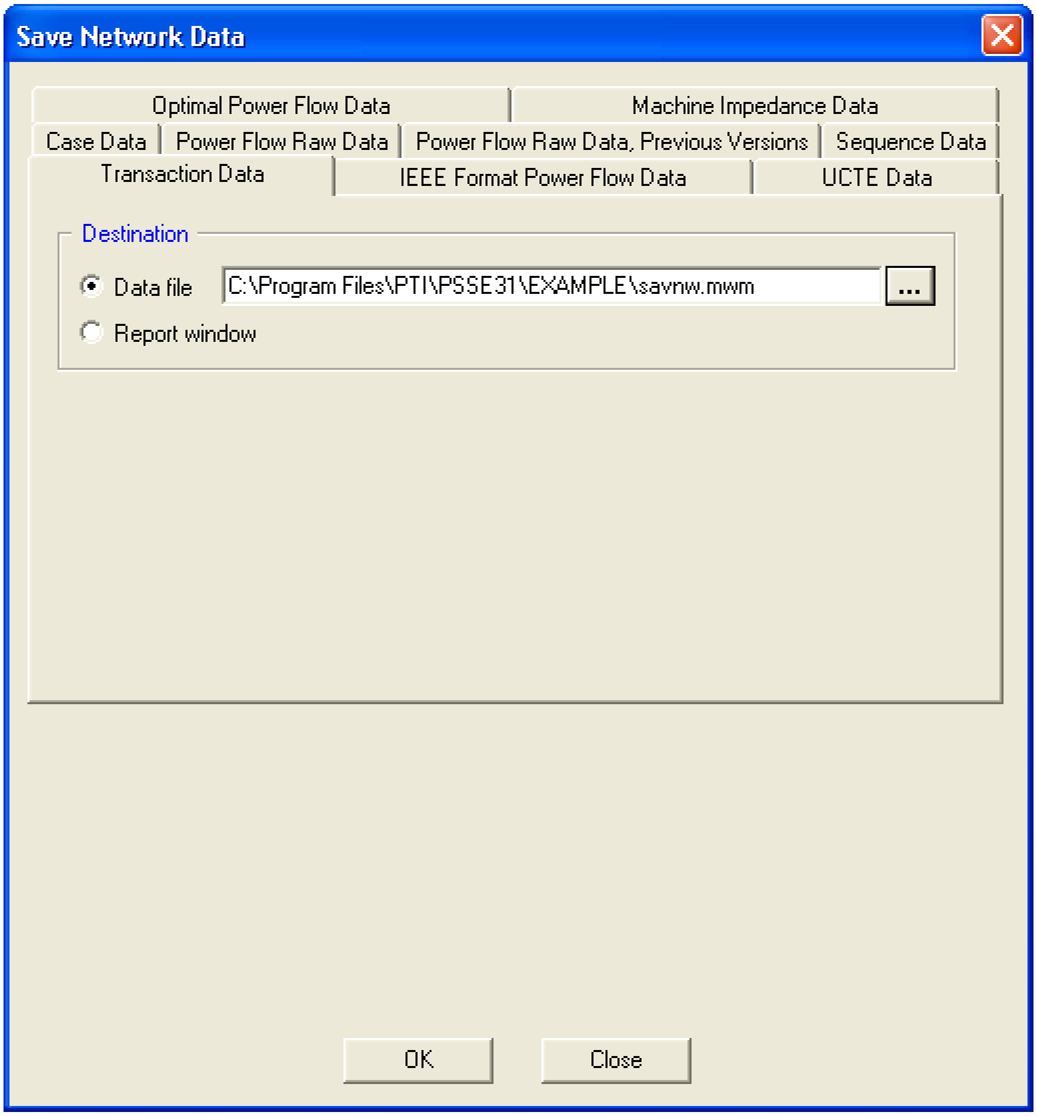


Figure 10.6. Save Network Data Dialog, Transaction Data

Additional Information
PSS® E Program Operation Manual, Creating a Transactions Raw Data File Transactions Raw Data File Contents *PSS® E Application Program Interface (API)*, RWMM

Chapter 11
Power Flow Solutions

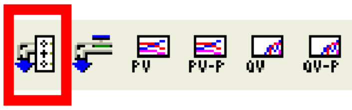
The Power Flow menu provides access to most of the PSS ®E steady-state analyses. Included are the power flow solutions for both ac and dc network analysis, data access and listing, network, dispatch, load and topology manipulations. Methods are available for checking network conditions and exporting results. Analysis methods provided in the power flow menu include the following:

- Decoupled Newton-Raphson Power Flow Solution (Section 11.2.1, "Decoupled Newton-Raphson Power Flow Solution")
- Fully-Coupled Newton-Raphson Power Flow Solution (Section 11.2.2, "Fully-Coupled Newton-Raphson Power Flow Solution")
- Fixed Slope Decoupled Newton-Raphson Power Flow Solution (Section 11.2.3, "Fixed Slope Decoupled Newton-Raphson Power Flow Solution")
- Newton-Raphson Power Flow Solution with Inertial Governot Dispatch (Section 11.2.4, "Newton-Raphson Power Flow Solution with Inertial / Governor Dispatch ")
- Gauss-Seidel Power Flow Solution (Section 11.2.5, "Gauss-Seidel Power Flow Solution ")
- AC Contingency Analysis (Section 11.3, "Running AC Contingency Analysis")
- Multi-Level Contingency Analysis (Section 11.5, "Running Multi-Level Contingency Analysis")
- Generation Dispatch (Section 11.6, "Generation Dispatch")
- PV Analysis (Section 11.7, "PV Analysis")
- QV Analysis (Section 11.8, "QV Analysis")
- Probabilistic Reliability Assessment (Section 11.9, "Running Probabilistic Reliability Assessment ")
- Substation Reliability Assessment (Section 11.10, "Running Substation Reliability Assessment")

Short-circuit analysis (Chapter 15), the Optimal Power Flow (Chapter 19), transmission access analysis (Chapter 18), and dynamic simulation and disturbances (Chapter 21) methods are available on separate menus.

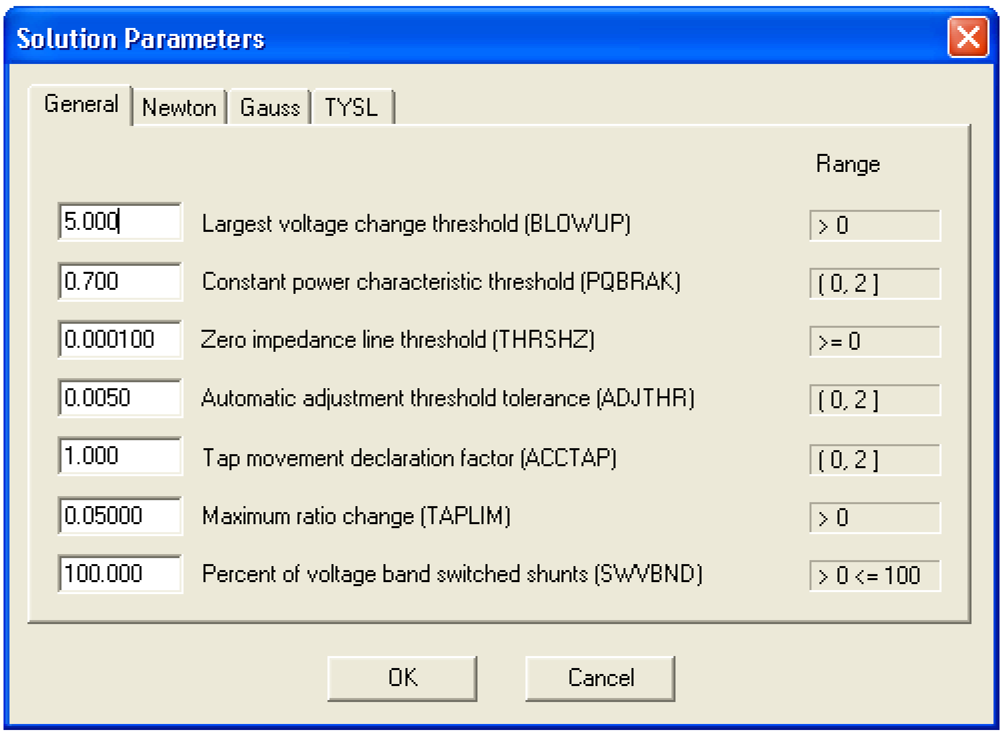
11.1. Specifying Solution Parameters

11.1.1. Boundary Conditions



Power Flow > Solution > Parameters...

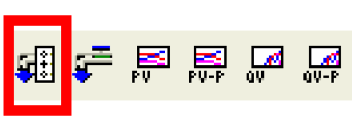
The constant power characteristic holds the load power constant as long as the bus voltage exceeds the value specified by the modifiable parameter PQBRAK. The *[Solution Parameters]* dialog *General* tab provides access to this parameter. Notification of the change is routed to the *Progress* tab.



Power Flow Solution Parameters Dialog

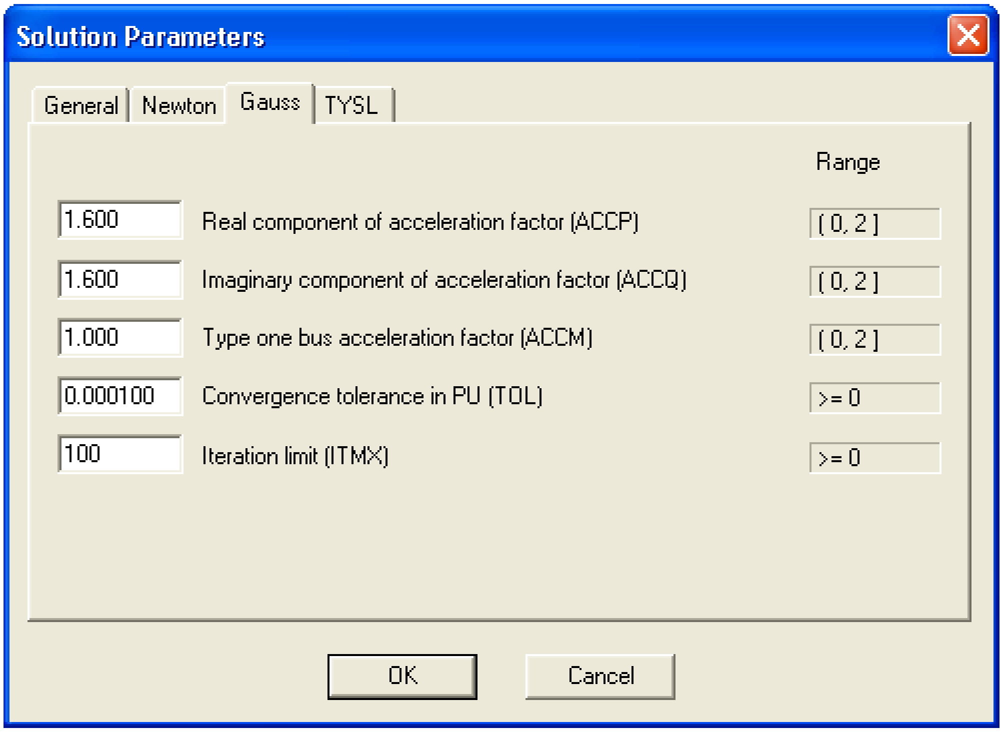
Additional Information
PSS®E Program Operation Manual, Characteristics of Activity SOLV

11.1.2. Gauss-Seidel Controls



Power Flow > Solution > Parameters...

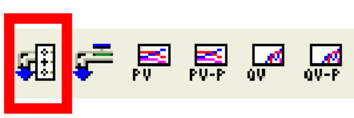
On the *Gauss* tab of *[Solution Parameters]*, changes can be made to the acceleration factors, ACCP/ACCQ, and the TOL and ITMX parameters. The BLOWUP parameter is available on the *General* tab.



Power Flow Solution Parameters Dialog, Gauss

Additional Information
PSS®E Program Operation Manual, Load Data

11.1.3. Newton-Raphson Solution Controls



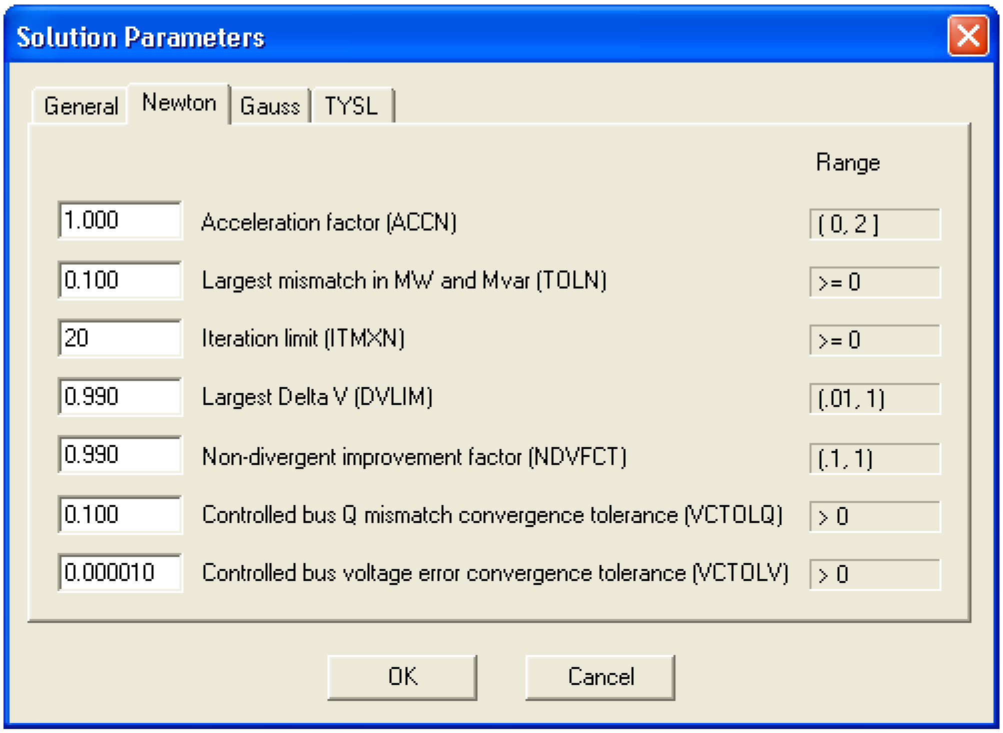
Power Flow > Solution > Parameters...

On the *Newton* tab of *[Solution Parameters]*, changes can be made to the the following:

- ACCN - the acceleration factor
- TOL - the largest mismatch in MW and Mvar
- ITMXN - the maximum number of iterations
- DVLIM - the largest change in bus voltage

- NDVFCT - the non-divergent improvement factor
- VCTOLQ - the controlled bus Q mismatch convergence tolerance
- VCTOLV - the controlled bus voltage error convergence tolerance

The BLOWUP parameter is available on the *General* tab.



Power Flow Solution Parameters Dialog, Newton

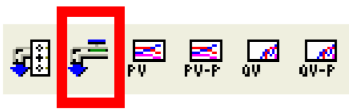
Additional Information
PSS®E Program Operation Manual, Characteristics of Activity FNSL

11.2. Running Power Flow Solutions

11.2.1. Decoupled Newton-Raphson Power Flow Solution

NSOL

Requirements / Prerequisites
Validly specified power flow case with voltages that are a reasonable estimate of a solution.



Power Flow > Solution > Solve (NSOL/FNSL/FDNS/SOLV/MSLV)...

The three Newton-Raphson iterative algorithms solve for the bus voltages needed to satisfy the bus boundary conditions contained in the working case. The *[Loadflow Solutions]* dialog (Figure 11.1, “Loadflow Solutions Dialog, Newton-Raphson, Decoupled”) provides options for all three Newton-Raphson solution methods.

The toolbar button opens *[Loadflow Solutions]* or automatically executes the previously used solution method without opening the dialog. To re-open the dialog for each analysis, enable the option *Show this window when using the Solve toolbar button*.

Newton-Raphson controls are modified using *[Solution Parameters]*. See Section 11.1.3, “Newton-Raphson Solution Controls ”.

Automatic adjustments that allow maneuvering the system to meet specified voltage, branch flow, and area net interchange schedules are enabled or disabled using *[Program Settings]*. See Changing Program Settings. The user must specify *Solution options* for *Tap adjustment*, *Switched shunt adjustments* and *Area interchange control*; these options override automatic adjustments.

Checkboxes to enable/disable *Solution options* for *Flat start*, *Adjust phase shift*, and *Adjust DC taps* are also available. *VAR limits* may also be specified to control the number of iterations during which generator reactive power limits will first be applied.

Click *[Solve]* to process the working case. Solution output is routed to the *Progress* tab (Figure 11.2, “Example of Newton-Raphson Decoupled Solution Output”).

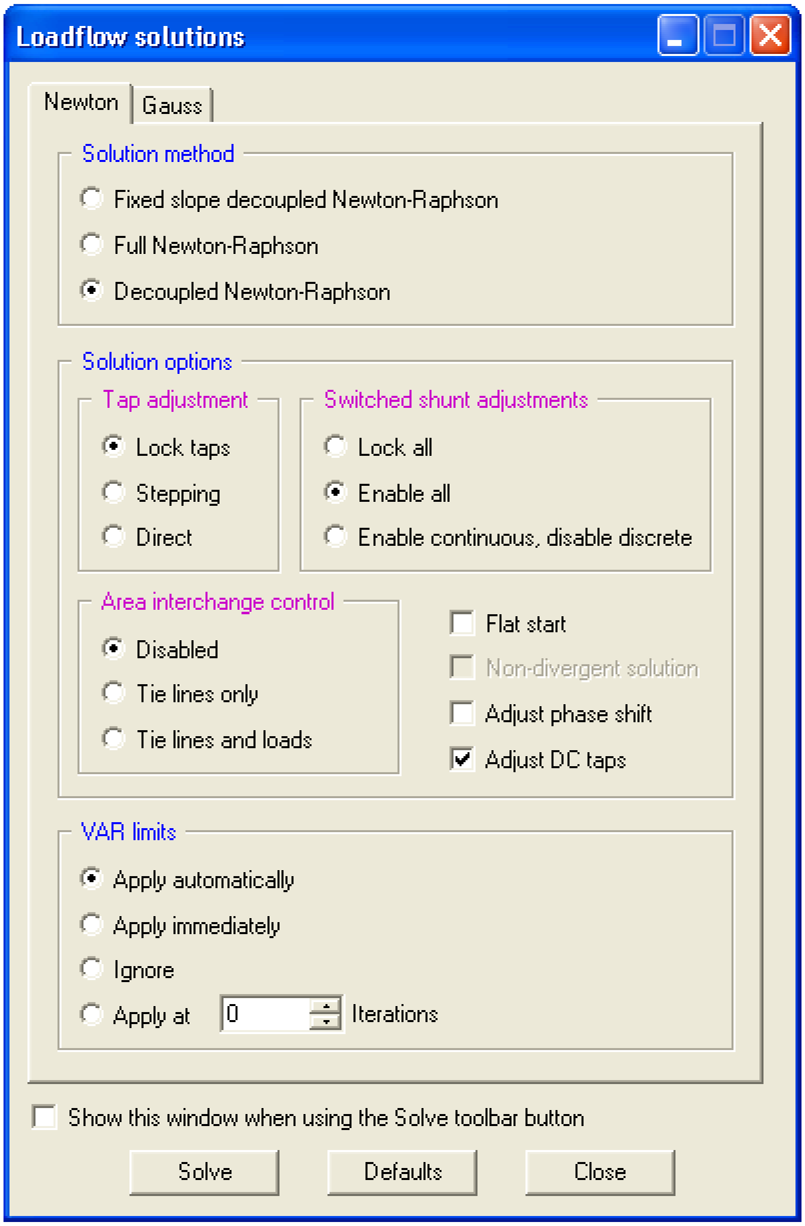
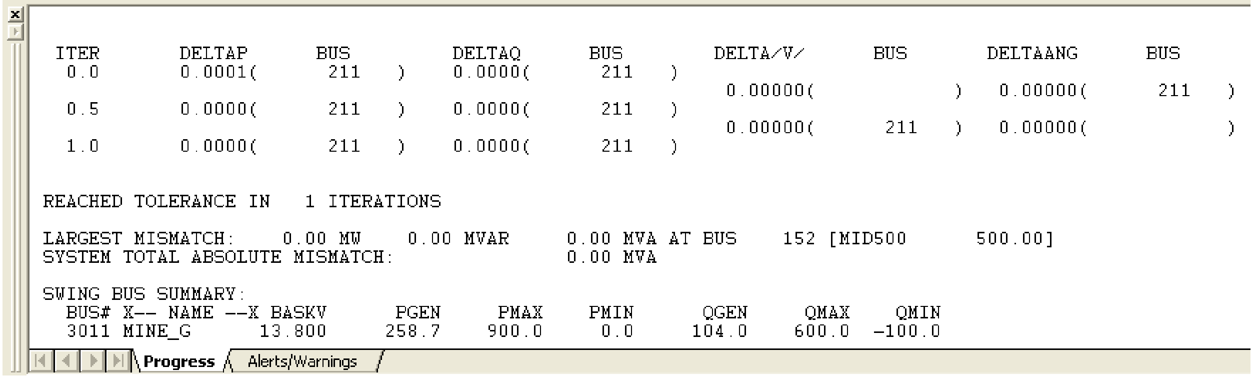


Figure 11.1. Loadflow Solutions Dialog, Newton-Raphson, Decoupled



```
ITER       DELTAP     BUS          DELTAQ     BUS          DELTA/V/      BUS        DELTAANG      BUS
 0.0       0.0001(     211    )    0.0000(     211    )
                                                             0.00000(             )  0.00000(      211   )
 0.5       0.0000(     211    )    0.0000(     211    )
                                                             0.00000(      211    )  0.00000(            )
 1.0       0.0000(     211    )    0.0000(     211    )

REACHED TOLERANCE IN   1 ITERATIONS

LARGEST MISMATCH:     0.00 MW     0.00 MVAR     0.00 MVA AT BUS    152 [MID500       500.00]
SYSTEM TOTAL ABSOLUTE MISMATCH:                 0.00 MVA

SWING BUS SUMMARY:
  BUS# X-- NAME --X BASKV      PGEN      PMAX      PMIN      QGEN      QMAX     QMIN
  3011 MINE_G       13.800    258.7     900.0      0.0     104.0     600.0   -100.0
```

Progress / Alerts/Warnings

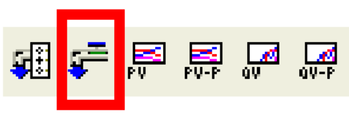
Figure 11.2. Example of Newton-Raphson Decoupled Solution Output

Additional Information
PSS® E Program Operation Manual, Applying Decoupled Newton-Raphson Power Flow Solution

11.2.2. Fully-Coupled Newton-Raphson Power Flow Solution

FNSL

Requirements / Prerequisites
Validly specified power flow case with voltages that are a reasonable estimate of a solution.



Power Flow > Solution > Solve (NSOL/FNSL/FDNS/SOLV/MSLV)...

The three Newton-Raphson iterative algorithms solve for the bus voltages needed to satisfy the bus boundary conditions contained in the working case. The *[Loadflow Solutions]* dialog (Figure 11.3, "Loadflow Solutions Dialog, Newton-Raphson, Fully-Coupled") provides options for all three Newton-Raphson solution methods.

The toolbar button opens *[Loadflow Solutions]* or automatically executes the previously used solution method without opening the dialog. To re-open the dialog for each analysis, enable the option *Show this window when using the Solve toolbar button*.

Newton-Raphson controls are modified using *[Solution Parameters]*. See Section 11.1.3, "Newton-Raphson Solution Controls ".

Automatic adjustments that allow maneuvering the system to meet specified voltage, branch flow, and area net interchange schedules are enabled or disabled using *[Program Settings]*. See Changing Program Settings. The user must specify *Solution options* for *Tap adjustment*, *Switched shunt adjustments* and *Area interchange control*; these options override automatic adjustments.

Activity FNSL requires the prior execution of activity ORDR. If the need for a new bus ordering is detected, activity ORDR is automatically executed before beginning the voltage change calculation.

Checkboxes to enable/disable *Solution options* for *Flat start*, *Non-divergent solution*, *Adjust phase shift*, and *Adjust DC taps* are also available. *VAR limits* may also be specified to control the number of iterations during which generator reactive power limits will first be applied.

Click *[Solve]* to process the working case. Solution output is routed to the *Progress* tab (Figure 11.4, "Example of Newton-Raphson Fully-Coupled Solution Output").

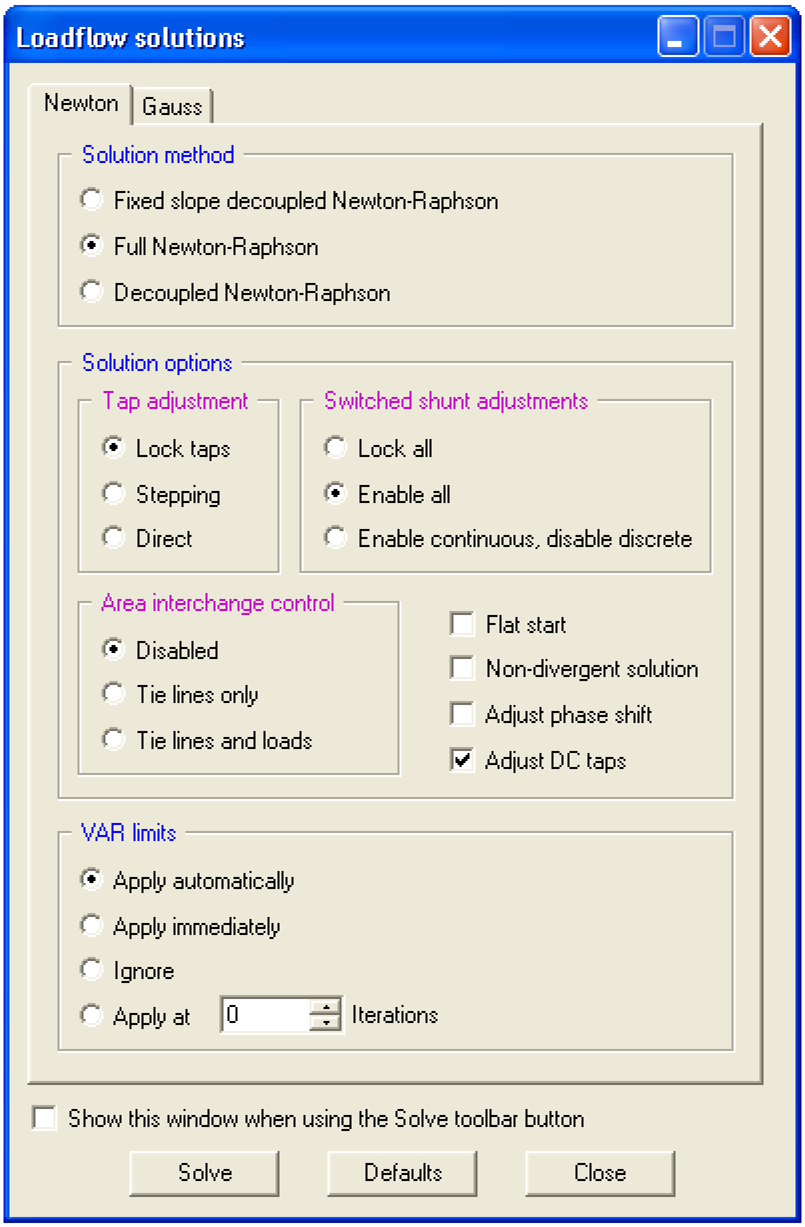
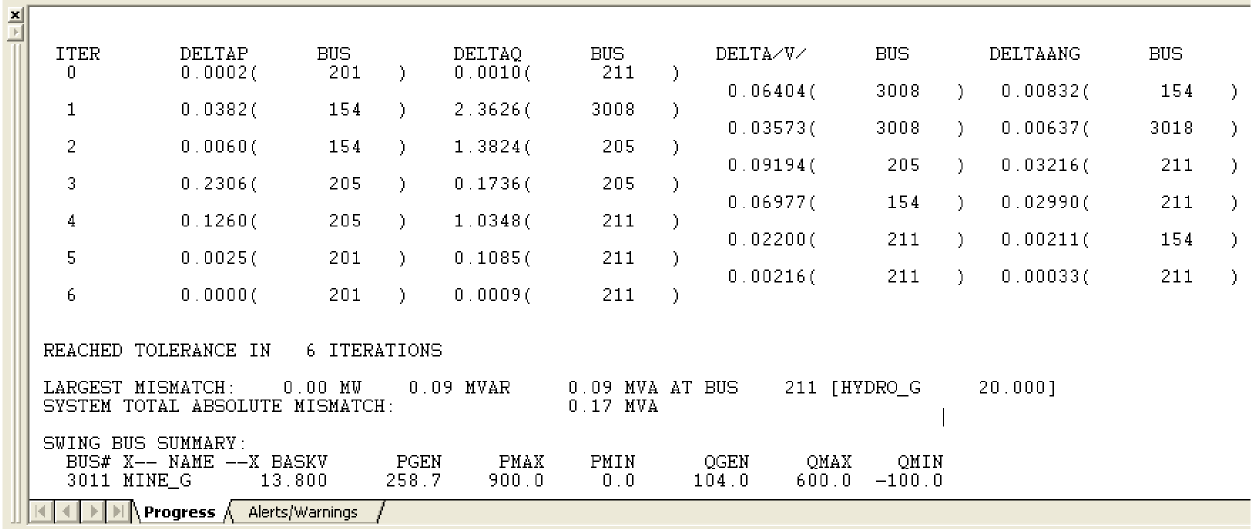


Figure 11.3. Loadflow Solutions Dialog, Newton-Raphson, Fully-Coupled



```
 ITER        DELTAP      BUS          DELTAQ      BUS        DELTA/V/       BUS        DELTAANG       BUS
  0          0.0002(     201    )     0.0010(     211   )
                                                              0.06404(     3008   )    0.00832(       154   )
  1          0.0382(     154    )     2.3626(    3008   )
                                                              0.03573(     3008   )    0.00637(      3018   )
  2          0.0060(     154    )     1.3824(     205   )
                                                              0.09194(      205   )    0.03216(       211   )
  3          0.2306(     205    )     0.1736(     205   )
                                                              0.06977(      154   )    0.02990(       211   )
  4          0.1260(     205    )     1.0348(     211   )
                                                              0.02200(      211   )    0.00211(       154   )
  5          0.0025(     201    )     0.1085(     211   )
                                                              0.00216(      211   )    0.00033(       211   )
  6          0.0000(     201    )     0.0009(     211   )

REACHED TOLERANCE IN   6 ITERATIONS

LARGEST MISMATCH:     0.00 MW     0.09 MVAR      0.09 MVA AT BUS     211 [HYDRO_G      20.000]
SYSTEM TOTAL ABSOLUTE MISMATCH:                  0.17 MVA

SWING BUS SUMMARY:
  BUS# X-- NAME --X BASKV      PGEN     PMAX     PMIN      QGEN     QMAX    QMIN
  3011 MINE_G       13.800     258.7    900.0     0.0      104.0    600.0  -100.0
```

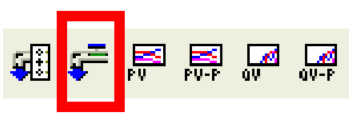

Figure 11.4. Example of Newton-Raphson Fully-Coupled Solution Output

Additional Information
PSS®E Program Operation Manual, Applying Fully-Coupled Newton-Raphson Power Flow Solution

11.2.3. Fixed Slope Decoupled Newton-Raphson Power Flow Solution

FDNS

Requirements / Prerequisites
Validly specified power flow case with voltages that are a reasonable estimate of a solution.



Power Flow > Solution > Solve (NSOL/FNSL/FDNS/SOLV/MSLV)...

The three Newton-Raphson iterative algorithms solve for the bus voltages needed to satisfy the bus boundary conditions contained in the working case. The *[Loadflow Solutions]* dialog (Figure 11.5, "Loadflow Solutions Dialog, Newton-Raphson, Fixed Slope Decoupled") provides options for all three Newton-Raphson solution methods.

The toolbar button opens *[Loadflow Solutions]* or automatically executes the previously used solution method without opening the dialog. To re-open the dialog for each analysis, enable the option *Show this window when using the Solve toolbar button*.

Newton-Raphson controls are modified using *[Solution Parameters]*. See Section 11.1.3, “Newton-Raphson Solution Controls ”.

Automatic adjustments that allow maneuvering the system to meet specified voltage, branch flow, and area net interchange schedules are enabled or disabled using *[Program Settings]*. See Changing Program Settings. The user must specify *Solution options* for *Tap adjustment*, *Switched shunt adjustments* and *Area interchange control*; these options override automatic adjustments.

Checkboxes to enable/disable *Solution options* for *Flat start*, *Non-divergent solution, Adjust phase shift*, and *Adjust DC taps* are also available. *VAR limits* may also be specified to control the number of iterations during which generator reactive power limits will first be applied.

Click *[Solve]* to process the working case. Solution output is routed to the *Progress* tab (Figure 11.6, “Example of Newton-Raphson Fixed Slope Decoupled Solution Output”).

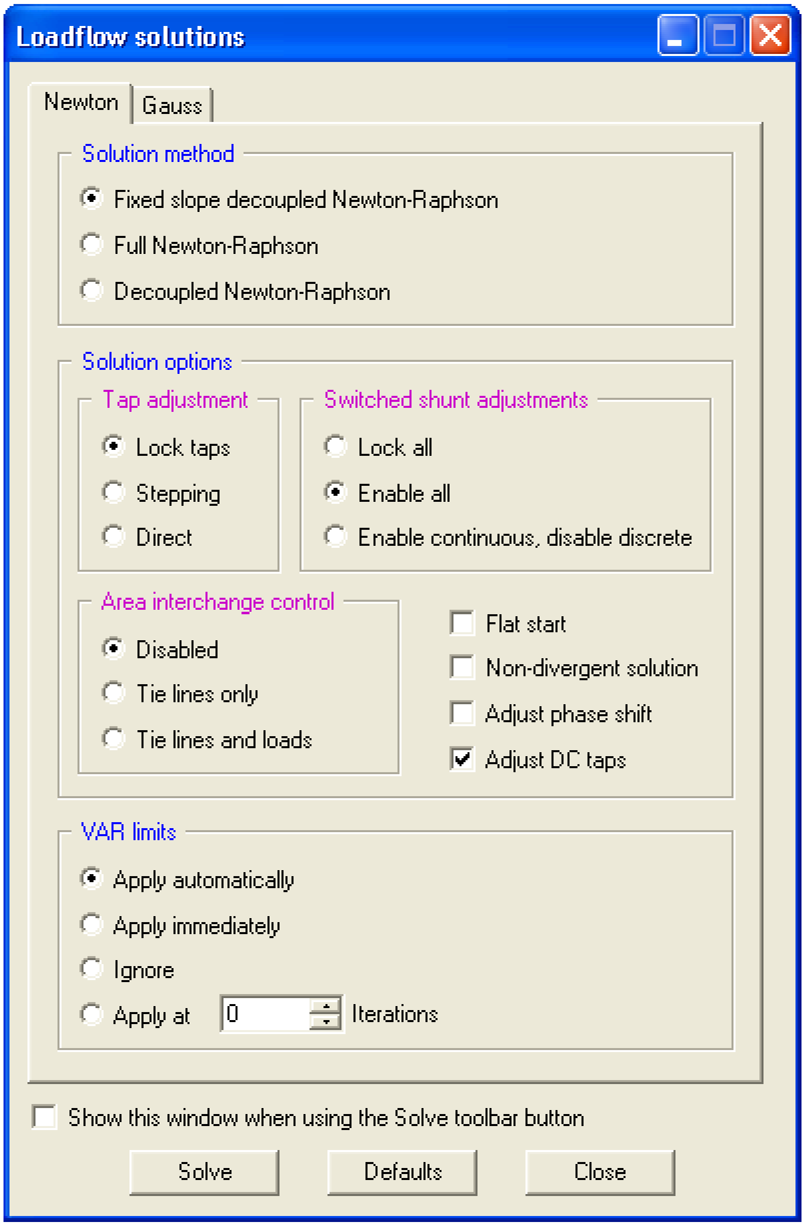
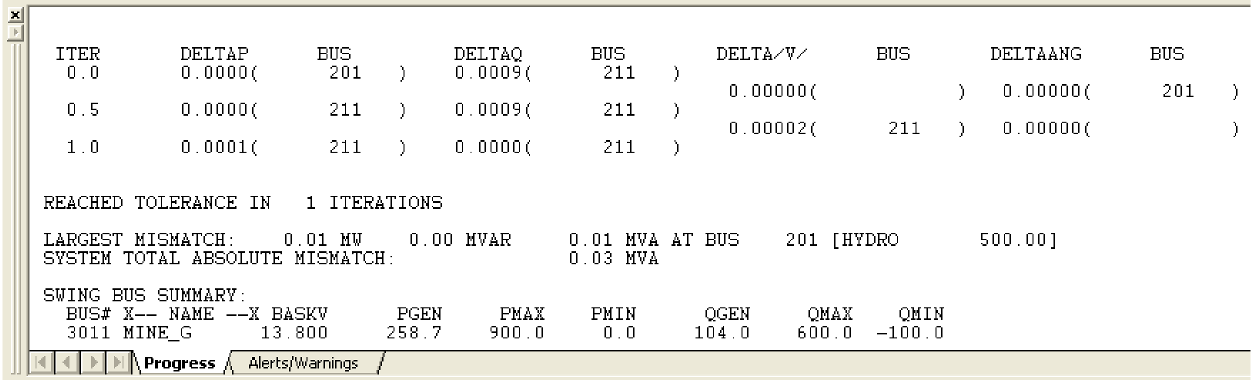


Figure 11.5. Loadflow Solutions Dialog, Newton-Raphson, Fixed Slope Decoupled



```
 ITER       DELTAP      BUS         DELTAQ      BUS        DELTA/V/       BUS       DELTAANG      BUS
  0.0       0.0000(     201    )    0.0009(     211    )
                                                             0.00000(              )   0.00000(       201    )
  0.5       0.0000(     211    )    0.0009(     211    )
                                                             0.00002(       211    )   0.00000(              )
  1.0       0.0001(     211    )    0.0000(     211    )

REACHED TOLERANCE IN    1 ITERATIONS

LARGEST MISMATCH:      0.01 MW     0.00 MVAR      0.01 MVA AT BUS     201 [HYDRO        500.00]
SYSTEM TOTAL ABSOLUTE MISMATCH:                   0.03 MVA

SWING BUS SUMMARY:
  BUS# X-- NAME --X BASKV       PGEN      PMAX     PMIN      QGEN      QMAX    QMIN
  3011 MINE_G       13.800     258.7     900.0      0.0     104.0     600.0  -100.0
```


Figure 11.6. Example of Newton-Raphson Fixed Slope Decoupled Solution Output

Additional Information
PSS® E Program Operation Manual, Applying Fixed Slope Decoupled Newton-Raphson Power Flow Solution

11.2.4. Newton-Raphson Power Flow Solution with Inertial / Governor Dispatch

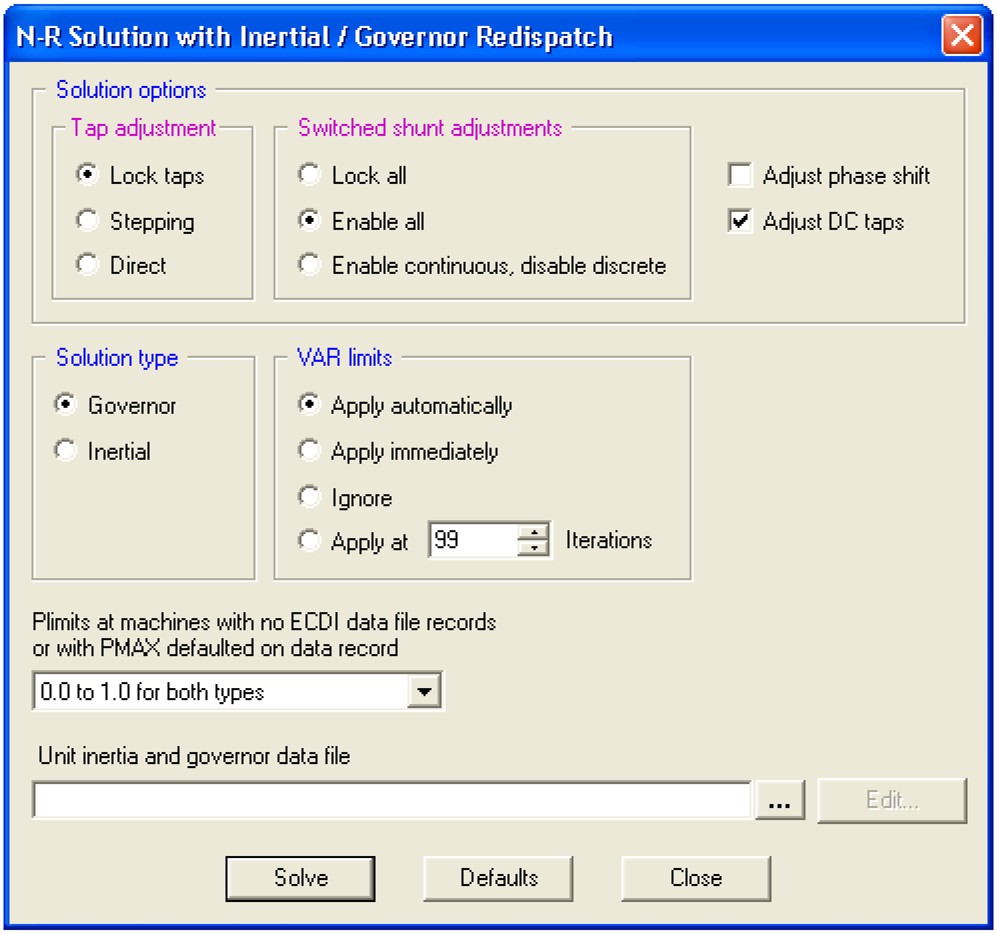
INLF

Requirements / Prerequisites
Validly specified power flow case, solved in the pre-event condition. No prior power flow solution activities in working case. Unit Inertia and Governor Data File (*.inl) containing machine data for all in-service machines.

Power Flow > Solution > N-R solution with inertial / governor dispatch (INLF)...

The *[N-R Solution with Inertial / Governor Redispatch]* dialog requires specification of *Solution options*, *Switched shunt adjustments*, *VAR limits*, and the *Solution type* (*Governor* or *Inertial*). The *Governor* solution requires specification of Plimits from among the following options:

- Pre PSS®E Rev-29 approach
- 0.0 to 1.0 for both types
- Working case values for both types



N-R Solution with Inertial / Governor Redispatch Dialog

Click *[...]* to open the selection window to save data in a *Unit Inertia and Governor Data file* (*.inl), which can be a new file or a previously-built file to be over-written.

Area interchange control and the non-divergent solution option are always disabled in this solution.

Click *[Solve]* to process the working case. Solution output is routed to the *Progress* tab (Figure 11.6, "Example of Newton-Raphson Fixed Slope Decoupled Solution Output").

This activity modifies the data in the working case. If you wish to protect the original data, you must save the redispatch data with a different filename.

```
WARNING: INLF MODIFIES DATA IN WORKING CASE

 1 ISLANDS FOUND

ORDERING NETWORK
DIAGONALS =      22  OFF-DIAGONALS =     40  MAX SIZE =     58

 ITER        DELTAP      BUS          DELTAQ      BUS         DELTA/V/       BUS       DELTAANG       BUS
  0          0.0003(     151    )     0.0026(     206    )
                                                               0.06404(      3008   )   0.00832(      154   )
  1          0.0382(     154    )     2.3628(     3018   )
                                                               0.16353(      3018   )   0.01292(      3018  )
  2          0.0255(     3008   )     0.2429(     3018   )
                                                               0.01095(      3018   )   0.00077(      3018  )

 LARGEST ISLAND POWER REDISPATCH =    2.23 MW

  3          0.0046(     206    )     0.0793(     3018   )
                                                               0.00350(      3018   )   0.00096(      3018  )
  4          0.0000(     3008   )     0.0262(     3018   )
                                                               0.00114(      3018   )   0.00008(      3018  )
  5          0.0000(     3008   )     0.0087(     3018   )
                                                               0.00038(      3018   )   0.00003(      3018  )
  6          0.0000(     3008   )     0.0029(     3018   )
                                                               0.00013(      3018   )   0.00001(      3018  )
  7          0.0000(     3008   )     0.0010(     3018   )

REACHED TOLERANCE IN   7 ITERATIONS

LARGEST MISMATCH:    0.00 MW    0.10 MVAR    0.10 MVA AT BUS   3008 [CATDOG      230.00]
SYSTEM TOTAL ABSOLUTE MISMATCH:              0.19 MVA

SWING BUS SUMMARY:
  BUS# X-- NAME --X BASKV      PGEN     PMAX     PMIN      QGEN     QMAX    QMIN
  3011 MINE_G       13.800     258.2    900.0     0.0      10.2     600.0  -100.0

FREQUENCY FOR ISLAND  1 IS 60.001 HERTZ
  SWING BUS FOR THIS ISLAND IS   3011 [MINE_G      13.800]
```

Progress | Alerts/Warnings

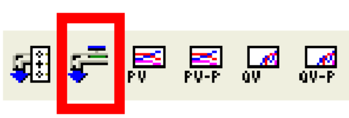
Example of Newton-Raphson Solution with Governor Redispatch

Additional Information
PSS® E Program Operation Manual, Applying Newton-Raphson Power Flow Solution with Inertial / Governor Dispatch Inertia and Governor Response Data File Contents

11.2.5. Gauss-Seidel Power Flow Solution

SOLV

Requirements / Prerequisites
Validly specified power flow case with voltages that are a reasonable estimate of a solution. No series capacitors.



Power Flow > Solution > Solve (NSOL/FNSL/FDNS/SOLV/MSLV)...

The Gauss-Seidel iterative algorithms solve for the bus voltages needed to satisfy the bus boundary conditions contained in the working case. The *[Loadflow Solutions]* dialog (Figure 11.7, "Loadflow Solutions Dialog, Gauss-Seidel") provides options for either the Gauss-Seidel or Modified Gauss-Seidel solutions.

The toolbar button opens *[Loadflow Solutions]* or automatically executes the previously used solution method without opening the dialog. To re-open the dialog for each analysis, enable the option *Show this window when using the Solve toolbar button*.

Gauss-Seidel controls are modified using *[Solution Parameters]*. See Section 11.1.2, "Gauss-Seidel Controls ".

Automatic adjustments that allow maneuvering the system to meet specified voltage, branch flow, and area net interchange schedules are enabled or disabled using *[Program Settings]*. See Changing Program Settings. The user must specify *Solution options* for *Switched shunt adjustments* and *Area interchange control*; these options override automatic adjustments.

Checkboxes to enable/disable *Solution options* for *Flat start*, *Ignore Var limits*, *Adjust DC taps*, and *Adjust taps* are also available.

Click *[Solve]* to process the working case. Solution output is routed to the *Progress* tab (Figure 11.8, "Example of Gauss-Seidel Solution Output").

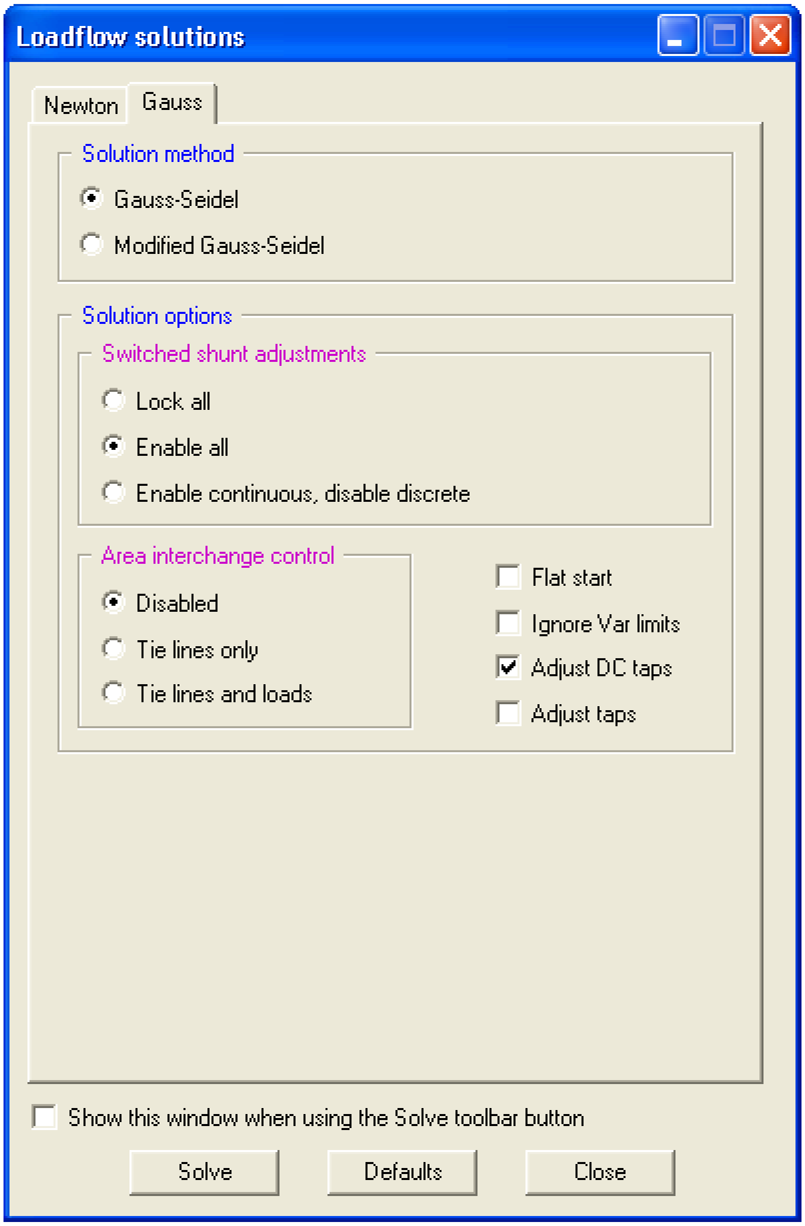
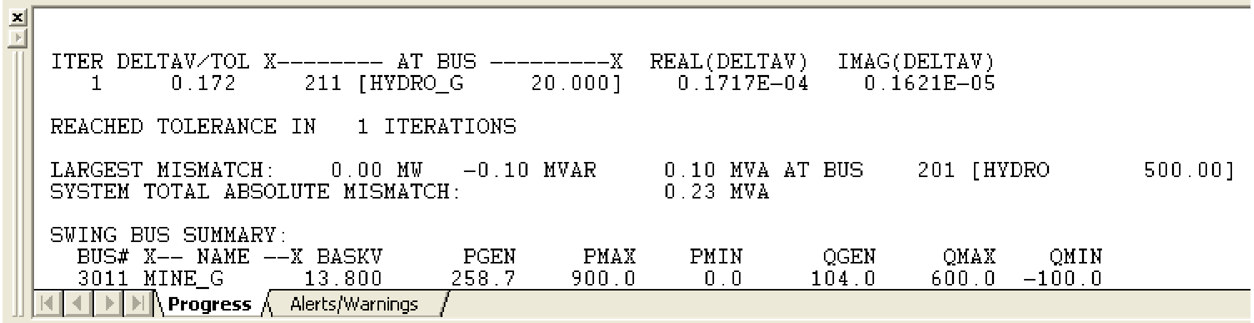


Figure 11.7. Loadflow Solutions Dialog, Gauss-Seidel



```
ITER DELTAV/TOL X-------- AT BUS ---------X  REAL(DELTAV)  IMAG(DELTAV)
   1     0.172      211 [HYDRO_G      20.000]  0.1717E-04    0.1621E-05

REACHED TOLERANCE IN   1 ITERATIONS

LARGEST MISMATCH:     0.00 MW   -0.10 MVAR     0.10 MVA AT BUS    201 [HYDRO       500.00]
SYSTEM TOTAL ABSOLUTE MISMATCH:                0.23 MVA

SWING BUS SUMMARY:
  BUS# X-- NAME --X BASKV     PGEN      PMAX     PMIN      QGEN      QMAX     QMIN
  3011 MINE_G       13.800   258.7     900.0     0.0     104.0     600.0   -100.0
```

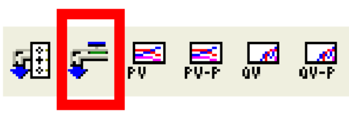

Figure 11.8. Example of Gauss-Seidel Solution Output

Additional Information
PSS® E Program Operation Manual, Applying Gauss-Seidel Power Flow Solution

11.2.6. Modified Gauss-Seidel Power Flow Solution

MSLV

Requirements / Prerequisites
Validly specified power flow case with voltages that are a reasonable estimate of a solution.



Power Flow > Solution > Solve (NSOL/FNSL/FDNS/SOLV/MSLV)...

The Gauss-Seidel iterative algorithms solve for the bus voltages needed to satisfy the bus boundary conditions contained in the working case. The *[Loadflow Solutions]* dialog (Figure 11.9, "Loadflow Solutions Dialog, Modified Gauss-Seidel") provides options for either the Gauss-Seidel or Modified Gauss-Seidel solutions.

The toolbar button opens *[Loadflow Solutions]* or automatically executes the previously used solution method without opening the dialog. To re-open the dialog for each analysis, enable the option *Show this window when using the Solve toolbar button*.

Gauss-Seidel controls are modified using *[Solution Parameters]*. See Section 11.1.2, "Gauss-Seidel Controls ".

Automatic adjustments that allow maneuvering the system to meet specified voltage, branch flow, and area net interchange schedules are enabled or disabled using *[Program Settings]*. See Changing Program Settings. The user must specify *Solution options* for *Switched shunt adjustments* and *Area interchange control*; these options override automatic adjustments.

Checkboxes to enable/disable *Solution options* for *Flat start*, *Ignore Var limits*, *Adjust DC taps*, and *Adjust taps* are also available.

Click *[Solve]* to process the working case. Solution output is routed to the *Progress* tab.

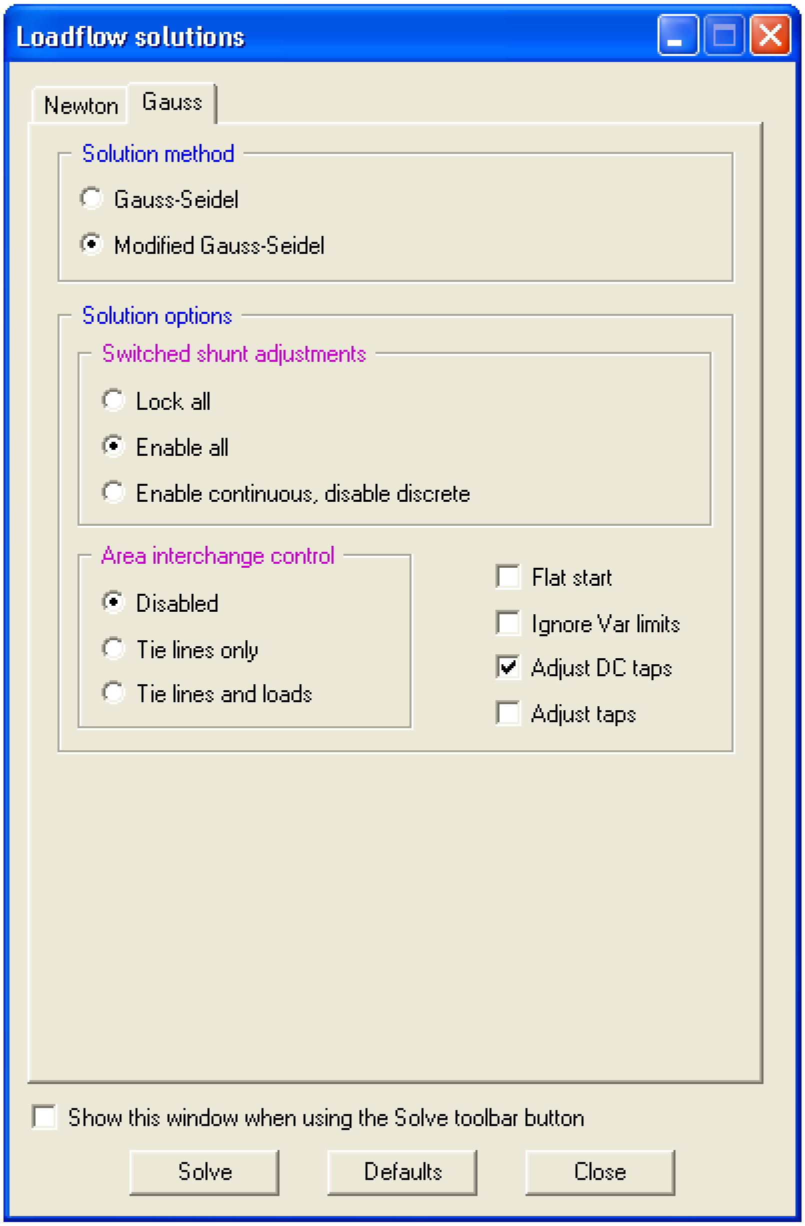


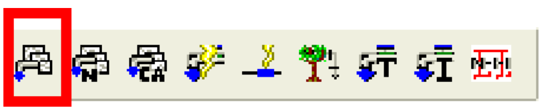
Figure 11.9. Loadflow Solutions Dialog, Modified Gauss-Seidel

Additional Information
PSS®E Program Operation Manual, Applying Modified Gauss-Seidel Power Flow Solution

11.3. Running AC Contingency Analysis

ACCC

Requirements / Prerequisites
Validly specified power flow case solved to an acceptable mismatch tolerance. Distribution Factor Data File (*.dfx) corresponding to the network condition. Building the Distribution Factor Data File



Power Flow > Solution > AC contingency solution (ACCC)...

Most work done with a power flow data base is investigative and linked to system performance under contingency conditions, usually N-1 (loss of any one element). The user can switch a network element out of service or modify element ratings (loads, shunts, element ratings, element impedances etc) by editing data cells in *[Network Spreadsheet]*. After the data change is made (status or value), the user can solve the revised power flow.

The network contingency calculation function calculates full AC power flow solutions for a specified set of contingency cases. Results are stored in a binary file. This file is subsequently processed to produce reports of violations, loadings, and available capacity (for details, see Section 16.5, “AC Contingency Reports”).

Since the information stored in the Distribution Factor Data File is a function of data organization and network topology in the working case, it follows that it must be re-executed with *Calculate Distribution factors disabled* before running an ac contingency analysis (see Section 13.1, “Building the Distribution Factor Data File”).

To change defaults for the single line contingency ranking process, see Section 13.3, “Estimating Severity Rankings for Single Line Outage Contingencies ”.

Solution options and a *Solution Engine* must be specified. Click *[...]* to open the selection window for the required *Distribution factor data file* (*.dfx). A filename for the *Contingency solution output file* (*.acc) is required; it can be a new file or a previously-built file to be over-written. If desired, an optional *Load throwover data file* (*.thr) may also be specified. If a dispatch mode is enabled, a*Unit inertia and governor data file* (*.inl) input file may be specified.

Dispatch modes may be enabled for the following:

- Subsystem machines (Reserve)
- Subsystem machines (PMAX)
- Subsystem machines (Inertia)
- Subsystem machines (Governor droop)

Click *[Solve]*. A summary of the solution process is routed to the *Progress* tab (Figure 11.11, “Example of AC Contingency Solution Output”).

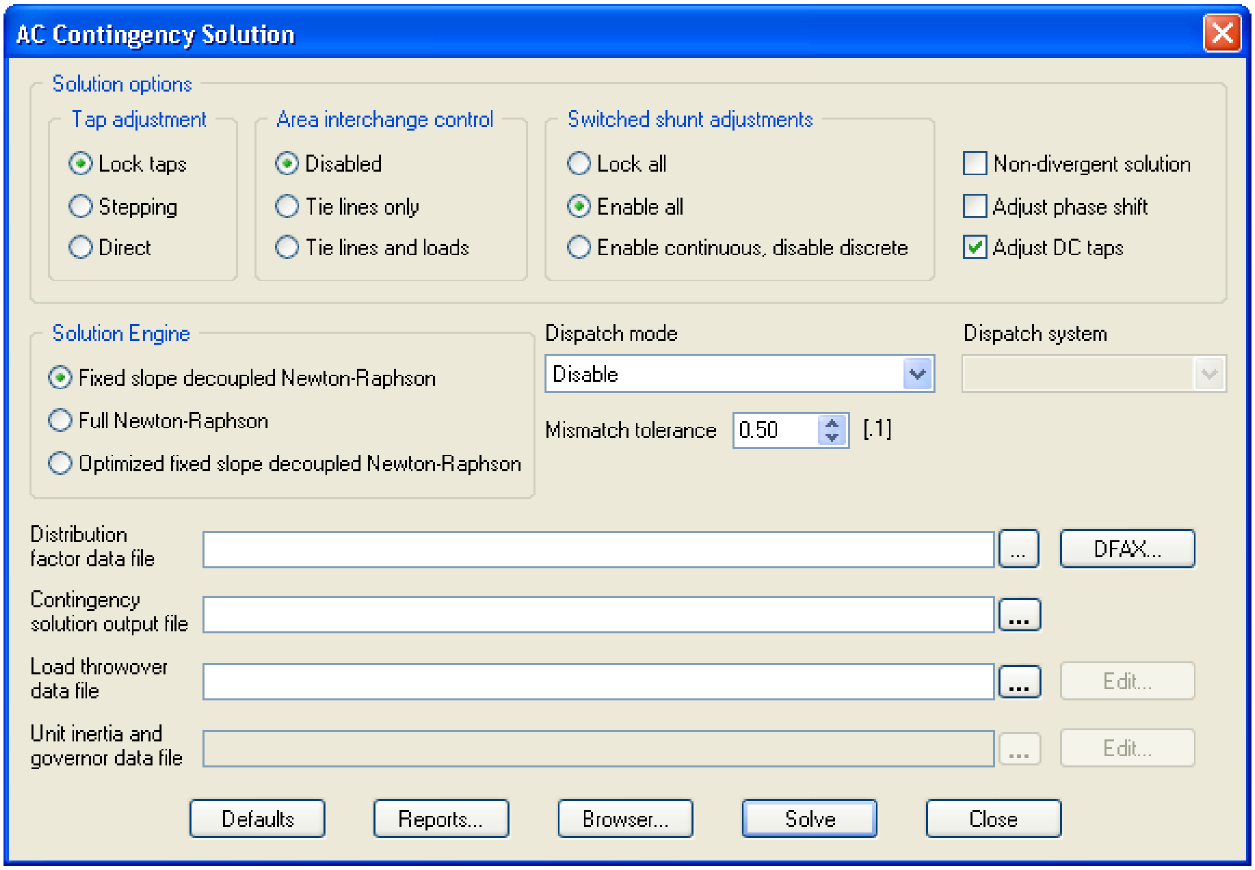


Figure 11.10. AC Contingency Solution Dialog

```
WORKING CASE HAS LARGEST MISMATCH OF      0.03  MW   AT BUS    151 [NUCPANT      500.00]
                                          0.26 MVAR AT BUS    205 [SUB230       230.00]

PROCESSING CONTINGENCY 'TRIP1NUCLEAR' (#1 OF 10):
REMOVE UNIT 1 FROM BUS 101 [NUC-A       21.600]

PROCESSING CONTINGENCY 'TRIP2NUCLEAR' (#2 OF 10):
REMOVE UNIT 1 FROM BUS 101 [NUC-A       21.600]
REMOVE UNIT 1 FROM BUS 102 [NUC-B       21.600]
*** SOLUTION NOT CONVERGED: BLOWN UP ***
LARGEST MISMATCH IS      797.99 MW OR MVAR AT BUS 206 [URBGEN      18.000]
TOTAL MISMATCH IS       3173.80 MVA

PROCESSING CONTINGENCY 'ADDLARGELOAD' (#3 OF 10):
INCREASE BUS 154 [DOWNTN      230.00] LOAD BY 50 PERCENT
*** SOLUTION NOT CONVERGED: BLOWN UP ***
LARGEST MISMATCH IS      795.39 MW OR MVAR AT BUS 206 [URBGEN      18.000]
TOTAL MISMATCH IS       3657.24 MVA

PROCESSING CONTINGENCY 'LOSEWESTGEN' (#4 OF 10):
REMOVE UNIT 1 FROM BUS 3018 [CATDOG_G    13.800]

PROCESSING CONTINGENCY 'LOSEWESTBIGT' (#5 OF 10):
TRIP LINE FROM BUS 3004 [WEST         500.00] TO BUS 152 [MID500      500.00]

PROCESSING CONTINGENCY 'LOSEEASTBIGT' (#6 OF 10):
TRIP LINE FROM BUS 151 [NUCPANT     500.00] TO BUS 201 [HYDRO       500.00]

PROCESSING CONTINGENCY 'LOSEEASTLOAD' (#7 OF 10):
SET BUS 205 [SUB230      230.00] LOAD TO 0 MW
*** SOLUTION NOT CONVERGED: BLOWN UP ***
LARGEST MISMATCH IS     2496.23 MW OR MVAR AT BUS 154 [DOWNTN      230.00]
TOTAL MISMATCH IS      17063.89 MVA
  1 VOLTAGE CONTROLLED BUSES WITH CONTROLLING EQUIPMENT INCORRECTLY AT THEIR VAR
    LIMITS (VARS HIGH & VOLTAGE HIGH, OR VARS LOW & VOLTAGE LOW) AND VOLTAGE ERROR
    MORE THAN 0.000010--LARGEST ERROR IS 1.157226 AT BUS 205 [SUB230      230.00]

PROCESSING CONTINGENCY 'LOSE2LINESWE' (#8 OF 10):
TRIP LINE FROM BUS 3004 [WEST         500.00] TO BUS 152 [MID500      500.00]
TRIP LINE FROM BUS 3006 [UPTOWN       230.00] TO BUS 153 [MID230      230.00]

PROCESSING CONTINGENCY 'LOSE2LINEEA' (#9 OF 10):
TRIP LINE FROM BUS 151 [NUCPANT     500.00] TO BUS 201 [HYDRO       500.00]
TRIP LINE FROM BUS 152 [MID500      500.00] TO BUS 202 [EAST500     500.00]
*** SOLUTION NOT CONVERGED: ITERATION LIMIT EXCEEDED ***
LARGEST MISMATCH IS         0.14 MW OR MVAR AT BUS 211 [HYDRO_G     20.000]
TOTAL MISMATCH IS           0.71 MVA

PROCESSING CONTINGENCY 'XFMR204-205' (#10 OF 10):
DISCONNECT BRANCH FROM BUS 201 [HYDRO       500.00] TO BUS 205 [SUB230      230.00] CKT &1
*** SOLUTION NOT CONVERGED: BLOWN UP ***
LARGEST MISMATCH IS      797.23 MW OR MVAR AT BUS 206 [URBGEN      18.000]
TOTAL MISMATCH IS       3537.01 MVA
```

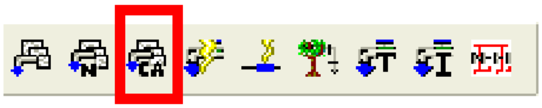
Progress | Alerts/Warnings

Figure 11.11. Example of AC Contingency Solution Output

Additional Information
PSS® E Program Operation Manual, Performing AC Contingency Analysis

11.4. AC Corrective Actions

Requirements / Prerequisites
Validly specified power flow case solved to an acceptable mismatch tolerance. Distribution Factor Data File (*.dfx) corresponding to the network condition. Building the Distribution Factor Data File



Power Flow > Solution > AC corrective actions...

Corrective actions are modeled as an optimal power flow problem. The objective function is to minimize the control adjustments needed to remove limit violations in the power system. The *[AC Corrective Actions]* dialog (Figure 11.13, "AC Corrective Actions Dialog") provides *Solution options*, *Constraint options*, and *Control options*, as well as a filter and *Mismatch tolerance* setting to refine the solution.

Click *[...]* to open the selection window for the required *Distribution factor data file* (*.dfx).

Click *[Solve]*. A summary of the solution process is routed to the *Progress* tab (Figure 11.12, "Example of AC Corrective Actions Output").

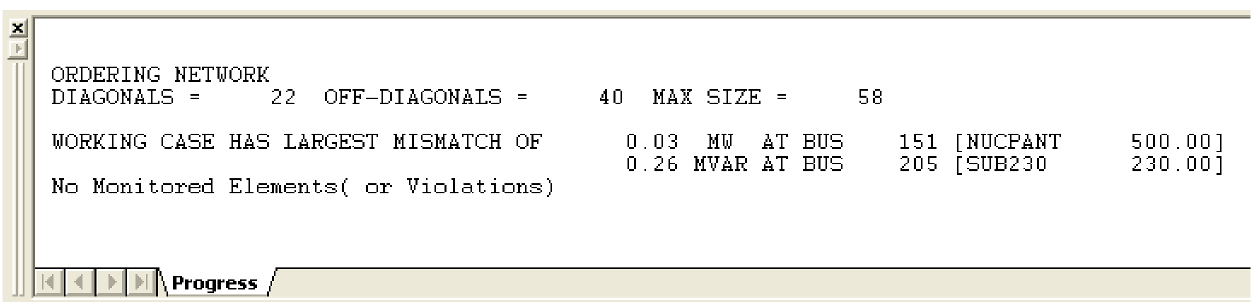


Figure 11.12. Example of AC Corrective Actions Output

Additional Information
PSS® E Program Operation Manual, AC Corrective Actions

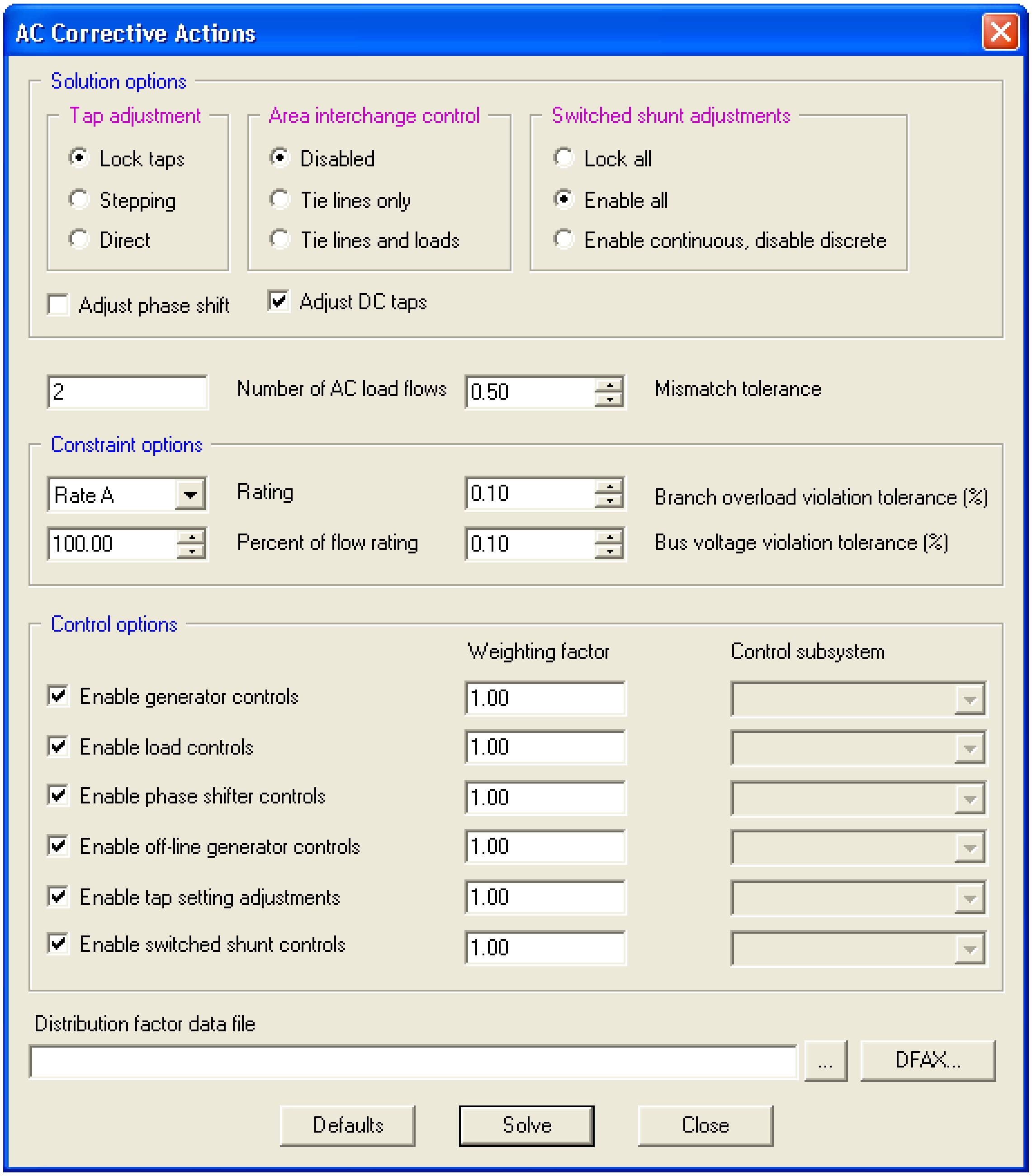
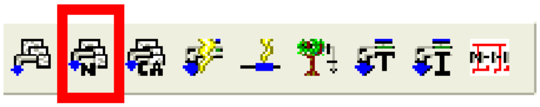


Figure 11.13. AC Corrective Actions Dialog

11.5. Running Multi-Level Contingency Analysis

Requirements / Prerequisites
Validly specified power flow case solved to an acceptable mismatch tolerance. Distribution Factor Data File (*.dfx) corresponding to the network condition. Building the Distribution Factor Data File



Power Flow > Solution > Multi-Level AC contingency solution...

The *[Multi-Level AC Contingency Solution]* dialog (Figure 11.14, “Multi-Level AC Contingency Solution Dialog, Power Flow Control”) contains four tabs, *Power Flow Control*, *Multiple Contingency Analysis*, *Tripping Simulation* and *Corrective Actions*, each of which provides options for one function of the analysis. One or more of these functions may be specified for the multi-level solution.

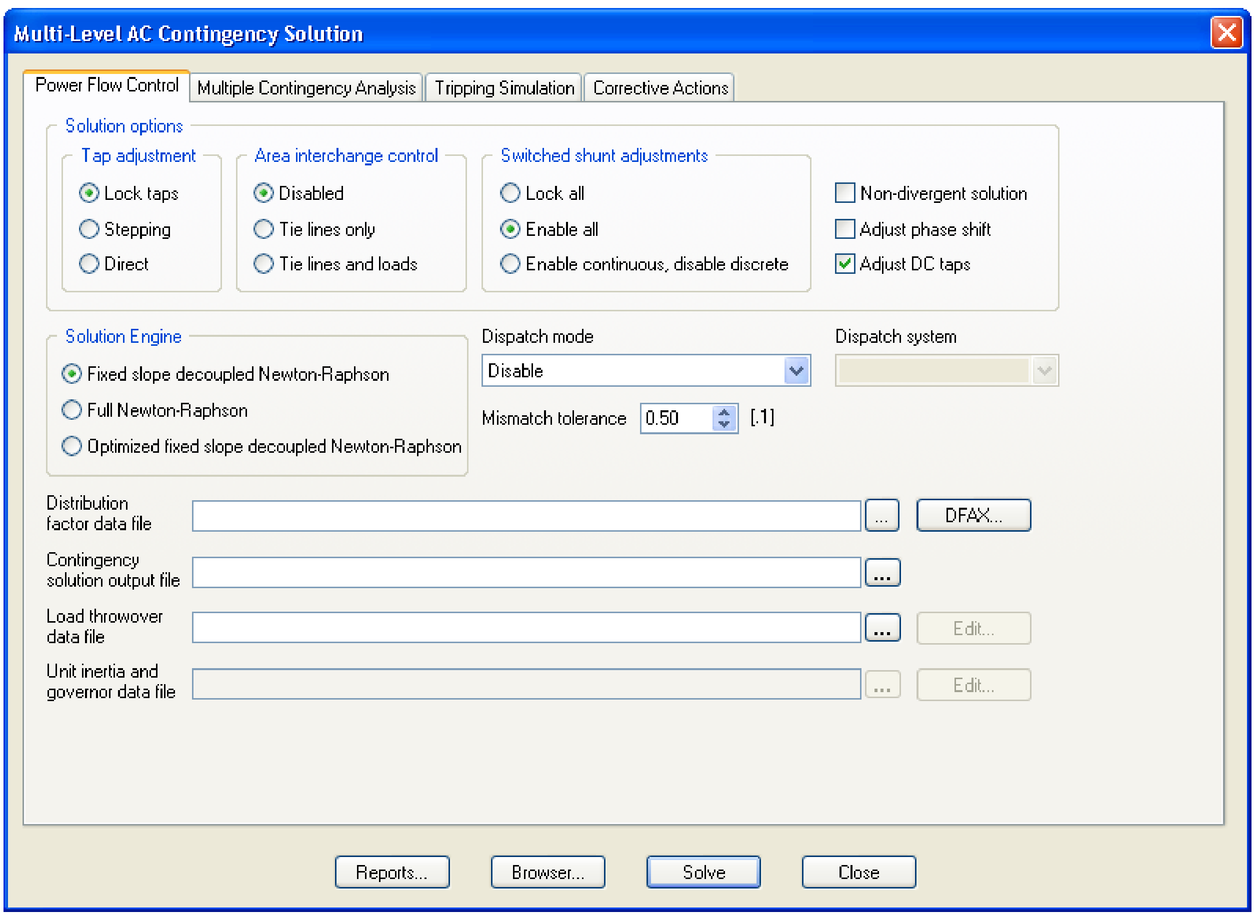


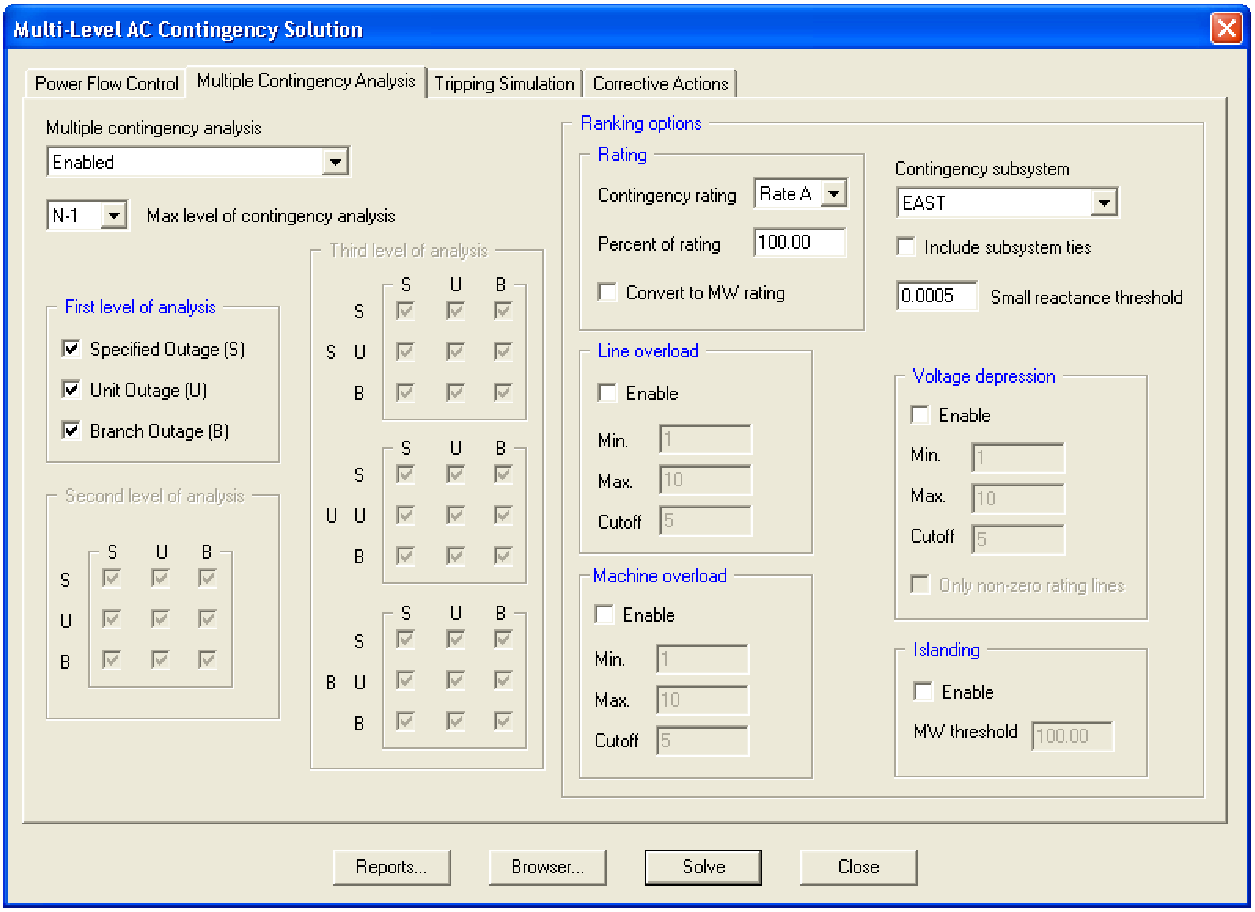
Figure 11.14. Multi-Level AC Contingency Solution Dialog, Power Flow Control

The *Power Flow Control* tab contains the same options that *[AC Contingency Solution]* provides (Figure 11.10, “AC Contingency Solution Dialog”). *Solution options* and a *Solution Engine* must be specified. Click *[...]* to open the selection window for the required *Distribution factor data file* (*.dfx). A filename for the *Contingency solution output file* (*.acc) is required; it can be a new file or a previously-built file to be over-written. If desired, an optional Load throwover data file (*.thr) may also be specified. If a dispatch mode is enabled, a Unit Inertia and Governor Data file (*.inl) input file may be specified.

Dispatch modes may be enabled for the following:

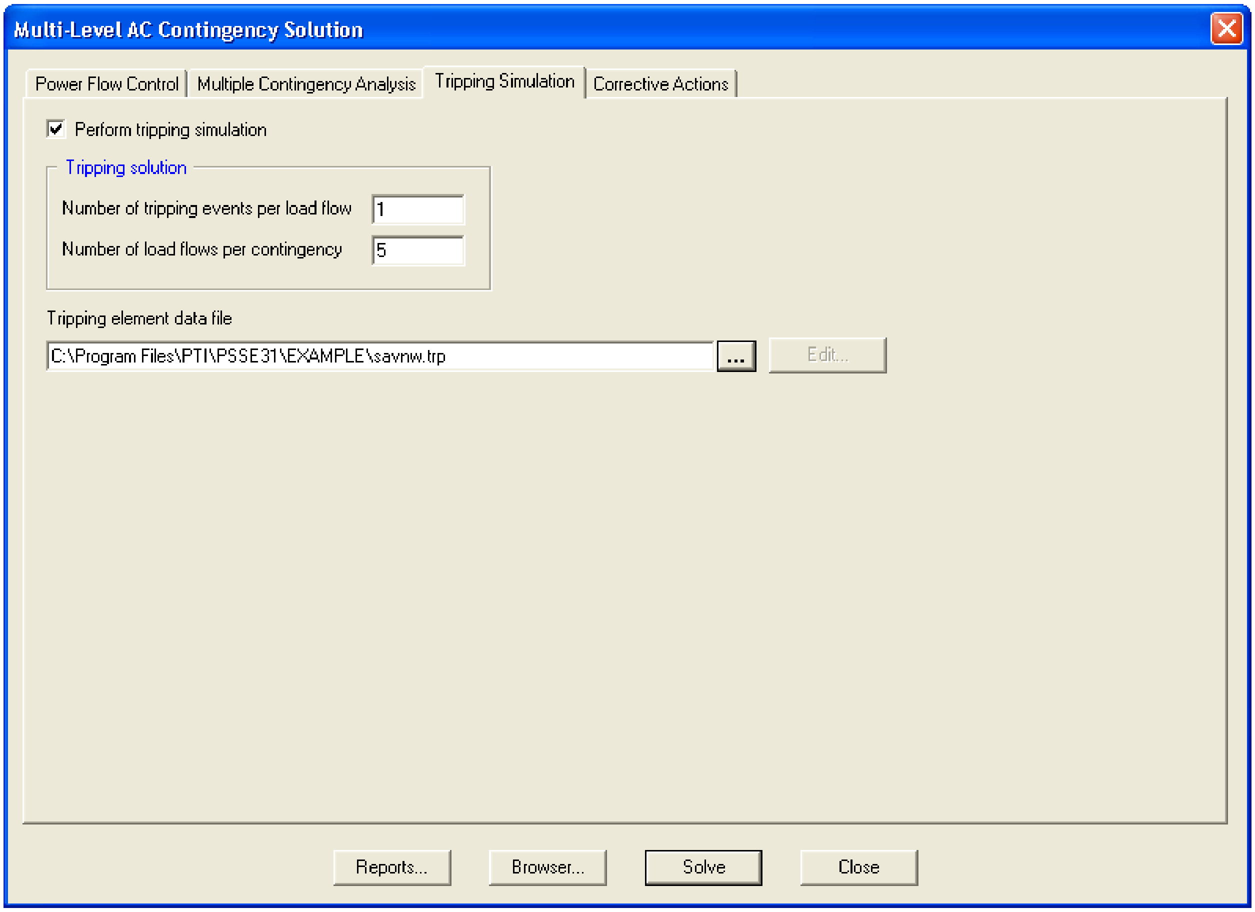
- Subsystem machines (Reserve)
- Subsystem machines (PMAX)
- Subsystem machines (Inertia)
- Subsystem machines (Governor droop)

The *Multiple Contingency Analysis* tab, when its analysis is enabled, allows specification of levels of analysis and *Ranking options* that include enabling filters for *Line overload*, *Machine overload*, *Voltage depression*, and *Islanding*.



Multi-Level AC Contingency Solution Dialog, Multiple Contingency Analysis

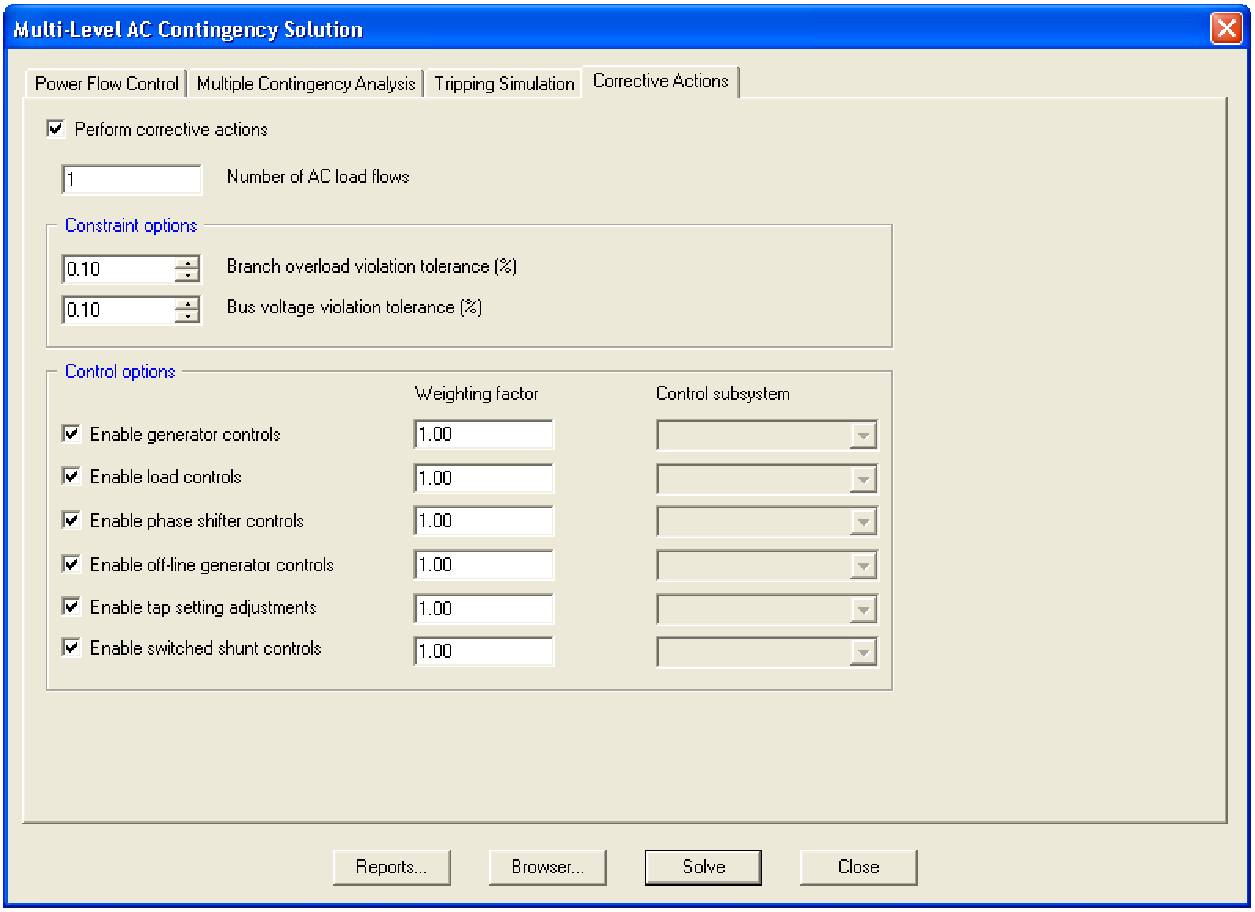
The *Tripping Simulation* tab, when its analysis is enabled, allows specification of the *Tripping solution*. Click *[...]* to open the selection window for the required *Tripping element data file* (*.trp).



Multi-Level AC Contingency Solution Dialog, Tripping Simulation

Specifications made at the GUI for the ac contingency solution are retained for future activities. If an activity that does not require a Tripping Element Data file is initiated, and Perform tripping simulation had been previously selected, an error message requesting the file will pop up. Deselect Perform tripping simulation to run the activity without specifying the file.

The *Corrective Actions* tab, when its analysis is enabled, allows specification of the desired *Constraint options* and *Control options*.



Multi-Level AC Contingency Solution Dialog, Corrective Actions

Click *[Solve]* when all the desired functions have been enabled. A summary of the solution process is routed to the *Report* tab.

Additional Information
PSS® E Program Operation Manual, Performing Multi-Level AC Contingency Solution

11.6. Generation Dispatch

Requirements / Prerequisites
Validly specified power flow case solved to an acceptable mismatch tolerance.
Distribution Factor Data File (*.dfx) corresponding to the network condition.
Building the Distribution Factor Data File

Power Flow > Solution > Implement Generation dispatch...

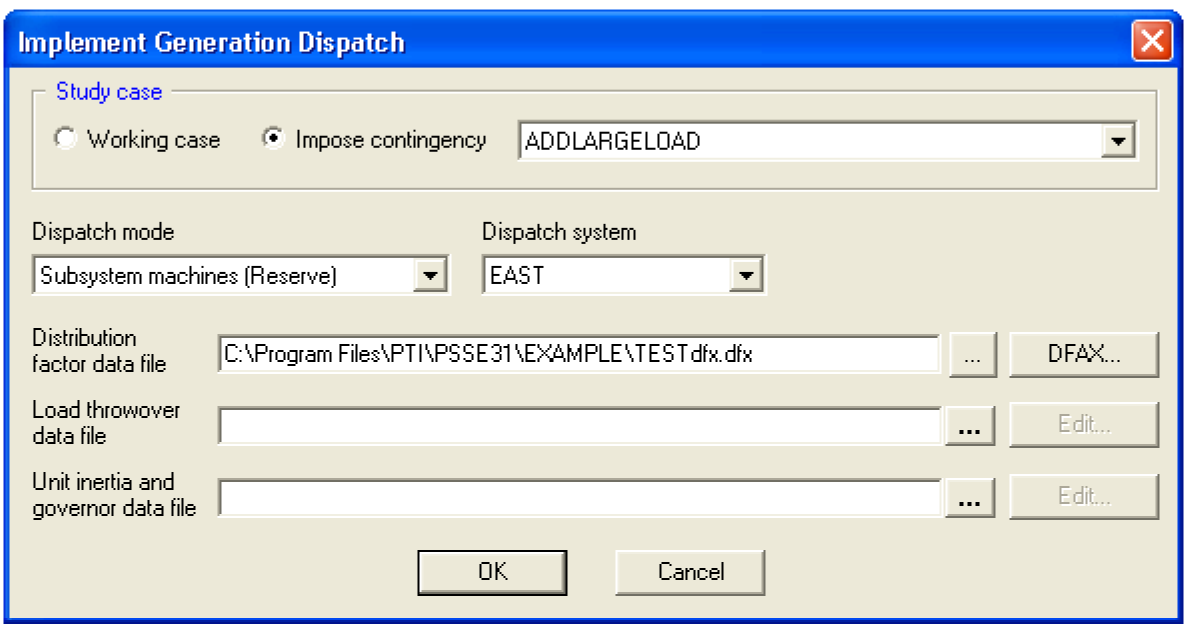
For each contingency, automatic contingency analysis imposes the contingency, implements generation re-dispatch if a generation dispatch mode is enabled, and solves AC power flow solution sequentially. The *[Implement Generation Dispatch]* dialog requires entering the filename of the study case. It permits the user to enable *Dispatch mode* for one of the following conditions:

- Subsystem machines (Reserve)
- Subsystem machines (PMAX)
- Subsystem machines (Inertia)
- Subsystem machines (Governor droop)

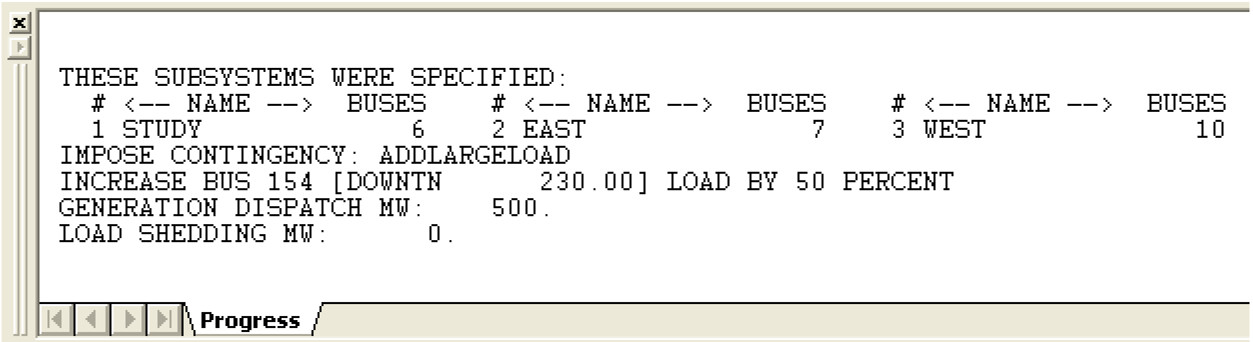
Click *[...]* to open the selection window for the required *Distribution factor data file* (*.dfx). If desired, an optional Load throwover data file (*.thr) may also be specified. If a dispatch mode is enabled, a Unit Inertia and Governor Data file (*.inl) input file may be specified.

The basis of the study must be specified as either the Working case or Impose contingency from the pull-down list of contingencies.

Click *[OK]* to process the study. Solution output is routed to the *Progress* tab (Figure 11.4, “Example of Newton-Raphson Fully-Coupled Solution Output”).



Implement Generation Dispatch Dialog

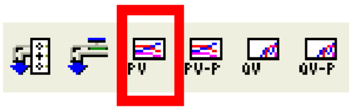


Example of Generation Dispatch Output

Additional Information
PSS® E Program Operation Manual, About Generation Dispatch Implementing Generation Dispatch Algorithm in Contingency Analysis

11.7. PV Analysis

Requirements / Prerequisites
Validly specified power flow case solved to an acceptable mismatch tolerance. Distribution Factor Data File (*.dfx) corresponding to the network condition. Building the Distribution Factor Data File



PowerFlow > Solution > PV analysis...

The *[PV Analysis]* dialog (Figure 11.15, "PV Analysis Dialog") requires the specification of *Solution options*, a *Solution Engine*, *VAR limit code* application, *Subsystem selection*, and a number of filters that define analysis results. The following *Transfer dispatch methods* are available for both study and opposing systems:

• DFAX generation	• Subsystem machines (MW)
• DFAX load	• Subsystem machines (MBASE)
• DFAX generation or load	• Subsystem machines (reserve)
• Subsystem load	• Subsystem machines (ECDI)

Click *[...]* to open the selection window for the required *Distribution Factor Data file* (*.dfx). If desired, an optional *Load Throwover Data file* (*.thr) and *Economic Dispatch file* (*.ecd) may also be specified. Output results can be written to a *PV Results file* (*.pv), which can be a new file or a previously-built file to be overwritten.

Click *[Go]* to perform the activity. A summary is routed to the *Progress* tab (Figure 11.16, "Example of PV Analysis, Partial Output") and *[PV Results]* (Figure 11.17, "PV Results Window") is displayed.

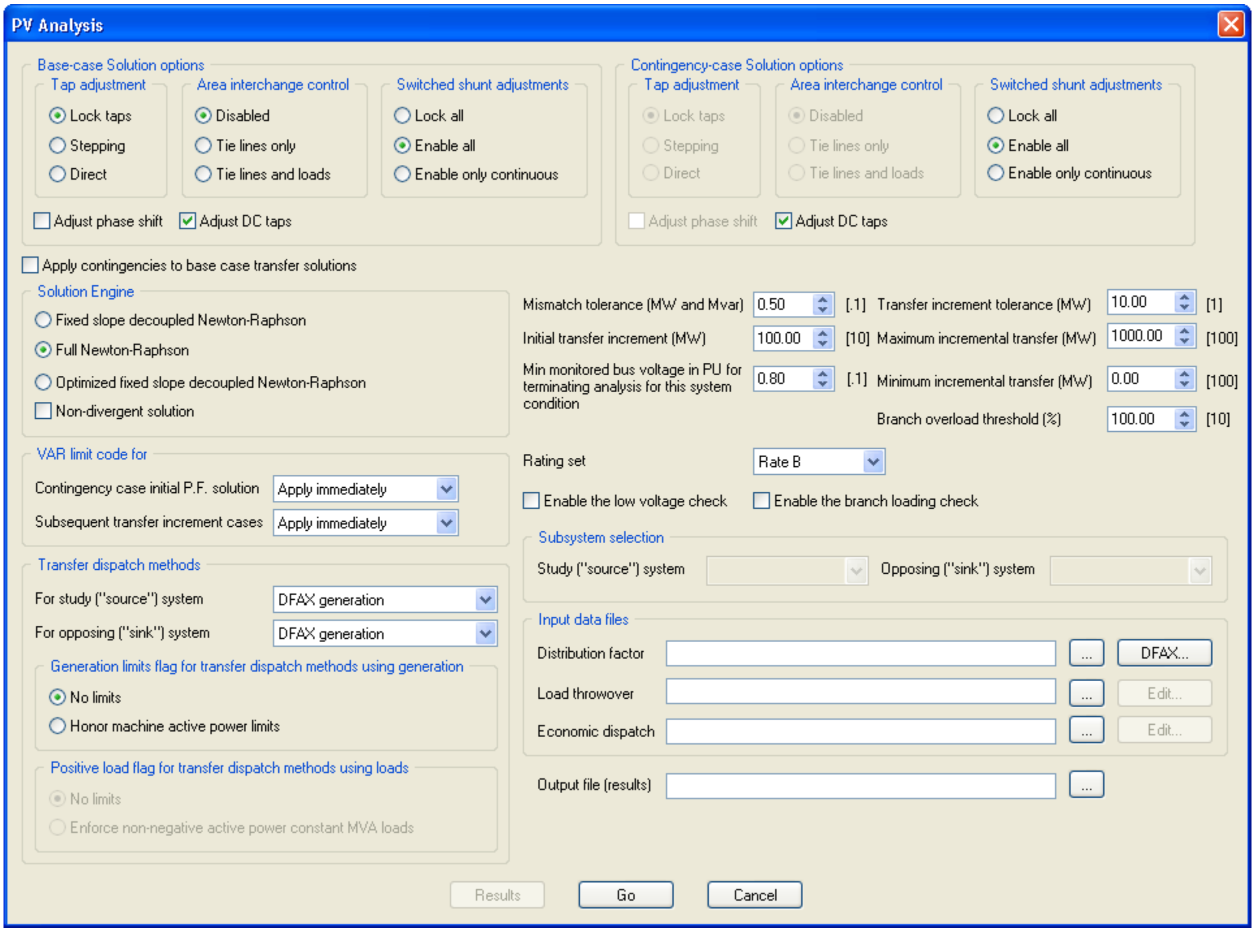


Figure 11.15. PV Analysis Dialog

```
PROCESSING CONTINGENCY 'LOSEWESTGEN' (#4 OF 10):
REMOVE UNIT 1 FROM BUS 3018 [CATDOG_G     13.800]
STARTING SOLUTION WITH TRANSFER INCREMENT =    0.0
STARTING SOLUTION WITH TRANSFER INCREMENT =  100.0
STARTING SOLUTION WITH TRANSFER INCREMENT =  200.0
STARTING SOLUTION WITH TRANSFER INCREMENT =  300.0
STARTING SOLUTION WITH TRANSFER INCREMENT =  400.0
STARTING SOLUTION WITH TRANSFER INCREMENT =  500.0
STARTING SOLUTION WITH TRANSFER INCREMENT =  600.0
STARTING SOLUTION WITH TRANSFER INCREMENT =  700.0
STARTING SOLUTION WITH TRANSFER INCREMENT =  800.0
STARTING SOLUTION WITH TRANSFER INCREMENT =  900.0
*** SOLUTION NOT CONVERGED: ITERATION LIMIT EXCEEDED ***
LARGEST MISMATCH IS         1.87 MW OR MVAR AT BUS 205 [SUB230      230.00]
TOTAL MISMATCH IS           5.90 MVA
  2 VOLTAGE CONTROLLED BUSES WITH CONTROLLING EQUIPMENT INCORRECTLY AT THEIR VAR
    LIMITS (VARS HIGH & VOLTAGE HIGH, OR VARS LOW & VOLTAGE LOW) AND VOLTAGE ERROR
    MORE THAN 0.000010--LARGEST ERROR IS 0.011276 AT BUS 101 [NUC-A       21.600]
STARTING SOLUTION WITH TRANSFER INCREMENT =  850.0
STARTING SOLUTION WITH TRANSFER INCREMENT =  900.0
*** SOLUTION NOT CONVERGED: ITERATION LIMIT EXCEEDED ***
LARGEST MISMATCH IS         1.87 MW OR MVAR AT BUS 205 [SUB230      230.00]
TOTAL MISMATCH IS           5.90 MVA
  2 VOLTAGE CONTROLLED BUSES WITH CONTROLLING EQUIPMENT INCORRECTLY AT THEIR VAR
    LIMITS (VARS HIGH & VOLTAGE HIGH, OR VARS LOW & VOLTAGE LOW) AND VOLTAGE ERROR
    MORE THAN 0.000010--LARGEST ERROR IS 0.011276 AT BUS 101 [NUC-A       21.600]
STARTING SOLUTION WITH TRANSFER INCREMENT =  875.0
*** SOLUTION NOT CONVERGED: ITERATION LIMIT EXCEEDED ***
LARGEST MISMATCH IS         0.11 MW OR MVAR AT BUS 205 [SUB230      230.00]
TOTAL MISMATCH IS           0.34 MVA
  2 VOLTAGE CONTROLLED BUSES WHOSE VOLTAGES DIFFER FROM THEIR SCHEDULED VOLTAGES BY
    MORE THAN 0.000010--LARGEST ERROR IS 0.002714 AT BUS 101 [NUC-A       21.600]
STARTING SOLUTION WITH TRANSFER INCREMENT =  862.5
STARTING SOLUTION WITH TRANSFER INCREMENT =  875.0
*** SOLUTION NOT CONVERGED: ITERATION LIMIT EXCEEDED ***
LARGEST MISMATCH IS         0.11 MW OR MVAR AT BUS 205 [SUB230      230.00]
TOTAL MISMATCH IS           0.34 MVA
  2 VOLTAGE CONTROLLED BUSES WHOSE VOLTAGES DIFFER FROM THEIR SCHEDULED VOLTAGES BY
    MORE THAN 0.000010--LARGEST ERROR IS 0.002714 AT BUS 101 [NUC-A       21.600]
STARTING SOLUTION WITH TRANSFER INCREMENT =  868.8
*** SOLUTION NOT CONVERGED: ITERATION LIMIT EXCEEDED ***
LARGEST MISMATCH IS         0.01 MW OR MVAR AT BUS 205 [SUB230      230.00]
TOTAL MISMATCH IS           0.02 MVA
  2 VOLTAGE CONTROLLED BUSES WHOSE VOLTAGES DIFFER FROM THEIR SCHEDULED VOLTAGES BY
    MORE THAN 0.000010--LARGEST ERROR IS 0.000651 AT BUS 101 [NUC-A       21.600]
```

Progress | Alerts/Warnings

Figure 11.16. Example of PV Analysis, Partial Output

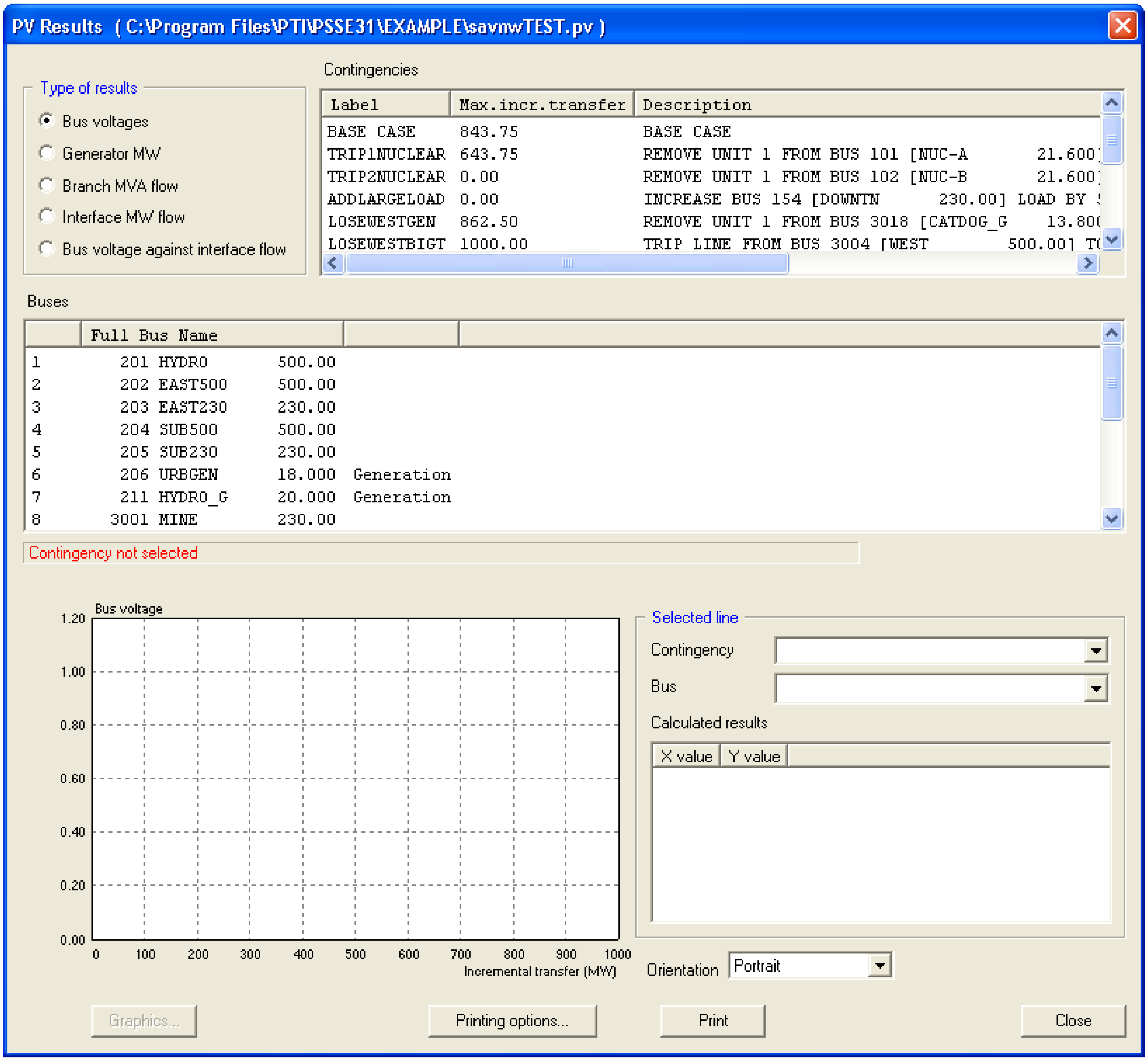


Figure 11.17. PV Results Window

Double-click in the graph area to open the *[Graph Area Visual Parameters]* dialog if you wish to change the colors and line style of the display.

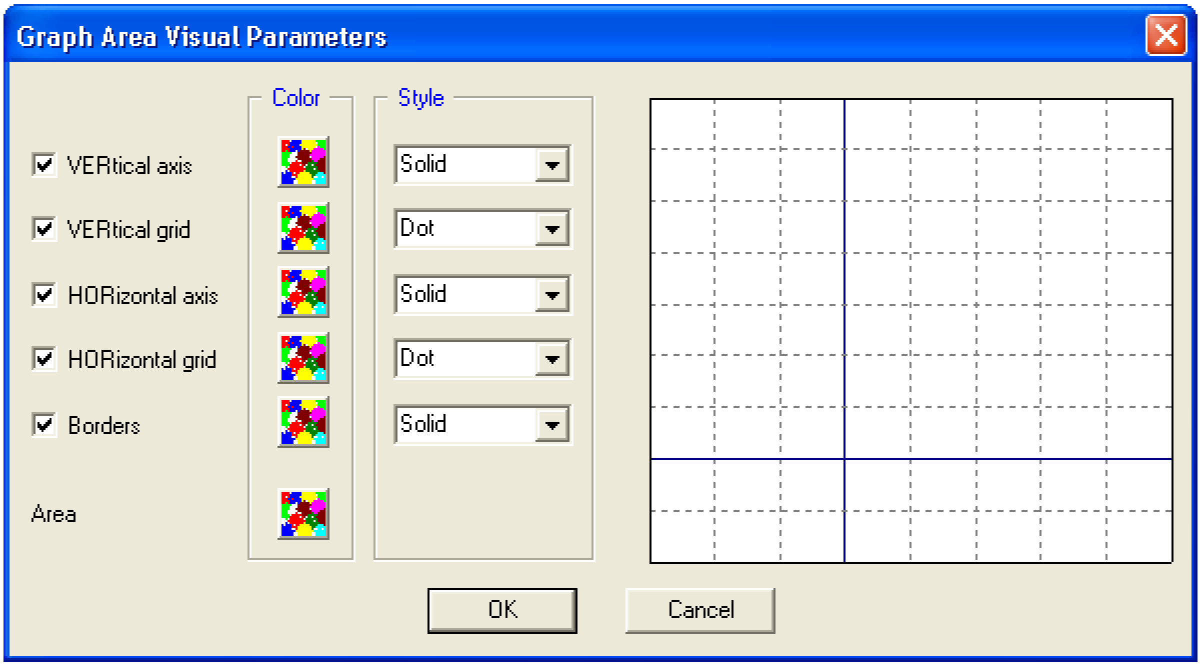


Figure 11.18. Graph Area Visual Parameters Dialog

To adjust parameters such as decimal places and axis labels, left-click the axis of interest. The scale values dialogs are displayed in Figure 11.19, "Vertical Scale Adjustment Dialog" and Figure 11.20, "Horizontal Scale Adjustment Dialog" for both vertical and horizontal axes.

Values: Specify a top value and bottom values of the axes. These values can be adjusted based in grid step size if *Adjust for grid step* is checked. Select the start point of the grid step. If undefined then grid step will start from bottom. Select grid step method either by step value or defined the number of values required on the axes.

View (not real values): Select the graphs display options in this section. The changes will be reflected on the sample display on the left.

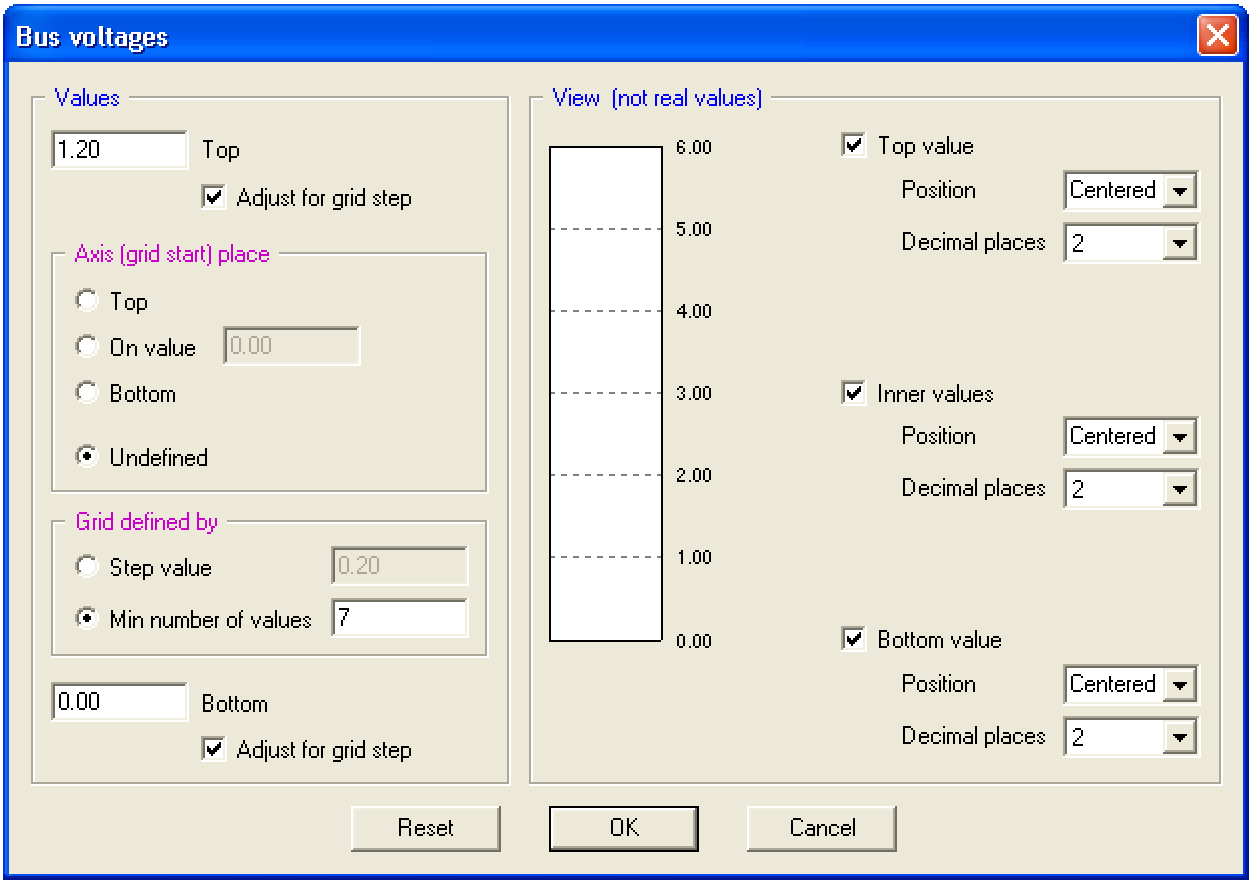


Figure 11.19. Vertical Scale Adjustment Dialog

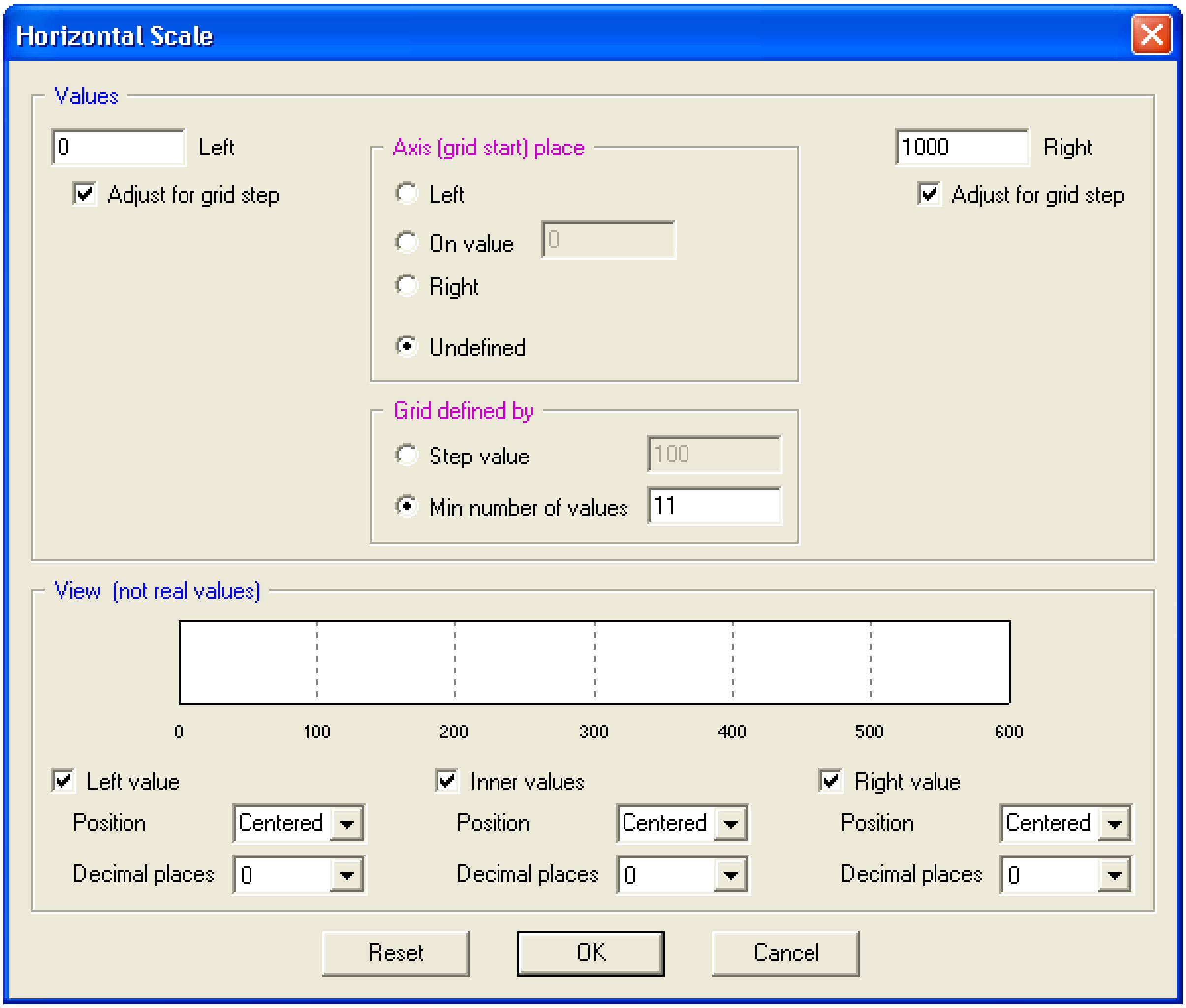


Figure 11.20. Horizontal Scale Adjustment Dialog

Select the *Type of results* desired. Highlight at least one of the *Contingencies* and one of the *Buses* to view the graphic. To select individual items, left-click the item you want to select. Hold the *[Ctrl]* key down while clicking the left mouse button to select the additional items. To select continuous items, hold the *[Shift]* key down while clicking the left mouse button.

Click *[Printing options]* (Figure 11.21, “”) to select desired output options. Click *[Graphics]* to view only the graphics area (Figure 11.22, “PV Results, Graphics”). Click *[Print]* to route the graphic to a print queue.

Print Settings Dialog

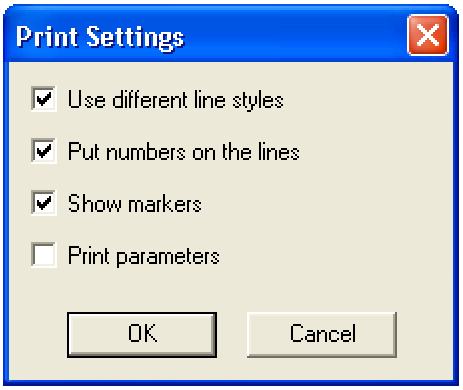


Figure 11.21.

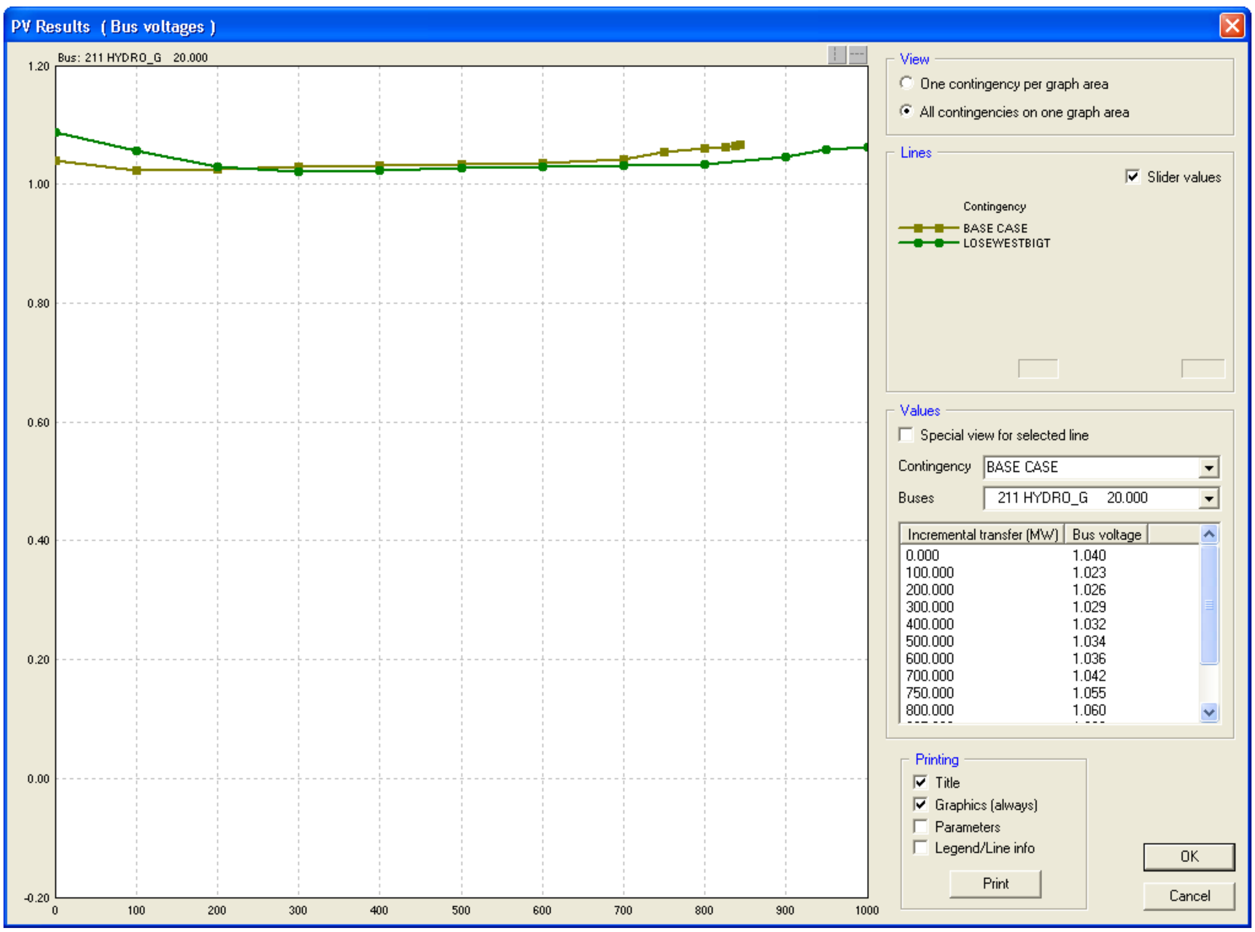


Figure 11.22. PV Results, Graphics

Additional Information
PSS®E Program Operation Manual, PV Analysis

11.7.1. Implementing a Specific PV Transfer

To impose a designated transfer:

Open the Saved Case file containing the power flow case on which the transfer is to be imposed by selecting the *File* > *Open* menu entry. Normally, the same Saved Case file on which an earlier PV analysis calculation had been performed is specified:

1. Select *Power Flow* > *Solution* > *Implement PV transfer...* to open the *[Implement PV Transfer]* dialog containing default settings (see Figure 11.23, "Implement PV Transfer Dialog ").

2. Specify the same *Distribution Factor Data file*, *source* and *sink* systems, and *Transfer dispatch method* data as specified in the earlier PV analysis calculation.

3. Specify the desired transfer increment.

4. Click *[OK]*.

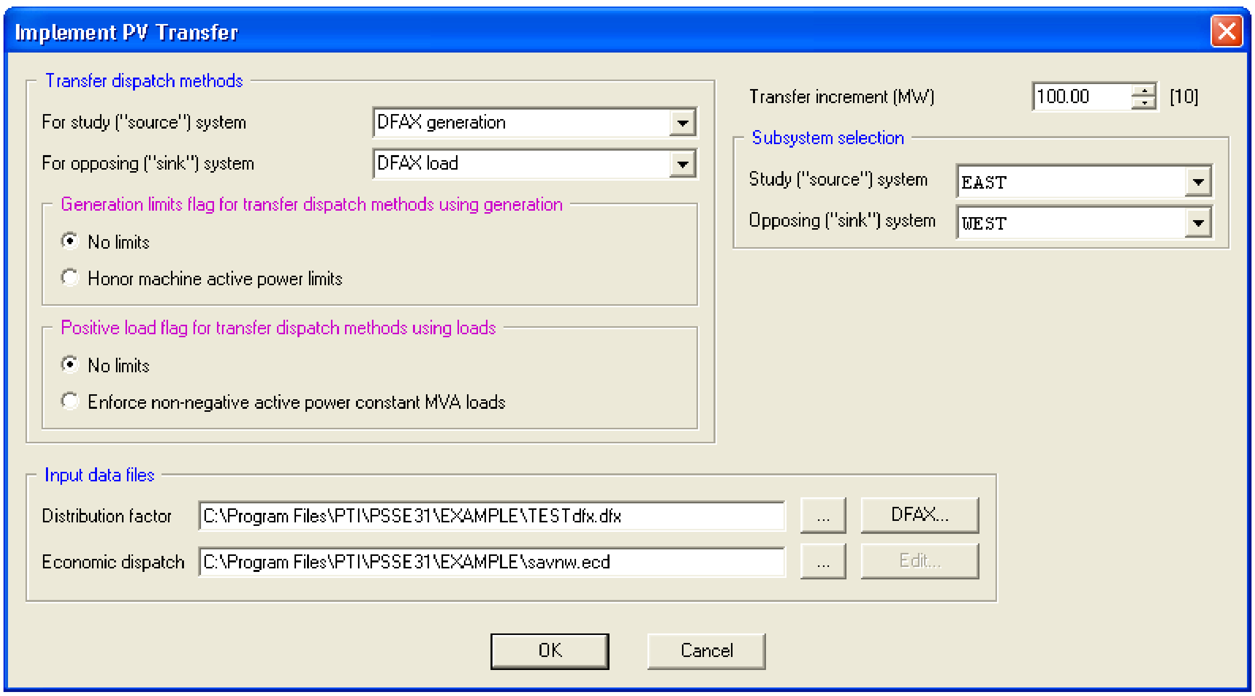


Figure 11.23. Implement PV Transfer Dialog

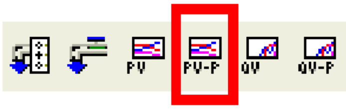
The implement PV transfer activity changes the generation or load, as appropriate, at those subsystem buses participating in the transfer.

Details on the transfer may be examined using the Powerflow Cases tab of the *File* > *Compare...* menu entry (see Figure 9-3).

11.7.2. PV Analysis Using Previous Results

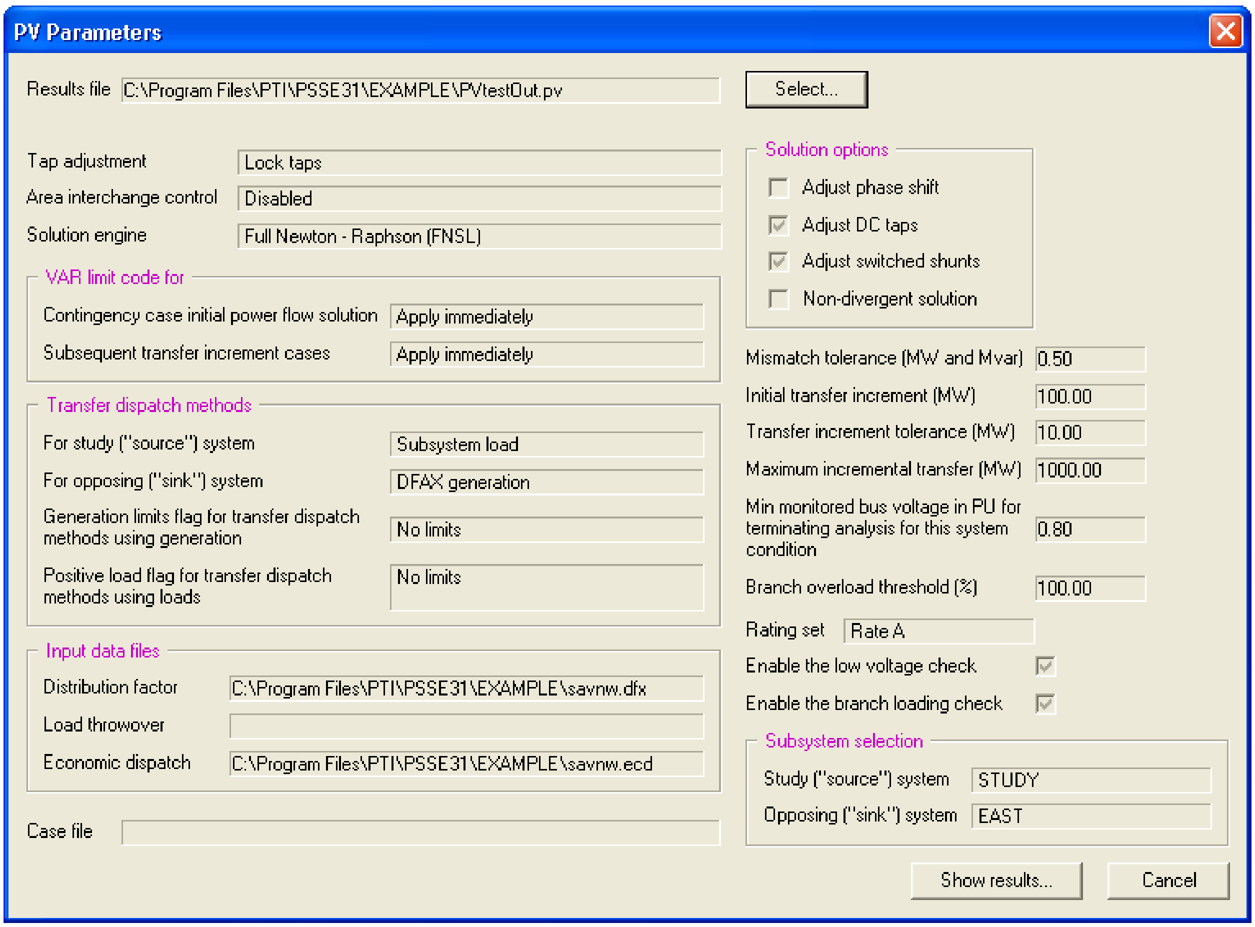
Requirements / Prerequisites
Validly specified power flow case solved to an acceptable mismatch tolerance.

Requirements / Prerequisites
PV Analysis File (*.pv) corresponding to the network condition. PV Analysis



PowerFlow > Solution > PV analysis using previous results...

Click *[Select]* to open the directory of PV Results files. Open the desired file. The *[PV Parameters]* dialog displays the parameters specified for the creation of that file.

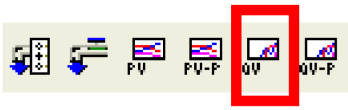


PV Parameters Dialog

Click *[Show results]* to display *[PV Results]* (Figure 11.17, “PV Results Window”).

11.8. QV Analysis

Requirements / Prerequisites
Validly specified power flow case solved to an acceptable mismatch tolerance.
Distribution Factor Data File (*.dfx) corresponding to the network condition.
Building the Distribution Factor Data File



PowerFlow > Solution > QV analysis...

The *[QV Analysis]* dialog (Figure 11.24, “QV Analysis Dialog”) requires the specification of a *Bus* subsystem *Solution options*, a *Solution Engine*, *VAR limit code* application, and a number of filters that define analysis results.

Click *[...]* to open the selection window for the required *Distribution factor data file* (*.dfx). If desired, an optional *Load throwover data file* (*.thr) may also be specified. Output results can be written to a *QV Results file* (*.qv), which can be a new file or a previously-built file to be over-written.

Click *[Go]* to perform the activity. A summary is routed to the *Progress* tab (Figure 11.25, “Example of QV Analysis, Partial Output”) and *[QV Results]* (Figure 11.26, “QV Results Window”) is displayed.

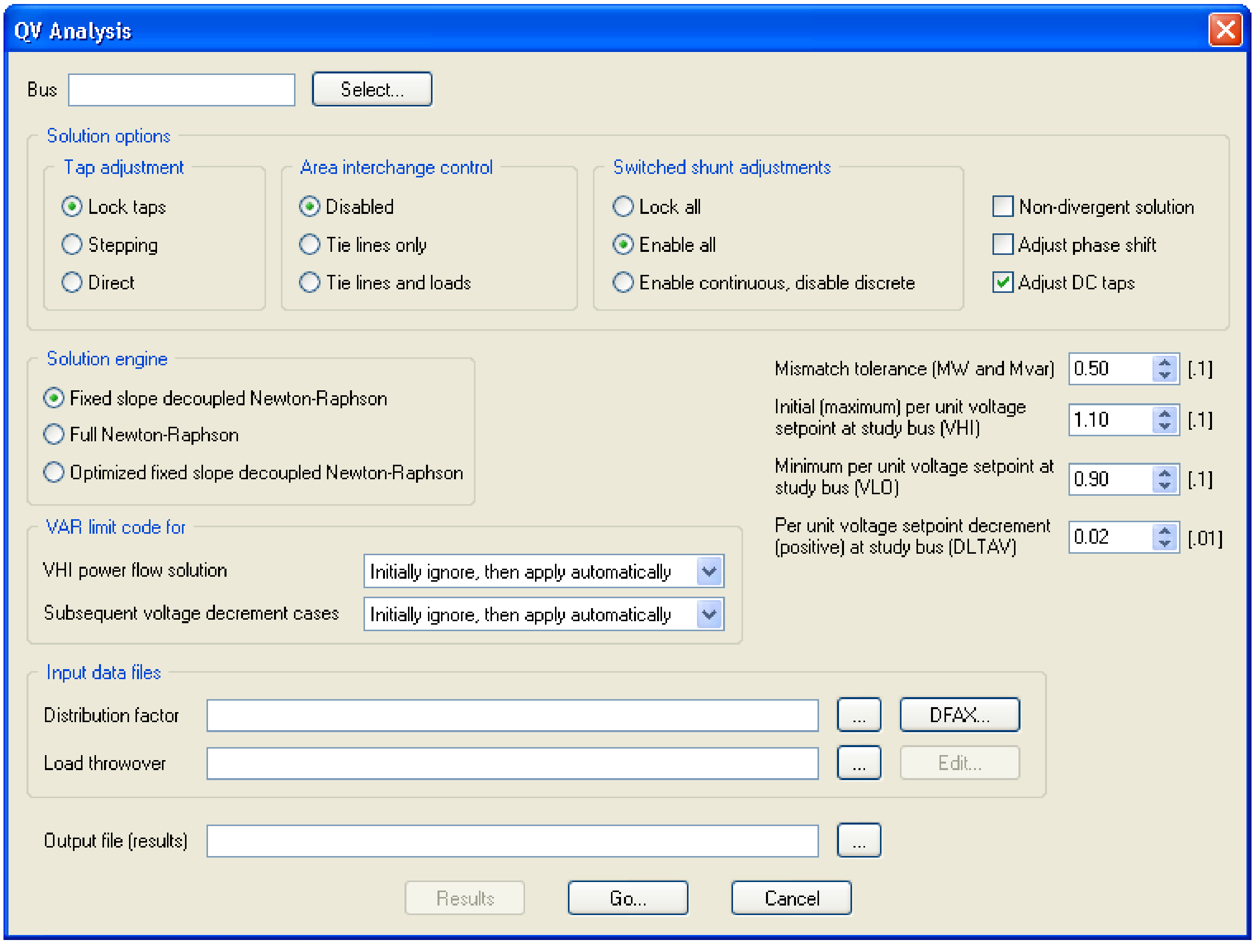
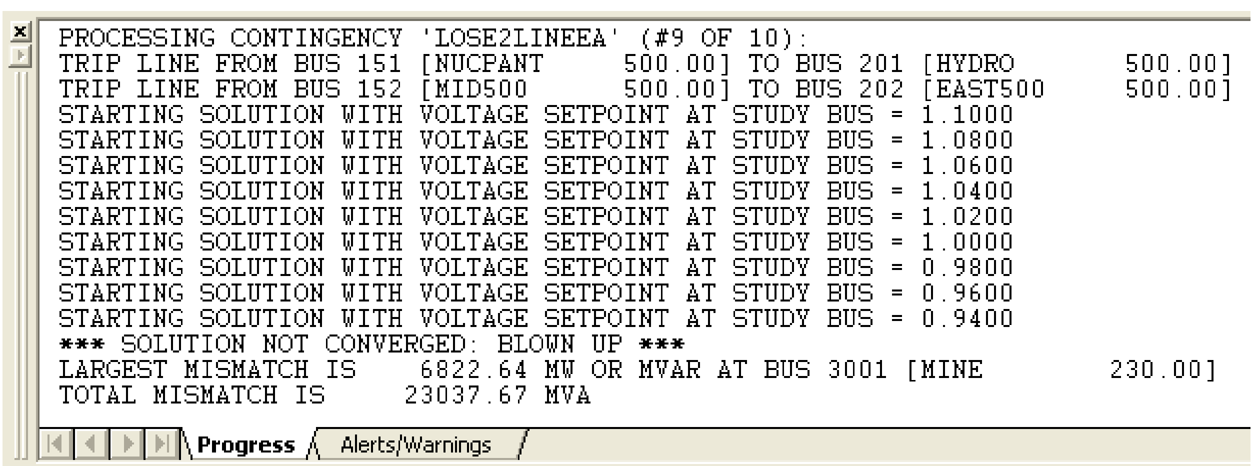


Figure 11.24. QV Analysis Dialog



```
PROCESSING CONTINGENCY 'LOSE2LINEEA' (#9 OF 10):
TRIP LINE FROM BUS 151 [NUCPANT      500.00] TO BUS 201 [HYDRO        500.00]
TRIP LINE FROM BUS 152 [MID500       500.00] TO BUS 202 [EAST500      500.00]
STARTING SOLUTION WITH VOLTAGE SETPOINT AT STUDY BUS = 1.1000
STARTING SOLUTION WITH VOLTAGE SETPOINT AT STUDY BUS = 1.0800
STARTING SOLUTION WITH VOLTAGE SETPOINT AT STUDY BUS = 1.0600
STARTING SOLUTION WITH VOLTAGE SETPOINT AT STUDY BUS = 1.0400
STARTING SOLUTION WITH VOLTAGE SETPOINT AT STUDY BUS = 1.0200
STARTING SOLUTION WITH VOLTAGE SETPOINT AT STUDY BUS = 1.0000
STARTING SOLUTION WITH VOLTAGE SETPOINT AT STUDY BUS = 0.9800
STARTING SOLUTION WITH VOLTAGE SETPOINT AT STUDY BUS = 0.9600
STARTING SOLUTION WITH VOLTAGE SETPOINT AT STUDY BUS = 0.9400
*** SOLUTION NOT CONVERGED: BLOWN UP ***
LARGEST MISMATCH IS    6822.64 MW OR MVAR AT BUS 3001 [MINE        230.00]
TOTAL MISMATCH IS     23037.67 MVA
```


Figure 11.25. Example of QV Analysis, Partial Output

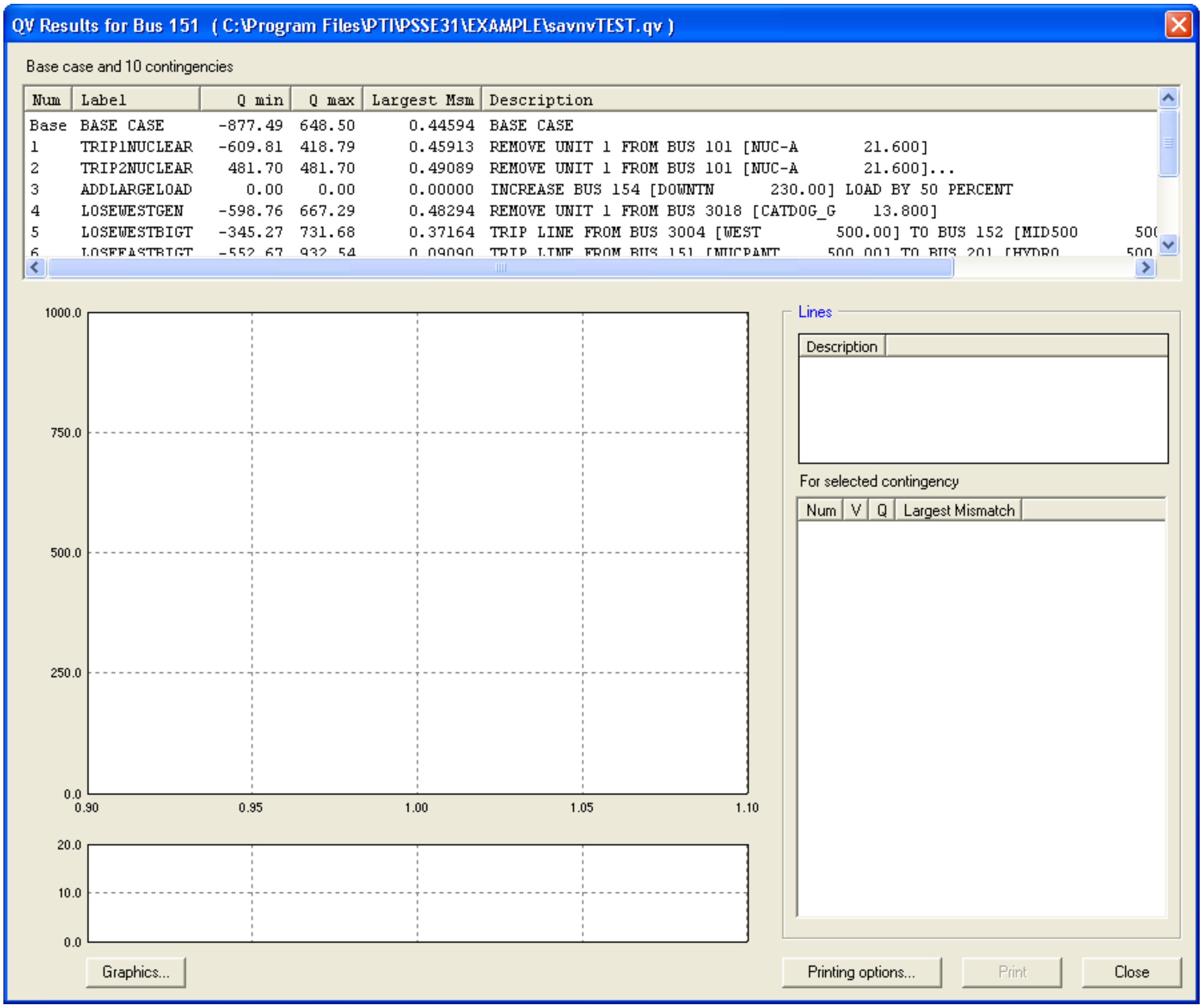


Figure 11.26. QV Results Window

To change the graph area display, see Figure 11.18, "Graph Area Visual Parameters Dialog", Figure 11.19, "Vertical Scale Adjustment Dialog", and Figure 11.20, "Horizontal Scale Adjustment Dialog".

Highlight at least one of the *Contingencies* to view the graphic. To select individual items, left-click the item you want to select. Hold the *[Ctrl]* key down while clicking the left mouse button to select the additional items. To select continuous items, hold the *[Shift]* key down while clicking the left mouse button.

Click *[Printing options]* (Figure 11.21, "") to select desired output options. Click *[Graphics]* to view only the graphics area (Figure 11.27, "QV Results, Graphics"). Click *[Print]* to route the graphic to a print queue.

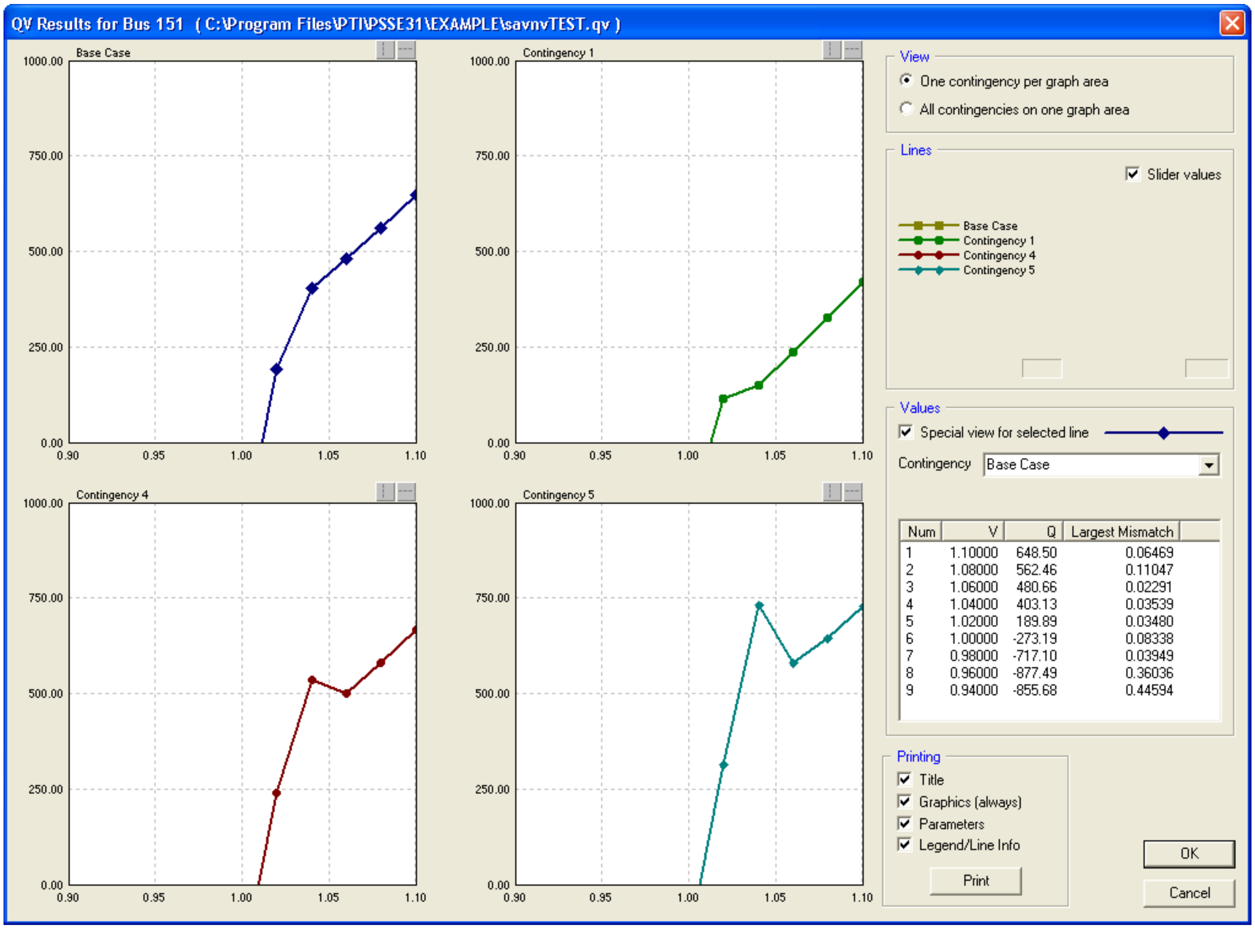
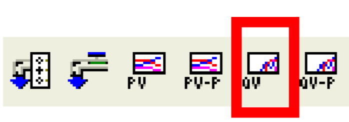


Figure 11.27. QV Results, Graphics

Additional Information
PSS® E Program Operation Manual, QV Analysis

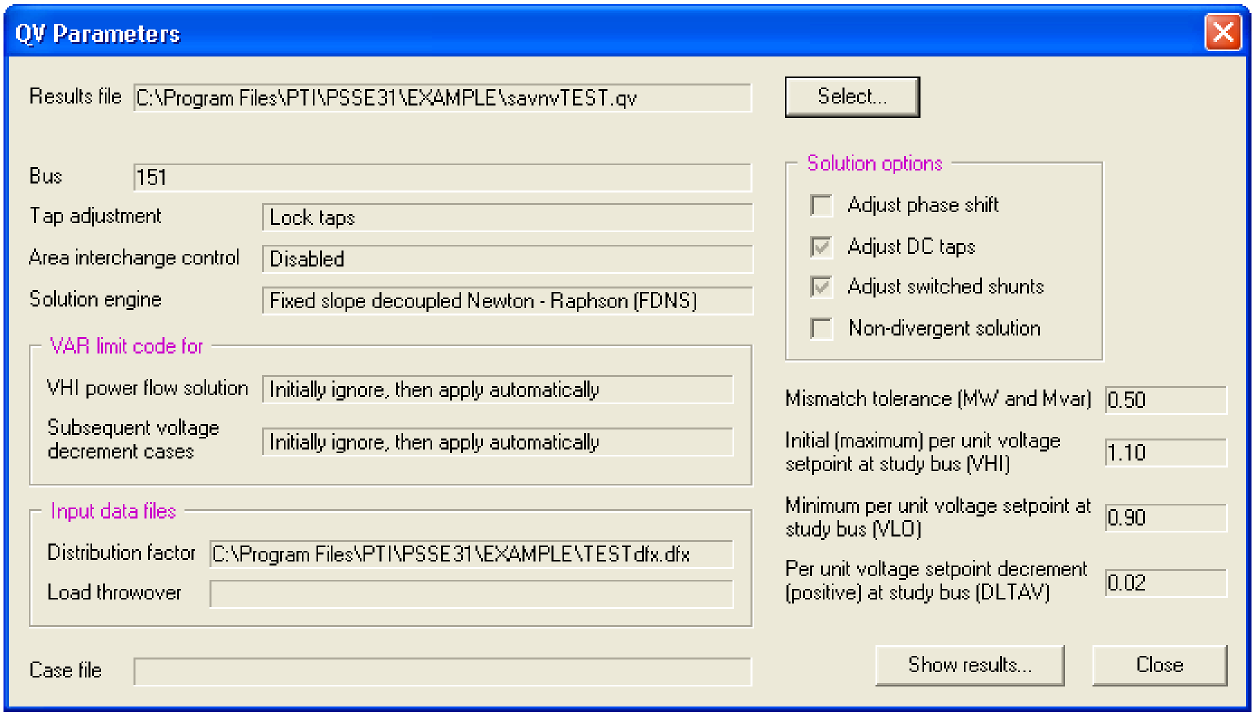
11.8.1. QV Analysis Using Previous Results

Requirements / Prerequisites
Validly specified power flow case solved to an acceptable mismatch tolerance. QV Analysis File (*.qv) corresponding to the network condition. QV Analysis



PowerFlow > Solution > QV analysis using previous results...

Click *[Select]* to open the directory of QV results files (*.qv). Open the desired file. The *[QV Parameters]* dialog displays the parameters specified for the creation of that file.

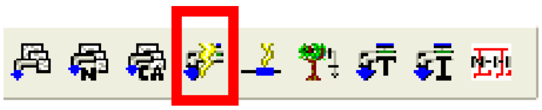


QV Parameters Dialog

Click *[Show results]* to display *[QV Results]* (Figure 11.26, “QV Results Window”).

11.9. Running Probabilistic Reliability Assessment

Requirements / Prerequisites
Validly specified power flow case solved to an acceptable mismatch tolerance. Valid contingency analysis. Running AC Contingency Analysis



Power flow > Reliability > Reliability assessment...

The *[Probabilistic Reliability Assessment]* dialog (Figure 11.28, “Probabilistic Reliability Assessment Dialog”) provides a variety of analysis options with report options available in the following formats:

- System problem summary
- System loss of load
- Bus loss of load
- Branch flow overloading
- Bus voltage violation
- Contingency summary

  with filters for *Probability cutoff* and *Frequency cutoff for the following formats:*

- System problem probabilistic indices
- System load curtailment probabilistic indices
- Bus load curtailment probabilistic indices
- Branch flow overloading probabilistic indices
- Bus voltage violation probabilistic indices
- Contingency summary with outage statistics

Click *[...]* to open the selection windows for the required *Distribution Factor Data file* (*.dfx) and *Contingency Solution Output file* (*.acc). If deterministic reliability indices are computed, a *Reliability Outage Statistics* file (*.prb) is not required.

Click *[Solve]* to process the working case. Solution output is routed to the *Report* tab by default (Figure 11.29, “Probabilistic Reliability Assessment Output, System Problem Summary, Post Contingency”).

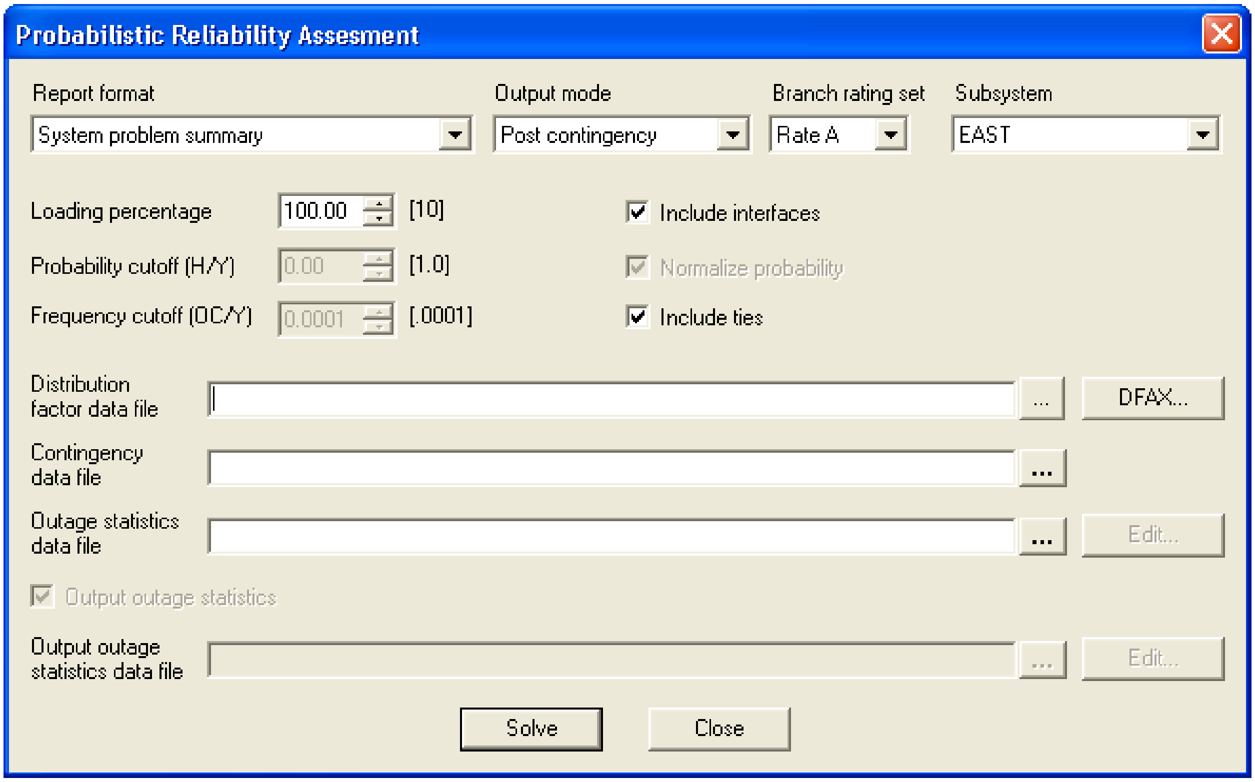


Figure 11.28. Probabilistic Reliability Assessment Dialog

```
. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
.
.                     PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS®E      TUE, SEP 23 2008   13:12
.
.                                                SYSTEM PROBLEM SUMMARY
.
.                                  MONITORED BRANCHES LOADED ABOVE  100.0% OF RATING SET A
.                                          OUTPUT MODE: POST CONTINGENCY SOLUTIONS
. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
AC CONTINGENCY SOLUTION OUTPUT FILES

AC CONTINGENCY RESULTS FILE:  C:\Program Files\PTI\PSSE31\EXAMPLE\TEST2savnw.acc
DISTRIBUTION FACTOR FILE:     C:\Program Files\PTI\PSSE31\EXAMPLE\TESTdfx.dfx
SUBSYSTEM DESCRIPTION FILE:   C:\Program Files\PTI\PSSE31\EXAMPLE\savnw.sub
MONITORED ELEMENT FILE:       C:\Program Files\PTI\PSSE31\EXAMPLE\savnw.mon
CONTINGENCY DESCRIPTION FILE: C:\Program Files\PTI\PSSE31\EXAMPLE\savnw.con

**PERCENT LOADING UNITS**
%MVA FOR TRANSFORMERS
% I  FOR NON-TRANSFORMER BRANCHES

**OPTIONS USED IN CONTINGENCY ANALYSIS**
Solution engine:              Fixed slope decoupled Newton-Raphson (FDNS)
Solution options
  Tap adjustment:             Lock taps
  Area interchange control:   Disable
  Phase shift adjustment:     Disable
  Dc tap adjustment:          Enable
  Switch shunt adjustment:    Enable all
  Non diverge:                Disable
Mismatch tolerance (MW ):     0.5
Dispatch mode:                Subsystem machines (Governor droop)
Dispatch subsystem:           EAST

                                                                     NO. OF    WORST.  WORST CONT.
<--             F A I L U R E   C R I T E R I A              -->      CONT.    VIOL.
AREA 2 BUSES WITH VOLTAGE LESS THAN 0.940 (PU)                           4     0.9075 LOSE2LINESWE
AREA 2 BUSES WITH VOLTAGE GREATER THAN 1.060 (PU)                        3     1.0982 LOSE2LINESWE
OVERLOAD (%)                                                             1   121.6474 LOSEWESTGEN
NOT CONVERGE                                                             5
SUBSYSTEM "EAST" TOTAL                                                   9

CONTINGENCY LEGEND:
LABEL         EVENTS
LOSE2LINESWE: TRIP LINE FROM BUS 3004 [WEST        500.00] TO BUS 152 [MID500      500.00]
              TRIP LINE FROM BUS 3006 [UPTOWN      230.00] TO BUS 153 [MID230      230.00]
LOSEWESTGEN : REMOVE UNIT 1 FROM BUS 3018 [CATDOG_G    13.800]
```

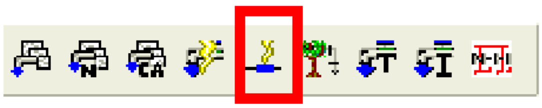
Progress | Alerts/Warnings | **Report**

Figure 11.29. Probabilistic Reliability Assessment Output, System Problem Summary, Post Contingency

Additional Information
PSS® E Program Operation Manual, Calculating Probabilistic Reliability

11.10. Running Substation Reliability Assessment

Requirements / Prerequisites
Validly specified power flow case solved to an acceptable mismatch tolerance. Valid contingency analysis. Running AC Contingency Analysis



Power flow > Reliability > Substation reliability assessment...

The *[Substation Reliability Assessment]* dialog (Figure 11.30, "Substation Reliability Assessment Dialog") provides a variety of analysis options.

- Branch rating set and Flow rating percentage
- Include system tie lines to source/sink systems
- Frequency cutoff
- Peak load percentage
- Switching time
- Stuck breaker fault rate

Report format: allows user selection from among the following reports:

- Substation component report
- Contingency report
- Bus load curtailment report
- Substation load curtailment report

Subsystem selection: allows user specification of the extent of the analysis, to include:

- Substation system
- Source system
- Sink system

Click *[...]* to open the selection windows for the required *Distribution factor data file* (*.dfx) and *Reliability Outage Statistics* file (*.prb) files.

Click *[Solve]* to process the working case. Solution output is routed to the *Report* tab by default.

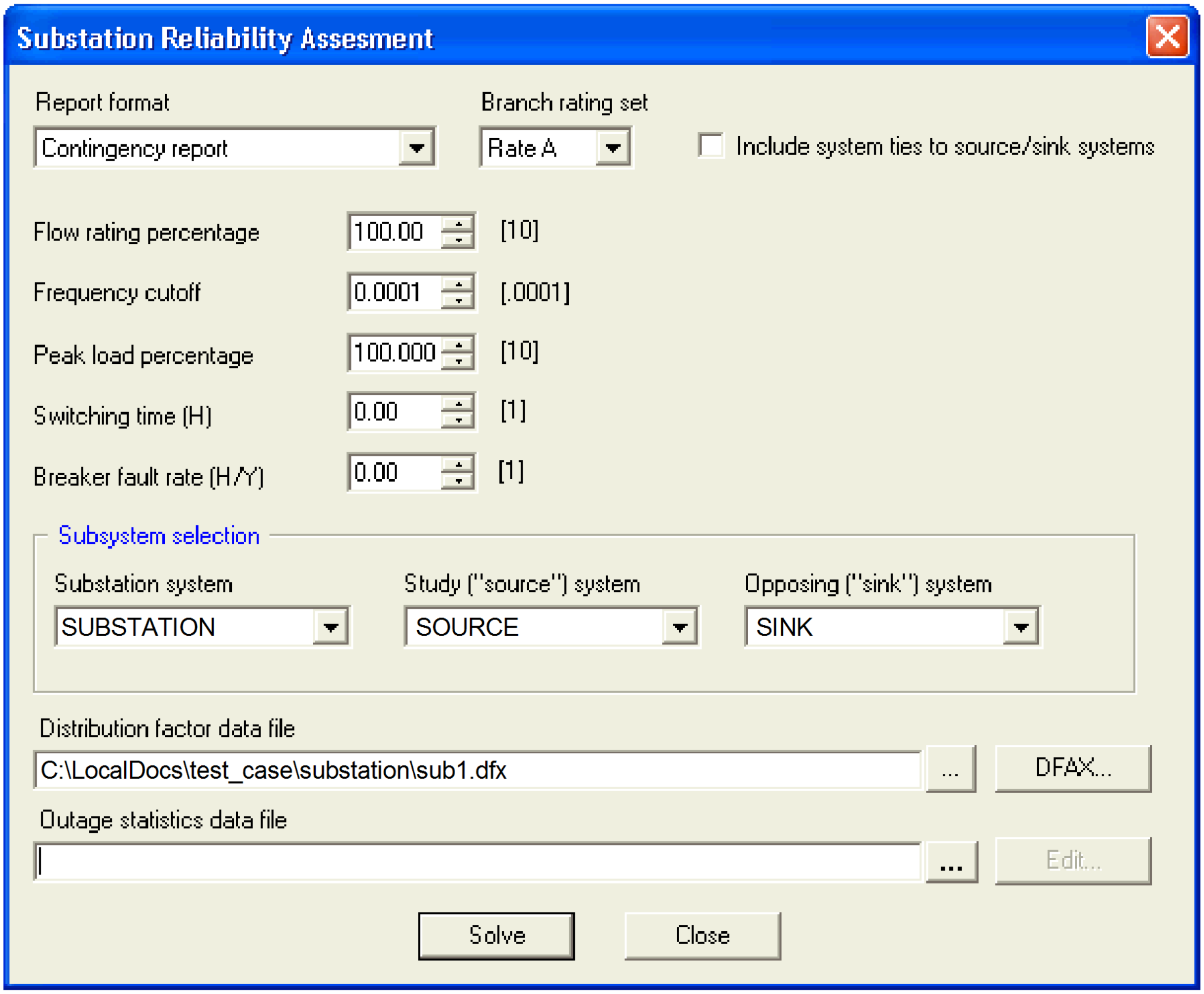


Figure 11.30. Substation Reliability Assessment Dialog

Additional Information
PSS® E Program Operation Manual, Calculating Substation Reliability

Chapter 12
Power Flow Data Verification

PSS®E provides a variety of means by which data can be validated in order to identify suspect parameters, conflicting voltage controls, unacceptable tap controls, and isolated buses or inadvertent islands. The data checking is accompanied by the generation of reports at the *Report* device for examination.

Data checking does not validate the state of a power flow solution.

12.1. Checking Branch Parameters

BRCH

Requirements / Prerequisites
The working case must contain a validly specified power flow case.

Power Flow > Check Data > Branch parameters (BRCH)...

The branch parameter checking activity BRCH tabulates those branches where impedances or other characteristics are such that they may be detrimental to the rate of convergence of one or more of the power flow solution activities.

In the *[Check Branch Parameters]* dialog (Figure 12.1, “Check Branch Parameters Dialog”), one or more data checks may be selected. Seven of the checks use limit or threshold values. The threshold values shown on the dialog may be used, or you may specify different values that might be more appropriate for the working case under examination. Threshold values are specified either by typing them directly in the data value fields or by using the up and down arrow buttons next to each input field.

The check box for the final check, missing zero sequence impedance, is disabled if sequence data is not present in the working case.

The *[Check Branch Parameters]* dialog enables the user to designate for processing either the entire working case or a specified bus subsystem (refer to Section 4.8, Subsystem Selection of the *PSS®E Program Operation Manual)*. A bus subsystem may be specified either via a *[Bus Subsystem Selector]* dialog by clicking *[Select...]*, or by entering buses directly in the *[Check Branch Parameters]* dialog

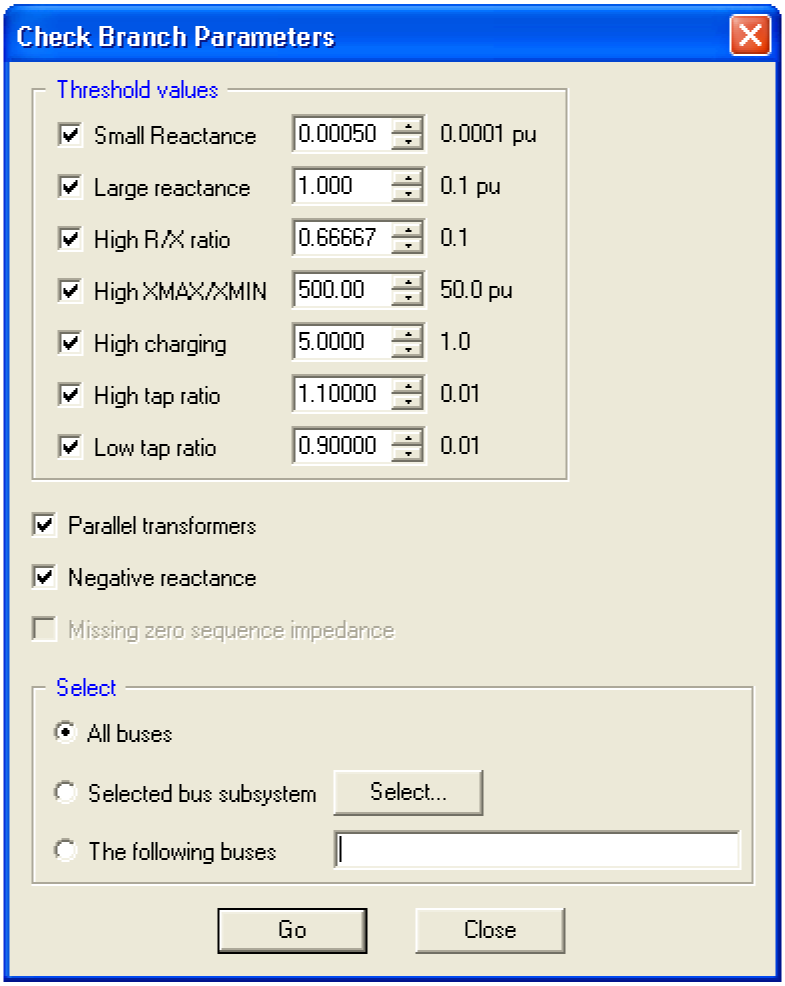


Figure 12.1. Check Branch Parameters Dialog

Additional Information
PSS®E Program Operation Manual, Section 5.27, Checking Branch Parameters *PSS®E Application Program Interface (API)*, Section 1.43, BRCH

12.2. Checking/Changing Controlled Bus Scheduled Voltage

CNTB

Requirements / Prerequisites
The working case must contain a validly specified power flow case solved to an acceptable mismatch level.

Power Flow > Check Data > Check/Change controlled bus scheduled voltages (CNTB)...

The bus scheduled voltage checking activity CNTB tabulates the voltage setpoints and desired voltage bands of voltage controlling equipment in the working case, and, optionally, allows the user to specify new scheduled voltages. It also performs certain checks on voltage controlling buses that are not themselves voltage controlled buses. It may be instructed to process all such buses, or only those with suspect or conflicting voltage schedules or other errors.

In the *[Check / Change Controlled Bus Scheduled Voltages]* dialog (Figure 12.2, " Check/Change Controlled Bus Scheduled Voltages Dialog"), three control options are specified:

- Process either all voltage controlled and controlling buses in the subsystem, or only those with apparent conflicting voltage objective data or other errors:
- Either operate in an interactive mode, in which new voltage schedules may be specified, or in a reporting mode:
- Either include or omit Type 4 controlled buses and out-of-service or disabled controlling equipment in its checking and reporting.

The *[Check / Change Controlled Bus Scheduled Voltages]* dialog enables the user to designate for processing either the entire working case or a specified bus subsystem (refer to Section 4.8, Subsystem Selection of the *PSS®E Program Operation Manual)*. A bus subsystem may be specified either via a *[Bus Subsystem Selector]* dialog by clicking *[Select...]*, or by entering buses directly in the *[Check / Change Controlled Bus Scheduled Voltages]* dialog.

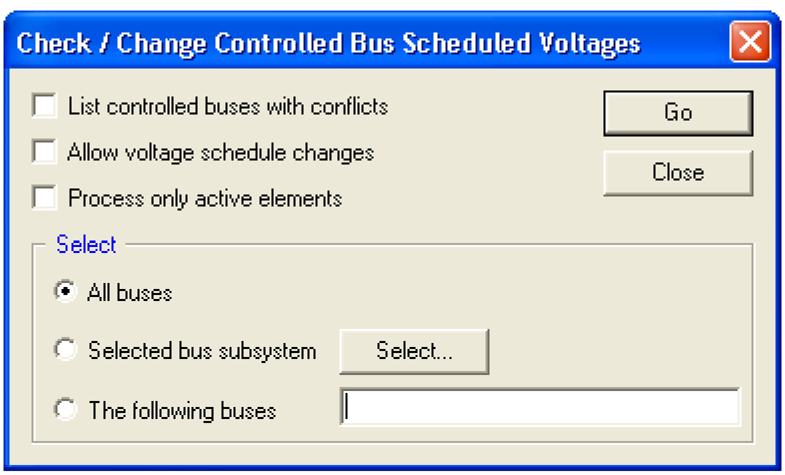


Figure 12.2. Check/Change Controlled Bus Scheduled Voltages Dialog

If the voltage schedule changing option was specified, as each voltage controlled bus is processed, the user has the option of entering a new scheduled voltage (Figure 12.3, “Change Voltage Setpoint Dialog”).

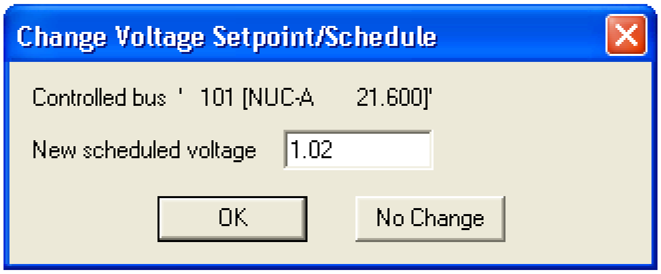


Figure 12.3. Change Voltage Setpoint Dialog

Any voltage controlling transformers with load drop compensation that are controlling voltage at the controlled bus being processed are listed. A new voltage band may be specified for any or all of such transformers (Figure 12.4, “Change Vmin/Vmax Dialog”).

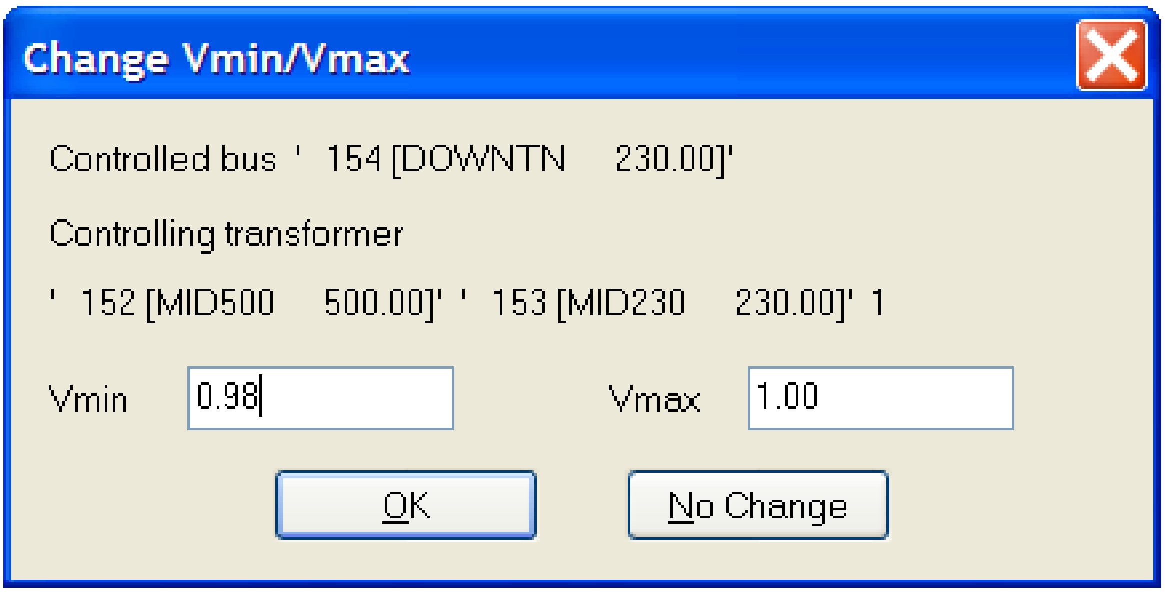


Figure 12.4. Change Vmin/Vmax Dialog

Additional Information
PSS®E Program Operation Manual, Section 5.29, Checking/Changing Controlled Bus Scheduled Voltage *PSS ® E Application Program Interface (API)*, Section 1.57, CNTB

12.3. Checking or Changing Transformer Adjustment Data

TPCH

Requirements / Prerequisites
The working case must contain a validly specified power flow case.

Power Flow > Check Data > Check / Change transformer adjustment data (TPCH)...

The controlling transformer parameter checking activity TPCH performs several checks on the adjustment data associated with voltage and flow controlling transformers.

In the *[Check / Change Transformer Adjustment Data]* dialog (Figure 12.5, "Check/Change Transformer Adjustment Data Dialog"), data checks are selected through check boxes. Those checks that use a threshold value have a value field next to the test description; you may override any default threshold by typing the desired value in its field.

The *[Check / Change Transformer Adjustment Data]* dialog enables the user to designate for processing either the entire working case or a specified bus subsystem (refer to Section 4.8, Subsystem Selection of the *PSS®E Program Operation Manual)*. A bus subsystem may be specified either via a *[Bus Subsystem Selector]* dialog by clicking *[Select...]*, or by entering buses directly in the *[Check / Change Transformer Adjustment Data]* dialog.

If any transformers are listed as failing a check, the user has the option of modifying the data of all transformers tabulated (Figure 7.36, "Economic Dispatch Dialog").

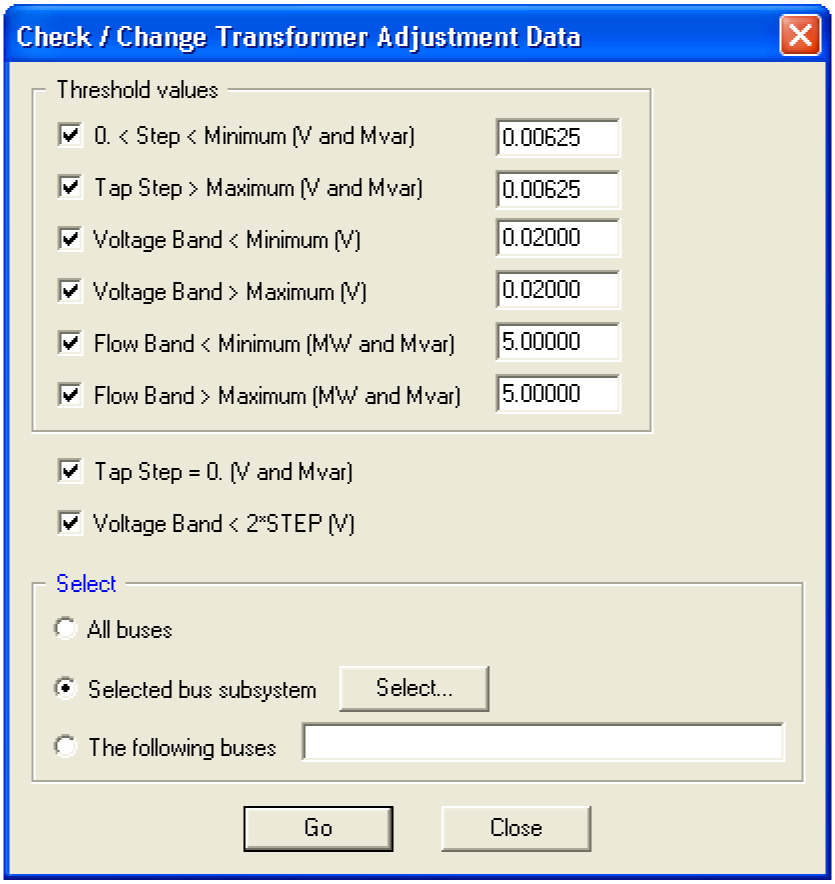


Figure 12.5. Check/Change Transformer Adjustment Data Dialog

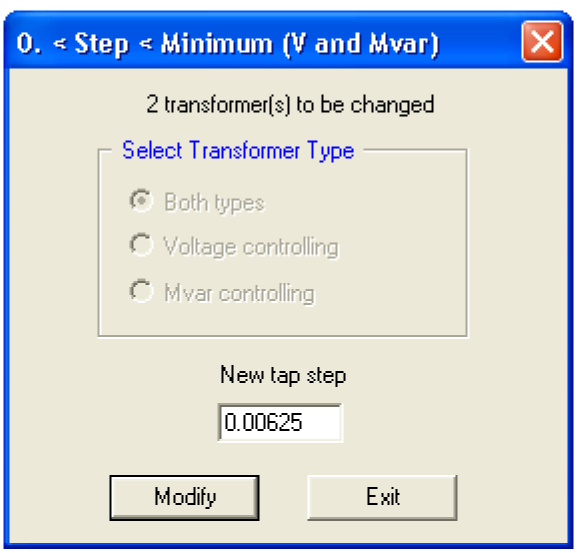
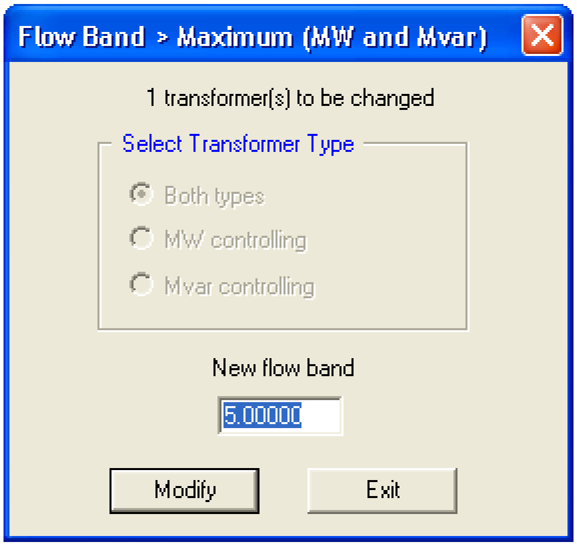


Figure 12.6. Change Transformer Tap Step Dialog



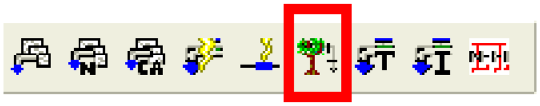
Change Transformer Flow Band Dialog

Additional Information
PSS®E Program Operation Manual, Section 5.30, Checking/Changing Transformer Adjustment Data *PSS® E Application Program Interface (API)*, Section 1.314, TPCH

12.4. Check for Islands Without a Swing Bus

TREE

Requirements / Prerequisites
The working case must contain a validly specified power flow case.



Power Flow > Check Data > Buses not in swing tree (TREE)

The network continuity checking activity TREE enables the user to identify buses not connected back to a Type 3 (swing) bus through the in-service ac network. It also tabulates in-service branches connected to Type 4 (disconnected) buses. Each swingless island may optionally be disconnected.

For each swingless island is detected, a dialog is brought up which allows the user to select the next action of activity TREE:

- Click [Yes] to disconnect this island, and then check for another swingless island.
- Click *[No]* to leave this island unchanged and check for another swingless island.
- Click *[Cancel]* to leave this island unchanged and exit activity TREE.

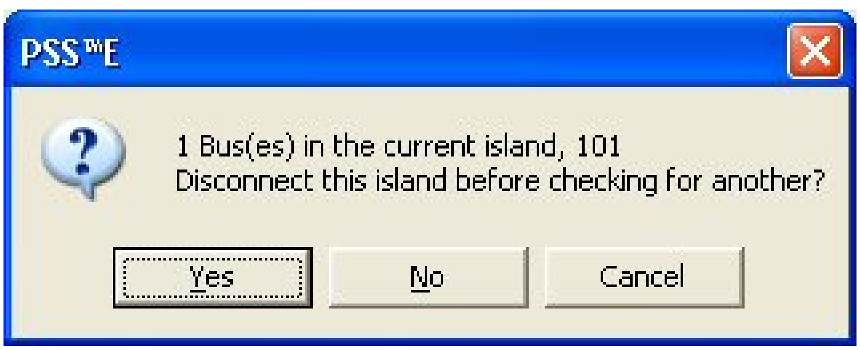


Figure 12.7. Example Dialog of Activity TREE

Additional Information
PSS® E Program Operation Manual, Section 5.28, Check for Islands Without a Swing Bus *PSS® E Application Program Interface (API)*, Section 1.318, TREE

Chapter 13

Linear Network Analysis

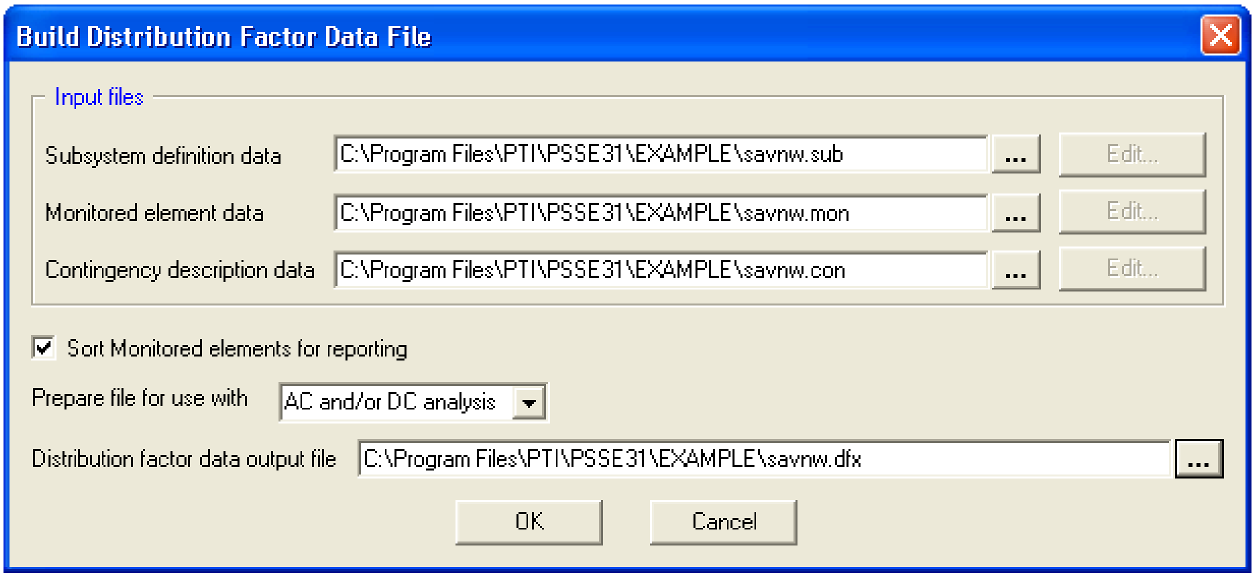
13.1. Building the Distribution Factor Data File

DFAX

Requirements / Prerequisites
Validly specified power flow case solved to an acceptable mismatch tolerance. Subsystem Description File Monitored Element Description File Contingency Description FIle

Power Flow > Linear Network > Build distribution factor data file (DFAX)...

This activity builds the ac contingency analysis distribution factor file. Click *[...]* to open selection windows for each of the required files.



Build Distribution Factor Data File Dialog (EXAMPLE Input Files)

The data files available in the PSS®E EXAMPLE directory can be selected to test the process. A filename for the Distribution Factor Data Output file (*.dfx) is required; it can be a new file or a previously-built file to be over-written.

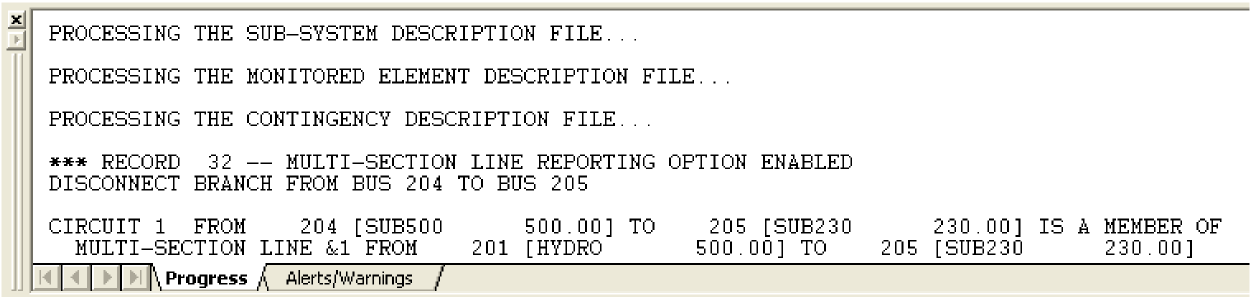
Line outage distribution factors are used by activity DFAX for building Distribution Factor Data Files for specific PSS®E activities as follows:

- *Prepare files for use with AC analysis only:* activities ACCC, IMPC, and LLRF (Section 11.3, "Running AC Contingency Analysis" and Chapter 18, *Transmission Pricing and Open Access*)
- *Prepare files for use with AC and/or DC analysis*: AC analysis plus activities OTDF, DCCC, TLTG, SPIL, Section 13.10, "Running Interchange Limit Analysis with Two Opposing Systems ")Section 13.9, "Calculating

Sequential Participation Interchange Limits ", and Section 13.8, "Calculating Transmission Interchange Limits ", Section 13.6, "Calculating Linearized Network Contingency", Section 13.2, "Calculating and Reporting Distribution Factors", POLY (

Since the information stored in the Distribution Factor Data File is a function of data organization and network topology in the working case, it follows that it must be re-executed before running the desired activity.

Calculation results are routed to the *Progress* tab.



Example of Output from Building the Distribution Factor Data File

Additional Information
PSS®E Program Operation Manual, Building the Distribution Factor Data File

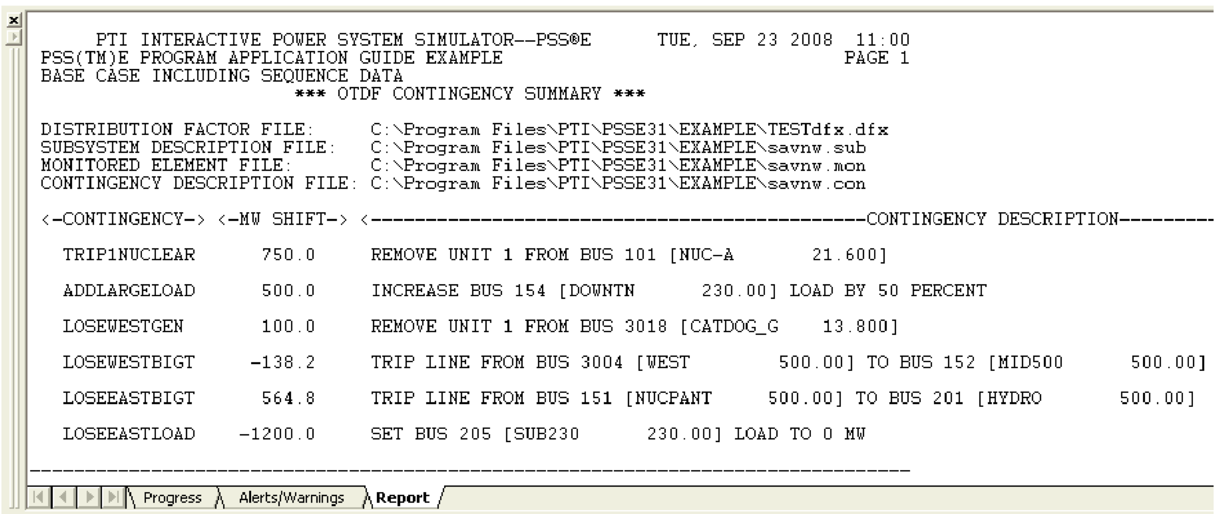
13.2. Calculating and Reporting Distribution Factors

OTDF

Requirements / Prerequisites
Validly specified power flow case solved to an acceptable mismatch tolerance. Distribution Factor Data File (*.dfx) corresponding to the network condition. Building the Distribution Factor Data File

Power Flow > Linear network > Calculate and print distribution factors (OTDF)...

This activity opens a selection screen listing available Distribution Factor Data files. Highlight the desired file and click *[Open]* to complete the process. By default, the report (example provided below) is directed to the *Report* tab.



```
     PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS®E      TUE, SEP 23 2008  11:00
PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE                                PAGE 1
BASE CASE INCLUDING SEQUENCE DATA
                       *** OTDF CONTINGENCY SUMMARY ***

DISTRIBUTION FACTOR FILE:     C:\Program Files\PTI\PSSE31\EXAMPLE\TESTdfx.dfx
SUBSYSTEM DESCRIPTION FILE:   C:\Program Files\PTI\PSSE31\EXAMPLE\savnw.sub
MONITORED ELEMENT FILE:       C:\Program Files\PTI\PSSE31\EXAMPLE\savnw.mon
CONTINGENCY DESCRIPTION FILE: C:\Program Files\PTI\PSSE31\EXAMPLE\savnw.con

<-CONTINGENCY-> <-MW SHIFT-> <---------------------------------------------CONTINGENCY DESCRIPTION---------

  TRIP1NUCLEAR      750.0     REMOVE UNIT 1 FROM BUS 101 [NUC-A       21.600]

  ADDLARGELOAD      500.0     INCREASE BUS 154 [DOWNTN      230.00] LOAD BY 50 PERCENT

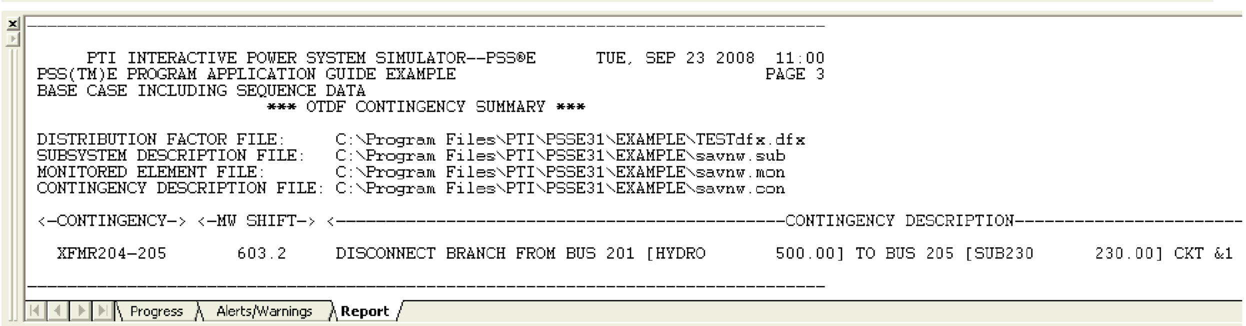
  LOSEWESTGEN       100.0     REMOVE UNIT 1 FROM BUS 3018 [CATDOG_G    13.800]

  LOSEWESTBIGT     -138.2     TRIP LINE FROM BUS 3004 [WEST        500.00] TO BUS 152 [MID500      500.00]

  LOSEEASTBIGT      564.8     TRIP LINE FROM BUS 151 [NUCPANT     500.00] TO BUS 201 [HYDRO       500.00]

  LOSEEASTLOAD    -1200.0     SET BUS 205 [SUB230      230.00] LOAD TO 0 MW

--------------------------------------------------------------------------------
```

```
--------------------------------------------------------------------------------

     PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS®E      TUE, SEP 23 2008  11:00
PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE                                PAGE 3
BASE CASE INCLUDING SEQUENCE DATA
                       *** OTDF CONTINGENCY SUMMARY ***

DISTRIBUTION FACTOR FILE:     C:\Program Files\PTI\PSSE31\EXAMPLE\TESTdfx.dfx
SUBSYSTEM DESCRIPTION FILE:   C:\Program Files\PTI\PSSE31\EXAMPLE\savnw.sub
MONITORED ELEMENT FILE:       C:\Program Files\PTI\PSSE31\EXAMPLE\savnw.mon
CONTINGENCY DESCRIPTION FILE: C:\Program Files\PTI\PSSE31\EXAMPLE\savnw.con

<-CONTINGENCY-> <-MW SHIFT-> <---------------------------------------------CONTINGENCY DESCRIPTION----------------------

  XFMR204-205       603.2     DISCONNECT BRANCH FROM BUS 201 [HYDRO       500.00] TO BUS 205 [SUB230      230.00] CKT &1

--------------------------------------------------------------------------------
```


Example of OTDF Contingency Summaries (pages 1 and 3)

```
--------------------------------------------------------------------------------

     PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS®E      TUE, SEP 23 2003  11:00
PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE                               PAGE 2
BASE CASE INCLUDING SEQUENCE DATA
                    *** OTDF DISTRIBUTION FACTOR TABLE ***

                                   CONTINGENCY LABEL--> BASE CASE MW TRIP1NUCLEAR ADDLARGELOAD  LOSEWESTGEN LOSEWESTBIGT LOSEEASTBIGT LOSEEASTLOAD
                                    POWER SHIFT (MW)-->   AC     DC      750.0        500.0        100.0       -138.2        564.8      -1200.0
<-------- FROM ---------> <---------- TO ---------->CKT <----> <----><-----------> <-----------> <-----------> <-----------> <-----------> <----------->
   201 HYDRO       500.00    151 NUCPANT     500.00 1 -564.8 -558.7   0.41339     -0.07415     -0.04159      0.06946      1.00000     -0.09100
   202 EAST500     500.00    152 MID500      500.00 1  -42.6  -50.7  -0.14785     -0.21055     -0.11808      0.19723     -0.68187     -0.24222
   203 EAST230     230.00    154 DOWNTN      230.00 1  122.4  122.4  -0.04237      0.07663      0.04298     -0.07178     -0.00808      0.03490
   205 SUB230      230.00    154 DOWNTN      230.00 1  354.2  356.1  -0.22317      0.20808      0.11669     -0.19491     -0.31005     -0.70168
  3001 MINE        230.00   3002 E. MINE     500.00 1   56.0   57.3   0.34914      0.33780      0.32009     -0.13514     -0.00801      0.33903
  3004 WEST        500.00    152 MID500      500.00 1 -138.2 -132.2   0.42977      0.34592      0.21485     -1.00000     -0.05931      0.35496
  3004 WEST        500.00   3005 WEST        230.00 1  193.2  188.5  -0.08063     -0.00811      0.10524      0.86486      0.05130     -0.01593
  3005 WEST        230.00   3008 CATDOG      230.00 1  135.9  133.0   0.13416      0.19828      0.33292      0.21377      0.04536      0.19137
  3006 UPTOWN      230.00    153 MID230      230.00 1  -78.6  -78.6   0.30190      0.25751      0.11931      0.57245     -0.03140      0.26230
  3008 CATDOG      230.00    154 DOWNTN      230.00 1   69.0   62.9   0.26833      0.39657     -0.33416      0.42755      0.09071      0.38274
  3008 CATDOG      230.00   3018 CATDOG_G    13.800 1 -100.0 -100.0   0.00000      0.00000      1.00000      0.00000      0.00000      0.00000
       INTERFACE WEST                                 -147.9 -147.9   1.00000      1.00000      0.00000      0.00000      0.00000      1.00000
       INTERFACE EAST                                 -130.8 -130.8   0.00000      0.00000      0.00000      0.00000      0.00000     -1.00000

--------------------------------------------------------------------------------
Progress  Alerts/Warnings  Report
```

```
--------------------------------------------------------------------------------

     PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS®E      TUE, SEP 23 2003  11:00
PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE                               PAGE 4
BASE CASE INCLUDING SEQUENCE DATA
                    *** OTDF DISTRIBUTION FACTOR TABLE ***

                                   CONTINGENCY LABEL--> BASE CASE MW  XFMR204-205
                                    POWER SHIFT (MW)-->   AC     DC      603.2
<-------- FROM ---------> <---------- TO ---------->CKT <----> <----><----------->
   201 HYDRO       500.00    151 NUCPANT     500.00 1 -564.8 -558.7   0.41592
   202 EAST500     500.00    152 MID500      500.00 1  -42.6  -50.7   0.12028
   203 EAST230     230.00    154 DOWNTN      230.00 1  122.4  122.4   0.13140
   205 SUB230      230.00    154 DOWNTN      230.00 1  354.2  356.1  -0.66760
  3001 MINE        230.00   3002 E. MINE     500.00 1   56.0   57.3  -0.01351
  3004 WEST        500.00    152 MID500      500.00 1 -138.2 -132.2  -0.09997
  3004 WEST        500.00   3005 WEST        230.00 1  193.2  188.5   0.08646
  3005 WEST        230.00   3008 CATDOG      230.00 1  135.9  133.0   0.07644
  3006 UPTOWN      230.00    153 MID230      230.00 1  -78.6  -78.6  -0.05292
  3008 CATDOG      230.00    154 DOWNTN      230.00 1   69.0   62.9   0.15289
  3008 CATDOG      230.00   3018 CATDOG_G    13.800 1 -100.0 -100.0   0.00000
       INTERFACE WEST                                 -147.9 -147.9   0.00000
       INTERFACE EAST                                 -130.8 -130.8   0.00000
Progress  Alerts/Warnings  Report
```

Example of OTDF Distribution Factor Tables (pages 2 and 4)

Additional Information
PSS® E Program Operation Manual, Calculating Distribution Factors

13.3. Estimating Severity Rankings for Single Line Outage Contingencies

RANK

Requirements / Prerequisites
Validly specified power flow case solved to an acceptable mismatch tolerance. When ranking contingencies with respect to line overloading, Subsystem Description Data File (*.sub) and Monitored Element Description File (*.mon) Subsystem Description File Monitored Element Description File

Power Flow > Linear Network > Single-line contingency ranking (RANK)...

Default solution and output control parameters may be changed using the *[Single Contingency Ranking]* dialog (Figure 13.1, "Single Contingency Ranking Dialog"). Click *[...]* to open selection windows for each of the required files. A filename for the *Contingency Solution Output file* (*.acc) is required.

Click *[OK]* to perform the activity. A summary is routed to the *Progress* tab (Figure 13.2, "Example of Single Contingency Ranking Output").

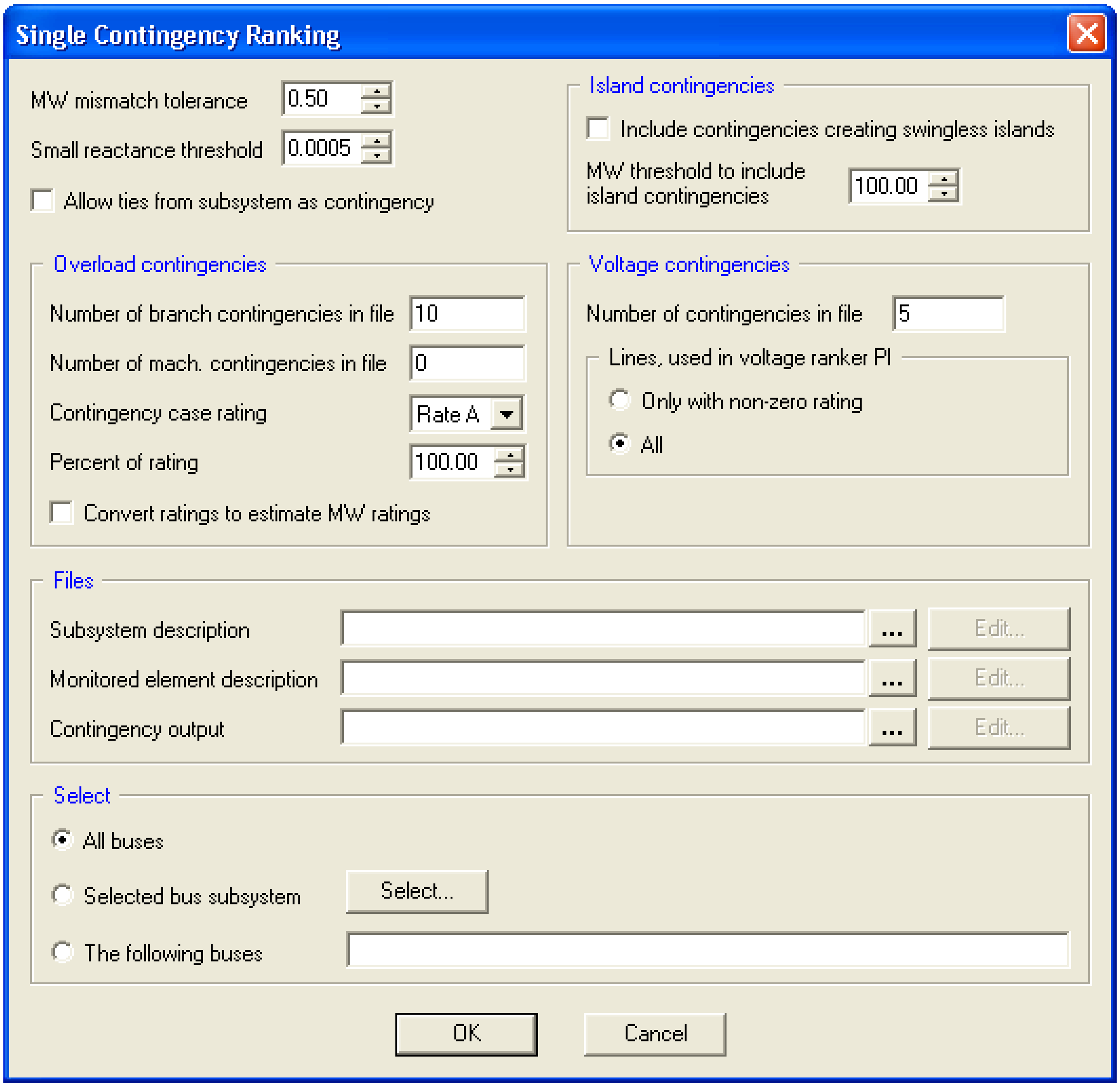


Figure 13.1. Single Contingency Ranking Dialog

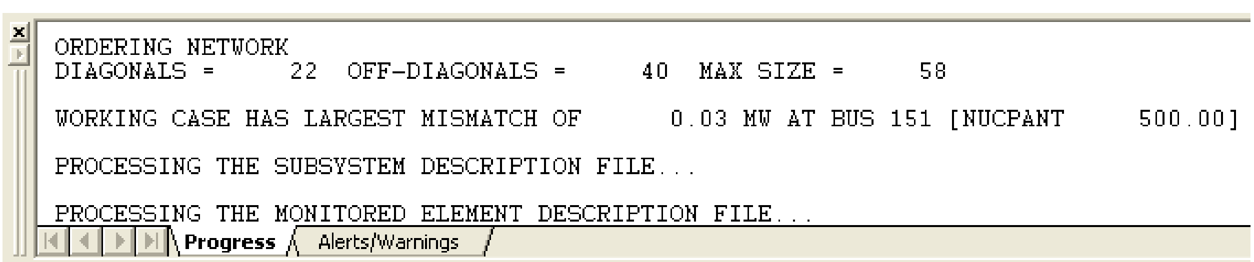
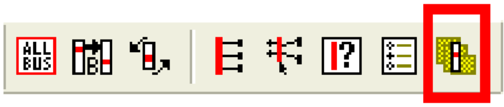


Figure 13.2. Example of Single Contingency Ranking Output

Additional Information
PSS® E Program Operation Manual, Estimating Severity Rankings for Single Line Outage Contingencies

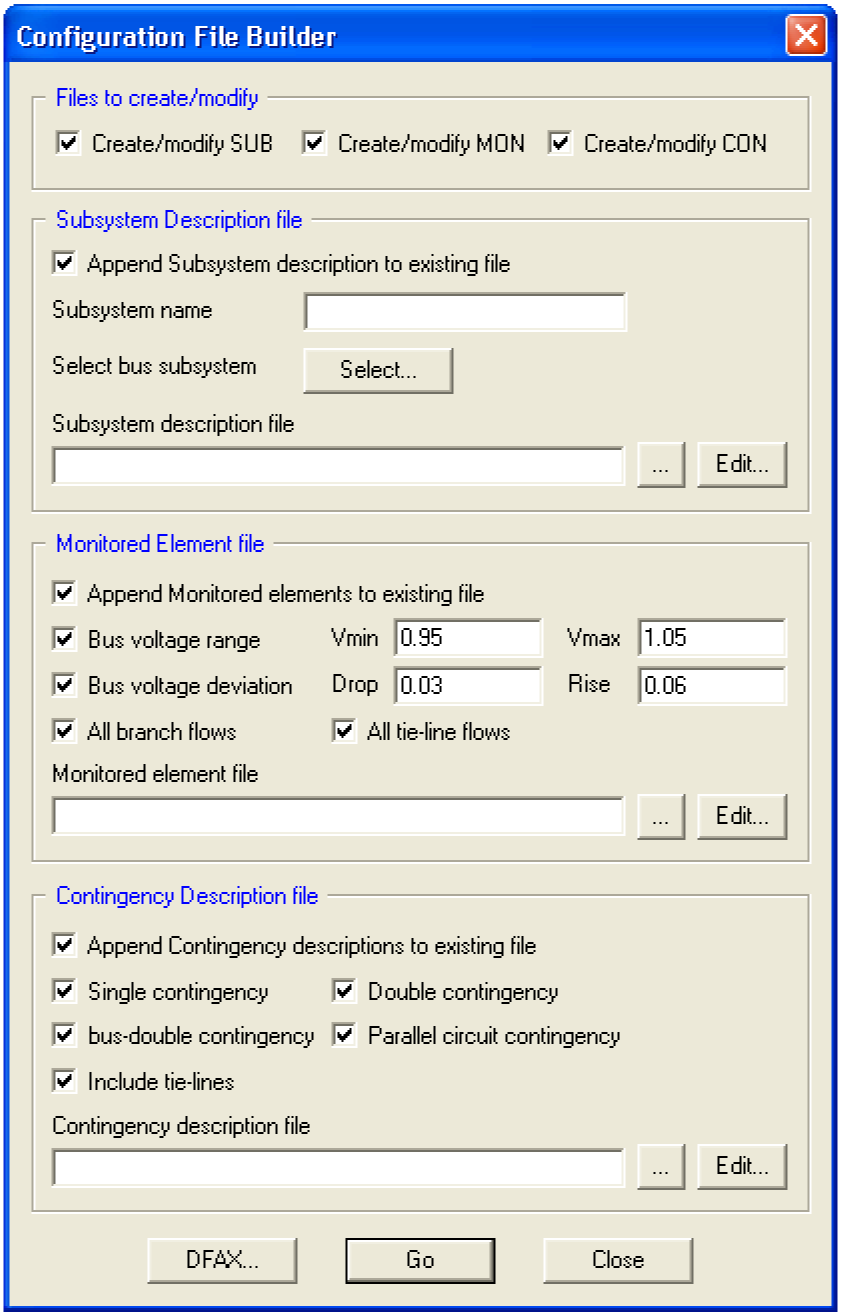
13.4. Creating Configuration Files



Power Flow > Linear Network > Create/modify SUB, MON and CON configuration files...

The *[Configuration File Builder]* dialog provides a method to create or modify supporting Input files that build the Distribution Factor Data file (see Section 13.1, “Building the Distribution Factor Data File”) one at a time or in a group. While not every complex contingency can be created using *[Configuration File Builder]*, most of the commonly used contingencies can be created with just a few clicks.

If a text file editor has been specified (see Changing Program Preferences), additional contingencies can be added to the configuration files created by *[Configuration File Builder]* by clicking *[Edit...]*.



Configuration File Builder Dialog

13.4.1. Subsystem Description File

This portion of *[Configuration File Builder]* contains a checkbox to enable appending the subsystem data to an existing file. A *Subsystem name* must be specified. Click *[...]* to open the selection window for the required *Subsystem Description file* (*.sub); it can be a new file or a previously-built file to be over-written.

Click *[Go]* to create/modify the file. The message `Configuration files created` is routed to the Progress tab.

13.4.2. Monitored Element Description File

This portion of *[Configuration File Builder]* contains a checkbox to enable appending the monitored elements data to an existing file. Thresholds may be specified for bus voltage and voltage deviation. Checkboxes are available to enable selection of all branch and all tie-line flows. A *Subsystem name* must be specified in the *Subsystem Description file* section. Click *[...]* to open the selection window for the required *Monitored Element Description file* (*.mon); it can be a new file or a previously-built file to be over-written.

Click *[Go]* to create/modify the file. The message `Configuration files created` is routed to the Progress tab.

13.4.3. Contingency Description FIle

This portion of *[Configuration File Builder]* contains a checkbox to enable appending the contingency data to an existing file. Checkboxes are available to enable contingency type and the inclusion of tie-lines. A *Subsystem name* must be specified in the *Subsystem Description file* section. Click *[...]* to open the selection window for the required Contingency Description Data file (*.con); it can be a new file or a previously-built file to be over-written.

Click *[Go]* to create/modify the file. The message `Configuration files created` is routed to the Progress tab.

Additional Information
PSS® E Program Operation Manual, Subsystem Description Data File Contents Monitored Element Data File Contents Contingency Description Data File Contents

13.5. Running the DC Linearized Network Solution

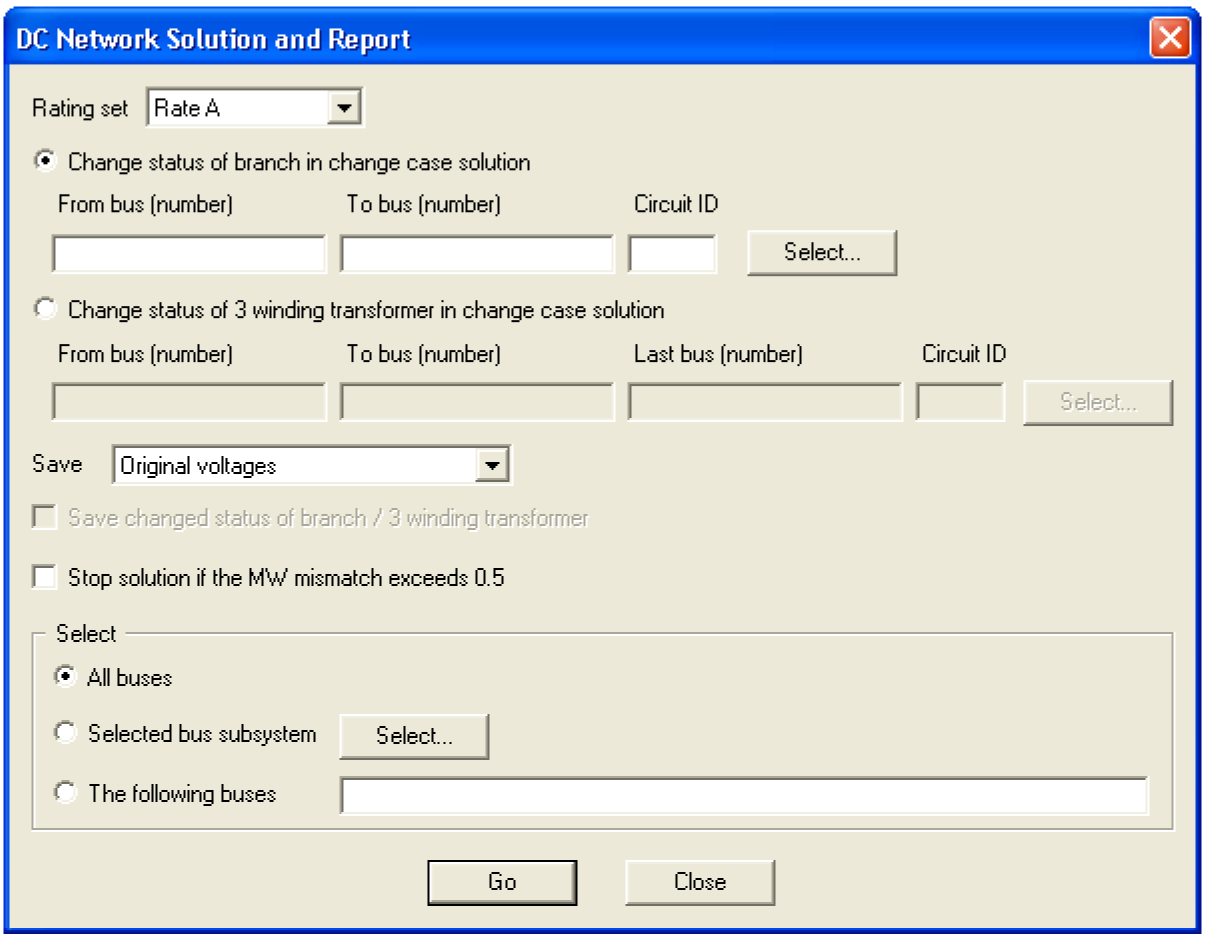
DCLF

Requirements / Prerequisites
Validly specified power flow case, normally solved to an acceptable mismatch tolerance.

Power Flow > Linear Network > DC network solution and report (DCLF)...

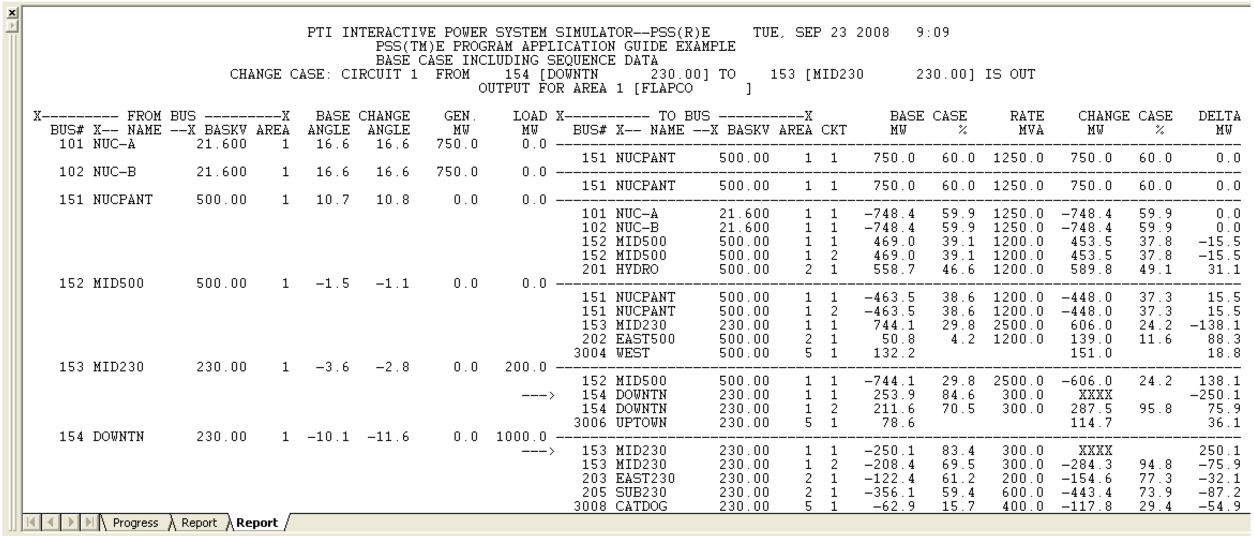
The dc power flow model is useful for rapid calculation of real power flow. The *[DC Network Solution and Report]* dialog requires the specification of status change for either a branch or a 3-winding transformer in the change case. It provides options to save one of the following voltage specifications:

- Original voltages
- Base case dc power flow voltage angle
- Change case dc power flow voltage angle



DC Network Solution and Report Dialog

Click *[Go]* to perform the activity. The report is routed to the *Report* tab by default (Figure 13.3, "Example of DC Network Solution Output").



```
                          PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS(R)E     TUE, SEP 23 2008    9:09
                                  PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE
                                  BASE CASE INCLUDING SEQUENCE DATA
                 CHANGE CASE: CIRCUIT 1  FROM    154 [DOWNTN      230.00] TO    153 [MID230      230.00] IS OUT
                                                    OUTPUT FOR AREA 1 [FLAPCO      ]

X--------- FROM BUS ---------X  BASE CHANGE   GEN.    LOAD X---------- TO BUS ----------X     BASE CASE    RATE   CHANGE CASE   DELTA
  BUS# X-- NAME --X BASKV AREA ANGLE  ANGLE    MW       MW   BUS# X-- NAME --X BASKV AREA CKT    MW    %     MVA     MW     %       MW
   101 NUC-A       21.600    1   16.6   16.6  750.0     0.0 ------------------------------------------------------------------------------
                                                              151 NUCPANT      500.00    1  1   750.0   60.0 1250.0   750.0   60.0     0.0
   102 NUC-B       21.600    1   16.6   16.6  750.0     0.0 ------------------------------------------------------------------------------
                                                              151 NUCPANT      500.00    1  1   750.0   60.0 1250.0   750.0   60.0     0.0
   151 NUCPANT     500.00    1   10.7   10.8    0.0     0.0 ------------------------------------------------------------------------------
                                                              101 NUC-A        21.600    1  1  -748.4   59.9 1250.0  -748.4   59.9     0.0
                                                              102 NUC-B        21.600    1  1  -748.4   59.9 1250.0  -748.4   59.9     0.0
                                                              152 MID500       500.00    1  1   469.0   39.1 1200.0   453.5   37.8   -15.5
                                                              152 MID500       500.00    1  2   469.0   39.1 1200.0   453.5   37.8   -15.5
                                                              201 HYDRO        500.00    2  1   558.7   46.6 1200.0   589.8   49.1    31.1
   152 MID500      500.00    1   -1.5   -1.1    0.0     0.0 ------------------------------------------------------------------------------
                                                              151 NUCPANT      500.00    1  1  -463.5   38.6 1200.0  -448.0   37.3    15.5
                                                              151 NUCPANT      500.00    1  2  -463.5   38.6 1200.0  -448.0   37.3    15.5
                                                              153 MID230       230.00    1  1   744.1   29.8 2500.0   606.0   24.2  -138.1
                                                              202 EAST500      500.00    2  1    50.8    4.2 1200.0   139.0   11.6    88.3
                                                             3004 WEST         500.00    5  1   132.2                 151.0            18.8
   153 MID230      230.00    1   -3.6   -2.8    0.0   200.0 ------------------------------------------------------------------------------
                                                              152 MID500       500.00    1  1  -744.1   29.8 2500.0  -606.0   24.2   138.1
                                                        ---> 154 DOWNTN       230.00    1  1   253.9   84.6  300.0    XXXX          -250.1
                                                              154 DOWNTN       230.00    1  2   211.6   70.5  300.0   287.5   95.8    75.9
                                                             3006 UPTOWN       230.00    5  1    78.6                 114.7            36.1
   154 DOWNTN      230.00    1  -10.1  -11.6    0.0  1000.0 ------------------------------------------------------------------------------
                                                        ---> 153 MID230       230.00    1  1  -250.1   83.4  300.0    XXXX           250.1
                                                              153 MID230       230.00    1  2  -208.4   69.5  300.0  -284.3   94.8   -75.9
                                                              203 EAST230      230.00    2  1  -122.4   61.2  200.0  -154.6   77.3   -32.1
                                                              205 SUB230       230.00    2  1  -356.1   59.4  600.0  -443.4   73.9   -87.2
                                                             3008 CATDOG       230.00    5  1   -62.9   15.7  400.0  -117.8   29.4   -54.9
```


Figure 13.3. Example of DC Network Solution Output

Additional Information
PSS® E Program Operation Manual, Applying the DC Linearized Network Solution

13.6. Calculating Linearized Network Contingency

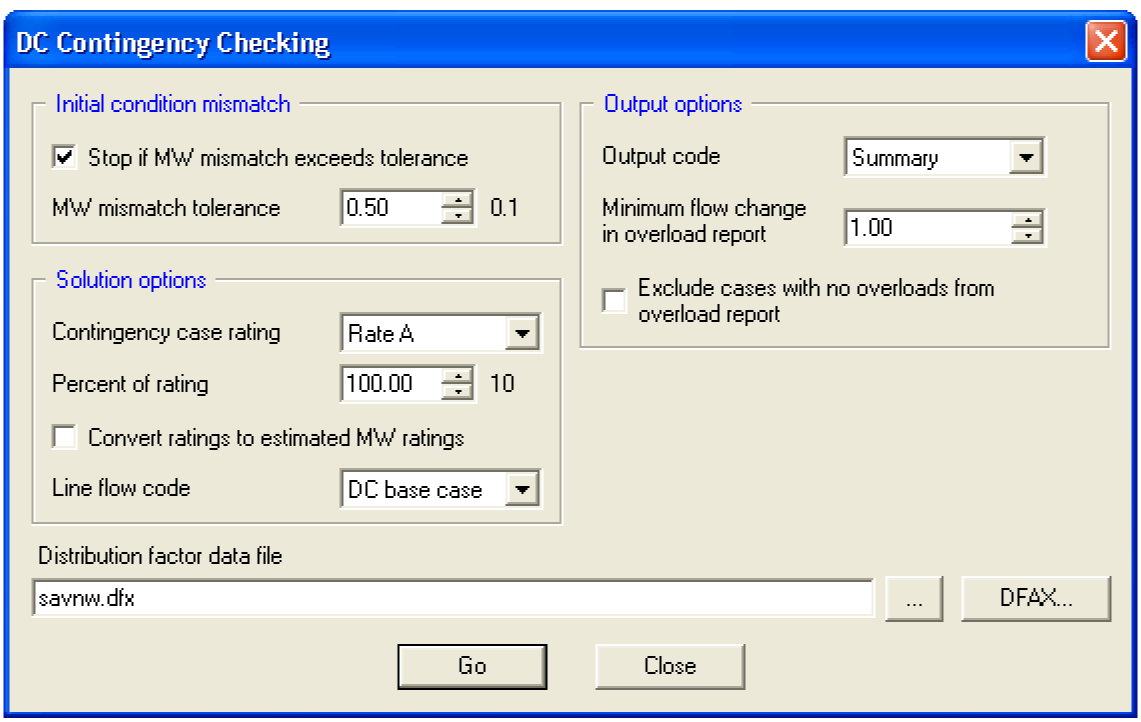
DCCC

Requirements / Prerequisites
Validly specified power flow case solved to an acceptable mismatch tolerance. Distribution Factor Data File (*.dfx) corresponding to the network condition. Building the Distribution Factor Data File

Power Flow > Linear Network > DC contingency checking (DCCC)...

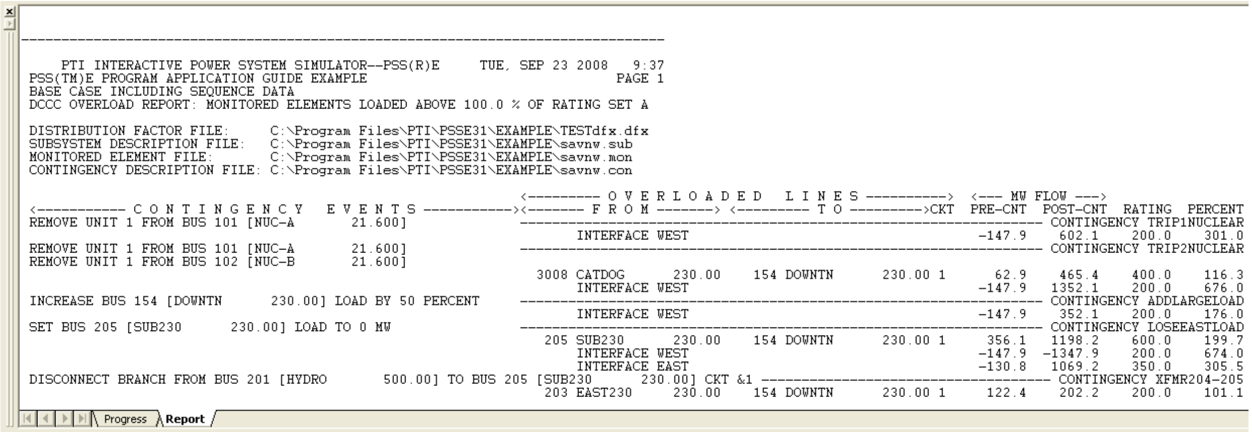
This activity estimates flows on a set of monitored elements for the base case and for a specified set of contingency cases, producing either an overload report or a loading table for each case. The *[DC Contingency Checking]* dialog (Section 13.8, "Calculating Transmission Interchange Limits ") provides a variety of solution and output options. Click *[...]* to open the selection window for the required *Distribution factor data file* (*.dfx).

The Distribution Factor Data file must contain distribution factors to perform this activity. Rerun Building the Distribution Factor Data File with with the *Calculate Distribution factors* option selected if a warning is displayed.



DC Contingency Checking Dialog

Click *[Go]* to perform the activity. The contingency event summary is routed to the *Report* tab by default (Figure 13.4, “Network Contingency Report ”).



```
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    PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS(R)E     TUE, SEP 23 2008   9:37
 PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE                              PAGE 1
 BASE CASE INCLUDING SEQUENCE DATA
 DCCC OVERLOAD REPORT: MONITORED ELEMENTS LOADED ABOVE 100.0 % OF RATING SET A

 DISTRIBUTION FACTOR FILE:     C:\Program Files\PTI\PSSE31\EXAMPLE\TESTdfx.dfx
 SUBSYSTEM DESCRIPTION FILE:   C:\Program Files\PTI\PSSE31\EXAMPLE\savnw.sub
 MONITORED ELEMENT FILE:       C:\Program Files\PTI\PSSE31\EXAMPLE\savnw.mon
 CONTINGENCY DESCRIPTION FILE: C:\Program Files\PTI\PSSE31\EXAMPLE\savnw.con

                                                             <--------- O V E R L O A D E D   L I N E S ----------> <--- MW FLOW --->
 <----------- C O N T I N G E N C Y   E V E N T S ----------><------- F R O M -------> <---------- T O --------->CKT  PRE-CNT  POST-CNT  RATING  PERCENT
 REMOVE UNIT 1 FROM BUS 101 [NUC-A       21.600]             ---------------------------------------------------------------- CONTINGENCY TRIP1NUCLEAR
                                                                    INTERFACE WEST                                   -147.9    602.1    200.0    301.0
 REMOVE UNIT 1 FROM BUS 101 [NUC-A       21.600]             ---------------------------------------------------------------- CONTINGENCY TRIP2NUCLEAR
 REMOVE UNIT 1 FROM BUS 102 [NUC-B       21.600]
                                                               3008 CATDOG       230.00    154 DOWNTN       230.00 1    62.9    465.4    400.0    116.3
                                                                    INTERFACE WEST                                   -147.9   1352.1    200.0    676.0
 INCREASE BUS 154 [DOWNTN      230.00] LOAD BY 50 PERCENT    ---------------------------------------------------------------- CONTINGENCY ADDLARGELOAD
                                                                    INTERFACE WEST                                   -147.9    352.1    200.0    176.0
 SET BUS 205 [SUB230      230.00] LOAD TO 0 MW               ---------------------------------------------------------------- CONTINGENCY LOSEEASTLOAD
                                                                205 SUB230       230.00    154 DOWNTN       230.00 1   356.1   1198.2    600.0    199.7
                                                                    INTERFACE WEST                                   -147.9  -1347.9    200.0    674.0
                                                                    INTERFACE EAST                                   -130.8   1069.2    350.0    305.5
 DISCONNECT BRANCH FROM BUS 201 [HYDRO       500.00] TO BUS 205 [SUB230       230.00] CKT &1 ------------------------------ CONTINGENCY XFMR204-205
                                                                203 EAST230      230.00    154 DOWNTN       230.00 1   122.4    202.2    200.0    101.1
```


Figure 13.4. Network Contingency Report

Additional Information
PSS® E Program Operation Manual, Calculating Linearized Network Contingency

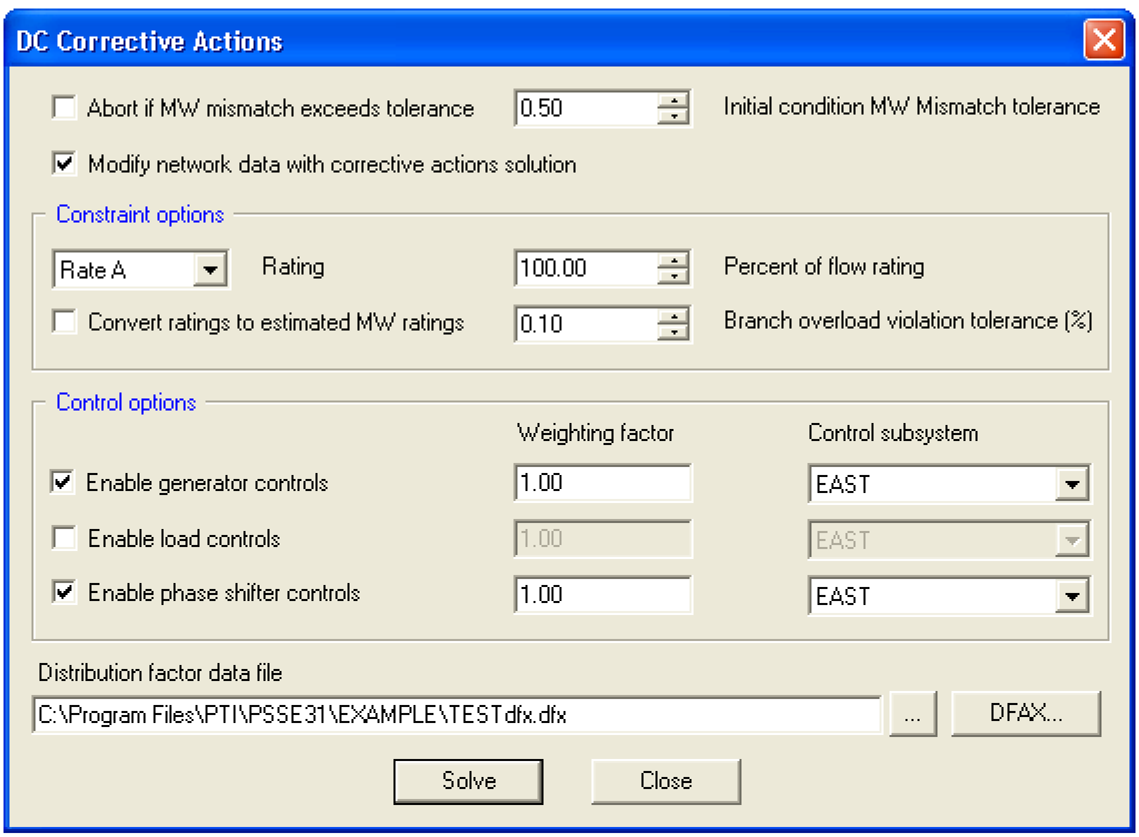
13.7. Running DC Corrective Action Analysis

Requirements / Prerequisites
Validly specified power flow case solved to an acceptable mismatch tolerance. Distribution Factor Data File (*.dfx) corresponding to the network condition. Building the Distribution Factor Data File

Power Flow > Linear Network > DC corrective actions...

The *[DC Corrective Actions]* dialog (Section 13.7, “Running DC Corrective Action Analysis”) provides a variety of constraint and control options. Click *[...]* to open the selection window for the required *Distribution factor data file* (*.dfx).

The Distribution Factor Data file must contain distribution factors to perform this activity. Rerun Building the Distribution Factor Data File with the *Prepare files for use with AC and/or DC analysis* option selected if a warning is displayed.



DC Corrective Actions Dialog

Click *[Solve]* to perform the activity. A summary is routed to the *Progress* tab.

Additional Information
PSS® E Program Operation Manual, Performing DC Corrective Action Analysis

13.8. Calculating Transmission Interchange Limits

TLTG

Requirements / Prerequisites
Validly specified power flow case solved to an acceptable mismatch tolerance. Distribution Factor Data File (*.dfx) corresponding to the network condition in the working case. Building the Distribution Factor Data File

Power Flow > Linear Network > Transmission interchange limits calculation (TLTG)...

The *[Transmission Interchange Limits Calculation]* dialog (Figure 13.5, "Transmission Interchange Limits Calculation Dialog") provides a variety of solution and output options. Click *[...]* to open the selection window for the required *Distribution Factor Data file* (*.dfx).

The Distribution Factor Data file must contain distribution factors to perform this activity. Rerun Building the Distribution Factor Data File with the *Calculate Distribution factors* option selected if a warning is displayed.

Click *[OK]* to perform the activity. A summary of the activity is routed to the *Progress* tab. The analysis is routed to the *Report* tab by default (Figure 13.6, "Example of Export Limit Summary Report (page 1)").

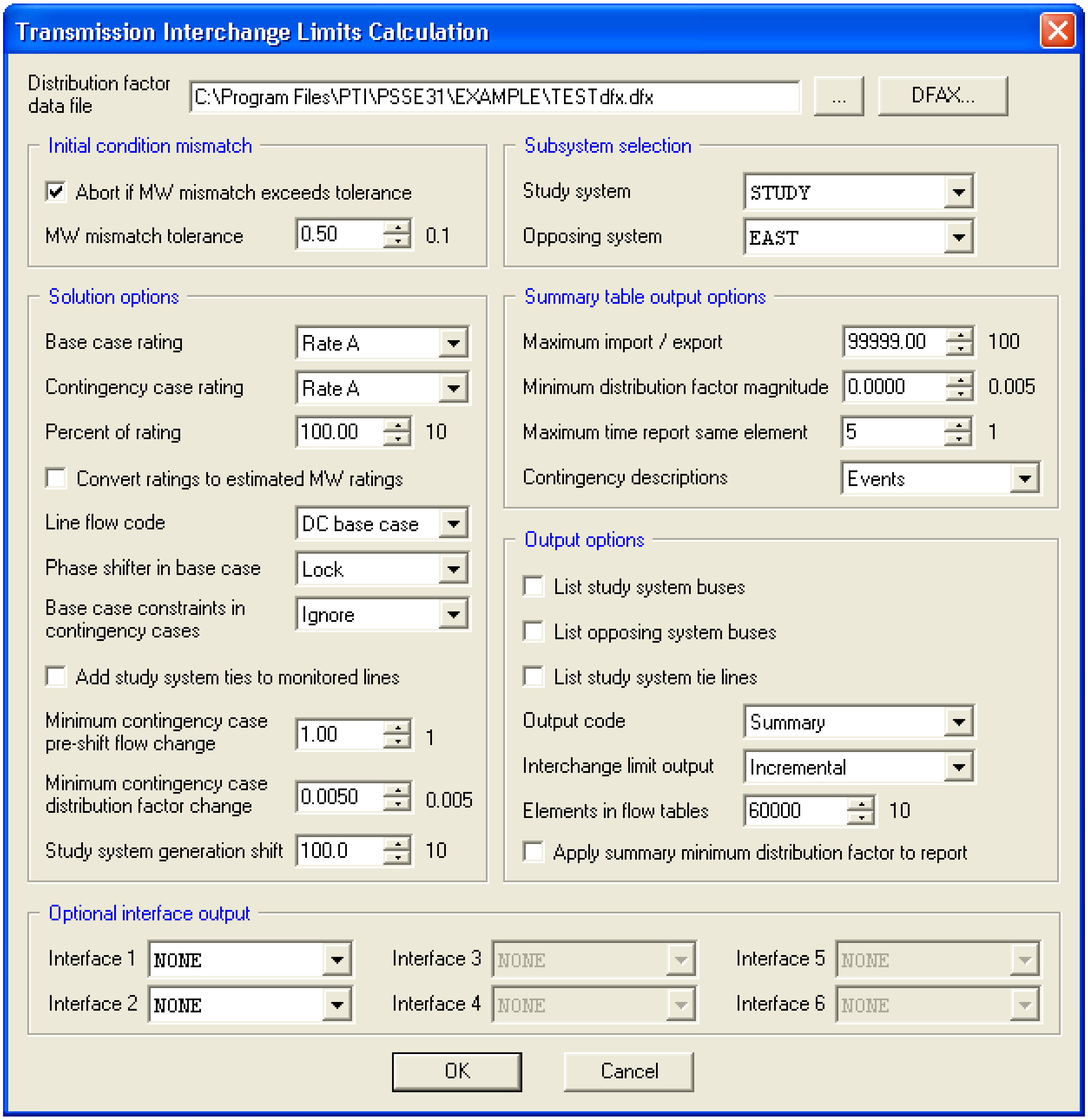


Figure 13.5. Transmission Interchange Limits Calculation Dialog

```
     PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS®E      WED, SEP 24 2008    9:06
PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE                               PAGE 1
BASE CASE INCLUDING SEQUENCE DATA
        *** TLTG EXPORT LIMIT OUTPUT FOR BASE CASE                ***

DISTRIBUTION FACTOR FILE:     C:\Program Files\PTI\PSSE31\EXAMPLE\TESTdfx.dfx
SUBSYSTEM DESCRIPTION FILE:   C:\Program Files\PTI\PSSE31\EXAMPLE\savnw.sub
MONITORED ELEMENT FILE:       C:\Program Files\PTI\PSSE31\EXAMPLE\savnw.mon
CONTINGENCY DESCRIPTION FILE: C:\Program Files\PTI\PSSE31\EXAMPLE\savnw.con

                                PRE-SHIFT     DELTA  POST-SHIFT
STUDY SYSTEM MW GENERATION:       1500.0      100.0    1600.0
OPPOSING SYSTEM MW GENERATION:    1400.0     -100.0    1300.0
STUDY SYSTEM NET INTERCHANGE:      278.7      100.0     378.7

<---------------- STUDY SYSTEM -----------------> <--------------- OPPOSING SYSTEM --------------->
                         <---- GENERATOR MW ---->                           <---- GENERATOR MW ---->
  BUS# X-- NAME --X BASKV    BASE    SHIFT  CHANGE   BUS# X-- NAME --X BASKV    BASE    SHIFT  CHANGE
   101 NUC-A         21.600  750.0   800.0    50.0    206 URBGEN       18.000  800.0   742.0   -58.0
   102 NUC-B         21.600  750.0   800.0    50.0    211 HYDRO_G      20.000  600.0   558.0   -42.0

LOADINGS AT OR ABOVE 100.0 %                                        <------------- BASE CASE ------------->
OF RATING ARE MARKED WITH '*'                            INCR.          PRE-    POST-   LIMIT
                                                         TRANS RATING  SHIFT   SHIFT    CASE      DISTR.
<------- F R O M -------> <---------- T O ---------> CKT  CAPAB    A      MW      MW       MW      FACTOR
       INTERFACE EAST                                     219.2   350  -130.8  -230.8  -350.0* -1.00000
   201 HYDRO         500.00     151 NUCPANT      500.00  1   1051.7  1200  -558.7  -619.7  -692.4  -0.60981
   203 EAST230       230.00     154 DOWNTN       230.00  1   1764.5   200   122.4   126.8   132.1   0.04396
   205 SUB230        230.00     154 DOWNTN       230.00  1   3091.4   600   356.1   325.2   288.3  -0.30929
  3008 CATDOG        230.00     154 DOWNTN       230.00  1   4456.2   400    62.9    70.4    79.4   0.07566
   202 EAST500       500.00     152 MID500       500.00  1   9205.2  1200   -50.7   -63.2   -78.1  -0.12486
  3004 WEST          500.00    3005 WEST         230.00  1  14293.3   800   188.5   192.8   197.9   0.04278
  3001 MINE          230.00    3002 E. MINE      500.00  1  >99999.   800    57.3    56.6    55.8  -0.00668
  3004 WEST          500.00     152 MID500       500.00  1  >99999.  NONE  -132.2  -137.1  -143.0  -0.04947
  3005 WEST          230.00    3008 CATDOG       230.00  1  >99999.  NONE   133.0   136.7   141.3   0.03783
  3006 UPTOWN        230.00     153 MID230       230.00  1  >99999.  NONE   -78.6   -81.2   -84.3  -0.02619
  3008 CATDOG        230.00    3018 CATDOG_G     13.800  1  >99999.   150  -100.0  -100.0  -100.0   0.00000
       INTERFACE WEST                                    >99999.   200  -147.9  -147.9  -147.9   0.00000

--------------------------------------------------------------------------------
Progress   Alerts/Warnings   Report
```

Figure 13.6. Example of Export Limit Summary Report (page 1)

```
--------------------------------------------------------------------------------

     PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS®E      WED, SEP 24 2008   9:06
 PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE                              PAGE 2
 BASE CASE INCLUDING SEQUENCE DATA

 CONTINGENCY TRIP1NUCLEAR:
     REMOVE UNIT 1 FROM BUS 101 [NUC-A        21.600]

 INSOLUBLE CASE: OVERLOAD IN PRE-SHIFT SOLUTION INSENSITIVE TO INTERCHANGE LEVEL

 CONTINGENCY TRIP2NUCLEAR:
     REMOVE UNIT 1 FROM BUS 101 [NUC-A        21.600]
     REMOVE UNIT 1 FROM BUS 102 [NUC-B        21.600]

 INSOLUBLE CASE: OVERLOAD IN PRE-SHIFT SOLUTION INSENSITIVE TO INTERCHANGE LEVEL

 CONTINGENCY ADDLARGELOAD:
     INCREASE BUS 154 [DOWNTN      230.00] LOAD BY 50 PERCENT

 INSOLUBLE CASE: OVERLOAD IN PRE-SHIFT SOLUTION INSENSITIVE TO INTERCHANGE LEVEL

 CONTINGENCY LOSEEASTLOAD:
     SET BUS 205 [SUB230      230.00] LOAD TO 0 MW

 INSOLUBLE CASE: OVERLOAD IN PRE-SHIFT SOLUTION INSENSITIVE TO INTERCHANGE LEVEL

--------------------------------------------------------------------------------
```

Progress | Alerts/Warnings | **Report**

Example of Export Limit Summary Report (page 2)

```
     PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS®E      WED, SEP 24 2008   9:06
PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE                             PAGE 3
BASE CASE INCLUDING SEQUENCE DATA
        *** TLTG EXPORT LIMIT OUTPUT FOR SUBSYSTEM STUDY        ***

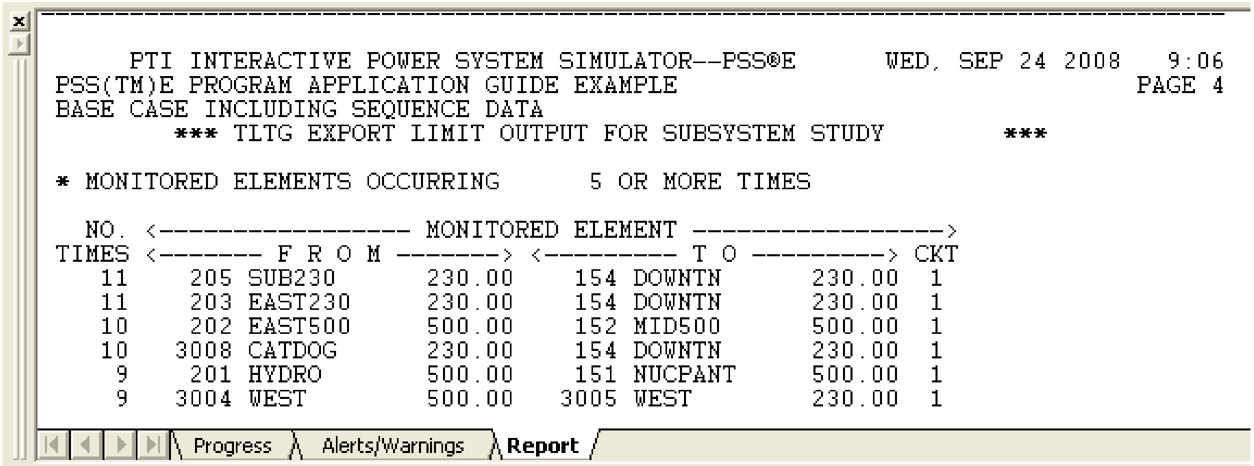
SOLUTION OF  11 SYSTEM CONDITIONS ATTEMPTED      4 INSOLUBLE SYSTEM CONDITIONS

  INCR.                                                         PRE- RATING
  TRANS <----------------- LIMITING ELEMENT ----------------->  DISTR.  SHIFT BAS/CNT
  CAPAB <------- F R O M -------> <--------- T O --------->CKT  FACTOR   MW     A/A  <------------------- CONTINGENCY DESCRIPTION -------------------->
 -863.9   3008 CATDOG       230.00     154 DOWNTN       230.00 1   0.07566   465.4  400.0 REMOVE UNIT 1 FROM BUS 101 [NUC-A        21.600]
                                                                                    REMOVE UNIT 1 FROM BUS 102 [NUC-B        21.600]
  -34.3    203 EAST230      230.00     154 DOWNTN       230.00 1   0.06321   202.2  200.0 OPEN 201 [HYDRO       500.00] TO 205 [SUB230       230.00] CKT &1
  219.2        INTERFACE EAST                                   -1.00000  -130.8  350.0 BASE CASE
  541.0    205 SUB230       230.00     154 DOWNTN       230.00 1  -0.88160  -123.0  600.0 OPEN 151 [NUCPANT     500.00] TO 201 [HYDRO        500.00] CKT 1
                                                                                    OPEN 152 [MID500      500.00] TO 202 [EAST500      500.00] CKT 1
  573.0   3008 CATDOG       230.00     154 DOWNTN       230.00 1   0.28513   236.6  400.0 OPEN 151 [NUCPANT     500.00] TO 201 [HYDRO        500.00] CKT 1
                                                                                    OPEN 152 [MID500      500.00] TO 202 [EAST500      500.00] CKT 1
  892.9    203 EAST230      230.00     154 DOWNTN       230.00 1   0.04396   160.8  200.0 INCREASE BUS 154 [DOWNTN      230.00] LOAD BY 50 PERCENT
  940.9    203 EAST230      230.00     154 DOWNTN       230.00 1   0.05371   149.5  200.0 OPEN 3004 [WEST        500.00] TO 152 [MID500       500.00] CKT 1
                                                                                    OPEN 3006 [UPTOWN      230.00] TO 153 [MID230       230.00] CKT 1
  990.9    201 HYDRO        500.00     151 NUCPANT      500.00 1  -0.60981  -595.8 1200.0 INCREASE BUS 154 [DOWNTN      230.00] LOAD BY 50 PERCENT
  993.4    201 HYDRO        500.00     151 NUCPANT      500.00 1  -0.61924  -584.8 1200.0 OPEN 3004 [WEST        500.00] TO 152 [MID500       500.00] CKT 1
                                                                                    OPEN 3006 [UPTOWN      230.00] TO 153 [MID230       230.00] CKT 1
 1030.8    201 HYDRO        500.00     151 NUCPANT      500.00 1  -0.61325  -567.9 1200.0 OPEN 3004 [WEST        500.00] TO 152 [MID500       500.00] CKT 1
 1044.8    201 HYDRO        500.00     151 NUCPANT      500.00 1  -0.60981  -562.8 1200.0 REMOVE UNIT 1 FROM BUS 3018 [CATDOG_G    13.800]
 1051.7*   201 HYDRO        500.00     151 NUCPANT      500.00 1  -0.60981  -558.7 1200.0 BASE CASE
 1353.6    205 SUB230       230.00     154 DOWNTN       230.00 1  -0.40709   -49.0  600.0 OPEN 201 [HYDRO       500.00] TO 205 [SUB230       230.00] CKT &1
 1419.2        INTERFACE EAST                                   -1.00000  1069.2  350.0 SET BUS 205 [SUB230      230.00] LOAD TO 0 MW
 1421.1    202 EAST500      500.00     152 MID500       500.00 1  -0.54067  -431.6 1200.0 OPEN 151 [NUCPANT     500.00] TO 201 [HYDRO        500.00] CKT 1
 1432.9    203 EAST230      230.00     154 DOWNTN       230.00 1   0.04751   131.9  200.0 OPEN 3004 [WEST        500.00] TO 152 [MID500       500.00] CKT 1
 1571.0    205 SUB230       230.00     154 DOWNTN       230.00 1  -0.49836   182.9  600.0 OPEN 151 [NUCPANT     500.00] TO 201 [HYDRO        500.00] CKT 1
 1623.6*   203 EAST230      230.00     154 DOWNTN       230.00 1  -0.11840    -7.8  200.0 OPEN 151 [NUCPANT     500.00] TO 201 [HYDRO        500.00] CKT 1
                                                                                    OPEN 152 [MID500      500.00] TO 202 [EAST500      500.00] CKT 1
 1796.1   3008 CATDOG       230.00     154 DOWNTN       230.00 1   0.07566   264.1  400.0 REMOVE UNIT 1 FROM BUS 101 [NUC-A        21.600]
 1835.3   3008 CATDOG       230.00     154 DOWNTN       230.00 1   0.07566   261.1  400.0 INCREASE BUS 154 [DOWNTN      230.00] LOAD BY 50 PERCENT
 2009.0    205 SUB230       230.00     154 DOWNTN       230.00 1  -0.30929    21.4  600.0 REMOVE UNIT 1 FROM BUS 101 [NUC-A        21.600]
                                                                                    REMOVE UNIT 1 FROM BUS 102 [NUC-B        21.600]
 2187.2*  3008 CATDOG       230.00     154 DOWNTN       230.00 1   0.13097   113.5  400.0 OPEN 151 [NUCPANT     500.00] TO 201 [HYDRO        500.00] CKT 1
 2550.2*   205 SUB230       230.00     154 DOWNTN       230.00 1  -0.30929   188.8  600.0 REMOVE UNIT 1 FROM BUS 101 [NUC-A        21.600]
 3183.1   3004 WEST         500.00    3005 WEST         230.00 1   0.16124   286.8  800.0 OPEN 151 [NUCPANT     500.00] TO 201 [HYDRO        500.00] CKT 1
                                                                                    OPEN 152 [MID500      500.00] TO 202 [EAST500      500.00] CKT 1
 7089.4    202 EAST500      500.00     152 MID500       500.00 1  -0.15164  -125.0 1200.0 OPEN 3004 [WEST        500.00] TO 152 [MID500       500.00] CKT 1
                                                                                    OPEN 3006 [UPTOWN      230.00] TO 153 [MID230       230.00] CKT 1
 7428.9    202 EAST500      500.00     152 MID500       500.00 1  -0.12486  -272.5 1200.0 REMOVE UNIT 1 FROM BUS 101 [NUC-A        21.600]
                                                                                    REMOVE UNIT 1 FROM BUS 102 [NUC-B        21.600]
 7869.6   3004 WEST         500.00    3005 WEST         230.00 1   0.07406   217.2  800.0 OPEN 151 [NUCPANT     500.00] TO 201 [HYDRO        500.00] CKT 1
 8317.0    202 EAST500      500.00     152 MID500       500.00 1  -0.12486  -161.6 1200.0 REMOVE UNIT 1 FROM BUS 101 [NUC-A        21.600]
 8344.3*   202 EAST500      500.00     152 MID500       500.00 1  -0.13461   -76.8 1200.0 OPEN 3004 [WEST        500.00] TO 152 [MID500       500.00] CKT 1
10082.2   3004 WEST         500.00    3005 WEST         230.00 1   0.05545   241.0  800.0 OPEN 201 [HYDRO       500.00] TO 205 [SUB230       230.00] CKT &1
13846.3   3004 WEST         500.00    3005 WEST         230.00 1   0.04278   207.6  800.0 SET BUS 205 [SUB230      230.00] LOAD TO 0 MW
14047.3*  3004 WEST         500.00    3005 WEST         230.00 1   0.04278   199.0  800.0 REMOVE UNIT 1 FROM BUS 3018 [CATDOG_G    13.800]
33417.9   3001 MINE         230.00    3002 E. MINE      500.00 1  -0.02519    41.9  800.0 OPEN 151 [NUCPANT     500.00] TO 201 [HYDRO        500.00] CKT 1
                                                                                    OPEN 152 [MID500      500.00] TO 202 [EAST500      500.00] CKT 1
67384.1   3001 MINE         230.00    3002 E. MINE      500.00 1  -0.00668  -349.6  800.0 SET BUS 205 [SUB230      230.00] LOAD TO 0 MW
73693.7   3001 MINE         230.00    3002 E. MINE      500.00 1  -0.01157    52.8  800.0 OPEN 151 [NUCPANT     500.00] TO 201 [HYDRO        500.00] CKT 1
98004.2   3001 MINE         230.00    3002 E. MINE      500.00 1  -0.00866    49.1  800.0 OPEN 201 [HYDRO       500.00] TO 205 [SUB230       230.00] CKT &1

-------------------------------------------------------------------------------
```

Progress | Alerts/Warnings | **Report**

Example of Export Limit Summary Report (page 3)



```
     PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS®E      WED, SEP 24 2008   9:06
PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE                                PAGE 4
BASE CASE INCLUDING SEQUENCE DATA
        *** TLTG EXPORT LIMIT OUTPUT FOR SUBSYSTEM STUDY        ***

* MONITORED ELEMENTS OCCURRING      5 OR MORE TIMES

  NO. <----------------- MONITORED ELEMENT ----------------->
TIMES <------- F R O M -------> <--------- T O ---------> CKT
   11     205 SUB230       230.00     154 DOWNTN      230.00  1
   11     203 EAST230      230.00     154 DOWNTN      230.00  1
   10     202 EAST500      500.00     152 MID500      500.00  1
   10    3008 CATDOG       230.00     154 DOWNTN      230.00  1
    9     201 HYDRO        500.00     151 NUCPANT     500.00  1
    9    3004 WEST         500.00    3005 WEST        230.00  1
```


Example of Export Limit Summary Report (page 4)

Additional Information
PSS® E Program Operation Manual, Calculating Transmission Interchange Limits

13.9. Calculating Sequential Participation Interchange Limits

SPIL

Requirements / Prerequisites
Validly specified power flow case solved to an acceptable mismatch tolerance. Distribution Factor Data File (*.dfx) corresponding to the network condition in the working case. Subsystem Participation Data File (*.prt) corresponding to the subsystem definitions in the Distribution Factor Data File. Building the Distribution Factor Data File Subsystem Description File

Power Flow > Linear Network > Sequential participation interchange limit (SPIL)...

The *[Sequential Participation Interchange Limit]* dialog (Figure 13.7, "Sequential Participation Interchange Limit Dialog") requires specification of the subsystems to be tested and solution and output options. Click *[...]* to open the selection windows for the required *Distribution Factor Data file* (*.dfx) and an appropriate *Subsystem Participation Data file* (*.prt) (see *PSS ® E Program Operation Manual* Subsystem Participation Data File Contents).

Click *[OK]* to perform the activity. An activity summary is routed to the *Progress* tab (Figure 13.8, "Sequential Participation Interchange Limit Activity Output").

The study is routed to the *Report* tab by default (Figure 13.9, "Example of Export Limit Report (page 1)", Figure 13.10, "Example of Export Limit Report, Base Case (page 2)", Figure 13.11, "Example of Export Limit, Partial Report (page 3)", and Figure 13.12, "Example of Export Limit Report (page 4)").

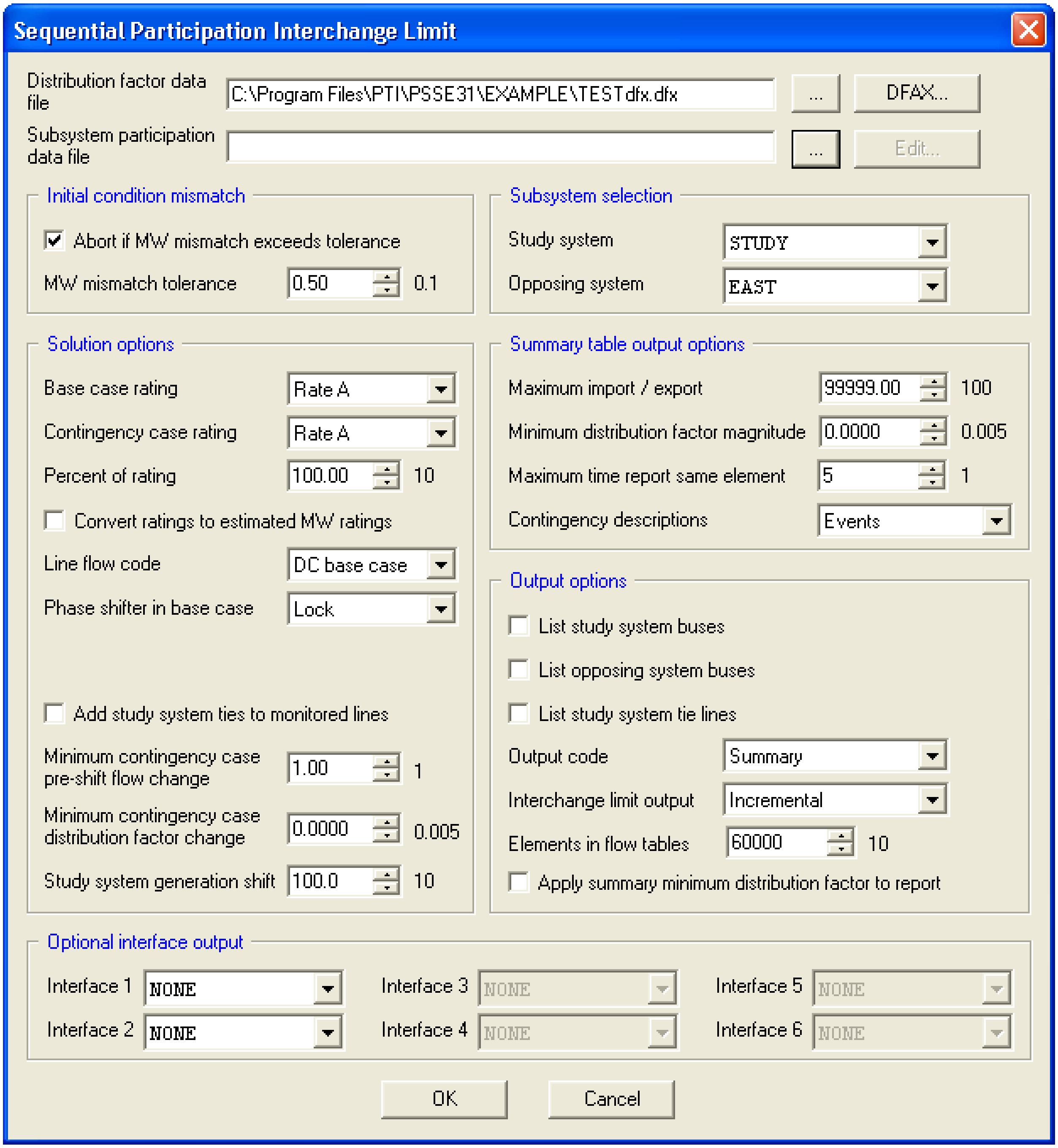


Figure 13.7. Sequential Participation Interchange Limit Dialog

```
ORDERING NETWORK
DIAGONALS =      22  OFF-DIAGONALS =      40  MAX SIZE =      58

WORKING CASE HAS LARGEST MISMATCH OF      0.03 MW AT BUS 151 [NUCPANT     500.00]

THESE SUBSYSTEMS WERE SPECIFIED:
  # <-- NAME -->  BUSES     # <-- NAME -->  BUSES     # <-- NAME -->  BUSES
  1 STUDY             6     2 EAST              7     3 WEST             10

STUDY SYSTEM GENERATION IS         1500.0 MW
OPPOSING SYSTEM GENERATION IS      1400.0 MW
STUDY SYSTEM NET INTERCHANGE IS     278.7 MW
```

Progress / Alerts/Warnings

Figure 13.8. Sequential Participation Interchange Limit Activity Output

```
    PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS®E      WED, SEP 24 2008   7:35
PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE                               PAGE 1
BASE CASE INCLUDING SEQUENCE DATA
        *** SPIL EXPORT LIMIT OUTPUT FOR BASE CASE                ***

DISTRIBUTION FACTOR FILE:     C:\Program Files\PTI\PSSE31\EXAMPLE\TESTdfx.dfx
SUBSYSTEM DESCRIPTION FILE:   C:\Program Files\PTI\PSSE31\EXAMPLE\savnw.sub
MONITORED ELEMENT FILE:       C:\Program Files\PTI\PSSE31\EXAMPLE\savnw.mon
CONTINGENCY DESCRIPTION FILE: C:\Program Files\PTI\PSSE31\EXAMPLE\savnw.con

                                PRE-SHIFT    DELTA  POST-SHIFT
STUDY SYSTEM MW GENERATION:       1500.0     100.0    1600.0
OPPOSING SYSTEM MW GENERATION:    1400.0    -100.0    1300.0
STUDY SYSTEM NET INTERCHANGE:      278.7     100.0     378.7

<---------------- STUDY SYSTEM -----------------> <--------------- OPPOSING SYSTEM --------------->
                         <---- GENERATOR MW ---->                          <---- GENERATOR MW ---->
  BUS# X-- NAME --X BASKV    BASE   SHIFT  CHANGE  BUS# X-- NAME --X BASKV    BASE   SHIFT  CHANGE
   101 NUC-A        21.600   750.0   800.0    50.0   206 URBGEN       18.000   800.0   742.0   -58.0
   102 NUC-B        21.600   750.0   800.0    50.0   211 HYDRO_G      20.000   600.0   558.0   -42.0

LOADINGS AT OR ABOVE 100.0 %                                  <------------- BASE CASE ------------->
OF RATING ARE MARKED WITH '*'                        INCR.           PRE-   POST-   LIMIT
                                                     TRANS RATING   SHIFT   SHIFT    CASE    DISTR.
<------- F R O M -------> <--------- T O ---------> CKT  CAPAB    A      MW      MW      MW    FACTOR
      INTERFACE EAST                                     219.2   350  -130.8  -230.8  -350.0* -1.00000
   201 HYDRO        500.00    151 NUCPANT      500.00  1  1051.7  1200  -558.7  -619.7  -692.4 -0.60981
   203 EAST230      230.00    154 DOWNTN       230.00  1  1764.5   200   122.4   126.8   132.1  0.04396
   205 SUB230       230.00    154 DOWNTN       230.00  1  3091.4   600   356.1   325.2   288.3 -0.30929
  3008 CATDOG       230.00    154 DOWNTN       230.00  1  4456.2   400    62.9    70.4    79.4  0.07566
   202 EAST500      500.00    152 MID500       500.00  1  9205.2  1200   -50.7   -63.2   -78.1 -0.12486
  3004 WEST         500.00   3005 WEST         230.00  1 14293.3   800   188.5   192.8   197.9  0.04278
  3001 MINE         230.00   3002 E. MINE      500.00  1 >99999.   800    57.3    56.6    55.8 -0.00668
  3004 WEST         500.00    152 MID500       500.00  1 >99999.  NONE  -132.2  -137.1  -143.0 -0.04947
  3005 WEST         230.00   3008 CATDOG       230.00  1 >99999.  NONE   133.0   136.7   141.3  0.03783
  3006 UPTOWN       230.00    153 MID230       230.00  1 >99999.  NONE   -78.6   -81.2   -84.3 -0.02619
  3008 CATDOG       230.00   3018 CATDOG_G     13.800  1 >99999.   150  -100.0  -100.0  -100.0  0.00000
      INTERFACE WEST                                    >99999.   200  -147.9  -147.9  -147.9  0.00000

--------------------------------------------------------------------------------
```

Progress / Alerts/Warnings / Report

Figure 13.9. Example of Export Limit Report (page 1)

```
--------------------------------------------------------------------------------

     PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS®E      WED, SEP 24 2008   7:35
PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE                              PAGE 2
BASE CASE INCLUDING SEQUENCE DATA

CONTINGENCY TRIP1NUCLEAR:
    REMOVE UNIT 1 FROM BUS 101 [NUC-A       21.600]

INSOLUBLE CASE: OVERLOAD IN PRE-SHIFT SOLUTION INSENSITIVE TO INTERCHANGE LEVEL

CONTINGENCY TRIP2NUCLEAR:
    REMOVE UNIT 1 FROM BUS 101 [NUC-A       21.600]
    REMOVE UNIT 1 FROM BUS 102 [NUC-B       21.600]

INSOLUBLE CASE: OVERLOAD IN PRE-SHIFT SOLUTION INSENSITIVE TO INTERCHANGE LEVEL

CONTINGENCY ADDLARGELOAD:
    INCREASE BUS 154 [DOWNTN      230.00] LOAD BY 50 PERCENT

INSOLUBLE CASE: OVERLOAD IN PRE-SHIFT SOLUTION INSENSITIVE TO INTERCHANGE LEVEL

CONTINGENCY LOSEEASTLOAD:
    SET BUS 205 [SUB230      230.00] LOAD TO 0 MW

INSOLUBLE CASE: OVERLOAD IN PRE-SHIFT SOLUTION INSENSITIVE TO INTERCHANGE LEVEL

--------------------------------------------------------------------------------
```

Figure 13.10. Example of Export Limit Report, Base Case (page 2)

```
--------------------------------------------------------------------------------

     PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS®E      WED, SEP 24 2008   7:35
PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE                              PAGE 3
BASE CASE INCLUDING SEQUENCE DATA
        *** SPIL EXPORT LIMIT OUTPUT FOR SUBSYSTEM STUDY        ***

SOLUTION OF  11 SYSTEM CONDITIONS ATTEMPTED      4 INSOLUBLE SYSTEM CONDITIONS

  INCR.                                                             PRE- RATING
  TRANS <----------------- LIMITING ELEMENT ----------------->  DISTR.  SHIFT BAS/CNT
  CAPAB <------- F R O M -------> <--------- T O --------->CKT  FACTOR    MW    A/A  <------------------- CONTINGENCY DESCRIPTION -------------------->
 -863.9   3008 CATDOG      230.00    154 DOWNTN      230.00 1  0.07566  465.4  400.0 REMOVE UNIT 1 FROM BUS 101 [NUC-A       21.600]
                                                                                   REMOVE UNIT 1 FROM BUS 102 [NUC-B       21.600]
  -34.3    203 EAST230     230.00    154 DOWNTN      230.00 1  0.06321  202.2  200.0 OPEN 201 [HYDRO       500.00] TO 205 [SUB230      230.00] CKT &1
  219.2        INTERFACE EAST                                -1.00000 -130.8  350.0 OPEN 151 [NUCPANT     500.00] TO 201 [HYDRO       500.00] CKT 1
  219.2        INTERFACE EAST                                -1.00000 -130.8  350.0 OPEN 201 [HYDRO       500.00] TO 205 [SUB230      230.00] CKT &1
  219.2        INTERFACE EAST                                -1.00000 -130.8  350.0 OPEN 3004 [WEST       500.00] TO 152 [MID500      500.00] CKT 1
  219.2        INTERFACE EAST                                -1.00000 -130.8  350.0 BASE CASE
  219.2*       INTERFACE EAST                                -1.00000 -130.8  350.0 OPEN 151 [NUCPANT     500.00] TO 201 [HYDRO       500.00] CKT 1
                                                                                   OPEN 152 [MID500      500.00] TO 202 [EAST500     500.00] CKT 1
  541.0    205 SUB230      230.00    154 DOWNTN      230.00 1 -0.88160 -123.0  600.0 OPEN 151 [NUCPANT     500.00] TO 201 [HYDRO       500.00] CKT 1
                                                                                   OPEN 152 [MID500      500.00] TO 202 [EAST500     500.00] CKT 1
  573.0   3008 CATDOG      230.00    154 DOWNTN      230.00 1  0.28513  236.6  400.0 OPEN 151 [NUCPANT     500.00] TO 201 [HYDRO       500.00] CKT 1
                                                                                   OPEN 152 [MID500      500.00] TO 202 [EAST500     500.00] CKT 1
  892.9    203 EAST230     230.00    154 DOWNTN      230.00 1  0.04396  160.8  200.0 INCREASE BUS 154 [DOWNTN      230.00] LOAD BY 50 PERCENT
  940.9    203 EAST230     230.00    154 DOWNTN      230.00 1  0.05371  149.5  200.0 OPEN 3004 [WEST       500.00] TO 152 [MID500      500.00] CKT 1
                                                                                   OPEN 3006 [UPTOWN     230.00] TO 153 [MID230      230.00] CKT 1
```

Figure 13.11. Example of Export Limit, Partial Report (page 3)

```
--------------------------------------------------------------------------------
     PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS®E      WED, SEP 24 2008   7:35
PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE                                PAGE 4
BASE CASE INCLUDING SEQUENCE DATA
        *** SPIL EXPORT LIMIT OUTPUT FOR SUBSYSTEM STUDY        ***

* MONITORED ELEMENTS OCCURRING      5 OR MORE TIMES

  NO. <----------------- MONITORED ELEMENT ----------------->
TIMES <------- F R O M -------> <--------- T O ----------> CKT
   11     205 SUB230       230.00     154 DOWNTN      230.00  1
   11     203 EAST230      230.00     154 DOWNTN      230.00  1
   11         INTERFACE EAST
   10     202 EAST500      500.00     152 MID500      500.00  1
   10    3008 CATDOG       230.00     154 DOWNTN      230.00  1
    9     201 HYDRO        500.00     151 NUCPANT     500.00  1
    9    3004 WEST         500.00    3005 WEST        230.00  1
```

Figure 13.12. Example of Export Limit Report (page 4)

Additional Information
PSS® E Program Operation Manual, Calculating Sequential Participation Interchange Limits

13.10. Running Interchange Limit Analysis with Two Opposing Systems

POLY

Requirements / Prerequisites
Validly specified power flow case solved to an acceptable mismatch tolerance. Distribution Factor Data File (*.dfx) corresponding to the network condition. Building the Distribution Factor Data File

Power Flow > Linear Network > Interchange limits with two opposing systems (POLY)...

The *[Interchange Limits with Two Opposing Systems]* dialog (Figure 13.13, “Interchange Limits with Two Opposing Systems Dialog”) requires specification of the subsystems to be tested and solution and output options. Click *[...]* to open the selection window for the required *Distribution factor data file* (*.dfx). If the data is to be saved in a file, a filename for the *POLY Results file* (*.pol) is required; it can be a new file or a previously-built file to be over-written.

Click *[Go]* to perform the activity. An activity summary is routed to the *Progress* tab (Figure 13.14, “Interchange Limits with Two Opposing Systems Activity Output”). The analysis is routed to the *Report* tab by default (Figure 13.15, “Example of Export Limit Report (page 1)”, Figure 13.16, “Example of Export Limit Report (page 2)”, and Figure 13.17, “Example of Export Limit Report (page 3)”).

The *[POLY plotting]* dialog displays visual analysis and printing options (Figure 13.18, “Example of Poly Plotting”). Highlight the desired analysis in the *Plots* column (base case, contingency, or all cases) to display the interchange limits. A description of the contingency is displayed as a label for the dialog. Highlight the desired analysis in the *Printing* column and click *[Print]* to print a hard copy.

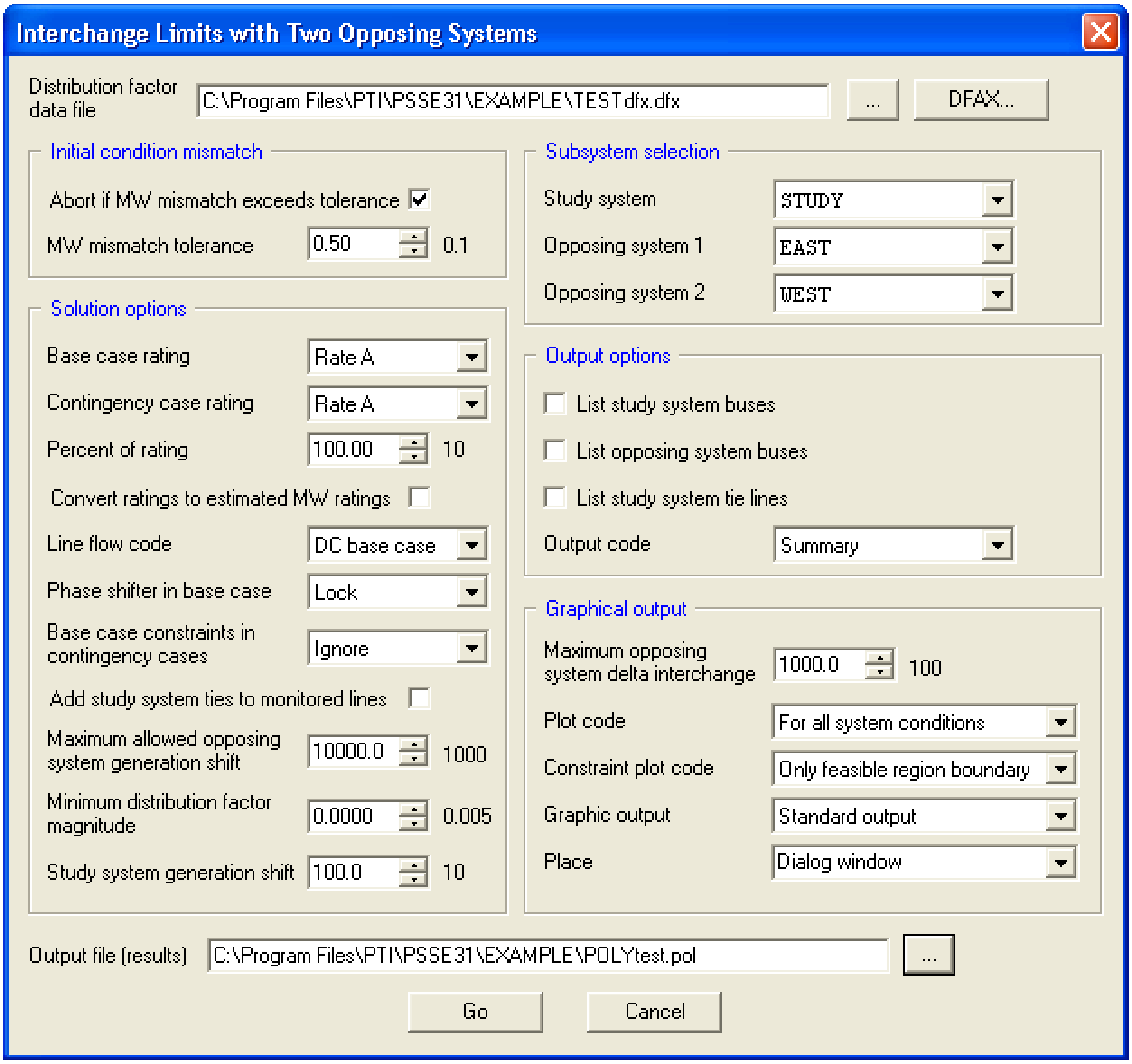


Figure 13.13. Interchange Limits with Two Opposing Systems Dialog

```
WORKING CASE HAS LARGEST MISMATCH OF      0.03 MW AT BUS 151 [NUCPANT     500.00]

THESE SUBSYSTEMS WERE SPECIFIED:
  # <-- NAME --> BUSES     # <-- NAME --> BUSES     # <-- NAME --> BUSES
  1 STUDY            6     2 EAST             7     3 WEST            10

OPPOSING SYSTEMS ARE SUBSYSTEMS 'EAST' AND 'WEST'

STUDY SYSTEM GENERATION IS         1500.0 MW
OPPOSING SYSTEM 1 GENERATION IS    1400.0 MW
OPPOSING SYSTEM 2 GENERATION IS     358.7 MW
STUDY SYSTEM NET INTERCHANGE IS     278.7 MW
```

Progress | Alerts/Warnings

Figure 13.14. Interchange Limits with Two Opposing Systems Activity Output

```
    PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS®E      WED, SEP 24 2008   8:06
PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE                           PAGE 1
BASE CASE INCLUDING SEQUENCE DATA
        *** POLY EXPORT LIMIT OUTPUT FOR BASE CASE                 ***

DISTRIBUTION FACTOR FILE:      C:\Program Files\PTI\PSSE31\EXAMPLE\TESTdfx.dfx
SUBSYSTEM DESCRIPTION FILE:    C:\Program Files\PTI\PSSE31\EXAMPLE\savnw.sub
MONITORED ELEMENT FILE:        C:\Program Files\PTI\PSSE31\EXAMPLE\savnw.mon
CONTINGENCY DESCRIPTION FILE: C:\Program Files\PTI\PSSE31\EXAMPLE\savnw.con

                                         X- SHIFT CASE 1 -X  X- SHIFT CASE 2 -X
                                PRE-SHIFT    DELTA  POST-SHIFT   DELTA  POST-SHIFT
STUDY SYSTEM MW GENERATION:       1500.0     100.0    1600.0     100.0    1600.0
OPPOSING SYSTEM 1 MW GENERATION:  1400.0    -100.0    1300.0       0.0    1400.0
OPPOSING SYSTEM 2 MW GENERATION:   358.7       0.0     358.7    -100.0     258.7
STUDY SYSTEM MW NET INTERCHANGE:   278.7     100.0     378.7     100.0     378.7

<---------------- STUDY SYSTEM -----------------> <------------ FIRST OPPOSING SYSTEM ------------> <----------- SECOND OPPOSING SYSTEM ------------>
                             <---- GENERATOR MW ---->                             <---- GENERATOR MW ---->                             <---- GENERATOR MW ---->
  BUS# X-- NAME --X BASKV     BASE   SHIFT  CHANGE   BUS# X-- NAME --X BASKV     BASE   SHIFT  CHANGE   BUS# X-- NAME --X BASKV     BASE   SHIFT  CHANGE
   101 NUC-A         21.600   750.0   800.0    50.0    206 URBGEN        18.000   800.0   742.0   -58.0   3011 MINE_G        13.800   258.7   170.2   -88.5
   102 NUC-B         21.600   750.0   800.0    50.0    211 HYDRO_G       20.000   600.0   558.0   -42.0   3018 CATDOG_G      13.800   100.0    88.5   -11.5

                                BASE CASE INCREMENTAL   TOTAL
STUDY SYSTEM GENERATION MW         1500.0      271.3    1771.3
OPPOSING SYSTEM 1 GENERATION MW    1400.0     -219.2    1180.8
OPPOSING SYSTEM 2 GENERATION MW     358.7      -52.1     306.6
STUDY SYSTEM MW NET INTERCHANGE     278.7      271.3     550.0

LIMITING MONITORED ELEMENTS LOADED AT 100.0 % OF RATING:
<-------- F R O M --------> <---------- T O ----------> CKT  RATING
           INTERFACE EAST                         350.0
           INTERFACE WEST                         200.0

LOADINGS AT OR ABOVE 100.0 %                            <-------------------- BASE CASE --------------------->
OF RATING ARE MARKED WITH '*'                             PRE- GEN SHIFT CASES   LIMIT              DISTRIBUTION
                                                          SHIFT  OPSYS1  OPSYS2   CASE   RATING       FACTORS
<------- F R O M -------> <--------- T O ---------> CKT    MW      MW      MW      MW      A      OPSYS1   OPSYS2
   201 HYDRO       500.00    151 NUCPANT     500.00  1  -558.7  -619.7  -600.5  -714.1   1200  -0.60981 -0.41817
   202 EAST500     500.00    152 MID500      500.00  1   -50.7   -63.2   -37.3   -71.1   1200  -0.12486  0.13426
   203 EAST230     230.00    154 DOWNTN      230.00  1   122.4   126.8   127.2   134.5    200   0.04396  0.04731
   205 SUB230      230.00    154 DOWNTN      230.00  1   356.1   325.2   379.8   300.7    600  -0.30929  0.23660
  3001 MINE        230.00   3002 E. MINE     500.00  1    57.3    56.6    26.0    39.5    800  -0.00668 -0.31231
  3004 WEST        500.00    152 MID500      500.00  1  -132.2  -137.1  -172.7  -164.1   NONE  -0.04947 -0.40505
  3004 WEST        500.00   3005 WEST        230.00  1   188.5   192.8   197.8   202.7    800   0.04278  0.09274
  3005 WEST        230.00   3008 CATDOG      230.00  1   133.0   136.7   123.4   136.3   NONE   0.03783 -0.09586
  3006 UPTOWN      230.00    153 MID230      230.00  1   -78.6   -81.2  -107.4   -99.3   NONE  -0.02619 -0.28817
  3008 CATDOG      230.00    154 DOWNTN      230.00  1    62.9    70.4    32.2    63.5    400   0.07566 -0.30677
  3008 CATDOG      230.00   3018 CATDOG_G    13.800  1  -100.0  -100.0   -88.5   -94.0    150   0.00000  0.11504
       INTERFACE WEST                                   -147.9  -147.9  -247.9* -200.0*   200   0.00000 -1.00000
       INTERFACE EAST                                   -130.8  -230.8  -130.8  -350.0*   350  -1.00000  0.00000

-------------------------------------------------------------------------------------
```

Progress | Alerts/Warnings | Report

Figure 13.15. Example of Export Limit Report (page 1)

```
     PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS®E      WED, SEP 24 2008   8:06
PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE                            PAGE 2
BASE CASE INCLUDING SEQUENCE DATA
        *** POLY EXPORT LIMIT OUTPUT FOR ALL CASES                ***

INSOLUBLE CASE: NO INTERCHANGE SCHEDULE WITH ALL MONITORED ELEMENTS IN LIMITS

LOADINGS AT OR ABOVE 100.0 %
OF RATING ARE MARKED WITH '*'                              PRE- GEN SHIFT CASES   LIMIT  RATING    DISTRIBUTION
                                                           SHIFT  OPSYS1  OPSYS2   CASE  BAS/CNT     FACTORS
<------- F R O M -------> <--------- T O ---------> CKT     MW      MW      MW      MW     A/A    OPSYS1   OPSYS2  SYSTEM CONDITION
   203 EAST230      230.00    154 DOWNTN       230.00  1    202.2*  208.5*  209.4*          200   0.06321  0.07195  CONTINGENCY XFMR204-205
   205 SUB230       230.00    154 DOWNTN       230.00  1    460.2   429.2   483.8           600  -0.30929  0.23660  CONTINGENCY ADDLARGELOAD
       INTERFACE WEST                                      -147.9  -147.9  -247.9*          200   0.00000 -1.00000  BASE CASE
                                                            602.1*  602.1*  502.1*          200   0.00000 -1.00000  CONTINGENCY TRIP1NUCLEAR
                                                           1352.1* 1352.1* 1252.1*          200   0.00000 -1.00000  CONTINGENCY TRIP2NUCLEAR
                                                            352.1*  352.1*  252.1*          200   0.00000 -1.00000  CONTINGENCY ADDLARGELOAD
                                                           -147.9  -147.9  -247.9*          200   0.00000 -1.00000  CONTINGENCY LOSEWESTGEN
                                                           -147.9  -147.9  -247.9*          200   0.00000 -1.00000  CONTINGENCY LOSEWESTBIGT
                                                           -147.9  -147.9  -247.9*          200   0.00000 -1.00000  CONTINGENCY LOSEEASTBIGT
                                                           -147.9  -147.9  -247.9*          200   0.00000 -1.00000  CONTINGENCY LOSE2LINESWE
                                                           -147.9  -147.9  -247.9*          200   0.00000 -1.00000  CONTINGENCY LOSE2LINEEA
                                                           -147.9  -147.9  -247.9*          200   0.00000 -1.00000  CONTINGENCY XFMR204-205
       INTERFACE EAST                                      -130.8  -230.8  -130.8           350  -1.00000  0.00000  BASE CASE
                                                           -130.8  -230.8  -130.8           350  -1.00000  0.00000  CONTINGENCY TRIP1NUCLEAR
                                                           -130.8  -230.8  -130.8           350  -1.00000  0.00000  CONTINGENCY TRIP2NUCLEAR
                                                           -130.8  -230.8  -130.8           350  -1.00000  0.00000  CONTINGENCY ADDLARGELOAD
                                                           -130.8  -230.8  -130.8           350  -1.00000  0.00000  CONTINGENCY LOSEWESTGEN
                                                           -130.8  -230.8  -130.8           350  -1.00000  0.00000  CONTINGENCY LOSEWESTBIGT
                                                           -130.8  -230.8  -130.8           350  -1.00000  0.00000  CONTINGENCY LOSEEASTBIGT
                                                           -130.8  -230.8  -130.8           350  -1.00000  0.00000  CONTINGENCY LOSE2LINESWE
                                                           -130.8  -230.8  -130.8           350  -1.00000  0.00000  CONTINGENCY LOSE2LINEEA
                                                           -130.8  -230.8  -130.8           350  -1.00000  0.00000  CONTINGENCY XFMR204-205
```

Figure 13.16. Example of Export Limit Report (page 2)

```
     PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS®E      WED, SEP 24 2008   8:06
PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE                            PAGE 3
BASE CASE INCLUDING SEQUENCE DATA
        *** POLY EXPORT LIMIT OUTPUT FOR SUBSYSTEM STUDY          ***

    12 OPTIMAL SOLUTIONS ATTEMPTED        2 INSOLUBLE CONDITIONS

CONTINGENCY    GENERATION SHIFTS  INTERCHANGE
   LABEL      1ST OPSYS 2ND OPSYS    LIMIT
BASE CASE       -219.2      -52.1     550.0
TRIP1NUCLEAR    -219.2     -802.1    1300.0
TRIP2NUCLEAR    -219.2    -1552.1    2050.0
ADDLARGELOAD    -219.2     -552.1    1050.0
LOSEWESTGEN     -219.2      -52.1     550.0
LOSEWESTBIGT    -219.2      -52.1     550.0
LOSEEASTBIGT    -219.2      -52.1     550.0
LOSEEASTLOAD           INSOLUBLE CASE
LOSE2LINESWE    -219.2      -52.1     550.0
LOSE2LINEEA     -219.2      -52.1     550.0
XFMR204-205     -219.2      222.7     275.2
ALL CASES              INSOLUBLE CASE
```

Figure 13.17. Example of Export Limit Report (page 3)

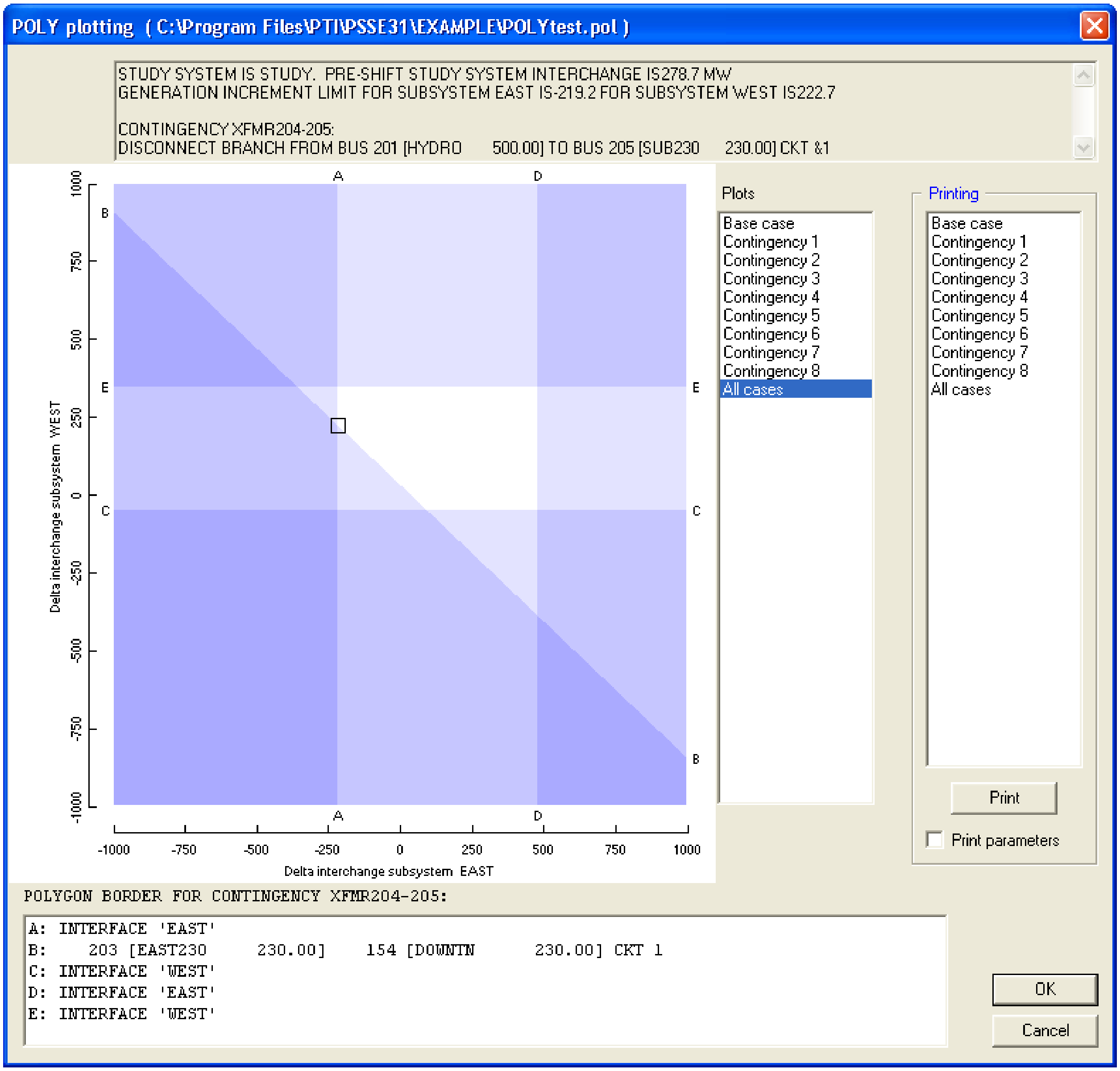


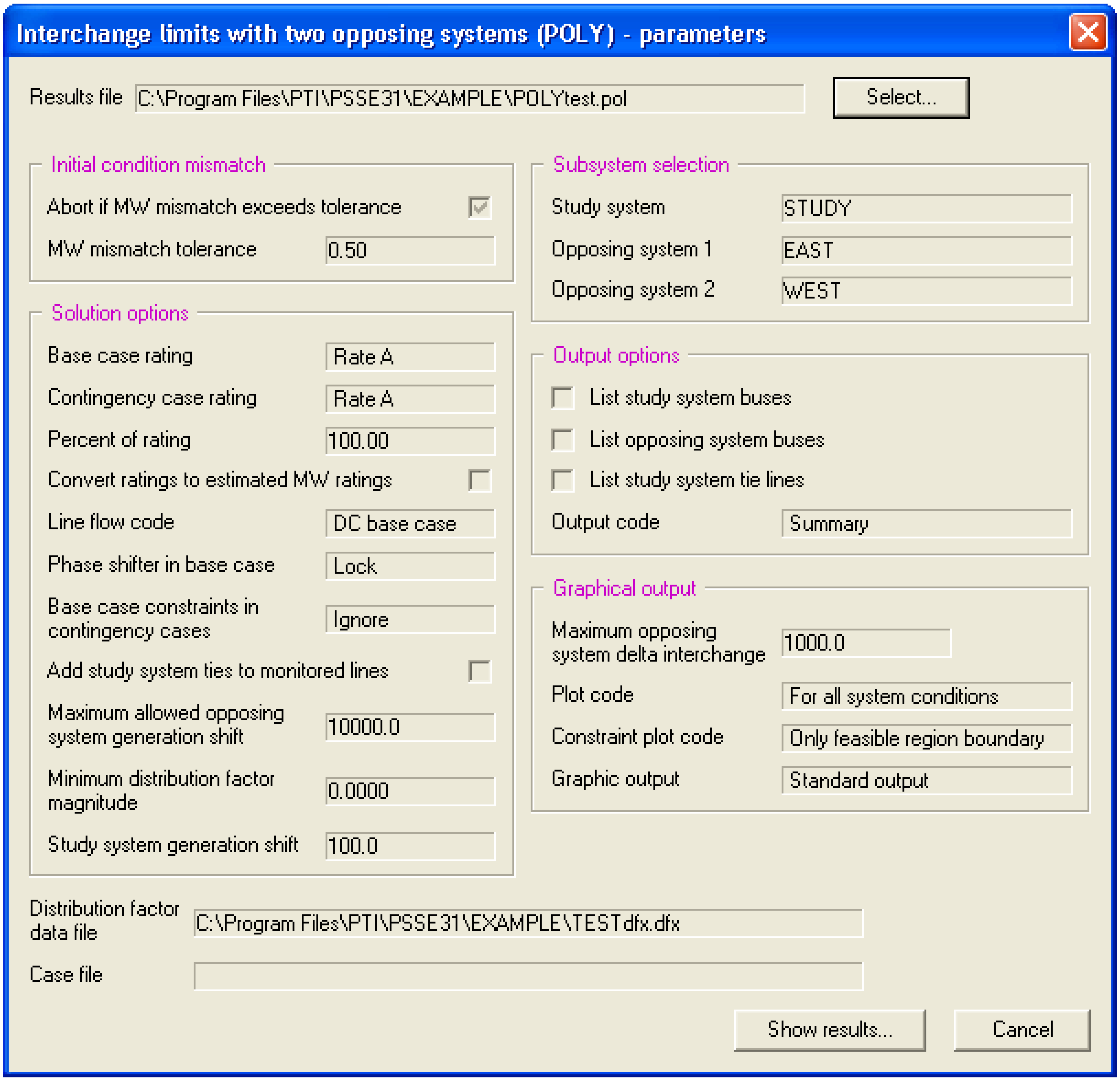
Figure 13.18. Example of Poly Plotting

Additional Information
PSS®E Program Operation Manual, Performing Interchange Limit Analysis with Two Opposing Systems

13.10.1. Interchange Limit Calculations using Previous Results

Power Flow > Linear Network > Interchange limits calculations (POLY) - previous results...

Click *[Select]* to open the directory of POLY Results files. Open the desired file. The *[POLY Parameters]* dialog displays the parameters specified for the creation of that file.



POLY Parameters Dialog

Click [Show results] to display *[POLY Plotting]* (Figure 13.18, “Example of Poly Plotting”).

13.11. Running Midwest MW-mile Calculation

MWMI

Power Flow > Linear Network > Midwest MW-mile calculation (MWMI)...

This activity was incorporated into PSS®E for the convenience of customers who use Midwest ISO (http://www.midwestiso.org/home) planning algorithms. Please contact MISO for current updates, as Siemens PTI does not provide warranty or support for Midwest Independent Transmission System Operator solutions.

Additional Information
PSS® E Program Operation Manual, Midwest MW-Mile Calculation

Chapter 14

Network Reduction

14.1. Building a Network Equivalent

Power Flow > Equivalence Networks...

The *[Equivalence Networks]* dialog prepares five different modeling options, enabled from separate tabs.

14.1.1. Electrical Equivalent

EEQV

Requirements / Prerequisites
Validly specified power flow case solved to an acceptable mismatch level.

The *Build electrical equivalent (EEQV)* tab on *[Equivalence Networks]* (Figure 14.1, “Equivalence Networks Dialog, Build Electrical Equivalent”) provides an option to equivalence *inside* or *outside* a *selected subsystem*. Checkboxes are provided to enable or disable various options, and filters are supplied for *Minimum generation* and *Branch threshold* tolerance that may also be applied to the selection of *All buses*.

Click *[Go]* to perform the activity. A summary is routed to the *Progress* tab (Figure 14.1, “Equivalence Networks Dialog, Build Electrical Equivalent”).

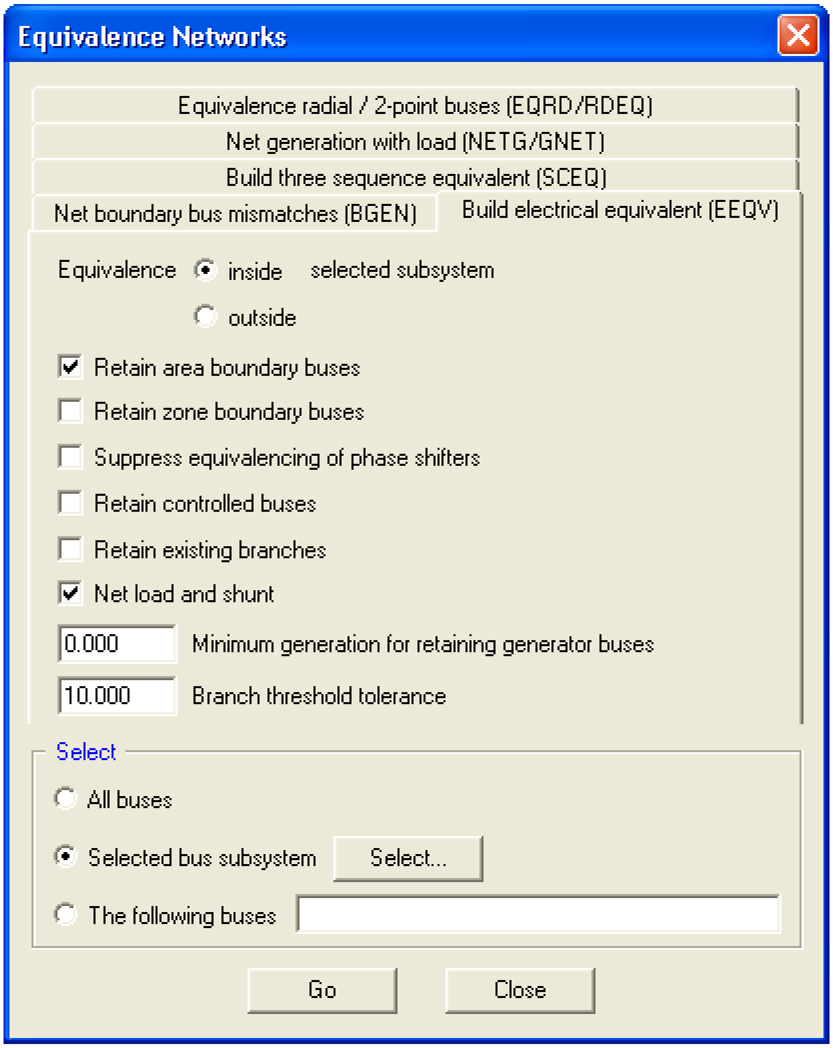
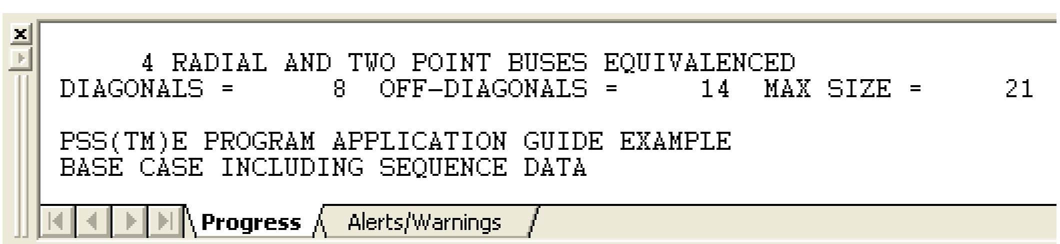


Figure 14.1. Equivalence Networks Dialog, Build Electrical Equivalent



Example of Build Electrical Equivalent Activity Output

Additional Information
PSS®E Program Operation Manual, Building an Electrical Equivalent

14.1.2. Net Generation with Load

NETG/GNET

Requirements / Prerequisites
Validly specified power flow case solved to an acceptable mismatch level.

The *Net generation with load (NETG/GNET)* tab on *[Equivalence Networks]* (Figure 14.2, "Equivalence Networks Dialog, Net Generation with Load") provides an option to equivalence *inside* or *outside* a *selected subsystem*. Click *[Go]* to perform the activity. The *Progress* tab displays the message GENERATION AT <quan-tity> BUSES NETTED WITH THEIR LOAD.

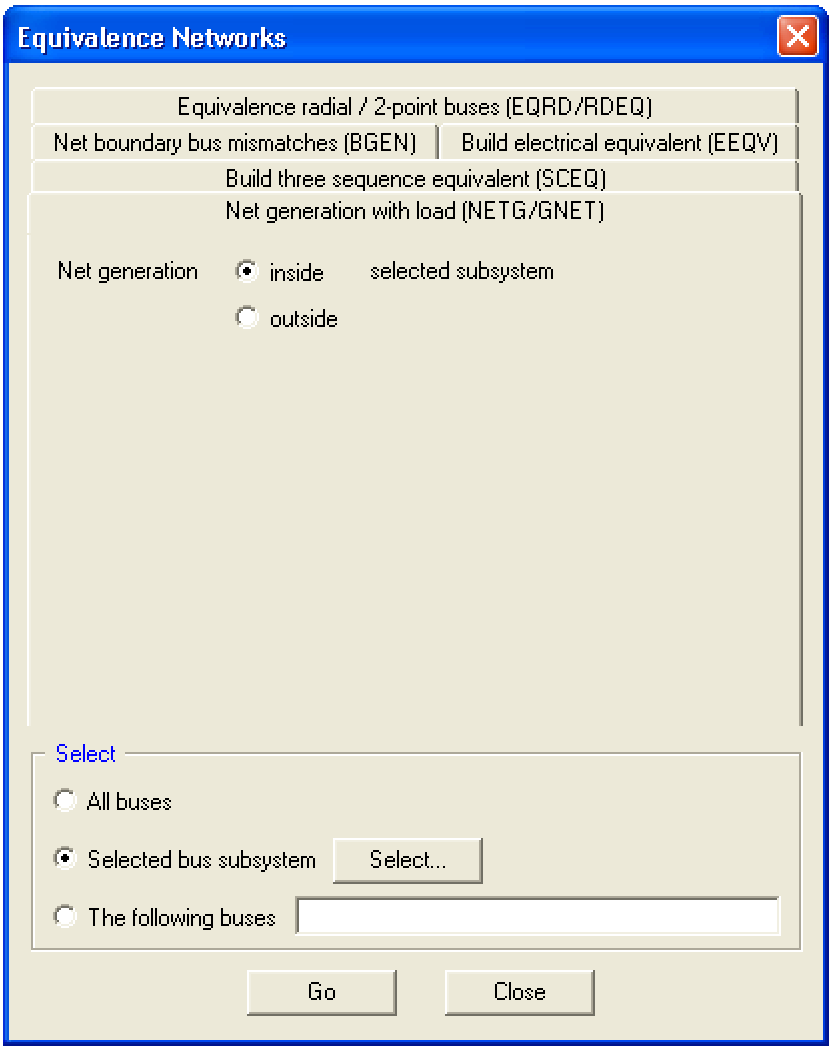


Figure 14.2. Equivalence Networks Dialog, Net Generation with Load

Additional Information
PSS®E Program Operation Manual, Net Generation with Load In a Subsystem Net Generation with Load Outside of a Subsystem

14.1.3. Radial and 2-Point Buses

RDEQ/EQRD

Requirements / Prerequisites
Validly specified power flow case solved to an acceptable mismatch level.

The *Equivalence radial / 2-point buses (EQRD/RDEQ)* tab on the *[Equivalence Networks]* dialog (Figure 14.3, "Equivalence Networks Dialog, Equivalence Radial Buses") provides an option to equivalence *inside* or *outside* a *selected subsystem*. Checkboxes are provided to enable or disable various options that may also be applied to the selection of *All buses*.

Click *[Go]* to perform the activity. The *Progress* tab displays the message `<quantity> BUSES EQUIVALENCED`.

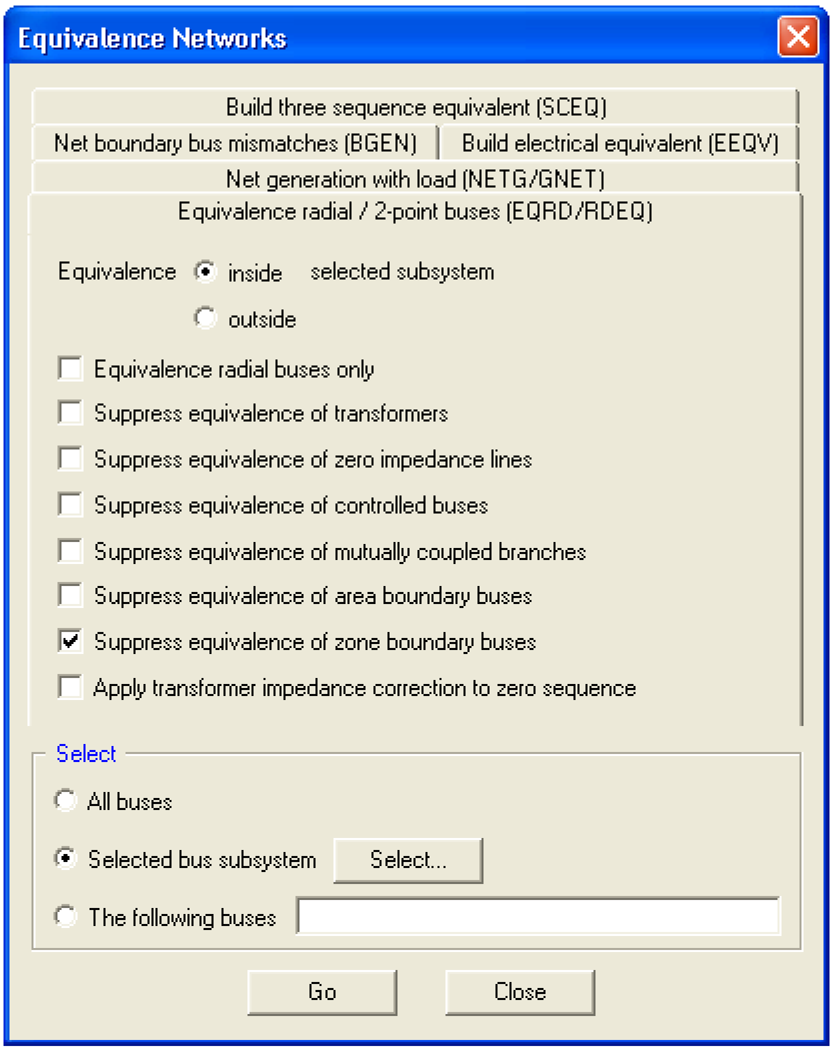


Figure 14.3. Equivalence Networks Dialog, Equivalence Radial Buses

Additional Information
PSS® E Program Operation Manual, Equivalencing Radial Buses Equivalencing Radial Buses, with Exception

14.1.4. Net Boundary Bus Mismatch

BGEN

Requirements / Prerequisites
Validly specified subsystem of a solved power flow case.

The *Net boundary bus mismatches (BGEN)* tab on *[Equivalence Networks]* (Figure 14.4, "Equivalence Networks Dialog, Net Boundary Mismatches") requires the user to select a *Boundary bus modification* from among the following options:

- Generator for inflow, load for outflow
- All equivalent generators
- All equivalent loads

Click *[Go]* to perform the activity. The *Report* tab displays the message `NO MISMATCHES ABOVE <quantity> FOUND`.

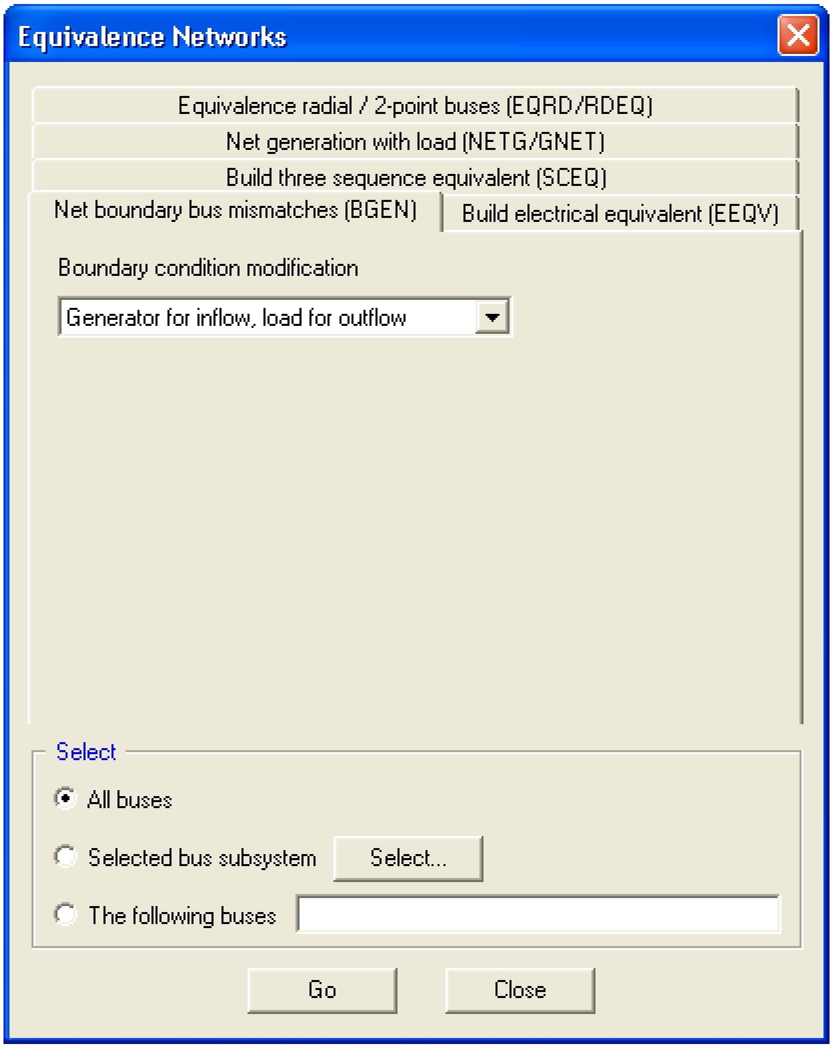


Figure 14.4. Equivalence Networks Dialog, Net Boundary Mismatches

Additional Information
PSS® E Program Operation Manual, Converting Net Boundary Bus Mismatch

14.2. Building a Three-Sequence Electrical Equivalent

SCEQ

Requirements / Prerequisites
Validly specified power flow case reflecting classical fault analysis assumptions with generators converted. Sequence data included in the case. Reading Sequence Data for Fault Analysis Converting Loads and Generators Using Classical Fault Analysis Option

The *Build three sequence equivalent (SCEQ)* tab on *[Equivalence Networks]* (Figure 14.5, "Equivalence Networks Dialog, Build Three Sequence Equivalent") provides a checkbox to enable *Apply impedance correction to zero sequence* and a filter for *Branch threshold tolerance*. Click *[...]* to open selection windows to save data of the external system to be equivalenced in a *Power Flow Raw Data file* (*.raw) or a *Sequence Data file* (*.seq), either of which can be a new file or a previously-built file to be over-written.

Click *[Go]* to perform the activity. A summary is routed to the *Progress* tab (Figure 14.6, "Example of Build Three Sequence Equivalent Activity Output").

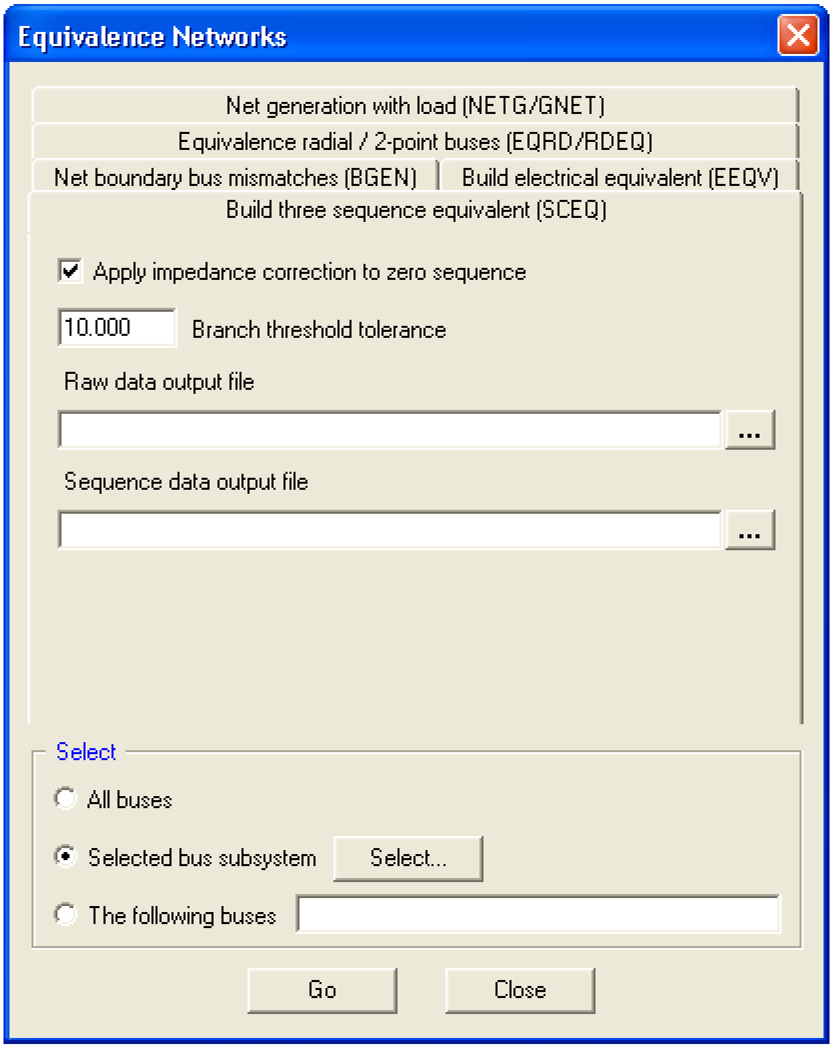


Figure 14.5. Equivalence Networks Dialog, Build Three Sequence Equivalent

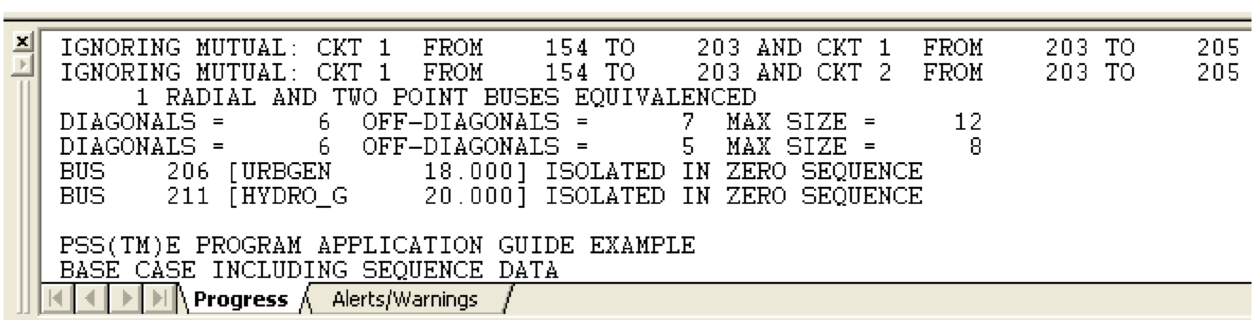


Figure 14.6. Example of Build Three Sequence Equivalent Activity Output

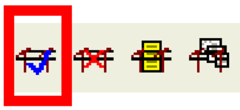
Additional Information
PSS®E Program Operation Manual, Building a Three-Sequence Electrical Equivalent

Chapter 15
Unbalanced Fault Analysis

15.1. Preparing Sequence Networks for Unbalanced Network Solution

SEQD

Requirements / Prerequisites
Validly specified power flow case, with sequence data appended, solved to an acceptable mismatch level with bus voltages corresponding to prefault network condition.



Fault > Setup network for unbalanced solution (SEQD)...

The sequence network set up activity is a prerequisite for running an unbalanced network solution (activity SCMU) or the separate pole circuit breaker duty (activity SPCB). If dc lines or FACTS devices are present in the working case, the *[Setup Network for Unbalanced Solution]* dialog (Figure 15.1, "Setup Network for Unbalanced Solution Dialog") requires specification of an option to block or convert their data.

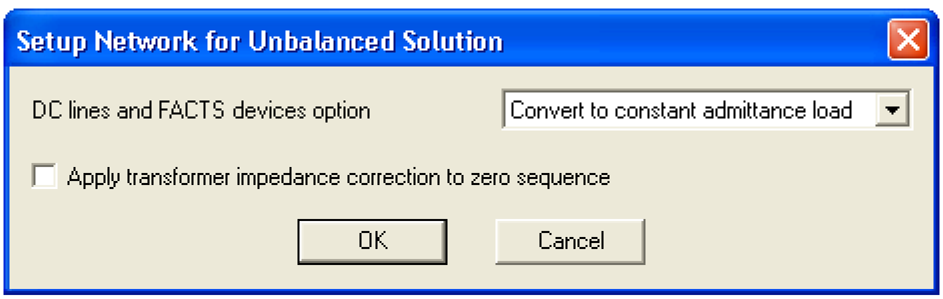


Figure 15.1. Setup Network for Unbalanced Solution Dialog

Click *[OK]* to perform the activity. Results of the preparation for use in SCMU or SPCB are routed to the *Progress* tab (Figure 15.2, "Example of Unbalanced Fault Analysis Setup Output"). However, this activity does not modify the contents of the working case.

```
DIAGONALS =      45  OFF-DIAGONALS =      63  MAX SIZE =      98
BUS     301 [NORTH        765.00] ISOLATED IN POS. SEQUENCE
BUS     401 [COGEN-1      500.00] ISOLATED IN POS. SEQUENCE
BUS     402 [COGEN-2      500.00] ISOLATED IN POS. SEQUENCE
     3 BUSES ISOLATED IN POS. SEQUENCE
POS. SEQUENCE: DIAGONALS =      45  OFF-DIAGONALS =      63
BUS     301 [NORTH        765.00] ISOLATED IN NEG. SEQUENCE
BUS     401 [COGEN-1      500.00] ISOLATED IN NEG. SEQUENCE
BUS     402 [COGEN-2      500.00] ISOLATED IN NEG. SEQUENCE
     3 BUSES ISOLATED IN NEG. SEQUENCE
NEG. SEQUENCE: DIAGONALS =      45  OFF-DIAGONALS =      63
DIAGONALS =      45  OFF-DIAGONALS =      40  MAX SIZE =      68
BUS     101 [NUC-A        21.600] ISOLATED IN ZERO SEQUENCE
BUS     102 [NUC-B        21.600] ISOLATED IN ZERO SEQUENCE
BUS     206 [URBGEN       18.000] ISOLATED IN ZERO SEQUENCE
BUS     211 [HYDRO_G      20.000] ISOLATED IN ZERO SEQUENCE
BUS     212 [INVERT1      230.00] ISOLATED IN ZERO SEQUENCE
BUS     301 [NORTH        765.00] ISOLATED IN ZERO SEQUENCE
ZERO SEQ. GEN. IMPEDANCE IGNORED AT BUS    301 [NORTH        765.00] MACH 1 --USING XT
ZERO SEQ. GEN. IMPEDANCE IGNORED AT BUS    301 [NORTH        765.00] MACH 2 --USING XT
ZERO SEQ. GEN. IMPEDANCE IGNORED AT BUS    301 [NORTH        765.00] MACH 3 --USING XT
BUS     401 [COGEN-1      500.00] ISOLATED IN ZERO SEQUENCE
BUS     402 [COGEN-2      500.00] ISOLATED IN ZERO SEQUENCE
BUS    3010 [URBANWEST2   21.600] ISOLATED IN ZERO SEQUENCE
BUS    3018 [CATDOG_G     13.800] ISOLATED IN ZERO SEQUENCE
BUS    3021 [WDUM         18.000] ISOLATED IN ZERO SEQUENCE
BUS    3022 [EDUM         18.000] ISOLATED IN ZERO SEQUENCE
BUS    9154 [WINDBUS1     4.1600] ISOLATED IN ZERO SEQUENCE
BUS    9204 [WINDBUS2     0.5750] ISOLATED IN ZERO SEQUENCE
BUS   93002 [WINDBUS3     0.6900] ISOLATED IN ZERO SEQUENCE
    15 BUSES ISOLATED IN ZERO SEQUENCE
ZERO SEQUENCE: DIAGONALS =      45  OFF-DIAGONALS =      40

X- XFRMER -X      S       X---- WINDING 1 BUS ----X S C  X---- WINDING 2 BUS ----X S C  X---- WINDING 3 BUS ----X S C
X-- NAME --X CKT  T   CC    BUS# X-- NAME --X BASKV T C    BUS# X-- NAME --X BASKV T C    BUS# X-- NAME --X BASKV T C
3WNDSTAT2      2  2    2    3008 CATDOG        230.00 1 1    3009 URBANWEST1  230.00 0 1    3010 URBANWEST2  21.600 1 3
3WNDSTAT3      3  3    2     205 SUB230        230.00 1 1     215 URBANEAST1  18.000 1 1     216 URBANEAST1  230.00 0 3
3WNDSTAT4      4  4    2     205 SUB230        230.00 0 1     217 URBANEAST1  230.00 1 1     218 URBANEAST1  230.00 1 3

WARNING:     3 THREE-WINDING TRANSFORMERS WITH ONE WINDING OUT-OF-SERVICE
               CHECK THEIR ZERO SEQUENCE DATA FOR APPROPRIATE MODELING
```

Progress | Alerts/Warnings

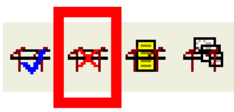
Figure 15.2. Example of Unbalanced Fault Analysis Setup Output

Additional Information
PSS® E Program Operation Manual, Preparing Sequence Network for Unbalanced Network Solution

15.2. Running Fault Analysis under Unbalance Condition

SCMU

Requirements / Prerequisites
Validly specified power flow case with sequence data appended to it. Reading Sequence Data for Fault Analysis Preparing Sequence Networks for Unbalanced Network Solution



Fault > Solve and report network with unbalances (SCMU/SCOP)...

The *[Multiple Simultaneous Unbalances]* dialog (Figure 15.3, "Multiple Simultaneous Unbalances Dialog") prepares up to nine different modeling options, enabled from separate tabs as follows:

[Select] opens *[Bus Selection]* options	*[Select]* opens *[Branch Selection]* options
• 3 phase fault	• 1 end opened
• first line-to-ground fault	• in-line slider
• second line-to-ground fault	
• first line-line-to-ground fault	
• second line-line-to-ground fault	
• 1 phase closed	
• 2 phases closed	

The *All unbalances status* column color-codes available unbalances for reference.

The Solution Output tab requires *Branch quantity desired* to be expressed as one of the following:

- Currents
- Apparent impedances
- Apparent admittances

Click *[Go]* to perform the activity. A summary is routed to the *Progress* tab (Figure 15.4, "Example of Multiple Simultaneous Unbalances Activity Output with Network Setup Option Selected"), and the report is routed to the *Report* tab by default (Figure 15.5, "Example of Multiple Simultaneous Unbalances Report").

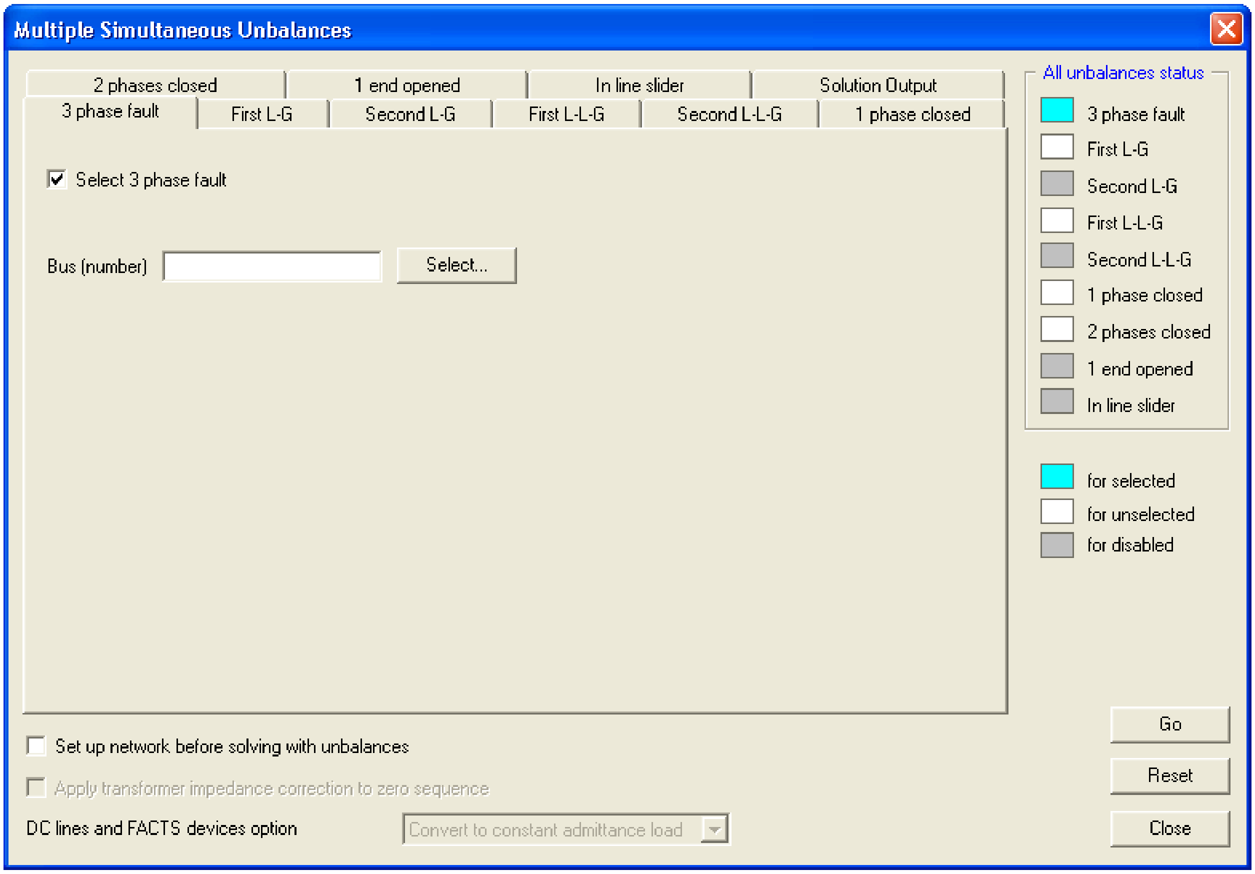


Figure 15.3. Multiple Simultaneous Unbalances Dialog

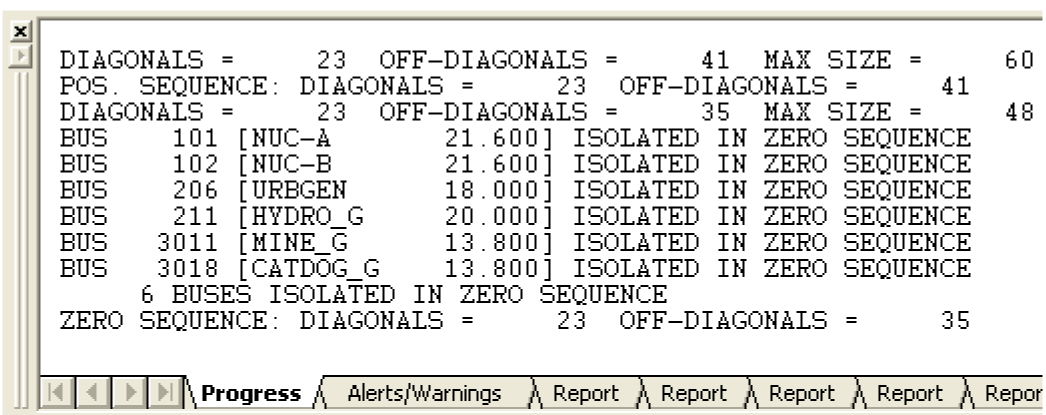


Figure 15.4. Example of Multiple Simultaneous Unbalances Activity Output with Network Setup Option Selected

```
--------------------------------------------------------------------------------

     PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS®E      WED, FEB 11 2009    8:48
 PSS(R)E PROGRAM APPLICATION GUIDE EXAMPLE
 BASE CASE INCLUDING SEQUENCE DATA

 UNBALANCES APPLIED:

 LINE TO GROUND FAULT AT BUS    101 [NUC-A        21.600]   PHASE 1
   L-G Z =     0.000         0.000

 LINE TO LINE TO GROUND FAULT AT BUS    101 [NUC-A        21.600]   EXCLUDED PHASE 1
   L-L Z =     0.000         0.000       L-G Z =    0.000         0.000

                     SEQUENCE THEVENIN IMPEDANCES AT FAULTED BUSES

   BUS# X-- NAME --X BASKV          ZERO              POSITIVE            NEGATIVE
    101 NUC-A        21.600   888.88889  0.06667    0.00304  0.02348    0.00304  0.02348

 THREE PHASE FAULT AT BUS    101 [NUC-A        21.600]:

 SEQUENCE                     RE(V0)     IM(V0)     RE(V+)     IM(V+)     RE(V-)     IM(V-)    RE(3V0)    IM(3V0)
 PHASE                        RE(VA)     IM(VA)     RE(VB)     IM(VB)     RE(VC)     IM(VC)

    101 (P.U.)                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
 NUC-A         21.600         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000

 SEQUENCE                     RE(I0)     IM(I0)     RE(I+)     IM(I+)     RE(I-)     IM(I-)    RE(3I0)    IM(3I0)
 PHASE                        RE(IA)     IM(IA)     RE(IB)     IM(IB)     RE(IC)     IM(IC)

 MACHINE 1                    0.0000     0.0000    11.4867   -13.3785     0.0000     0.0000     0.0000     0.0000
                             11.4867   -13.3785   -17.3295    -3.2585     5.8428    16.6370

 FROM     151 CKT 1           0.0000     0.0000     5.6799   -26.1450     0.0000     0.0000     0.0000     0.0000
 NUCPANT       500.00         5.6799   -26.1450   -25.4822     8.1535    19.8023    17.9915

 SUM OF CONTRIBUTIONS INTO BUS    101 [NUC-A        21.600]:

    101                       0.0000     0.0000    17.1666   -39.5236     0.0000     0.0000     0.0000     0.0000
 NUC-A         21.600        17.1666   -39.5236   -42.8117     4.8951    25.6451    34.6285

 FAULT CURRENT AT BUS    101 [NUC-A        21.600]:

    101                       0.0000     0.0000    17.1666   -39.5236     0.0000     0.0000     0.0000     0.0000
 NUC-A         21.600        17.1666   -39.5236   -42.8117     4.8951    25.6451    34.6285
```

Progress | Alerts/Warnings | Report | Report | Report | **Report**

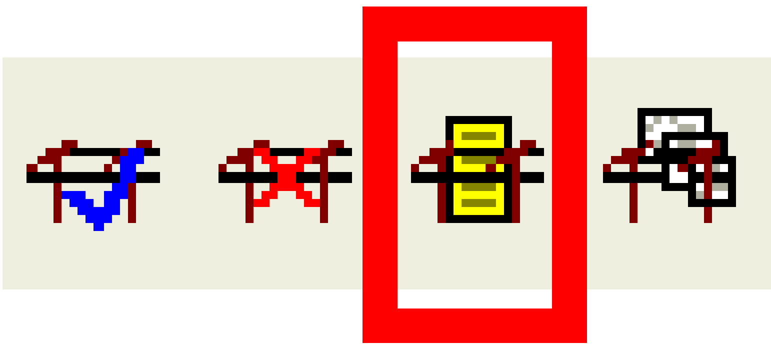
Figure 15.5. Example of Multiple Simultaneous Unbalances Report

Additional Information
PSS® E Program Operation Manual, Performing Fault Analysis with Multiple Unbalances

15.3. Running Detailed Fault Analysis under Unbalance Condition

SCOP

Requirements / Prerequisites
Validly specified power flow case. Reading Sequence Data for Fault Analysis Running Fault Analysis under Unbalance Condition



Fault > Unbalanced network tabular output (SCOP)...

The *[Multiple Unbalanced Solution Output]* dialog (Figure 15.6, “Multiple Unbalanced Solution Output Dialog”) requires *Branch quantity desired* to be expressed as one of the following:

- Currents
- Apparent impedances
- Apparent admittances

Click *[Go]* to perform the activity. The report is displayed in the *Report* tab by default (Figure 15.6, “Multiple Unbalanced Solution Output Dialog”).

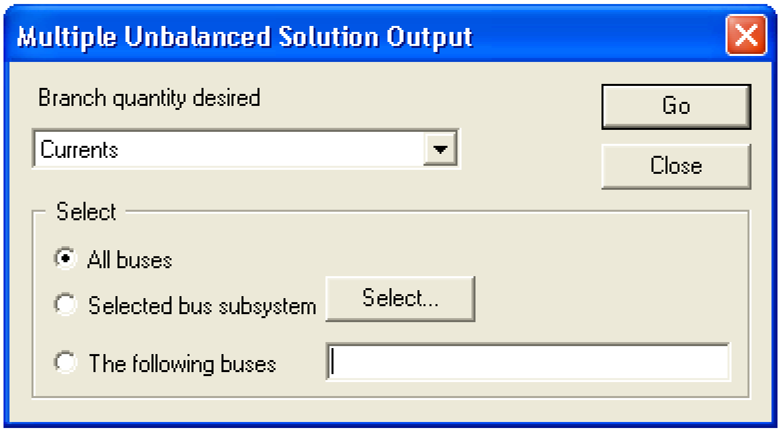


Figure 15.6. Multiple Unbalanced Solution Output Dialog

```
    PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS®E      WED, SEP 24 2008  14:25
PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE                                BRANCH
BASE CASE INCLUDING SEQUENCE DATA                                       CURRENTS
                       OUTPUT FOR AREA 1 [FLAPCO       ]

LINE TO GROUND FAULT AT BUS 999999 [DUMMYBUS    500.00]   PHASE 1
  L-G Z =      0.000        0.000
  DUMMY BUS IS  50.0% FROM BUS    201 [HYDRO       500.00] TO BUS    204 [SUB500      500.00]
  BUS    204 [SUB500      500.00] END IS OPEN

TWO PHASES CLOSED BETWEEN BUSES    101 [NUC-A       21.600] AND    102 [NUC-B       21.600]
  PHASE 1 OPEN  Z =      0.000        0.000

SEQUENCE                RE(V0)    IM(V0)    RE(V+)    IM(V+)    RE(V-)    IM(V-)   RE(3V0)   IM(3V0)
PHASE                   RE(VA)    IM(VA)    RE(VB)    IM(VB)    RE(VC)    IM(VC)

   101 (P.U.)           0.0000    0.0000    0.8831    0.3284   -0.1087   -0.0085    0.0000    0.0000
NUC-A        21.600     0.7743    0.3199   -0.0954   -1.0189   -0.6789    0.6990

SEQUENCE                RE(I0)    IM(I0)    RE(I+)    IM(I+)    RE(I-)    IM(I-)   RE(3I0)   IM(3I0)
PHASE                   RE(IA)    IM(IA)    RE(IB)    IM(IB)    RE(IC)    IM(IC)

MACHINE 1               0.0000    0.0000   -6.7303    0.0982   -0.1548    1.6285    0.0000    0.0000
                       -6.8850    1.7267    2.1173    4.8312    4.7678   -6.5579

TO    102 CKT           0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
NUC-B        21.600     0.0000    0.0000    0.0000    0.0000    0.0000    0.0000

TO    151 CKT 1         0.0000    0.0000    6.7303   -0.0982    0.1548   -1.6285    0.0000    0.0000
NUCPANT      500.00     6.8850   -1.7267   -2.1173   -4.8312   -4.7678    6.5579

SUM OF                  0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
CONTRIBUTIONS           0.0000    0.0000    0.0000    0.0000    0.0000    0.0000


SEQUENCE                RE(V0)    IM(V0)    RE(V+)    IM(V+)    RE(V-)    IM(V-)   RE(3V0)   IM(3V0)
PHASE                   RE(VA)    IM(VA)    RE(VB)    IM(VB)    RE(VC)    IM(VC)

   102 (P.U.)           0.0000    0.0000    0.8831    0.3284   -0.1087   -0.0085    0.0000    0.0000
NUC-B        21.600     0.7743    0.3199   -0.0954   -1.0189   -0.6789    0.6990

SEQUENCE                RE(I0)    IM(I0)    RE(I+)    IM(I+)    RE(I-)    IM(I-)   RE(3I0)   IM(3I0)
PHASE                   RE(IA)    IM(IA)    RE(IB)    IM(IB)    RE(IC)    IM(IC)

MACHINE 1               0.0000    0.0000   -6.7303    0.0982   -0.1548    1.6285    0.0000    0.0000
                       -6.8850    1.7267    2.1173    4.8312    4.7678   -6.5579

TO    101 CKT           0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
NUC-A        21.600     0.0000    0.0000    0.0000    0.0000    0.0000    0.0000

TO    151 CKT 1         0.0000    0.0000    6.7303   -0.0982    0.1548   -1.6285    0.0000    0.0000
NUCPANT      500.00     6.8850   -1.7267   -2.1173   -4.8312   -4.7678    6.5579

SUM OF                  0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
CONTRIBUTIONS           0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
```

Progress | Alerts/Warnings | **Report**

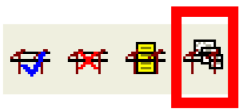
Detailed Fault Analysis, Partial Report

Additional Information
PSS® E Program Operation Manual, Multiple Unbalanced Fault Report

15.4. Calculating Automatic Sequencing Fault

ASCC

Requirements / Prerequisites
Validly specified power flow case. For unbalanced fault calculations, sequence data appended to saved case. Reading Sequence Data for Fault Analysis



Fault > Automatic sequence fault calculation (ASCC)...

If sequence data is not present in the working case, only three phase faults will be calculated.

The *[Automatic Sequence Fault Calculation]* dialog (Figure 15.7, "Automatic Sequence Fault Calculation Dialog") provides checkboxes to enable six types of fault application and other model conditions. The user must specify one of the following output options:

- Total fault currents
- I"k contributions to N levels away
- Total fault currents and I"k contributions to N levels away

Click *[...]* to open the selection window for a Fault Control Data file (*.fcd). A Relay Output Data file (*.rel) and a Short Circuit Output file (*.sc) may be specified to save the model data.

Click *[Go]* to perform the activity. A summary is routed to the *Progress* tab (Figure 15.7, "Automatic Sequence Fault Calculation Dialog"), and the report is routed to the *Report* tab by default (Figure 15.7, "Automatic Sequence Fault Calculation Dialog").

You will need to click *[Close]* to end this activity.

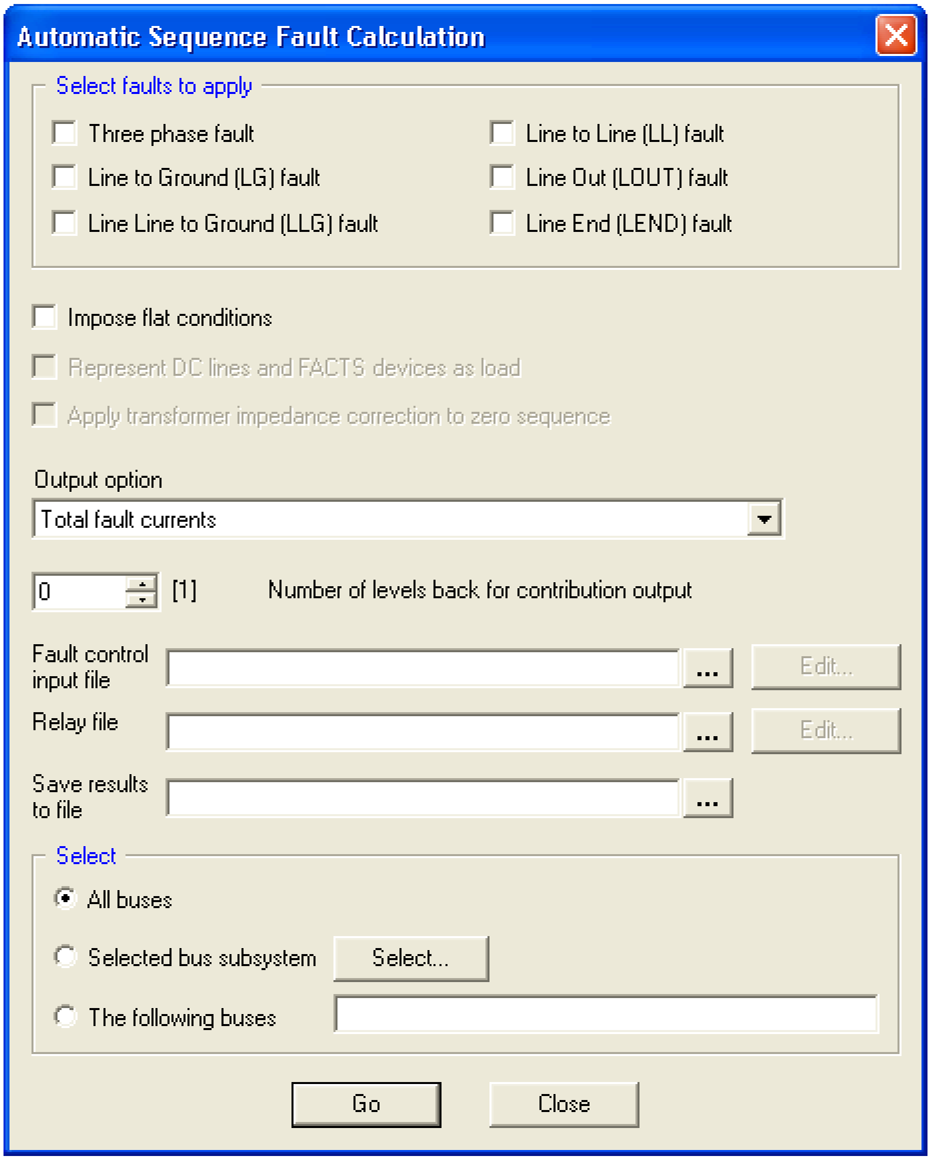


Figure 15.7. Automatic Sequence Fault Calculation Dialog

Additional Information
PSS® E Program Operation Manual, Calculating Automatic Sequencing Fault

15.5. Calculating Fault Currents to ANSI Standards

ANSI

Requirements / Prerequisites
Validly specified specified power flow case with sequence data appended to it. Reading Sequence Data for Fault Analysis

Fault > ANSI fault calculation (ANSI)...

The *[ANSI Fault Current Calculation]* dialog (Figure 15.8, “ANSI Fault Current Calculation Dialog”) provides *Fault Specifications* to be input from an ANSI Fault Specification Data file (*.ans) or interactively.

Select the Interactive fault specification option and click *[Select]* to choose buses from the *[Bus Selection]* dialog. Click *[Add to list]* to display the *[Add Bus]* dialog (Figure 15.9, “Add Bus Dialog”), where the default *Maximum operating voltage* and *Contact parting time* may be changed. Click *[Save]* to add the bus to the list.

Specifications may be made for branch and machine *Divisors*. The user must select a *Fault multiplying factor*. The calculation is output using one of the following formats:

- Summary output using ANSI X only (blank delimited fields)
- Summary output using ANSI X only (comma delimited fields)
- Detailed output using ANSI X only
- Detailed output using ANSI R and X
- Summary output using ANSI R and X (blank delimited fields)
- Summary output using ANSI R and X (comma delimited fields)

Click *[Go]* to perform the activity. A summary is routed to the *Progress* tab (Figure 15.10, “Example of ANSI Fault Current Calculation Activity Output”), and the report is routed to the *Report* tab by default (Figure 15.11, “Example of ANSI Fault Current Calculation Report”).

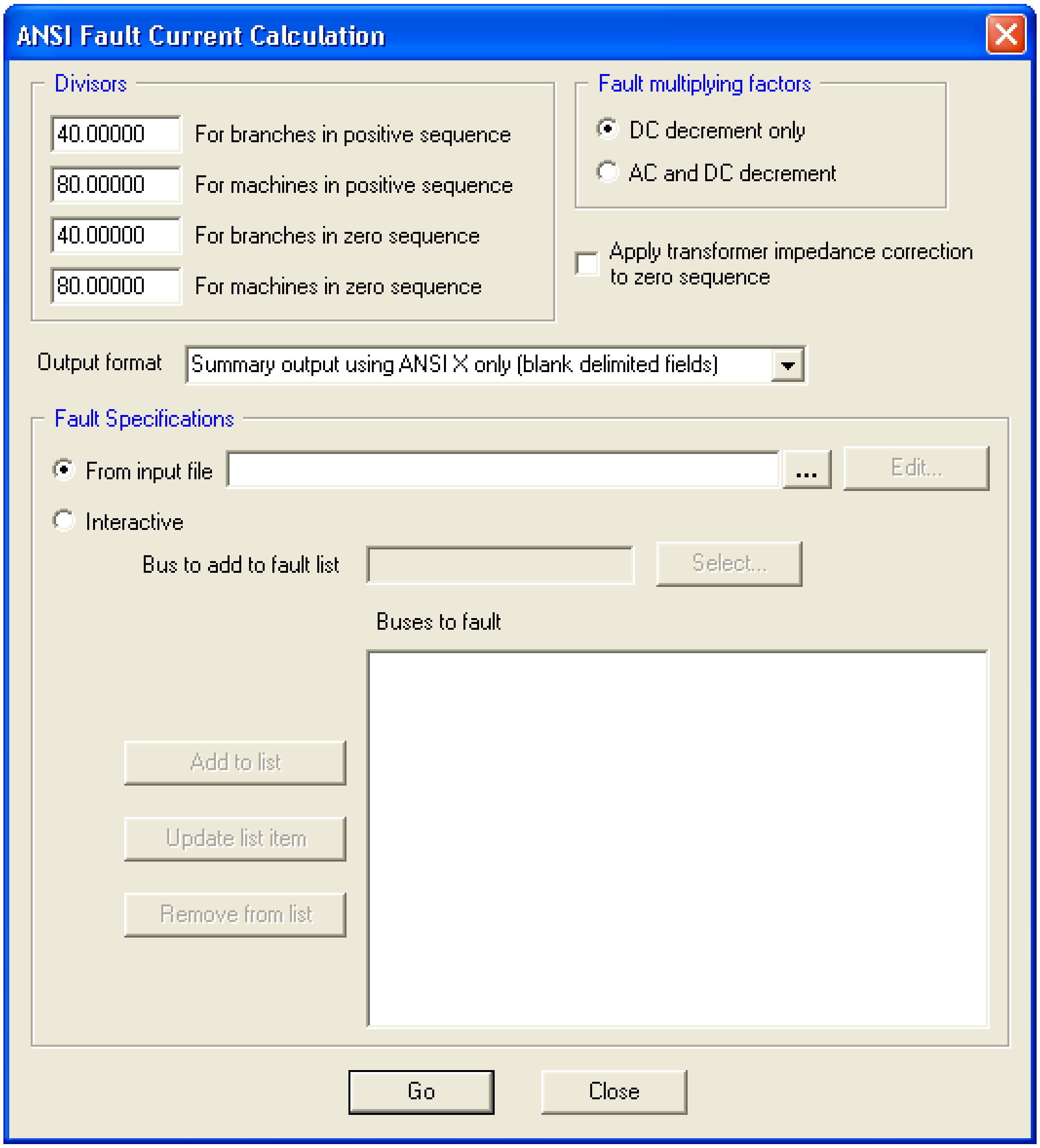


Figure 15.8. ANSI Fault Current Calculation Dialog

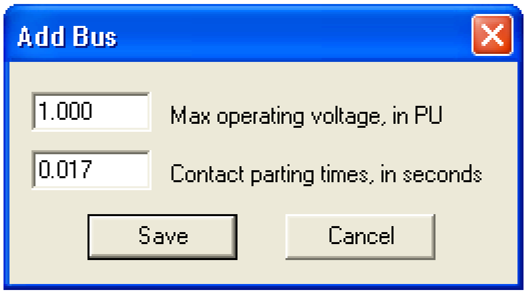
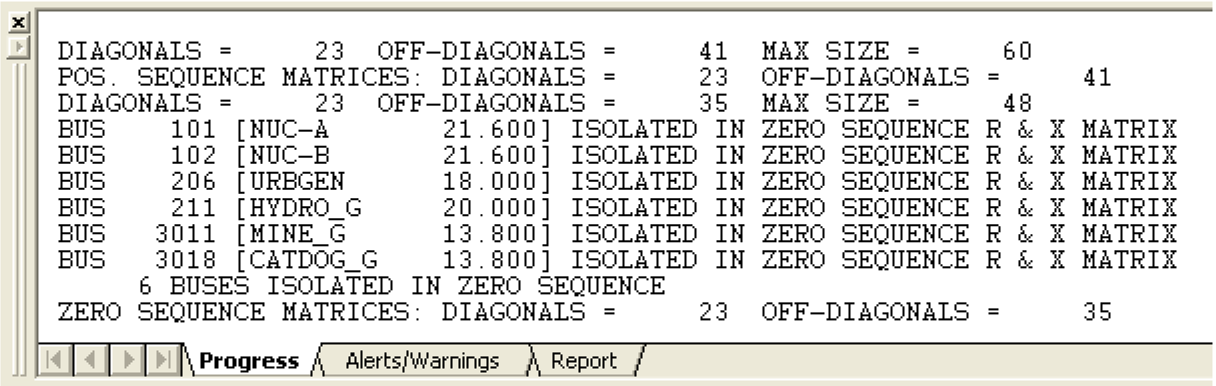
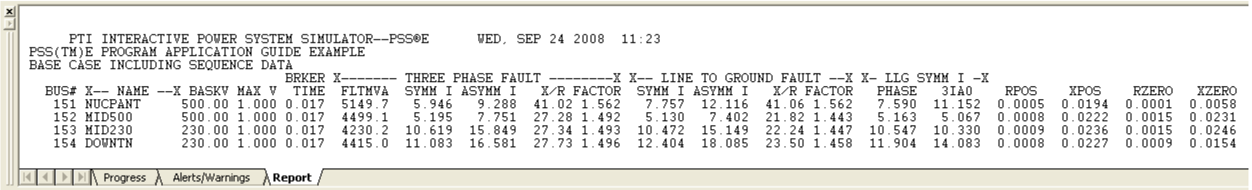


Figure 15.9. Add Bus Dialog



```
DIAGONALS =      23   OFF-DIAGONALS =      41   MAX SIZE =      60
POS. SEQUENCE MATRICES: DIAGONALS =      23   OFF-DIAGONALS =      41
DIAGONALS =      23   OFF-DIAGONALS =      35   MAX SIZE =      48
BUS     101 [NUC-A        21.600] ISOLATED IN ZERO SEQUENCE R & X MATRIX
BUS     102 [NUC-B        21.600] ISOLATED IN ZERO SEQUENCE R & X MATRIX
BUS     206 [URBGEN       18.000] ISOLATED IN ZERO SEQUENCE R & X MATRIX
BUS     211 [HYDRO_G      20.000] ISOLATED IN ZERO SEQUENCE R & X MATRIX
BUS    3011 [MINE_G       13.800] ISOLATED IN ZERO SEQUENCE R & X MATRIX
BUS    3018 [CATDOG_G     13.800] ISOLATED IN ZERO SEQUENCE R & X MATRIX
     6 BUSES ISOLATED IN ZERO SEQUENCE
ZERO SEQUENCE MATRICES: DIAGONALS =      23   OFF-DIAGONALS =      35
```


Figure 15.10. Example of ANSI Fault Current Calculation Activity Output



```
     PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS®E      WED, SEP 24 2008  11:23
PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE
BASE CASE INCLUDING SEQUENCE DATA
                                BRKER X------- THREE PHASE FAULT --------X X-- LINE TO GROUND FAULT --X X- LLG SYMM I -X
  BUS# X-- NAME --X BASKV MAX V  TIME  FLTMVA  SYMM I ASYMM I   X/R FACTOR  SYMM I ASYMM I   X/R FACTOR   PHASE   3IA0    RPOS    XPOS    RZERO   XZERO
   151 NUCPANT      500.00 1.000 0.017  5149.7  5.946   9.288  41.02 1.562   7.757  12.116  41.06 1.562   7.590  11.152  0.0005  0.0194  0.0001  0.0058
   152 MID500       500.00 1.000 0.017  4499.1  5.195   7.751  27.28 1.492   5.130   7.402  21.82 1.443   5.163   5.067  0.0008  0.0222  0.0015  0.0231
   153 MID230       230.00 1.000 0.017  4230.2 10.619  15.849  27.34 1.493  10.472  15.149  22.24 1.447  10.547  10.330  0.0009  0.0236  0.0015  0.0246
   154 DOWNTN       230.00 1.000 0.017  4415.0 11.083  16.581  27.73 1.496  12.404  18.085  23.50 1.458  11.904  14.083  0.0008  0.0227  0.0009  0.0154
```


Figure 15.11. Example of ANSI Fault Current Calculation Report

Additional Information
PSS® E Program Operation Manual, Calculating Fault Currents to ANSI Standards

15.6. Using Classical Fault Analysis Option

FLAT

Requirements / Prerequisites
Validly specified power flow case.

Fault > Setup for special fault calculations (FLAT)...

The *[Setup for Special Fault Calculations]* dialog (Figure 15.12, “Setup for Special Fault Calculations Dialog, Classical Fault Analysis”) prepares three different modeling options. Select *Set classical short circuit assumptions* for this activity. Checkboxes are then available to enable *Set tap ratios to unity* and *Set charging to zero*. The user must specify shunt configuration from the following options:

- Leave shunts unchanged
- Set shunts to zero in positive sequence
- Set shunts to zero in all sequences

Click *[OK]* to perform the activity. The message `SELECTED FLAT CHANGES IMPOSED` is displayed in the *Progress* tab.

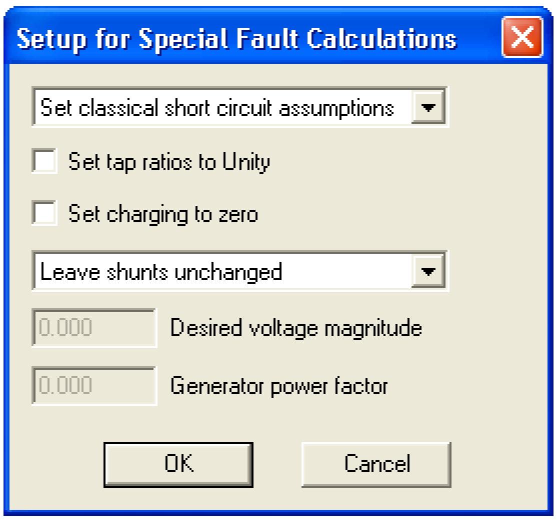


Figure 15.12. Setup for Special Fault Calculations Dialog, Classical Fault Analysis

Additional Information
PSS®E Program Operation Manual, Setting up Classical Fault Analysis Conditions

15.7. Calculating Short Circuit Currents According to IEC 60909 Standard

IECS

Requirements / Prerequisites
Validly specified specified power flow case with sequence data appended to it. Reading Sequence Data for Fault Analysis

Fault > IEC 60909 fault calculation (IECS)...

The *[IEC 60909 Fault Calculation]* dialog (Figure 15.13, “IEC 60909 Fault Calculation Dialog”) provides check-boxes to enable fault application. The user must also specify an option from each of the following:

Output option:

- Total fault currents
- I"k contributions to N levels away
- Total fault currents and I"k contributions to N levels away

Fault location:

- Network bus
- LV bus of Power Station Unit (PSU)
- Auxiliary transformer (connected to PSU) LV bus

Shunt option:

- Set shunts to zero in positive sequence
- Set shunts to zero in all sequences
- Leave shunts unchanged

Line charging:

- Set line charging to zero in positive sequence
- Set line charging to zero in all sequences
- Leave line charging unchanged

Click *[...]* to open selection windows for an IEC Fault Calculation Data file (*.iec) and a Fault Control Data file (*.fcd). A Short Circuit Output file (*.sc) may be specified to save the model data.

Click *[Go]* to perform the activity. A summary is output to the *Progress* tab and the report is displayed in the *Report* tab by default.

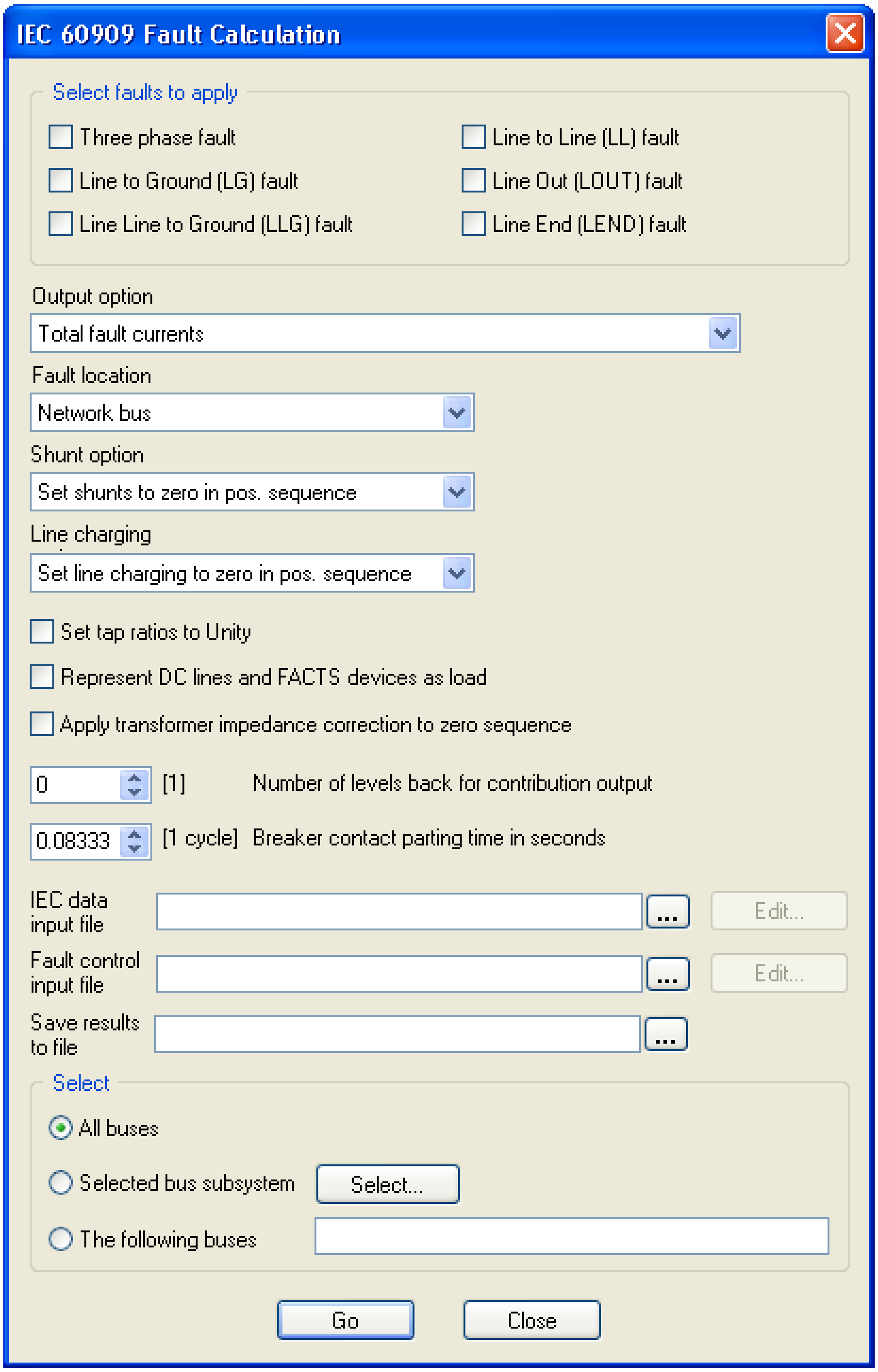


Figure 15.13. IEC 60909 Fault Calculation Dialog

Additional Information
PSS® E Program Operation Manual, Calculating Short Circuit Currents According to IEC 60909 Standard

15.8. Calculating Circuit Breaker Interrupting Duty

BKDY

Requirements / Prerequisites
Validly specified power flow case must reflect the pre-fault network condition. Generators converted; Converting Loads and Generators Breaker Duty Data file (*.bkd)

Fault > Circuit breaker interrupting duty (BKDY)...

The *[Circuit Breaker Interrupting Duty]* dialog (Figure 15.14, "Circuit Breaker Interrupting Duty Dialog") provides a checkbox to enable fault specifications from a previously saved file. Click *[...]* to open selection windows for the required *Breaker Duty Data file* (*.bkd) and the desired *Fault Specification Data file* (*.bkf).

Click *[Go]* to perform the activity. A summary is routed to the *Progress* tab (Figure 15.15, "Example of Circuit Breaker Interrupting Duty Activity Output"), and the report is routed to the *Report* tab by default (Figure 15.16, "Example of Circuit Breaker Interrupting Duty Report").

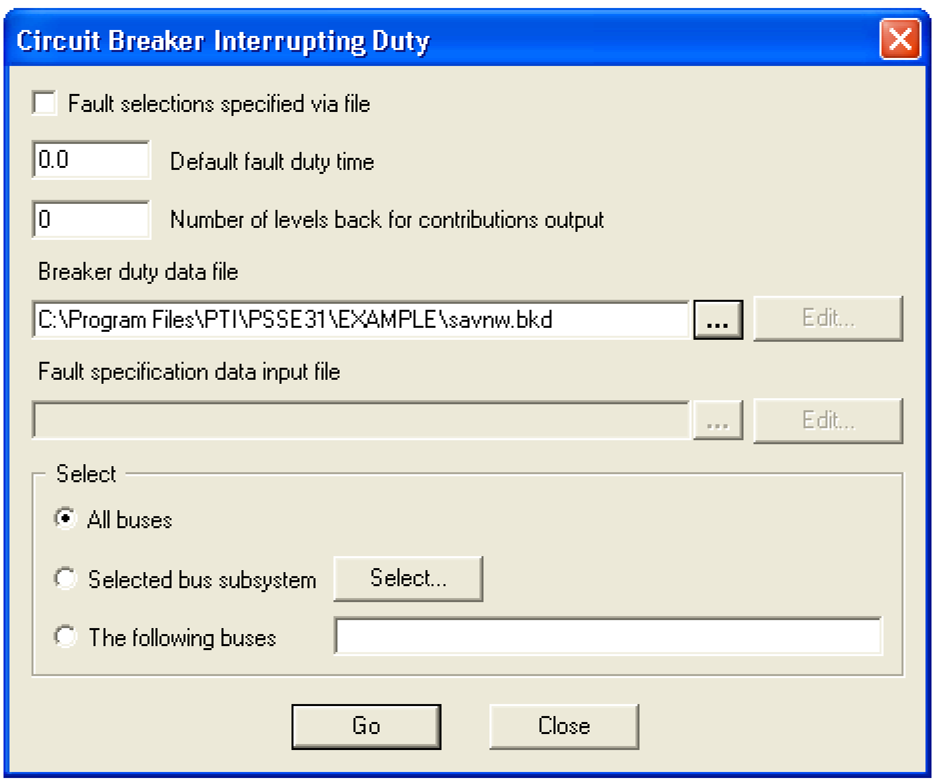


Figure 15.14. Circuit Breaker Interrupting Duty Dialog

```
    23 DIAGONAL AND      41 OFF-DIAGONAL ELEMENTS

 TERMINATED AFTER  20 ITERATIONS

 LARGEST MISMATCH:  708.88 MW  -10.52 MVAR   708.96 MVA AT BUS    205 [SUB230       230.00]
 SYSTEM TOTAL ABSOLUTE MISMATCH:            1609.40 MVA

 TERMINATED AFTER  20 ITERATIONS

 LARGEST MISMATCH:  600.61 MW  -37.74 MVAR   601.80 MVA AT BUS    205 [SUB230       230.00]
 SYSTEM TOTAL ABSOLUTE MISMATCH:            1350.09 MVA

 TERMINATED AFTER  20 ITERATIONS

 LARGEST MISMATCH:  604.04 MW  -63.75 MVAR   607.39 MVA AT BUS    205 [SUB230       230.00]
 SYSTEM TOTAL ABSOLUTE MISMATCH:            1391.66 MVA

 TERMINATED AFTER  20 ITERATIONS

 LARGEST MISMATCH:  623.37 MW  286.90 MVAR   686.23 MVA AT BUS    154 [DOWNTN       230.00]
 SYSTEM TOTAL ABSOLUTE MISMATCH:            1626.65 MVA

 PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE
 BASE CASE INCLUDING SEQUENCE DATA
```

Progress | Alerts/Warnings | Report | Report | Report

Figure 15.15. Example of Circuit Breaker Interrupting Duty Activity Output

```
--------------------------------------------------------------------------------

     PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS®E      WED, SEP 24 2008  10:59
 PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE                     RECTANGULAR
 BASE CASE INCLUDING SEQUENCE DATA                              COORDINATES
 FAULT DUTY TIME IS  0.000 SECONDS - ALL BREAKERS

 AT     152 [MID500      500.00]   INITIAL RMS      DECREMENTED RMS     /DECREMENTED CURRENTS/
 X-------- FROM ---------X CKT ALTERNATING CURNT  ALTERNATING CURNT PEAK DC   TOT RMS  TOT PEAK
    151 NUCPANT      500.00 1    5.6444  -9.0673    5.5997  -8.8987  11.4955  15.5785  26.3645
    151 NUCPANT      500.00 2    5.6444  -9.0673    5.5997  -8.8987  11.4955  15.5785  26.3645
    153 MID230       230.00 1    7.0018  -6.8651    6.3294  -4.4689  24.5139  25.7092  35.4713
    202 EAST500      500.00 1    9.4289 -11.1680    8.9707  -9.4405  21.3935  25.0455  39.8106
   3004 WEST         500.00 1    1.8369  -5.7993    1.6653  -5.2687   7.7886   9.5496  15.6030
 FAULT CURRENT  (P.U.)         29.5564 -41.9669   28.1648 -36.9753  72.5898  86.1958 138.3231
 THEVENIN IMPEDANCE:            0.00082  0.01638 V: 1.0171     -1.12  72.5920  86.1977 138.3253

 AT     153 [MID230      230.00]   INITIAL RMS      DECREMENTED RMS     /DECREMENTED CURRENTS/
 X-------- FROM ---------X CKT ALTERNATING CURNT  ALTERNATING CURNT PEAK DC   TOT RMS  TOT PEAK
    152 MID500       500.00 1   14.3666 -28.6550   13.3501 -32.1351  37.5297  51.1798  86.7413
    154 DOWNTN       230.00 1    3.0652  -4.3190    2.4809  -6.7268  11.0097  13.1384  21.1492
    154 DOWNTN       230.00 2    2.5543  -3.5991    2.0674  -5.6057   9.1438  10.9228  17.5935
   3006 UPTOWN       230.00 1    1.5593  -5.7565    1.3559  -6.7951   8.6430  11.0776  18.4422
 FAULT CURRENT  (P.U.)         21.5454 -42.3296   19.2543 -51.2628  64.5329  84.6351 141.9745
 THEVENIN IMPEDANCE:            0.00089  0.01811 V: 0.9930     -3.24  67.1715  86.6638 144.6131
```

Progress | Alerts/Warnings | Report | Report | **Report**

Figure 15.16. Example of Circuit Breaker Interrupting Duty Report

Additional Information
PSS® E Program Operation Manual, Calculating Circuit Breaker Interrupting Duty

15.9. Calculating pi-Equivalent, Single Transmission Line Unbalance

SPCB

Requirements / Prerequisites
Validly specified power flow case with sequence data appended to it. It must be solved to an acceptable mismatch level with bus voltages corresponding to the pre-unbalance condition. The branch to have the unbalance must be removed from service. Reading Sequence Data for Fault Analysis

Fault > Separate pole circuit breaker (SPCB)...

The *[Separate Pole Circuit Breaker]* dialog (Figure 15.17, "Separate Pole Circuit Breaker Dialog") requires specification of the *Out-of-service branch for unbalance*. Click *[Select]* to display the *[Branch Selection]* dialog, from which the out-of-service branch must be selected.

The *Unbalance type* must be specified as one of the following options:

- No unbalance reporting
- One phase open (checkbox for *Include a path to ground* and impedance filter option)
- Two phases open
- In-line fault
- One breaker (checkbox for *Include a path to ground* and impedance filter option)
- No unbalance

The in-line fault option may be further specified as:

- Line-to-ground (with impedance filter)
- Line-line-to-ground (with impedance filters)
- Three phase

Click *[Go]* to perform the activity. A summary is routed to the *Progress* tab (Figure 15.17, "Separate Pole Circuit Breaker Dialog"), and the report is routed to the *Report* tab by default (Figure 15.17, "Separate Pole Circuit Breaker Dialog").

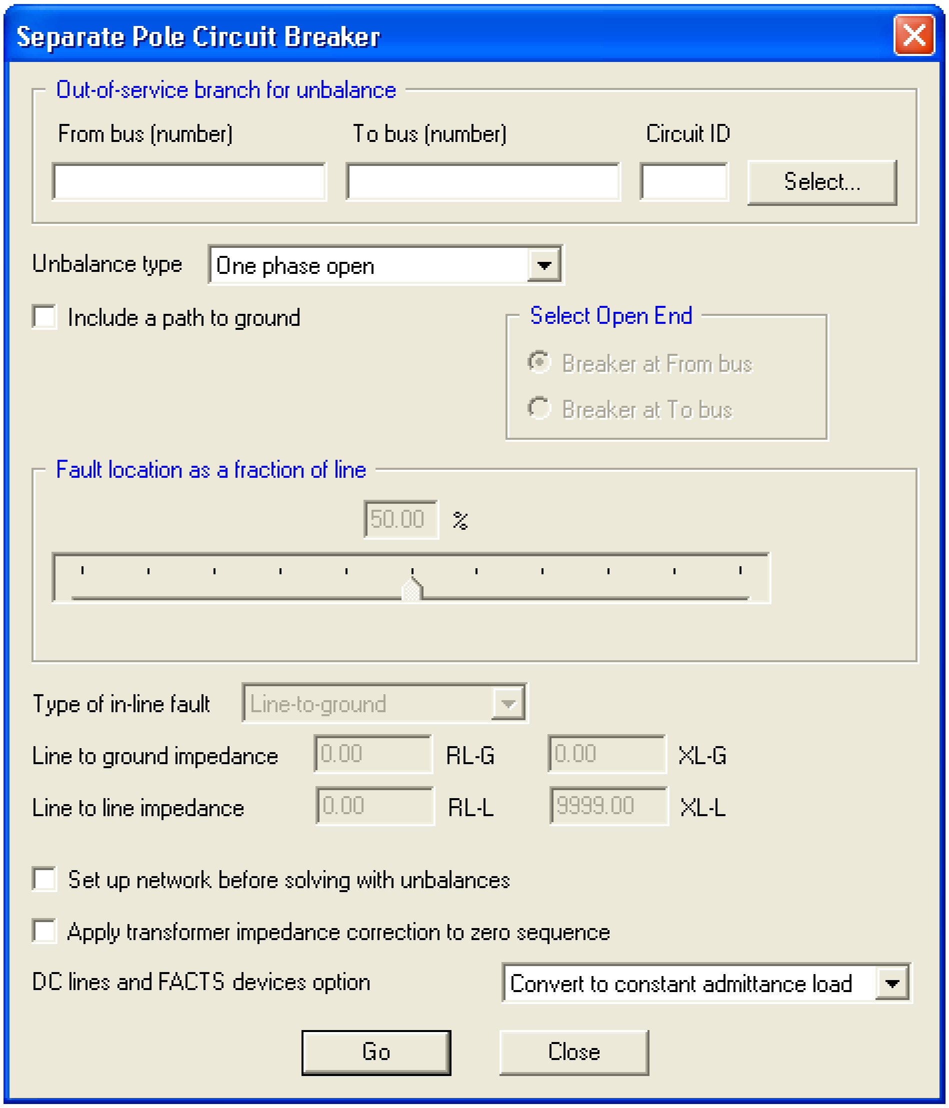
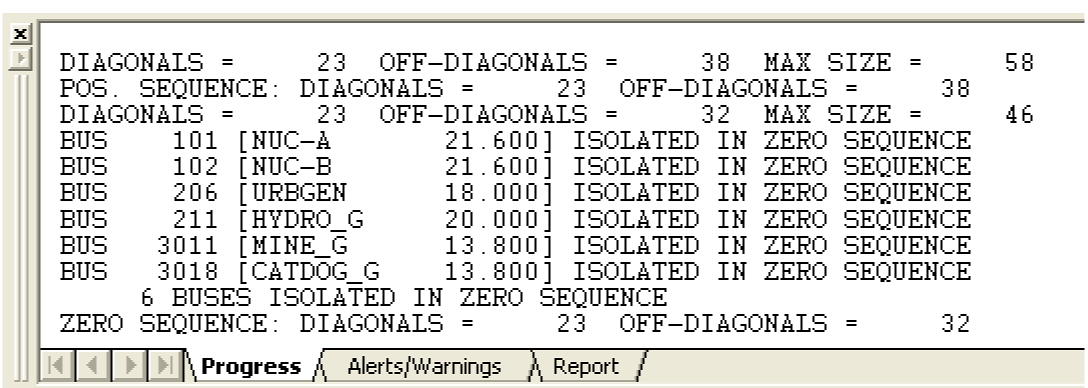
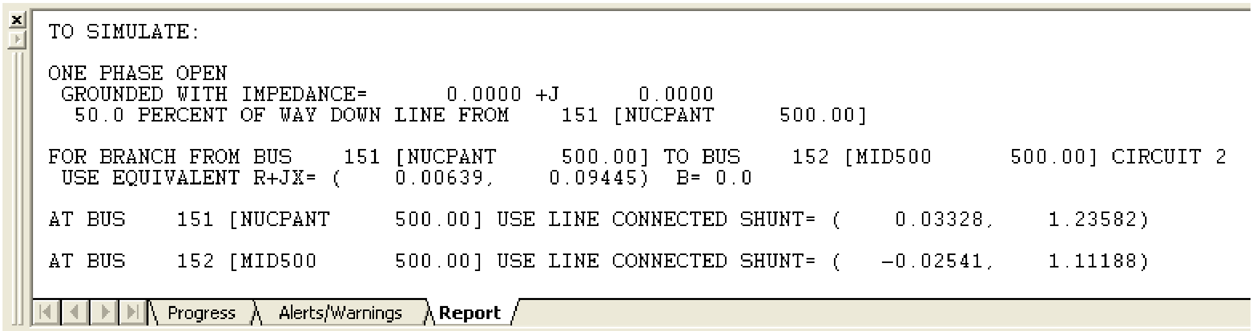


Figure 15.17. Separate Pole Circuit Breaker Dialog



Example of Separate Pole Circuit Breaker Activity Output



```
TO SIMULATE:

ONE PHASE OPEN
 GROUNDED WITH IMPEDANCE=      0.0000 +J      0.0000
  50.0 PERCENT OF WAY DOWN LINE FROM    151 [NUCPANT     500.00]

FOR BRANCH FROM BUS    151 [NUCPANT     500.00] TO BUS    152 [MID500      500.00] CIRCUIT 2
 USE EQUIVALENT R+JX= (    0.00639,    0.09445)  B= 0.0

AT BUS    151 [NUCPANT     500.00] USE LINE CONNECTED SHUNT= (    0.03328,    1.23582)

AT BUS    152 [MID500      500.00] USE LINE CONNECTED SHUNT= (   -0.02541,    1.11188)
```


Example of Separate Pole Circuit Breaker Report

Additional Information
PSS® E Program Operation Manual, Calculating pi-Equivalent, Single Transmission Line Unbalance

Chapter 16
Power Flow Reports

16.1. Area and Zone-Based Reports

16.1.1. Area-to-Area Interchange

INTA

Requirements / Prerequisites
Validly specified power flow case solved to an acceptable mismatch tolerance.

Power Flow > Reports > Area / zone based reports...

The *[Area/Zone Based Reports]* dialog (Figure 16.1, "Area/Zone Based Reports Dialog, Area") provides options for interchange reports and tie line loading reports, of all subsystems or selected subsystems, by area or zone.

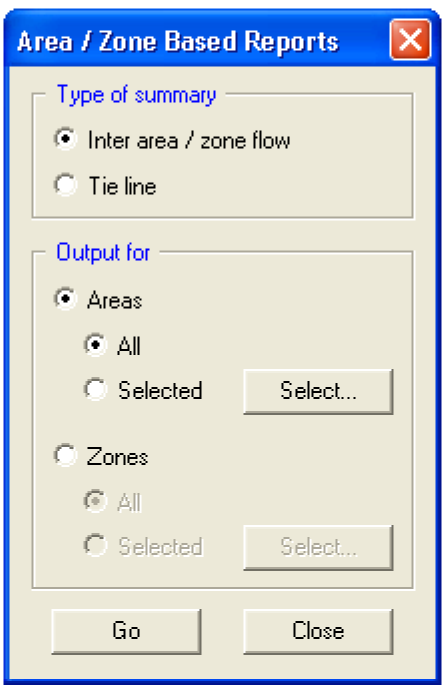
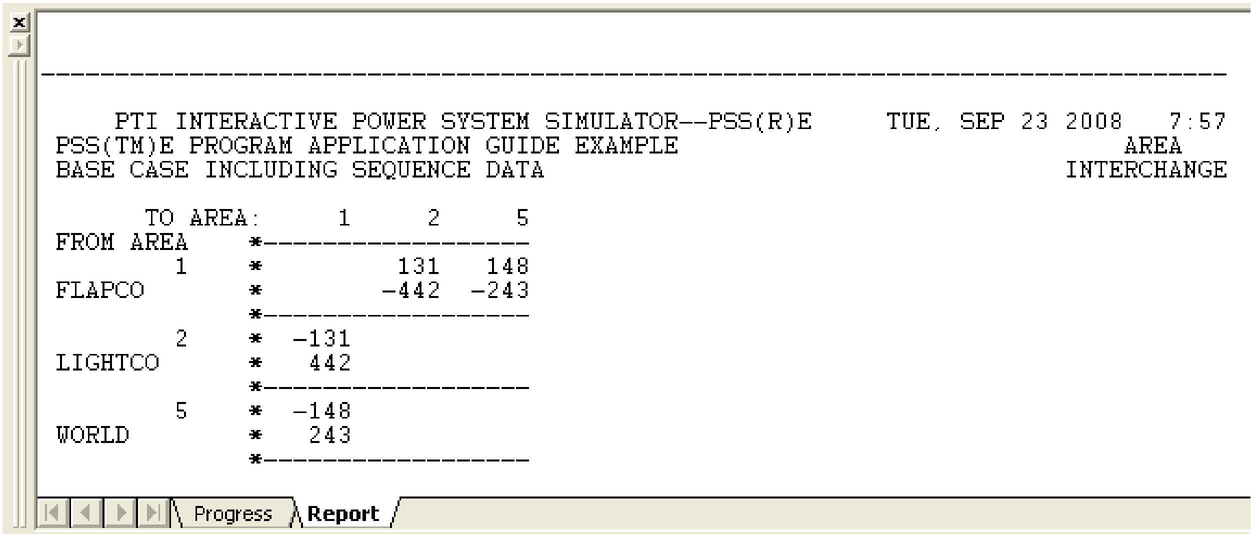


Figure 16.1. Area/Zone Based Reports Dialog, Area

Click *[Go]* to produce the report (Figure 16.2, "Example of Area Interchange Report"), which is displayed in the *Report* tab by default.



```
-------------------------------------------------------------------------------

    PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS(R)E     TUE, SEP 23 2008   7:57
PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE                                AREA
BASE CASE INCLUDING SEQUENCE DATA                                   INTERCHANGE

      TO AREA:      1      2      5
FROM AREA     *------------------
        1     *          131    148
FLAPCO        *         -442   -243
              *------------------
        2     *  -131
LIGHTCO       *   442
              *------------------
        5     *  -148
WORLD         *   243
              *------------------
```


Figure 16.2. Example of Area Interchange Report

Additional Information
PSS® E Program Operation Manual, Summarizing Area-to-Area Interchange

16.1.2. Zone-to-Zone Interchange

INTZ

Requirements / Prerequisites
Validly specified power flow case solved to an acceptable mismatch tolerance.

Power Flow > Reports > Area / zone based reports...

The *[Area/Zone Based Reports]* dialog (Figure 16.3, “Area/Zone Based Reports Dialog, Zone”) provides options for interchange reports and tie line loading reports, of all subsystems or selected subsystems, by area or zone.

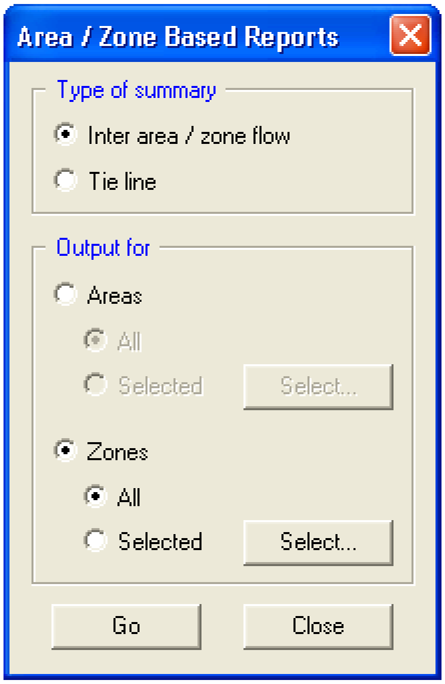
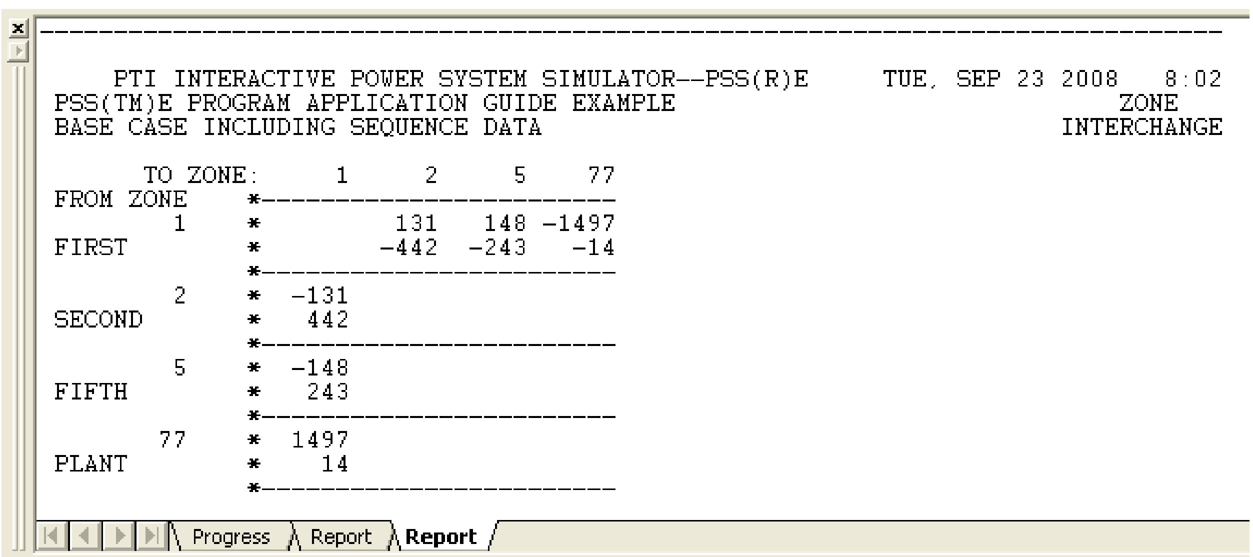


Figure 16.3. Area/Zone Based Reports Dialog, Zone

Click *[Go]* to produce the report (Figure 16.4, "Example of Zone Interchange Report"), which is displayed in the *Report* tab by default.



```
--------------------------------------------------------------------------------

    PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS(R)E     TUE, SEP 23 2008    8:02
 PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE                            ZONE
 BASE CASE INCLUDING SEQUENCE DATA                                 INTERCHANGE

       TO ZONE:      1      2      5     77
 FROM ZONE     *------------------------
         1     *           131    148 -1497
 FIRST         *          -442   -243   -14
               *------------------------
         2     *   -131
 SECOND        *    442
               *------------------------
         5     *   -148
 FIFTH         *    243
               *------------------------
        77     *   1497
 PLANT         *     14
               *------------------------
```


Figure 16.4. Example of Zone Interchange Report

Additional Information
PSS® E Program Operation Manual, Summarizing Zone-to-Zone Interchange

16.1.3. Loadings on Tie Lines from Interchange Areas

TIES

Requirements / Prerequisites
Validly specified power flow case solved to an acceptable mismatch tolerance.

Power Flow > Reports > Area / zone based reports...

The *[Area/Zone Based Reports]* dialog (Figure 16.5, "Area/Zone Based Reports Dialog, Area Tie Line Loadings") provides options for interchange reports and tie line loading reports, of all subsystems or selected subsystems, by area or zone.

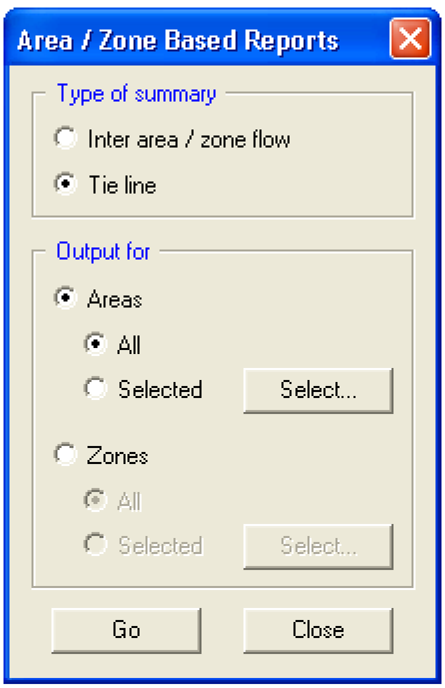
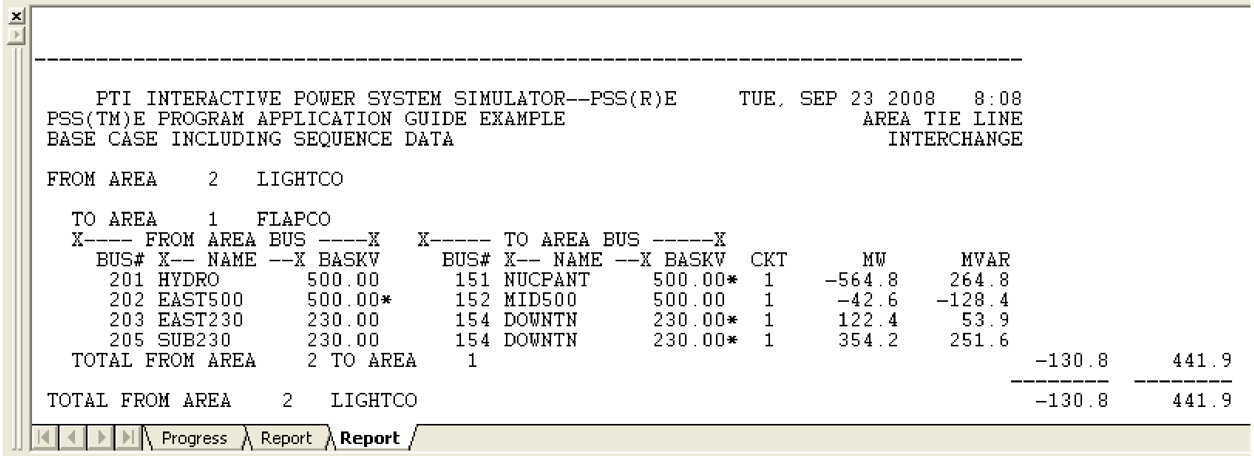


Figure 16.5. Area/Zone Based Reports Dialog, Area Tie Line Loadings

Click *[Go]* to produce the report (Figure 16.6, "Area/Owner/Zone Totals Dialog, Area"), which is displayed in the *Report* tab by default.



```
--------------------------------------------------------------------------------

    PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS(R)E     TUE, SEP 23 2008   8:08
 PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE                      AREA TIE LINE
 BASE CASE INCLUDING SEQUENCE DATA                                 INTERCHANGE

 FROM AREA     2   LIGHTCO

   TO AREA     1   FLAPCO
   X---- FROM AREA BUS ----X   X----- TO AREA BUS -----X
     BUS# X-- NAME --X BASKV     BUS# X-- NAME --X BASKV  CKT      MW      MVAR
      201 HYDRO        500.00     151 NUCPANT      500.00*  1    -564.8    264.8
      202 EAST500      500.00*    152 MID500       500.00   1     -42.6   -128.4
      203 EAST230      230.00     154 DOWNTN       230.00*  1     122.4     53.9
      205 SUB230       230.00     154 DOWNTN       230.00*  1     354.2    251.6
   TOTAL FROM AREA     2 TO AREA    1                                         -130.8     441.9
                                                                             --------  --------
 TOTAL FROM AREA    2   LIGHTCO                                               -130.8     441.9
```


Example of Area Tie Line Loadings Report

Additional Information
PSS® E Program Operation Manual, Summarizing Loadings on Ties from Interchange Areas

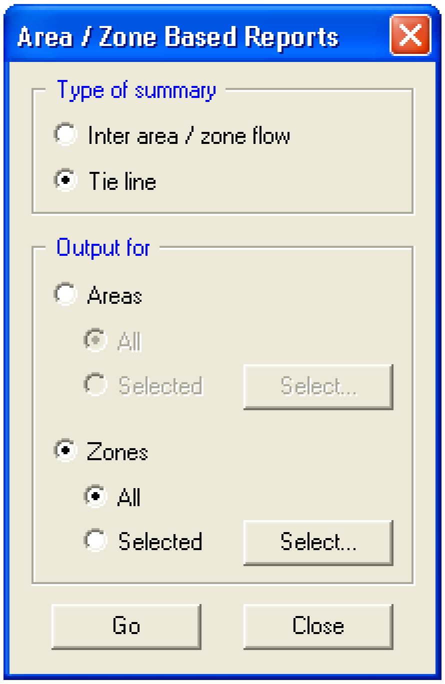
16.1.4. Loadings on Tie Lines from Zones

TIEZ

Requirements / Prerequisites
Validly specified power flow case solved to an acceptable mismatch tolerance.

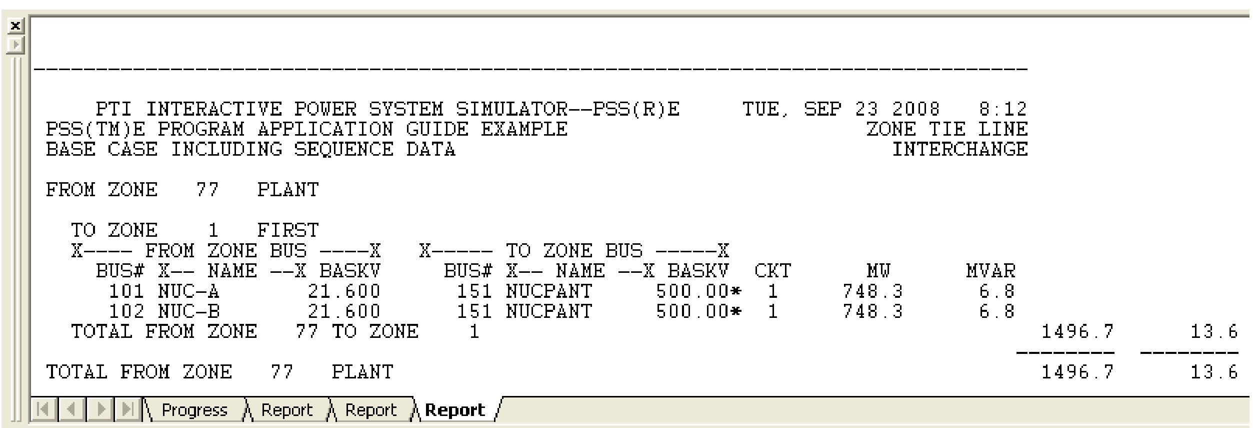
Power Flow > Reports > Area / zone based reports...

The *[Area/Zone Based Reports]* dialog (Figure 16.5, "Area/Zone Based Reports Dialog, Area Tie Line Loadings") provides options for interchange reports and tie line loading reports, of all subsystems or selected subsystems, by area or zone.



Area/Zone Based Reports Dialog, Zone Tie Line Loadings

Click *[Go]* to produce the report (Figure 16.6, "Area/Owner/Zone Totals Dialog, Area"), which is displayed in the *Report* tab by default.



```
------------------------------------------------------------------------------

    PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS(R)E     TUE, SEP 23 2008   8:12
 PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE                        ZONE TIE LINE
 BASE CASE INCLUDING SEQUENCE DATA                                   INTERCHANGE

 FROM ZONE   77   PLANT

   TO ZONE    1   FIRST
   X---- FROM ZONE BUS ----X   X----- TO ZONE BUS -----X
     BUS# X-- NAME --X BASKV     BUS# X-- NAME --X BASKV  CKT      MW      MVAR
      101 NUC-A        21.600     151 NUCPANT      500.00*  1     748.3     6.8
      102 NUC-B        21.600     151 NUCPANT      500.00*  1     748.3     6.8
   TOTAL FROM ZONE   77 TO ZONE    1                                       1496.7      13.6
                                                                         --------- ---------
 TOTAL FROM ZONE   77   PLANT                                              1496.7      13.6
```


Example of Zone Tie Line Loadings Report

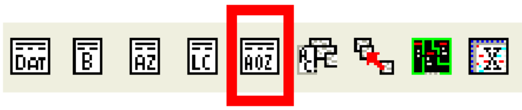
Additional Information
PSS® E Program Operation Manual, Summarizing Loadings on Ties from Zones

16.2. Area,Owner and Zone Totals

16.2.1. Area Totals

AREA

Requirements / Prerequisites
Validly specified power flow case solved to an acceptable mismatch tolerance.



Power Flow > Reports > Area / owner / zone totals...

The *[Area/Owner/Zone Totals]* dialog (Figure 16.6, "Area/Owner/Zone Totals Dialog, Area") provides options for subsystem totals, of all subsystems or selected subsystems, by area, owner, or zone. The area report may also include zone subtotals.

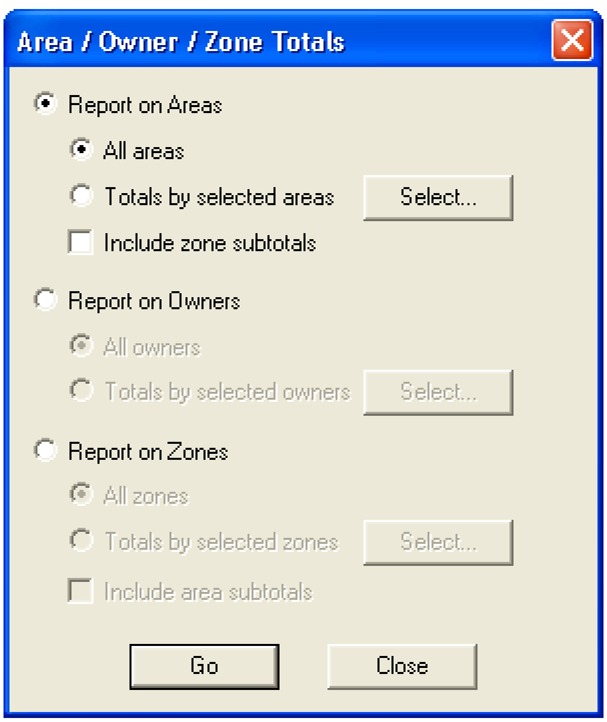


Figure 16.6. Area/Owner/Zone Totals Dialog, Area

Click *[Go]* to produce the report (Figure 16.7, "Example of Area Totals Report with Zone Subtotals"), which is displayed in the *Report* tab by default.

```
----------------------------------------------------------------------------------

    PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS(R)E      TUE, SEP 23 2008   7:36
 PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE                          AREA TOTALS
 BASE CASE INCLUDING SEQUENCE DATA                                   IN MW/MVAR

 AREA     1 [FLAPCO      ] TOTALS BY ZONE
                     X---GENERATION--X X----TO LOAD----X X--TO BUS SHUNT-X X-TO LINE SHUNT-X CHARGING X---TO LOSSES---X X--TO NET INT---X  DES NET
 X------ ZONE -----X       MW     MVAR       MW     MVAR       MW     MVAR       MW     MVAR     MVAR       MW     MVAR       MW     MVAR   INT MW
    1 [FIRST       ]      0.0      0.0    200.0    100.0      0.0    349.9      0.0      0.0    841.3     18.0    289.6    278.7   -684.8
   77 [PLANT       ]   1500.0    162.4      0.0      0.0      0.0      0.0      0.0      0.0      0.0      3.3    148.8      0.0      0.0
                     -------- -------- -------- -------- -------- -------- -------- -------- -------- -------- -------- -------- --------
 AREA     1 TOTALS:    1500.0    162.4    200.0    100.0      0.0    349.9      0.0      0.0    841.3     21.3    438.3    278.7   -684.8    250.0

 AREA     2 [LIGHTCO     ] TOTALS BY ZONE
                     X---GENERATION--X X----TO LOAD----X X--TO BUS SHUNT-X X-TO LINE SHUNT-X CHARGING X---TO LOSSES---X X--TO NET INT---X  DES NET
 X------ ZONE -----X       MW     MVAR       MW     MVAR       MW     MVAR       MW     MVAR     MVAR       MW     MVAR       MW     MVAR   INT MW
    1 [FIRST       ]      0.0      0.0   1000.0    800.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0
    2 [SECOND      ]   1400.0    617.8   1500.0    850.0      0.0   -641.4      0.0      0.0    623.0     30.8    590.4   -130.8    441.9
                     -------- -------- -------- -------- -------- -------- -------- -------- -------- -------- -------- -------- --------
 AREA     2 TOTALS:    1400.0    617.8   2500.0   1650.0      0.0   -641.4      0.0      0.0    623.0     30.8    590.4   -130.8    441.9   -100.0

 AREA     5 [WORLD       ] TOTALS BY ZONE
                     X---GENERATION--X X----TO LOAD----X X--TO BUS SHUNT-X X-TO LINE SHUNT-X CHARGING X---TO LOSSES---X X--TO NET INT---X  DES NET
 X------ ZONE -----X       MW     MVAR       MW     MVAR       MW     MVAR       MW     MVAR     MVAR       MW     MVAR       MW     MVAR   INT MW
    5 [FIFTH       ]    358.7    184.0    500.0    200.0      0.0      0.0      0.0      0.0    345.8      6.6     87.0   -147.9    242.9
                     -------- -------- -------- -------- -------- -------- -------- -------- -------- -------- -------- -------- --------
 AREA     5 TOTALS:     358.7    184.0    500.0    200.0      0.0      0.0      0.0      0.0    345.8      6.6     87.0   -147.9    242.9   -150.0

                     X---GENERATION--X X----TO LOAD----X X--TO BUS SHUNT-X X-TO LINE SHUNT-X CHARGING X---TO LOSSES---X X--TO NET INT---X  DES NET
 TOTALS OF ALL             MW     MVAR       MW     MVAR       MW     MVAR       MW     MVAR     MVAR       MW     MVAR       MW     MVAR   INT MW
 AREAS REPORTED        3258.7    964.2   3200.0   1950.0      0.0   -291.5      0.0      0.0   1810.1     58.7   1115.7      0.0      0.0      0.0
```

Progress Report

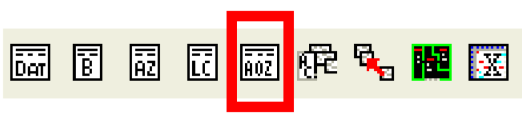
Figure 16.7. Example of Area Totals Report with Zone Subtotals

Additional Information
PSS® E Program Operation Manual, Summarizing Area Totals

16.2.2. Owner Totals

OWNR

Requirements / Prerequisites
Validly specified power flow case solved to an acceptable mismatch tolerance.



Power Flow > Reports > Area / owner / zone totals...

The *[Area/Owner/Zone Totals]* dialog (Figure 16.8, "Area/Owner/Zone Totals Dialog, Owner") provides options for subsystem totals, of all subsystems or selected subsystems, by area, owner, or zone:

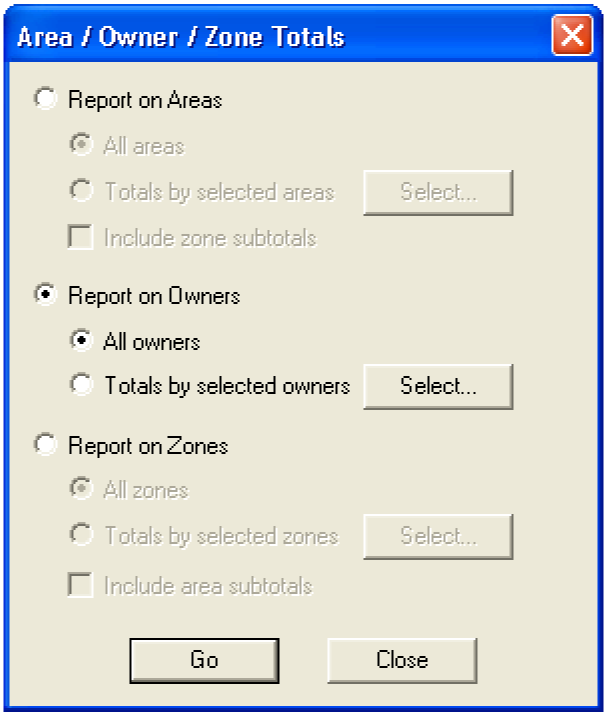
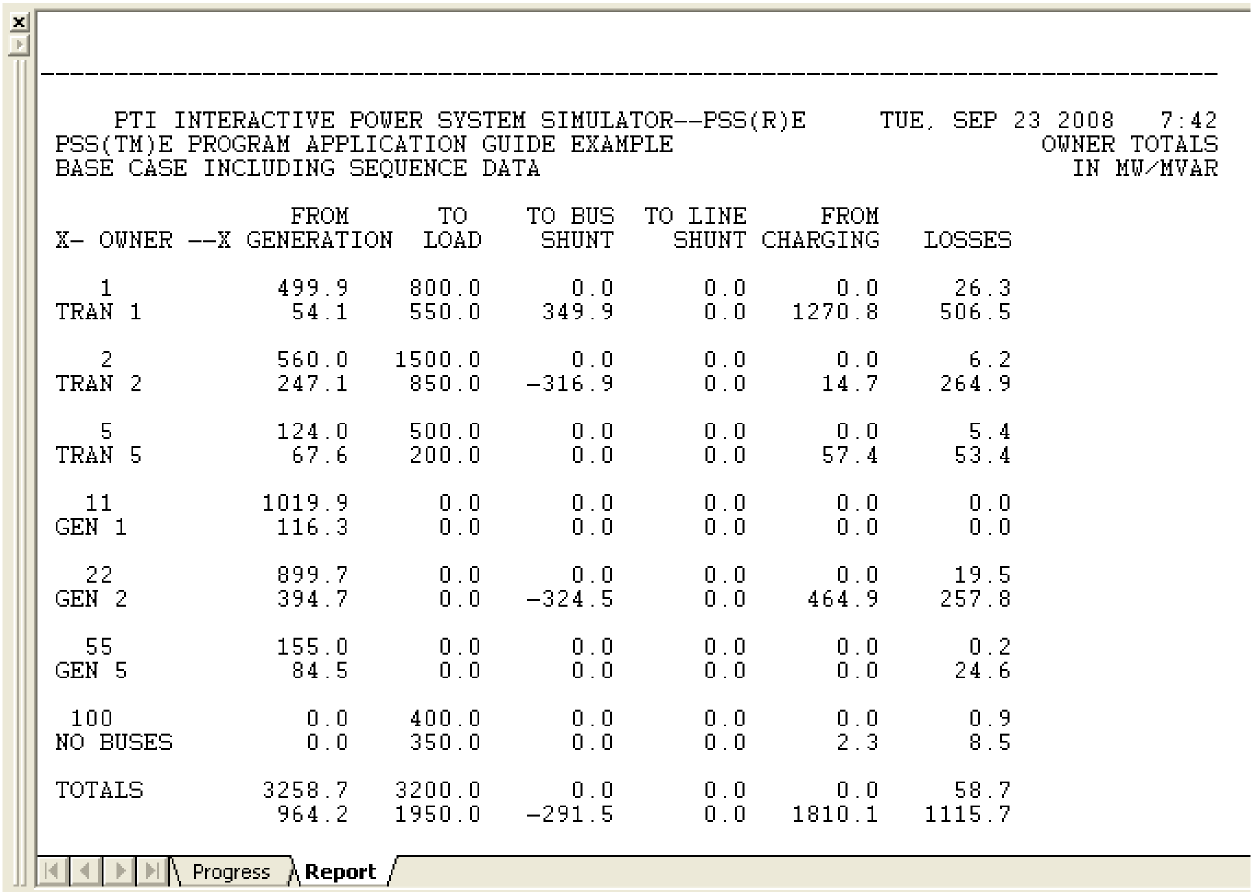


Figure 16.8. Area/Owner/Zone Totals Dialog, Owner

Click *[Go]* to produce the report (Figure 16.9, “Example of Owner Totals Report”), which is displayed in the *Report* tab by default.



```
-------------------------------------------------------------------------------

    PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS(R)E     TUE, SEP 23 2008    7:42
PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE                         OWNER TOTALS
BASE CASE INCLUDING SEQUENCE DATA                                    IN MW/MVAR

                FROM       TO    TO BUS  TO LINE     FROM
X- OWNER --X GENERATION  LOAD     SHUNT    SHUNT CHARGING    LOSSES

    1             499.9   800.0     0.0      0.0      0.0      26.3
TRAN 1             54.1   550.0   349.9      0.0   1270.8     506.5

    2             560.0  1500.0     0.0      0.0      0.0       6.2
TRAN 2            247.1   850.0  -316.9      0.0     14.7     264.9

    5             124.0   500.0     0.0      0.0      0.0       5.4
TRAN 5             67.6   200.0     0.0      0.0     57.4      53.4

   11            1019.9     0.0     0.0      0.0      0.0       0.0
GEN 1             116.3     0.0     0.0      0.0      0.0       0.0

   22             899.7     0.0     0.0      0.0      0.0      19.5
GEN 2             394.7     0.0  -324.5      0.0    464.9     257.8

   55             155.0     0.0     0.0      0.0      0.0       0.2
GEN 5              84.5     0.0     0.0      0.0      0.0      24.6

  100               0.0   400.0     0.0      0.0      0.0       0.9
NO BUSES            0.0   350.0     0.0      0.0      2.3       8.5

TOTALS           3258.7  3200.0     0.0      0.0      0.0      58.7
                  964.2  1950.0  -291.5      0.0   1810.1    1115.7
```

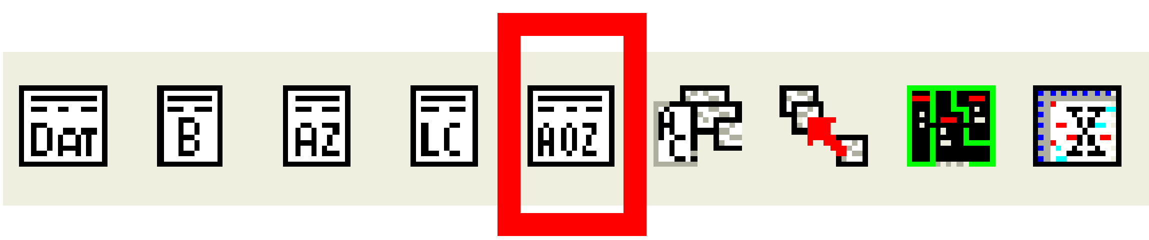

Figure 16.9. Example of Owner Totals Report

Additional Information
PSS® E Program Operation Manual, Summarizing Owner Totals

16.2.3. Zone Totals

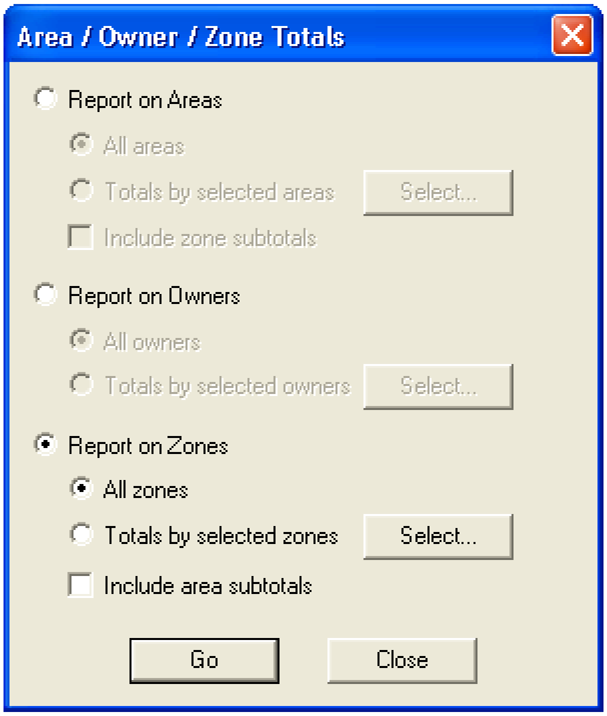
ZONE

Requirements / Prerequisites
Validly specified power flow case solved to an acceptable mismatch tolerance.



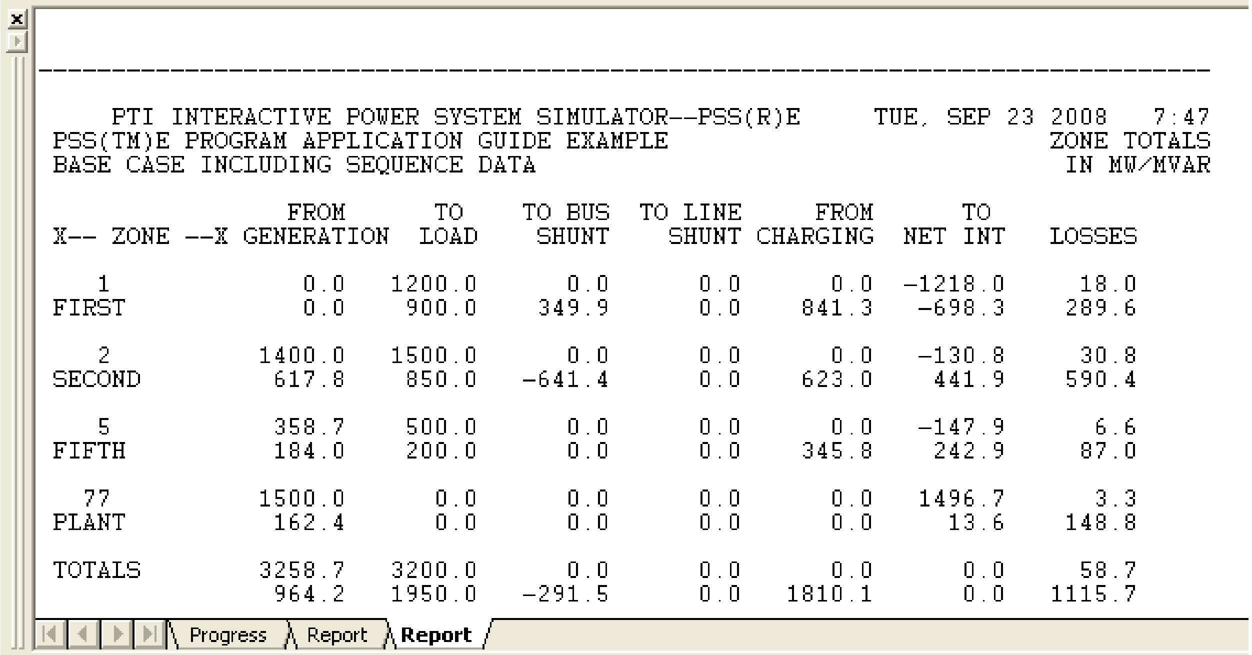
Power Flow > Reports > Area / owner / zone totals...

The *[Area/Owner/Zone Totals]* dialog (Figure 16.8, "Area/Owner/Zone Totals Dialog, Owner") provides options for subsystem totals, of all subsystems or selected subsystems, by area, owner, or zone. The zone report may also include area subtotals.



Area/Owner/Zone Totals Dialog, Zone

Click *[Go]* to produce the report (Figure 16.9, "Example of Owner Totals Report"), which is displayed in the *Report* tab by default.



```
-------------------------------------------------------------------------------

    PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS(R)E     TUE, SEP 23 2008   7:47
 PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE                         ZONE TOTALS
 BASE CASE INCLUDING SEQUENCE DATA                                   IN MW/MVAR

                 FROM        TO    TO BUS  TO LINE      FROM       TO
 X-- ZONE --X GENERATION   LOAD     SHUNT    SHUNT  CHARGING  NET INT    LOSSES

    1                0.0  1200.0      0.0      0.0       0.0  -1218.0      18.0
 FIRST               0.0   900.0    349.9      0.0     841.3   -698.3     289.6

    2             1400.0  1500.0      0.0      0.0       0.0   -130.8      30.8
 SECOND            617.8   850.0   -641.4      0.0     623.0    441.9     590.4

    5              358.7   500.0      0.0      0.0       0.0   -147.9       6.6
 FIFTH             184.0   200.0      0.0      0.0     345.8    242.9      87.0

   77             1500.0     0.0      0.0      0.0       0.0   1496.7       3.3
 PLANT             162.4     0.0      0.0      0.0       0.0     13.6     148.8

 TOTALS           3258.7  3200.0      0.0      0.0       0.0      0.0      58.7
                   964.2  1950.0   -291.5      0.0    1810.1      0.0    1115.7
```


Example of Zone Totals Report

Additional Information
PSS® E Program Operation Manual, Summarizing Zone Totals

16.3. Bus-Based Reports

Through the *[Bus Based Reports]* dialog (Figure 16.10, “Bus Based Reports Dialog, Standard Format”), several power flow solution reports may be obtained.

The *[Bus Based Reports]* dialog enables the user to designate for processing either the entire working case or a specified bus subsystem (refer to Subsystem Selection of the *PSS®E Program Operation Manual)*. A bus subsystem may be specified either via a *[Bus Subsystem Selector]* dialog by clicking *[Select...]*, or by entering buses directly in the *[Bus Based Reports]* dialog.

Click *[Go]* to produce the report . The report is written to the *Report* device.

16.3.1. Producing a Standard Power Flow Solution Report

POUT

Requirements / Prerequisites
Validly specified power flow case solved to an acceptable mismatch tolerance.

Power Flow > Reports > Bus based reports...

In the *[Bus Based Reports]* dialog (Figure 16.10, “Bus Based Reports Dialog, Standard Format”), select Powerflow output with the Wide format output check box unchecked. Click *[Go]* to produce the report (Figure 16.11, “Example of Standard Format Power Flow Solution Report”).

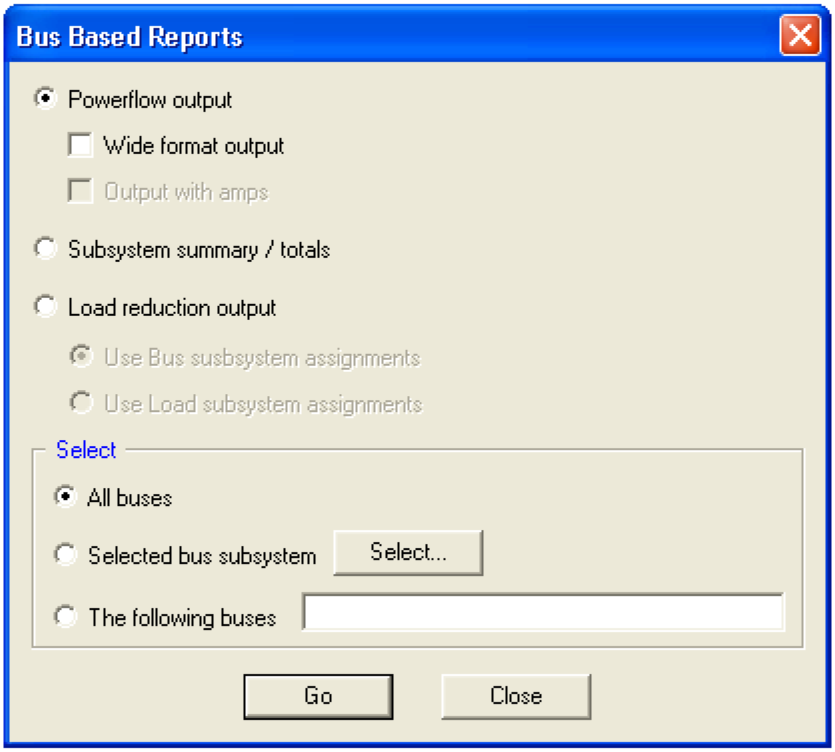
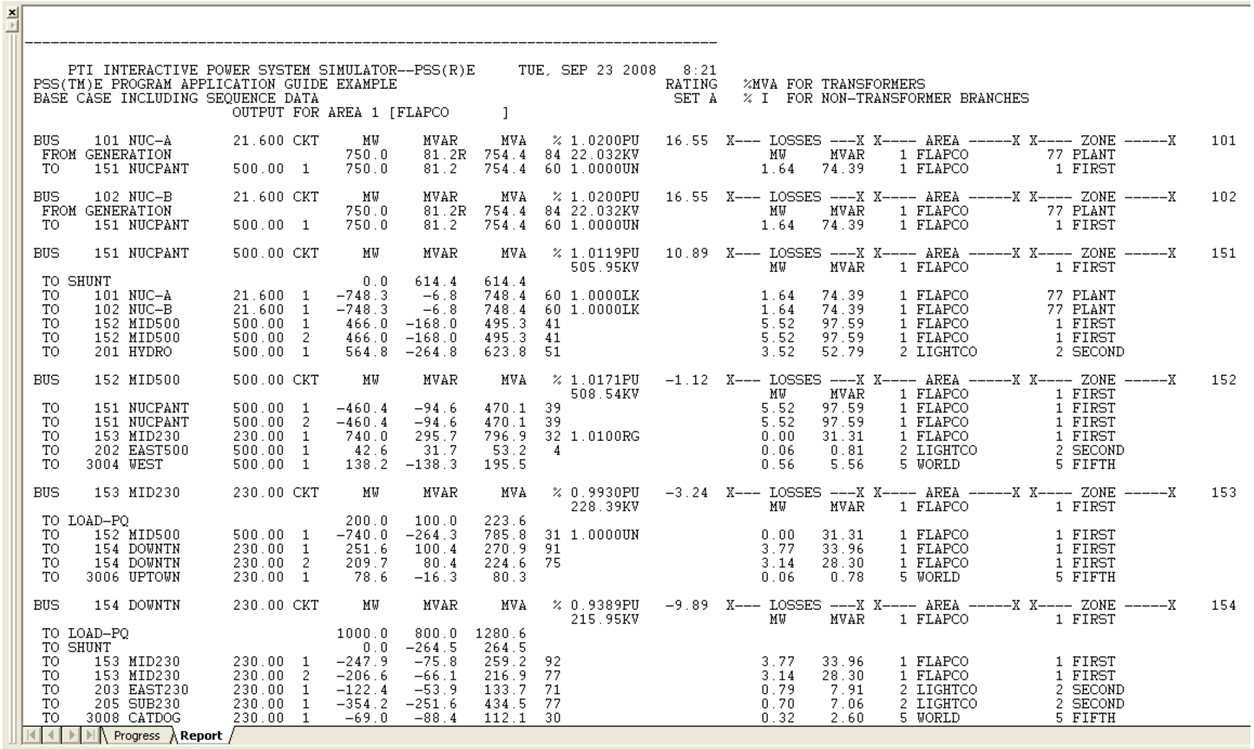


Figure 16.10. Bus Based Reports Dialog, Standard Format



```
---------------------------------------------------------------------------------

    PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS(R)E     TUE, SEP 23 2008   8:21
 PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE                               RATING   %MVA FOR TRANSFORMERS
 BASE CASE INCLUDING SEQUENCE DATA                                         SET A   % I  FOR NON-TRANSFORMER BRANCHES
                        OUTPUT FOR AREA 1 [FLAPCO      ]

 BUS    101 NUC-A       21.600 CKT     MW     MVAR     MVA   % 1.0200PU   16.55  X--- LOSSES ---X X---- AREA -----X X---- ZONE -----X    101
  FROM GENERATION                    750.0     81.2R  754.4  84 22.032KV              MW     MVAR    1 FLAPCO            77 PLANT
  TO     151 NUCPANT    500.00  1    750.0     81.2   754.4  60 1.0000UN            1.64    74.39    1 FLAPCO             1 FIRST

 BUS    102 NUC-B       21.600 CKT     MW     MVAR     MVA   % 1.0200PU   16.55  X--- LOSSES ---X X---- AREA -----X X---- ZONE -----X    102
  FROM GENERATION                    750.0     81.2R  754.4  84 22.032KV              MW     MVAR    1 FLAPCO            77 PLANT
  TO     151 NUCPANT    500.00  1    750.0     81.2   754.4  60 1.0000UN            1.64    74.39    1 FLAPCO             1 FIRST

 BUS    151 NUCPANT     500.00 CKT     MW     MVAR     MVA   % 1.0119PU   10.89  X--- LOSSES ---X X---- AREA -----X X---- ZONE -----X    151
                                                                505.95KV              MW     MVAR    1 FLAPCO             1 FIRST
  TO SHUNT                             0.0   614.4    614.4
  TO     101 NUC-A      21.600  1   -748.3    -6.8    748.4  60 1.0000LK            1.64    74.39    1 FLAPCO            77 PLANT
  TO     102 NUC-B      21.600  1   -748.3    -6.8    748.4  60 1.0000LK            1.64    74.39    1 FLAPCO            77 PLANT
  TO     152 MID500     500.00  1    466.0  -168.0    495.3  41                     5.52    97.59    1 FLAPCO             1 FIRST
  TO     152 MID500     500.00  2    466.0  -168.0    495.3  41                     5.52    97.59    1 FLAPCO             1 FIRST
  TO     201 HYDRO      500.00  1    564.8  -264.8    623.8  51                     3.52    52.79    2 LIGHTCO            2 SECOND

 BUS    152 MID500      500.00 CKT     MW     MVAR     MVA   % 1.0171PU   -1.12  X--- LOSSES ---X X---- AREA -----X X---- ZONE -----X    152
                                                                508.54KV              MW     MVAR    1 FLAPCO             1 FIRST
  TO     151 NUCPANT    500.00  1   -460.4   -94.6    470.1  39                     5.52    97.59    1 FLAPCO             1 FIRST
  TO     151 NUCPANT    500.00  2   -460.4   -94.6    470.1  39                     5.52    97.59    1 FLAPCO             1 FIRST
  TO     153 MID230     230.00  1    740.0   295.7    796.9  32 1.0100RG            0.00    31.31    1 FLAPCO             1 FIRST
  TO     202 EAST500    500.00  1     42.6    31.7     53.2   4                     0.06     0.81    2 LIGHTCO            2 SECOND
  TO    3004 WEST       500.00  1    138.2  -138.3    195.5                         0.56     5.56    5 WORLD              5 FIFTH

 BUS    153 MID230      230.00 CKT     MW     MVAR     MVA   % 0.9930PU   -3.24  X--- LOSSES ---X X---- AREA -----X X---- ZONE -----X    153
                                                                228.39KV              MW     MVAR    1 FLAPCO             1 FIRST
  TO LOAD-PQ                         200.0   100.0    223.6
  TO     152 MID500     500.00  1   -740.0  -264.3    785.8  31 1.0000UN            0.00    31.31    1 FLAPCO             1 FIRST
  TO     154 DOWNTN     230.00  1    251.6   100.4    270.9  91                     3.77    33.96    1 FLAPCO             1 FIRST
  TO     154 DOWNTN     230.00  2    209.7    80.4    224.6  75                     3.14    28.30    1 FLAPCO             1 FIRST
  TO    3006 UPTOWN     230.00  1     78.6   -16.3     80.3                         0.06     0.78    5 WORLD              5 FIFTH

 BUS    154 DOWNTN      230.00 CKT     MW     MVAR     MVA   % 0.9389PU   -9.89  X--- LOSSES ---X X---- AREA -----X X---- ZONE -----X    154
                                                                215.95KV              MW     MVAR    1 FLAPCO             1 FIRST
  TO LOAD-PQ                        1000.0   800.0   1280.6
  TO SHUNT                             0.0  -264.5    264.5
  TO     153 MID230     230.00  1   -247.9   -75.8    259.2  92                     3.77    33.96    1 FLAPCO             1 FIRST
  TO     153 MID230     230.00  2   -206.6   -66.1    216.9  77                     3.14    28.30    1 FLAPCO             1 FIRST
  TO     203 EAST230    230.00  1   -122.4   -53.9    133.7  71                     0.79     7.91    2 LIGHTCO            2 SECOND
  TO     205 SUB230     230.00  1   -354.2  -251.6    434.5  77                     0.70     7.06    2 LIGHTCO            2 SECOND
  TO    3008 CATDOG     230.00  1    -69.0   -88.4    112.1  30                     0.32     2.60    5 WORLD              5 FIFTH
```


Figure 16.11. Example of Standard Format Power Flow Solution Report

Additional Information
PSS®E Program Operation Manual, Producing a Standard Power Flow Solution Report

16.3.2. Wide-Format Power Flow Solution Report

LOUT

Requirements / Prerequisites
Validly specified power flow case solved to an acceptable mismatch tolerance.

Power Flow > Reports > Bus based reports...

In the *[Bus Based Reports]* dialog (Figure 16.12, "Bus Based Reports Dialog, Wide Format"), select Powerflow output with the Wide format output check box checked and the Output with amps check box unchecked. Click *[Go]* to produce the report (Figure 16.13, "Example of Wide Format Power Flow Solution Report").

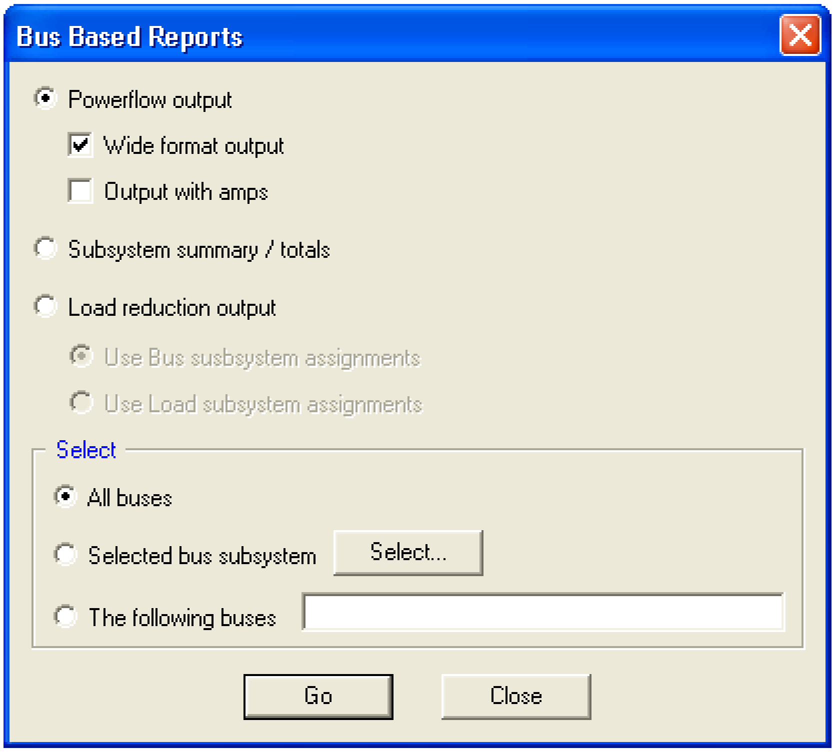
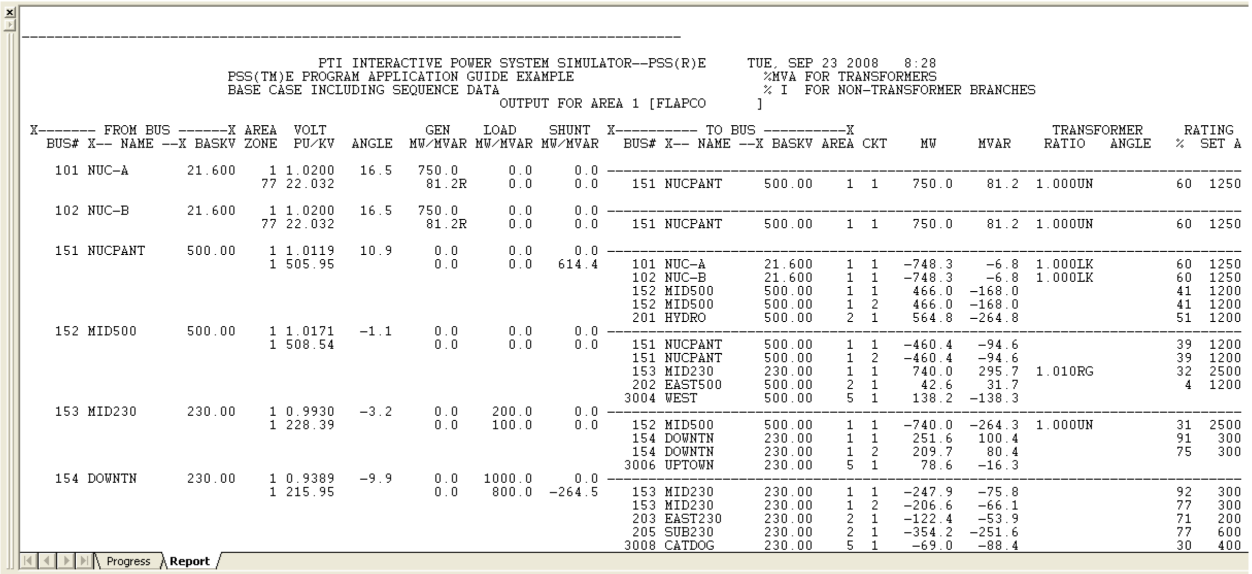


Figure 16.12. Bus Based Reports Dialog, Wide Format



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                         PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS(R)E     TUE, SEP 23 2008   8:28
                    PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE                 %MVA FOR TRANSFORMERS
                    BASE CASE INCLUDING SEQUENCE DATA                          % I  FOR NON-TRANSFORMER BRANCHES
                                                OUTPUT FOR AREA 1 [FLAPCO       ]

X------- FROM BUS ------X AREA  VOLT            GEN     LOAD    SHUNT  X---------- TO BUS ----------X                               TRANSFORMER      RATING
  BUS# X-- NAME --X BASKV ZONE  PU/KV   ANGLE  MW/MVAR MW/MVAR MW/MVAR   BUS# X-- NAME --X BASKV AREA CKT      MW       MVAR     RATIO    ANGLE   %  SET A

   101 NUC-A        21.600    1 1.0200   16.5   750.0     0.0     0.0 ------------------------------------------------------------------------------------
                             77 22.032            81.2R    0.0     0.0    151 NUCPANT      500.00    1  1     750.0     81.2  1.000UN               60  1250

   102 NUC-B        21.600    1 1.0200   16.5   750.0     0.0     0.0 ------------------------------------------------------------------------------------
                             77 22.032            81.2R    0.0     0.0    151 NUCPANT      500.00    1  1     750.0     81.2  1.000UN               60  1250

   151 NUCPANT      500.00    1 1.0119   10.9     0.0     0.0     0.0 ------------------------------------------------------------------------------------
                              1 505.95             0.0     0.0   614.4    101 NUC-A         21.600   1  1    -748.3     -6.8  1.000LK               60  1250
                                                                          102 NUC-B         21.600   1  1    -748.3     -6.8  1.000LK               60  1250
                                                                          152 MID500       500.00    1  1     466.0   -168.0                        41  1200
                                                                          152 MID500       500.00    1  2     466.0   -168.0                        41  1200
                                                                          201 HYDRO        500.00    2  1     564.8   -264.8                        51  1200
   152 MID500       500.00    1 1.0171   -1.1     0.0     0.0     0.0 ------------------------------------------------------------------------------------
                              1 508.54             0.0     0.0     0.0    151 NUCPANT      500.00    1  1    -460.4    -94.6                        39  1200
                                                                          151 NUCPANT      500.00    1  2    -460.4    -94.6                        39  1200
                                                                          153 MID230       230.00    1  1     740.0    295.7  1.010RG               32  2500
                                                                          202 EAST500      500.00    2  1      42.6     31.7                         4  1200
                                                                         3004 WEST         500.00    5  1     138.2   -138.3
   153 MID230       230.00    1 0.9930   -3.2     0.0   200.0     0.0 ------------------------------------------------------------------------------------
                              1 228.39             0.0   100.0     0.0    152 MID500       500.00    1  1    -740.0   -264.3  1.000UN               31  2500
                                                                          154 DOWNTN       230.00    1  1     251.6    100.4                        91   300
                                                                          154 DOWNTN       230.00    1  2     209.7     80.4                        75   300
                                                                         3006 UPTOWN       230.00    5  1      78.6    -16.3
   154 DOWNTN       230.00    1 0.9389   -9.9     0.0  1000.0     0.0 ------------------------------------------------------------------------------------
                              1 215.95             0.0   800.0  -264.5    153 MID230       230.00    1  1    -247.9    -75.8                        92   300
                                                                          153 MID230       230.00    1  2    -206.6    -66.1                        77   300
                                                                          203 EAST230      230.00    2  1    -122.4    -53.9                        71   200
                                                                          205 SUB230       230.00    2  1    -354.2   -251.6                        77   600
                                                                         3008 CATDOG       230.00    5  1     -69.0    -88.4                        30   400
```


Figure 16.13. Example of Wide Format Power Flow Solution Report

Additional Information
PSS®E Program Operation Manual, Producing a Wide-Format Power Flow Solution Report

16.3.3. Wide-Format Power Flow Solution Report with Branch Current Loadings

LAMP

Requirements / Prerequisites
Validly specified power flow case solved to an acceptable mismatch tolerance.

Power Flow > Reports > Bus based reports...

In the *[Bus Based Reports]* dialog (Figure 16.14, "Bus Based Reports Dialog, Wide Format, with Branch Current Loadings"), select Powerflow output with the Wide format output and Output with amps check boxes both checked. Click *[Go]* to produce the report (Figure 16.15, "Example of Wide Format Power Flow Solution Report with Branch Current Loadings").

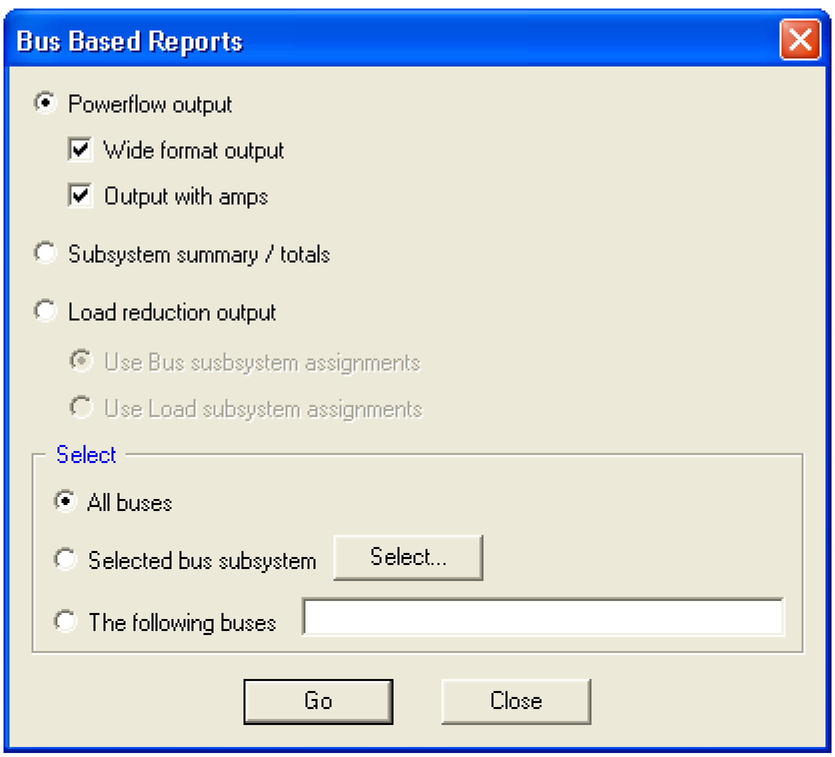
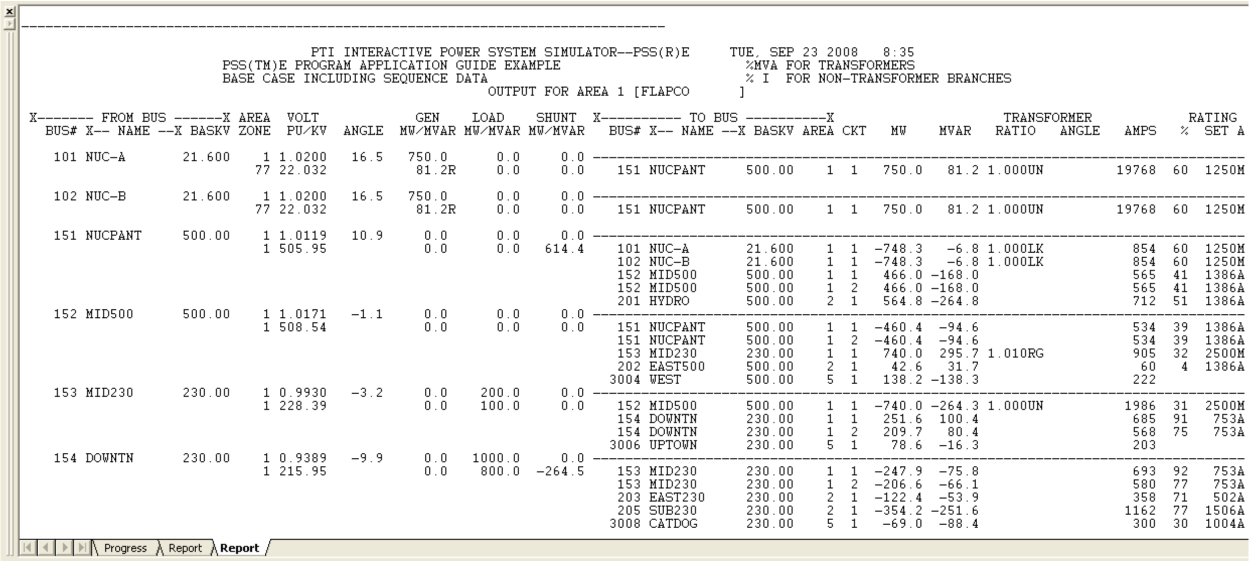


Figure 16.14. Bus Based Reports Dialog, Wide Format, with Branch Current Loadings



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                         PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS(R)E     TUE, SEP 23 2008    8:35
                   PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE                 %MVA FOR TRANSFORMERS
                   BASE CASE INCLUDING SEQUENCE DATA                          % I  FOR NON-TRANSFORMER BRANCHES
                                                    OUTPUT FOR AREA 1 [FLAPCO      ]

X------- FROM BUS ------X AREA  VOLT          GEN    LOAD   SHUNT X---------- TO BUS ----------X                    TRANSFORMER          RATING
  BUS# X-- NAME --X BASKV ZONE  PU/KV   ANGLE  MW/MVAR MW/MVAR MW/MVAR  BUS# X-- NAME --X BASKV AREA CKT   MW     MVAR   RATIO   ANGLE   AMPS   %  SET A

   101 NUC-A        21.600    1 1.0200   16.5   750.0     0.0     0.0 ------------------------------------------------------------------------------------
                             77 22.032           81.2R    0.0     0.0   151 NUCPANT     500.00   1  1   750.0   81.2 1.000UN          19768  60  1250M

   102 NUC-B        21.600    1 1.0200   16.5   750.0     0.0     0.0 ------------------------------------------------------------------------------------
                             77 22.032           81.2R    0.0     0.0   151 NUCPANT     500.00   1  1   750.0   81.2 1.000UN          19768  60  1250M

   151 NUCPANT      500.00    1 1.0119   10.9     0.0     0.0     0.0 ------------------------------------------------------------------------------------
                              1 505.95             0.0     0.0   614.4   101 NUC-A       21.600   1  1  -748.3   -6.8 1.000LK            854  60  1250M
                                                                         102 NUC-B       21.600   1  1  -748.3   -6.8 1.000LK            854  60  1250M
                                                                         152 MID500      500.00   1  1   466.0 -168.0                      565  41  1386A
                                                                         152 MID500      500.00   1  2   466.0 -168.0                      565  41  1386A
                                                                         201 HYDRO       500.00   2  1   564.8 -264.8                      712  51  1386A
   152 MID500       500.00    1 1.0171   -1.1     0.0     0.0     0.0 ------------------------------------------------------------------------------------
                              1 508.54             0.0     0.0     0.0   151 NUCPANT     500.00   1  1  -460.4  -94.6                      534  39  1386A
                                                                         151 NUCPANT     500.00   1  2  -460.4  -94.6                      534  39  1386A
                                                                         153 MID230      230.00   1  1   740.0  295.7 1.010RG              905  32  2500M
                                                                         202 EAST500     500.00   2  1    42.6   31.7                       60   4  1386A
                                                                        3004 WEST        500.00   5  1   138.2 -138.3                      222
   153 MID230       230.00    1 0.9930   -3.2     0.0   200.0     0.0 ------------------------------------------------------------------------------------
                              1 228.39             0.0   100.0     0.0   152 MID500      500.00   1  1  -740.0 -264.3 1.000UN             1986  31  2500M
                                                                         154 DOWNTN      230.00   1  1   251.6  100.4                      685  91   753A
                                                                         154 DOWNTN      230.00   1  2   209.7   80.4                      568  75   753A
                                                                        3006 UPTOWN      230.00   5  1    78.6  -16.3                      203
   154 DOWNTN       230.00    1 0.9389   -9.9     0.0  1000.0     0.0 ------------------------------------------------------------------------------------
                              1 215.95             0.0   800.0  -264.5   153 MID230      230.00   1  1  -247.9  -75.8                      693  92   753A
                                                                         153 MID230      230.00   1  2  -206.6  -66.1                      580  77   753A
                                                                         203 EAST230     230.00   2  1  -122.4  -53.9                      358  71   502A
                                                                         205 SUB230      230.00   2  1  -354.2 -251.6                     1162  77  1506A
                                                                        3008 CATDOG      230.00   5  1   -69.0  -88.4                      300  30  1004A
```


Figure 16.15. Example of Wide Format Power Flow Solution Report with Branch Current Loadings

Additional Information
PSS® E Program Operation Manual, Producing a Wide-Format Power Flow Solution Report in Amps

16.3.4. Summary of Subsystem Conditions

SUBS

Requirements / Prerequisites
Validly specified power flow case solved to an acceptable mismatch tolerance.

Power Flow > Reports > Bus based reports...

In the *[Bus Based Reports]* dialog (Figure 16.16, "Bus Based Reports Dialog, Subsystem Summary"), select Subsystem summary / totals. Click *[Go]* to produce the report (Figure 16.17, "Example of Subsystem Summary Report ").

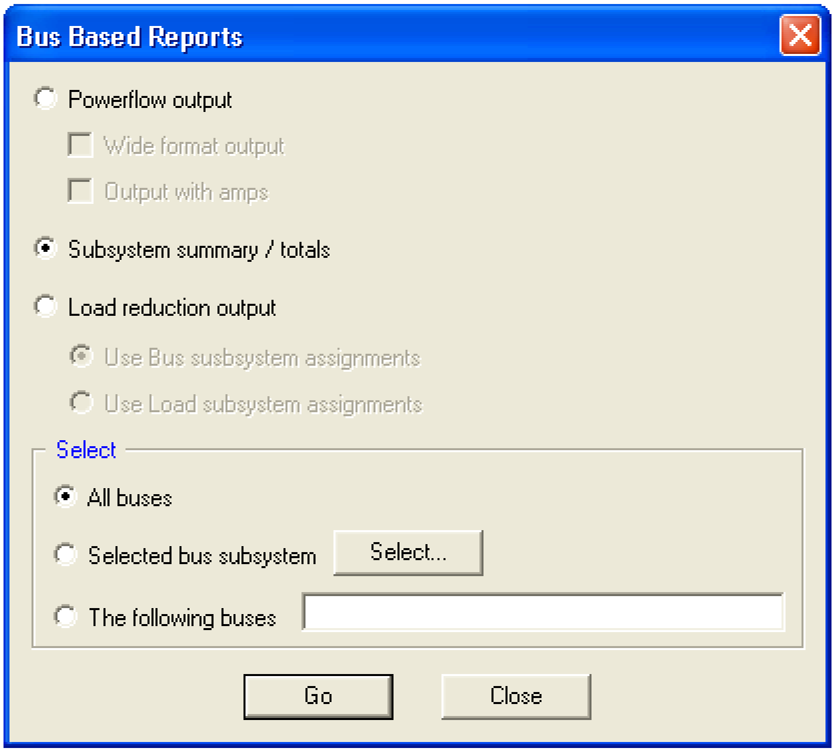
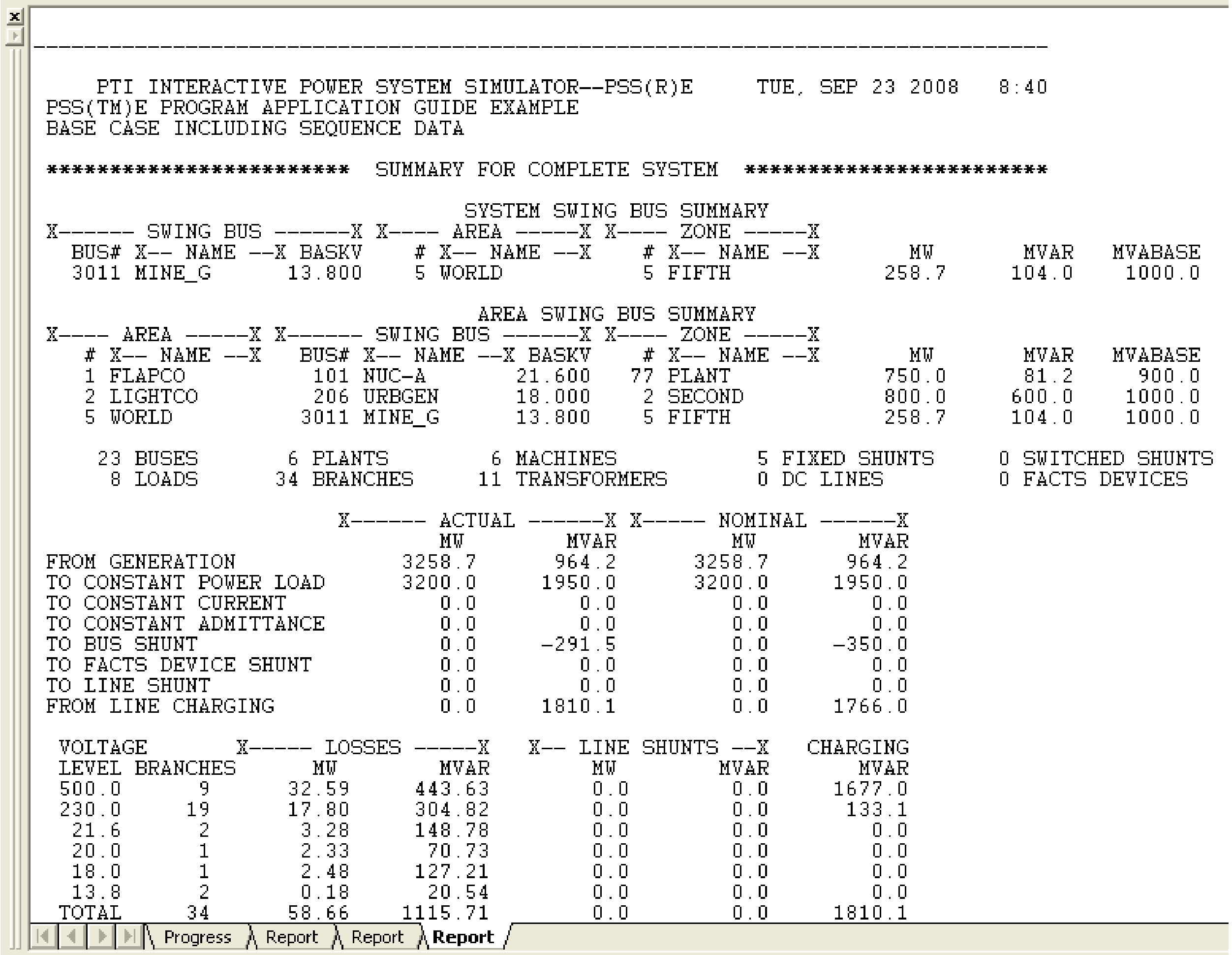


Figure 16.16. Bus Based Reports Dialog, Subsystem Summary



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    PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS(R)E     TUE, SEP 23 2008   8:40
 PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE
 BASE CASE INCLUDING SEQUENCE DATA

 ************************  SUMMARY FOR COMPLETE SYSTEM  ************************

                                     SYSTEM SWING BUS SUMMARY
 X------ SWING BUS ------X X---- AREA -----X X---- ZONE -----X
   BUS# X-- NAME --X BASKV     # X-- NAME --X     # X-- NAME --X        MW        MVAR    MVABASE
   3011 MINE_G       13.800    5 WORLD            5 FIFTH             258.7      104.0    1000.0

                                      AREA SWING BUS SUMMARY
 X---- AREA -----X X------ SWING BUS ------X X---- ZONE -----X
    # X-- NAME --X    BUS# X-- NAME --X BASKV     # X-- NAME --X        MW        MVAR    MVABASE
    1 FLAPCO           101 NUC-A        21.600   77 PLANT             750.0       81.2     900.0
    2 LIGHTCO          206 URBGEN       18.000    2 SECOND            800.0      600.0    1000.0
    5 WORLD           3011 MINE_G       13.800    5 FIFTH             258.7      104.0    1000.0

     23 BUSES        6 PLANTS        6 MACHINES          5 FIXED SHUNTS      0 SWITCHED SHUNTS
      8 LOADS       34 BRANCHES     11 TRANSFORMERS      0 DC LINES          0 FACTS DEVICES

                              X------ ACTUAL ------X X----- NOMINAL ------X
                                      MW       MVAR        MW       MVAR
 FROM GENERATION                  3258.7      964.2    3258.7      964.2
 TO CONSTANT POWER LOAD           3200.0     1950.0    3200.0     1950.0
 TO CONSTANT CURRENT                 0.0        0.0       0.0        0.0
 TO CONSTANT ADMITTANCE              0.0        0.0       0.0        0.0
 TO BUS SHUNT                        0.0     -291.5       0.0     -350.0
 TO FACTS DEVICE SHUNT               0.0        0.0       0.0        0.0
 TO LINE SHUNT                       0.0        0.0       0.0        0.0
 FROM LINE CHARGING                  0.0     1810.1       0.0     1766.0

  VOLTAGE      X----- LOSSES -----X    X-- LINE SHUNTS --X    CHARGING
  LEVEL BRANCHES      MW       MVAR          MW       MVAR       MVAR
  500.0      9     32.59     443.63         0.0        0.0     1677.0
  230.0     19     17.80     304.82         0.0        0.0      133.1
   21.6      2      3.28     148.78         0.0        0.0        0.0
   20.0      1      2.33      70.73         0.0        0.0        0.0
   18.0      1      2.48     127.21         0.0        0.0        0.0
   13.8      2      0.18      20.54         0.0        0.0        0.0
  TOTAL     34     58.66    1115.71         0.0        0.0     1810.1
```


Figure 16.17. Example of Subsystem Summary Report

Additional Information
PSS® E Program Operation Manual, Summarizing Subsystem Conditions

16.3.5. Summarizing Load Reduction

LODR

Requirements / Prerequisites
The working case must contain a validly specified power flow case solved to an acceptable mismatch tolerance.

Power Flow > Reports > Bus based reports...

The load reduction reporting activity LODR summarizes the reduction in:

- Nominal constant MVA load caused when voltage at a load bus falls below PQBRAK.
- Nominal constant current load caused when voltage at a load bus falls below 0.5 pu.

In the *[Bus Based Reports]* dialog (Figure 16.18, "Bus Based Reports Dialog, Load Reduction Output"), select Load reduction output. If subsystem selection by area, owner and/or zone had been specified, select the desired option for defining subsystem loads. Click *[Go]* to produce the report.

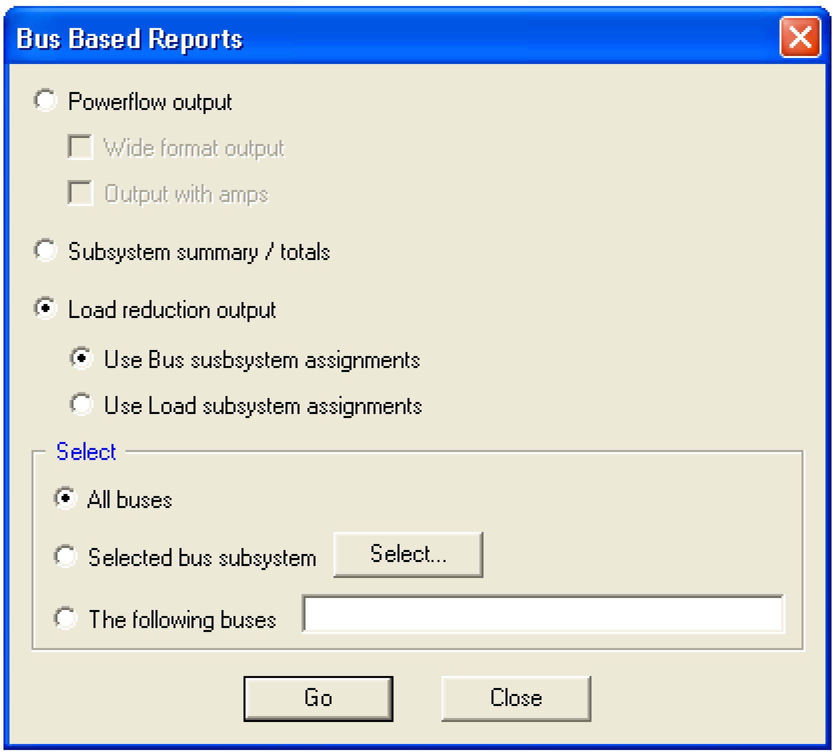
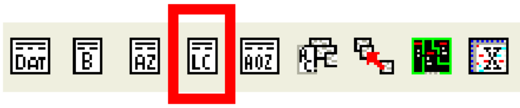


Figure 16.18. Bus Based Reports Dialog, Load Reduction Output

Additional Information
PSS® E Program Operation Manual, Summarizing Load Reduction Section 11.1.1, "Boundary Conditions"

16.4. Limit Checking Reports

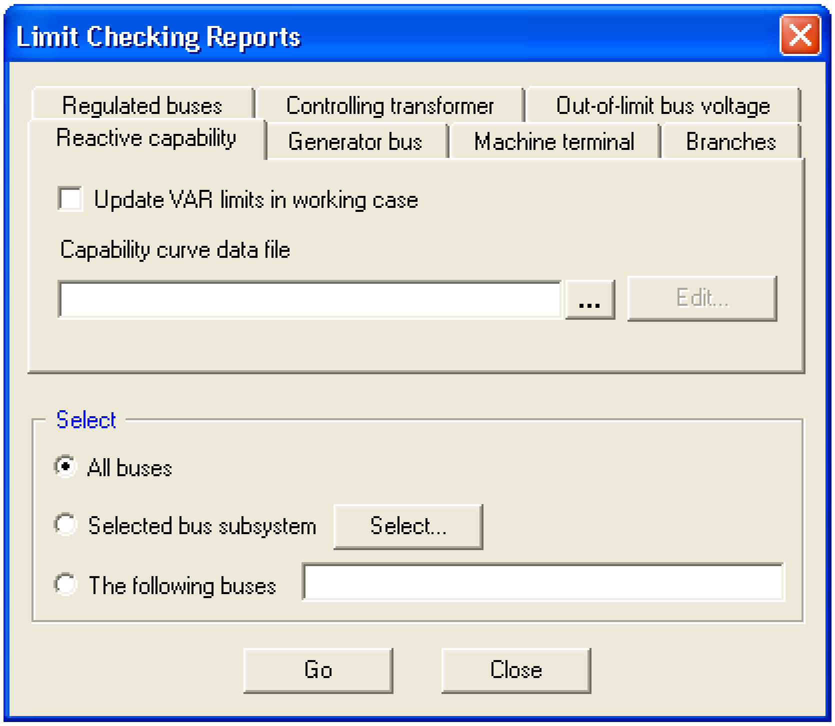


Power Flow > Reports > Limit checking reports...

The *[Limit Checking Reports]* dialog provides tabs to produce all PSS®E limit checking reports:

- Machine Reactive Capability
- Generator Bus Limits
- Machine Terminal Limits
- Transmission Line Overloads
- Transformer Overloads
- Branch Overloads
- Transmission Line Overloads
- Transformer Overloads
- Branch Current Ratings
- Voltage Controlled Buses
- Controlling Transformers
- Out-of-limit Bus Voltage

Note that each report can be restricted by Area, Owner, Zone, Base kV and Bus, using the *Select* option of the dialog.



Limit Checking Reports Dialog

16.4.1. Machine Reactive Capability

GCAP

Requirements / Prerequisites
Validly specified power flow case. Machine Capability Data File (*.gcp)

Power Flow > Reports > Limit checking reports...

Clicking the *Reactive capability* tab in *[Limit Checking Reports]* will generate a report that tabulates machine loading and limit data. There is a checkbox option to update the machine reactive power limits in the power flow case. The *PSS® E Program Operation Manual* (Machine Capability Curve Data File Contents) provides details of the data records for the required Machine Capability Data file (*.gcp).

```
PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS®E      THU, SEP 18 2008    8:07
PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE
BASE CASE INCLUDING SEQUENCE DATA

CAPABILITY CURVE CHECK:
                                                X-- CAPABILITY CURVE --X X------- WORKING  CASE --------X
  BUS# X-- NAME --X BASKV ID     PGEN     QGEN     QMAX     QMIN   PLIMIT     QMAX     QMIN     PMAX     PMIN
   101 NUC-A        21.600 1    750.0     81.2    243.8    -37.5    900.0    600.0   -100.0    810.0      0.0
   102 NUC-B        21.600 1    750.0     81.2    243.8    -37.5    900.0    600.0   -100.0    810.0      0.0
   206 URBGEN       18.000 1    800.0    600.0*   160.0      0.0   1000.0    600.0      0.0    900.0      0.0
   211 HYDRO_G      20.000 1    600.0     17.8    583.3    -77.8    950.0    400.0   -100.0    616.2      0.0
  3011 MINE_G       13.800 1    258.7    104.0    270.5   -100.0   1000.0    600.0   -100.0    900.0      0.0
  3018 CATDOG_G     13.800 1    100.0     80.0     80.0      0.0    130.0     80.0      0.0    117.0      0.0
```

Example of Reactive Capability Report

Additional Information
PSS® E Program Operation Manual, Producing a Machine Reactive Capability Report Machine Capability Curve Data File Contents

16.4.2. Generator Bus Limits

GENS

Requirements / Prerequisites
Validly specified power flow case. Plant outputs and voltages are valid only if the working case is solved to an acceptable mismatch tolerance.

Power Flow > Reports > Limit checking reports...

Clicking the *Generator bus* tab in *[Limit Checking Reports]* will generate a report that tabulates the loading and voltage conditions at generator buses. The following reports can be selected:

- Var limited plants with unequal var limits
- All var limited plants
- On-line plants
- All plants

```
    PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS®E      THU, SEP 18 2008    8:19
PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE
BASE CASE INCLUDING SEQUENCE DATA
GENERATOR SUMMARY:
                          # MACH                                                              X----- REMOTE BUS ------X
  BUS# X-- NAME --X BASKV ON/OFF TYP     MW     MVAR     QMAX     QMIN  VSCHED VACTUAL   BUS# X-- NAME --X BASKV   MVABASE ZONE AREA SWING
   101 NUC-A       21.600  1   0   2   750.0     81.2    600.0   -100.0  1.0200  1.0200                              900.0   77    1  AREA
   102 NUC-B       21.600  1   0   2   750.0     81.2    600.0   -100.0  1.0200  1.0200                              900.0   77    1
   206 URBGEN      18.000  1   0   2   800.0    600.0    600.0      0.0  0.9800  0.9490    205 SUB230      230.00   1000.0    2    2  AREA
   211 HYDRO_G     20.000  1   0   2   600.0     17.8    400.0   -100.0  1.0400  1.0400    201 HYDRO       500.00    725.0    2    2
  3011 MINE_G      13.800  1   0   3   258.7    104.0    600.0   -100.0  1.0400  1.0400                             1000.0    5    5  SYST
  3018 CATDOG_G    13.800  1   0   2   100.0     80.0     80.0      0.0  1.0200  0.9586   3008 CATDOG      230.00    130.0    5    5
SUBSYSTEM TOTALS                      3258.7    964.2   2880.0   -400.0                                             4655.0
```

Example of Generator Bus Report, On-line Plants

Additional Information
PSS® E Program Operation Manual, Producing a Generator Bus Limits Report

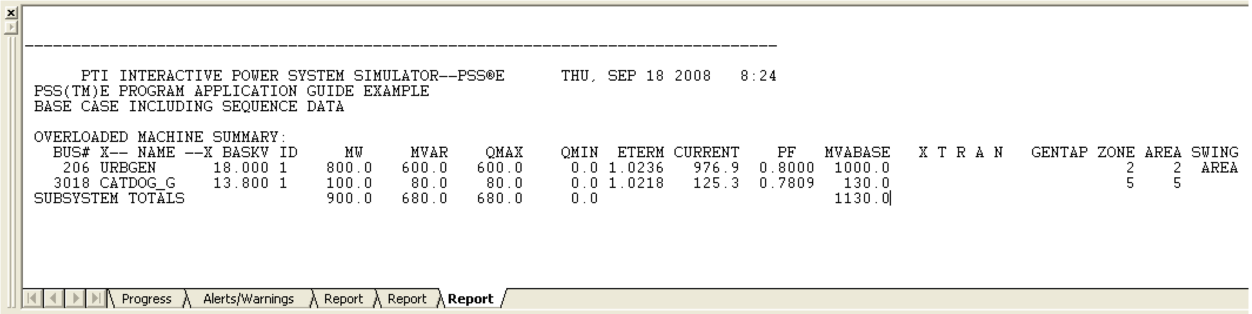
16.4.3. Machine Terminal Limits

GEOL

Requirements / Prerequisites
Validly specified power flow case. Machine outputs and voltages are valid only if the working case is solved to an acceptable mismatch tolerance.

Power Flow > Reports > Limit checking reports...

Clicking the *Machine terminal* tab in *[Limit Checking Reports]* will generate a report that tabulates machine loading and voltage conditions at the generator terminals of on-line machines at type two and three buses in the working case. The report may include all on-line machines or only those that are overloaded.


```
--------------------------------------------------------------------------------

      PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS®E      THU, SEP 18 2008   8:24
 PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE
 BASE CASE INCLUDING SEQUENCE DATA

 OVERLOADED MACHINE SUMMARY:
   BUS# X-- NAME --X BASKV ID     MW     MVAR    QMAX    QMIN  ETERM CURRENT    PF   MVABASE   X T R A N   GENTAP ZONE AREA SWING
    206 URBGEN      18.000 1   800.0   600.0   600.0    0.0 1.0236   976.9  0.8000  1000.0                         2    2  AREA
   3018 CATDOG_G    13.800 1   100.0    80.0    80.0    0.0 1.0218   125.3  0.7809   130.0                         5    5
 SUBSYSTEM TOTALS              900.0   680.0   680.0    0.0                         1130.0
```


Example of Machine Terminal Limits Report, Overloaded Machines Only

Additional Information
PSS® E Program Operation Manual, Producing a Machine Terminal Limits Report

16.4.4. Branch Overloads

RAT3

Requirements / Prerequisites
Validly specified power flow case solved to an acceptable mismatch tolerance.

Power Flow > Reports > Limit checking reports...

Clicking the *Branches* tab in *[Limit Checking Reports]* and then selecting the *both transformer and non-transformer branches* option from the pull-down list will generate a report that tabulates branch overloads. Options are available to specify the *Rating Set* and *Percent Loading* limit.

```
---------------------------------------------------------------------------------

     PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS®E      THU, SEP 18 2008   9:05
 PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE
 BASE CASE INCLUDING SEQUENCE DATA

 SUBSYSTEM LOADING CHECK (INCLUDED: LINES; BREAKERS AND SWITCHES; TRANSFORMERS) (EXCLUDED: NONE)
 LOADINGS ABOVE 100.0 % OF RATING SET A (MVA FOR TRANSFORMERS, CURRENT FOR NON-TRANSFORMER BRANCHES):

 X--------- FROM BUS ----------X X---------- TO BUS -----------X
   BUS# X-- NAME --X BASKV  AREA   BUS# X-- NAME --X BASKV  AREA CKT LOADING  RATING PERCENT
    205 SUB230       230.00     2    206 URBGEN      18.000*    2  1   1000.0   900.0   111.1
```

Progress | Alerts/Warnings | **Report**

Example of Branch Overload Report, Default Settings

Additional Information
PSS® E Program Operation Manual, Producing a Branch Overload Checking Report

16.4.5. Transmission Line Overloads

OLTL

Requirements / Prerequisites
Validly specified power flow case solved to an acceptable mismatch tolerance.

Power Flow > Reports > Limit checking reports...

Clicking the *Branches* tab in *[Limit Checking Reports]* and then selecting the *only non-transformer branches* option from the pull-down list will generate a report that tabulates transmission line overloads. Options are available to specify the *Rating Set* and *Percent Loading* limit.

```
--------------------------------------------------------------------------------

     PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS®E      THU, SEP 18 2008    9:08
 PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE
 BASE CASE INCLUDING SEQUENCE DATA

 SUBSYSTEM LOADING CHECK (INCLUDED: LINES; BREAKERS AND SWITCHES) (EXCLUDED: TRANSFORMERS)
 CURRENT LOADINGS ABOVE 100.0 % OF RATING SET C:

 X--------- FROM BUS ----------X X---------- TO BUS -----------X
   BUS# X-- NAME --X BASKV  AREA   BUS# X-- NAME --X BASKV  AREA CKT LOADING  RATING PERCENT
    151 NUCPANT    500.00*    1     152 MID500     500.00     1   1    489.5     1.0 48947.9
    151 NUCPANT    500.00*    1     152 MID500     500.00     1   2    489.5     1.0 48947.9
    151 NUCPANT    500.00*    1     201 HYDRO      500.00     2   1    616.5     1.0 61647.0
    152 MID500     500.00     1     202 EAST500    500.00*    2   1    134.1     1.0 13409.4
    152 MID500     500.00*    1    3004 WEST       500.00     5   1    192.2     1.0 19223.7
    153 MID230     230.00     1     154 DOWNTN     230.00*    1   1    276.0     1.0 27604.3
    153 MID230     230.00     1     154 DOWNTN     230.00*    1   2    231.0     1.0 23097.0
    153 MID230     230.00*    1    3006 UPTOWN     230.00     5   1     80.9     1.0  8087.5
    154 DOWNTN     230.00*    1     203 EAST230    230.00     2   1    142.4     1.0 14244.1
    154 DOWNTN     230.00*    1     205 SUB230     230.00     2   1    462.7     1.0 46273.9
    154 DOWNTN     230.00*    1    3008 CATDOG     230.00     5   1    119.4     1.0 11937.9
    201 HYDRO      500.00     2     202 EAST500    500.00*    2   1    564.4     1.0 56442.0
    201 HYDRO      500.00     2     204 SUB500     500.00*    2   1    641.7     1.0 64174.8
    203 EAST230    230.00     2     205 SUB230     230.00*    2   1     93.2     1.0  9320.2
    203 EAST230    230.00     2     205 SUB230     230.00*    2   2     93.2     1.0  9320.2
   3001 MINE       230.00*    5    3003 S. MINE    230.00     5   1    213.2     1.0 21319.1
   3002 E. MINE    500.00     5    3004 WEST       500.00*    5   1     58.0     1.0  5803.3
   3003 S. MINE    230.00     5    3005 WEST       230.00*    5   1    110.1     1.0 11011.2
   3003 S. MINE    230.00     5    3005 WEST       230.00*    5   2    110.1     1.0 11011.2
   3005 WEST       230.00     5    3006 UPTOWN     230.00*    5   1     80.3     1.0  8032.9
   3005 WEST       230.00     5    3007 RURAL      230.00*    5   1    260.2     1.0 26015.2
   3005 WEST       230.00     5    3008 CATDOG     230.00*    5   1    151.4     1.0 15138.4
   3007 RURAL      230.00     5    3008 CATDOG     230.00*    5   1     40.8     1.0  4082.5
```

Progress | Alerts/Warnings | Report | Report | Report | **Report**

Example of Transmission Line Overload Report, Rate C

Additional Information
PSS® E Program Operation Manual, Producing a Transmission Line Overload Checking Report

16.4.6. Transformer Overloads

OLTR

Requirements / Prerequisites
Validly specified power flow case solved to an acceptable mismatch tolerance.

Power Flow > Reports > Limit checking reports...

Clicking the *Branches* tab in *[Limit Checking Reports]* and then selecting the *only transformers* option from the pull-down list will generate a report that tabulates transformer overloads. Options are available to specify the *Rating Set* and *Percent Loading* limit.

```
--------------------------------------------------------------------------------

     PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS®E      THU, SEP 18 2008   9:15
 PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE
 BASE CASE INCLUDING SEQUENCE DATA

 SUBSYSTEM LOADING CHECK (INCLUDED: TRANSFORMERS) (EXCLUDED: LINES; BREAKERS AND SWITCHES)
 MVA LOADINGS ABOVE 100.0 % OF RATING SET A:

 X--------- FROM BUS ----------X X---------- TO BUS -----------X
   BUS# X-- NAME --X BASKV  AREA   BUS# X-- NAME --X BASKV  AREA CKT LOADING  RATING PERCENT
    205 SUB230       230.00    2    206 URBGEN       18.000*    2  1   1000.0   900.0   111.1
```

Progress | Alerts/Warnings | **Report**

Example of Transformer Overload Report, Default Options

Additional Information
PSS®E Program Operation Manual, Producing a Transformer Overload Checking Report

16.4.7. Branch Current Ratings

RATE

Requirements / Prerequisites
Validly specified power flow case solved to an acceptable mismatch tolerance.

Power Flow > Reports > Limit checking reports...

Clicking the *Branches* tab in *[Limit Checking Reports]* provides options to include any of the following network components in the output:

- Include non-transformer branches that are not breakers or switches
- Include transformer branches
- Include branches that are breakers or switches.

Options are available to specify the Rating Set and *Percent Loading* limit.

Selecting all three network component options with the all ratings option will generate a report that tabulates branch current ratings.

```
--------------------------------------------------------------------------------

     PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS®E      FRI, FEB 20 2009  14:38
 PSS(R)E PROGRAM APPLICATION GUIDE EXAMPLE
 BASE CASE INCLUDING SEQUENCE DATA
                        OUTPUT FOR AREA 2 [LIGHTCO     ]
 SUBSYSTEM LOADING CHECK (INCLUDED: LINES; BREAKERS AND SWITCHES; TRANSFORMERS) (EXCLUDED: NONE)
 LOADINGS ABOVE 100.0 % OF RATING (MVA FOR TRANSFORMERS, CURRENT FOR NON-TRANSFORMER BRANCHES):

 X--------- FROM BUS ----------X X---------- TO BUS -----------X              RATING SET A    RATING SET B    RATING SET C
   BUS# X-- NAME --X BASKV  AREA   BUS# X-- NAME --X BASKV  AREA CKT LOADING  RATING PERCENT  RATING PERCENT  RATING PERCENT
    151 NUCPANT      500.00*    1    201 HYDRO        500.00     2  1   616.5  1200.0    51.4  1300.0    47.4     1.0 61647.0
    152 MID500       500.00     1    202 EAST500      500.00*    2  1   134.1  1200.0    11.2  1300.0    10.3     1.0 13409.4
    154 DOWNTN       230.00*    1    203 EAST230      230.00     2  1   142.4   200.0    71.2   250.0    57.0     1.0 14244.1
    154 DOWNTN       230.00*    1    205 SUB230       230.00     2  1   462.7   600.0    77.1   660.0    70.1     1.0 46273.9
    201 HYDRO        500.00     2    202 EAST500      500.00*    2  1   564.4  1200.0    47.0  1300.0    43.4     1.0 56442.0
    201 HYDRO        500.00     2    204 SUB500       500.00*    2  1   641.7  1200.0    53.5  1300.0    49.4     1.0 64174.8
    203 EAST230      230.00     2    205 SUB230       230.00*    2  1    93.2   200.0    46.6   250.0    37.3     1.0  9320.2
    203 EAST230      230.00     2    205 SUB230       230.00*    2  2    93.2   200.0    46.6   250.0    37.3     1.0  9320.2
    205 SUB230       230.00     2    206 URBGEN       18.000*    2  1  1000.0   900.0   111.1  1080.0    92.6  1350.0    74.1
```

Progress | Alerts/Warnings | Report | Report | Report | Report | **Report**

Example of Branch Current Ratings Report, Default Option

Additional Information
PSS® E Program Operation Manual, Producing a Branch Current Ratings Report

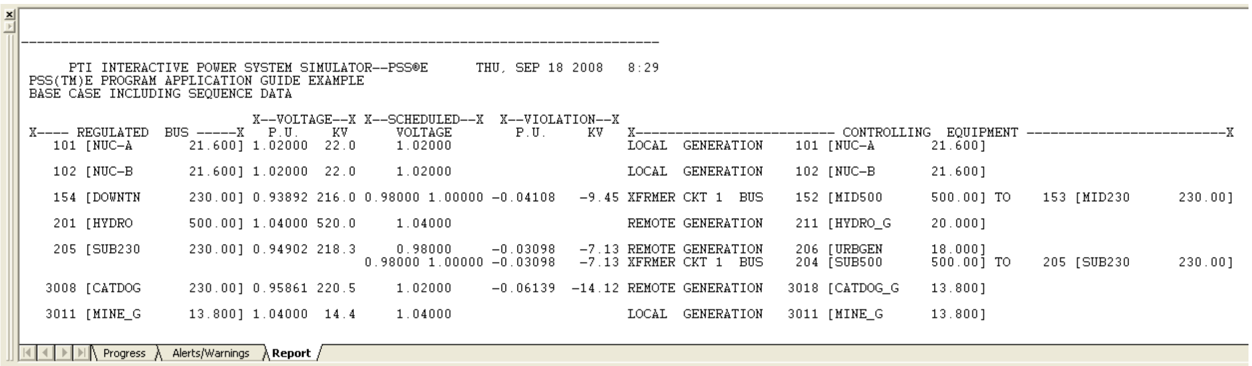
16.4.8. Voltage Controlled Buses

REGB

Requirements / Prerequisites
Validly specified power flow case. Bus voltages are valid only if the working case is solved to an acceptable mismatch tolerance.

Power Flow > Reports > Limit checking reports...

Clicking the *Regulated buses* tab in *[Limit Checking Reports]* will generate a report that tabulates those buses where voltages are controlled by generation, switched shunts, voltage controlling transformers, FACTS devices, and/or VSC dc line converters.



```
---------------------------------------------------------------------------------

      PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS®E      THU, SEP 18 2008    8:29
 PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE
 BASE CASE INCLUDING SEQUENCE DATA

                            X--VOLTAGE--X X--SCHEDULED--X  X--VIOLATION--X
 X---- REGULATED  BUS -----X  P.U.    KV      VOLTAGE        P.U.      KV   X------------------------- CONTROLLING  EQUIPMENT --------------------------X
    101 [NUC-A       21.600] 1.02000  22.0     1.02000                      LOCAL  GENERATION    101 [NUC-A       21.600]

    102 [NUC-B       21.600] 1.02000  22.0     1.02000                      LOCAL  GENERATION    102 [NUC-B       21.600]

    154 [DOWNTN      230.00] 0.93892 216.0 0.98000 1.00000 -0.04108   -9.45 XFRMER CKT 1  BUS    152 [MID500      500.00] TO    153 [MID230      230.00]

    201 [HYDRO       500.00] 1.04000 520.0     1.04000                      REMOTE GENERATION    211 [HYDRO_G     20.000]

    205 [SUB230      230.00] 0.94902 218.3     0.98000     -0.03098   -7.13 REMOTE GENERATION    206 [URBGEN      18.000]
                                           0.98000 1.00000 -0.03098   -7.13 XFRMER CKT 1  BUS    204 [SUB500      500.00] TO    205 [SUB230      230.00]

   3008 [CATDOG      230.00] 0.95861 220.5     1.02000     -0.06139  -14.12 REMOTE GENERATION   3018 [CATDOG_G    13.800]

   3011 [MINE_G      13.800] 1.04000  14.4     1.04000                      LOCAL  GENERATION   3011 [MINE_G      13.800]
```


Example of Regulated Buses Report

Additional Information
PSS® E Program Operation Manual, Producing a Regulated Bus Report

16.4.9. Controlling Transformers

TLST

Requirements / Prerequisites
Validly specified power flow case solved to an acceptable mismatch tolerance.

Power Flow > Reports > Limit checking reports...

Clicking the *Controlling transformer* tab in *[Limit Checking Reports]* will generate a report that tabulates those transformers in the power flow case where off-nominal turns ratio or phase-shift angle may be adjusted by power flow solution activities.

The user has the option of listing *All controlling transformers* or of restricting the report to *Controlling transformer violations*, those transformers where the controlled quantity is outside of its specified band. The *Out-*

put with voltage reversed option produces a report reversing the voltage option specified (pu or kV) in the Program Settings Dialog.

```
--------------------------------------------------------------------------------

      PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS®E      THU, SEP 18 2008   8:39
 PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE                         TRANSFORMER
 BASE CASE INCLUDING SEQUENCE DATA                                   VIOLATIONS
                     ** TRANSFORMERS CONTROLLING VOLTAGE **

 X--- ADJUSTABLE SIDE ---X X--------- TO ----------X                              X--- CONTROLLED BUS ----X
   BUS# X-- NAME --X BASKV   BUS# X-- NAME --X BASKV CKT     VOLT     MAX V   MIN V    BUS# X-- NAME --X BASKV  RATIO     MAX RAT MIN RAT NTAPOS
    152 MID500      500.00    153 MID230      230.00  1   0.93892LO 1.00000 0.98000     154 DOWNTN      230.00 1.01000   1.05000 0.95000     33
    204 SUB500      500.00    205 SUB230      230.00  1   0.94902LO 1.00000 0.98000     205 SUB230      230.00 1.00000   1.05000 0.95000     33

--------------------------------------------------------------------------------

      PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS®E      THU, SEP 18 2008   8:39
 PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE                         TRANSFORMER
 BASE CASE INCLUDING SEQUENCE DATA                                   VIOLATIONS
                    ** PHASE SHIFTERS CONTROLLING MW FLOW **

 X--- ADJUSTABLE SIDE ---X X--------- TO ----------X
   BUS# X-- NAME --X BASKV   BUS# X-- NAME --X BASKV CKT     MW      MAX MW  MIN MW   ANGLE    MAX AN  MIN AN
    202 EAST500     500.00    203 EAST230     230.00  1    592.4HI   555.0   545.0    0.00     30.00  -30.00

Progress  Alerts/Warnings  Report  Report
```

Example of Controlling Transformer Report, Violations Only

Additional Information
PSS® E Program Operation Manual, Producing a Controlling Transformer Report

16.4.10. Out-of-limit Bus Voltage

VCHK

Requirements / Prerequisites
Validly specified power flow case solved to an acceptable mismatch tolerance.

Power Flow > Reports > Limit checking reports...

Clicking the *Out-of-limit bus voltage* tab in *[Limit Checking Reports]* will generate a report that tabulates those buses where voltage magnitude is outside the specified range. The example (Figure 16.19, "Example of Out-of-Limit Bus Voltage Report") is based on the default limits, which can be changed by the user in .01 pu increments.

```
      PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS®E      THU, SEP 18 2008   7:58
 PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE
 BASE CASE INCLUDING SEQUENCE DATA

 BUSES WITH VOLTAGE GREATER THAN 1.0500:

   BUS# X-- NAME --X BASKV AREA  V(PU)  V(KV)      BUS# X-- NAME --X BASKV AREA  V(PU)  V(KV)

                                              * NONE *


 BUSES WITH VOLTAGE LESS THAN 0.9500:

   BUS# X-- NAME --X BASKV AREA  V(PU)  V(KV)      BUS# X-- NAME --X BASKV AREA  V(PU)  V(KV)
    154 DOWNTN      230.00    1 0.9389 215.95       205 SUB230      230.00    2 0.9490 218.27

Progress  Alerts/Warnings  Report
```

Figure 16.19. Example of Out-of-Limit Bus Voltage Report

Additional Information
PSS® E Program Operation Manual, Producing an Out-of-Limits Bus Voltage Report

16.5. AC Contingency Reports

Power Flow > Reports > AC Contingency reports...

The *[AC Contingency Reports]* dialog (Figure 16.20, "AC Contingency Reports Dialog ") allows the user to configure a variety of reports from the results of an ac contingency analysis. These formats include:

- Spreadsheet overload report
- Spreadsheet loading table
- Available capacity table
- Non-spreadsheet overload report
- Non-spreadsheet loading table
- Non-converged network
- Non-spreadsheet corrective actions

Checkboxes are available to enable/disable a variety of options, and filters may be set for a range of violations and tolerances. Details on the significance of the input parameters are discussed in the *PSS®E Program Operation Manual*,AC Contingency Single Run Report.

Click *[...]* to open a selection window for the required *Contingency solution output file* (*.acc).

Click *[Go]* to produce the report, which is displayed in the *Report* tab by default (Figure 16.21, "Example of Available Capacity Table").

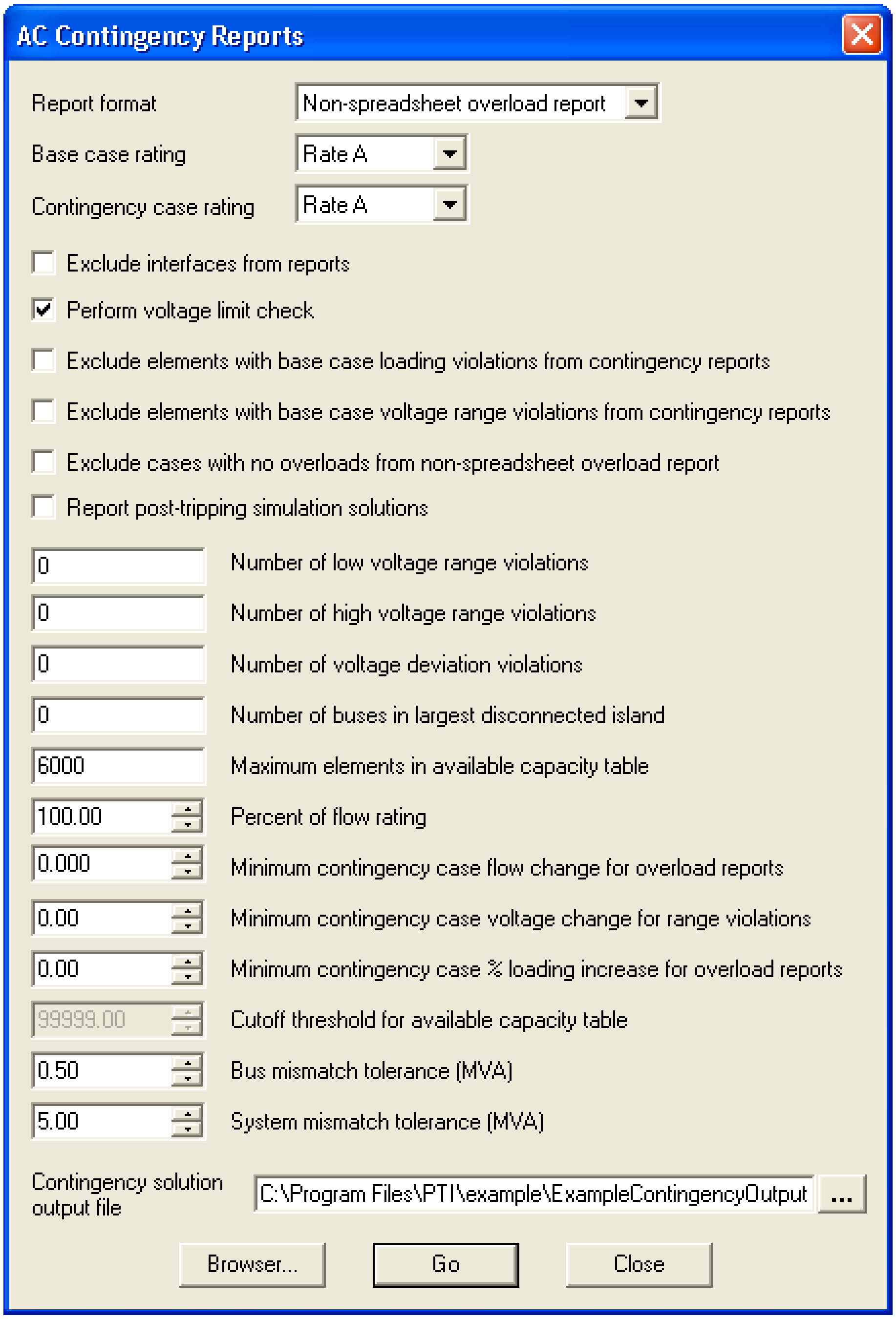


Figure 16.20. AC Contingency Reports Dialog

```
ACCC AVAILABLE CAPACITY REPORT: MONITORED BRANCHES AND INTERFACES USING RATING SET A
                                % LOADING VALUES ARE % MVA FOR TRANSFORMERS AND % CURRENT FOR NON-TRANSFORMER BRANCHES

AC CONTINGENCY RESULTS FILE:  C:\Program Files\PTI\PSSE31\EXAMPLE\NewTest.acc
DISTRIBUTION FACTOR FILE:     C:\Program Files\PTI\PSSE31\EXAMPLE\TESTdfx.dfx
SUBSYSTEM DESCRIPTION FILE:   C:\Program Files\PTI\PSSE31\EXAMPLE\savnw.sub
MONITORED ELEMENT FILE:       C:\Program Files\PTI\PSSE31\EXAMPLE\savnw.mon
CONTINGENCY DESCRIPTION FILE: C:\Program Files\PTI\PSSE31\EXAMPLE\savnw.con

**PERCENT LOADING UNITS**
%MVA FOR TRANSFORMERS
% I  FOR NON-TRANSFORMER BRANCHES

**OPTIONS USED IN CONTINGENCY ANALYSIS**
Solution engine:              Fixed slope decoupled Newton-Raphson (FDNS)
Solution options
  Tap adjustment:             Lock taps
  Area interchange control:   Tie lines only
  Phase shift adjustment:     Disable
  Dc tap adjustment:          Enable
  Switch shunt adjustment:    Enable continuous, disable discrete
  Non diverge:                Disable
Mismatch tolerance (MW ):     0.5
Dispatch mode:                Subsystem machines (Governor droop)
Dispatch subsystem:           STUDY

<------- F R O M -------> <--------- T O --------->CKT CONTINGENCY  OTHERS    BASE  MAXIMUM   IMPACT   RATING  PERCENT  AVAILABLE
       INTERFACE WEST                                  TRIP1NUCLEAR     0    147.9    372.6    372.6    200.0    186.3   -172.6
   205 SUB230       230.00    154 DOWNTN       230.00 1 LOSE2LINEEA      0    434.5    494.8    601.6    600.0    100.3     -1.6
  3008 CATDOG       230.00   3018 CATDOG_G     13.800 1 TRIP1NUCLEAR     0    128.1    141.7    141.7    150.0     94.5      8.3
   203 EAST230      230.00    154 DOWNTN       230.00 1 LOSE2LINESWE     0    133.7    158.4    176.7    200.0     88.3     23.3
  3008 CATDOG       230.00    154 DOWNTN       230.00 1 LOSE2LINEEA      0    112.1    257.2    312.7    400.0     78.2     87.3
       INTERFACE EAST                                  BASE CASE        0    130.8    130.8    130.8    350.0     37.4    219.2
  3004 WEST         500.00   3005 WEST         230.00 1 LOSE2LINEEA      0    235.2    317.3    317.3    800.0     39.7    482.7
   201 HYDRO        500.00    151 NUCPANT      500.00 1 LOSE2LINESWE     0    623.8    662.3    658.2   1200.0     54.9    541.8
  3001 MINE         230.00   3002 E. MINE      500.00 1 TRIP1NUCLEAR     0     57.2    240.4    240.4    800.0     30.1    559.6
   202 EAST500      500.00    152 MID500       500.00 1 LOSEEASTBIGT     0    135.3    441.1    452.4   1200.0     37.7    747.6

CONTINGENCY LEGEND:
LABEL          EVENTS
BASE CASE    : BASE CASE
TRIP1NUCLEAR: REMOVE UNIT 1 FROM BUS 101 [NUC-A       21.600]
LOSEEASTBIGT: TRIP LINE FROM BUS 151 [NUCPANT     500.00] TO BUS 201 [HYDRO       500.00]
LOSE2LINESWE: TRIP LINE FROM BUS 3004 [WEST        500.00] TO BUS 152 [MID500      500.00]
              TRIP LINE FROM BUS 3006 [UPTOWN      230.00] TO BUS 153 [MID230      230.00]
LOSE2LINEEA : TRIP LINE FROM BUS 151 [NUCPANT     500.00] TO BUS 201 [HYDRO       500.00]
              TRIP LINE FROM BUS 152 [MID500      500.00] TO BUS 202 [EAST500     500.00]
```

Progress | Report | Report | Report | Report | Report | Report | Report | **Report**

Figure 16.21. Example of Available Capacity Table

Additional Information
PSS® E Program Operation Manual, Single Run Report Formats

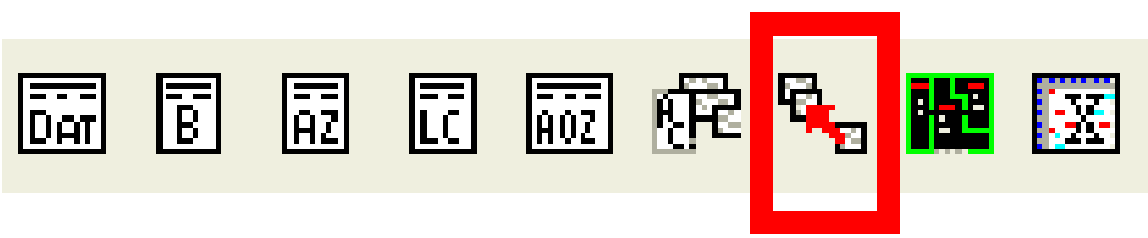
16.5.1. ACCC Post Processor (AcccBrwsGrid)

START > Programs > PSSE 32 > PSSE Utilities > ACCC Post Processor (AcccBrwsGrid)

Refer to Refer to *Additional Resources for PSS®E*, AcccBrwsGrid, for a description of ACCC post-processor data format.

16.5.2. Appending to ACCC Output File

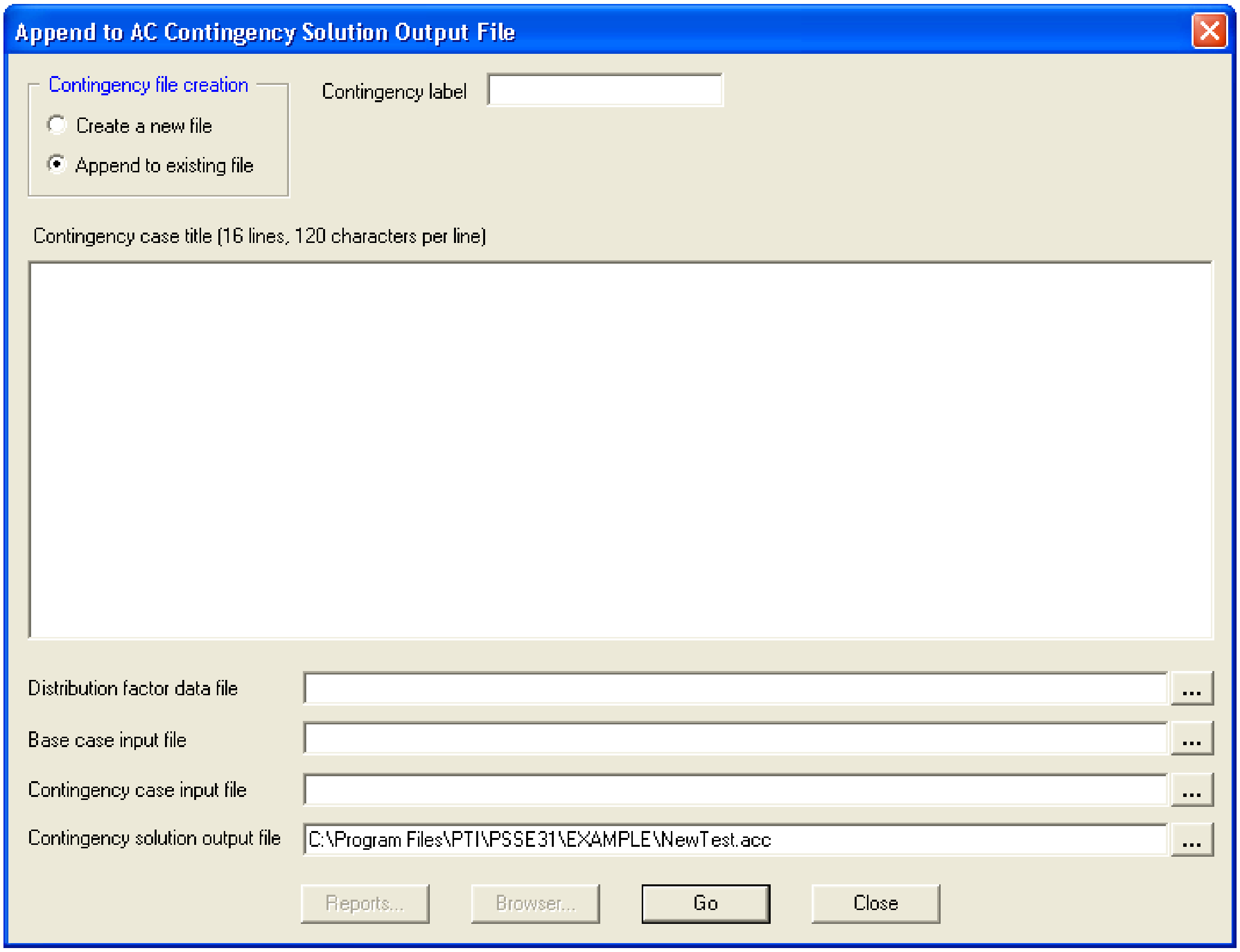
Power Flow > Reports > Append to AC Contingency solution output file...



This activity preserves the output system conditions of a contingency case solution when a contingency case exceeds the capability of the ac contingency solution. The *[Append to AC Contingency Solution Output File]* dialog is used to specify:

- *Contingency label*: contingency identifier (12 characters)
- *Contingency case title*: up to sixteen lines of text describing the contingency
- *Contingency file creation*: the option to append to an existing *Contingency solution output file* (*.acc) or to create a new one
- the names of four files:
- Distribution Factor Data file (*.dfx) that specifies the network elements to be monitored
- *Base case input file*: Saved Case file (*.sav) containing the pre-contingency power flow case
- *Contingency case input file*: Saved Case file (*.sav) containing the contingency case solution to be appended
- *Contingency solution output file* (*.acc) into which the results of the specified contingency case are to be placed

Click *[Go]* to append the data; a summary is routed to the *Progress* tab (Figure 16.21, “Example of Available Capacity Table”).



Append to AC Contingency Solution Output File Dialog

Additional Information
PSS® E Program Operation Manual, Appending Data to a Contingency Solution Output File

16.6. Multiple AC Contingency Run Reports

Power Flow > Report > Multiple AC Contingency runs report...

The *[Multiple AC Contingency Run Report]* dialog (Figure 16.22, "Multiple AC Contingency Run Report Dialog") allows the user to configure a variety of reports from the results of multiple ac contingency analyses. These formats include:

- Monitored Elements Summary
- Missing Monitored Elements
- Missing Monitored Voltage Buses
- Missing Contingencies
- Non-converged Contingencies
- Base Case Loading Violations
- Contingency Case All Loading Violations
- Contingency Case Worst Case Loading Violations
- Base Case Voltage Violations
- Contingency Case All Voltage Violations
- Contingency Case Worst Case Voltage Violations

Checkboxes are available to enable/disable a variety of options, and filters may be set for a range of violations and tolerances. Details on the significance of the input parameters are discussed in the *PSS®E Program Operation Manual*,AC Contingency Multiple Run Report

Click *[...]* to open a selection window for the required *Contingency Solution Output file* (*.acc). As many as nine Contingency Solution Output files may be specified.

Click *[Go]* to produce the report, which is displayed in the *Report* tab by default.

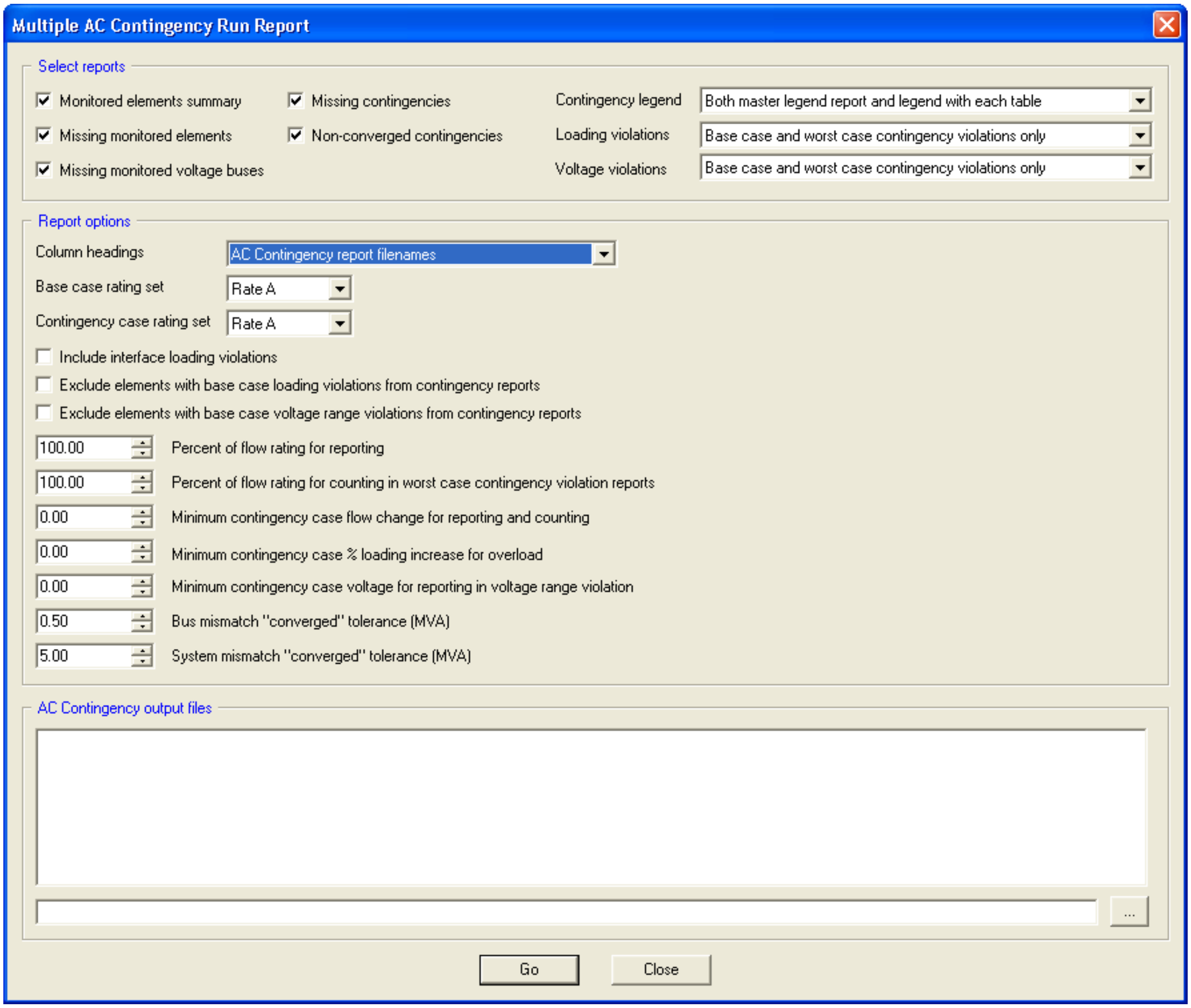


Figure 16.22. Multiple AC Contingency Run Report Dialog

Additional Information
PSS® E Program Operation Manual, Multiple Run Output Report Formats

16.7. Reporting DC Network Conditions

MTDC

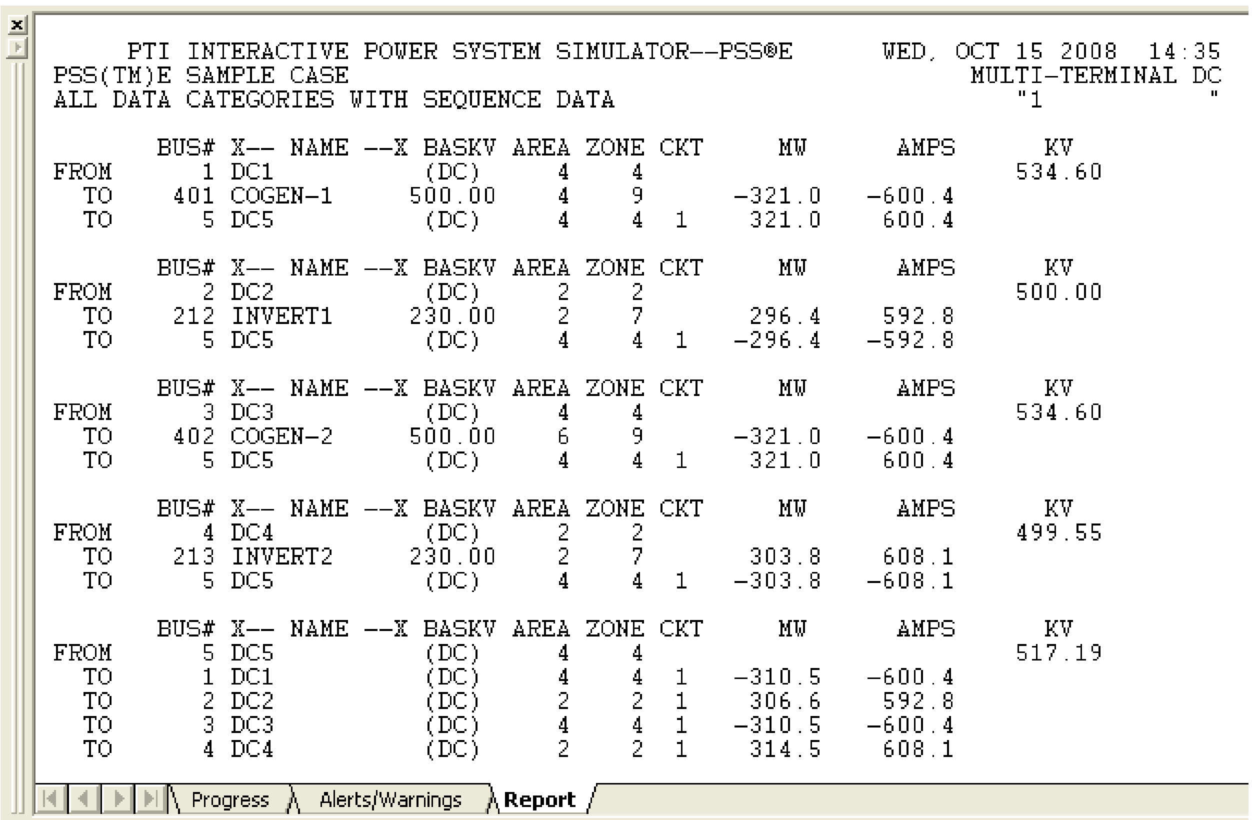
Requirements / Prerequisites
Validly specified power flow case solved to an acceptable mismatch tolerance. Unblocked multi-terminal dc lines must be present in the working case.

Power Flow > Reports > Multi-terminal DC line solution output (MTDC)

The multi-terminal dc line power flow output activity MTDC prints power flow solution results at all dc buses of all unblocked multi-terminal dc lines in the working case.

Activity MTDC displays a popup message *No unblocked multi-terminal dc lines in this case* and terminates if these network conditions are not found. Click *[OK]* to remove the message.

There are no user-defined options. The report is displayed in the *Report* tab by default (Figure 16.23, "Example of DC Network Conditions Report").



```
     PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS®E      WED, OCT 15 2008  14:35
PSS(TM)E SAMPLE CASE                                          MULTI-TERMINAL DC
ALL DATA CATEGORIES WITH SEQUENCE DATA                           "1          "

       BUS# X-- NAME --X BASKV AREA ZONE CKT      MW      AMPS       KV
FROM      1 DC1          (DC)     4    4                          534.60
  TO    401 COGEN-1    500.00     4    9       -321.0    -600.4
  TO      5 DC5          (DC)     4    4   1    321.0     600.4

       BUS# X-- NAME --X BASKV AREA ZONE CKT      MW      AMPS       KV
FROM      2 DC2          (DC)     2    2                          500.00
  TO    212 INVERT1    230.00     2    7        296.4     592.8
  TO      5 DC5          (DC)     2    4   1   -296.4    -592.8

       BUS# X-- NAME --X BASKV AREA ZONE CKT      MW      AMPS       KV
FROM      3 DC3          (DC)     4    4                          534.60
  TO    402 COGEN-2    500.00     6    9       -321.0    -600.4
  TO      5 DC5          (DC)     4    4   1    321.0     600.4

       BUS# X-- NAME --X BASKV AREA ZONE CKT      MW      AMPS       KV
FROM      4 DC4          (DC)     2    2                          499.55
  TO    213 INVERT2    230.00     2    7        303.8     608.1
  TO      5 DC5          (DC)     4    4   1   -303.8    -608.1

       BUS# X-- NAME --X BASKV AREA ZONE CKT      MW      AMPS       KV
FROM      5 DC5          (DC)     4    4                          517.19
  TO      1 DC1          (DC)     4    4   1   -310.5    -600.4
  TO      2 DC2          (DC)     2    2   1    306.6     592.8
  TO      3 DC3          (DC)     4    4   1   -310.5    -600.4
  TO      4 DC4          (DC)     2    2   1    314.5     608.1
```


Figure 16.23. Example of DC Network Conditions Report

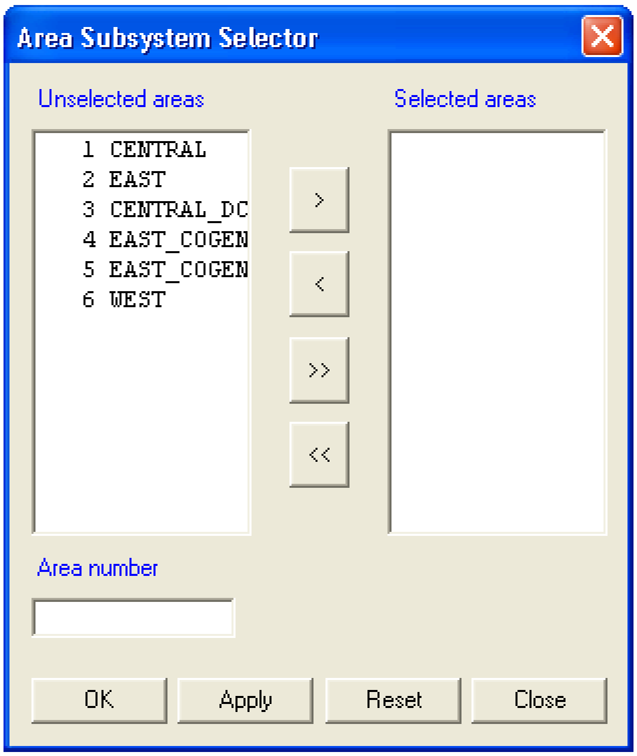
Additional Information
PSS® E Program Operation Manual, Reporting DC Network Conditions

16.8. Restricting the Output of Large Reports

16.8.1. By Area

Subsystem > Area...

The *[Area Subsystem Selector]* dialog is similar to the area tab in the *[Bus Subsystem Selector]* (see Figure 2-9). The buttons respond the same way, but the *Memorize* and *Recall* options are not available. This dialog is used to limit report output and does not affect the *[Spreadsheet]* display.

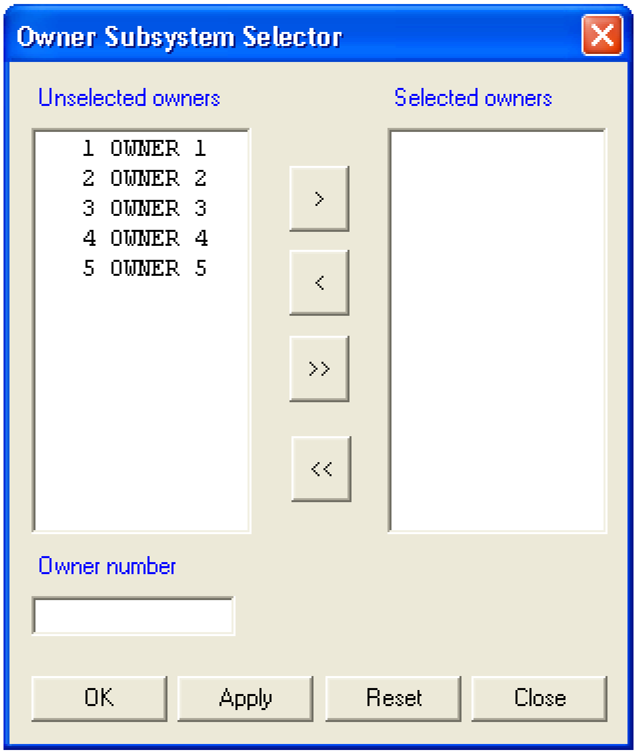


Area Subsystem Selector Dialog

16.8.2. By Owner

Subsystem > Owner...

The *[Owner Subsystem Selector]* dialog is similar to the owner tab in the *[Bus Subsystem Selector]* (see Figure 2-9). The buttons respond the same way, but the *Memorize* and *Recall* options are not available. This dialog is used to limit report output and does not affect the *[Spreadsheet]* display.

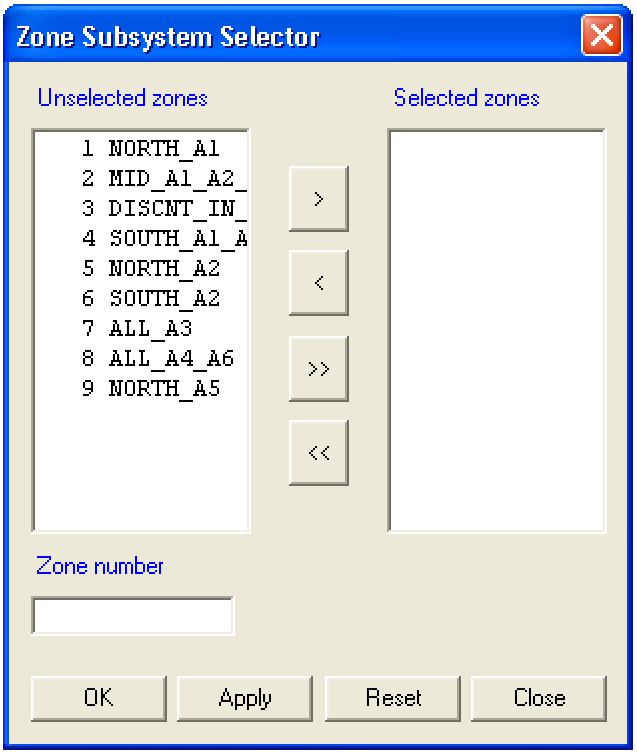


Owner Subsystem Selector Dialog

16.8.3. By Zone

Subsystem > Zone...

The *[Zone Subsystem Selector]* dialog is similar to the zone tab in the *[Bus Subsystem Selector]* (see Figure 2-9). The buttons respond the same way, but the *Memorize* and *Recall* options are not available. This dialog is used to limit report output and does not affect the *[Spreadsheet]* display.



Zone Subsystem Selector Dialog

16.9. Exporting Power Flow Results to Microsoft Excel®

Power Flow > Reports > Export ACCC, PV/QV results to Excel...

OR

Start > Programs > PSSE > Export results to Excel...

The *[Export PSS®E Data/Result to Excel]* dialog (Figure 16.25, "Export Data/Result to Excel Dialog") requires specification of the Contingency for export:

- ACCC Analysis Results
- PV Solution Results
- QV Solution Results

If *ACCC Analysis Results* is selected, additional options are available. Click *[Options]* to open *[Specify psseexcel.accc Options]* (Figure 16.24, "Specify psseexcel.accc Options Dialog"). The *Solution Type* (*Contingency*, *Corrective Action*, or *Tripping*), *Rating*, and filters for *Bus* and *System Mismatch* may be specified.

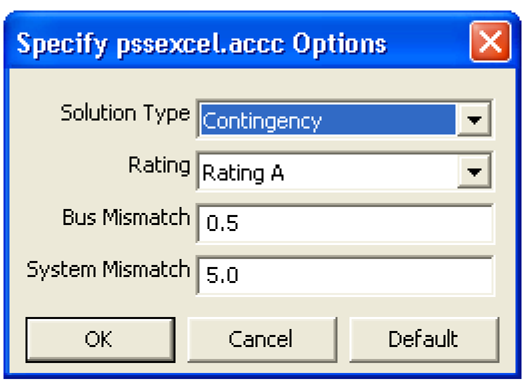


Figure 16.24. Specify psseexcel.accc Options Dialog

Click *[OK]* to return to *[Export PSS®E Data/Result to Excel]*. Click *[...]* to open selection windows for the file to be exported and the Excel output file, which can be a new file with the default name of the *.acc file, a designated filename, or a previously-built file to be over-written.

Checkboxes are provided to select the desired *Quantities to Export* and contingencies.

Click *[Export]* to complete the action. The Excel ® Workbook will open in a new window.

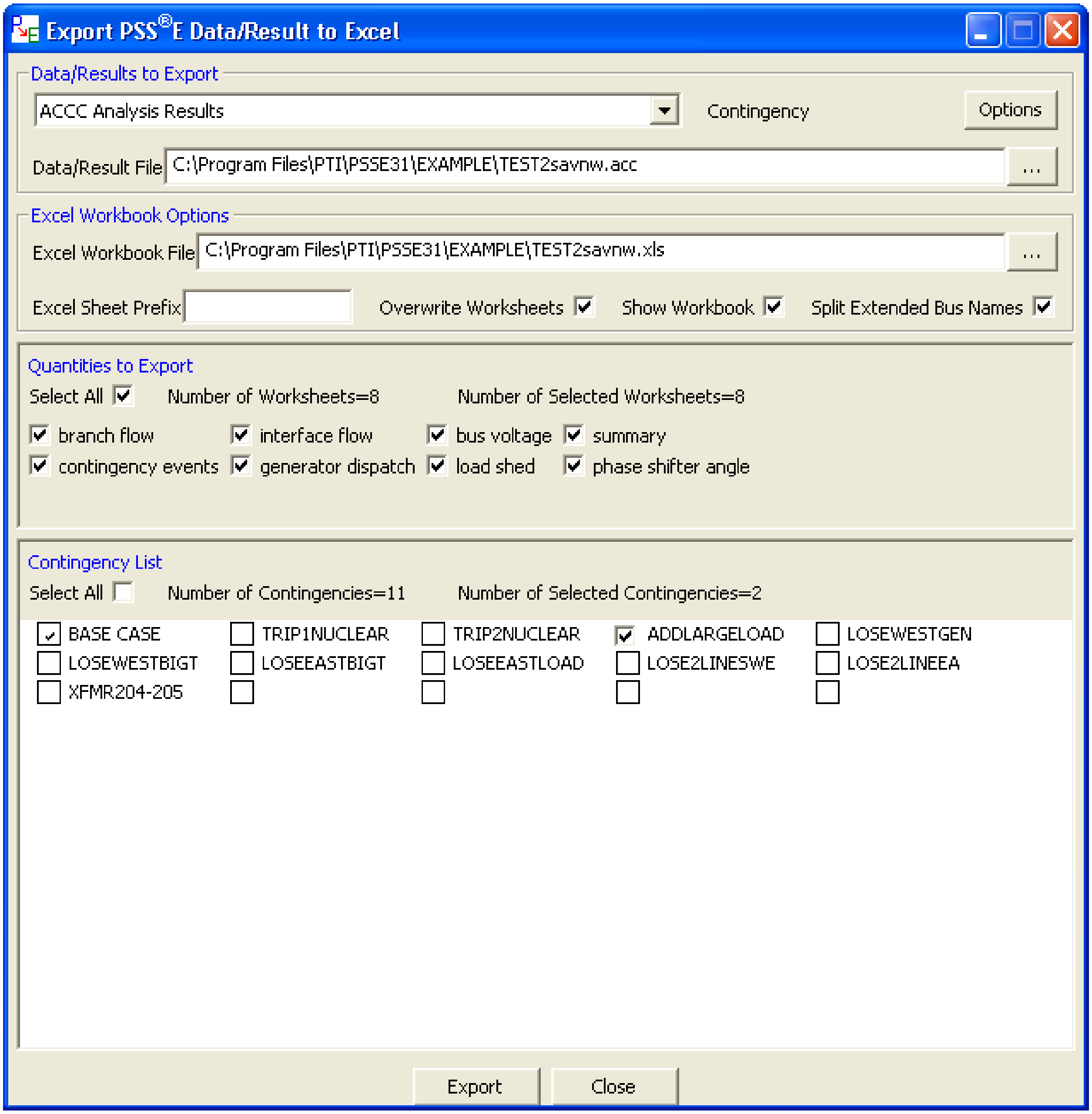


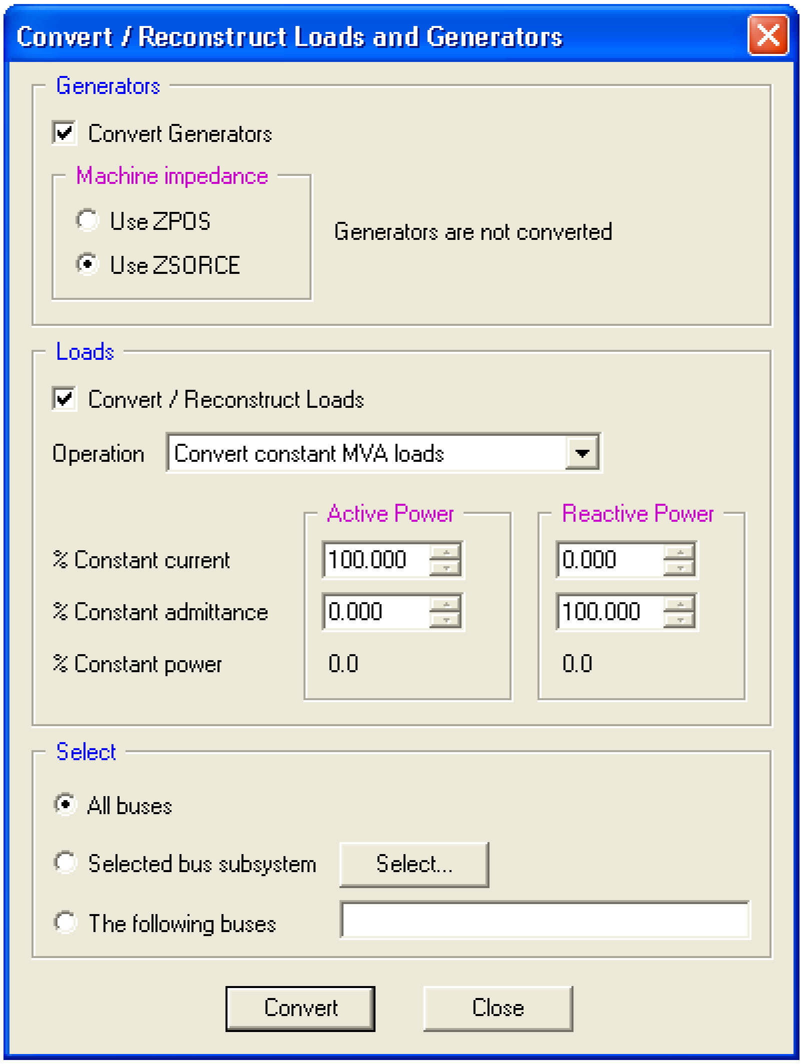
Figure 16.25. Export Data/Result to Excel Dialog

Chapter 17
Balanced Switching

17.1. Converting Loads and Generators

Power Flow > Convert Loads and Generators...

This task opens the *[Convert / Reconstruct Loads and Generators]* dialog where reallocations of constant MVA loads can be specified.



Convert / Reconstruct Loads and Generators Dialog

17.1.1. Generators

CONG

Requirements / Prerequisites
Validly specified power flow case solved to an acceptable mismatch level. Machine impedance data must be correctly specified for all online machines.

Power Flow > Convert Loads and Generators...

Click the *Convert Generators* checkbox in *[Convert / Reconstruct Loads and Generators]* and select the desired machine impedance (ZSORCE for dynamic simulations or ZPOS for short circuit calculations) to convert generators for subsequent PSS®E activities. Generators must be represented as current sources for the following activities:

Fault Analysis / Switching Analysis	*Dynamics Simulation Analysis*	
Factorizing the Network Admittance Matrix	Reading Dynamics Model Data	Running State-Space Simulation
Solving the Converted Case	Simulation Variables	Running Exciter Simulation
Calculating Circuit Breaker Interrupting Duty	Subsystem Simulation Data	Running Extended Term Dynamic Simulation
	Restoring Dynamics Working Memory from a Binary Snapshot File Created in PSS®E-26 or Earlier	Running Governor Response Simulation Test
	Modifying Dynamics Model Pointer Tables	Building a State Variable Matrix for Linear Dynamic Analysis
	Creating a Dynamics Model Raw Data File	
	Displaying Model Data	
	Displaying Model Storage Location	

The notice `GENERATOR CONVERSION COMPLETED` is printed in the *Progress* tab and *[Convert / Reconstruct Loads and Generators]* displays *Generators are converted* when the conversion process is complete. You will need to click *[Close]* to end this activity.

Additional Information
PSS®E Program Operation Manual, Converting Generators

17.1.2. Load Characteristics

CONL

Requirements / Prerequisites
Validly specified power flow case solved to an acceptable mismatch level.

Power Flow > Convert Loads and Generators...

Click the *Convert/Reconstruct Loads* checkbox in *[Convert / Reconstruct Loads and Generators]* and select the *Convert constant MVA loads* option to convert loads for subsequent PSS®E activities. Options are available to change the default active and reactive power quantities. Loads to be converted can be selected by the Area, Zone or Owner number to which the loads are assigned (NOT to the bus assignment to which the loads are connected). When selected by kV, all loads connected to buses with the selected voltage(s) will be converted in the selected Areas, Zones and/or Owners.

For most types of analyses, loads are converted for the following activities:

- Factorizing the Network Admittance Matrix

- Solving the Converted Case
- Calculating Circuit Breaker Interrupting Duty

The notice `<quantity> LOADS CONVERTED DURING THIS STEP` and `<quantity> OF <quantity> LOADS CONVERTED` is printed in the *Progress* tab when the conversion process is complete. The dialog closes automatically after load conversion.

Additional Information
PSS® E Program Operation Manual, Converting Load Characteristics

17.1.3. Reconverting Load Characteristics

RCNL

Requirements / Prerequisites
Validly specified power flow case. If the existing voltage vector is used in the load reconstruction, the working case must be solved to an acceptable mismatch.

Power Flow > Convert Loads and Generators...

Click the *Convert/Reconstruct Loads* checkbox in *[Convert / Reconstruct Loads and Generators]* and select one of the following options from the Operation pull-down list.

- Reconstruct loads using present voltage
- Reconstruct loads using unity voltage

The notice `<quantity > LOADS CONVERTED DURING THIS STEP` and `<quantity > OF <quantity > LOADS CONVERTED` is printed in the *Progress* tab when the reconstruction process is complete.

Additional Information
PSS® E Program Operation Manual, Reconverting Load Characteristics

17.2. Ordering Network Buses for Matrix Manipulation

ORDR

Requirements / Prerequisites
Validly specified power flow case.

Powerflow > Solution > Order network for matrix operations (ORDR)

The network ordering process requires branch selection from the *[Order Network]* dialog (Figure 17.1, “Order Network Dialog”) with the following options:

- *Ignore out of service branches*: recognize the status of network branches and ignore out-of-service branches in determining the bus ordering
- *Assume all branches are in-service*: ignore the service status of all branches and assume all branches connected to Type 1, 2, or 3 buses are in-service

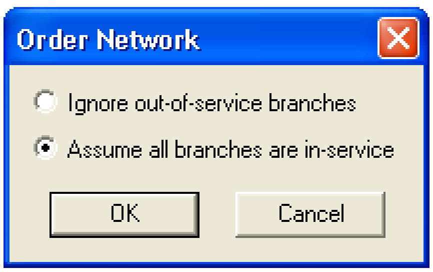


Figure 17.1. Order Network Dialog

The notice DIAGONALS = <quantity> OFF-DIAGONALS = <quantity> MAX SIZE = <quantity> is printed in the *Progress* tab when the network ordering process is complete.

Additional Information
PSS®E Program Operation Manual, Ordering Network Buses for Matrix Manipulation

17.3. Factorizing the Network Admittance Matrix

FACT

Requirements / Prerequisites
Validly specified power flow case. Normally, the load characteristics are modified. Converting Loads and Generators Load Characteristics

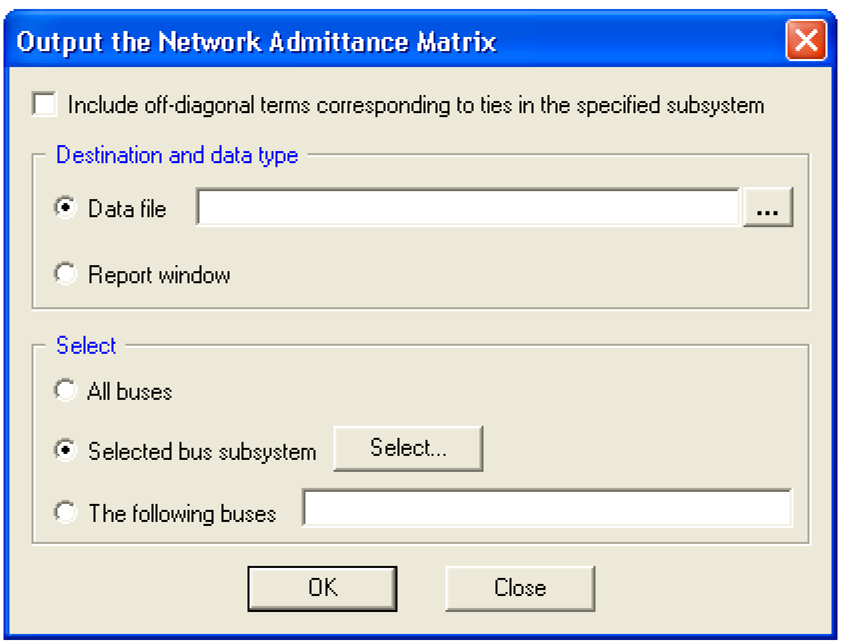
Powerflow > Solution > Factorize admittance matrix (FACT)

The notice `<quantity> DIAGONAL AND <quantity> OFF-DIAGONAL ELEMENTS` is printed in the *Progress* tab when the factorization process is complete.

Additional Information
PSS® E Program Operation Manual, Factorizing the Network Admittance Matrix

17.3.1. Exporting the Network Admittance Matrix

To initiate the output Y matrix function, select *File > Export > Network admittance matrix...* to export the network admittance matrix to the *Report* tab or a data file. This is the matrix used for the powerflow calculations. This matrix can be used for external calculations such as flow loss.



Output the Network Admittance Matrix Dialog

The user specifies the desired portion of the admittance matrix from the following options:

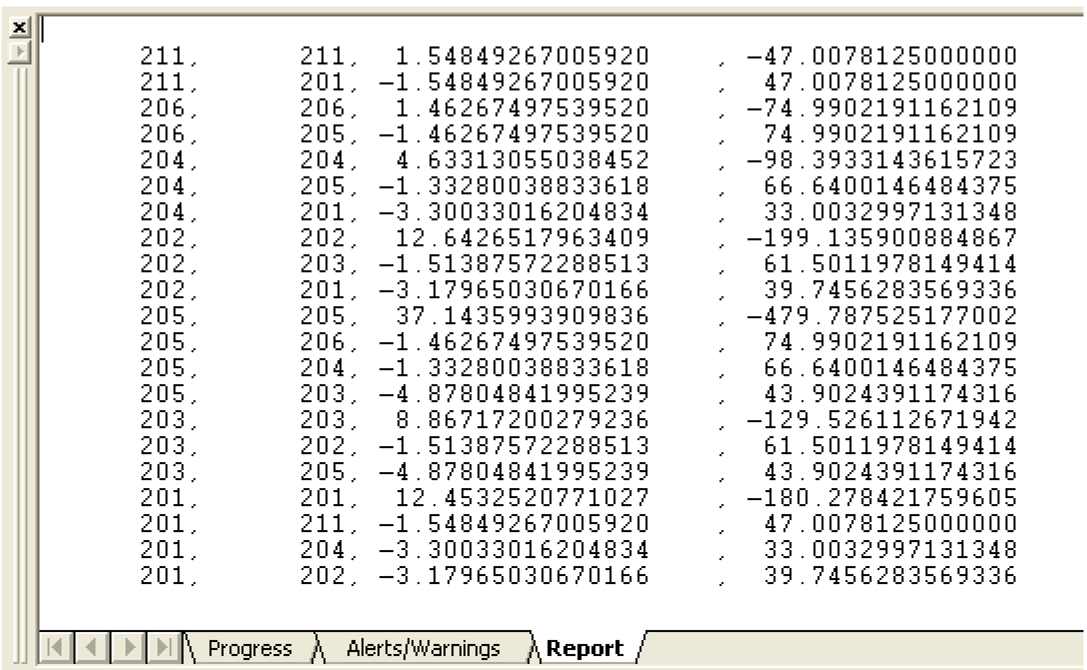
- *All buses*: the entire admittance matrix.

- *Selected bus subsystem*: admittance matrix rows corresponding to buses in the current bus subsystem, either as defined, or as redefined using *[Select]*.
- *The following buses*: only those buses specified.

Unless *All buses* is selected, the *Include off-diagonal terms corresponding to ties in the specified subsystem* check box is enabled. Select this option to display all non-zero off-diagonal terms in the rows being processed. If this check box option is not selected, only off-diagonal terms corresponding to other rows being processed are displayed.

Direct the matrix to either a named file or to the *Report* tab using the *Destination and data type* options.

When this matrix is generated by PSS®E, buses connected together by zero impedance are combined together in the matrix. Therefore, the matrix may not have separate rows and columns for each bus. Instead one bus ID will represent the combined buses.



Example of Exported Network Admittance Matrix

Additional Information
PSS® E Program Operation Manual, Exporting the Power Flow Network Admittance Matrix

17.4. Solving the Converted Case

TYSL

Requirements / Prerequisites
Validly specified power flow case with voltages corresponding to the preswitching network condition, and with impedance data specified for all machines.
Converting Loads and Generators
Load Characteristics
Ordering Network Buses for Matrix Manipulation
Factorizing the Network Admittance Matrix

Powerflow > Solution > Solution for switching studies (TYSL)

The switching studies solution requires a starting point option from the *[Solution for Switching Studies]* dialog (Figure 17.2, "Solution for Switching Studies Dialog") with the following options:

- *Flat start*: all bus voltages are reset to unity magnitude at zero phase angle
- *Use voltage vector as start point*: existing voltage vector in the working case is used as the initial voltage estimate

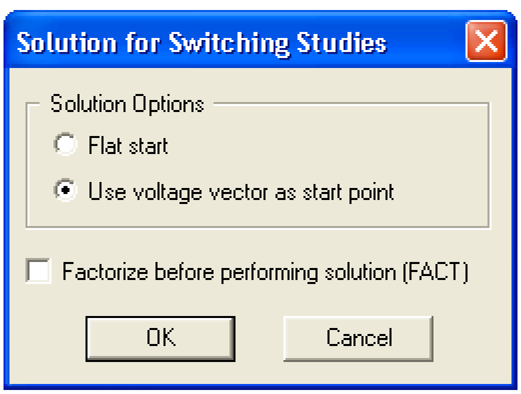
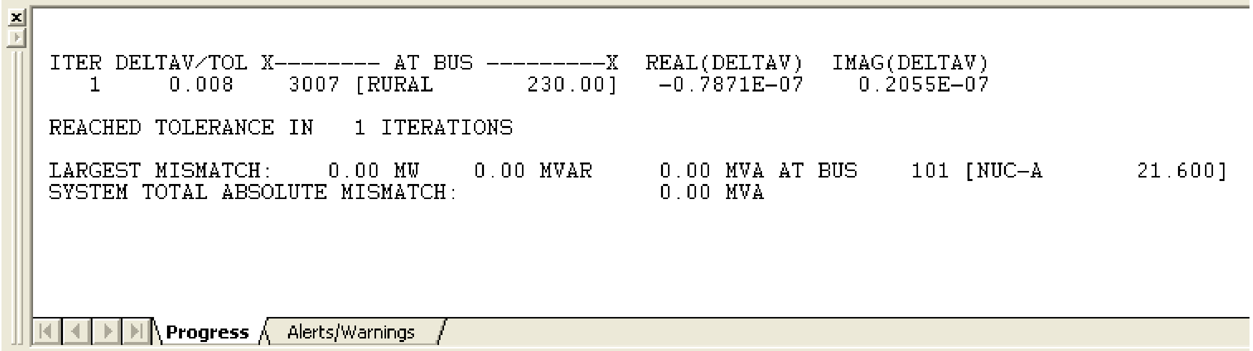


Figure 17.2. Solution for Switching Studies Dialog



Example of Switching Studies Output

Additional Information
PSS® E Program Operation Manual, Solving the Converted Case

Chapter 18

Transmission Pricing and Open Access

18.1. Open Access and Pricing Data

Trans Access > Data...

The *[Transaction Data]* dialog (Figure 18.1, “Transaction Data Dialog”) provides a form where *Transactions* are input.

Click *[Add]* when the attribute data for a transaction has been completed. Then highlight the transaction and input *Participating Buses* data. Click *[Add]* in the buses dialog to complete the transaction data. Both attribute and bus data can be modified.

Transaction data is not saved with the power flow case, but it can be saved/retrieved from external *.mwm files.

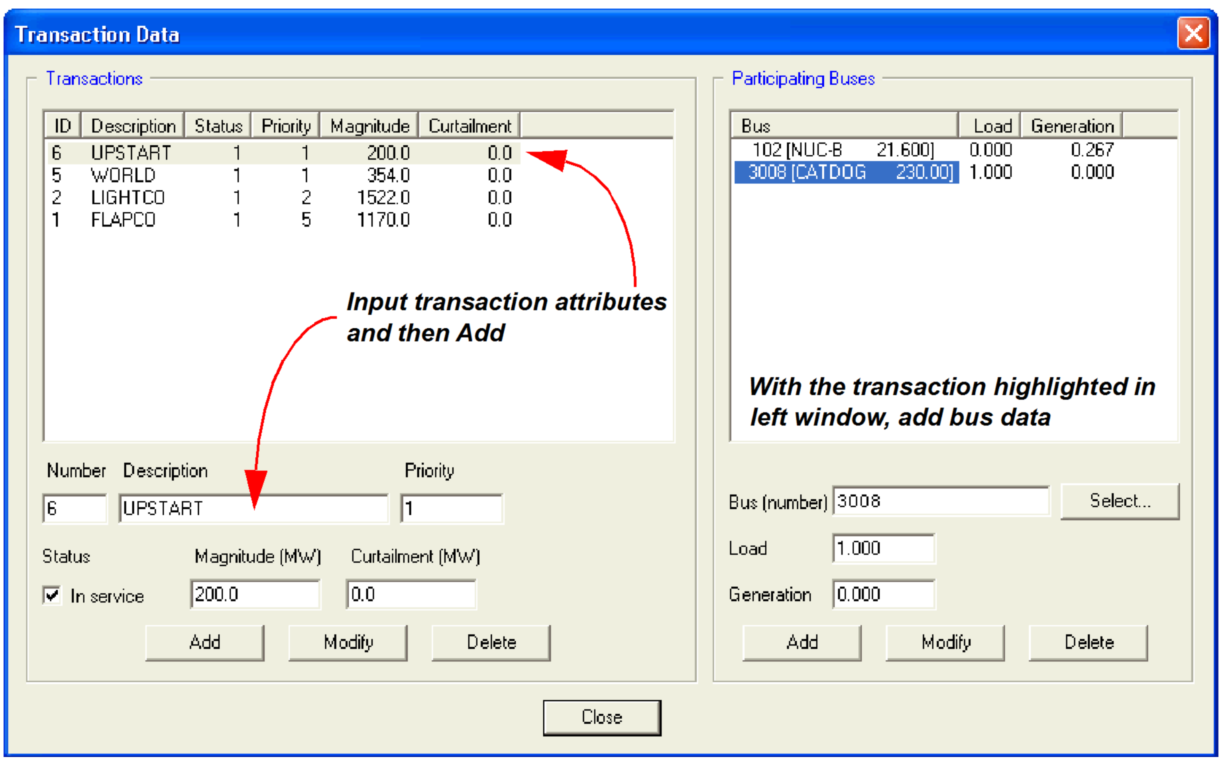


Figure 18.1. Transaction Data Dialog

18.2. Calculating Transaction Event Impact on Monitored Elements

IMPC

Requirements / Prerequisites
Validly specified power flow case. Reading Transactions Raw Data Distribution Factor Data File (*.dfx) corresponding to the network condition. Building the Distribution Factor Data File

Trans Access > Calculators > Impact on Monitored Elements...

The *[Impact on Monitored Elements]* dialog (Figure 18.2, "Impact on Monitored Elements Dialog") calculates and reports the incremental MW flow impact on a set of monitored elements due to a single transaction event. Click *[...]* to open the selection window for the required *Distribution factor data file* (*.dfx). If desired, an optional ATC Updates file (*.dat) may also be specified. Click *[Go]* to perform the activity.

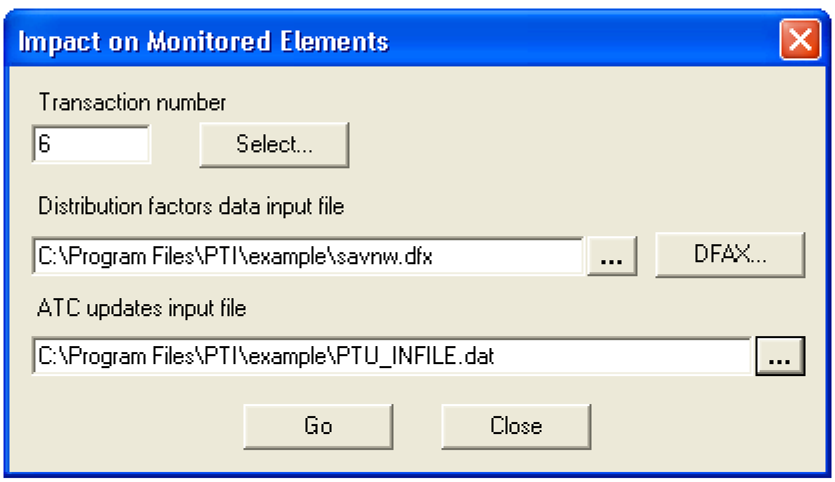


Figure 18.2. Impact on Monitored Elements Dialog

Additional Information
PSS® E Program Operation Manual, Calculating Transaction Event Impact on Monitored Elements

18.3. Calculating Line Loading Relief

LLRF

Requirements / Prerequisites
Validly specified power flow case.
Reading Transactions Raw Data
Distribution Factor Data File (*.dfx) corresponding to the network condition.
Building the Distribution Factor Data File

Trans Access > Calculators > Line loading relief by transaction adjustment...

The *[Line Loading Relief by Transaction Adjustment]* dialog (Figure 18.3, “Line Loading Relief by Transaction Adjustment Dialog”) requires setting the desired Distribution factor tolerance. Then click *[...]* to open the selection window for the required *Distribution Factor Data file* (*.dfx).

Select a line loading relief function from among the following options:

- Curtail
- DF Report
- Restore

Highlight the desired *monitored element* and the desired *priority*. A priority may be modified with an *adjustment method* from among the following options:

- FILO (first in - last out)
- DF-Order (decreasing order of distribution factor magnitude)
- DF-Pro Rata (distribution factor pro rata)
- DF-Sched-Pro Rata (pro rata base on the product of distribution factor with transaction schedule

Click *[OK]* to produce the report (Figure 18.4, “Example of Line Loading Relief Report: Transaction Curtailment”), which is displayed in the *Report* tab by default.

Additional Information
PSS® E Program Operation Manual, Calculating Line Loading Relief

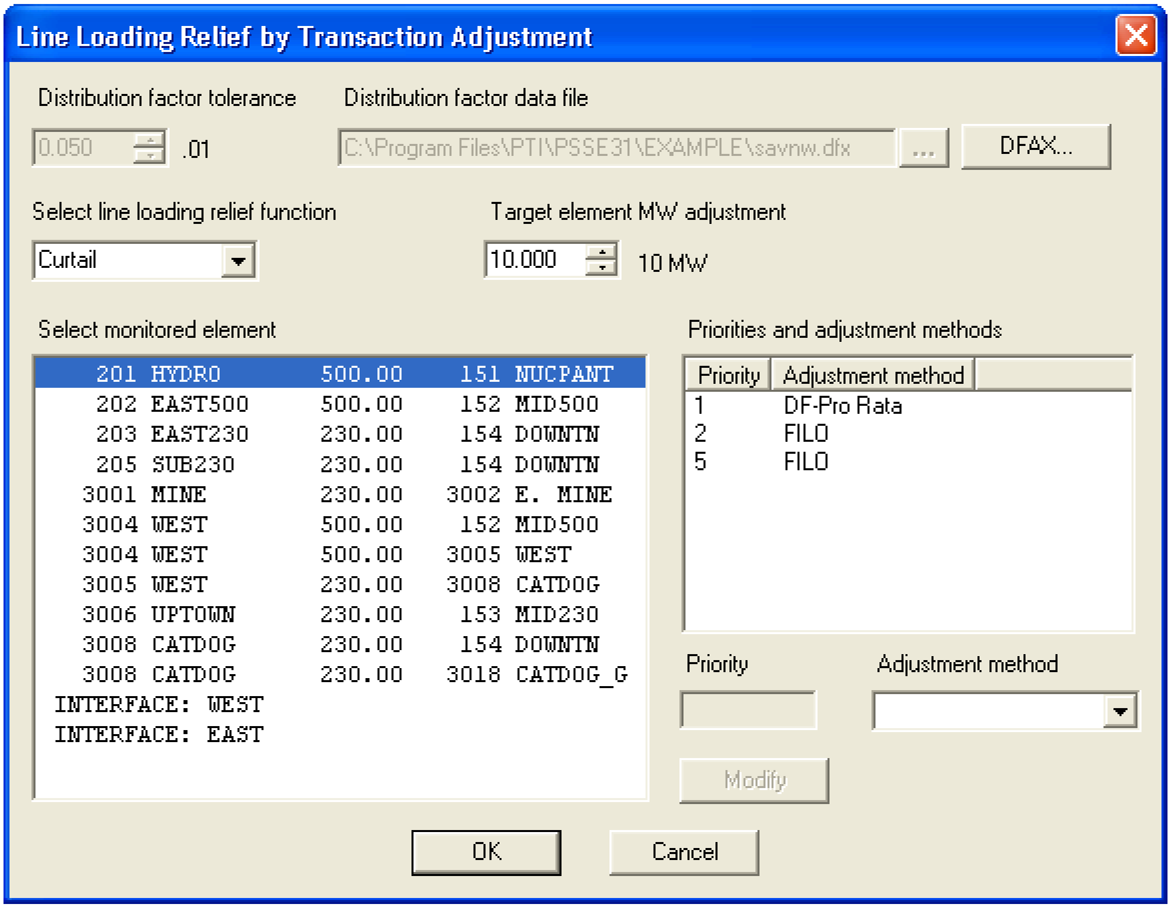
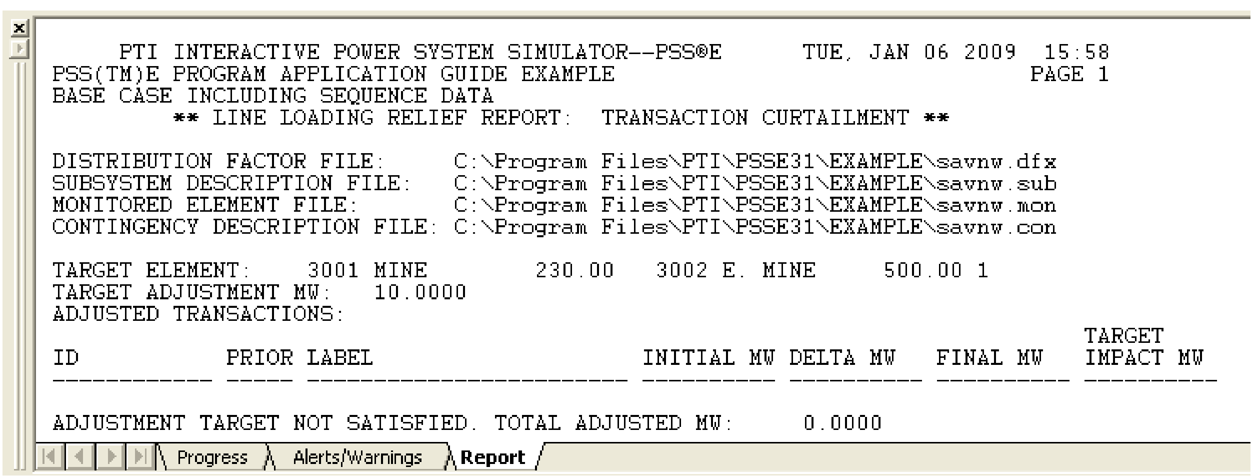


Figure 18.3. Line Loading Relief by Transaction Adjustment Dialog



```
    PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS®E      TUE, JAN 06 2009  15:58
PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE                              PAGE 1
BASE CASE INCLUDING SEQUENCE DATA
         ** LINE LOADING RELIEF REPORT:  TRANSACTION CURTAILMENT **

DISTRIBUTION FACTOR FILE:      C:\Program Files\PTI\PSSE31\EXAMPLE\savnw.dfx
SUBSYSTEM DESCRIPTION FILE:    C:\Program Files\PTI\PSSE31\EXAMPLE\savnw.sub
MONITORED ELEMENT FILE:        C:\Program Files\PTI\PSSE31\EXAMPLE\savnw.mon
CONTINGENCY DESCRIPTION FILE:  C:\Program Files\PTI\PSSE31\EXAMPLE\savnw.con

TARGET ELEMENT:     3001 MINE        230.00    3002 E. MINE     500.00 1
TARGET ADJUSTMENT MW:    10.0000
ADJUSTED TRANSACTIONS:
                                                                                TARGET
ID           PRIOR LABEL                    INITIAL MW DELTA MW   FINAL MW   IMPACT MW
------------ ----- ------------------------ ---------- ---------- ---------- ----------

ADJUSTMENT TARGET NOT SATISFIED. TOTAL ADJUSTED MW:      0.0000
```


Figure 18.4. Example of Line Loading Relief Report: Transaction Curtailment

18.4. Making Allocations

ALOC

Requirements / Prerequisites
Validly specified power flow case. Reading Transactions Raw Data Building the Distribution Factor Data File

This activity performs various analyses related to identifying the MW-mile impact of transaction events on transmission facility owners.

18.4.1. Megawatt Shift Factors

Trans Access > Allocations > Megawatt shift factors...

The *[Megawatt Shift Factors]* dialog (Figure 18.5, "Megawatt Shift Factors Dialog ") requires a *Shift factor selection*, MW-mile or MW-ohm, to report the impact of a particular transaction event.

Click *[OK]* to perform the analysis. The report is routed to the *Report* tab by default.

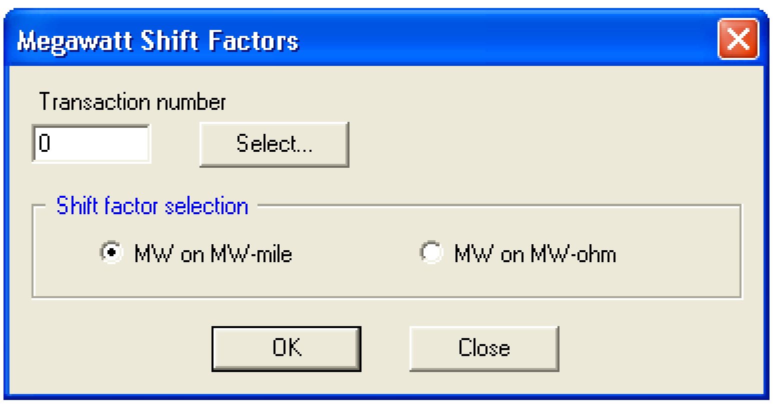


Figure 18.5. Megawatt Shift Factors Dialog

18.4.2. Vector Absolute MW-mile

Trans Access > Allocations > Vector Absolute MW-mile

The report is routed to the *Report* tab by default.

18.4.3. Vector Absolute MW-ohm

Trans Access > Allocations > Vector Absolute MW-ohm

The report is routed to the *Report* tab by default (Figure 18.6, "Example of Vector Absolute MW-ohm Report").

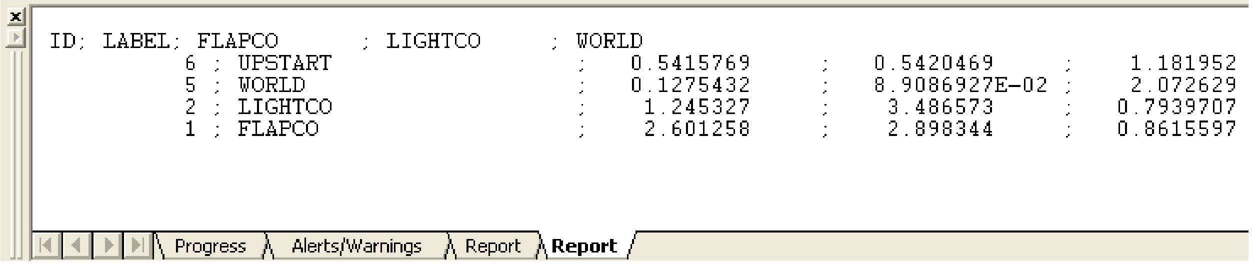


Figure 18.6. Example of Vector Absolute MW-ohm Report

18.4.4. Vector Sum MW-ohm

Trans Access > Allocations > Vector Sum MW-ohm

The report is routed to the *Report* tab by default (Figure 18.7, “Example of Vector Sum MW-ohm Report”).

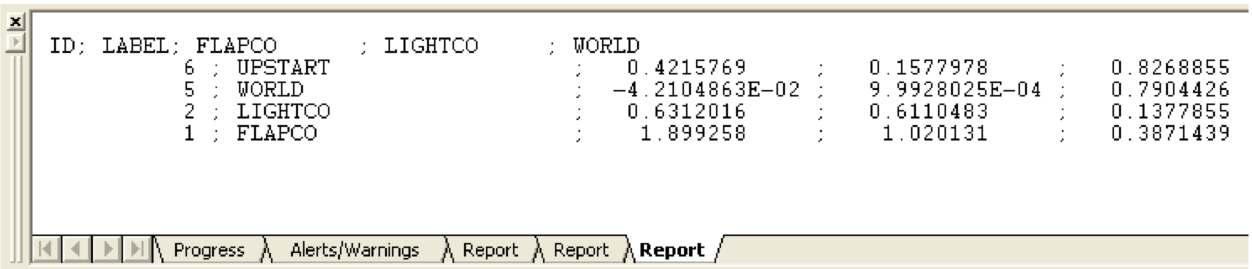


Figure 18.7. Example of Vector Sum MW-ohm Report

18.4.5. Branch Mileage

Trans Access > Summaries > Summary of branch mileage by owner

The report is routed to the *Report* tab by default (Figure 18.8, “Example of Branch Mileage by Owner Summary”).

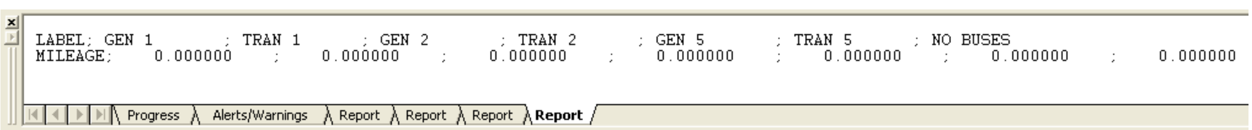


Figure 18.8. Example of Branch Mileage by Owner Summary

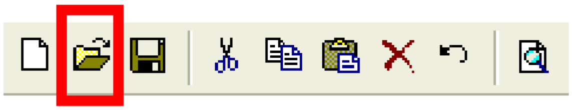
Additional Information
PSS® E Program Operation Manual, Making Allocations

Chapter 19
Optimal Power Flow

19.1. Reading Optimal Power Flow Data

ROPF

Requirements / Prerequisites
Validly specified power flow case. Optimal Power Flow Data File (*.rop) Creating an Optimal Power Flow Raw Data File



File > Open...

The file selection window in the *[Open]* dialog lists only those files available when the *Files of type:* field has been scrolled to the desired file type.

For this activity, scroll to *Optimal Power Flow Data file (*.rop)*. Highlight the desired file and click *[Open]*. The OPF data is read into the working case.

Additional Information
PSS®E Program Operation Manual, *Optimal Power Flow Raw Data File*

19.2. Data Initialization for OPF

Requirements / Prerequisites
Validly specified power flow case.

OPF > Data...

If optimal power flow data is not present in the working case, then the option to initialize OPF data is provided. Click *[Yes]* on the dialog (Figure 19.1, "OPF Initialization Pop-up Dialog") to configure *[OPF Spreadsheet]* and *[OPF Tree]* with the appropriate data categories to enter or modify constraint and control data.

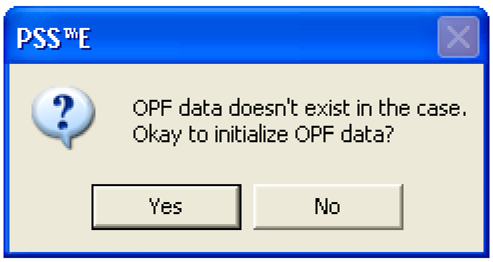


Figure 19.1. OPF Initialization Pop-up Dialog

If data is changed through the subsequent reading of an Optimal Power Flow Data file (*.rop), a summary of changes is routed to the *Progress* tab (see Figure 19.2, "Example of Bus Attribute Data Changed by OPF Data File").

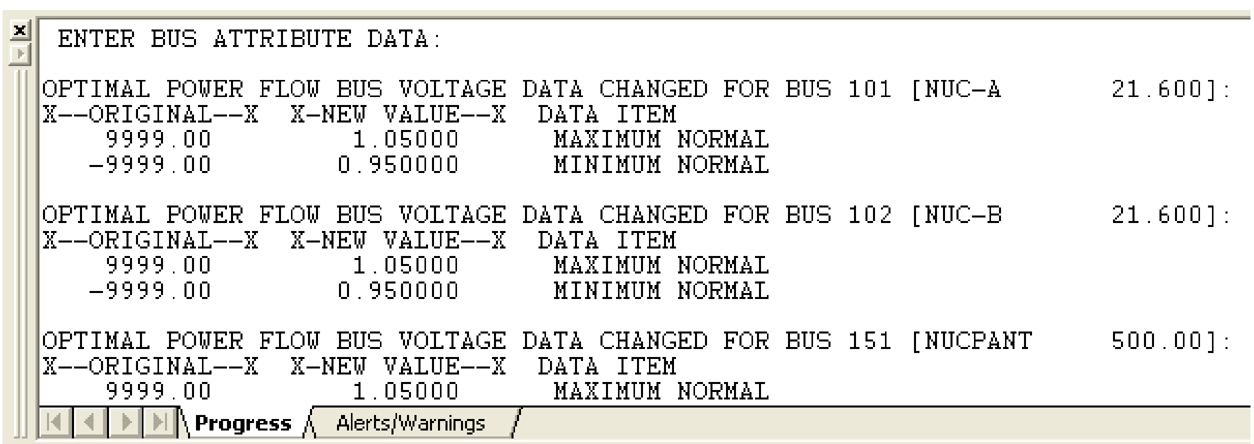


Figure 19.2. Example of Bus Attribute Data Changed by OPF Data File

The following sections describe the OPF attribute spreadsheets available after either data initialization or the reading of OPF data from a file. *[OPF Spreadsheet]* records display default data values until modified.

Numeric data cells of the subsystem attribute spreadsheets support use of the summation (+) and multiplication (*) operators. These operators may be used to automatically adjust numerical data by either a constant or a scale factor. The operators must be specified directly in front of the number. The following examples illustrate different uses of these operators:

- If a floating point field contains the value 100, then the corresponding data item for each element in the specified subsystem will be set to 100.0.
- If a floating point field contains the value +100, then 100.0 is added to the present value of each data item within the specified subsystem.
- If a floating point field contains the value +-100, then 100 is subtracted from the present value of each data item within the specified subsystem.
- If a floating point field contains the value *1.1, then the presents values of each data item within the specified subsystem will be multiplied by 1.1.

It is not possible to add new records through an attribute spreadsheet, nor is it possible to introduce new buses through any of the OPF data input functions. Use *[Network Spreadsheet]* or *[Diagram]* to add a new bus and then, if desired, return to *[OPF Spreadsheet]* to modify the automatically created record.

If a bus is removed from the power flow network, the corresponding *[OPF Spreadsheet]* record will also be removed.

19.2.1. Bus Voltage Attribute Spreadsheet

Bus Number	Bus Name	Normal Volt Limit Max(pu)	Normal Volt Limit Min(pu)	Adjust Limits	Emergency Volt Limit Max(pu)	Emergency Volt Limit Min(pu)	Limit Type	Soft Limit Penalty
101	NUC-A 21.600	1.0500	0.9500	No change	9999.0000	-9999.0000	Hard limit	1.0000
102	NUC-B 21.600	1.0500	0.9500	No change	9999.0000	-9999.0000	Hard limit	1.0000
151	NUCPANT 500.00	1.0500	0.9500	No change	9999.0000	-9999.0000	Hard limit	1.0000
152	MID500 500.00	1.0500	0.9500	No change	9999.0000	-9999.0000	Hard limit	1.0000
153	MID230 230.00	1.0500	0.9500	No change	9999.0000	-9999.0000	Hard limit	1.0000
154	DOWNTN 230.00	1.0500	0.9500	No change	9999.0000	-9999.0000	Hard limit	1.0000
201	HYDRO 500.00	1.0500	0.9500	No change	9999.0000	-9999.0000	Hard limit	1.0000
202	EAST500 500.00	1.0500	0.9500	No change	9999.0000	-9999.0000	Hard limit	1.0000
203	EAST230 230.00	1.0500	0.9500	No change	9999.0000	-9999.0000	Hard limit	1.0000
204	SUB500 500.00	1.0500	0.9500	No change	9999.0000	-9999.0000	Hard limit	1.0000
205	SUB230 230.00	1.0500	0.9500	No change	9999.0000	-9999.0000	Hard limit	1.0000
206	URBGEN 18.000	1.0500	0.9500	No change	9999.0000	-9999.0000	Hard limit	1.0000
211	HYDRO_G 20.000	1.0500	0.9500	No change	9999.0000	-9999.0000	Hard limit	1.0000
3001	MINE 230.00	1.0500	0.9500	No change	9999.0000	-9999.0000	Hard limit	1.0000
3002	E. MINE 500.00	1.0500	0.9500	No change	9999.0000	-9999.0000	Hard limit	1.0000
3003	S. MINE 230.00	1.0500	0.9500	No change	9999.0000	-9999.0000	Hard limit	1.0000
3004	WEST 500.00	1.0500	0.9500	No change	9999.0000	-9999.0000	Hard limit	1.0000
3005	WEST 230.00	1.0500	0.9500	No change	9999.0000	-9999.0000	Hard limit	1.0000
3006	UPTOWN 230.00	1.0500	0.9500	No change	9999.0000	-9999.0000	Hard limit	1.0000
3007	RURAL 230.00	1.0500	0.9500	No change	9999.0000	-9999.0000	Hard limit	1.0000
3008	CATDOG 230.00	1.0500	0.9500	No change	9999.0000	-9999.0000	Hard limit	1.0000
3011	MINE_G 13.800	1.0500	0.9500	No change	9999.0000	-9999.0000	Hard limit	1.0000
3018	CATDOG_G 13.80	1.0500	0.9500	No change	9999.0000	-9999.0000	Hard limit	1.0000

Bus Voltage | Bus Voltage / Sbs | Adj. Bus Shunt | Adj. Bus Shunt / Sbs | Adj. Branch Reac. | Adj. Branch Reac. / Sbs | Branch Flow

Example of Bus Voltage Spreadsheet

The *Bus Number* and *Bus Name* cells uniquely identify the record and cannot be edited. Values for *Normal* or *Emergency Voltage Limits* may be entered directly into the spreadsheet cells. An *Adjust Limits* cell provides a menu from which one of three options may be selected:

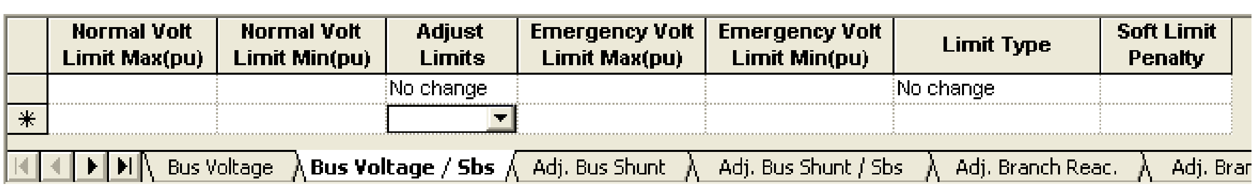
No Change	preserves the normal maximum and minimum voltage limits as indicated by the values in the *Normal Voltage Limits Maximum* and *Minimum* cells
Fix	updates the *Normal Voltage Limits Maximum* and *Minimum* cells to reflect the present voltage magnitude of the bus
	For example, if the *Normal Voltage Limits Maximum* and *Minimum* cells contain values of 1.05 and 0.95 respectively, and the present voltage magnitude of the bus is 0.92, then the *Fix* option will automatically update the values in both the *Normal Voltage Limits Maximum* and *Minimum* cells to reflect a value of 0.92.
Open	updates the *Normal Voltage Limits Maximum* or *Minimum* cell to reflect the present voltage magnitude of the bus, if the present voltage magnitude of the bus falls outside of the voltage range defined by the specified maximum or minimum voltage limits.
	For example, if the *Normal Voltage Limits Minimum* cell contains a value of 0.95 and the present voltage magnitude of the bus is 0.92, then when Open selected, the value in the *Normal Voltage Limits Minimum* cell will automatically be updated to reflect the value of 0.92. A similar action will result if the current voltage magnitude exceeds the maximum limit.

The *Limit Type* cell provides a menu from which one of the following options may be selected:

- Reporting
- Hard limit
- Soft-linear limit
- Soft-quadratic limit

A *Soft Limit Penalty* cell becomes active and the default value may be modified if either the *Soft-linear* or *Soft-quadratic limit* type is selected in the *Limit Type* cell. Otherwise, this cell is locked.

19.2.2. Bus Voltage Attribute / Subsystem Spreadsheet



Bus Voltage Subsystem Spreadsheet

The Bus Voltage Subsystem spreadsheet is particularly helpful when establishing the same voltage attributes for all buses within a particular subsystem. Define the subsystem (see Section 2.3.2, "Creating a Bus Subsystem"). The values entered into the record are subsequently applied to all buses within the specified subsystem. Cells left blank, or set to *No change*, indicate that no changes are to be made to the present working case values.

Values for *Normal* or *Emergency Voltage Limits* may be entered directly into the spreadsheet cells.

The *Normal* and *Emergency Voltage Limit* cells support use of the summation (+) and multiplication (*) operator functions. These operators may be used to automatically adjust the maximum and/or minimum voltage magnitudes at all buses within the specified subsystem by either a constant or a scale factor.

Adjust Limits provides the options menu described for the Bus Voltage Attribute Spreadsheet. *Limit Type* cell also provides the options menu described for the Bus Voltage Attribute Spreadsheet, with the addition of a *No change* option to retain the current settings. A change to the *Soft Limit Penalty* can be applied only if either the *Soft-linear* or *Soft-quadratic limit* type is selected in the *Limit Type* cell.

19.2.3. Adjustable Bus Shunt Spreadsheet

	Bus Number	Bus Name	Id	Susceptance (Mvar) Initial	Susceptance (Mvar) Max	Susceptance (Mvar) Min	Cost Scale ($/Mvar)	In Service
	151	NUCPANT 500.00	1	0.00	100.00	-100.00	1.00	☑
	151	NUCPANT 500.00	2	0.00	400.00	-200.00	100.00	☑
	154	DOWNTN 230.00	1	120.00	200.00	0.00	10.00	☑
*								☑

Bus Voltage / Bus Voltage / Sbs / **Adj. Bus Shunt** / Adj. Bus Shunt / Sbs / Adj. Branch Reac. / Adj. Br

Example of Adjustable Bus Shunt Spreadsheet

By default, all Adjustable Bus Shunt records within the working case are displayed. A limited set may be displayed by specifying a subsystem (see Section 2.3.2, "Creating a Bus Subsystem"). If no Adjustable Bus Shunt records exist in the working case, the Adjustable Bus Shunt spreadsheet will display a blank record.

To add a new Adjustable Bus Shunt record, enter a valid bus number in the *Bus Number* cell of the row containing the * and enter a bus shunt identifier in the *Id* cell. Unique shunt identifiers must be used if more than one Adjustable Bus Shunt record is to exist for the same bus number.

Optionally, the *Bus Number* and bus shunt *Id* may correspond to a fixed shunt record in the power flow network. If so, then the corresponding fixed shunt data record may be updated with new B-Shunt (Mvar) data after an OPF solution.

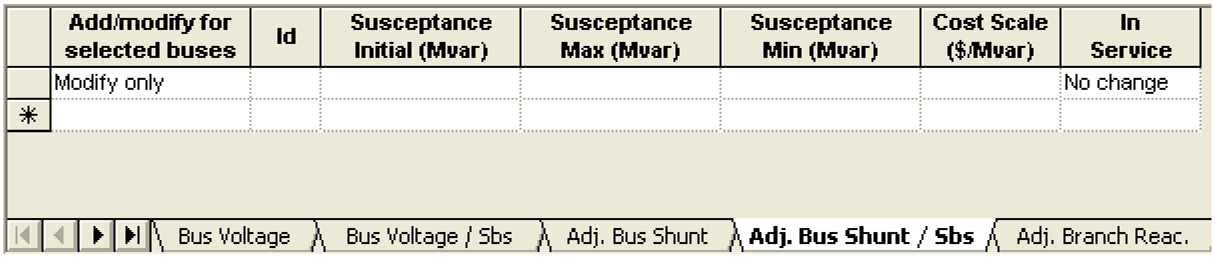
After the bus number and shunt identifier are entered, click on another row to retrieve the *Bus Name*; all other cells are populated with default data values.

If another row is clicked before a new *Id* value is entered, the *Id* cell will be set to 1 and locked. Delete the record and re-enter it to reset the *Id*.

New values for the *Initial Susceptance*, *Maximum Susceptance*, *Minimum Susceptance* or *Cost Scale* values may be entered directly in the cells provided.

If desired, uncheck the *In Service* toggle switch to set the Adjustable Bus Shunt record to out-of-service.

19.2.4. Adjustable Bus Shunt / Subsystem Spreadsheet



Adjustable Bus Shunt Subsystem Spreadsheet

The Adjustable Bus Shunt Subsystem spreadsheet is particularly helpful in modifying and/or introducing a large number of adjustable bus shunts that all have the same values. It can also be used to delete a group of adjustable bus shunt records.

Define the subsystem (see Section 2.3.2, "Creating a Bus Subsystem"). The values entered into the record are subsequently applied to all buses within the specified subsystem. Cells left blank, or set to *No change*, indicate that no changes are to be made to the present working case values.

To add or modify a group of Adjustable Bus Shunt records, click the *Add/modify for selected buses* cell and choose one of the following options:

Modify only	updates only existing adjustable bus shunt records where the bus number corresponds to a bus within the selected subsystem and the shunt identifier corresponds to the one specified in the *Id* cell. No new adjustable bus shunt records are added.
Add/Modify	(1) updates existing adjustable bus shunt records where the bus number corresponds to a bus within the selected subsystem and the shunt identifier corresponds to the one specified in the *Id* cell. (2) if an Adjustable Bus Shunt record does not already exist with the bus number and shunt identifier specified, a new Adjustable Bus Shunt record is added
	For example, if 2 is entered into the *Id* cell, then all adjustable bus shunt records whose buses reside within the specified subsystem and have a shunt identifier of 2 will be updated to reflect the new values defined. Buses within the subsystem that do not currently have a corresponding adjustable bus shunt record

	with a shunt identifier of 2 will have a new shunt record introduced into the working case.

Values for *Susceptance* and the *Cost Scale* coefficient may be entered directly in the cells provided. Cells left blank indicate that no changes are to be made to the current working case values of existing Adjustable Bus Shunt records, and that default values are to be applied to new records.

The *Susceptance* and *Cost Scale* coefficient cells support use of the summation (+) and multiplication (*) operator functions. These operators may be used to automatically adjust the maximum and/or minimum voltage magnitudes at all buses within the specified subsystem by either a constant or a scale factor.

The *In Service* cell provides options for in-service and out-of-service as well as a *No change* option to retain the current settings.

To delete a group of Adjustable Bus Shunt records, go to the *Id* cell in the subsystem and do one of the following steps:

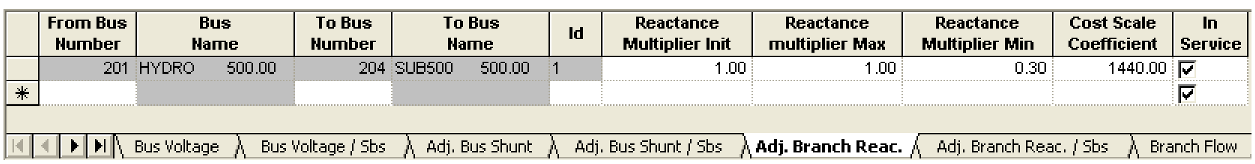
- enter a shunt *Id* value, if only Adjustable Bus Shunt records with the specified shunt *Id* are to be deleted

  OR

- leave the shunt *Id* value blank, if all Adjustable Bus Shunt records within the subsystem are to be deleted.

Highlight the row and press *[Delete]*. The setting of the *Add/modify for selected buses* cell is ignored; either option will allow successful deletion of the specified group of records.

19.2.5. Adjustable Branch Reactance Spreadsheet



	From Bus Number	Bus Name	To Bus Number	To Bus Name	Id	Reactance Multiplier Init	Reactance multiplier Max	Reactance Multiplier Min	Cost Scale Coefficient	In Service
	201	HYDRO 500.00	204	SUB500 500.00	1	1.00	1.00	0.30	1440.00	☑
*										☑

Example of Adjustable Branch Reactance Spreadsheet

Only those branches that have Adjustable Branch Reactance data records defined in the working case are displayed in the spreadsheet. The list of records shown can be reduced by specifying a subsystem (see Section 2.3.2, “Creating a Bus Subsystem”).

To add an Adjustable Branch Reactance record, either enter a valid *From Bus*, *To Bus* and branch *Id* in the cells provided, or double click in any of the *Bus* or *Id* cells and choose from a list of available branches in the *[Branch Selection]* dialog (Figure 7.19, “Specification of a Branch for the Tap Line”). Only nontransformer branches are valid for use in Adjustable Branch Reactance records.

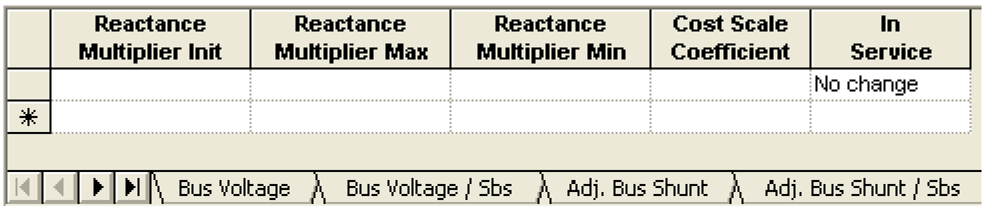
Values for the three *Reactance Multipliers* and the *Cost Scale Coefficient* may be entered directly in the cells provided.

If desired, uncheck the *In Service* toggle switch to set the Adjustable Branch Reactance record to out-of-service.

It is not possible to introduce new branches through the Adjustable Branch Reactance spreadsheet. Use the standard power flow branch spreadsheet and diagram tools to add a branch.

If a branch is removed from the power flow network, the corresponding Adjustable Branch Reactance record is also removed.

19.2.6. Adjustable Branch Reactance / Subsystem Spreadsheet



	Reactance Multiplier Init	Reactance Multiplier Max	Reactance Multiplier Min	Cost Scale Coefficient	In Service
					No change
*					

Adjustable Branch Reactance Subsystem Spreadsheet

To add and/or modify a group of Adjustable Branch Reactance records, define a subsystem and enter values in the first row of the spreadsheet.

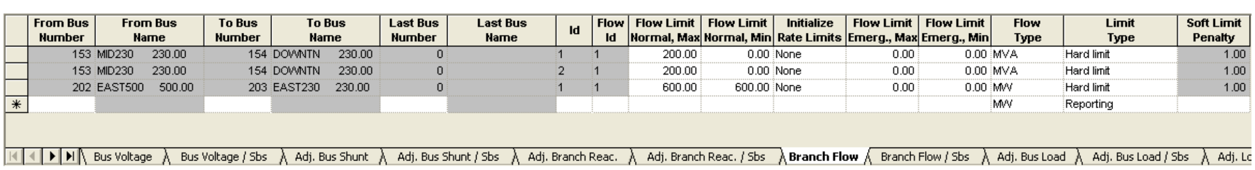
Values for the three *Reactance Multipliers* and the *Cost Scale Coefficient* may be entered directly in the cells provided. New Adjustable Branch Reactance data records will either be created or existing ones modified to the values specified in the table. Cells left blank, or set to *No change*, indicate that no changes are to be made to the present working case values, and that default values are to be used for new records.

The three *Reactance Multipliers* and the *Cost Scale Coefficient* cells support use of the summation (+) and multiplication (*) operator functions. These operators may be used to automatically adjust the working case values of each Adjustable Branch Reactance record within the specified subsystem by either a constant or scale factor.

The *In Service* cell provides options for in-service and out-of-service as well as a *No change* option to retain the current settings.

To delete a group of Adjustable Branch Reactance records, define a subsystem, highlight the first row, and press *[Delete]*.

19.2.7. Branch Flow Spreadsheet



	From Bus Number	From Bus Name	To Bus Number	To Bus Name	Last Bus Number	Last Bus Name	Id	Flow Id	Flow Limit Normal, Max	Flow Limit Normal, Min	Initialize Rate Limits	Flow Limit Emerg., Max	Flow Limit Emerg., Min	Flow Type	Limit Type	Soft Limit Penalty
	153	MID230 230.00	154	DOWNTN 230.00	0		1	1	200.00	0.00	None	0.00	0.00	MVA	Hard limit	1.00
	153	MID230 230.00	154	DOWNTN 230.00	0		2	1	200.00	0.00	None	0.00	0.00	MVA	Hard limit	1.00
	202	EAST500 500.00	203	EAST230 230.00	0		1	1	600.00	600.00	None	0.00	0.00	MW	Hard limit	1.00
*														MW	Reporting	

Example of Branch Flow Spreadsheet

By default all Branch Flow Constraint records within the working case are displayed in the spreadsheet. The list of records can be further reduced by specifying a subsystem (see Section 2.3.2, "Creating a Bus Subsystem").

To add an Branch Flow Constraint record, either enter a valid *From Bus*, *To Bus*, *Last Bus* (for a three-winding transformer), branch *Id* and *Flow Id* in the cells provided, or double click in any of the *Bus* or *Id* cells and choose from a list of available branches in the *[Branch Selection]* dialog (Figure 7.19, “Specification of a Branch for the Tap Line”). Non-transformer branches, two-winding transformers, and individual windings of three-winding transformers are valid for use in Branch Flow Constraint records.

Unique flow identifiers must be used if more than one Branch Flow Constraint record is to exist for the same branch or transformer.

If another row is clicked before a new flow identifier is entered, the *Flow Id* cell will be set to 1 and locked. Delete the record and re-enter it to reset the *Id*.

Values for *Normal* or *Emergency Flow Limits* may be entered directly into the spreadsheet cells.

The *Initialize Rate Limits* cell provides provides a menu from which one of four options may be selected:

None	has no impact on the values specified in the *Flow Limit Normal, Max* or *Flow Limit Normal, Min* cells
RateA, *RateB*, or *RateC*	places the positive magnitude of the specified branch flow rating in the *Flow Limit Normal, Max* cell, and the negative magnitude of the specified branch flow rating in the *Flow Limit Normal, Min* cell The branch flow ratings are obtained directly from the values stored in the working case.

The *Flow Type* cell provides provides a menu from which one of four options may be selected: MW, MVAR, MVA, or ampere.

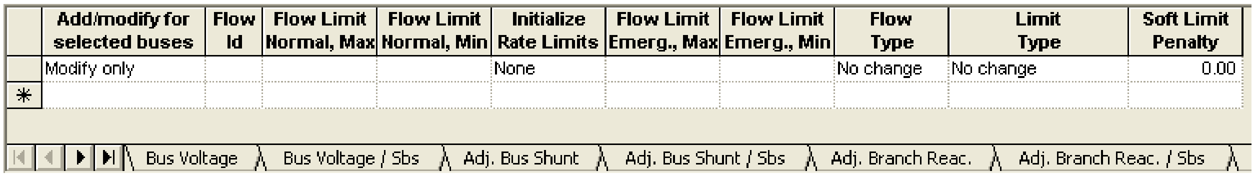
The *Limit Type* cell provides a menu from which one of the following options may be selected:

- Reporting
- Hard limit
- Soft-linear limit
- Soft-quadratic limit

A *Soft Limit Penalty* cell becomes active and the default value may be modified if either the *Soft-linear* or *Soft-quadratic limit* type is selected in the *Limit Type* cell. Otherwise, this cell is locked.

If a branch is removed from the power flow network, the corresponding Branch Flow Constraint record is also removed.

19.2.8. Branch Flow / Subsystem Spreadsheet



	Add/modify for selected buses	Flow Id	Flow Limit Normal, Max	Flow Limit Normal, Min	Initialize Rate Limits	Flow Limit Emerg., Max	Flow Limit Emerg., Min	Flow Type	Limit Type	Soft Limit Penalty
	Modify only				None			No change	No change	0.00
*										

Branch Flow Subsystem Spreadsheet

The Branch Flow Constraint Subsystem spreadsheet is particularly helpful in modifying and/or introducing a large number of branch flow constraints that have the same values. It can also be used to delete a group of adjustable branch flow constraints.

Values entered in the input record apply to all Branch Flow records within a previously defined subsystem.

For all branches in the defined subsystem, new Branch Flow Constraint records will either be created or existing records modified with the values specified in the table. Cells left blank will indicate that no changes are to be made to present working case values of existing records, and that default values are to be used for new records.

To add or modify a group of Branch Flow records, click the *Add/modify for selected branches* cell and choose one of the following options:

Modify only	updates existing branch flow constraint records whose branch identifiers correspond to a branch within the selected subsystem and whose flow identifier corresponds to the one specified in the *Flow Id* cell. No new Branch Flow Constraint records are automatically added.
Add/Modify	(1) updates existing branch flow constraint records where the branch identifiers correspond to a branch within the selected subsystem and the flow identifier corresponds to the one specified in the *Flow Id* cell (2) if a Branch Flow Constraint record does not already exist with the branch and flow identifiers specified, a new Branch Flow Constraint record will be added
	For example, if 2 is entered in the *Flow Id* cell, then all branch flow constraints whose corresponding branches reside within the specified subsystem and have a flow identifier of 2 will be updated to reflect the new values specified. Branches within the subsystem that do not currently have a corresponding branch flow constraint record

	with a flow identifier of 2 will have a new branch flow constraint automatically introduced into the working case.

Values for *Normal* or *Emergency Flow Limits* may be entered directly into the spreadsheet cells.

The *Flow Limits* cells support use of the summation (+) and multiplication (*) operator functions. These operators may be used to automatically adjust the values for all branch flow constraints within the selected subsystem by either a constant or a scale factor.

The *Initialize Rate Limits* cell provides provides a menu from which one of four options may be selected:

None	has no impact on the values specified in the *Flow Limit Normal, Max* or *Flow Limit Normal, Min* cells
RateA, *RateB*, or *RateC*	places the positive magnitude of the specified branch flow rating in the *Flow Limit Normal, Max* cell, and the negative magnitude of the specified branch flow rating in the *Flow Limit Normal, Min* cell The branch flow ratings are obtained directly from the values stored in the working case.

The *Flow Type* cell provides provides a menu from which one of five options may be selected: MW, MVAR, MVA, ampere, or no change.

The *Limit Type* cell provides a menu from which one of the following options may be selected:

- No change
- Reporting
- Hard limit
- Soft-linear limit
- Soft-quadratic limit

A *Soft Limit Penalty* cell becomes active and the default value may be modified if either the *Soft-linear* or *Soft-quadratic limit* type is selected in the *Limit Type* cell. Otherwise, this cell is locked.

To delete a group of Branch Flow Constraint records, go to the *Flow Id* cell in the subsystem and do one of the following steps:

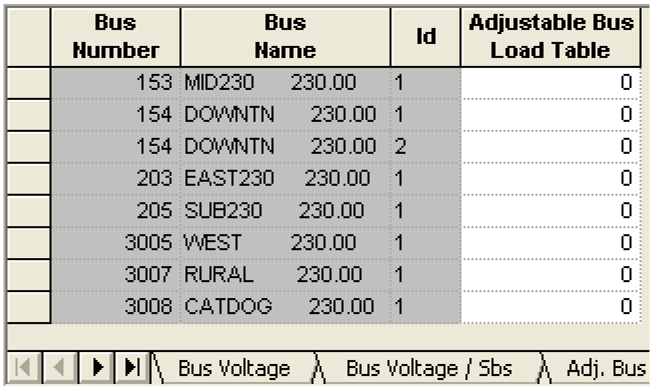
- enter a *Flow Id* value, if only Branch Flow Constraint records with the specified *Flow Id* are to be deleted

  OR

- leave the *Flow Id* value blank, if all Branch Flow Constraint records within the subsystem are to be deleted.

Highlight the row and press *[Delete]*. The setting of the *Add/modify for selected buses* cell is ignored; either option will allow successful deletion of the specified group of records.

19.2.9. Adjustable Bus Load Spreadsheet



Bus Number	Bus Name	Id	Adjustable Bus Load Table
153	MID230 230.00	1	0
154	DOWNTN 230.00	1	0
154	DOWNTN 230.00	2	0
203	EAST230 230.00	1	0
205	SUB230 230.00	1	0
3005	WEST 230.00	1	0
3007	RURAL 230.00	1	0
3008	CATDOG 230.00	1	0

Example of Adjustable Bus Load Spreadsheet

By default all bus loads in the working case are displayed in the Adjustable Bus Load spreadsheet. A reduced set of loads can be displayed by specifying a subsystem (see Section 2.3.2, “Creating a Bus Subsystem”). Adjustable Bus Load records that have not been previously modified will display a default value of zero in the *Adjustable Bus Load Table* cell.

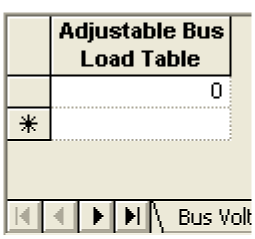
The *Bus Number*, *Bus Name* and *Id* cells are used for identification of the bus load and cannot be edited.

To modify a reference to an Adjustable Bus Load table, either enter the desired value directly into the *Adjustable Bus Load Table* cell, or double click in the cell and choose from a list of available adjustable bus load tables in the *[Adjustable Bus Load Table Selection]* dialog. If an invalid table number is entered, a warning is displayed and the original value is replaced in the cell.

To delete a reference to an Adjustable Bus Load table, either reset the value in the cell to zero or highlight the row and press *[Delete]*.

If a bus load is removed from the power flow network, the corresponding Adjustable Bus Load record will also be removed.

19.2.10. Adjustable Bus Load / Subsystem Spreadsheet



Adjustable Bus Load Table
0

Adjustable Bus Load Subsystem Spreadsheet

Usage of the Adjustable Bus Load Subsystem spreadsheet is particularly helpful in specifying that multiple loads should all point to the same Adjustable Bus Load Table.

Values entered in the input record are applied to all Adjustable Bus Loads within a previously defined subsystem.

To modify a reference to an Adjustable Bus Load table, either enter the desired value directly into the *Adjustable Bus Load Table* cell, or double click in the cell and choose from a list of available adjustable bus load tables in the *[Adjustable Bus Load Table Selection]* dialog. If an invalid table number is entered, a warning is displayed and a zero is replaced in the cell.

To reset the Adjustable Bus Load table to zero for all OPF Bus Loads in the specified subsystem, either reset the value in the cell to zero or highlight the row and press *[Delete]*.

19.2.11. Adjustable Load Table Spreadsheet

	Table	Load Multiplier Initial	Max	Min	Cost Scale	In Service
	2	1.00	2.20	0.40	10.00	☑
	1	0.90	1.50	0.80	100.00	☑
	3	1.00	2.00	0.20	20.00	☑
*						☑

Bus Voltage / Sbs | Adj. Bus Shunt | Adj. Bus Shunt / Sbs | Adj. B

Example of Adjustable Load Table Spreadsheet

All Adjustable Load Tables within the working case are displayed. The subsystem filter has no affect on the editor. If there are no Adjustable Load Tables in the working case, the spreadsheet will be blank.

To add a new Adjustable Load Table record, enter the desired table number in the *Table* cell of the row containing the *. All other cells are populated with default data values.

Values for the three load multipliers (initial, maximum, and minimum) and *Cost Scale* may be entered directly into the spreadsheet cells.

If desired, uncheck the *In Service* toggle switch to set the Adjustable Load Table record to out-of-service.

To delete an Adjustable Load Table record, highlight the row and press *[Delete]*. If the Adjustable Load Table record is not being referenced by any Adjustable Bus Load records, then it is deleted. If it is still being referenced by an Adjustable Bus Load record, a message pops up and the record is preserved.

19.2.12. Generator Dispatch Spreadsheet

Bus Number	Bus Name	Id	Dispatch	Dispatch Table
101	NUC-A 21.600	1	0.00	0
102	NUC-B 21.600	1	0.00	0
206	URBGEN 18.000	1	1.00	2
211	HYDRO_G 20.000	1	1.00	4
3011	MINE_G 13.800	1	1.00	3
3018	CATDOG_G 13.80	1	1.00	1

Sbs | Adj. Bus Shunt | Adj. Bus Shunt / Sbs | Adj. Bu

Example of Generator Dispatch Spreadsheet

By default all machines in the working case are displayed in the Generator Dispatch spreadsheet. A reduced set of machines may be displayed by specifying a subsystem (see Section 2.3.2, "Creating a Bus Subsystem"). Generator Dispatch records that have not been previously modified will display default values of zero.

The *Bus Number*, *Bus Name* and *Id* cells are used for identification of the machine and cannot be edited.

To modify the *Dispatch* cell, enter the desired value in the cell.

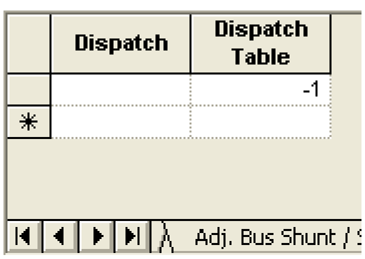
To modify a *Dispatch Table* number, either enter the desired value directly into the cell, or double click in the cell and choose from a list of available active power dispatch tables in the *[Active Dispatch Selection]* dialog. If an invalid table number is entered, a warning is displayed and the original value is replaced in the cell.

A valid Adjustable Dispatch Table record must exist before it can be referenced by a Generator Dispatch record.

To remove a reference to a Dispatch table and reset the *Dispatch Table* value to zero, either enter a zero in the cell or highlight the row and press *[Delete]*.

If a machine is removed from the load flow network, the corresponding Generator Dispatch record will also be removed.

19.2.13. Generator Dispatch / Subsystem Spreadsheet



Generator Dispatch Subsystem Spreadsheet

The Generator Dispatch Subsystem spreadsheet is used to define the same *Dispatch* value and/or *Dispatch Table* number for all machines within a specified subsystem.

To modify a group of Generation Dispatch records, define a subsystem and enter values in the first row of the spreadsheet.

Value for *Dispatch* may be entered directly into the spreadsheet cell. This cell supports use of the summation (+) and multiplication (*) operator functions. These operators may be used to automatically adjust the dispatch fraction at all generators within the specified subsystem by either a constant or a scale factor.

The modify the *Dispatch Table* number, either directly enter the table number in the cell provided or double click in the cell and choose from a list of available active power dispatch tables in the *[Active Dispatch Selection]* dialog. If an invalid table number is entered, a warning is displayed and the original value is replaced in the cell.

The *Dispatch Table* number -1 implies that current *Dispatch Table* values for all Generator Dispatch records in the selected subsystem should be preserved. This allows the Dispatch value to be modified independent of the Dispatch table.

To reset the values for all Generator Dispatch records in the selected subsystem, either enter a zero in the cell or highlight the row and press *[Delete]*.

19.2.14. Active Power Dispatch Table Spreadsheet

	Table	Generation Max (MW)	Generation Min (MW)	Fuel Cost Scale Coef.	Cost Curve Type	Cost Table	In Service
	1	130.00	10.00	1.00	Piece-wise linear	1	☑
	2	1000.00	100.00	1.00	Piece-wise quadratic	2	☑
	3	1000.00	100.00	1.00	Piece-wise quadratic	3	☑
	4	725.00	10.00	1.00	Piece-wise quadratic	4	☑
*					Polynomial & Exponential		☑

unt / Sbs | Adj. Branch Reac. | Adj. Branch Reac. / Sbs | Branch Flow | Branch Flow / Sbs

Example of Active Power Dispatch Table Spreadsheet

All Active Power Dispatch Tables within the working case are always shown in the editor. The subsystem filter has no effect on the list displayed. If no Active Power Dispatch Tables exist in the working case, the spreadsheet is blank.

To add a new Active Power Dispatch Table record, enter the desired table number in the *Table* cell of the row containing the *. All other cells are populated with default data values.

Values for *Generation Max, Generation Min*, and *Fuel Cost Scale Coefficient* may be entered directly into the spreadsheet cells.

The *Cost Curve Type* cell provides a provides a menu from which one of the following options may be selected:

- Polynomial & Exponential
- Piece-wise linear
- Piece-wise quadratic

To modify a *Cost Table* number, either enter the desired value directly into the cell, or double click in the cell and choose from a list of available piece-wise linear tables in the *[Cost Table Selection]* dialog. If an invalid table number is entered, a warning is displayed and the original value is replaced in the cell.

If desired, uncheck the *In Service* toggle switch to set the Active Power Dispatch Table record to out-of-service.

To delete an Active Power Dispatch Table record, highlight the row and press *[Delete]*. If the Active Power Dispatch Table record is not being referenced by any Generator Dispatch records, then it is deleted; otherwise a message is produced and the record is preserved.

19.2.15. Generation Reactive Capability Spreadsheet

Bus Number	Bus Name	Id	Xd (pu)	Stator Current Limit (pu)	Lagging Pwr Factor	Leading Pwr Factor	Max Qgen Absorption (pu)	Reactive Capability Limit
101	NUC-A 21.600	1	1.76	1.00	0.95	0.95	0.4540	Enabled
206	URBGEN 18.000	1	1.76	1.00	0.95	0.90	0.4550	Enabled
211	HYDRO_G 20.000	1	1.76	1.00	0.95	0.95	0.4550	Enabled
3011	MINE_G 13.800	1	1.47	1.00	0.90	0.85	0.5440	Enabled
3018	CATDOG_G 13.80	1	1.76	1.00	0.95	0.90	0.4540	Fixed Efd

Load / Sbs | Adj. Load Table | Gen. Dispatch | Gen. Dispatch / Sbs | Disp. Table | **Gen. Reac. Cap.** | Gen. Reac. Cap. / S

Example of Generation Reactive Capability Spreadsheet

Only those machines that have Generation Reactive Capability data records defined in the working case are displayed in the spreadsheet. The list of records can be further reduced by specifying a subsystem (see Section 2.3.2, “Creating a Bus Subsystem”).

To add a Generation Reactive Capability record, either enter a valid *Bus Number* and machine *Id* in the cells provided or double click in the blank Bus Number cell and choose from a list of available machines in the *[Machine Selection]* dialog (Figure 20.11, “Machine Selection Dialog”). All other cells are populated with default data values.

Values for *Xd*, *Stator Current Limit*, *Lagging Power Factor*, *Leading Power Factor*, and *Maximum Qgen Absorption* may be entered directly into the spreadsheet cells.

The *Reactive Capability Limit* cell provides a provides a menu from which one of the following status options may be selected:

- Out-of-service
- Enables
- + Delta Efd inhibit
- - Delta Efd inhibit
- Fixed Efd

To delete an Generation Reactive Capability record, highlight the row and press *[Delete]*.

If a machine is removed from the power flow network, the corresponding Generation Reactive Capability record will also be removed.

19.2.16. Generation Reactive Capability / Subsystem Spreadsheet

	Xd (pu)	Stator Current Limit (pu)	Lagging Pwr Factor	Leading Pwr Factor	Max Qgen Absorption (pu)	Reactive Capability Limit
						No change
*						

th Reac. / Sbs | Branch Flow | Branch Flow / Sbs | Adj. Bus Load | Adj. Bus Load / Sb

Generation Reactive Capability Subsystem Spreadsheet

To modify a group of Generation Reactive Capability records within a subsystem, define a subsystem and enter values in the first row of the spreadsheet.

Values for *Xd*, *Stator Current Limit*, *Lagging Power Factor*, *Leading Power Factor*, and *Maximum Qgen Absorption* may be entered directly into the spreadsheet cells. The values entered into the record are subsequently applied to all machines within the specified subsystem. Cells left blank, or set to *No change*, indicate that no changes are to be made to the present working case values.

The data input cells support use of the summation (+) and multiplication (*) operator functions. These operators may be used to automatically adjust the working case values of each Generation Reactive Capability record within the specified subsystem by either a constant or a scale factor.

The *Reactive Capability Limit* cell provides a provides a menu from which one of the following status options may be selected:

- No change
- Out-of-service
- Enables
- + Delta Efd inhibit
- - Delta Efd inhibit
- Fixed Efd

To delete a group of Generation Reactive Capability records, define a subsystem, highlight the first row, and press *[Delete]*.

19.2.17. Generation Reserve Spreadsheet

	Bus Number	Bus Name	Id	Unit Ramp Rate (MW/Minute)	Unit Capability (MW)
	206	URBGEN 18.000	1	10.00	1100.00
	211	HYDRO_G 20.000	1	100.00	725.00
*					

Branch Flow | Branch Flow / Sbs | Adj. Bus Load | Adj. Bus

Example of Generation Reserve Spreadsheet

Only those machines that have Generation Reserve data records defined are displayed in the editor. The list of records shown can be further reduced by specifying a subsystem (see Section 2.3.2, “Creating a Bus Subsystem”).

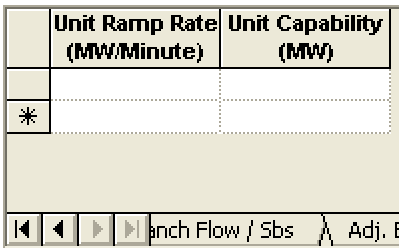
To add a Generation Reserve record, either enter a valid *Bus Number* and machine *Id* in the cells provided or double click in the blank Bus Number cell and choose from a list of available machines in the *[Machine Selection]* dialog (Figure 20.11, “Machine Selection Dialog”). All other cells are populated with default data values.

Values for *Unit Ramp Rate* and *Unit Capability* may be entered directly into the spreadsheet cells.

To delete an Generation Reserve record, highlight the row and press *[Delete]*.

If a machine is removed from the power flow network, the corresponding Generation Reserve record is also removed.

19.2.18. Generation Reserve / Subsystem Spreadsheet



Generation Reserve Subsystem Spreadsheet

To modify a group of Generation Reserve records, define a subsystem and enter values in the first row of the spreadsheet.

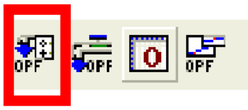
Values for *Unit Ramp Rate* and *Unit Capability* may be entered directly into the spreadsheet cells. The values entered into the record are subsequently applied to all buses within the specified subsystem. Cells left blank indicate that no changes are to be made to the present working case values and that default values are to be applied to new records.

The *Unit Ramp Rate* and *Unit Capability* cells support use of the summation (+) and multiplication (*) operator functions. These operators may be used to automatically adjust the working case values for each Generation Reserve record within the specified subsystem by either a constant or a scale factor.

To delete a group of Generation Reserve records, define a subsystem, highlight the first row, and press *[Delete]*.

19.3. OPF Parameters

Requirements / Prerequisites
Validly specified power flow case.



OPF > Parameters...

The *[OPF - Change Parameters]* dialog provides a number of checkboxes to enable specific functions and filters to establish specified tolerances and controls. These are grouped by function on dialog tabs.

The user may restore default values using one of the following options:

- Restore system default settings
- Restore working case settings

Changes may be saved to the PSSOPF.OPT file.

19.3.1. General

The *[OPF - Change Parameters]* General tab (Figure 19.3, “OPF - Change Parameters Dialog, General”) provides checkboxes to enable various functions. If the parameters are to be saved to the options file, select the save settings to PSSOPF.OPT file checkbox. Click *[OK]* to employ the new parameters when analyzing the working case.

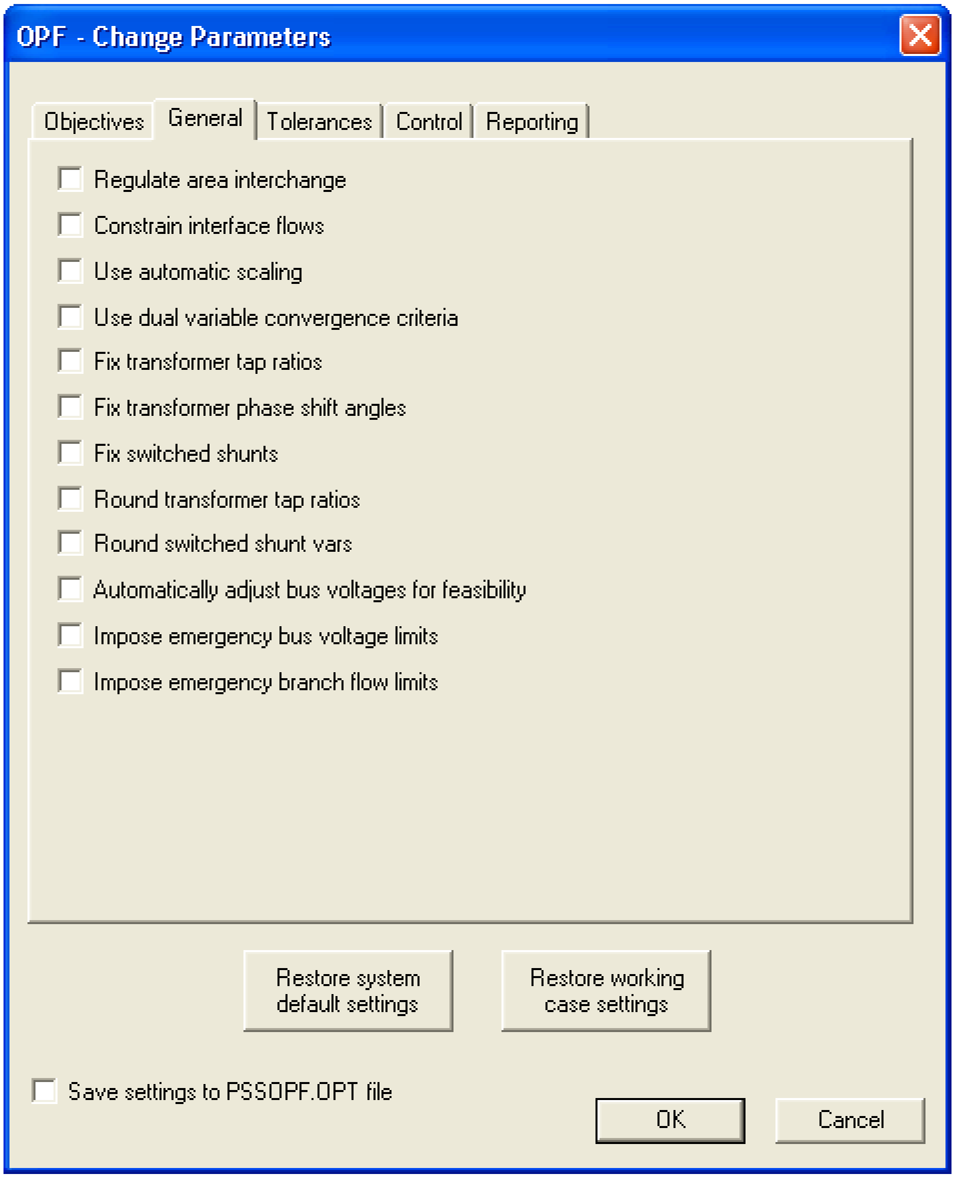


Figure 19.3. OPF - Change Parameters Dialog, General

Additional Information
PSS®E Program Operation Manual, Optimal Power Flow, General Options

19.3.2. Objectives

The *[OPF - Change Parameters]* Objectives tab provides checkboxes to enable various functions. Some of them permit changes to cut-off values (defaults are shown in Figure 19.4, "OPF - Change Parameters Dialog, Objectives"). If the parameters are to be saved to the options file, select the save settings to PSSOPF.OPT file checkbox. Click *[OK]* to employ the new parameters when analyzing the working case.

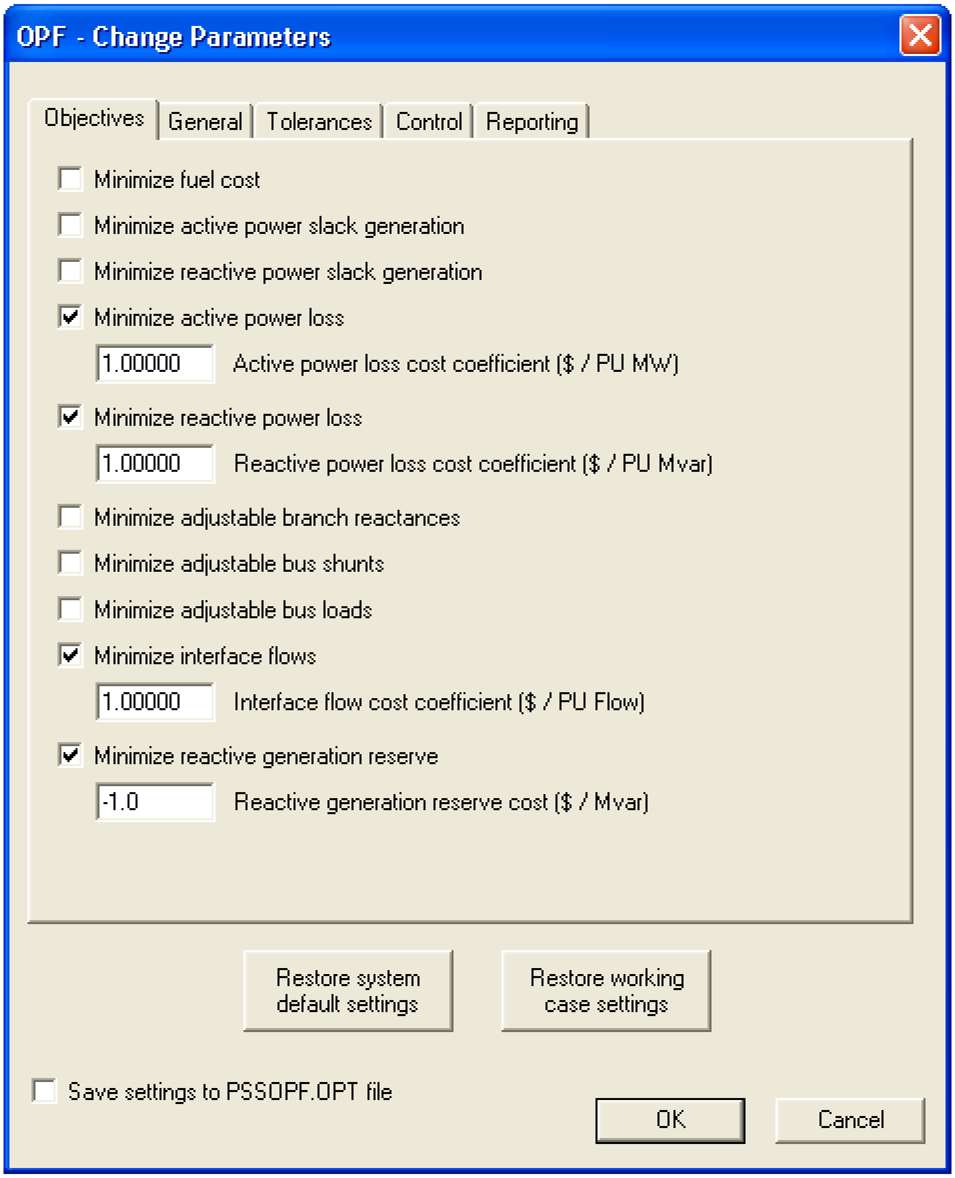


Figure 19.4. OPF - Change Parameters Dialog, Objectives

Additional Information
PSS®E Program Operation Manual, Optimal Power Flow, Objectives

19.3.3. Tolerances

The *[OPF - Change Parameters]* Tolerances tab provides cut-off values for various values (defaults are shown in Figure 19.5, "OPF - Change Parameters Dialog, Tolerances") that may be changed. If the parameters are to be saved to the options file, select the save settings to PSSOPF.OPT file checkbox. Click *[OK]* to employ the new parameters when analyzing the working case.

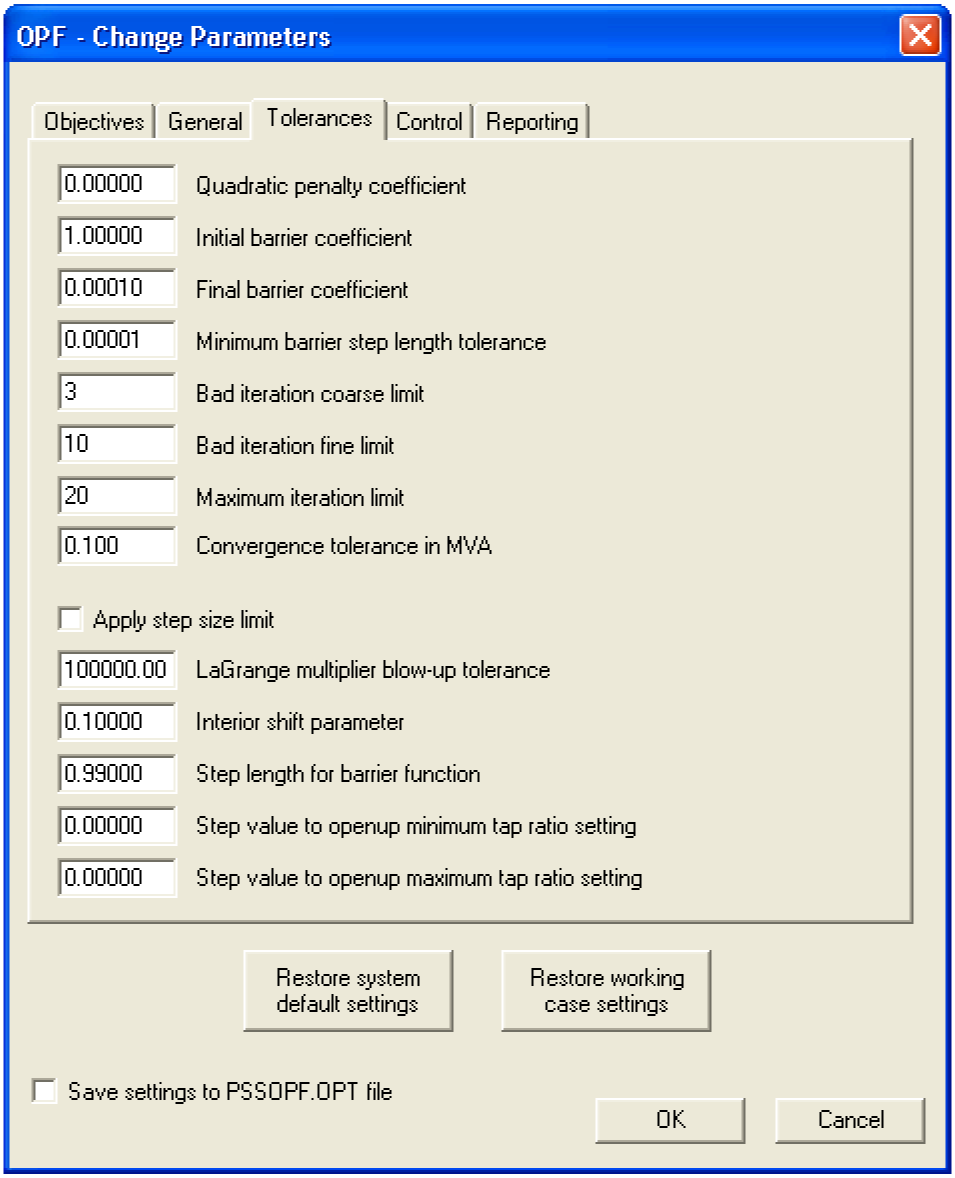


Figure 19.5. OPF - Change Parameters Dialog, Tolerances

Additional Information
PSS®E Program Operation Manual, *Optimal Power Flow*, *Tolerance Options*

19.3.4. Control

The *[OPF - Change Parameters]* Control tab provides checkboxes to enable various functions. Some of them permit changes to cut-off values (defaults are shown in Figure 19.6, "OPF - Change Parameters Dialog, Control"). If the parameters are to be saved to the options file, select the save settings to PSSOPF.OPT file checkbox. Click *[OK]* to employ the new parameters when analyzing the working case.

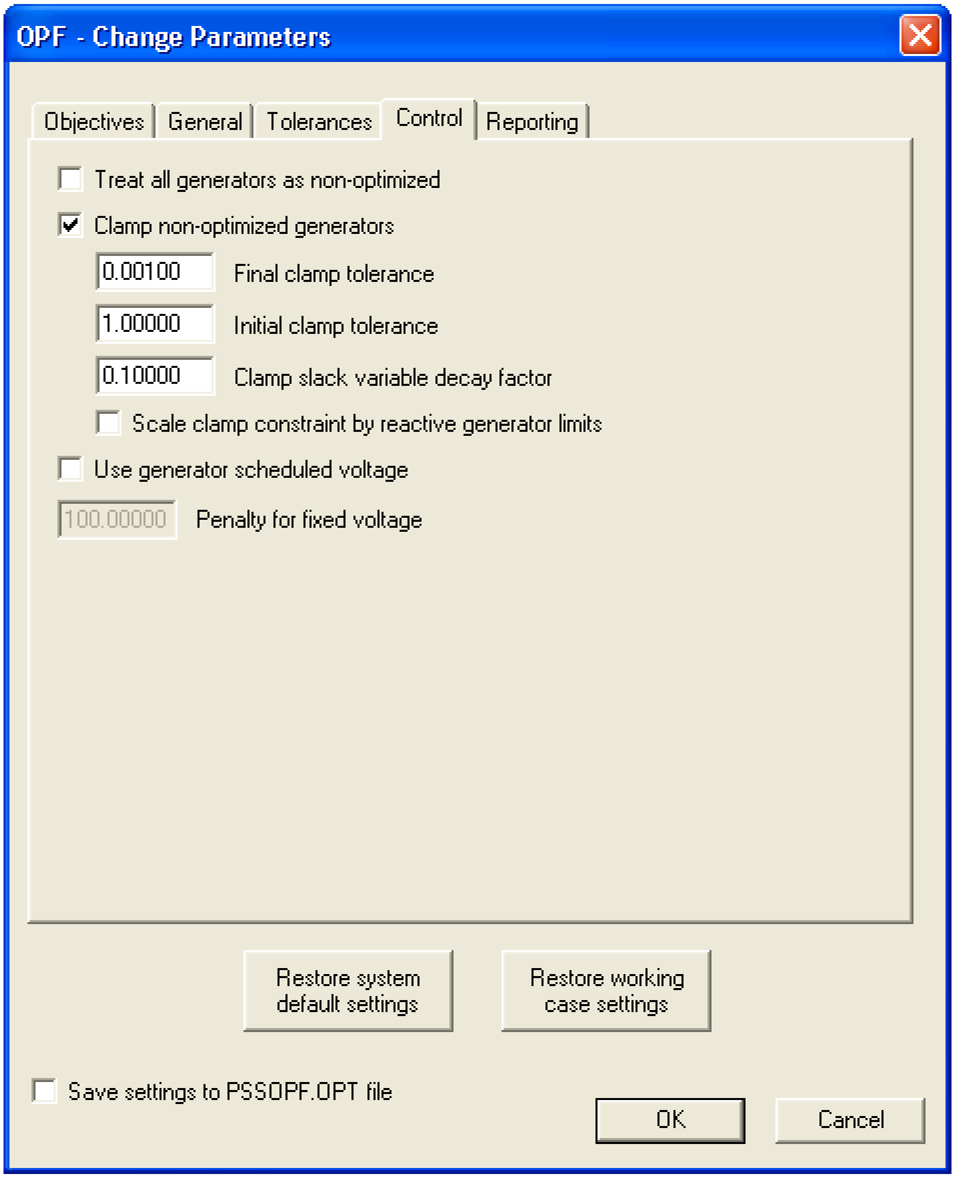


Figure 19.6. OPF - Change Parameters Dialog, Control

Additional Information
PSS®E Program Operation Manual, *Optimal Power Flow*, *Control Options*

19.3.5. Reporting

The *[OPF - Change Parameters]* Reporting tab (Figure 19.7, "OPF - Change Parameters Dialog, Reporting") provides checkboxes to enable various functions. Click *[...]* to open the selection window to save optimization data in a *Log file* (*.log), which can be a new file or a previously-built file to be over-written. The report may be specified by bus subsystem. If the parameters are to be saved to the options file, select the save settings to PSSOPF.OPT file checkbox. Click *[OK]* to employ the new parameters when analyzing the working case.

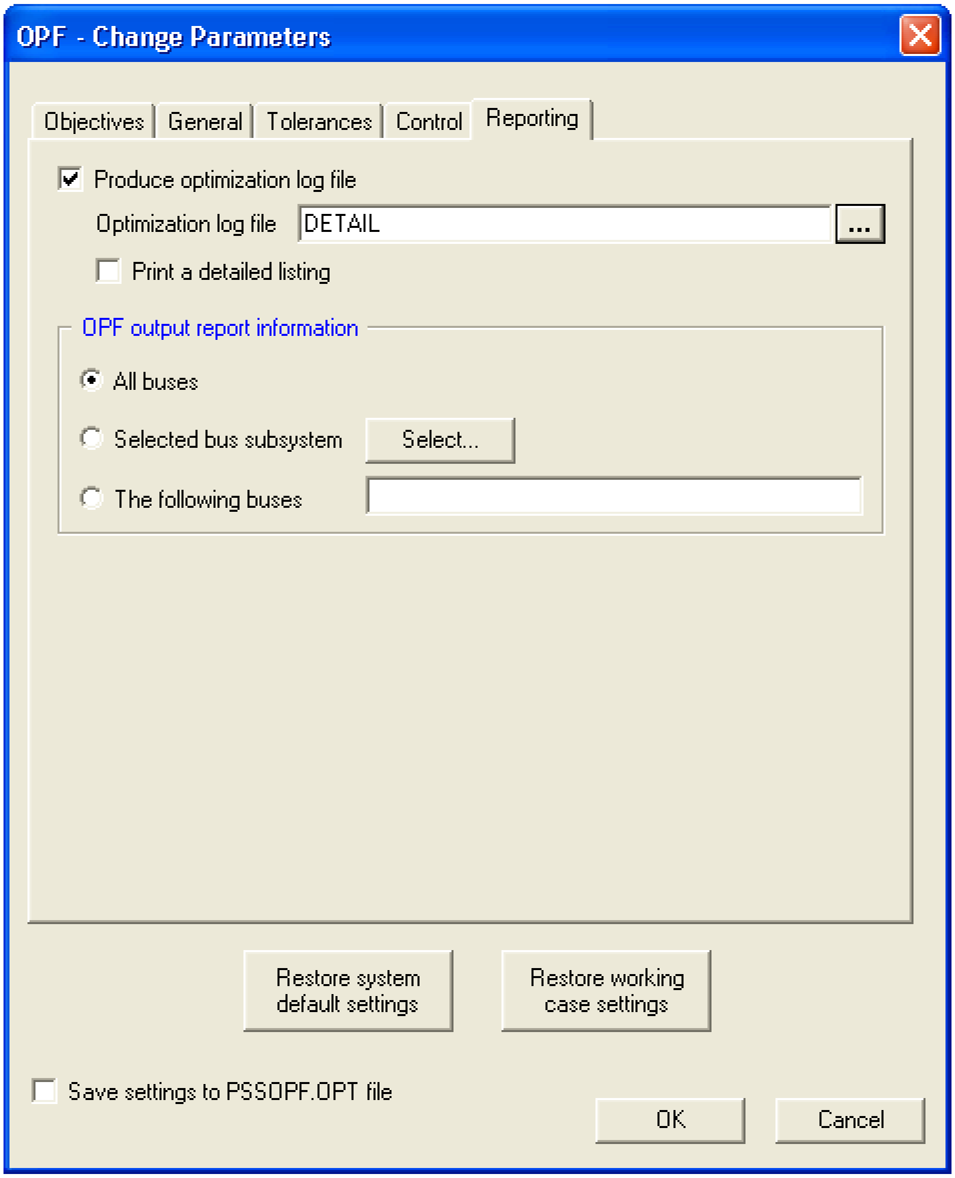
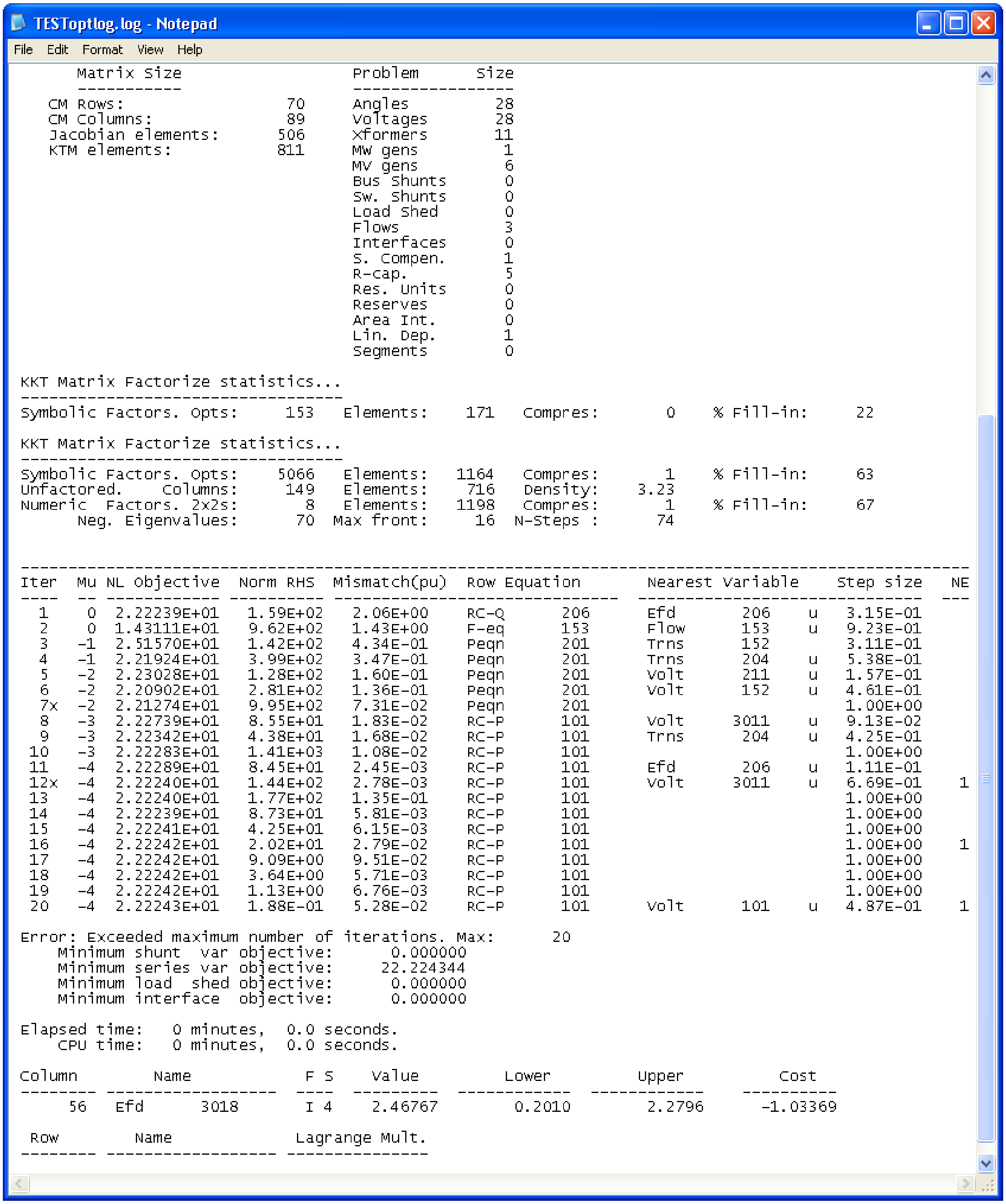


Figure 19.7. OPF - Change Parameters Dialog, Reporting

The Optimization Log is a text file that can be read in any text editor. It can be specified in standard (Figure 19.8, "Example of Optimization Log") or detailed (Figure 19.9, "Example of Detailed Optimization Log (Partial)") format.



TESToptlog.log - Notepad

File Edit Format View Help

```
     Matrix Size                  Problem      Size
     -----------                  ----------------
  CM Rows:                 70     Angles          28
  CM Columns:              89     Voltages        28
  Jacobian elements:      506     Xformers        11
  KTM elements:           811     Mw gens          1
                                  MV gens          6
                                  Bus Shunts       0
                                  Sw. Shunts       0
                                  Load Shed        0
                                  Flows            3
                                  Interfaces       0
                                  S. Compen.       1
                                  R-cap.           5
                                  Res. Units       0
                                  Reserves         0
                                  Area Int.        0
                                  Lin. Dep.        1
                                  Segments         0

KKT Matrix Factorize statistics...
----------------------------------
Symbolic Factors. Opts:     153   Elements:    171   Compres:      0   % Fill-in:    22

KKT Matrix Factorize statistics...
----------------------------------
Symbolic Factors. Opts:    5066   Elements:   1164   Compres:      1   % Fill-in:    63
Unfactored.     Columns:    149   Elements:    716   Density:   3.23
Numeric   Factors. 2x2s:      8   Elements:   1198   Compres:      1   % Fill-in:    67
      Neg. Eigenvalues:      70  Max front:     16  N-Steps :     74


----------------------------------------------------------------------------------------------------
Iter  Mu NL Objective   Norm RHS  Mismatch(pu)  Row Equation        Nearest Variable    Step size  NE
----  -- ------------  ---------  ------------  ----------------  -------------------  ---------  ---
  1    0  2.22239E+01   1.59E+02   2.06E+00     RC-Q       206      Efd      206    u  3.15E-01
  2    0  1.43111E+01   9.62E+02   1.43E+00     F-eq       153      Flow     153    u  9.23E-01
  3   -1  2.51570E+01   1.42E+02   4.34E-01     Peqn       201      Trns     152       3.11E-01
  4   -1  2.21924E+01   3.99E+02   3.47E-01     Peqn       201      Trns     204    u  5.38E-01
  5   -2  2.23028E+01   1.28E+02   1.60E-01     Peqn       201      Volt     211    u  1.57E-01
  6   -2  2.20902E+01   2.81E+02   1.36E-01     Peqn       201      Volt     152    u  4.61E-01
  7x  -2  2.21274E+01   9.95E+02   7.31E-02     Peqn       201                         1.00E+00
  8   -3  2.22739E+01   8.55E+01   1.83E-02     RC-P       101      Volt    3011    u  9.13E-02
  9   -3  2.22342E+01   4.38E+01   1.68E-02     RC-P       101      Trns     204    u  4.25E-01
 10   -3  2.22283E+01   1.41E+03   1.08E-02     RC-P       101                         1.00E+00
 11   -4  2.22289E+01   8.45E+01   2.45E-03     RC-P       101      Efd      206    u  1.11E-01
 12x  -4  2.22240E+01   1.44E+02   2.78E-03     RC-P       101      Volt    3011    u  6.69E-01   1
 13   -4  2.22240E+01   1.77E+02   1.35E-01     RC-P       101                         1.00E+00
 14   -4  2.22239E+01   8.73E+01   5.81E-03     RC-P       101                         1.00E+00
 15   -4  2.22241E+01   4.25E+01   6.15E-03     RC-P       101                         1.00E+00
 16   -4  2.22242E+01   2.02E+01   2.79E-02     RC-P       101                         1.00E+00   1
 17   -4  2.22242E+01   9.09E+00   9.51E-02     RC-P       101                         1.00E+00
 18   -4  2.22242E+01   3.64E+00   5.71E-03     RC-P       101                         1.00E+00
 19   -4  2.22242E+01   1.13E+00   6.76E-03     RC-P       101                         1.00E+00
 20   -4  2.22243E+01   1.88E-01   5.28E-02     RC-P       101      Volt     101    u  4.87E-01   1

Error: Exceeded maximum number of iterations. Max:      20
    Minimum shunt  var objective:        0.000000
    Minimum series var objective:       22.224344
    Minimum load   shed objective:       0.000000
    Minimum interface  objective:        0.000000

Elapsed time:   0 minutes,   0.0 seconds.
    CPU time:   0 minutes,   0.0 seconds.

Column         Name              F S    Value        Lower         Upper         Cost
--------  ------------------    ----  ---------  ------------  ------------  ------------
     56    Efd       3018        I 4   2.46767       0.2010        2.2796      -1.03369

 Row          Name              Lagrange Mult.
--------  ------------------  ---------------
```

Figure 19.8. Example of Optimization Log

TESToptlog.log - Notepad

File Edit Format View Help

```
        Matrix Size                        Problem       Size
        -----------                        ----------------
     CM Rows:                   70         Angles          28
     CM Columns:                89         Voltages        28
     Jacobian elements:        506         Xformers        11
     KTM elements:             811         Mw gens          1
                                           MV gens          6
                                           Bus  Shunts      0
                                           Sw.  Shunts      0
                                           Load Shed        0
                                           Flows            3
                                           Interfaces       0
                                           S. Compen.       1
                                           R-cap.           5
                                           Res. Units       0
                                           Reserves         0
                                           Area Int.        0
                                           Lin. Dep.        1
                                           Segments         0

KKT Matrix Factorize statistics...
----------------------------------
Symbolic Factors. Opts:     153   Elements:    171   Compres:       0   % Fill-in:     22

KKT Matrix Factorize statistics...
----------------------------------
Symbolic Factors. Opts:    5066   Elements:   1164   Compres:       1   % Fill-in:     63
Unfactored.     Columns:    149   Elements:    716   Density:    3.23
Numeric   Factors. 2x2s:      8   Elements:   1198   Compres:       1   % Fill-in:     67
      Neg. Eigenvalues:      70  Max front:     16  N-Steps :      74


----------------------------------------------------------------------------------------------------
Iter   Mu  NL Objective   Norm RHS  Mismatch(pu)  Row Equation        Nearest Variable     Step size   NE
----   --  -----------   ---------  ------------ ------------------  ------------------  ---------  ---
  1     0  2.22239E+01   1.59E+02    2.06E+00    RC-Q       206      Flow      153    u  3.64E-01
  2     0  1.24426E+01   1.26E+02    1.37E+00    F-eq       153                          1.00E+00
  3    -1  2.66769E+01   1.23E+02    7.28E-01    Pegn       201      Trns      152       2.63E-01
  4    -1  2.35707E+01   4.58E+02    6.06E-01    Pegn       201      Trns      204    u  4.10E-01
  5    -1  2.30078E+01   1.28E+03    3.63E-01    Pegn       201                          1.00E+00
  6    -2  2.27445E+01   6.73E+01    3.88E-03    Pegn       201      Flow      153    u  9.74E-02
  7x   -2  2.24657E+01   6.87E+01    4.17E-03    Pegn       201      Volt      152    u  2.39E-01
  8    -2  2.23092E+01   4.77E+02    3.49E-03    Pegn       201                          1.00E+00
  9    -3  2.22604E+01   8.11E+01    2.26E-03    RC-Q      3011      Trns      204    u  1.20E-01
 10    -3  2.22352E+01   4.63E+02    1.99E-03    RC-Q      3011      Trns      152       8.19E-01
 11    -4  2.22265E+01   3.32E+02    3.68E-04    RC-Q      3011      Volt      152    u  1.13E-01
 12x   -4  2.22248E+01   3.43E+02    9.29E-04    RC-P       101      Volt      211    u  5.75E-01     1
 13    -4  2.22239E+01   9.46E+02    1.03E-01    RC-P       101                          1.00E+00
 14    -4  2.22238E+01   4.67E+02    6.84E-03    RC-P       101                          1.00E+00
 15    -4  2.22240E+01   2.27E+02    1.21E-02    RC-P       101      Volt      101    u  7.25E-01     1
 16    -4  2.22240E+01   1.27E+02    1.22E-01    RC-P       101                          1.00E+00
 17    -4  2.22238E+01   5.76E+01    1.43E-03    RC-Q       101                          1.00E+00
 18    -4  2.22239E+01   2.34E+01    5.62E-05    RC-P       101

Optimal Solution Found.
    Minimum shunt  var objective:       0.000000
    Minimum series var objective:      22.223916
    Minimum load  shed objective:       0.000000
    Minimum interface  objective:       0.000000

Elapsed time:   0 minutes,  0.0 seconds.
    CPU time:   0 minutes,  0.0 seconds.

Column          Name            F S      Value         Lower          Upper          Cost
--------  ------------------  ----  ---------  ------------  ------------     ----------
       1  Angl       101         3    0.25303       -6.2832        6.2832
       2  Angl       102         3    0.25749       -6.2832        6.2832
       3  Angl       151         3    0.15862       -6.2832        6.2832
       4  Angl       152         3   -0.02958       -6.2832        6.2832
```

Figure 19.9. Example of Detailed Optimization Log (Partial)

Additional Information
PSS®E Program Operation Manual, Optimal Power Flow, Reporting Options

19.4. Running the Optimal Power Flow Solution

NOPF

Requirements / Prerequisites
Validly specified power flow case with optimal power flow data appended to it. Reading Optimal Power Flow Data

OPF > Solve...

The *[OPF Solution]* dialog (Figure 19.10, "OPF Solution Dialog") provides access to *[OPF - Change Parameters]* and permits the report to be specified by bus subsystem. These options over-ride previously loaded settings from either the PSSOPF.OPT file or any changes made earlier in a work session using *[OPF - Change Parameters]*. Click *[Go]* to create the report. A summary of activity conditions is displayed in the *Progress* tab (Figure 19.11, "Example of OPF Conditions"). The report is displayed in the *Report* tab by default. The content and number of pages of the report are dependent upon the specified objectives and other options.

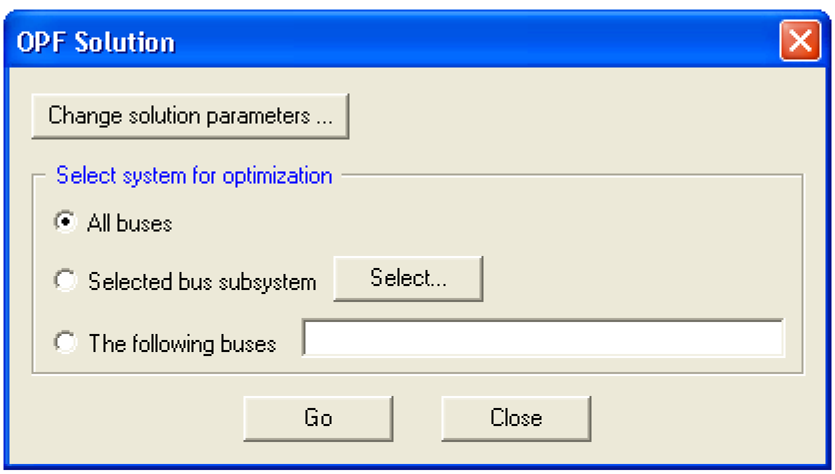
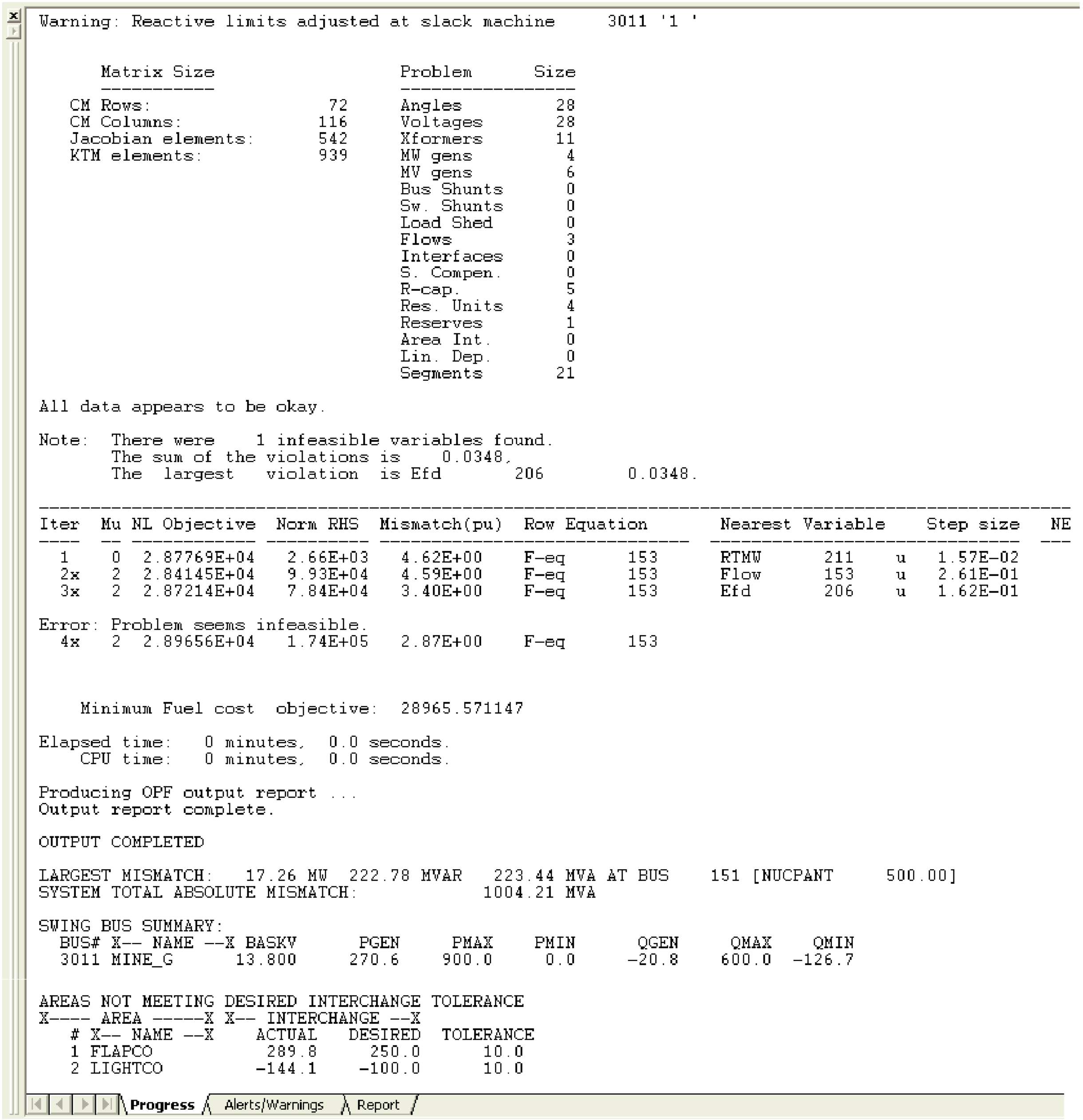


Figure 19.10. OPF Solution Dialog



```
Warning: Reactive limits adjusted at slack machine     3011 '1 '


      Matrix Size                        Problem       Size
      -----------                        ------------------
   CM Rows:                  72          Angles          28
   CM Columns:              116          Voltages        28
   Jacobian elements:       542          Xformers        11
   KTM elements:            939          MW gens          4
                                         MV gens          6
                                         Bus Shunts       0
                                         Sw. Shunts       0
                                         Load Shed        0
                                         Flows            3
                                         Interfaces       0
                                         S. Compen.       0
                                         R-cap.           5
                                         Res. Units       4
                                         Reserves         1
                                         Area Int.        0
                                         Lin. Dep.        0
                                         Segments        21

All data appears to be okay.

Note:  There were    1 infeasible variables found.
       The sum of the violations is     0.0348,
       The  largest   violation  is Efd        206         0.0348.

----------------------------------------------------------------------------------------------------
Iter  Mu NL Objective  Norm RHS  Mismatch(pu)  Row Equation        Nearest Variable    Step size  NE
----  -- ------------ ---------- ------------ ------------------  -------------------------------- ---
  1    0  2.87769E+04   2.66E+03   4.62E+00    F-eq       153       RTMW       211     u    1.57E-02
  2x   2  2.84145E+04   9.93E+04   4.59E+00    F-eq       153       Flow       153     u    2.61E-01
  3x   2  2.87214E+04   7.84E+04   3.40E+00    F-eq       153       Efd        206     u    1.62E-01

Error: Problem seems infeasible.
  4x   2  2.89656E+04   1.74E+05   2.87E+00    F-eq       153


    Minimum Fuel cost  objective:  28965.571147

Elapsed time:   0 minutes,  0.0 seconds.
    CPU time:   0 minutes,  0.0 seconds.

Producing OPF output report ...
Output report complete.

OUTPUT COMPLETED

LARGEST MISMATCH:   17.26 MW  222.78 MVAR   223.44 MVA AT BUS    151 [NUCPANT     500.00]
SYSTEM TOTAL ABSOLUTE MISMATCH:            1004.21 MVA

SWING BUS SUMMARY:
  BUS# X-- NAME --X BASKV      PGEN     PMAX     PMIN      QGEN      QMAX    QMIN
  3011 MINE_G       13.800     270.6    900.0     0.0     -20.8     600.0  -126.7

AREAS NOT MEETING DESIRED INTERCHANGE TOLERANCE
X---- AREA -----X X-- INTERCHANGE --X
   # X-- NAME --X     ACTUAL   DESIRED   TOLERANCE
   1 FLAPCO            289.8     250.0       10.0
   2 LIGHTCO          -144.1    -100.0       10.0
```

Progress | Alerts/Warnings | Report

Figure 19.11. Example of OPF Conditions

Additional Information
PSS® E Program Operation Manual, Optimal Power Flow

19.5. Displaying OPF Data

LSTO

Requirements / Prerequisites
Validly specified power flow case with optimal power flow data appended to it. Reading Optimal Power Flow Data

Power Flow > List Data...

The *[List Data]* dialog (Figure 8.1, "List Data Dialog") provides options for listing the following data types in either pu or kV *Output voltage*.

• Case summary	• Generation reactive capability
• All data	• Generation reserve
• Active power dispatch tables	• Interface flow constraint
• Adjustable bus loads	• Linear constraint
• Adjustable bus load tables	• Period reserve constraint
• Adjustable branch reactance	• Piece-wise linear cost table
• Branch flow constraint	• Piece-wise quadratic cost table
• Bus	• Polynomial and exponential cost table
• Bus shunt	• Two-terminal DC lines
• Generator dispatch	

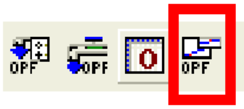
The report may be specified by bus subsystem. Click *[Go]* to create the report, which is displayed in the *Report* tab by default

You will need to click *[Close]* to end this activity.

Additional Information
PSS® E Program Operation Manual, *Listing Control and Constraint Data*

19.6. Data Tables

OPF > Data Tables...



The *[OPF Data Tables]* dialog holds tabs that display six different data records. Examples of the records are provided in the following sections:

- Linear Cost Tables: Section 19.6.1, "Linear Cost Tables "
- Quadratic Cost Tables: Section 19.6.2, "Quadratic Cost Tables "
- Polynomial and Exponential Cost Tables: Section 19.6.3, "Polynomial and Exponential Cost Tables "
- Period Reserve Constraints: Section 19.6.4, "Period Reserve Constraints "
- Interface Flow Constraints: Section 19.6.5, "Interface Flow Constraints "
- Linear Constraint Dependencies: Section 19.6.6, "Linear Constraint Dependencies "

Clicking *[OK]* dismisses *[OPF Data Tables]*.

19.6.1. Linear Cost Tables

If there are no piece-wise linear cost tables in the working case, the *Tables* window will be empty. To display a graphic of the data, highlight the desired table (see Figure 19.12, "Example of Piece-wise Linear Cost Table"). Highlighting an ordered pair changes the color of the data point display (to red in the example).

To create a new table, enter the next available *Number* and a descriptive *Label* (limit 12 characters, spaces allowed) in the fields and click *[Add]*. To define an ordered pair, highlight the table, enter the values in the *X coordinate* and *Y coordinate* fields, and click *[Add]*.

You may reset *Scales tuning* from *Automatic* to *Manual* to adjust the slope of the graphic display. Select *Manual*, double-click a data label on the axis to be changed, and adjust either the vertical (Figure 19.13, "Vertical Scale Dialog") or horizontal (Figure 19.14, "Horizontal Scale Dialog") axis. All piece-wise linear cost tables will then display the adjusted scale. To return to the default, select *Automatic* and click in the *Pairs* window.

To modify a coordinate, highlight the ordered pair, change the *X coordinate* or *Y coordinate* field, and click *[Modify]*.

To remove a table or an ordered pair, highlight it and click *[Delete]* on your keyboard.

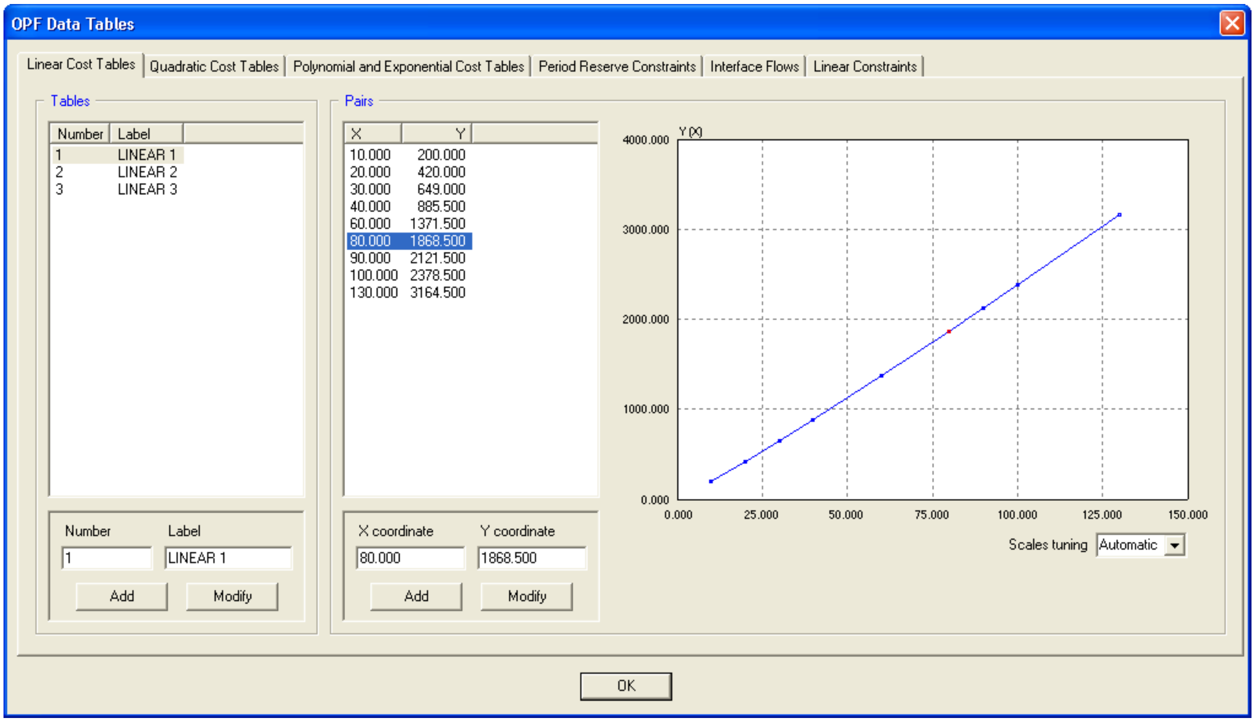


Figure 19.12. Example of Piece-wise Linear Cost Table

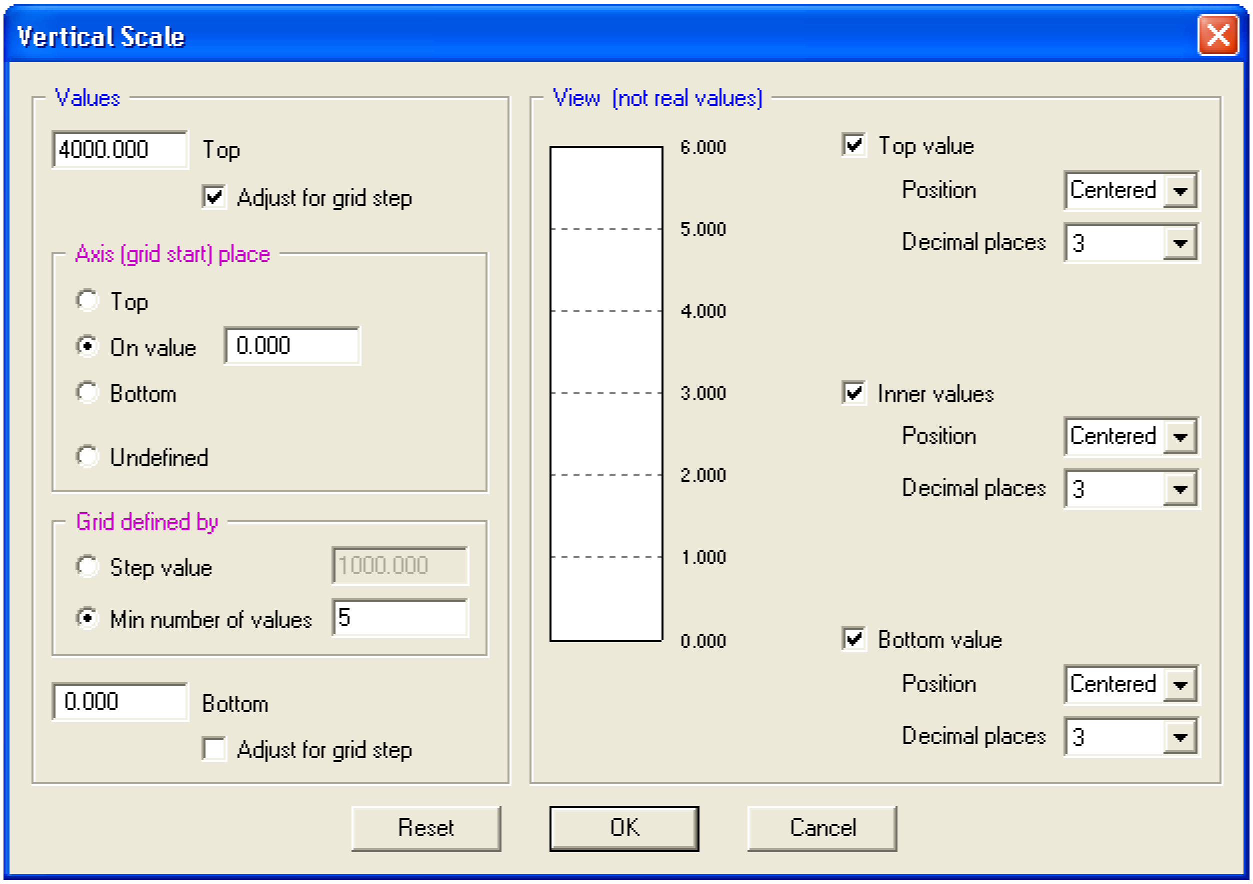


Figure 19.13. Vertical Scale Dialog

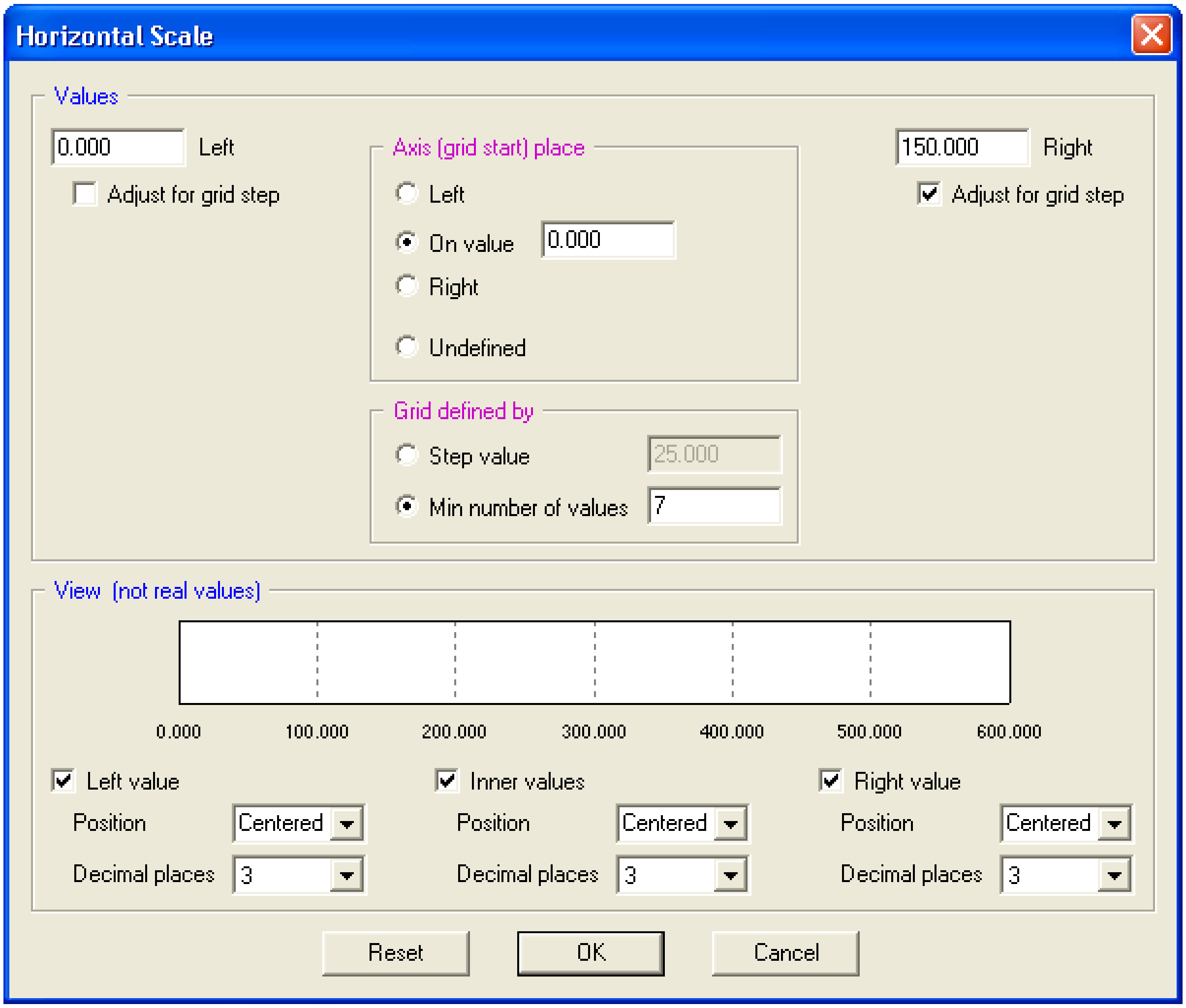


Figure 19.14. Horizontal Scale Dialog

19.6.2. Quadratic Cost Tables

If there are no piece-wise quadratic cost tables in the working case, the *Tables* window will be empty. To display a graphic of the data, highlight the desired table (see Figure 19.15, "Example of Piece-wise Quadratic Cost Table"). Highlighting an ordered pair changes the color of the data point display (to red in the example).

Creating and removing tables, defining and modifying ordered pairs, and adjusting the slope of the graphic display are performed as described in Section 19.6.1, "Linear Cost Tables ".

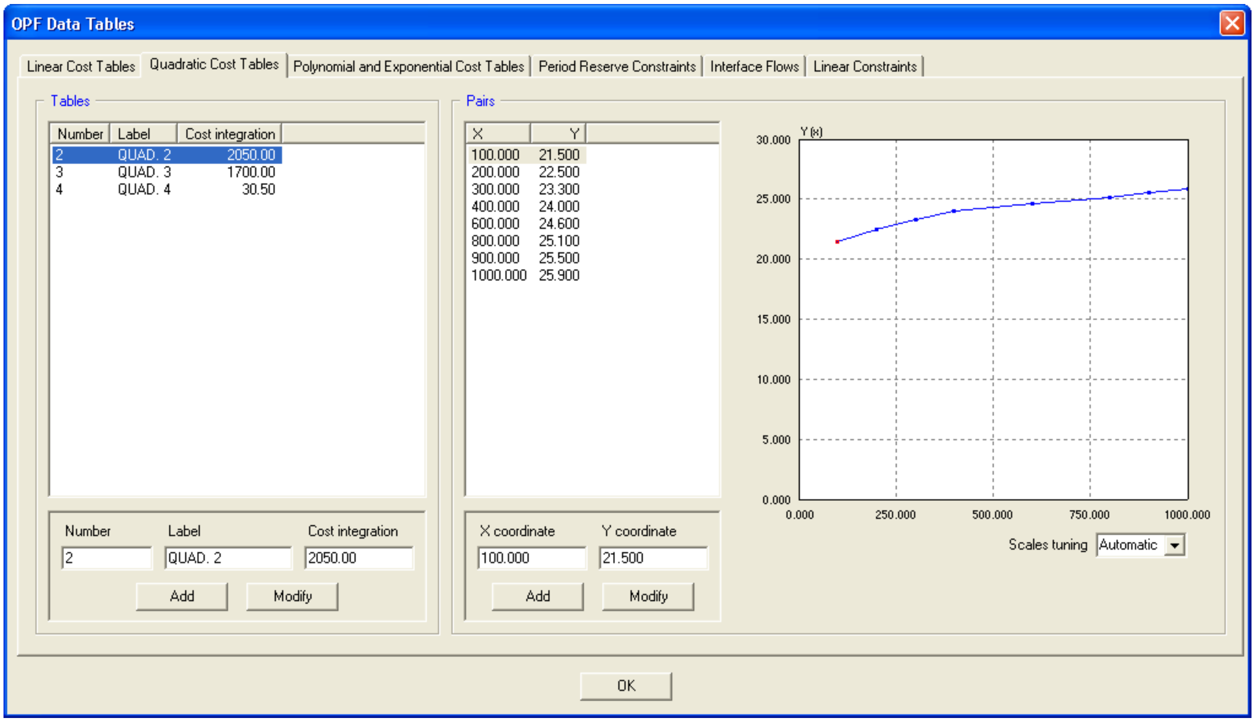


Figure 19.15. Example of Piece-wise Quadratic Cost Table

19.6.3. Polynomial and Exponential Cost Tables

This tab provides access to existing tables in spreadsheet format. To add a new table, enter a number in the first blank *Table number* cell. Clicking in a blank cell on the next line populates the new table with default data values (see Figure 19.16, “Default Polynomial and Exponential Cost Table Spreadsheet”), which may be modified. Enter a descriptive *Label* (limit 12 characters, spaces allowed). Clicking in a blank cell on the next line saves the table entries.

To remove a table, highlight the entire line and click *[Delete]* on your keyboard.

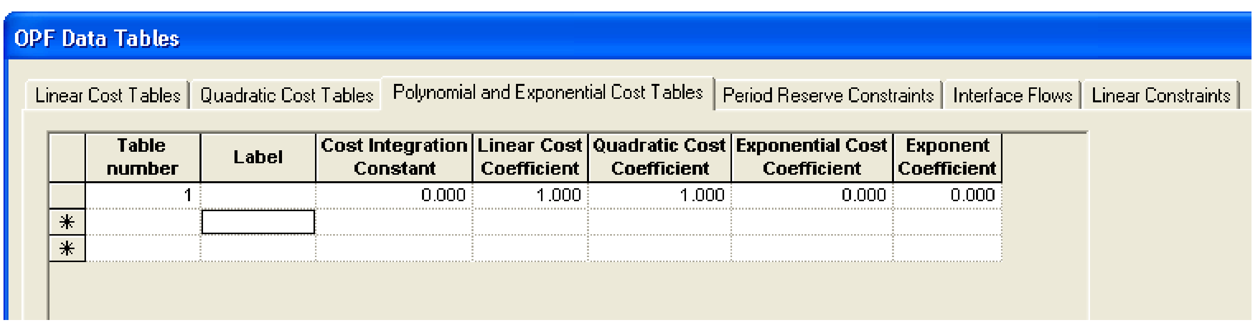


Figure 19.16. Default Polynomial and Exponential Cost Table Spreadsheet

19.6.4. Period Reserve Constraints

If there are no period reserve constraint records in the working case, the *Period Reserve Constraints* window will be empty. To display the *Participating Reserve Units*, highlight the desired record (see Figure 19.17, "Example of Period Reserve Constraints Record").

To create a new record, enter the next available *Number* (15 is the highest number accepted), specify values for *Reserve limit* and *Period* in their fields, and click *[Add]*. To modify an existing record, highlight it, change its values or *Status*, and click *[Modify]*.

To define another participating reserve unit, highlight the record, enter the *Bus number* and *Machine ID*, and click *[Add]*.

To remove a record or participating unit, highlight the item and click *[Delete]* on your keyboard.

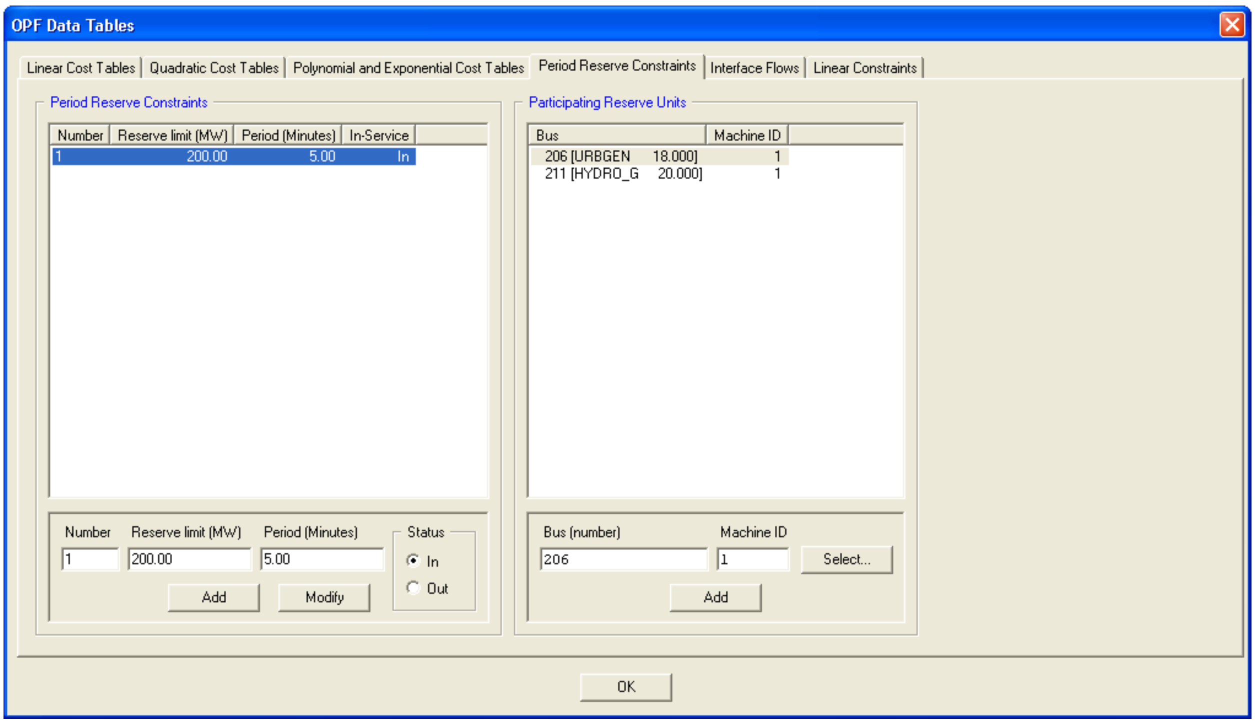


Figure 19.17. Example of Period Reserve Constraints Record

19.6.5. Interface Flow Constraints

If there are no interface flow constraint records in the working case, the *Interface Flows* window will be empty. To display the *Participating Branches*, highlight the desired record (see Figure 19.18, "Example of Interface Flow Constraints Record").

To create a new record, enter the next available *Number*, specify values for the appropriate fields, and click *[Add]*. To modify an existing record, highlight it, change its values, and click *[Modify]*.

To define another participating branch, highlight the record, enter the *Branch* or *3-Winding Transformer Type*, enter bus numbers and *Circuit ID*, and click *[Add]*.

To remove a record or participating branch, highlight the item and click *[Delete]* on your keyboard.

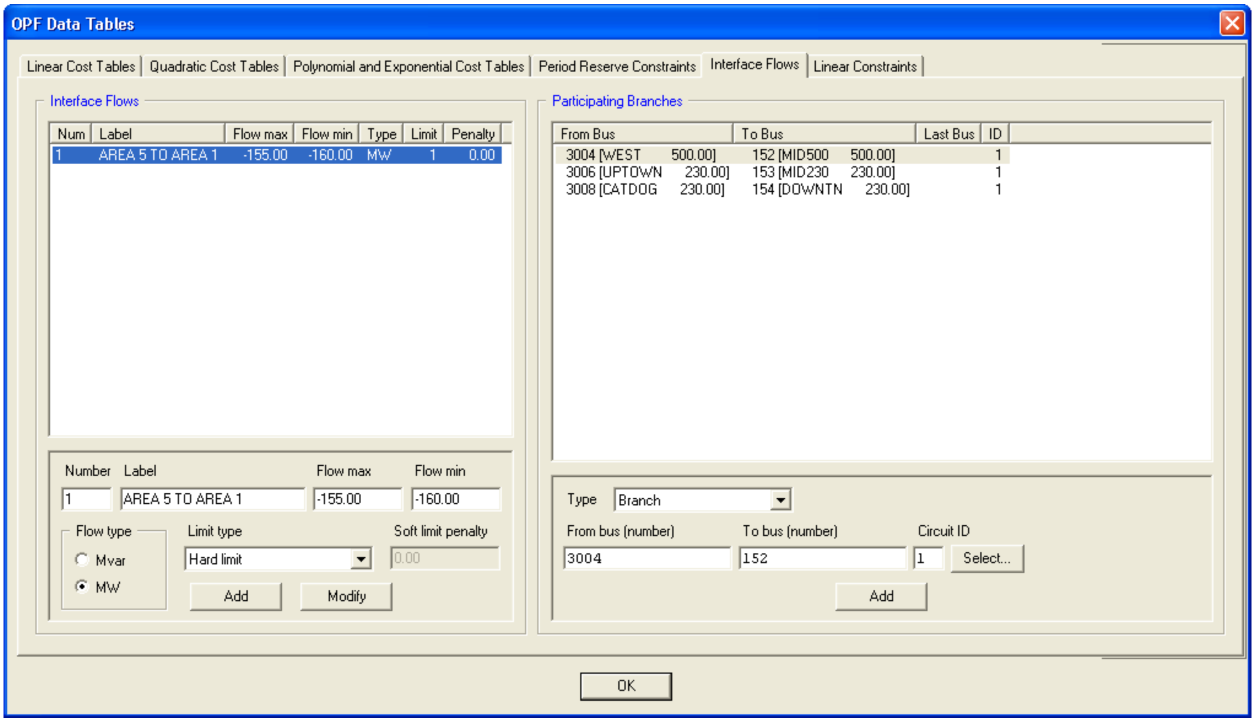


Figure 19.18. Example of Interface Flow Constraints Record

19.6.6. Linear Constraint Dependencies

The *[OPF Data Tables]* dialog allows the user to define linear constraint dependencies records by using the tabs for the following parameters:

• Voltage Magnitudes	• Branch Flow
• Voltage Angles	• Interface Flow
• Active Power Dispatch	• Adjustable Bus Shunts
• Reactive Generators	• Switched Shunts
• Transformers	• Load Adjustment

If there are no linear constraint records in the working case, the *Linear Constraints* window will be empty. To display the information contained in the record, highlight it (see Figure 19.19, "Example of Linear Constraint Dependencies Record").

To create a new record, enter the next available *Number*, specify values for the appropriate fields, and click *[Add]*. To modify an existing record, highlight it, change its values, and click *[Modify]*.

To define another parameters record, highlight the record, specify values for the appropriate fields, and click *[Add]*.

To remove a record or parameter record, highlight the item and click *[Delete]* on your keyboard.

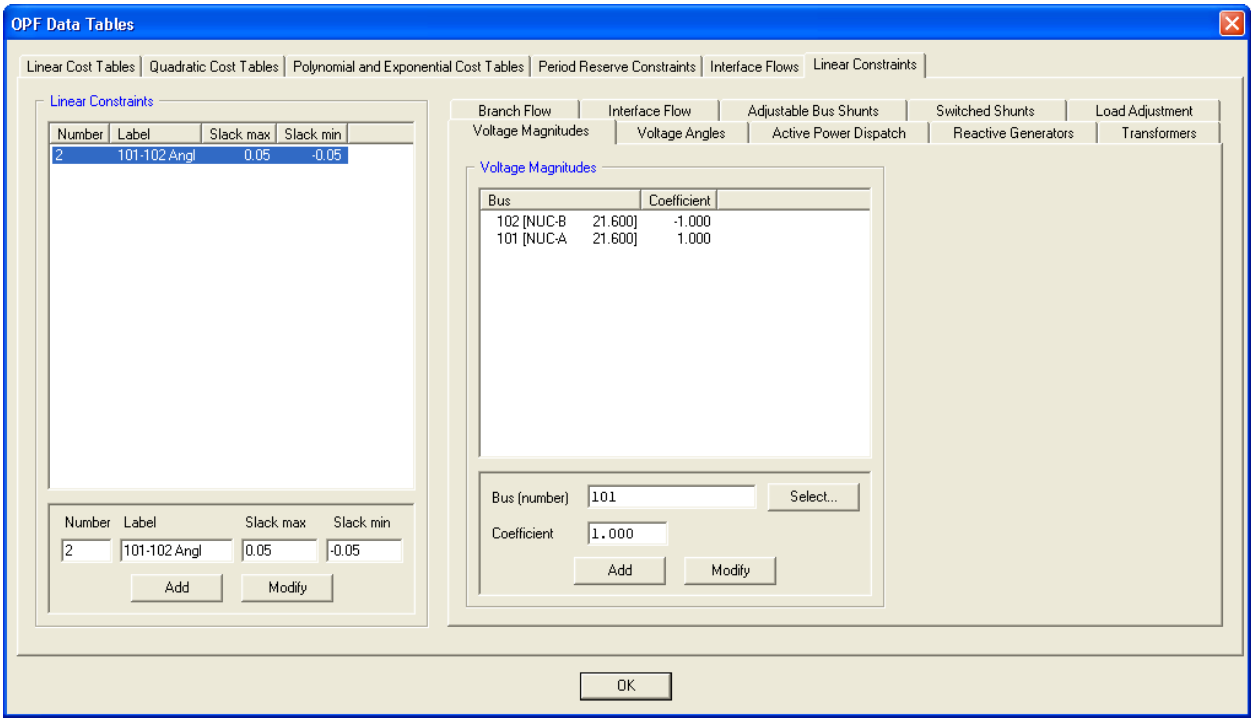
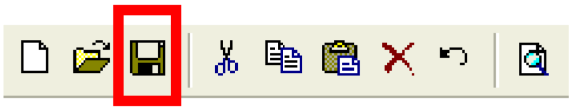


Figure 19.19. Example of Linear Constraint Dependencies Record

19.7. Creating an Optimal Power Flow Raw Data File

RWOP

Requirements / Prerequisites
Validly specified power flow case with optimal power flow data appended to it.



File > Save...

The *[Save Network Data]* dialog provides a tab (Figure 19.20, “Save Network Data Dialog, Optimal Power Flow Data”) that allows specification of the data content for an Optimal Power Flow Data file (*.rop).

Click *[...]* to open the selection window to specify the filename; this can be a new file or a previously-built file to be over-written. Click *[OK]* to save the file.

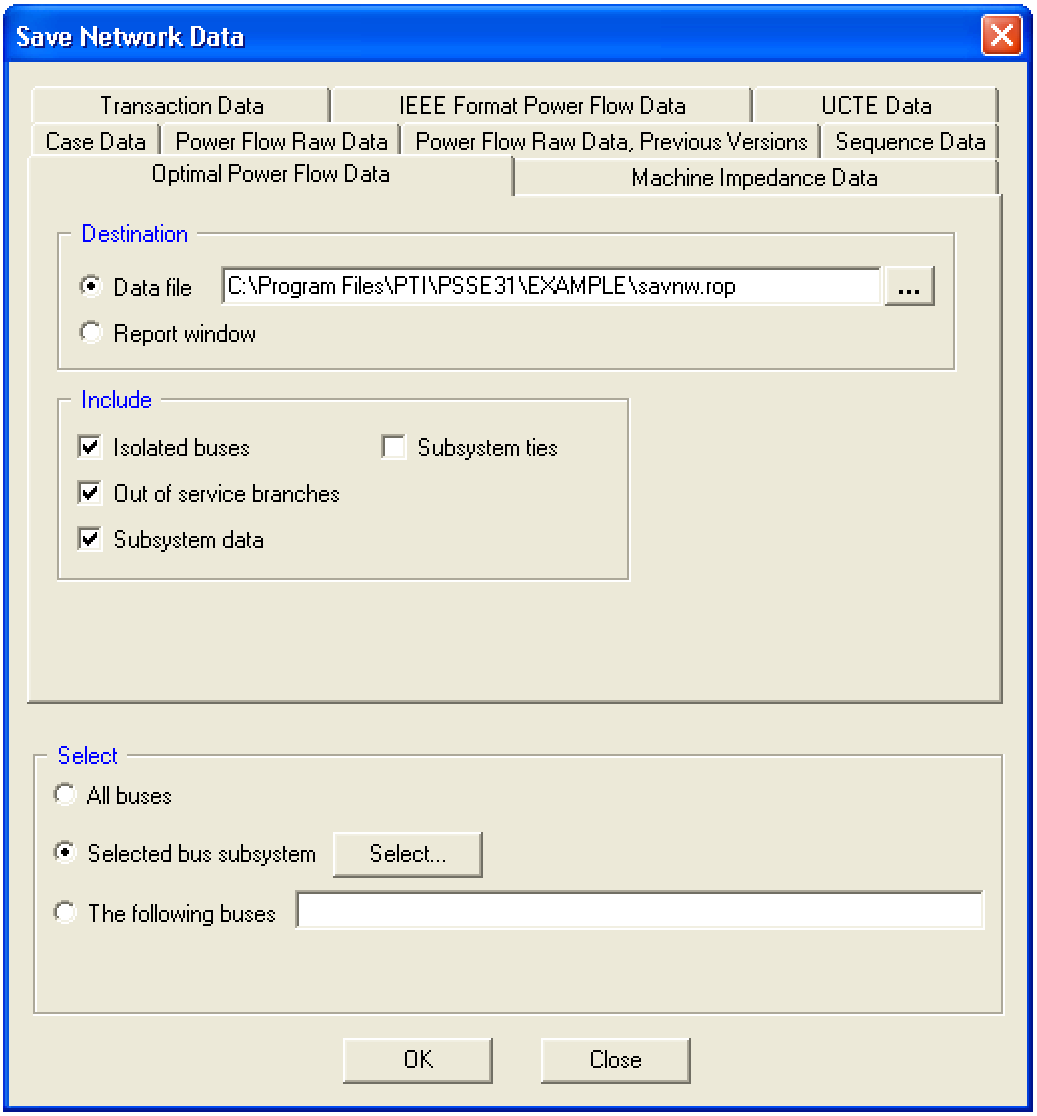


Figure 19.20. Save Network Data Dialog, Optimal Power Flow Data

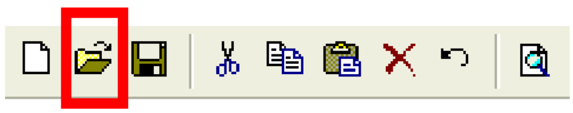
Additional Information
PSS® E Program Operation Manual, OPF Raw Data File Format

Chapter 20
Dynamic Simulation Data Entry and Modification

20.1. Reading Dynamics Model Data

DYRE

Requirements / Prerequisites
Validly specified power flow case, solved to an acceptable mismatch level.



File > Open...

Scroll *Files of Type:* to select *Dynamics Model Raw Data file (*.dyr)*. Highlight the desired file and click *[Open]*. The *[Read Raw Format Dynamics Data]* dialog (Figure 20.1, "Read Raw Format Dynamics Data Dialog") requires specification of CONEC/CONET FLECS files (*.flx) and a CONEC/CONET Compile file (*.bat) for some dynamics model applications. Provide these filenames as appropriate for your simulation.

Modified starting values for CONs, ICONs, STATEs and VARs may be specified.

Click *[OK]*. PSS®E reads the specified file and updates *[Dynamics Tree]* and *[Spreadsheet]* with the Dynamics data contained in the file. A summary is routed to the *Progress* tab (Figure 20.2, "Example of Read Raw Format Dynamics Data Summary Output").

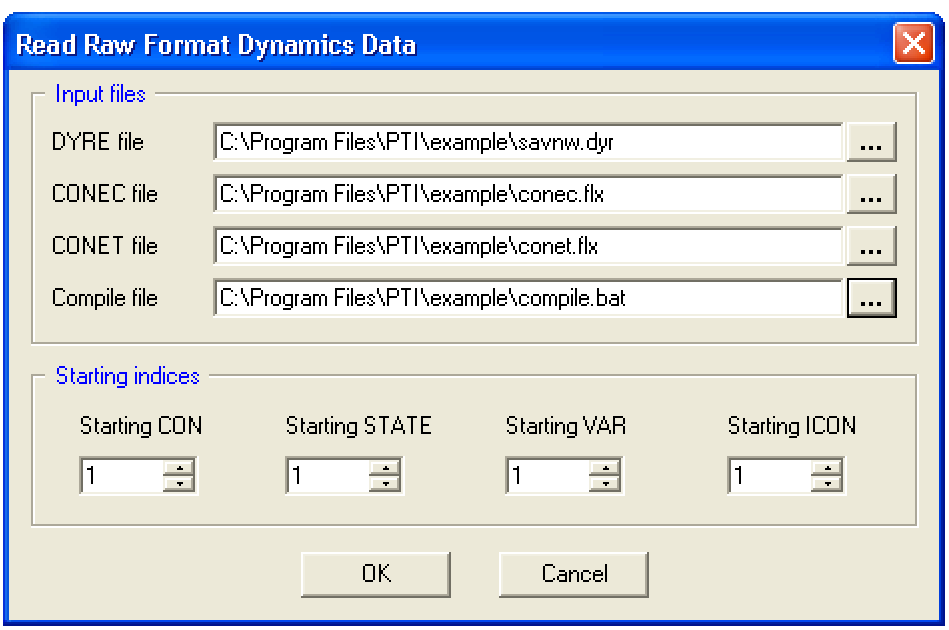
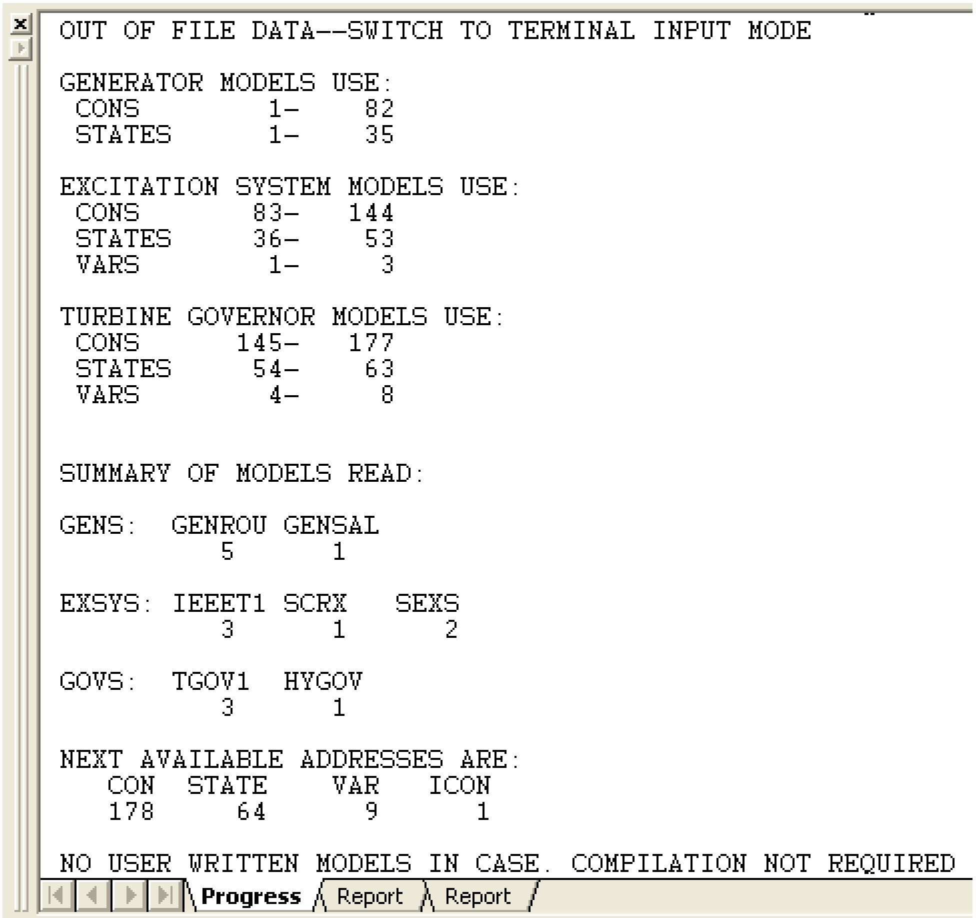


Figure 20.1. Read Raw Format Dynamics Data Dialog



```
OUT OF FILE DATA--SWITCH TO TERMINAL INPUT MODE

GENERATOR MODELS USE:
 CONS          1-     82
 STATES        1-     35

EXCITATION SYSTEM MODELS USE:
 CONS         83-    144
 STATES       36-     53
 VARS          1-      3

TURBINE GOVERNOR MODELS USE:
 CONS        145-    177
 STATES       54-     63
 VARS          4-      8


SUMMARY OF MODELS READ:

GENS:   GENROU GENSAL
             5      1

EXSYS:  IEEET1 SCRX   SEXS
             3      1      2

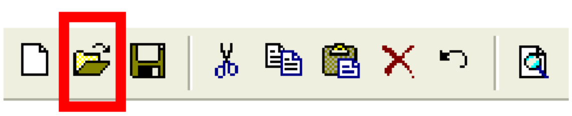
GOVS:   TGOV1  HYGOV
             3      1

NEXT AVAILABLE ADDRESSES ARE:
   CON  STATE     VAR    ICON
   178     64       9       1

NO USER WRITTEN MODELS IN CASE. COMPILATION NOT REQUIRED
```


Figure 20.2. Example of Read Raw Format Dynamics Data Summary Output

20.1.1. Adding Dynamics Data to Existing Dynamics Working Case



File > Open...

Scroll *Files of Type:* to select Add *Dynamics Model Data (*.dyr)*. Highlight the desired file and click *[Open]*. The *[Read Raw Format Dynamics Data (Adding to existing data)]* dialog (Figure 20.3, "Read Raw Format Dynamics Data Dialog when Adding Data") requires specification of CONEC/CONET FLECS files (*.flx) and a CONEC/CONET Compile file (*.bat) for some dynamics model applications. Provide these filenames as appropriate for your simulation.

Starting values for CONs, ICONs, STATEs and VARs reflect the data already populating the working case. These may be modified.

Click *[OK]*. PSS®E reads the specified file and updates *[Dynamics Tree]* and *[Spreadsheet]* with the Dynamics data contained in the file. A summary is routed to the *Progress* tab.

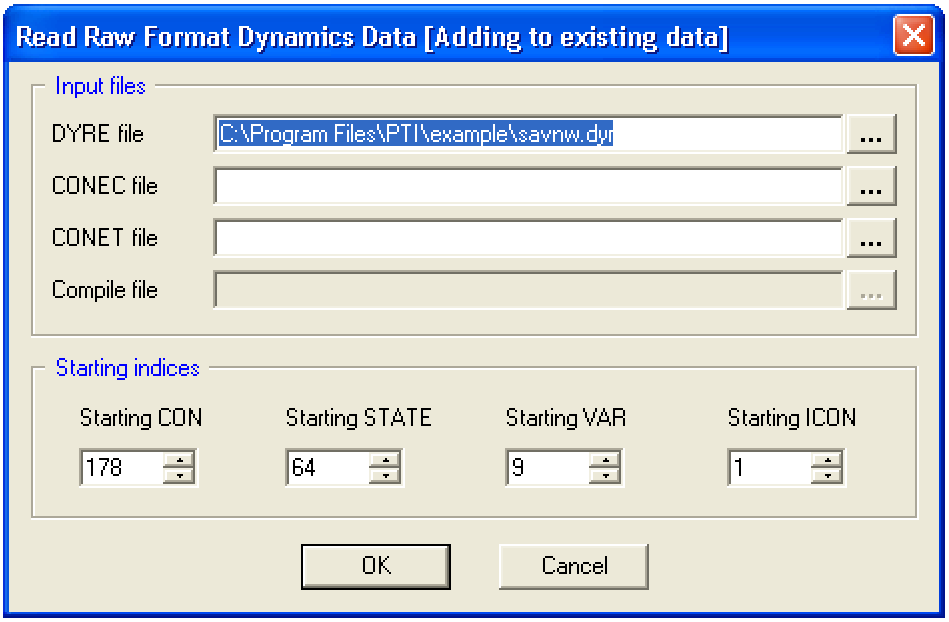


Figure 20.3. Read Raw Format Dynamics Data Dialog when Adding Data

Additional Information
PSS®E Program Operation Manual, Reading Dynamics Model Data

20.2. Restoring Dynamics Working Memory from a Binary Snapshot File

RSTR

Requirements / Prerequisites
Dynamics Snapshot Data File (*.snp) Saving Dynamics Working Memory in a Binary FIle Listing Snapshot Filenames

File > Open...

From the *[Open]* file selector window, select *Dynamics Snapshot Data File (*.snp)*. Highlight the desired file and click *[Open]*. The file will populate the dynamics spreadsheets.

Additional Information
PSS®E Program Operation Manual, Restoring Dynamics Working Memory from a Binary Snapshot File

20.3. Restoring Dynamics Working Memory from a Binary Snapshot File Created in PSS®E-26 or Earlier

SRRS

Requirements / Prerequisites
Validly specified power flow case, solved to an acceptable mismatch level. Converting Loads and Generators

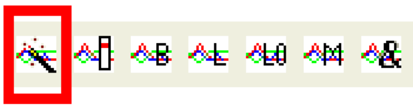
File > Open...

From the *[Open]* file selector window, select *Dynamics Snapshot Raw Data File (*.srs)*. Highlight the desired file and click *[Open]*. The file will populate the dynamics spreadsheets.

Additional Information
PSS®E Program Operation Manual, Restoring Dynamics Working Memory from a Snapshot File Created in PSS®E-26 or Earlier

20.4. Channel Setup

Requirements / Prerequisites
Validly specified power flow case, solved to an acceptable mismatch level. Dynamics data must exist in dynamics working memory. Reading Dynamics Model Data



Dynamics > Channel Setup Wizard

The *[Channel Setup Wizard]* dialog (Figure 20.4, "Channel Setup Wizard Dialog ") provides checkboxes to route specified dynamics quantities to plot channels. Click *[...]* to open the selection window to specify a Channel Output file (*.out) to retain channel data. This can be a new file or a previously-built file to be over-written.

The *Machine* option in *Categories to Output* provides a pull-down list where pre-selected groups of machine quantities may be specified. *Wind Machine*, *Load*, *Bus*, and *Branch* quantities may be specified as the entire group of quantities. Quantities may also be specified individually for all categories.

Click *[Finish]* to save channel specifications. A summary is routed to the *Progress* tab (Figure 20.5, "Example of Channel Setup Output").

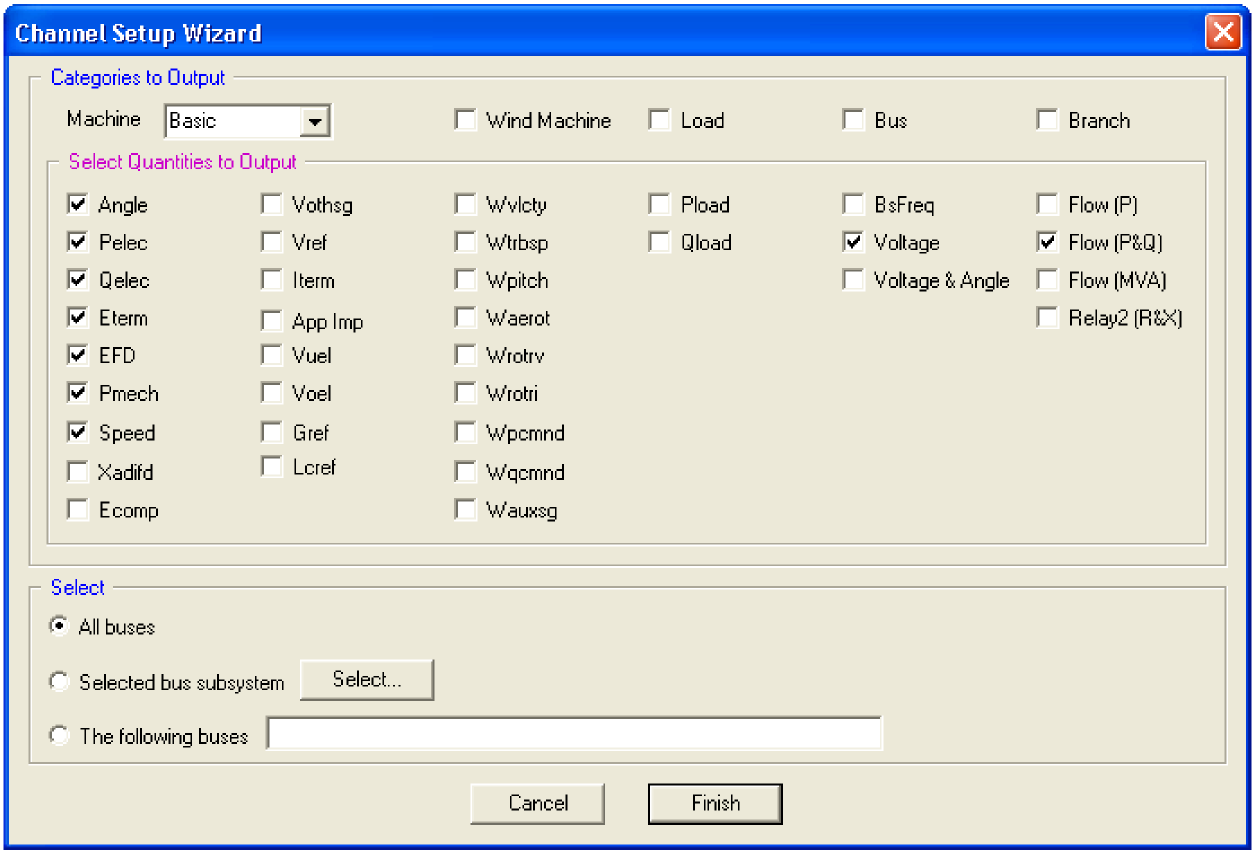


Figure 20.4. Channel Setup Wizard Dialog

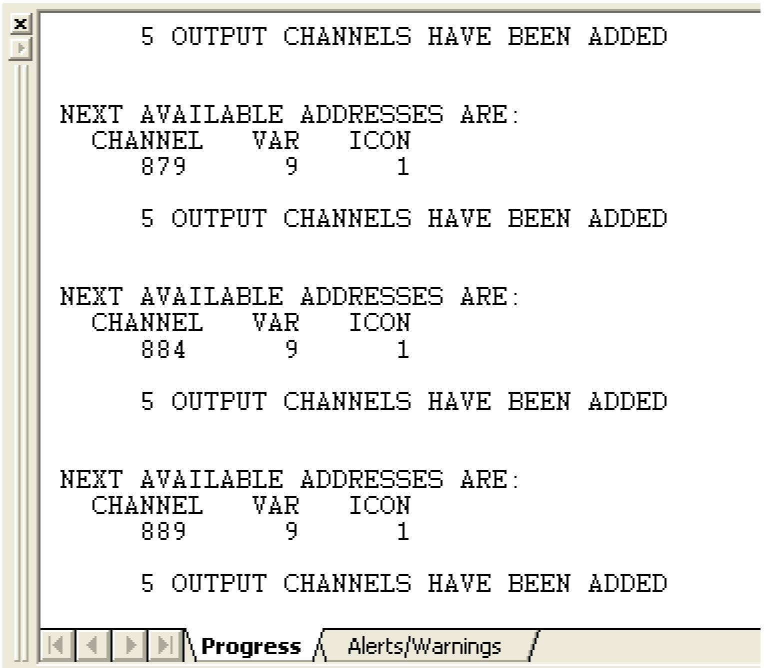


Figure 20.5. Example of Channel Setup Output

Additional Information
PSS® E Program Operation Manual, Assigning Simulation Variables to Output Channels Table 14-2 and Dynamic Simulation Arrays for parameter definitions

20.5. Assigning Output Channels

20.5.1. Simulation Variables

CHAN

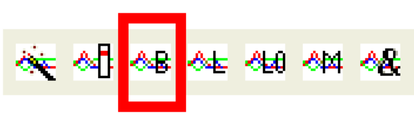
Requirements / Prerequisites
Validly specified power flow case, solved to an acceptable mismatch level. Dynamics data must exist in dynamics working memory.

This activity assigns simulation variables to output channels, grouping the variables in the following categories:

- Bus Quantity
- Line Quantity
- Load Quantity
- Machine Quantity
- Miscellaneous Quantity

Additional Information
PSS® E Program Operation Manual, Assigning Simulation Variables to Output Channels

Bus Quantity



Dynamics > Define simulation output (CHAN) > Bus quantity

The *[Assign Channels for Bus Quantities]* dialog (Figure 20.6, "Assign Channels for Bus Quantities Dialog") provides channel assignment for individual bus quantities of *Frequency*, *Voltage*, or *Voltage and angle*. The user creates channel identifier(s) for specific simulations. Click *[Select]* to display *[Bus Selection]* where the desired bus may be specified. Click *[Go]* to assign the channel output. A summary is routed to the *Progress* tab (Figure 20.7, "Example of Bus Channel Assignment Output"). *[Dynamics Tree]* displays an index of the channels as they are built (Figure 20.8, "Channel Output Assignments in Tree View").

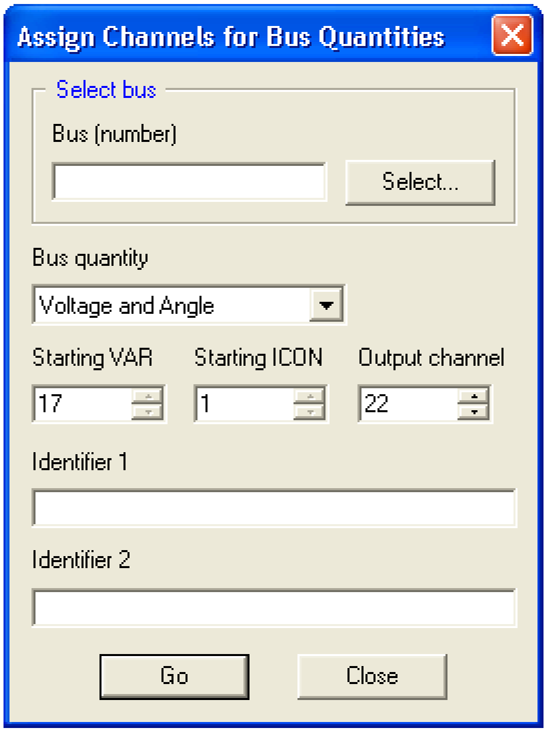


Figure 20.6. Assign Channels for Bus Quantities Dialog

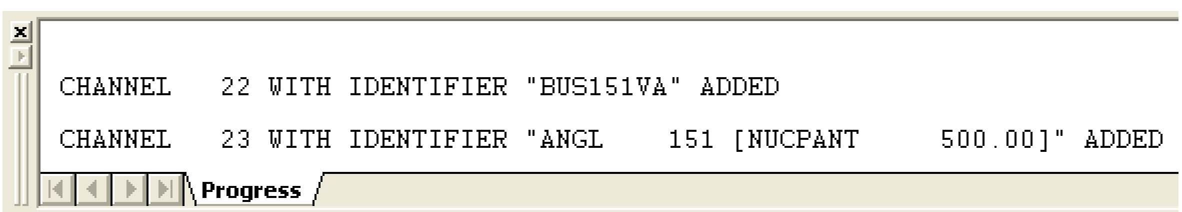


Figure 20.7. Example of Bus Channel Assignment Output

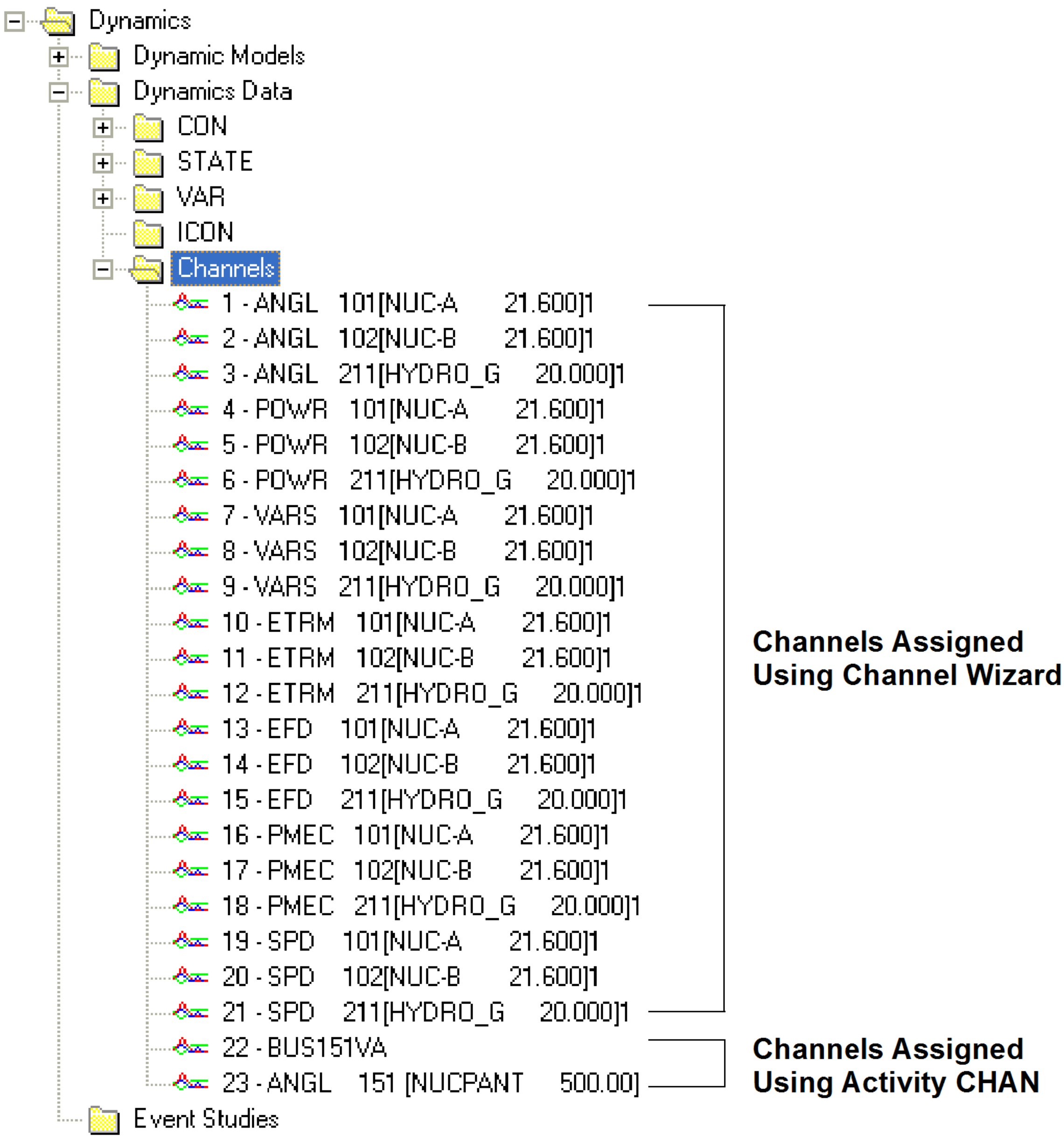
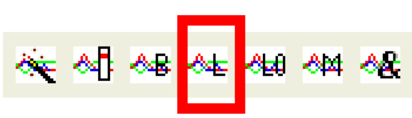


Figure 20.8. Channel Output Assignments in Tree View

Line Quantity



Dynamics > Define simulation output (CHAN) > Line quantity

The *[Assign Channels for Line Quantities]* dialog (Figure 20.9, "Assign Channels for Line Quantities Dialog") provides channel assignment for individual line quantities of *Flow (P)*, *Flow (PQ)*, *Flow (MVA)*, or *Relay2 (R&X)*. The user creates channel identifier(s) for specific simulations. Click *[Select]* to display *[Branch Selection]* where the desired buses may be specified. Click *[Go]* to assign the channel output. A summary is routed to the *Progress* tab. *[Dynamics Tree]* displays an index of the channels as they are built (Figure 20.8, "Channel Output Assignments in Tree View").

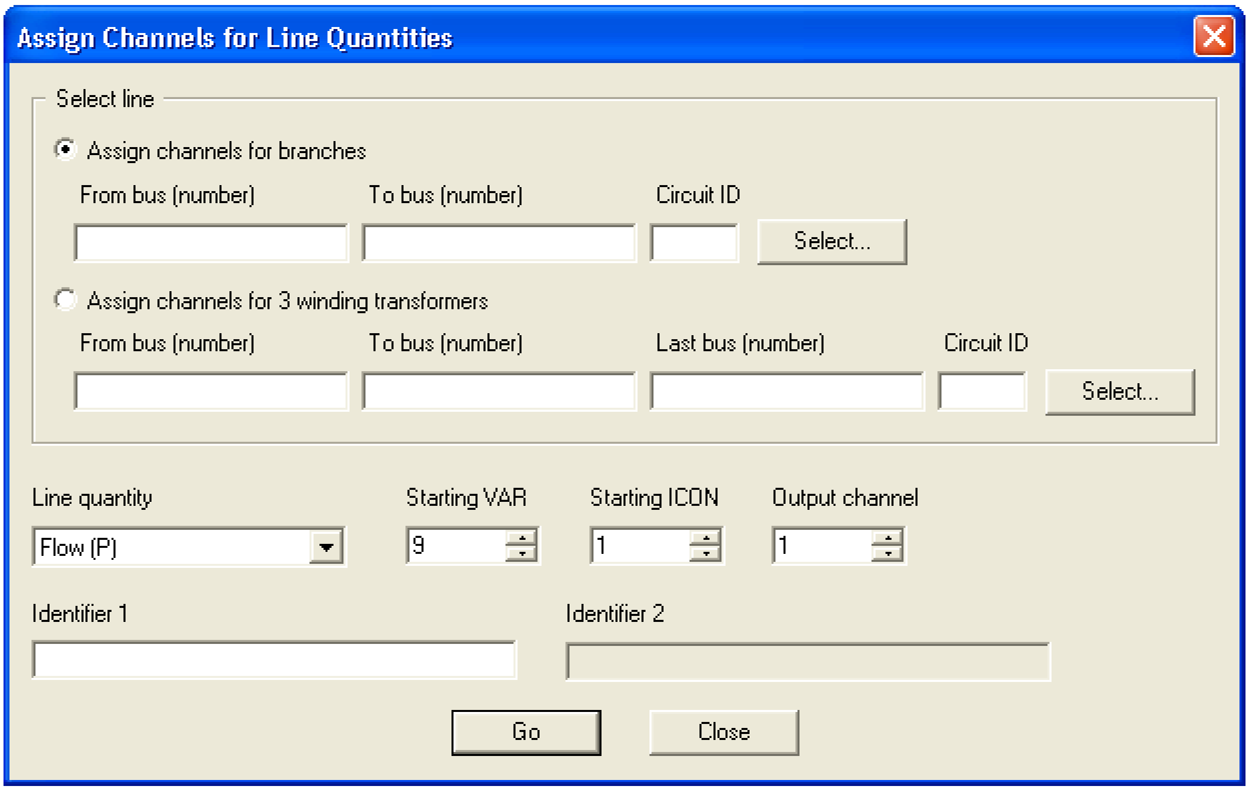
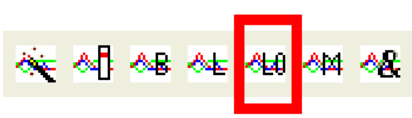


Figure 20.9. Assign Channels for Line Quantities Dialog

Load Quantity



Dynamics > Define simulation output (CHAN) > Load quantity

The *[Assign Channels for Load Quantities]* dialog (Figure 20.10, "Assign Channels for Load Quantities Dialog") provides channel assignment for individual load quantities of *Pload* or *Qload*. The user creates channel identifier(s) for specific simulations. Click *[Select]* to display *[Load Selection]* where the from bus and load may be specified. Click *[Go]* to assign the channel output. A summary is routed to the *Progress* tab. *[Dynamics Tree]* displays an index of the channels as they are built (Figure 20.8, "Channel Output Assignments in Tree View").

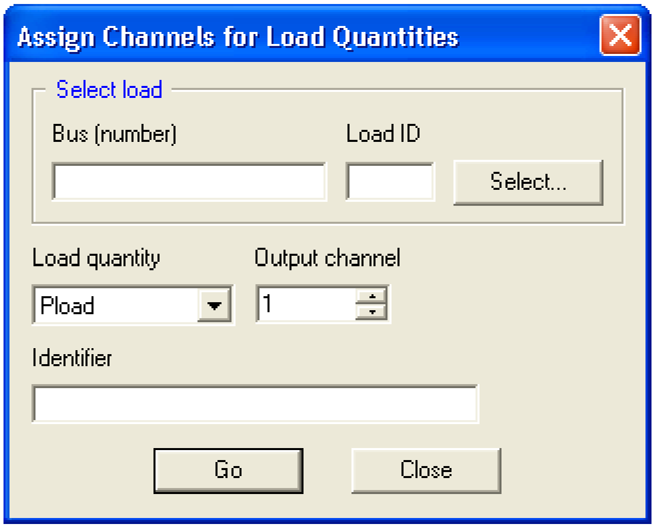


Figure 20.10. Assign Channels for Load Quantities Dialog

Machine Quantity

Dynamics > Define simulation output (CHAN) > Machine quantity

The *[Assign Channels for Machine Quantities]* dialog (Figure 20.12, "Assign Channels for Machine Quantities Dialog") provides channel assignment for individual machine quantities of any of the following data:

• Angle	• EFD	• Ecomp	• Voel
• Pelec	• Pmech	• Vothsg	• Gref
• Qelec	• Speed	• Vref	• Lcref
• Eterm	• Xadifd	• Vuel	

The user creates channel identifier(s) for specific simulations. Click *[Select]* to display *[Machine Selection]* where the *From bus* and *Machine ID* may be specified (Figure 20.11, "Machine Selection Dialog"). Click *[OK]* to return to *[Assign Channels for Machine Quantities]*.

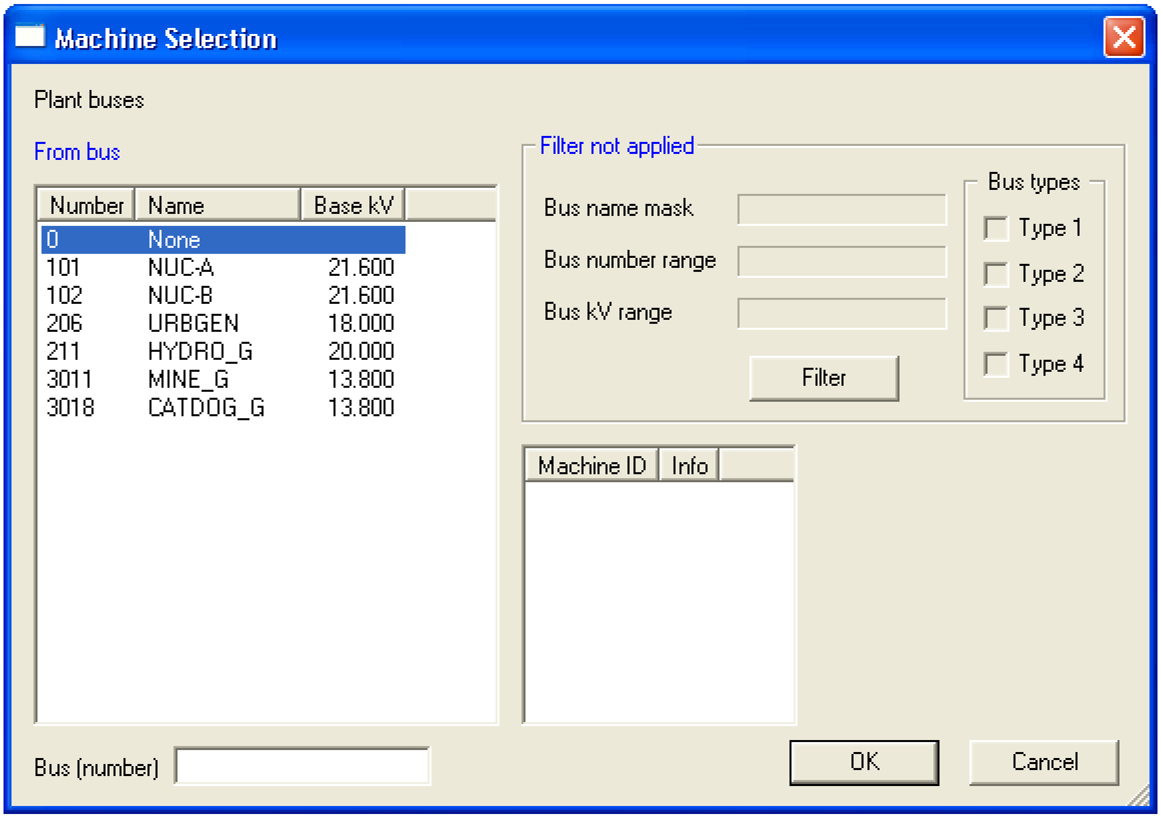


Figure 20.11. Machine Selection Dialog

Click *[Go]* to assign the channel output. A summary is routed to the *Progress* tab. *[Dynamics Tree]* displays an index of the channels as they are built (Figure 20.8, "Channel Output Assignments in Tree View").

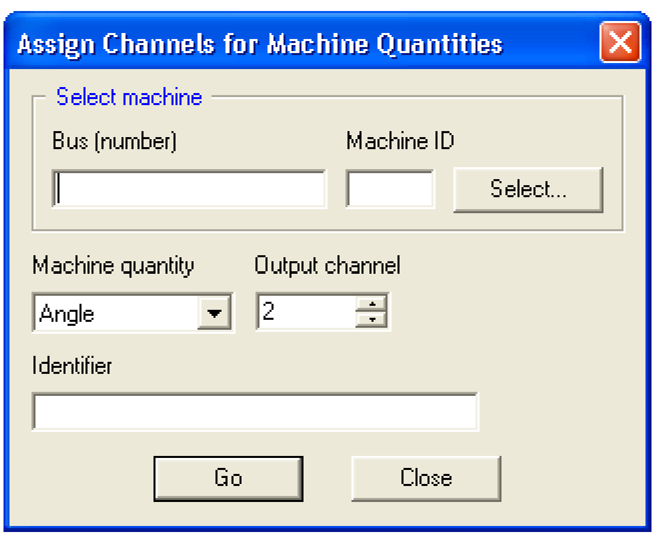


Figure 20.12. Assign Channels for Machine Quantities Dialog

Miscellaneous Quantity

Dynamics > Define simulation output (CHAN) > Misc quantity

The *[Assign Channels for Miscellaneous Quantities]* dialog (Figure 20.13, “Assign Channels for Miscellaneous Quantities Dialog”) provides channel assignment for individual VARs or STATEs.

The user creates channel identifier(s) for specific simulations. Click *[Go]* to assign the channel output. A summary is routed to the *Progress* tab. *[Dynamics Tree]* displays an index of the channels as they are built (Figure 20.8, “Channel Output Assignments in Tree View”).

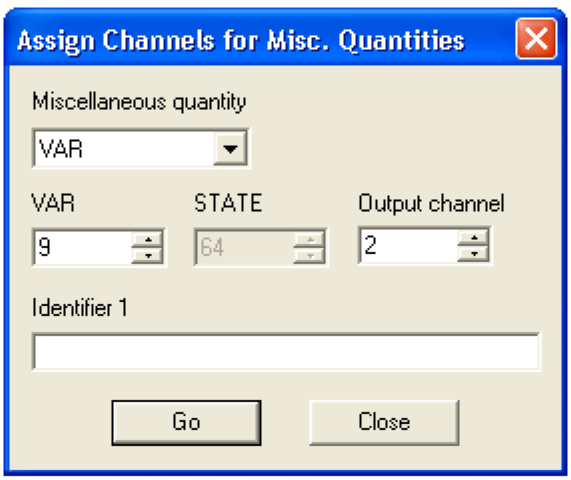
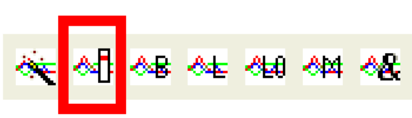


Figure 20.13. Assign Channels for Miscellaneous Quantities Dialog

20.5.2. Channel Selection

CHSB

Requirements / Prerequisites
Validly specified power flow case, solved to an acceptable mismatch level. Dynamics data must exist in dynamics working memory. Converting Loads and Generators



Dynamics > Define simulation output by subsystem (CHSB)...

The *[Select Channels by Subsystem]* dialog (Figure 20.14, "Select Channels by Subsystem Dialog, Tie Line") permits channel assignment for all elements defined by a bus subsystem. Simulation variables that are monitored during the Dynamic simulation are selected for recording. The dialog contains tabs that support channel assignment of the following types of data:

- Tie line quantities:
- Flow (P)
- Flow (P&Q)
- Flow (MVA)
- Relay2 (R&X)

  Selection by *Area* or *Zone*; can include out-of-service equipment.

- Machine, bus, load, and branch quantities:

	• Angle	• Xadifd	• Flow (P)	• Voel	• Wpitch
	• Pelec	• Ecomp	• Flow (P&Q)	• Pload	• Waerot
	• Qelec	• Vothsg	• Flow (MVA)	• Qload	• Wrotrv
	• Eterm	• Vref	• Relay2 (R&X)	• Gref	• Wrotri
	• EFD	• BsFreq	• Mach Item	• Lcref	• Wpcmnd
	• Pmech	• Voltage	• Mach App Imp	• Wvlcty	• Wqcmnd
	• Speed	• Volt & Ang	• Vuel	• Wtrbsp	• Wauxsg

  Selection by *Bus* subsystem; can include out-of-service equipment.

- Subsystem power totals: selection by *Area*, *Zone*, *Owner*, or *All Buses*
- Machine angle statistics

Click *[Go]* to assign the channel output. A summary is routed to the *Progress* tab (Figure 20.15, "Example of Channel Assignment by Subsystem Output").

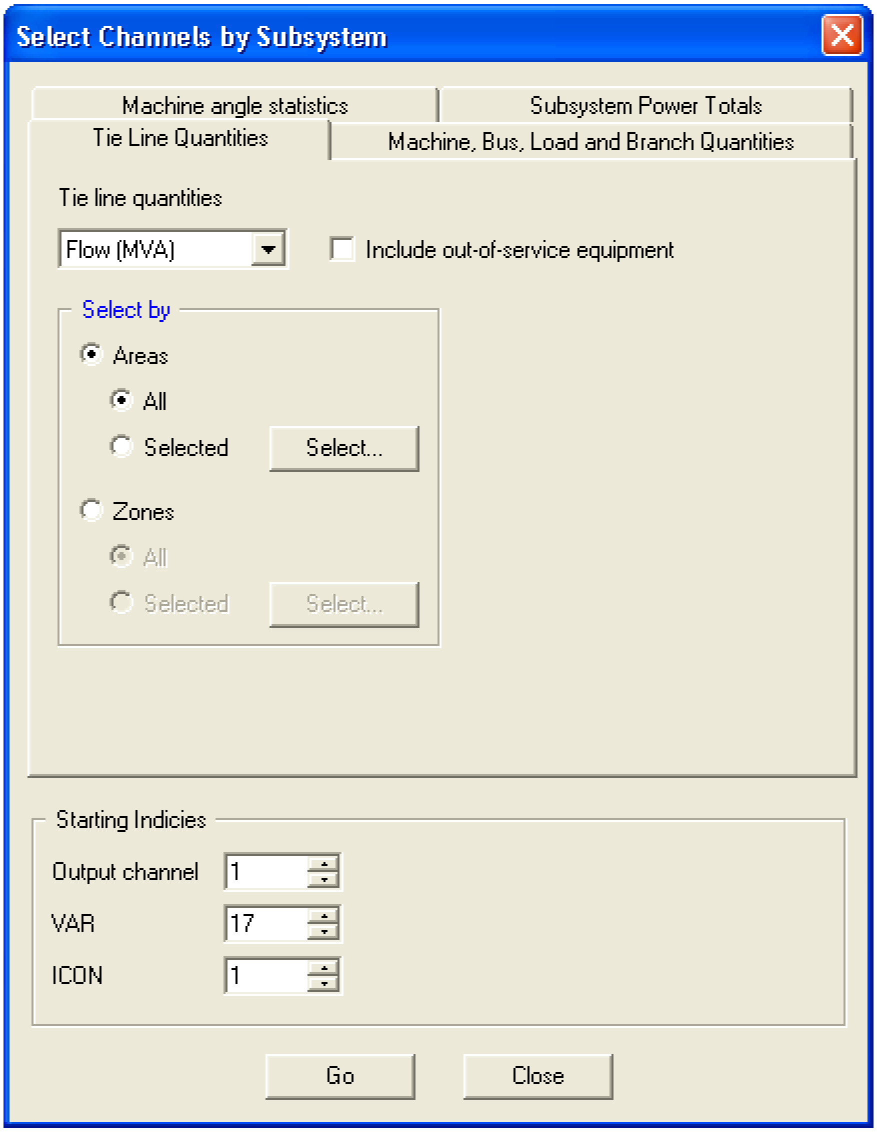


Figure 20.14. Select Channels by Subsystem Dialog, Tie Line

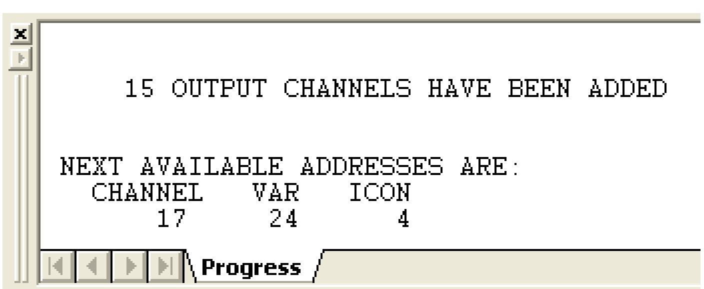


Figure 20.15. Example of Channel Assignment by Subsystem Output

Additional Information
PSS® E Program Operation Manual, Assigning Subsystem Simulation Data to Output Channels

20.6. Saving Dynamics Working Memory in a Binary FIle

SNAP

Requirements / Prerequisites
Dynamics working memory must contain the appropriate dynamics data.

File > Save

The snapshot activity SNAP preserves the contents of dynamics working memory in a user specified Dynamics Snapshot Data File (*.snp). The *Snapshot Data* tab of the *[Save / Show Dynamics Data]* dialog (Figure 20.16, “Save / Show Dynamics Snapshot Data Dialog”) requires a *Destination* filename, which may overwrite an existing file using the selection window or be entered directly to create a new file.

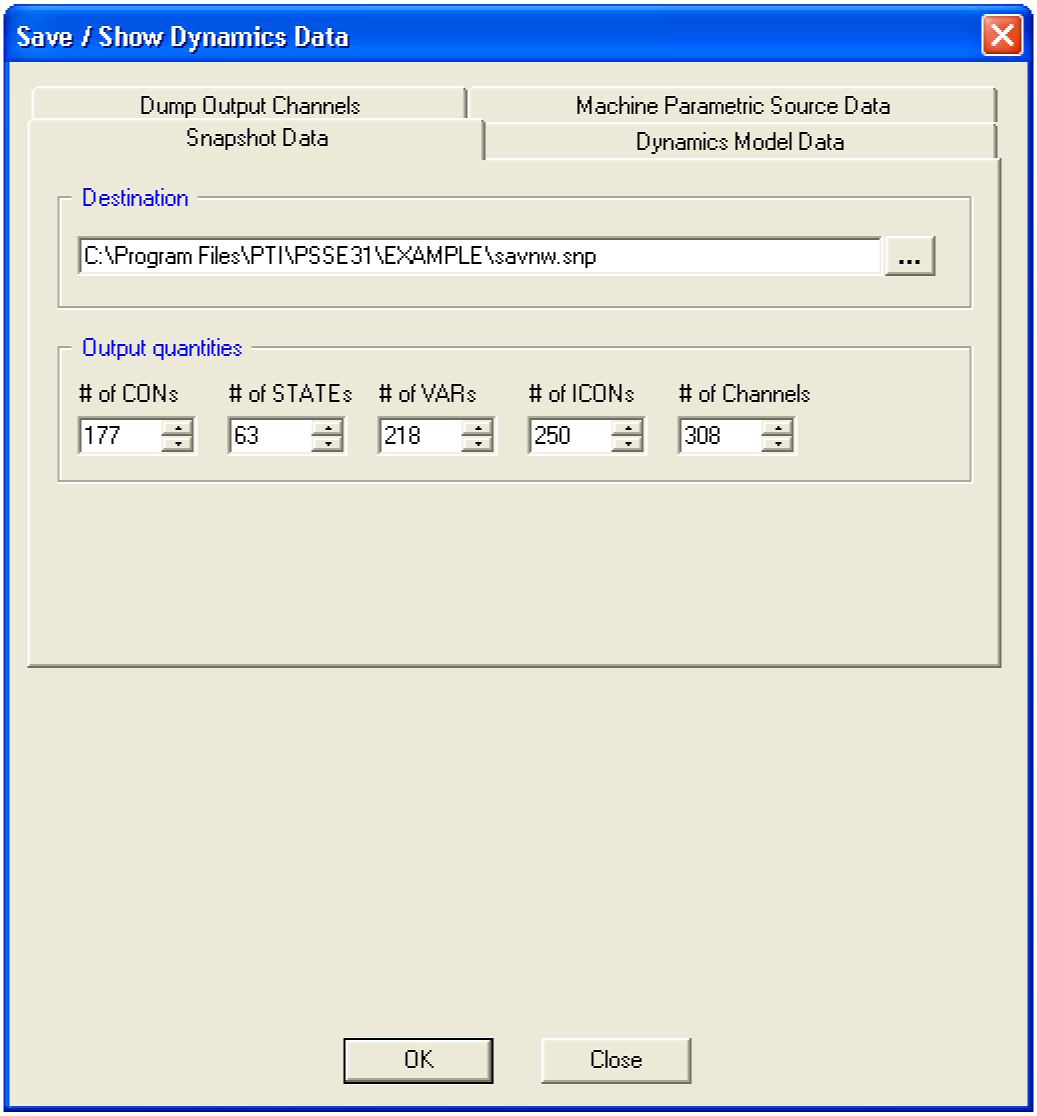


Figure 20.16. Save / Show Dynamics Snapshot Data Dialog

Output quantities describes the number of elements in the CON, STATE, VAR and ICON arrays and the number of output channels specified in the working case. The defaults may be changed, but should be at least as large as the number of elements in use in the corresponding data arrays.

Click *[OK]* to save the data. The following message is displayed in the *Progress* tab.

```
SNAPSHOT STORED IN FILE C:\…\<filename>.snp AT TIME = 0.000
```

Additional Information
PSS® E Program Operation Manual, Saving Dynamics Working Memory in a Binary File

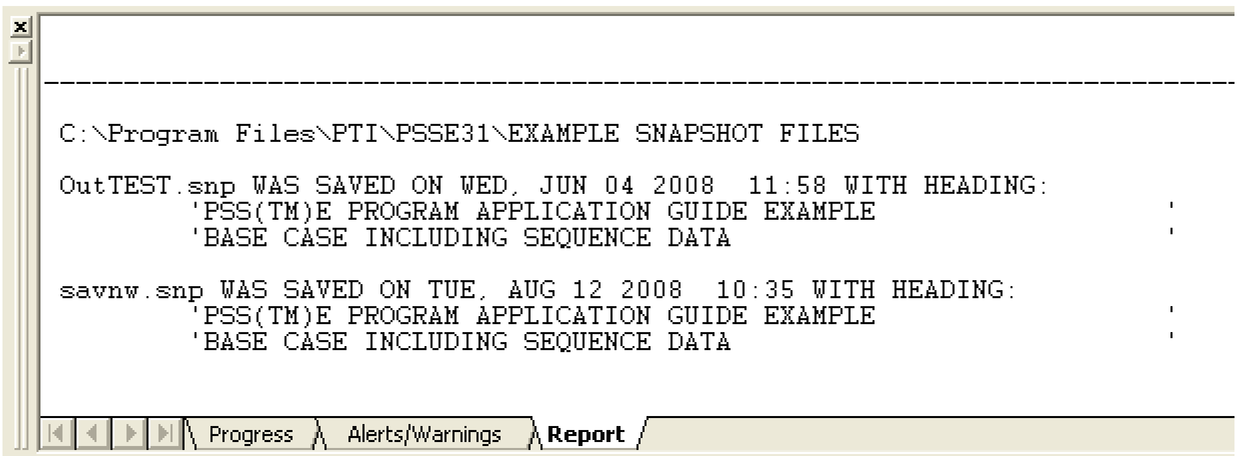
20.7. Listing Snapshot Filenames

SHOW

Requirements / Prerequisites
none

File > File information (SIZE/SHOW/BUSN)...

Selecting the *Dynamic Snapshots* option from *[File Information]* produces a report of dynamic snapshots filenames in the current working directory.



Example of Dynamic Snapshot File Report

Additional Information
PSS® E Program Operation Manual, Listing Saved Case or Snapshot Files

20.8. Modifying Data in Dynamics Working Memory

ALTR

Requirements / Prerequisites
Dynamics data must exist in dynamics working memory. Spreadsheet View

The *[Dynamics Spreadsheet]* is used to add, remove, edit, and change the status of models attached to network components (see Figure 20.17, "Example of Dynamics Spreadsheet"). It is formatted with tabs. Formatting the spreadsheet and modifying the data is described in Section 2.2, "Editing and Formatting the Spreadsheet".

Additional Information
PSS® E Program Operation Manual, Modifying Data in Dynamics Working Memory *PSS® E Program Operation Manual*, Simulation Outputs

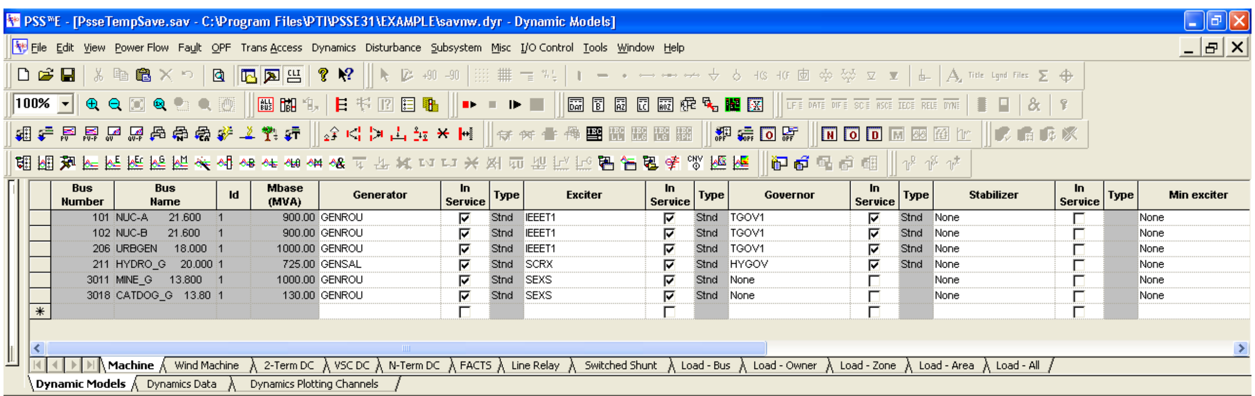
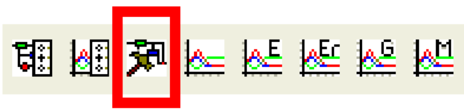


Figure 20.17. Example of Dynamics Spreadsheet

20.9. Modifying Dynamics Model Pointer Tables

DYCH

Requirements / Prerequisites
Validly specified power flow case. Dynamics data must exist in dynamics working memory. Converting Loads and Generators



Dynamics > Model Maintenance...

The *[Model Maintenance]* dialog provides maintenance functions for unconnected models and user-defined models. In addition, consistency checks are available for Plant and Wind models.

List unconnected models: lists all models of the selected type that are not connected to any network elements

Remove unconnected models: removes all models of the selected type that are not connected to any network elements. They will no longer appear in any saved Snapshot or DYRE files.

Pack models: packs the internal storage tables and removes holes (i.e., entries that are marked as unused) from the model connection table and the array allocation table for all models of the selected type. If these tables are packed, messages are printed at the *Progress* tab.

List user models: lists all user models of the selected type found in the active User Dynamics Dll.

Remove unused user models: deletes any model definitions of the selected type that are not referenced from the array allocation table from the user model definition table. Vacated slots are available for new model definitions.

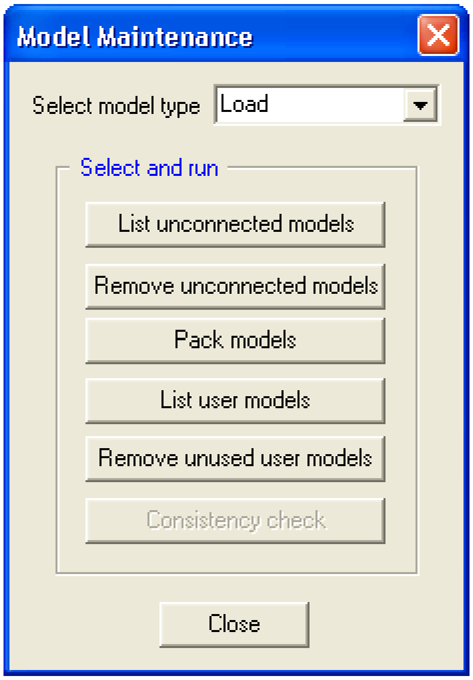
Consistency check: performs an internal consistency check that loops through all machines in the working case and displays an alarm message for any invalid model combinations.

Select the desired model type and click the maintenance function from the *Select and run* list. The *Progress* tab displays an appropriate message, for example:

```
ALL LINE RELAY MODELS ARE CONNECTED TO POWER FLOW BRANCHES

NO USER MODEL LOAD-TYPE DEFINITIONS IN TABLES

CONSISTENCY CHECK OK FOR PLANT MODELS
```



Model Maintenance Dialog

You will need to click *[Close]* to end this activity.

Additional Information
PSS® E Program Operation Manual, Modifying Dynamics Model Pointer Tables

20.10. Creating a Dynamics Model Raw Data File

DYDA

Requirements / Prerequisites
Validly specified power flow case. Dynamics data must exist in dynamics working memory. Converting Loads and Generators

File > Save

Activity DYDA replicates dynamics model data in the working case in a file that can be read by activity DYRE (Section 20.1, “Reading Dynamics Model Data”). *The Dynamics Model Data* tab of the *[Save / Show Dynamics Data]* dialog (Figure 20.18, “Save / Show Dynamics Data Dialog”) requires a *Destination*: the Report window or a filename, which may be selected from existing files using the selection window or be entered directly to create a new file.

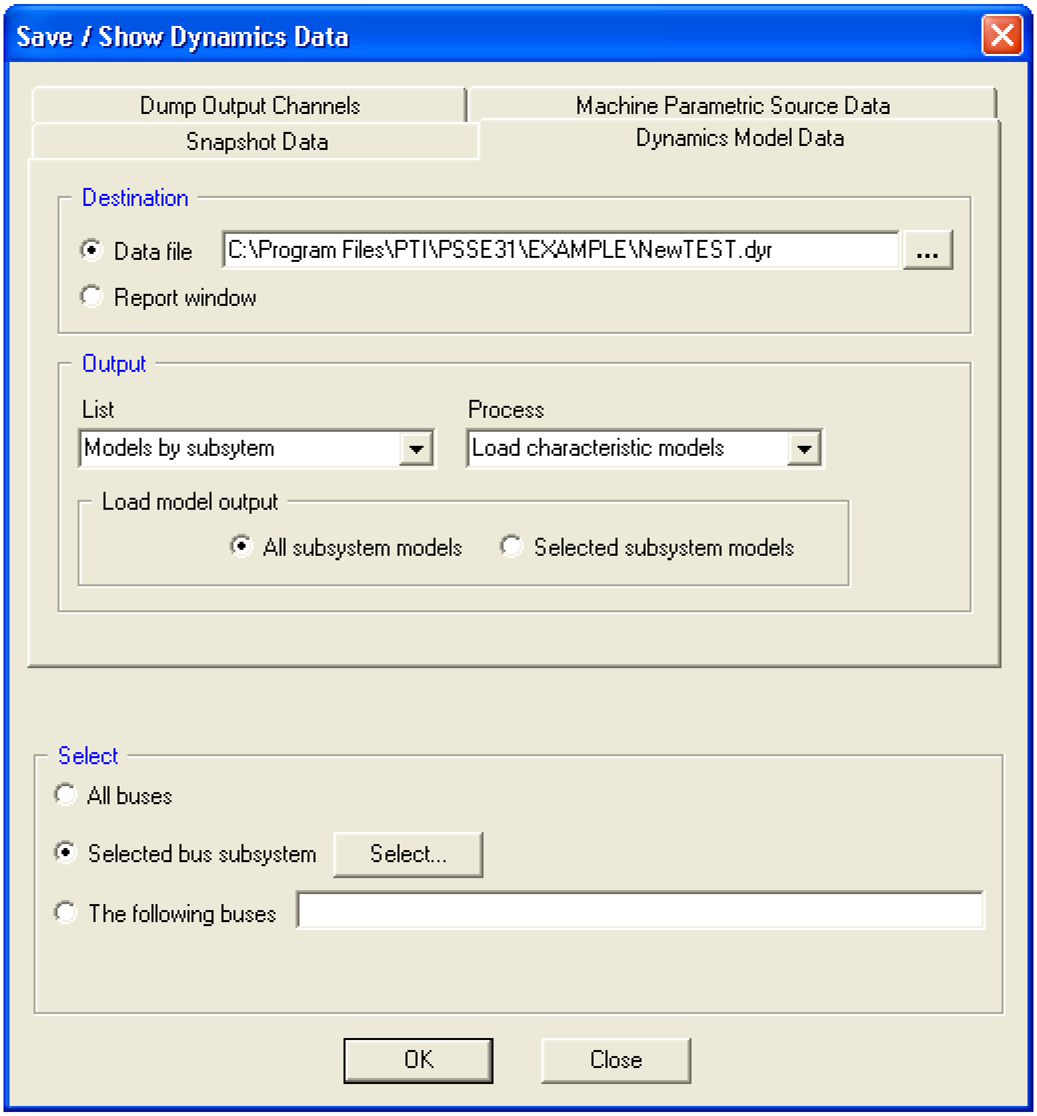


Figure 20.18. Save / Show Dynamics Data Dialog

The data output can be listed by subsystem, or all subroutine CONEC or CONET models can be replicated. If the output selected is *Models by subsystem*, the list may include all models or be limited by model type as follows:

• All models	• VSC dc models
• All plant models	• FACTS device models
• Generator models	• Turbine load controller models
• Compensator models	• Switched shunt models
• Stabilizer models	• Wind models
• Minimum exciter limiter models	• Wind generator models
• Maximum exciter limiter models	• Wind electrical control models

• Excitation system models	• Wind mechanical models
• Turbine governor models	• Wind pitch models
• Load characteristic models	• Wind aerodynamic models
• Load relay models	• Wind gust models
• Line relay models	• Wind auxiliary control models
• Auxiliary signal models	• CONEC models
• 2-Terminal dc models	• CONET models
• N-Terminal dc models	

If either *Load characteristic models* or *Load relay models* are selected to be processed for a *Selected bus subsystem*, *Load model output* may also be specified.

Click *[OK]* to save or report the data. If a filename has been specified, the message `OUTPUT COMPLETED` is displayed on the *Progress* tab and a summary of model CONS is generated on the *Report* tab.

Additional Information
PSS® E Program Operation Manual,   Creating a Dynamics Model Raw Data File

20.11. Creating Dynamic Data Records for Use by Other Activities

RWDY

Requirements / Prerequisites
Validly specified power flow case. Dynamics data must exist in dynamics working memory.

File > Save

The auxiliary dynamics data output activity replicates machine parametric data from dynamics working memory in the following formats:

- Inertia and Governor Response Data File for input to activity INLF
- Breaker Duty Data File for input to activity BKDY
- Line relay data and branch impedances in the form required by the PSSPLT activity RELY

The *Machine Parametric Source Data* tab of the *[Save / Show Dynamics Data]* dialog (Figure 20.19, “Save / Show Machine Parametric Source Data Dialog”) requires a *Destination* filename, which may overwrite an existing file using the selection window or be entered directly to create a new file.

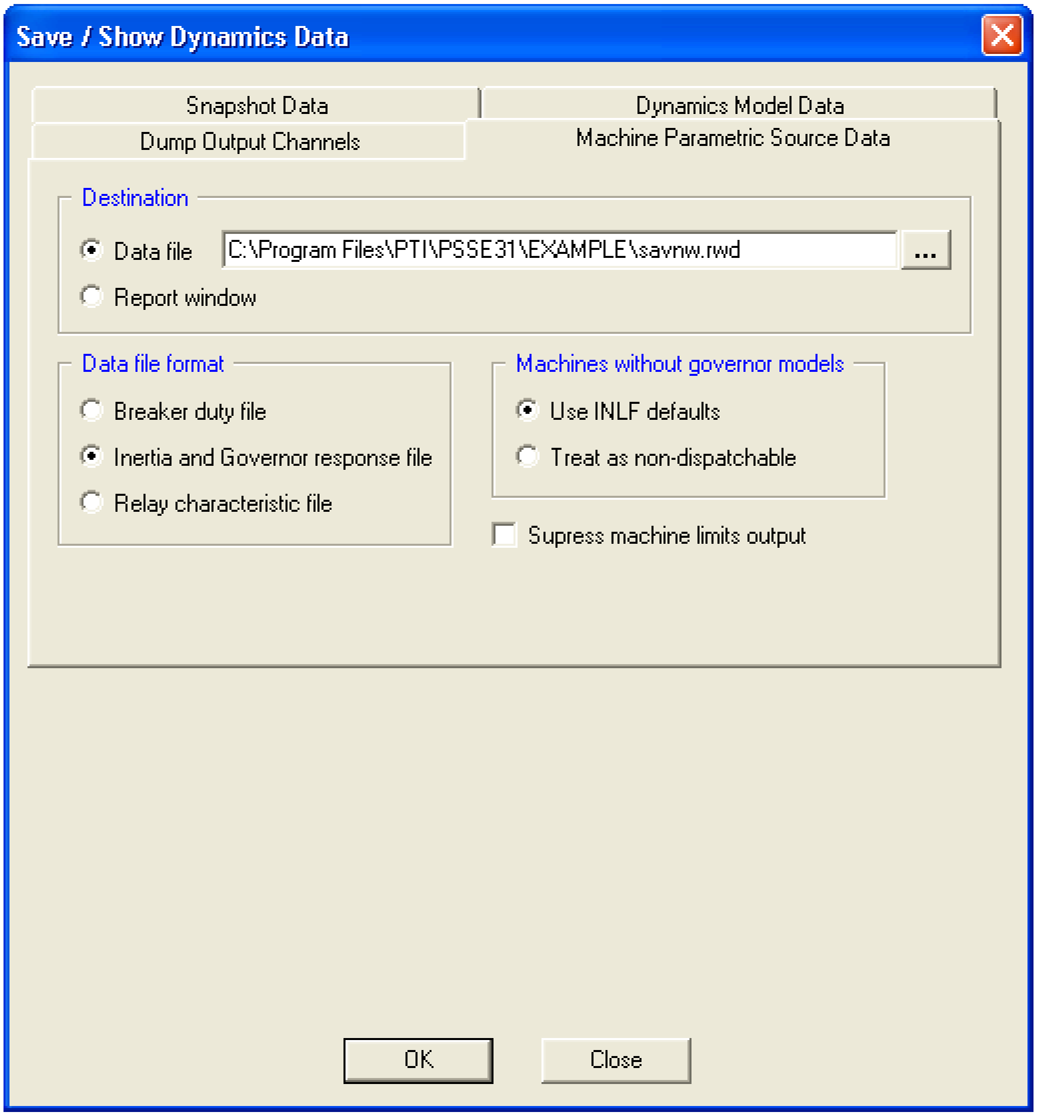


Figure 20.19. Save / Show Machine Parametric Source Data Dialog

The user must specify a *Data file format*. If the *Inertia and Governor response file format* is selected, additional specifications may be made.

Click *[OK]* to save or report the data.

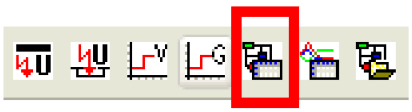
Additional Information
PSS® E Program Operation Manual, Creating Dynamic Data Records for Use by Other Activities

20.12. Listing Dynamics Data

20.12.1. Model Data

DOCU

Requirements
Validly specified power flow case. Dynamics data must exist in dynamics working memory.



Dynamics > List > Models and data (DOCU)...

This activity generates reports or checks dynamics data for equipment models of specified categories of models. The *[List Dynamics Model Data]* dialog (Figure 20.20, "List Dynamics Model Data Dialog") requires the user to select the operating mode, list format, and model type to be processed. The report may be specified by bus subsystem.

Click *[Go]* to create the report, which is displayed in the *Report* tab by default (Figure 20.21, "Example of Dynamics Model Data Checking Report").

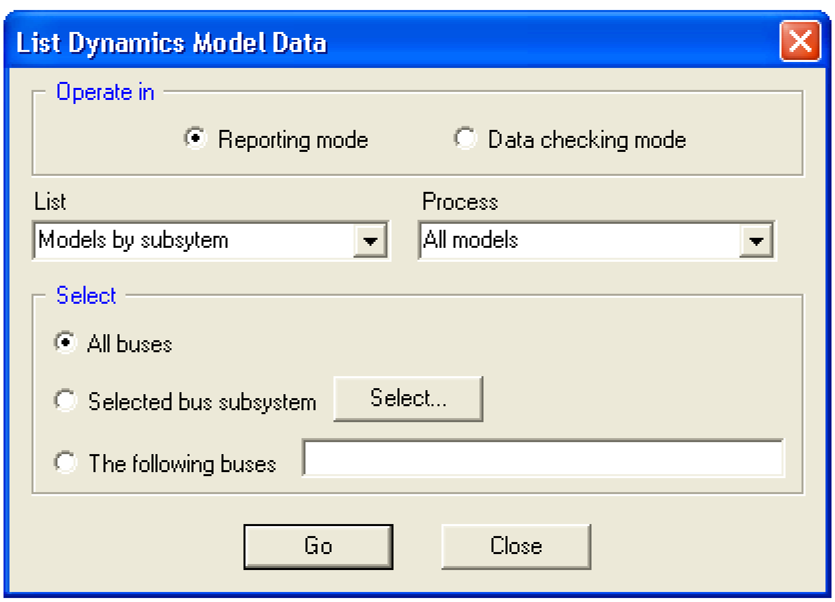


Figure 20.20. List Dynamics Model Data Dialog

You will need to click *[Close]* to end this activity.

```
1     PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS(R)E     TUE, SEP 30 2008   7:43
 PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE
 BASE CASE INCLUDING SEQUENCE DATA

 PLANT MODELS
                                            BUS 206 [URBGEN      18.000] MODELS
 DATA CHECK FOR ALL MODELS IN AREA 2 [LIGHTCO     ]


 BUS    206  MACHINE 1 :
 T'Q0=      0.1500


 ** GENROU **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S
               206 URBGEN       18.000 1      29-42        13-18

             MBASE     Z S O R C E         X T R A N       GENTAP
            1000.0  0.01000+J 0.25000  0.00000+J 0.00000  1.00000

  T'D0 T''D0  T'Q0 T''Q0     H   DAMP   XD     XQ     X'D    X'Q    X''D    XL
  4.50 0.070  0.15 0.050   2.50  0.00 1.4000 1.3500 0.5000 0.7000 0.2500 0.1000

                               S(1.0)  S(1.2)
                               0.0900  0.3800

--------------------------------------------------------------------------------
1     PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS(R)E     TUE, SEP 30 2008   7:43
 PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE
 BASE CASE INCLUDING SEQUENCE DATA

 PLANT MODELS
                                            BUS 211 [HYDRO_G     20.000] MODELS
 DATA CHECK FOR ALL MODELS IN AREA 2 [LIGHTCO     ]


 BUS    211  MACHINE 1 :
 TA/TB=     0.1000    K=       200.0000   TRANSIENT GAIN=    20.0000
 EMIN=     -5.0000


 ** SCRX **    BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S    SOLID
               211 HYDRO_G      20.000 1    125-132        48-49         FED

        TA/TB     TB       K       TE      EMIN    EMAX  SWITCH  RC/RFD
        0.100  10.000   200.0    0.050    -5.00    5.00    1.0    10.00


 BUS    211  MACHINE 1 :
 DTURB=     0.5000


 ** HYGOV **   BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S     V A R S
               211 HYDRO_G      20.000 1    166-177        60-63          7-8

  R-PERM R-TEMP   TR    TF    TG    VELM  GMAX  GMIN   TW    AT  DTURB   QNL
   0.050  0.300 5.00 0.050 0.500  0.200  1.00  0.00  1.25  1.20 0.50 0.080
```

Progress | Report | **Report**

Figure 20.21. Example of Dynamics Model Data Checking Report

Additional Information
PSS® E Program Operation Manual, Listing Dynamics Model Data

20.12.2. Data Arrays

DLST

Requirements
Dynamics data must exist in dynamics working memory.

Dynamics > List > Dynamics data (DLST)...

This activity generates reports listing principle dynamics data arrays, within defined index ranges. The *[List Dynamics Data Common]* dialog (Figure 20.22, "List Dynamics Data Common Dialog") provides checkboxes to specify the type of data contained in the list and field boxes to limit the range reported.

Click *[Reset]* to restore the values that reflect the number of elements being used in the current simulation.

Click *[OK]* to create the report, which is displayed in the *Report* tab by default (Figure 20.23, "Example of Dynamics Data Report").

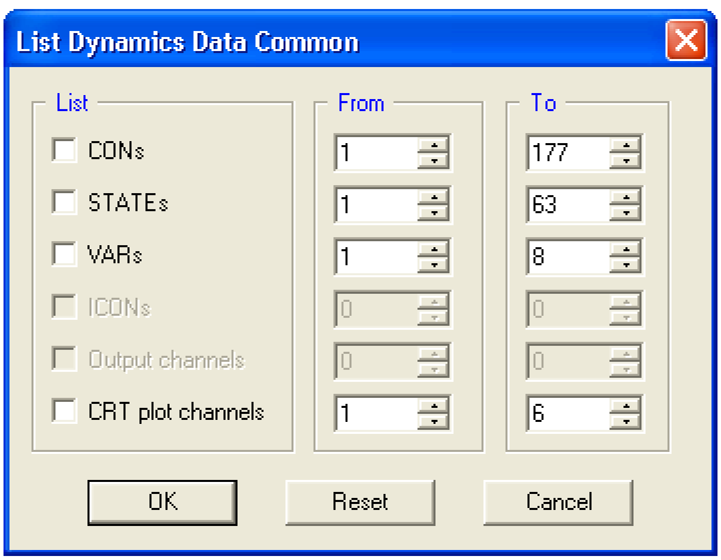


Figure 20.22. List Dynamics Data Common Dialog

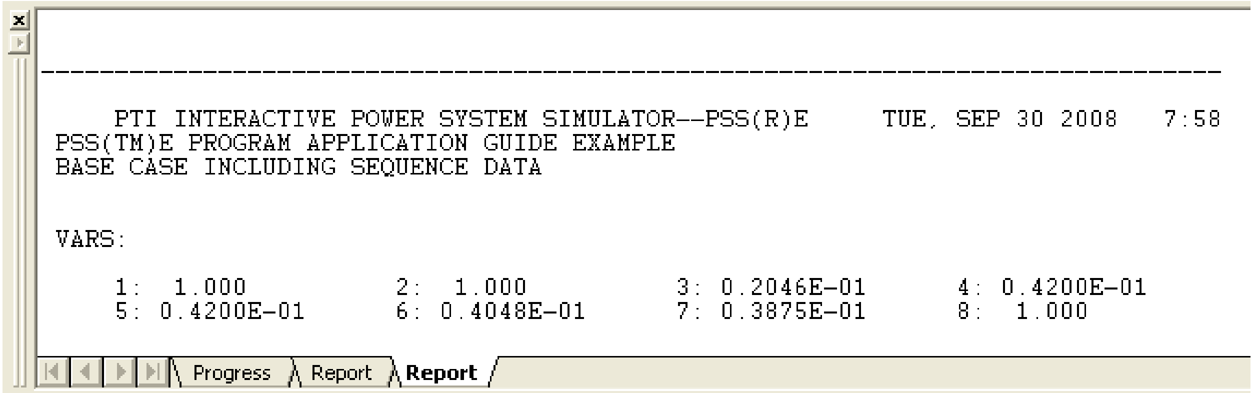


Figure 20.23. Example of Dynamics Data Report

Additional Information
PSS® E Program Operation Manual, Listing Dynamics Data Arrays

20.12.3. Model Storage Location

Requirements
Validly specified power flow case. Dynamics data must exist in dynamics working memory.

Dynamics > List > Model storage locations...

This activity generates reports listing the storage locations, by model category, associated with table-driven models referenced in the user's simulation setup. These locations store CON, STATE, VAR, and ICON data. The *[List Model Storage Locations]* dialog (Figure 20.24, "List Model Storage Locations Dialog") provides tabs that specify reports for the following model types:

• Machines	• Auxiliary Signals
• Loads	• FACTS Devices
• Wind Machines	• Switched Shunts
• Relays	• DC Lines

All reports require specification of model status. Some reports may be limited to specific model types; for example, the option *All wind machines* or only *Mechanical* wind machines may be selected. Each report may be specified by bus subsystem.

Click *[Go]* to create the report, which is displayed in the *Report* tab by default (Figure 20.24, "List Model Storage Locations Dialog").

You will need to click *[Close]* to end this activity.

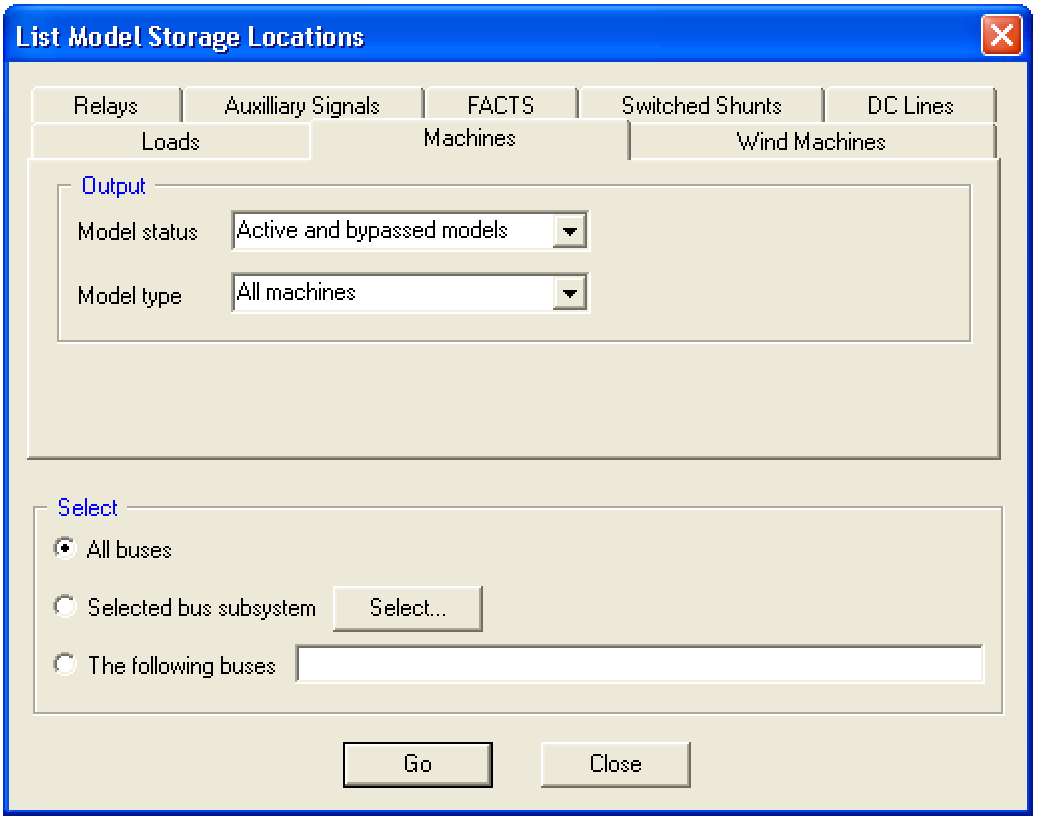
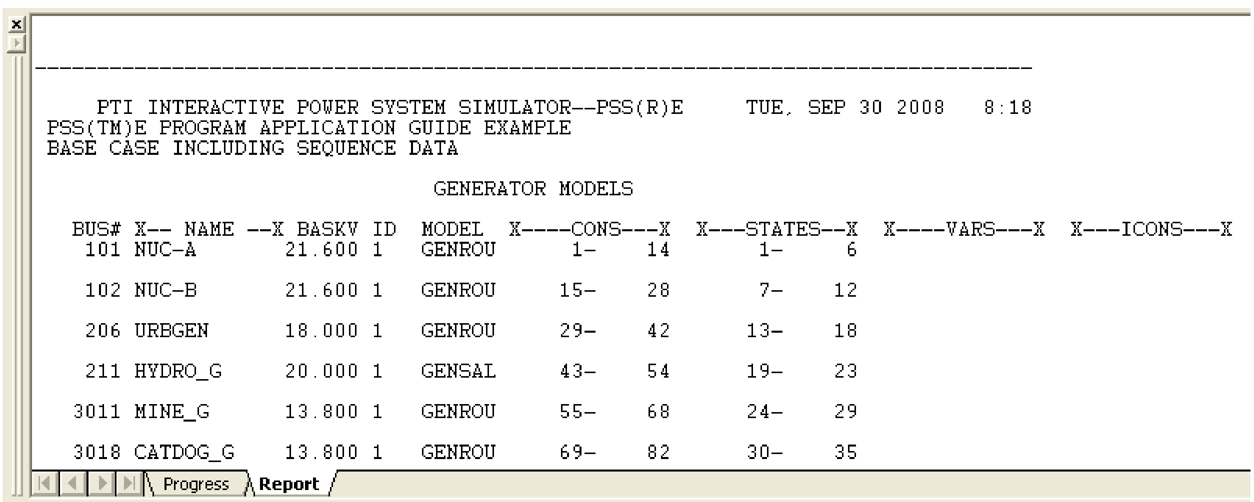


Figure 20.24. List Model Storage Locations Dialog



```
    PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS(R)E     TUE, SEP 30 2008    8:18
 PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE
 BASE CASE INCLUDING SEQUENCE DATA

                                GENERATOR MODELS

   BUS# X-- NAME --X BASKV ID  MODEL  X----CONS---X  X---STATES--X  X----VARS---X  X---ICONS---X
    101 NUC-A        21.600 1  GENROU       1-    14         1-     6

    102 NUC-B        21.600 1  GENROU      15-    28         7-    12

    206 URBGEN       18.000 1  GENROU      29-    42        13-    18

    211 HYDRO_G      20.000 1  GENSAL      43-    54        19-    23

   3011 MINE_G       13.800 1  GENROU      55-    68        24-    29

   3018 CATDOG_G     13.800 1  GENROU      69-    82        30-    35
```

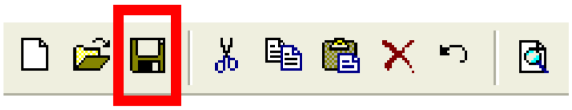

Example of Model Storage Locations Report

Additional Information
PSS®E Program Operation Manual, Listing Dynamics Model Storage Locations

20.13. Dumping Dynamic Simulation Output Channels into a Response File

DMPC

Requirements / Prerequisites
Dynamics data must exist in dynamics working memory.



File > Save

The output channel dumping activity DMPC replicates dynamic simulation output channels contained in dynamics working memory in a PSS®E Response file. *The Dump Output Channels* tab of the *[Save / Show Dynamics Data]* dialog (Figure 20.25, "Save / Show Dump Output Channels Dialog") requires a *Destination* filename, which may overwrite an existing file using the selection window or be entered directly to create a new file.

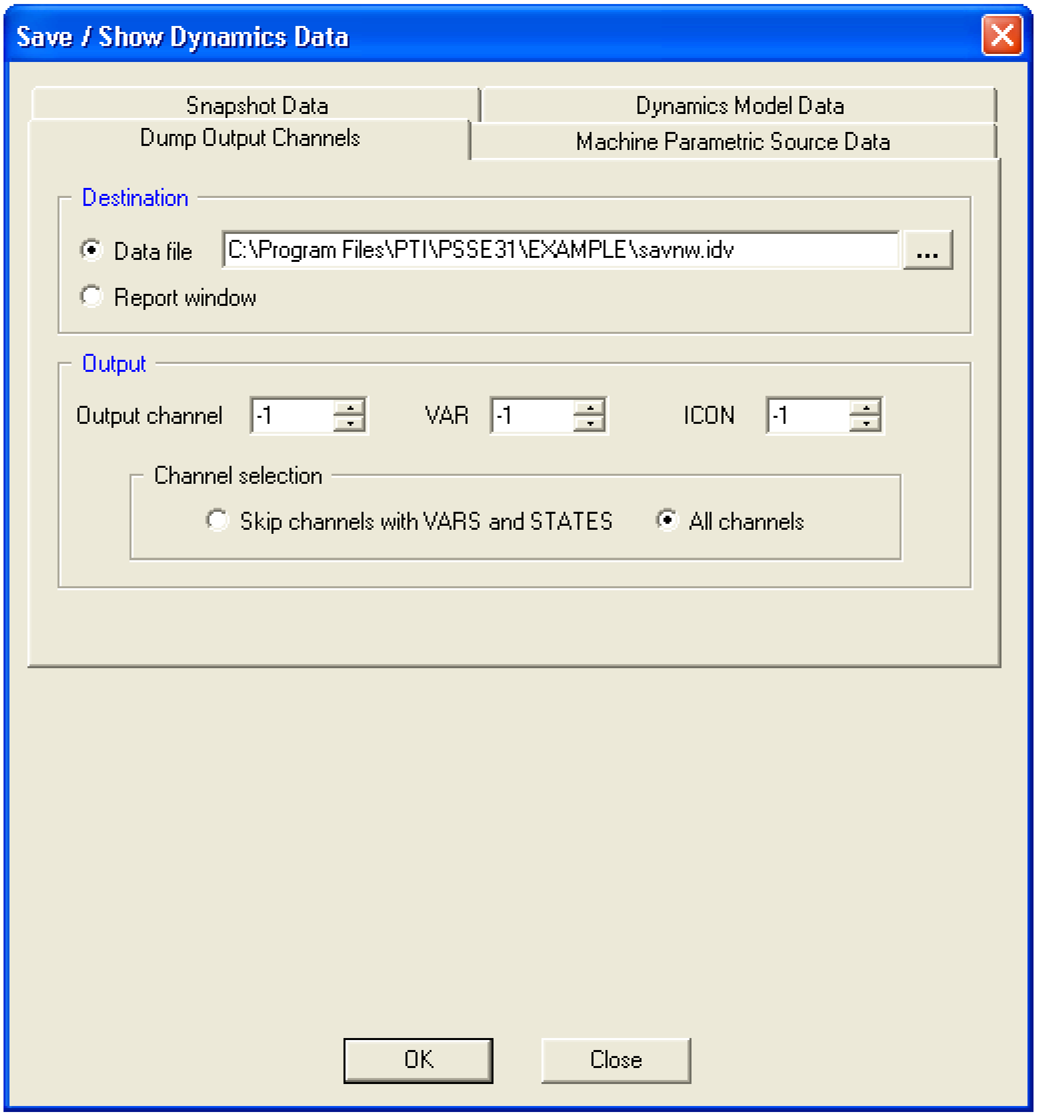


Figure 20.25. Save / Show Dump Output Channels Dialog

The user must specify channel preference for all channels or omitting channels containing VARs and STATEs.

Click *[OK]* to save or report the data.

Additional Information
PSS® E Program Operation Manual, Dumping Dynamic Simulation Output Channels into a Response File

20.14. Defining Model Search Paths

Tools > Define model search paths...

The use of external formats to support Dynamics models was first made available in Version 30.3 with the Graphical Model Builder (GMB). The GMB uses a Visio-based interface to graphically create Dynamics equipment models. These GMB models can then be attached to network equipment in the same manner as PSS®E standard models and user-written and compiled models. Since the GMB models are defined in external files, the application must be made aware of the location of these files.

The *[Define Model File Search Paths]* dialog (Figure 20.26, "Define Model Search Paths") allows the user to define specific directories in which the program can search to find required data-driven files.

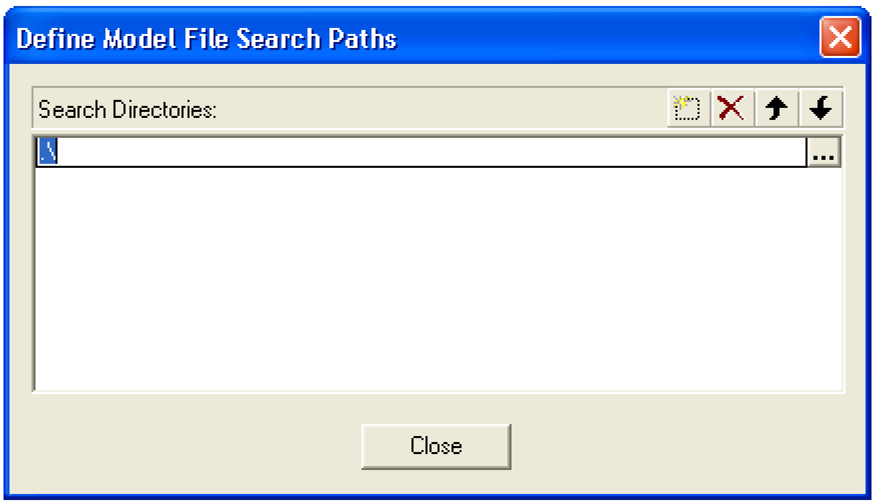


Figure 20.26. Define Model Search Paths

The initial default directory is the current directory (.\). Click the New (Insert) button to add a new directory to the search list. A blank line will be displayed. Click *[...]* to open the *[Select Directory]* dialog (see Figure 20.27, "Add a New Directory to the Search List").

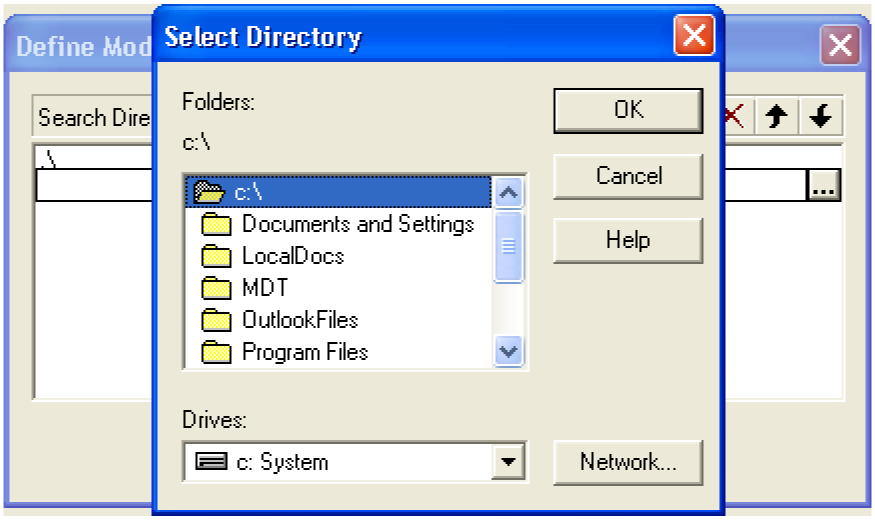


Figure 20.27. Add a New Directory to the Search List

Select a file directory to be searched and press OK. The new filepath will be added to the search list, as seen in Figure 20.28, "New Search Item".

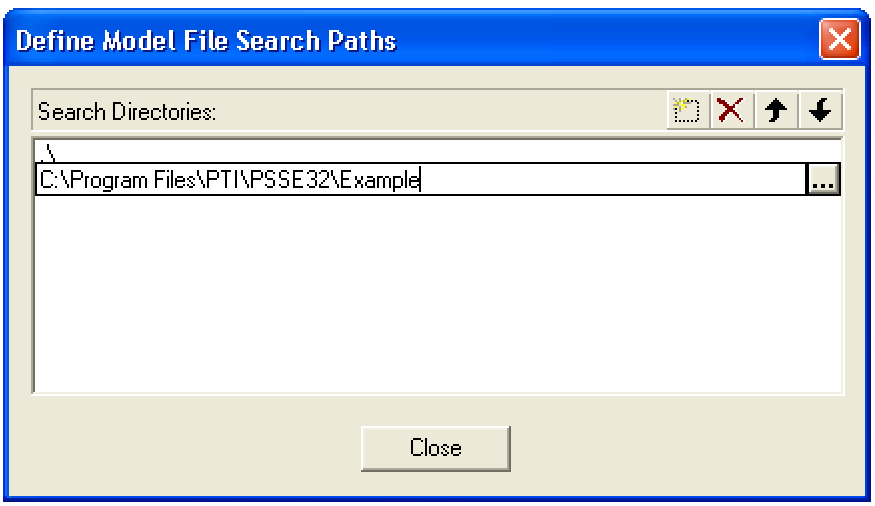


Figure 20.28. New Search Item

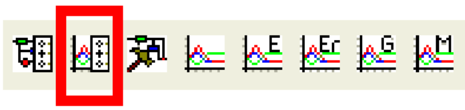
Additional directories may be added, deleted or moved up and down in the search list by using the buttons at the top of the dialog. When the application is closed, the defined paths will be saved in a file named DynModelPaths.prm found in the Document and Settings directory for the active user. A total of five model search paths may be defined.

Directories are searched for GMB models in the order in which they appear in the dialog shown in Figure 20.28, "New Search Item". To change the search order, select an item file item in the dialog and move it up or down in the search order by use of the arrow icons found on the dialog.

Chapter 21
Dynamic Simulation Solutions

21.1. Dynamic Solution Parameters

Requirements / Prerequisites
Validly specified power flow case, solved to an acceptable mismatch level.
Dynamics data must exist in dynamics working memory.
Reading Dynamics Model Data



Dynamics > Simulation > Solution parameters...

Dynamics solution parameters are set and modified using the *[Dynamic Solution Parameters]* dialog (Figure 21.1, "Dynamic Solution Parameters Dialog"). A number of controls affecting network solutions in dynamic simulations as well as the dynamic simulation itself can be set, and the channel output file can also be specified. Typically a dynamic simulation is run to a certain time, solution parameters are modified, and the run continued with the new parameters.

Click *[OK]* to keep modified settings.

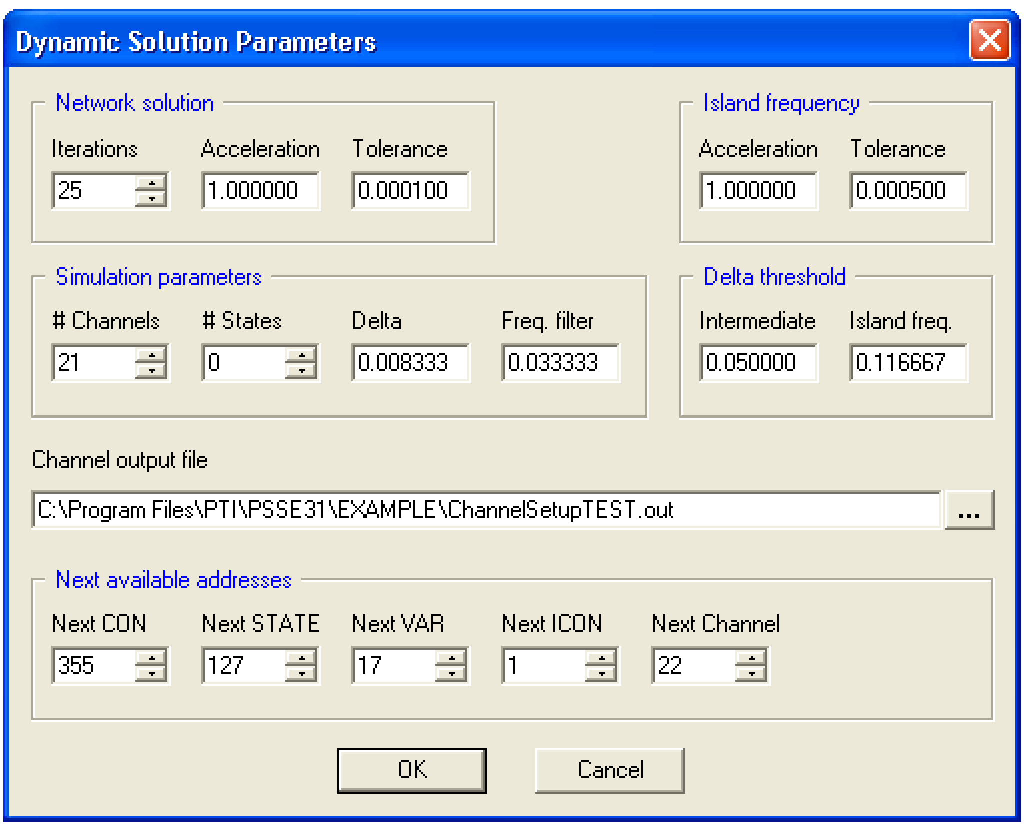
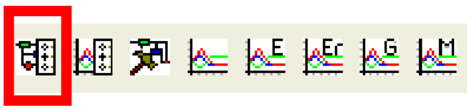


Figure 21.1. Dynamic Solution Parameters Dialog

21.2. Solution Options

Requirements / Prerequisites
Validly specified power flow case, solved to an acceptable mismatch level. Dynamics data must exist in dynamics working memory. Reading Dynamics Model Data Converting Loads and Generators



Dynamics > *Simulation* > Simulation options...

System-wide monitoring and solution options are set and modified using the *[Dynamic Simulation Options]* dialog (Figure 21.2, "Dynamic Simulation Options Dialog"). Checkboxes are available to enable/disable the following modeling options:

Network frequency dependence (NETFRQ)	If enabled, both network parameters and the flux calculations of generator models are made dependent on local frequency.
Scan for out-of-step conditions (OSSCAN)	If enabled, every circuit in both directions checked for out-of-step conditions.
Scan for generators exceeding angle threshold	If enabled, trip machines instantaneously if the specified threshold is violated. For the angle scan option there is provision to restrict the angle scan only to those machines whose MVA rating is greater than or equal to the value specified
Scan for generators exceeding power unbalance threshold	
Scan circuits against generic relay zones (model RELAY1)	If enabled, every circuit in both directions checked against generic relay characteristics.
Scan for buses outside of voltage range	If enabled, bus voltages outside of the specified band are reported.
Set relative machine angles	If enabled, machine angles, as well as any output channels containing machine angles, are expressed relative to the specified value rather than as absolute angles. This option applies to the Machine Angle Monitoring Model (SYSANG) in CHSB.
Dynamic voltage violation checks	If enabled, bus voltages will be checked for primary and sec-ondary recovery and for voltage dip violations (collectively called voltage violation checks). The voltage violation checks can be performed on every bus or on a subsystem basis.

Click *[OK]* to keep modified simulation option settings.

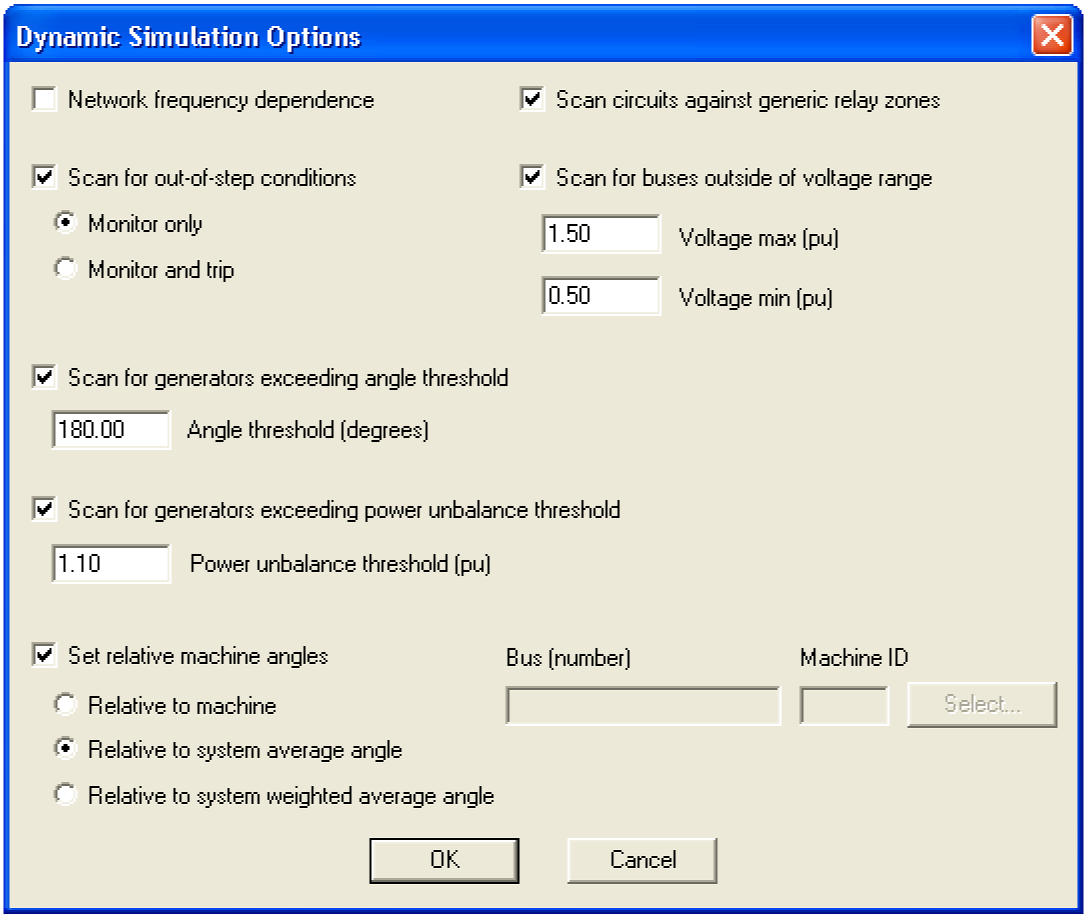
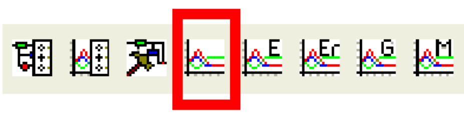


Figure 21.2. Dynamic Simulation Options Dialog

21.3. Running State-Space Simulation

STRT/RUN

Requirements / Prerequisites
Validly specified power flow case. Reading Power Flow Raw Data into the Working Case OR Retrieving a Power Flow Saved Case File Dynamics data must exist in dynamics working memory. Restoring Dynamics Working Memory from a Binary Snapshot File OR Restoring Dynamics Working Memory from a Binary Snapshot File Created in PSS®E-26 or Earlier - - - - - - Generators Converted Factorizing the Network Admittance Matrix



Dynamics > Simulation > Perform simulation (STRT/RUN)...

The *[Perform Dynamic Simulation]* dialog (Figure 21.3, “Perform Dynamic Simulation Dialog”) provides *Simulation options* and a checkbox to enable the display of the network convergence monitor. Click *[...]* to open the selection window for the required *Channel Output file* (*.out), which can be a new file or a previously-built file to be over-written.

[Perform Dynamic Simulation] is a modeless dialog; you may access other program functions while it is active.

Click *[Initialize]* to verify that initial conditions meet the criteria for simulation. A summary of initial conditions and suspect states, if any, is routed to the *Progress* tab (Figure 21.4, “Example of Dynamic Simulation Initial Conditions Output”), and the *[Run]* button is enabled.

Click *[Run]* to perform the simulation. If the display of the network convergence monitor has been enabled, it is routed to the *Progress* tab (Figure 21.5, “Example of Dynamic Simulation Run Output”). Otherwise, only the file path of the Channel Output file is displayed.

After the simulation has been run to the specified time, disturbances and faults can be applied and the simulation run again to a new specified time (see Section 21.7, “Applying Disturbances”).

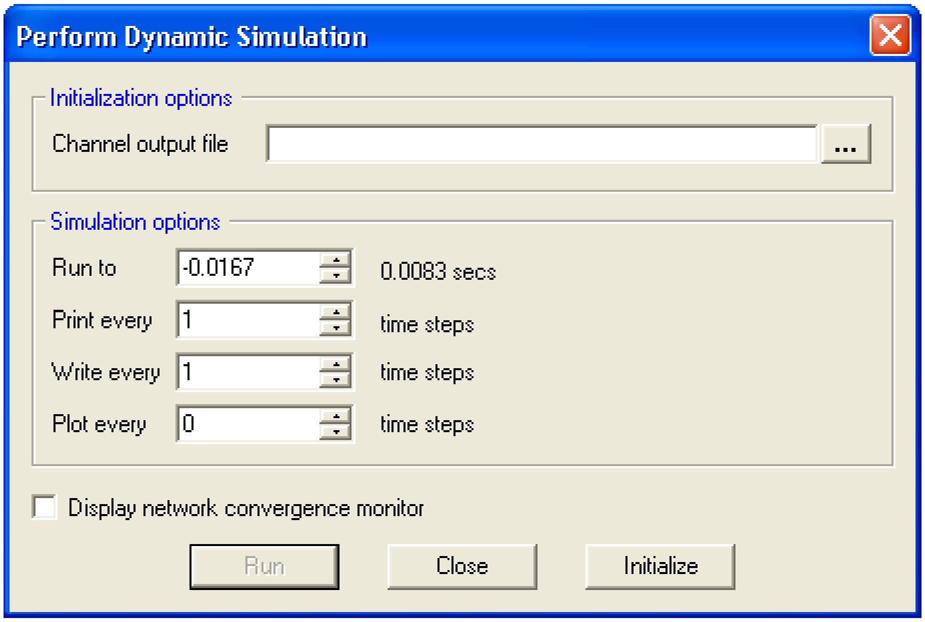
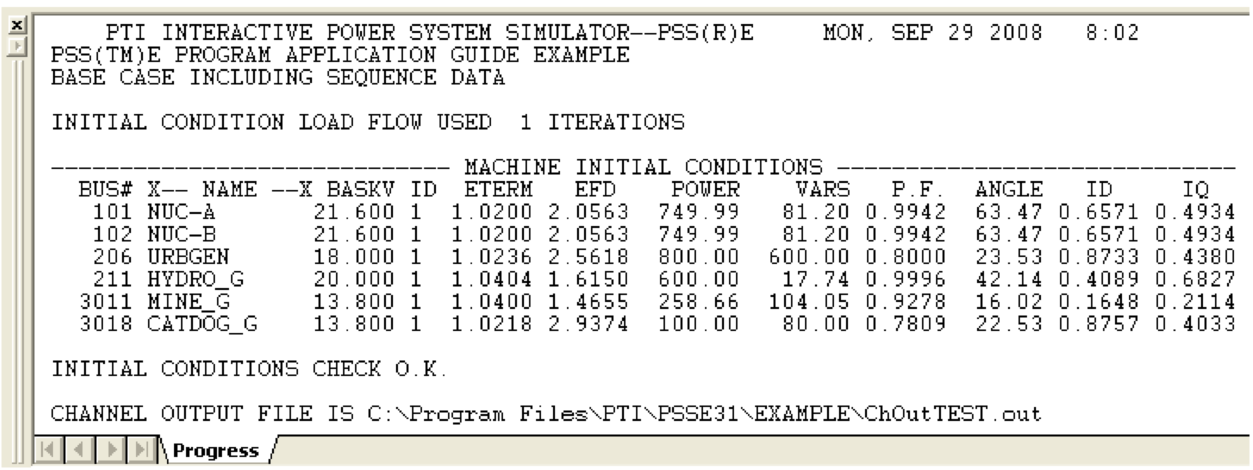


Figure 21.3. Perform Dynamic Simulation Dialog



```
    PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS(R)E     MON, SEP 29 2008   8:02
PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE
BASE CASE INCLUDING SEQUENCE DATA

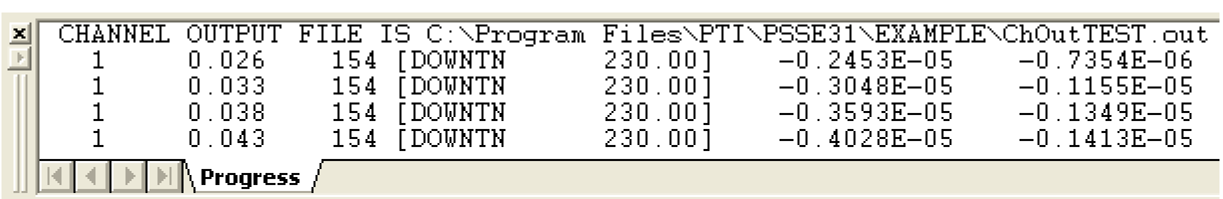
INITIAL CONDITION LOAD FLOW USED  1 ITERATIONS

----------------------------- MACHINE INITIAL CONDITIONS ----------------------------
  BUS# X-- NAME --X BASKV ID  ETERM   EFD    POWER    VARS   P.F.  ANGLE   ID     IQ
   101 NUC-A        21.600 1  1.0200 2.0563  749.99   81.20 0.9942 63.47 0.6571 0.4934
   102 NUC-B        21.600 1  1.0200 2.0563  749.99   81.20 0.9942 63.47 0.6571 0.4934
   206 URBGEN       18.000 1  1.0236 2.5618  800.00  600.00 0.8000 23.53 0.8733 0.4380
   211 HYDRO_G      20.000 1  1.0404 1.6150  600.00   17.74 0.9996 42.14 0.4089 0.6827
  3011 MINE_G       13.800 1  1.0400 1.4655  258.66  104.05 0.9278 16.02 0.1648 0.2114
  3018 CATDOG_G     13.800 1  1.0218 2.9374  100.00   80.00 0.7809 22.53 0.8757 0.4033

INITIAL CONDITIONS CHECK O.K.

CHANNEL OUTPUT FILE IS C:\Program Files\PTI\PSSE31\EXAMPLE\ChOutTEST.out
Progress
```

Figure 21.4. Example of Dynamic Simulation Initial Conditions Output



```
CHANNEL OUTPUT FILE IS C:\Program Files\PTI\PSSE31\EXAMPLE\ChOutTEST.out
   1      0.026    154 [DOWNTN       230.00]     -0.2453E-05     -0.7354E-06
   1      0.033    154 [DOWNTN       230.00]     -0.3048E-05     -0.1155E-05
   1      0.038    154 [DOWNTN       230.00]     -0.3593E-05     -0.1349E-05
   1      0.043    154 [DOWNTN       230.00]     -0.4028E-05     -0.1413E-05
Progress
```

Figure 21.5. Example of Dynamic Simulation Run Output

Additional Information
PSS® E Program Operation Manual, Initializing Models for State-Space Simulation

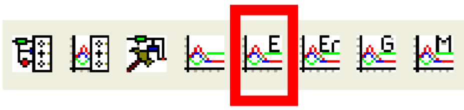
Additional Information
Performing State-Space Simulation in Time Steps

21.4. Running Exciter Simulation

ESTR/ERUN

Requirements / Prerequisites
Validly specified power flow case. Dynamics data must exist in dynamics working memory. Converting Loads and Generators

21.4.1. Exciter Simulation



Dynamics > Simulation > Perform exciter simulation (ESTR/ERUN)...

Excitation system testing, run to any point in time, is specified using the *[Perform Exciter Simulation Test]* dialog (Figure 21.6, “Perform Exciter Simulation Test Dialog”). Click *[...]* to open the selection window for the required *Channel Output file* (*.out), which can be a new file or a previously-built file to be over-written.

Click *[Select]* to display *[Bus Selection]* where the desired bus may be specified. If a bus is specified, the simulation tests the excitation system response of all connected machines having exciter models. If no bus is specified, the simulation tests all machines with connected exciter models.

Specify the step to be applied at all voltage regulator setpoints in the *VREF pu step change* field, typically 0.02 to 0.1. The step magnitude should not exceed about ten percent (0.1) since the object of this test is to reveal small disturbance behavior. Also specify *Simulation options*.

Click *[Initialize]*; a summary of initial conditions is routed to the *Progress* tab (Figure 21.7, “Example of Exciter Simulation Initialization Output”), and the *[Run]* button is enabled.

Click *[Run]* to perform the simulation. A summary is routed to the *Progress* tab (Figure 21.8, “Example of Exciter Simulation Run Output”).

After the simulation has been run to the specified time, disturbances and faults can be applied and the simulation run again to a new specified time (see Section 21.7, “Applying Disturbances”).

[Perform Exciter Simulation Test] is a modeless dialog; you may access other program functions while it is active.

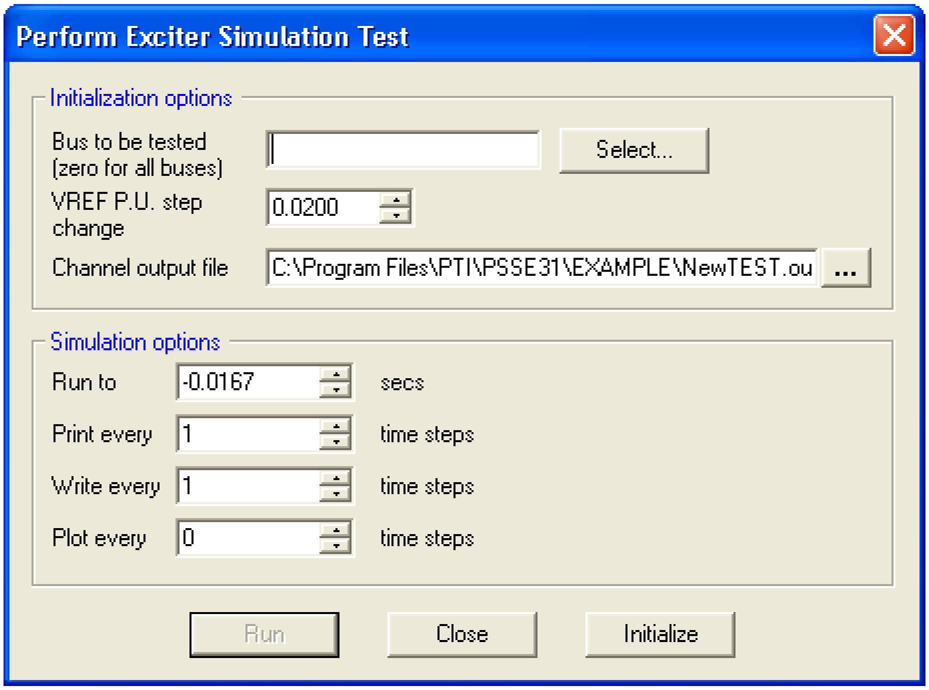
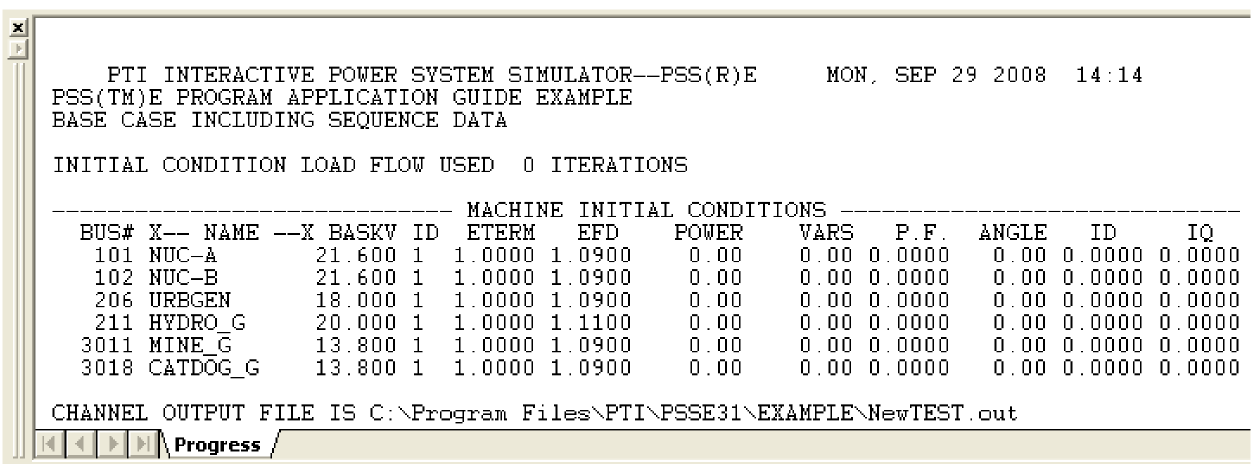


Figure 21.6. Perform Exciter Simulation Test Dialog



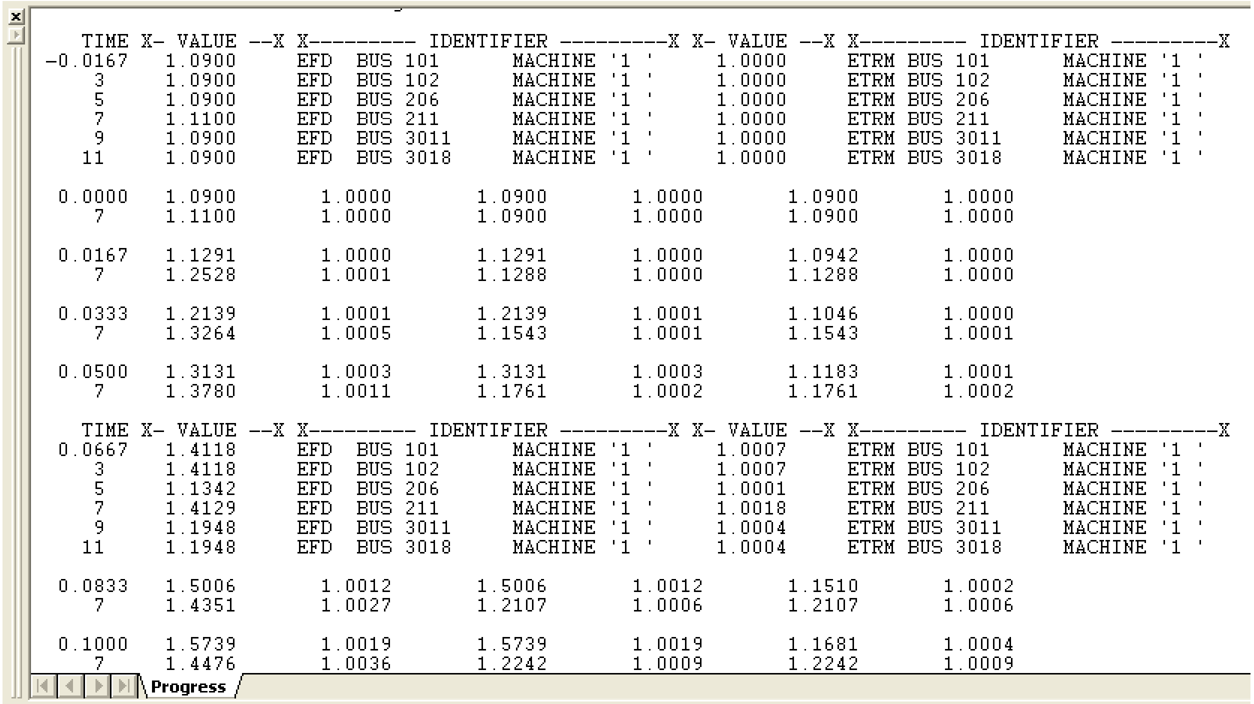
```
    PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS(R)E     MON, SEP 29 2008  14:14
PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE
BASE CASE INCLUDING SEQUENCE DATA

INITIAL CONDITION LOAD FLOW USED   0 ITERATIONS

----------------------------- MACHINE INITIAL CONDITIONS -----------------------------
  BUS# X-- NAME --X BASKV ID  ETERM    EFD    POWER    VARS   P.F.  ANGLE   ID      IQ
   101 NUC-A        21.600 1  1.0000 1.0900   0.00     0.00 0.0000   0.00 0.0000 0.0000
   102 NUC-B        21.600 1  1.0000 1.0900   0.00     0.00 0.0000   0.00 0.0000 0.0000
   206 URBGEN       18.000 1  1.0000 1.0900   0.00     0.00 0.0000   0.00 0.0000 0.0000
   211 HYDRO_G      20.000 1  1.0000 1.1100   0.00     0.00 0.0000   0.00 0.0000 0.0000
  3011 MINE_G       13.800 1  1.0000 1.0900   0.00     0.00 0.0000   0.00 0.0000 0.0000
  3018 CATDOG_G     13.800 1  1.0000 1.0900   0.00     0.00 0.0000   0.00 0.0000 0.0000

CHANNEL OUTPUT FILE IS C:\Program Files\PTI\PSSE31\EXAMPLE\NewTEST.out
```


Figure 21.7. Example of Exciter Simulation Initialization Output



```
  TIME X- VALUE --X X--------- IDENTIFIER ---------X X- VALUE --X X--------- IDENTIFIER ---------X
-0.0167   1.0900     EFD  BUS 101       MACHINE '1 '    1.0000     ETRM BUS 101      MACHINE '1 '
   3      1.0900     EFD  BUS 102       MACHINE '1 '    1.0000     ETRM BUS 102      MACHINE '1 '
   5      1.0900     EFD  BUS 206       MACHINE '1 '    1.0000     ETRM BUS 206      MACHINE '1 '
   7      1.1100     EFD  BUS 211       MACHINE '1 '    1.0000     ETRM BUS 211      MACHINE '1 '
   9      1.0900     EFD  BUS 3011      MACHINE '1 '    1.0000     ETRM BUS 3011     MACHINE '1 '
  11      1.0900     EFD  BUS 3018      MACHINE '1 '    1.0000     ETRM BUS 3018     MACHINE '1 '

 0.0000   1.0900       1.0000       1.0900       1.0000       1.0900       1.0000
   7      1.1100       1.0000       1.0900       1.0000       1.0900       1.0000

 0.0167   1.1291       1.0000       1.1291       1.0000       1.0942       1.0000
   7      1.2528       1.0001       1.1288       1.0000       1.1288       1.0000

 0.0333   1.2139       1.0001       1.2139       1.0001       1.1046       1.0000
   7      1.3264       1.0005       1.1543       1.0001       1.1543       1.0001

 0.0500   1.3131       1.0003       1.3131       1.0003       1.1183       1.0001
   7      1.3780       1.0011       1.1761       1.0002       1.1761       1.0002

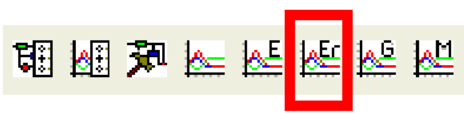
  TIME X- VALUE --X X--------- IDENTIFIER ---------X X- VALUE --X X--------- IDENTIFIER ---------X
 0.0667   1.4118     EFD  BUS 101       MACHINE '1 '    1.0007     ETRM BUS 101      MACHINE '1 '
   3      1.4118     EFD  BUS 102       MACHINE '1 '    1.0007     ETRM BUS 102      MACHINE '1 '
   5      1.1342     EFD  BUS 206       MACHINE '1 '    1.0001     ETRM BUS 206      MACHINE '1 '
   7      1.4129     EFD  BUS 211       MACHINE '1 '    1.0018     ETRM BUS 211      MACHINE '1 '
   9      1.1948     EFD  BUS 3011      MACHINE '1 '    1.0004     ETRM BUS 3011     MACHINE '1 '
  11      1.1948     EFD  BUS 3018      MACHINE '1 '    1.0004     ETRM BUS 3018     MACHINE '1 '

 0.0833   1.5006       1.0012       1.5006       1.0012       1.1510       1.0002
   7      1.4351       1.0027       1.2107       1.0006       1.2107       1.0006

 0.1000   1.5739       1.0019       1.5739       1.0019       1.1681       1.0004
   7      1.4476       1.0036       1.2242       1.0009       1.2242       1.0009
```


Figure 21.8. Example of Exciter Simulation Run Output

21.4.2. Exciter Response Ratio Simulation



Dynamics > Simulation > Perform exciter response ratio simulation (ESTR/ERUN)...

Excitation system response ratio testing, run to any point in time, is specified using the *[Perform Exciter Response Ratio Simulation Test]* dialog (Figure 21.9, “Perform Exciter Response Ratio Simulation Test Dialog”). Click *[...]* to open the selection window for the required *Channel Output file* (*.out), which can be a new file or a previously-built file to be over-written.

Click *[Select]* to display *[Bus Selection]* where the desired bus may be specified. If a bus is specified, the simulation tests the excitation system response of all connected machines having exciter models. If no bus is specified, the simulation tests all machines with connected exciter models.

Specify the value used to initialize each generator to rated MVA (i.e., to MBASE as contained in the power flow generator data) in the *Default power factor* field. Also specify *Simulation options*.

If you wish to initialize machines with a power factor other than the *Default power factor*, list them in the window under *Machines initialized with own power factor*. Click *[Select]* to display *[Machine Selection]* where the *Bus* and *Machine ID* may be selected. Adjust the *Power factor* and click *[Add]*. To remove a machine from the list, highlight it and press the *[Delete]* key on your keyboard.

Click *[Initialize]*; a summary of initial conditions is routed to the *Progress* tab (Figure 21.9, "Perform Exciter Response Ratio Simulation Test Dialog"), and the *[Run]* button is enabled.

Click *[Run]* to perform the simulation. A summary is routed to the *Progress* tab (Figure 21.9, "Perform Exciter Response Ratio Simulation Test Dialog").

After the simulation has been run to the specified time, disturbances and faults can be applied and the simulation run again to a new specified time (see Section 21.7, "Applying Disturbances").

[Perform Exciter Response Ratio Simulation Test] is a modeless dialog; you may access other program functions while it is active.

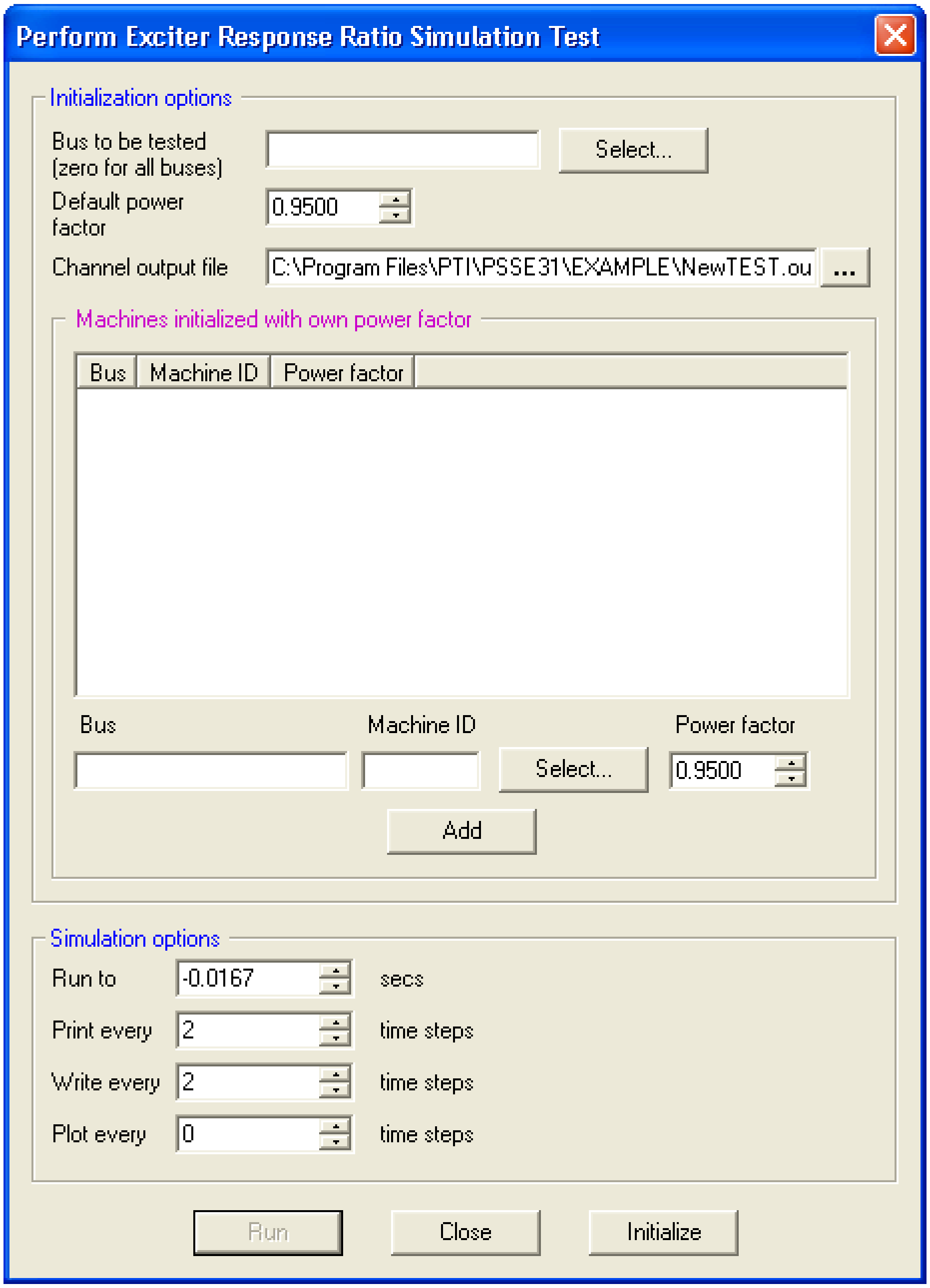


Figure 21.9. Perform Exciter Response Ratio Simulation Test Dialog

```
   PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS(R)E     MON, SEP 29 2008  14:52
PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE
BASE CASE INCLUDING SEQUENCE DATA

INITIAL CONDITION LOAD FLOW USED  0 ITERATIONS

----------------------------- MACHINE INITIAL CONDITIONS -----------------------------
  BUS# X-- NAME --X BASKV ID  ETERM   EFD    POWER    VARS   P.F.  ANGLE   ID     IQ
  3011 MINE_G       13.800 1  1.0000 2.4745  950.00  312.25 0.9500  40.50 0.8544 0.5196

CHANNEL OUTPUT FILE IS C:\Program Files\PTI\PSSE31\EXAMPLE\NewTEST.out

Progress
```

Example of Exciter Response Ratio Simulation Initialization Output

```
CHANNEL OUTPUT FILE IS C:\Program Files\PTI\PSSE31\EXAMPLE\NewTEST.out

   TIME X- VALUE --X X--------- IDENTIFIER ---------X X- VALUE --X X--------- IDENTIFIER ---------X
-0.0167   2.4745     EFD  BUS 3011     MACHINE '1 '

 0.0000   2.4745

 0.0167   3.4451

 0.0333   4.0000

 0.0500   4.0000

   TIME X- VALUE --X X--------- IDENTIFIER ---------X X- VALUE --X X--------- IDENTIFIER ---------X
 0.0667   4.0000     EFD  BUS 3011     MACHINE '1 '

 0.0833   4.0000

 0.1000   4.0000
Progress
```

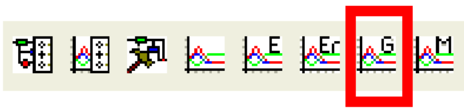
Example of Exciter Response Ratio Simulation Run Output

Additional Information
PSS® E Program Operation Manual, Initializing Excitation System Models Performing Exciter Simulation in Time Steps

21.5. Running Governor Response Simulation Test

GSTR/GRUN

Requirements / Prerequisites
Validly specified power flow case.
Dynamics data must exist in dynamics working memory.
Converting Loads and Generators



Dynamics > Simulation > Perform governor response simulation (GSTR/GRUN)...

Governor response testing, run to any point in time, is specified using the *[Perform Governor Response Simulation]* dialog (Figure 21.10, “Perform Governor Response Simulation Dialog”).

Click *[...]* to open the selection window for the required *Channel Output file* (*.out), which can be a new file or a previously-built file to be over-written.

Click *[Select]* to display *[Bus Selection]* where the desired bus may be specified. If a generating bus is specified, the simulation tests the governor response of all connected machines having governor models. If no bus is specified, the simulation tests all machines in the Snapshot file with connected governor models. The test is performed with each machine in isolation with a load.

Specify the initial machine loading in per unit of machine base, MBASE in the *Initial pu loading* field. Specify the load step change to be applied at TIME equals zero during the simulation in the *pu loading step* field. This test assumes that generator and governor model parameters are entered on actual machine base. Also specify *Simulation options*.

Click *[Initialize]*; a summary of initial conditions is routed to the *Progress* tab (Figure 21.11, “Example of Governor Response Simulation Initialization Output”), and the *[Run]* button is enabled.

Click *[Run]* to perform the simulation. A summary is routed to the *Progress* tab (Figure 21.12, “Example of Governor Response Simulation Run Output”).

After the simulation has been run to the specified time, disturbances and faults can be applied and the simulation run again to a new specified time (see Section 21.7, “Applying Disturbances”).

[Perform Governor Response Simulation] is a modeless dialog; you may access other program functions while it is active.

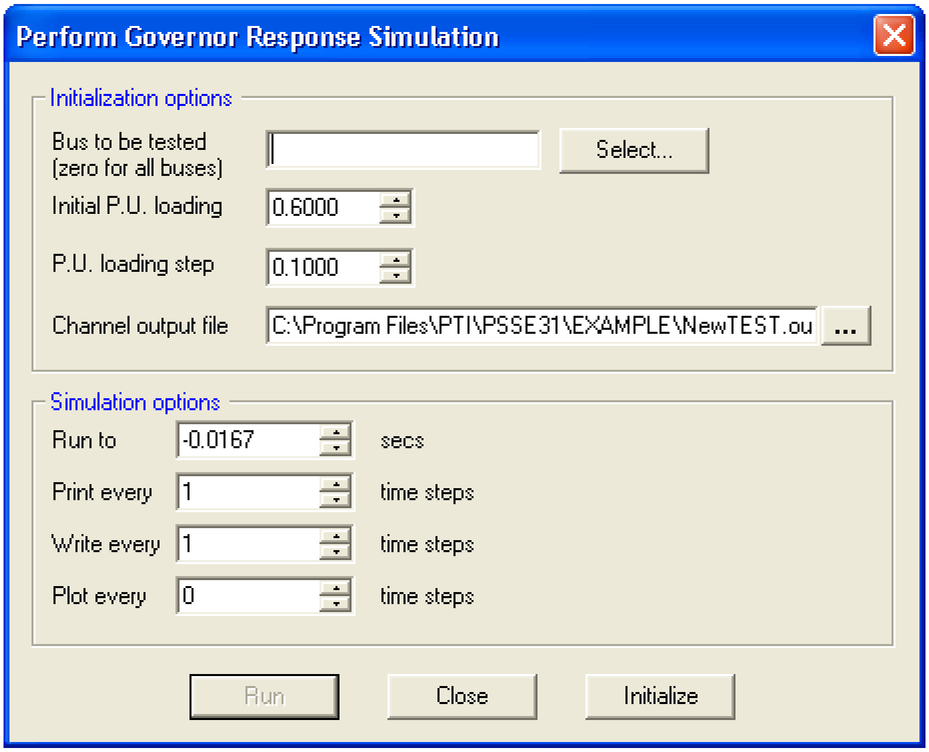
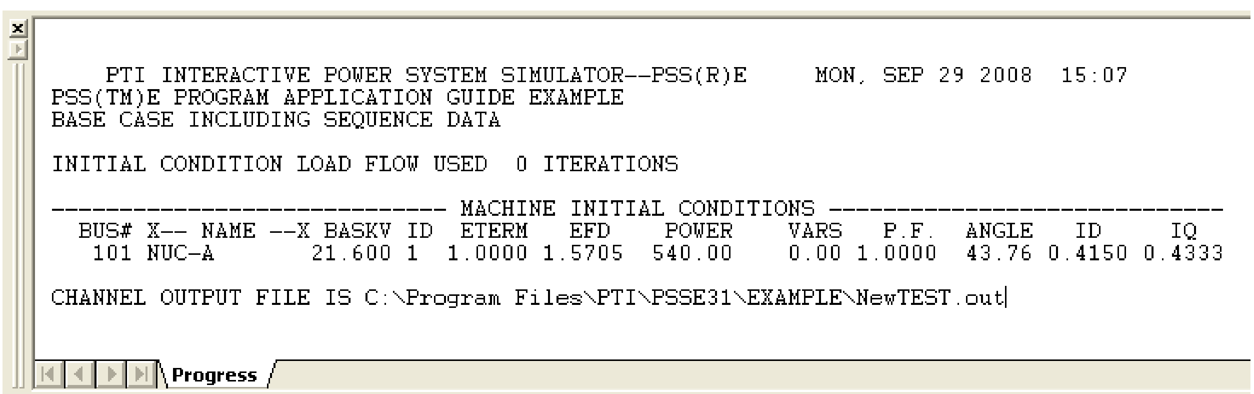


Figure 21.10. Perform Governor Response Simulation Dialog



```
    PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS(R)E     MON, SEP 29 2008  15:07
PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE
BASE CASE INCLUDING SEQUENCE DATA

INITIAL CONDITION LOAD FLOW USED  0 ITERATIONS

----------------------------- MACHINE INITIAL CONDITIONS -----------------------------
  BUS# X-- NAME --X BASKV ID  ETERM    EFD    POWER    VARS   P.F.  ANGLE   ID      IQ
   101 NUC-A        21.600 1  1.0000 1.5705  540.00    0.00 1.0000  43.76 0.4150 0.4333

CHANNEL OUTPUT FILE IS C:\Program Files\PTI\PSSE31\EXAMPLE\NewTEST.out
```


Figure 21.11. Example of Governor Response Simulation Initialization Output

```
   TIME X- VALUE --X X--------- IDENTIFIER ---------X X- VALUE --X X--------- IDENTIFIER ---------X
-0.0167   0.0000      SPD  BUS 101       MACHINE '1 '    0.60360     PMEC BUS 101       MACHINE '1 '

-0.0083   0.0000       0.60360

 0.0000   0.0000       0.60360

 0.0083 -1.58290E-04  0.60360

 0.0167 -2.63663E-04  0.60439

   TIME X- VALUE --X X--------- IDENTIFIER ---------X X- VALUE --X X--------- IDENTIFIER ---------X
 0.0250 -3.67751E-04 SPD  BUS 101       MACHINE '1 '    0.60525     PMEC BUS 101       MACHINE '1 '

 0.0333 -4.70847E-04  0.60630

 0.0417 -5.72679E-04  0.60750

 0.0500 -6.73114E-04  0.60883

 0.0583 -7.72037E-04  0.61026

   TIME X- VALUE --X X--------- IDENTIFIER ---------X X- VALUE --X X--------- IDENTIFIER ---------X
 0.0667 -8.69356E-04 SPD  BUS 101       MACHINE '1 '    0.61177     PMEC BUS 101       MACHINE '1 '

 0.0750 -9.64998E-04  0.61334

 0.0833 -1.05891E-03  0.61496

 0.0917 -1.15104E-03  0.61662
```

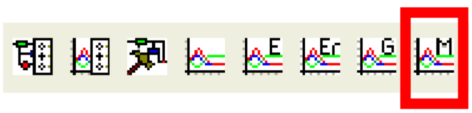
Figure 21.12. Example of Governor Response Simulation Run Output

Additional Information
PSS®E Program Operation Manual, Initializing Turbine Governor Models Performing Governor Response Simulation in Time Steps

21.6. Running Extended Term Dynamic Simulation

MSTR/MRUN

Requirements / Prerequisites
Validly specified power flow case. Dynamics data must exist in dynamics working memory. All equipment models used in the system dynamic model must have been upgraded for use in the extended term simulation mode Converting Loads and Generators Factorizing the Network Admittance Matrix



Dynamics > Simulation > Perform extended term simulation (MSTR/MRUN)...

The *[Perform Extended Term Simulation]* dialog (Figure 21.13, “Perform Extended Term Dynamic Simulation Dialog”) provides *Simulation options* and a checkbox to enable the display of the network convergence monitor. Click *[...]* to open the selection window for the required *Channel Output file* (*.out), which can be a new file or a previously-built file to be over-written.

[Perform Extended Term Simulation] is a modeless dialog; you may access other program functions while it is active.

Click *[Initialize]* to verify that initial conditions meet the criteria for simulation. A summary of initial conditions is routed to the *Progress* tab (Figure 21.13, “Perform Extended Term Dynamic Simulation Dialog”), and the *[Run]* button is enabled.

Click *[Run]* to perform the simulation. If the display of the network convergence monitor has been enabled, it is routed to the *Progress* tab (Figure 21.13, “Perform Extended Term Dynamic Simulation Dialog”). Otherwise, only the file path of the Channel Output file is displayed.

After the simulation has been run to the specified time, disturbances and faults can be applied and the simulation run again to a new specified time (see Section 21.7, “Applying Disturbances”).

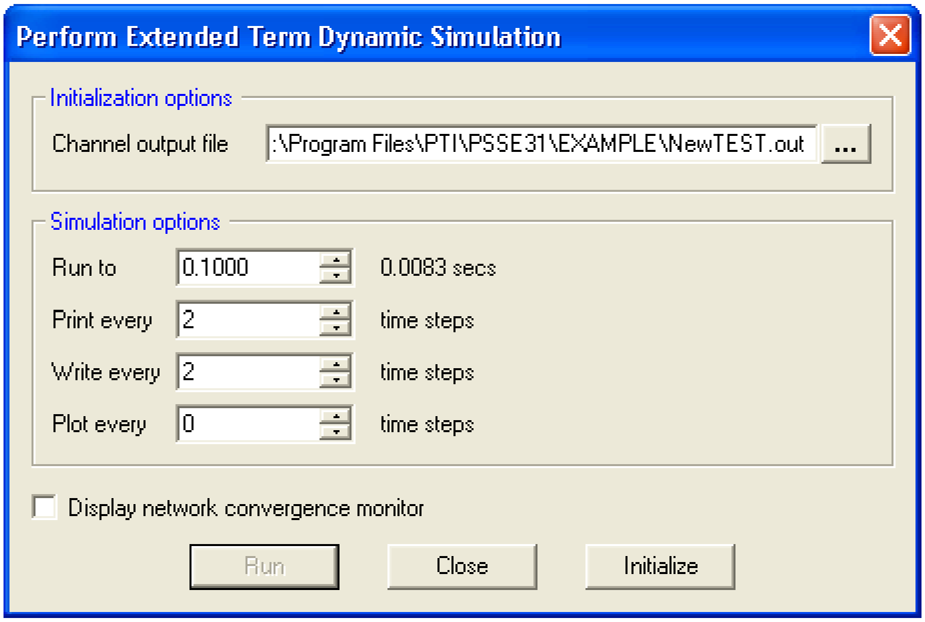
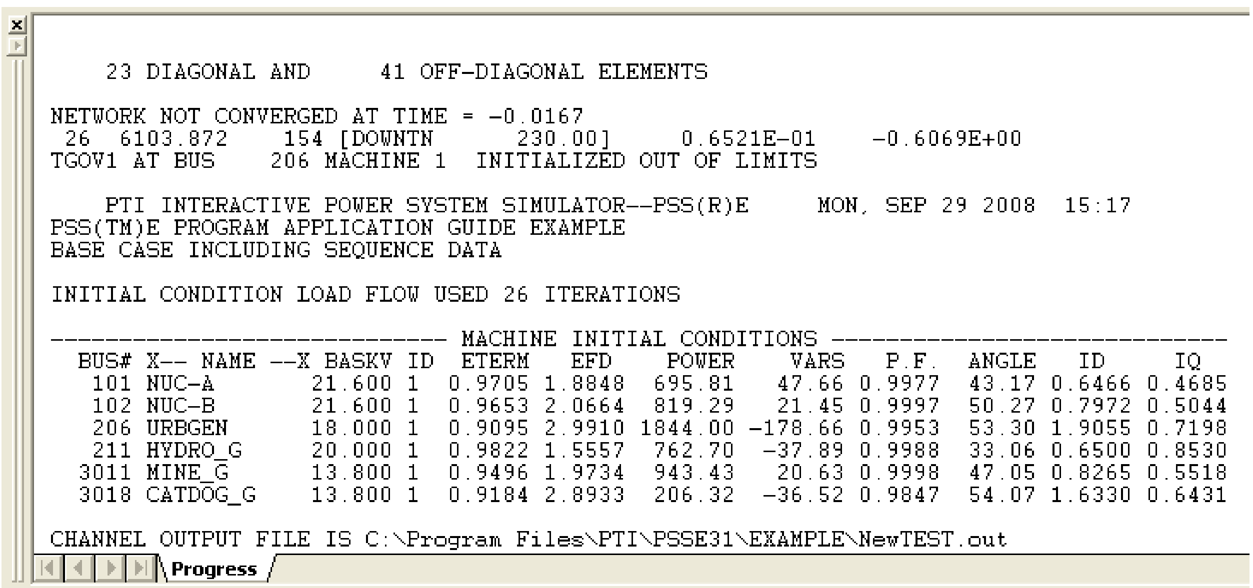


Figure 21.13. Perform Extended Term Dynamic Simulation Dialog



```
    23 DIAGONAL AND     41 OFF-DIAGONAL ELEMENTS

NETWORK NOT CONVERGED AT TIME = -0.0167
 26   6103.872     154 [DOWNTN       230.00]      0.6521E-01    -0.6069E+00
TGOV1 AT BUS     206 MACHINE 1  INITIALIZED OUT OF LIMITS

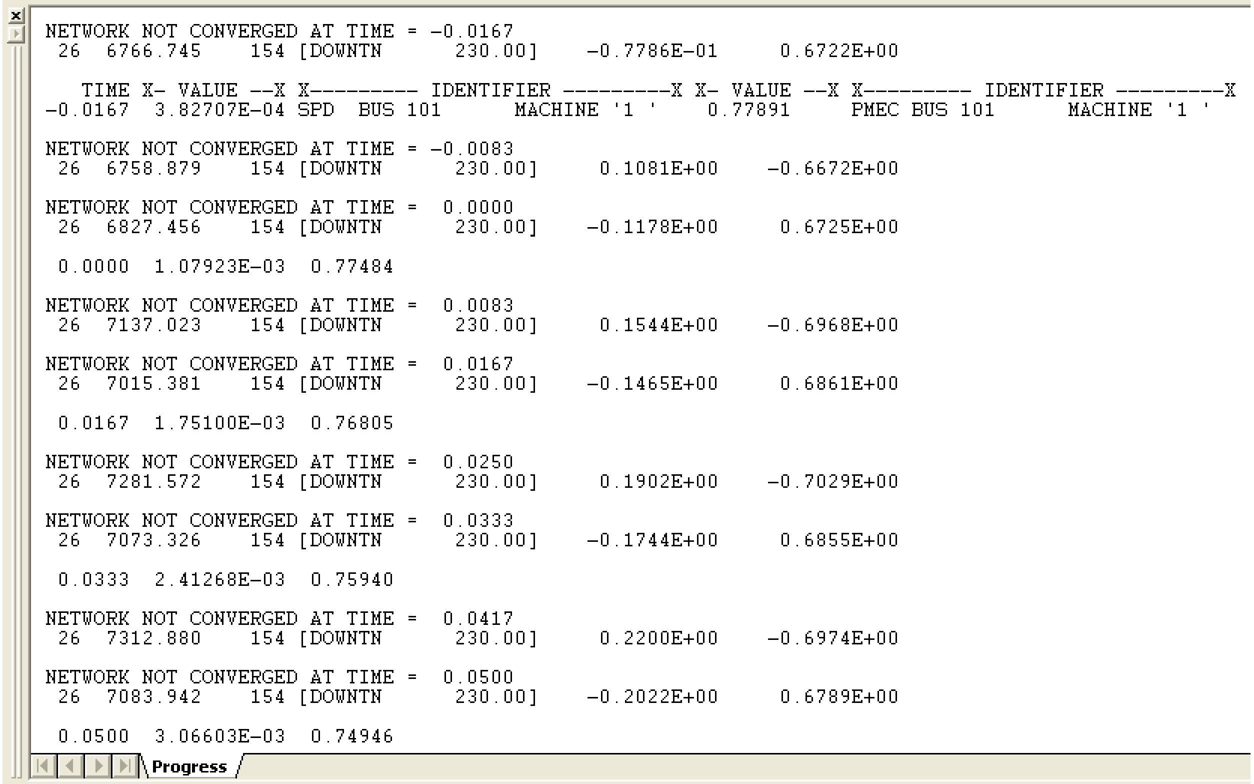
    PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS(R)E     MON, SEP 29 2008  15:17
PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE
BASE CASE INCLUDING SEQUENCE DATA

INITIAL CONDITION LOAD FLOW USED 26 ITERATIONS

----------------------------- MACHINE INITIAL CONDITIONS -----------------------------
  BUS# X-- NAME --X BASKV ID  ETERM  EFD    POWER    VARS   P.F.   ANGLE   ID     IQ
   101 NUC-A       21.600 1  0.9705 1.8848  695.81   47.66 0.9977  43.17 0.6466 0.4685
   102 NUC-B       21.600 1  0.9653 2.0664  819.29   21.45 0.9997  50.27 0.7972 0.5044
   206 URBGEN      18.000 1  0.9095 2.9910 1844.00 -178.66 0.9953  53.30 1.9055 0.7198
   211 HYDRO_G     20.000 1  0.9822 1.5557  762.70  -37.89 0.9988  33.06 0.6500 0.8530
  3011 MINE_G      13.800 1  0.9496 1.9734  943.43   20.63 0.9998  47.05 0.8265 0.5518
  3018 CATDOG_G    13.800 1  0.9184 2.8933  206.32  -36.52 0.9847  54.07 1.6330 0.6431

CHANNEL OUTPUT FILE IS C:\Program Files\PTI\PSSE31\EXAMPLE\NewTEST.out
```


Example of Extended Term Simulation Initialization Output



```
NETWORK NOT CONVERGED AT TIME = -0.0167
 26   6766.745     154 [DOWNTN      230.00]    -0.7786E-01     0.6722E+00

   TIME X- VALUE --X X--------- IDENTIFIER ---------X X- VALUE --X X--------- IDENTIFIER ---------X
-0.0167  3.82707E-04 SPD  BUS 101       MACHINE '1 '    0.77891      PMEC BUS 101       MACHINE '1 '

NETWORK NOT CONVERGED AT TIME = -0.0083
 26   6758.879     154 [DOWNTN      230.00]     0.1081E+00    -0.6672E+00

NETWORK NOT CONVERGED AT TIME =  0.0000
 26   6827.456     154 [DOWNTN      230.00]    -0.1178E+00     0.6725E+00

 0.0000  1.07923E-03  0.77484

NETWORK NOT CONVERGED AT TIME =  0.0083
 26   7137.023     154 [DOWNTN      230.00]     0.1544E+00    -0.6968E+00

NETWORK NOT CONVERGED AT TIME =  0.0167
 26   7015.381     154 [DOWNTN      230.00]    -0.1465E+00     0.6861E+00

 0.0167  1.75100E-03  0.76805

NETWORK NOT CONVERGED AT TIME =  0.0250
 26   7281.572     154 [DOWNTN      230.00]     0.1902E+00    -0.7029E+00

NETWORK NOT CONVERGED AT TIME =  0.0333
 26   7073.326     154 [DOWNTN      230.00]    -0.1744E+00     0.6855E+00

 0.0333  2.41268E-03  0.75940

NETWORK NOT CONVERGED AT TIME =  0.0417
 26   7312.880     154 [DOWNTN      230.00]     0.2200E+00    -0.6974E+00

NETWORK NOT CONVERGED AT TIME =  0.0500
 26   7083.942     154 [DOWNTN      230.00]    -0.2022E+00     0.6789E+00

 0.0500  3.06603E-03  0.74946
Progress
```

Example of Extended Term Simulation Run Output

Additional Information
PSS® E Program Operation Manual, Initializing Models for Extended Term Simulation Performing Extended Term Simulation in Time Steps

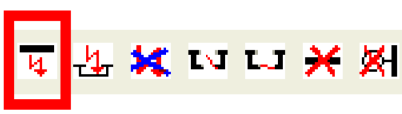
21.7. Applying Disturbances

Requirements / Prerequisites
Validly specified power flow case.
Dynamics data must exist in dynamics working memory.
Converting Loads and Generators
Factorizing the Network Admittance Matrix
Valid Dynamics Simulation

Faults applied in a dynamic simulation session are not preserved in Snapshot Files or Saved Case Files for use in the next session. The fault list is initialized to empty when PSS®E is restarted and during the simulation initialization activities STRT, MSTR, ASTR, ESTR and GSTR.

Unlike previous versions of PSS®E, where it was necessary to use activities LOFL and RTRN to switch back and forth between the Dynamics and Power Flow modes, mode switching is now automatic. Therefore, disturbance functions can be accessed and run at any time.

21.7.1. Bus Fault



Disturbance > Bus fault...

A fault at a specified in-service bus (that is, Bus Type 1 or 2) can be applied using the *[Apply a Bus Fault]* dialog (Figure 21.14, "Apply a Bus Fault Dialog"). Click *[Select]* to open *[Bus Selection]* where the desired bus with base kV may be selected. The *Base kV* field must contain a positive value in order to calculate *Admittance* using MHOs or OHMs. Default *Admittance* simulates a three phase fault. Specification of these data items is identical to the APPLY FAULT BUS command of activity PSAS.

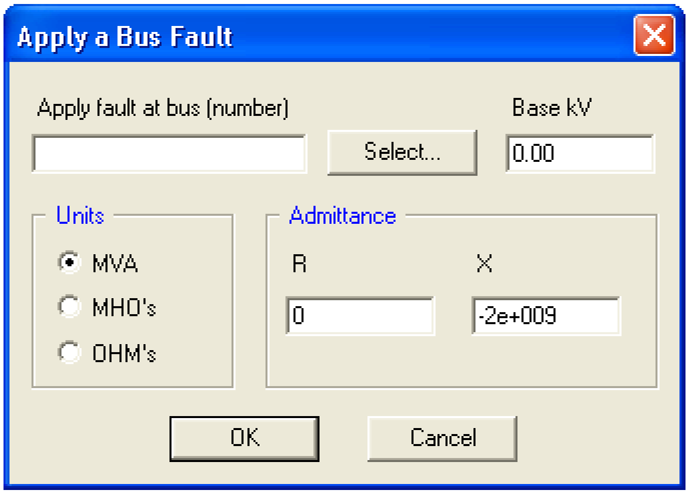


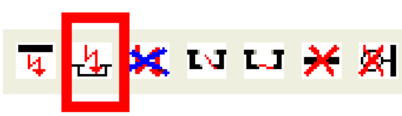
Figure 21.14. Apply a Bus Fault Dialog

Click *[OK]* to replace the fixed shunt at the designated bus with the MVA admittance equivalent for the negative and/or zero sequence networks to the *Admittance* values entered. The following summary is routed to the *Progress* tab.

```
*** BUS <number> [<bus name> <kV> ] SHUNT <number> = (<R value> , <X value> )
ADDED ***
```

Additional Information
PSS®E Program Operation Manual, PSAS Commands

21.7.2. Line Fault



Disturbance > Line fault...

A fault at the from bus end of a specified branch can be applied using the *[Apply a Line Fault]* dialog (Figure 21.15, "Apply a Line Fault Dialog "). If the branch to be faulted is a non-transformer branch or a two-winding transformer, it must be in-service. If the branch to be faulted is a three-winding transformer, the winding connected to the first bus specified must be in-service.

Click *[Select]* to display *[Branch Selection]* where the desired buses and *Circuit ID* may be selected. The *Base kV* field of the from bus must contain a positive value in order to calculate *Admittance* using MHOs or OHMs. Default *Admittance* simulates a three phase fault. Specification of these data items is identical to the APPLY FAULT BRANCH command of activity PSAS.

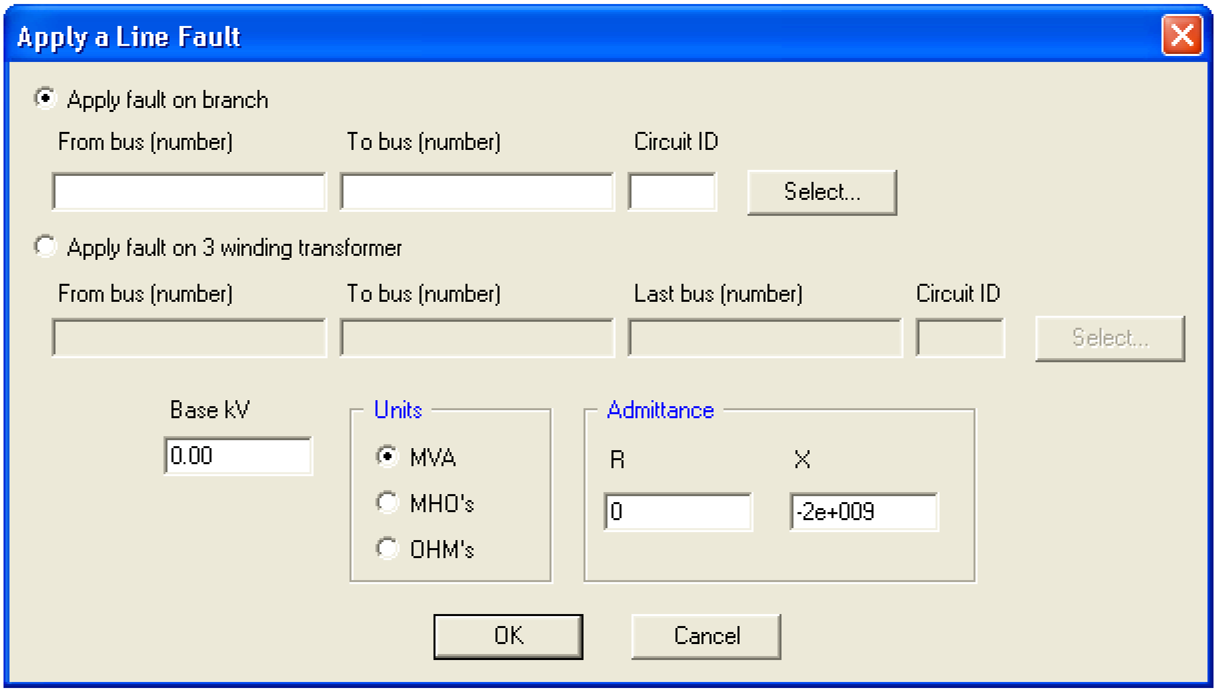


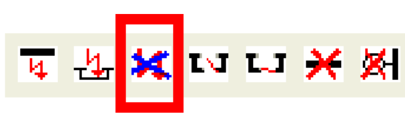
Figure 21.15. Apply a Line Fault Dialog

Click *[OK]* to replace the line shunt at the from bus end of the designated branch with the MVA admittance equivalent for the negative sequence network and/or the zero sequence network to the *Admittance* values entered. The following summary is routed to the *Progress* tab.

```
*** CKT <number> BUS <number> [<bus name> <kV> ] TO <number> [<bus name> kV>]
LINE SHUNT SET TO (<R value> , <X value>) ***
```

Additional Information
PSS® E Program Operation Manual, PSAS Commands

21.7.3. Clear Fault



Disturbance > Clear fault...

Any faults applied using *[Apply a Bus Fault]*, *[Apply a Line Fault]*, *[Calculate and Apply a Bus Fault]* and *[Calculate and Apply Branch Unbalance]* can be cleared using the *[Clear Fault]* dialog (Figure 21.16, “Clear Fault Dialog”).

The dialog lists those buses and/or branches that have been faulted in the current session. Highlight the fault to be cleared and click *[Go]*. The cleared bus or branch returns to its status previous to the application of a fault. A summary is routed to the *Progress* tab (Figure 21.17, “Example of Clear Fault Output”).

You will need to click *[Close]* to end this activity.

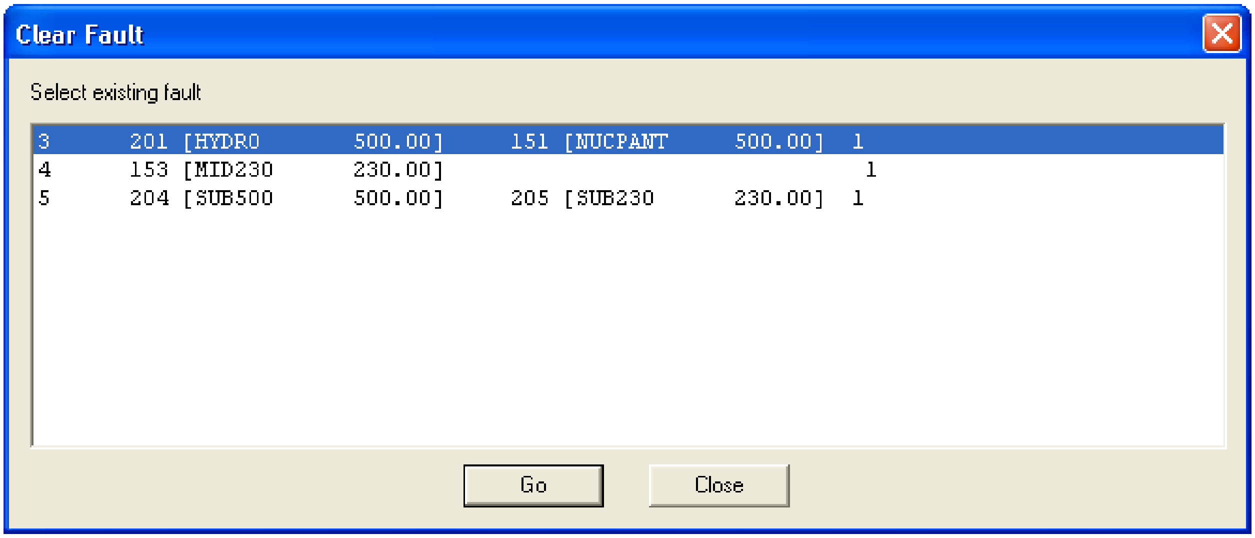


Figure 21.16. Clear Fault Dialog

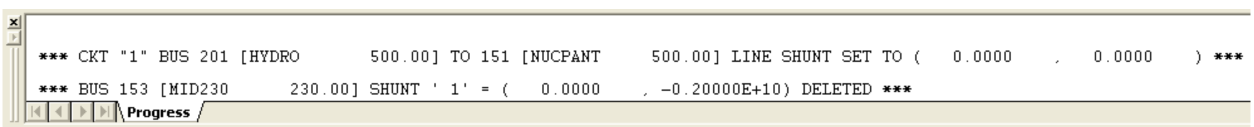
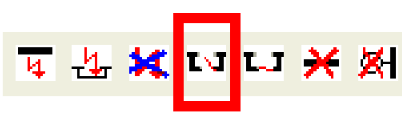


Figure 21.17. Example of Clear Fault Output

21.7.4. Trip Line



Disturbance > Trip line...

The status of a line can be set to out-of-service using the *[Trip a LIne]* dialog (Figure 21.18, "Trip a Line Dialog").

Click *[Select]* to display *[Branch Selection]* where the desired buses and *Circuit ID* may be selected.

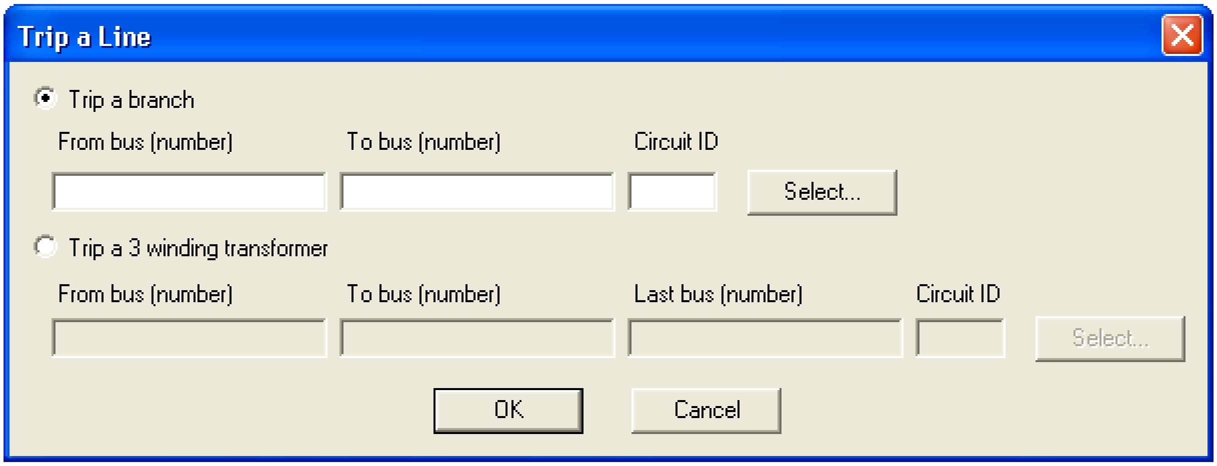
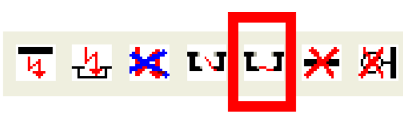


Figure 21.18. Trip a Line Dialog

Click *[OK]* to set the status of the designated branch to zero (out-of-service). A summary is routed to the *Progress* tab.

```
*** CKT <number> BUS <number> [<bus name> kV>] TO <number> [<bus name> kV>]
SET TO OUT-OF-SERVICE ***
```

21.7.5. Close Line



Disturbance > Close line...

The status of a line can be set to in-service using the *[Close a Tripped Line]* dialog (Figure 21.19, "Close a Tripped Line Dialog"). Only Type 1 or Type 2 bus branches can be faulted using this method.

Click *[Select]* to display *[Branch Selection]* where the desired buses and *Circuit ID* may be selected.

Click *[OK]* to set the status of the designated branch to one (in-service). A summary is routed to the *Progress* tab.

>

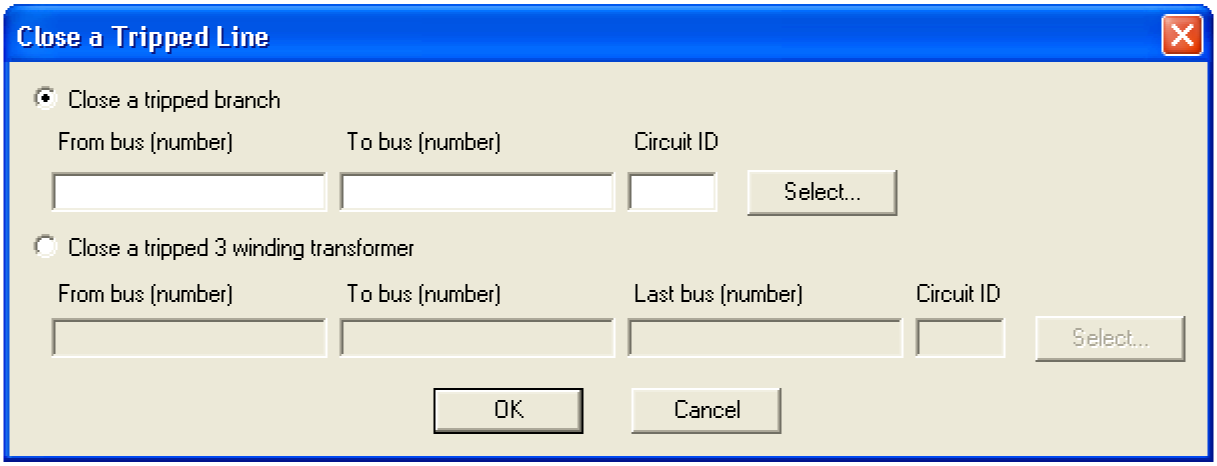
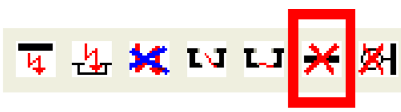


Figure 21.19. Close a Tripped Line Dialog

21.7.6. Disconnect Bus



Disturbance > Disconnect bus...

An in-service bus (i.e., a bus with a type code of one or two) can be electrically disconnected using the *[Disconnect a Bus]* dialog (Figure 21.20, "Disconnect a Bus Dialog").

Click *[Select]* to display *[Bus Selection]* where the desired bus may be specified.

Click *[OK]* to electrically disconnect the specified bus. A summary is routed to the *Progress* tab (Figure 21.21, "Example of Disconnect a Bus Output").

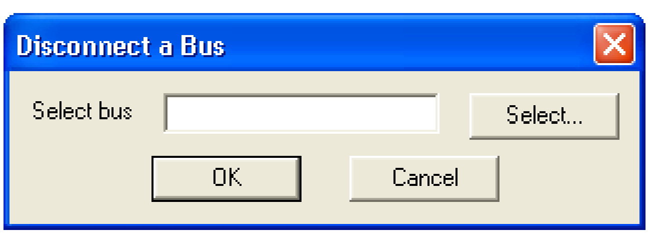


Figure 21.20. Disconnect a Bus Dialog

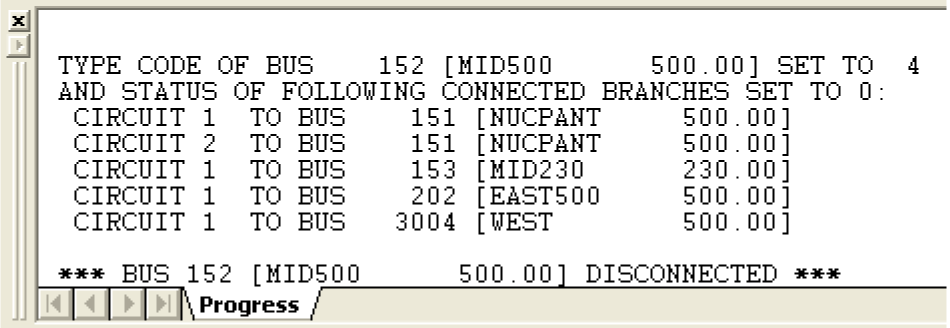
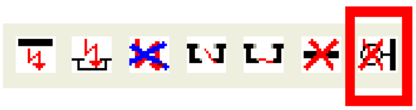


Figure 21.21. Example of Disconnect a Bus Output

21.7.7. Disconnect Machine



Disturbance > Disconnect machine...

An in-service machine (i.e., a machine with a service status of one connected to a Type 2 bus) can be electrically disconnected using the the *[Disconnect a Machine]* dialog (Figure 21.22, "Disconnect a Machine Dialog ").

Click *[Select]* to display *[Machine Selection]* where the desired from bus and *Machine ID* may be specified.

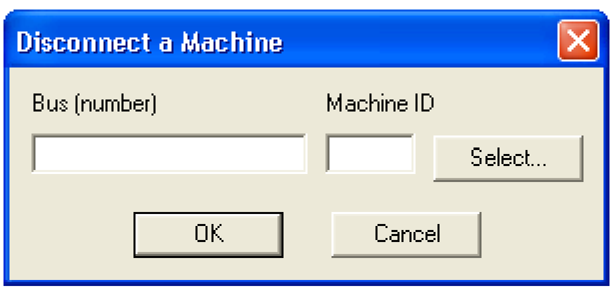
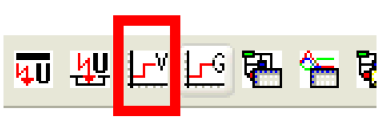


Figure 21.22. Disconnect a Machine Dialog

Click *[OK]* to electrically disconnect the specified machine. The following summary is routed to the *Progress* tab.

```
*** MACHINE <number> AT BUS <number> [<bus name> kV>] SET TO OUT-OF-SERVICE ***
```

21.7.8. Change Vref



Disturbance > Change Vref...

The voltage reference (Vref) for any specified machine can be changed using the *[AVR Reference (VREF)]* dialog.

Click *[Select]* to display *[Machine Selection]* where the desired from bus and *Machine ID* may be specified.

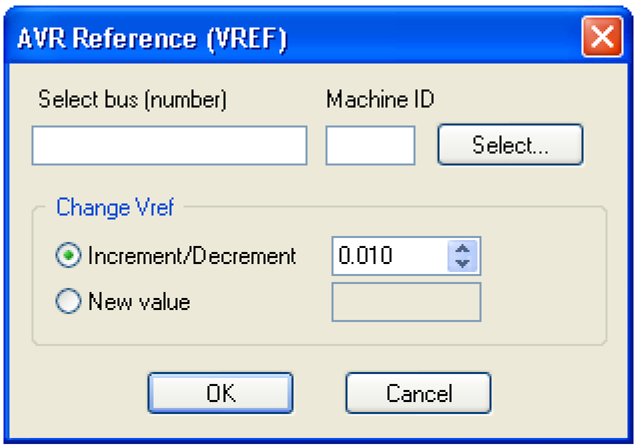
The user must specify the *Change Vref* method:

- *Increment/Decrement*: change the existing Vref value in 0.010 steps.

  OR

- *New value*: change the existing Vref using a specified value

A positive value will increment the existing Vref, a negative value will decrement the existing Vref.



AVR Reference (VREF) Change Dialog

Click *[OK]* to reset the specified machine's Vref value as indicated. The following summary is routed to the *Progress* tab.

```
VREF AT BUS <number> [<bus name> <kV>] MACHINE "<ID>" CHANGED FROM <original
value> TO <original value ± specified value>
```

21.7.9. Change Gref

Disturbance > Change Gref...

The governor reference (Gref) for any specified machine can be changed using the *[Governor Reference (GREF)]* dialog.

Click *[Select]* to display *[Machine Selection]* where the desired from bus and *Machine ID* may be specified.

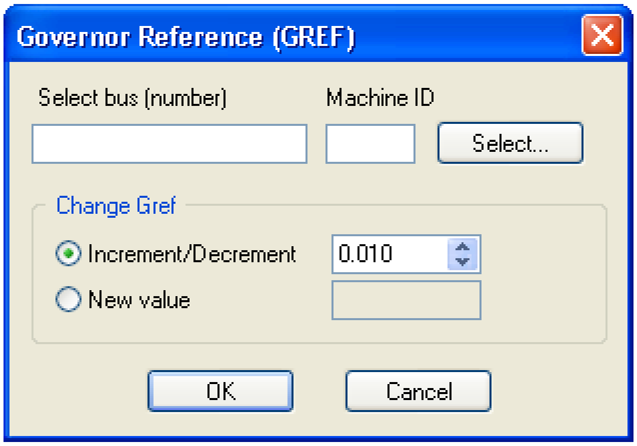
The user must specify the *Change Gref* method:

- *Increment/Decrement*: change the existing Gref value in 0.010 steps.

  OR

- *New value*: change the existing Gref using a specified value

A positive value will increment the existing Gref, a negative value will decrement the existing Gref.

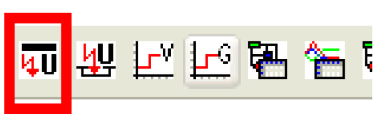


Governor Reference (GREF) Change Dialog

Click *[OK]* to reset the specified machine's Gref value as indicated. The following summary is routed to the *Progress* tab.

```
GREF AT BUS <number> [<bus name> <kV>] MACHINE "<ID>" CHANGED FROM <original
value> TO <original value ± specified value>
```

21.7.10. Unbalanced Bus Fault



Disturbance > Calculate and apply unbalanced bus fault...

The fault admittance for a specified bus can be calculated and applied during the dynamic simulations using the *[Calculate and Apply a Bus Fault]* dialog (Figure 21.23, "Calculate and Apply a Bus Fault Dialog"). The fault calculation is similar to that of activity SCMU except that a flat voltage profile of 1.0 is established as the default value.

Sequence data must be present in the working case.

Click *[Select]* to display *[Bus Selection]* where the desired bus may be specified.

The user must specify the unbalance type, which activates the appropriate impedance fields for specification.

The *DC line and FACTS devices option* is enabled only when this equipment is present in the working case. The user can block load unblocked DC lines and in-service FACTS devices or convert constant admittance load.

A checkbox is available to enable *Apply transformer impedance to zero correction* only when the actual positive sequence impedance of a transformer in the working case differs from its nominal value. Otherwise, these transformers remain at their nominal values.

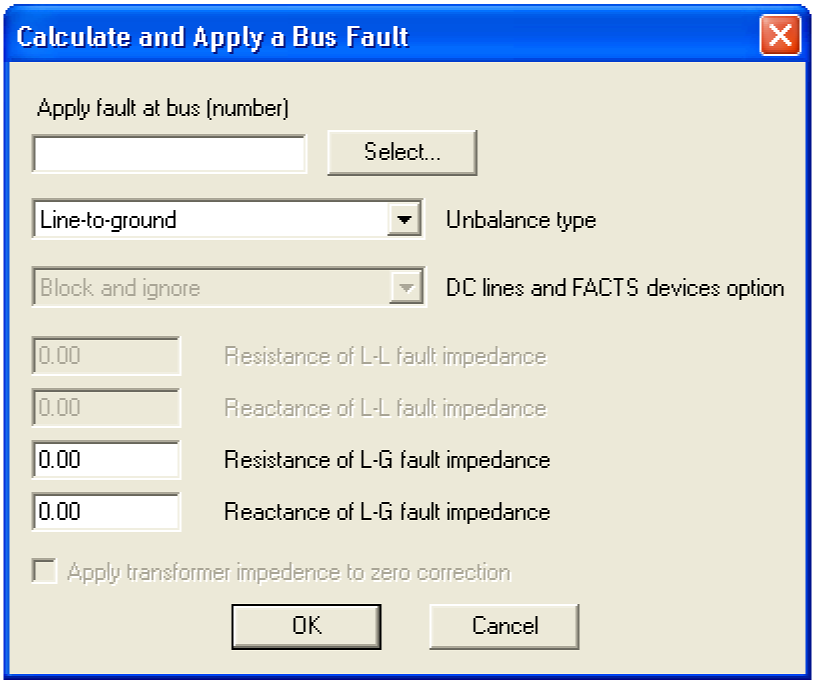


Figure 21.23. Calculate and Apply a Bus Fault Dialog

Click *[OK]* to initiate the fault calculation. The calculated equivalent positive sequence fault admittance of the driving point admittance for the negative sequence network and/or the zero sequence network is added to the fixed shunt at the designated bus. A summary is routed to the *Progress* tab (Figure 21.24, "Example of Dynamic Bus Fault Output").

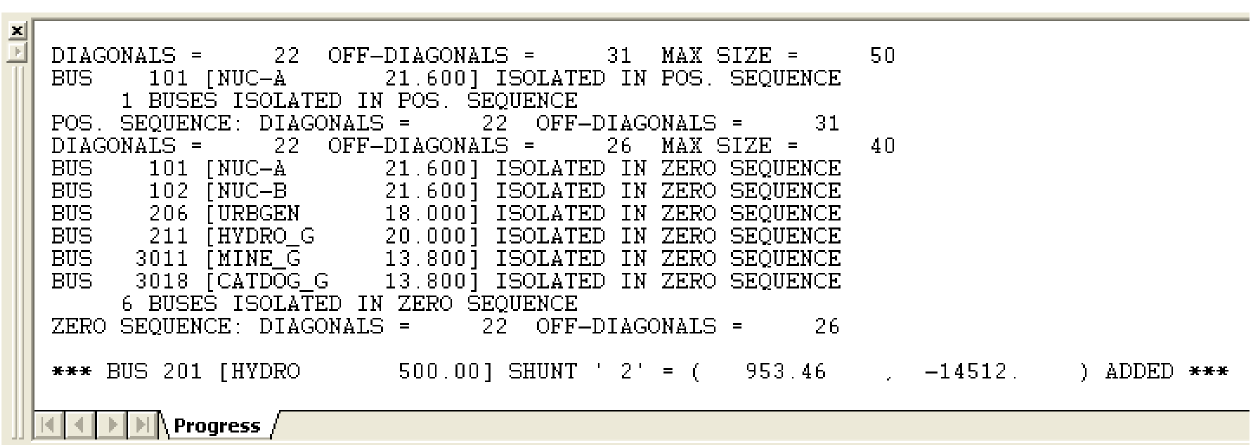
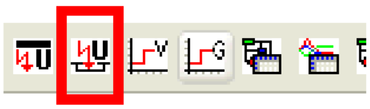


Figure 21.24. Example of Dynamic Bus Fault Output

This activity calculates the equivalent admittance for the negative and/or zero sequence networks of an unbalanced condition using activity SCMU (see *PSS®E Program Operation Manual*, Performing Fault Analysis with Multiple Unbalances). The requirements and restrictions applicable to activity SCMU must be recognized. Further, the use of the dynamic fault calculation is restricted to the application of a single unbalance. It would not be valid to apply a fault using any of the methods described in this section, and then, with that fault is still applied, calculate the positive sequence equivalent of another unbalanced condition.

21.7.11. Branch Unbalance



Disturbance > Calculate and apply branch unbalance...

A positive sequence pi-equivalent for a single transmission line unbalance can be calculated and applied during the dynamic simulations using the *[Calculate and Apply Branch Unbalance]* dialog (Figure 21.25, "Calculate and Apply Branch Unbalance Dialog"). The fault calculation is similar to that of activity SPCB except that a flat voltage profile of 1.0 is established as the default value.

Sequence data must be present in the working case.

Click *[Select]* to display *[Branch Selection]* where the desired buses and *Circuit ID* may be selected.

The user must specify the *Unbalance type* and *Type of in-line fault*, which activate the appropriate impedance fields and fault location for specification. The availability of additional options is dependent upon the fault configuration.

The *DC line and FACTS devices option* is enabled only when this equipment is present in the working case. The user can block load unblocked DC lines and in-service FACTS devices or convert constant admittance load.

A checkbox is available to enable *Apply transformer impedance to zero correction* only when the actual positive sequence impedance of a transformer in the working case differs from its nominal value. Otherwise, these transformers remain at their nominal values.

Click *[OK]* to initiate the fault calculation. The calculated positive sequence pi-equivalent replaces the branch parameters of the branch subjected to the unbalance. A summary is routed to the *Progress* tab (Figure 21.26, "Example of Dynamic Line Fault Output").

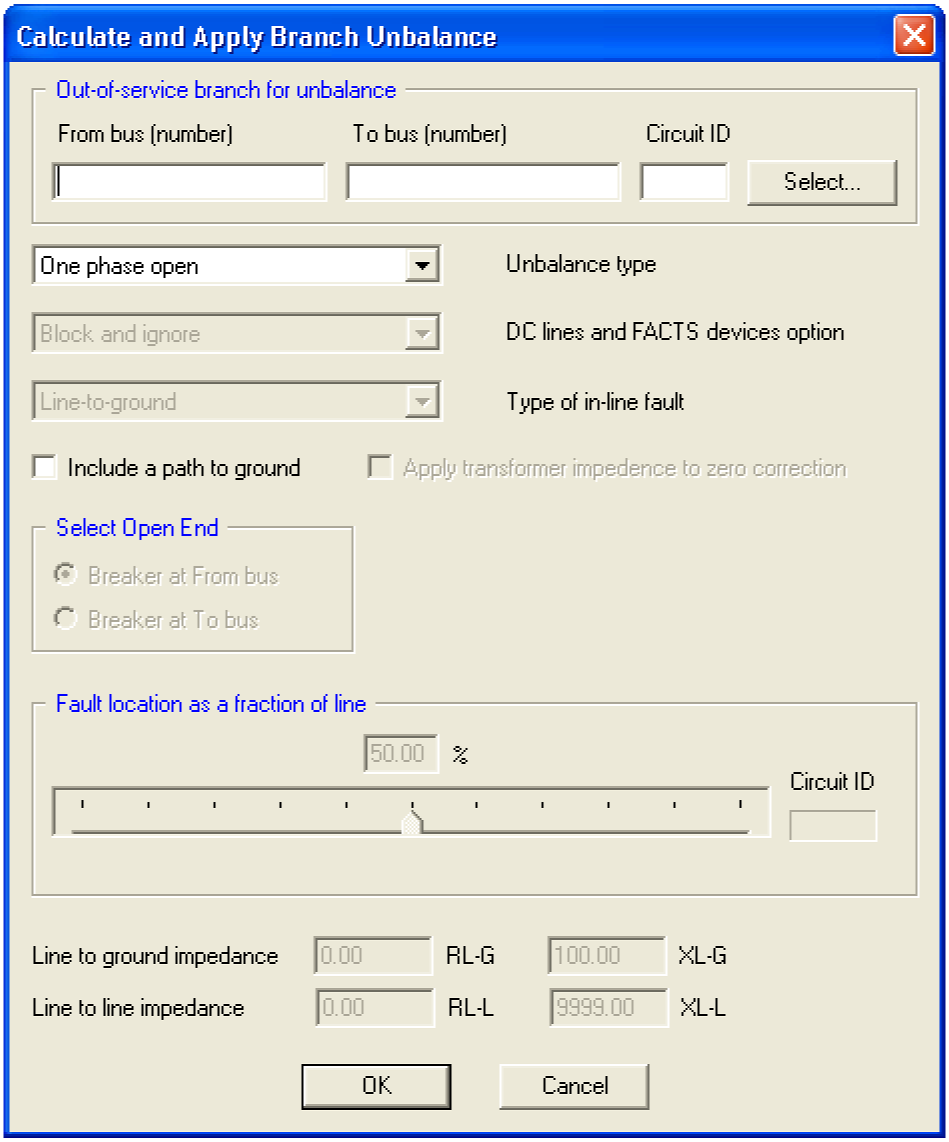
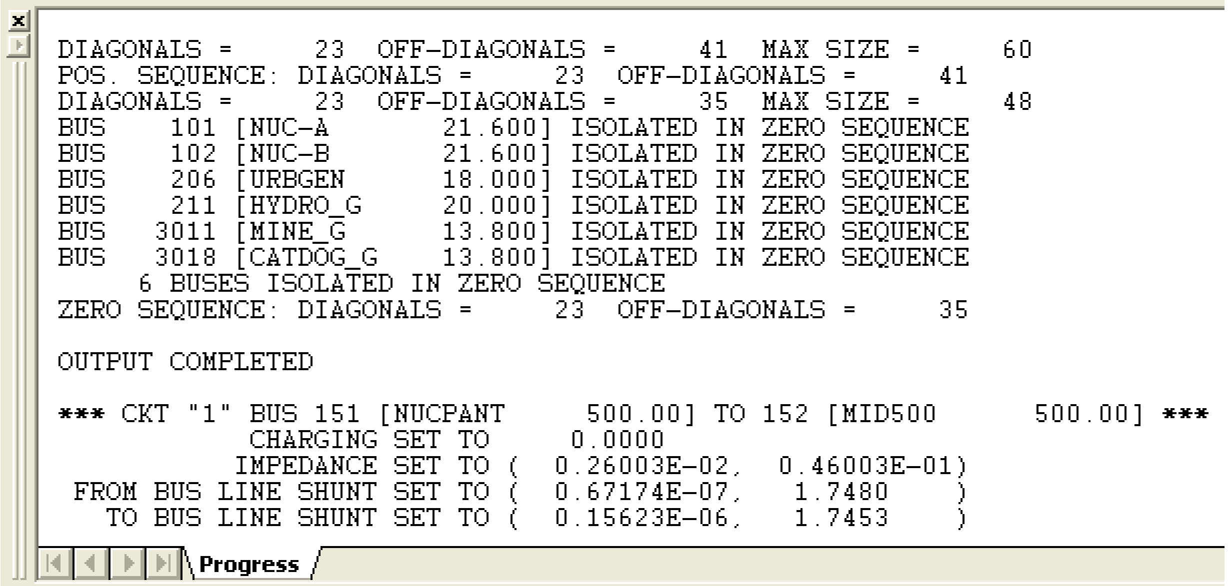


Figure 21.25. Calculate and Apply Branch Unbalance Dialog



```
DIAGONALS =      23  OFF-DIAGONALS =      41  MAX SIZE =      60
POS. SEQUENCE: DIAGONALS =      23  OFF-DIAGONALS =      41
DIAGONALS =      23  OFF-DIAGONALS =      35  MAX SIZE =      48
BUS     101 [NUC-A        21.600] ISOLATED IN ZERO SEQUENCE
BUS     102 [NUC-B        21.600] ISOLATED IN ZERO SEQUENCE
BUS     206 [URBGEN       18.000] ISOLATED IN ZERO SEQUENCE
BUS     211 [HYDRO_G      20.000] ISOLATED IN ZERO SEQUENCE
BUS    3011 [MINE_G       13.800] ISOLATED IN ZERO SEQUENCE
BUS    3018 [CATDOG_G     13.800] ISOLATED IN ZERO SEQUENCE
     6 BUSES ISOLATED IN ZERO SEQUENCE
ZERO SEQUENCE: DIAGONALS =      23  OFF-DIAGONALS =      35

OUTPUT COMPLETED

*** CKT "1" BUS 151 [NUCPANT      500.00] TO 152 [MID500       500.00] ***
            CHARGING SET TO     0.0000
           IMPEDANCE SET TO (  0.26003E-02,  0.46003E-01)
 FROM BUS LINE SHUNT SET TO (  0.67174E-07,   1.7480     )
   TO BUS LINE SHUNT SET TO (  0.15623E-06,   1.7453     )
```


Figure 21.26. Example of Dynamic Line Fault Output

This activity calculates the positive sequence equivalent of an unbalanced condition using activity SPCB (see *PSS®E Program Operation Manual*,Calculating pi-Equivalent, Single Transmission Line Unbalance). The requirements and restrictions applicable to activity SPCB must be recognized. Further, the use of the dynamic fault calculation is restricted to the application of a single unbalance. It would not be valid to apply a fault using any of the methods described in this section, and then, with that fault is still applied, calculate the positive sequence equivalent of another unbalanced condition.

21.8. Launching NEVA Eigenvalue Analysis

Dynamics>Launch NEVA Eigenvalue analysis

This action allows the user to perform an Eigenvalue analysis using the optional NEVA module. The current dynamics simulation setup is transferred into NEVA, and the Eigenvalue analysis can be performed.

A summary of the Python script process is routed to the *Progress* tab.

For details on the use of NEVA, refer to the NEVA documentation.

21.9. Building a State Variable Matrix for Linear Dynamic Analysis

ASTR

(LSYSAN)

Requirements / Prerequisites
Validly specified power flow case, solved to an acceptable mismatch level.
Dynamics data exists in dynamics working memory.
Converting Loads and Generators
Factorizing the Network Admittance Matrix

Dynamics>Build matrices for LSYSAN program (ASTR)...

The input file containing the A, B, H and F system matrices used in the LSYSAN program is specified using the *[Build Matrices for LSYSAN]* dialog (Figure 21.27, “Build Matrices for LSYSAN Dialog”). Click *[...]* to open the selection window for the required *Matrix Output file* (*.lsa), which can be a new file or a previously-built file to be over-written.

Use the *[Add]* and *[Remove]* buttons to specify desired *States* and *Channels* by range. If none are specified, the matrices are built using all *States* and the first 50 *Channels*.

Click *[Select]* to display *[Machine Selection]* where the desired from bus and *Machine ID* may be specified. Leaving the *Identifier* field blank results in a PSS®E-generated identifier.

Input quantities may be specified as EFD, Pmech, Vothsg, Vref, or Var. The Perturbation and Var fields are editable.

A checkbox enables the display of the network convergence monitor.

Click *[OK]* to process the selected items and create the Matrix Output file for use in the LSYSAN program. A summary is routed to the *Progress* tab (Figure 21.28, “Example of LSYSAN Matrix-Building Output”).

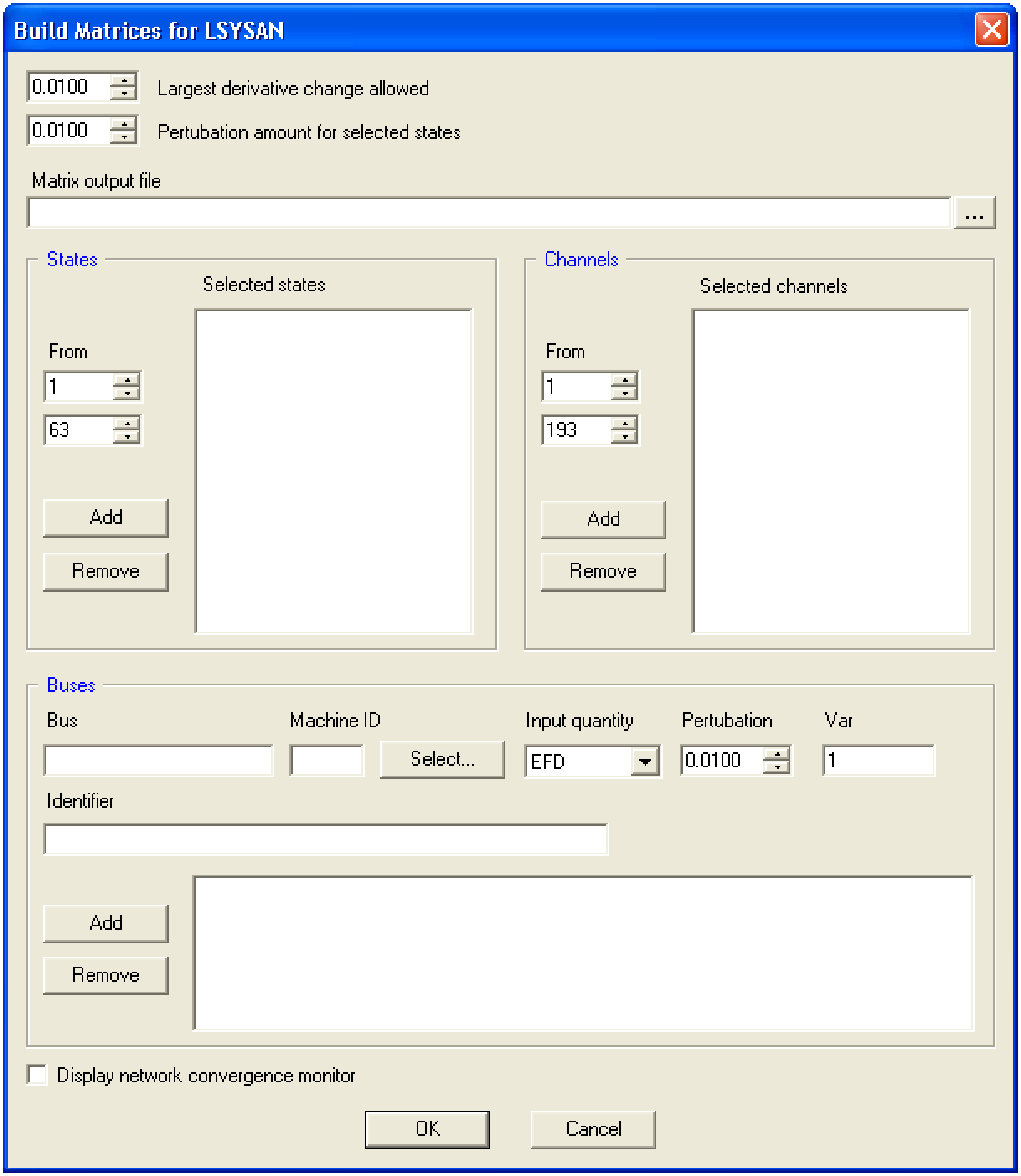


Figure 21.27. Build Matrices for LSYSAN Dialog

```
    PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS(R)E     TUE, SEP 30 2008    8:54
PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE
BASE CASE INCLUDING SEQUENCE DATA

INITIAL CONDITION LOAD FLOW USED  1 ITERATIONS

----------------------------- MACHINE INITIAL CONDITIONS -----------------------------
  BUS# X-- NAME --X BASKV ID  ETERM   EFD    POWER    VARS   P.F.   ANGLE    ID      IQ
   101 NUC-A        21.600 1  1.0200 2.0563  750.00   81.20 0.9942  63.47 0.6571 0.4934
   102 NUC-B        21.600 1  1.0200 2.0563  750.00   81.20 0.9942  63.47 0.6571 0.4934
   206 URBGEN       18.000 1  1.0236 2.5618  800.01  600.00 0.8000  23.53 0.8733 0.4380
   211 HYDRO_G      20.000 1  1.0404 1.6150  600.00   17.74 0.9996  42.14 0.4089 0.6827
  3011 MINE_G       13.800 1  1.0400 1.4655  258.66  104.05 0.9278  16.02 0.1648 0.2114
  3018 CATDOG_G     13.800 1  1.0218 2.9374  100.00   80.00 0.7809  22.53 0.8757 0.4033
  1      0.036    154 [DOWNTN      230.00]    -0.3158E-05     0.1789E-05

INITIAL CONDITIONS CHECK O.K.
  1     18.660    101 [NUC-A       21.600]     0.8371E-03     0.1668E-02
  2      5.489    154 [DOWNTN      230.00]     0.4943E-03    -0.2388E-03
  3      4.076    154 [DOWNTN      230.00]     0.1916E-03     0.3597E-03
  4      3.018    154 [DOWNTN      230.00]     0.2718E-03    -0.1312E-03
  5      2.234    154 [DOWNTN      230.00]     0.1050E-03     0.1972E-03
  6      1.653    154 [DOWNTN      230.00]     0.1489E-03    -0.7186E-04
  7      1.223    154 [DOWNTN      230.00]     0.5744E-04     0.1080E-03
  8      0.905    154 [DOWNTN      230.00]     0.8146E-04    -0.3931E-04
  1     18.911    101 [NUC-A       21.600]    -0.4511E-03    -0.1837E-02
  2      5.150    154 [DOWNTN      230.00]    -0.3965E-03     0.3287E-03
  3      3.819    154 [DOWNTN      230.00]    -0.9352E-04    -0.3702E-03
  4      2.827    154 [DOWNTN      230.00]    -0.2176E-03     0.1804E-03
  5      2.093    154 [DOWNTN      230.00]    -0.5132E-04    -0.2029E-03
  6      1.550    154 [DOWNTN      230.00]    -0.1193E-03     0.9896E-04
  7      1.148    154 [DOWNTN      230.00]    -0.2817E-04    -0.1113E-03
  8      0.851    154 [DOWNTN      230.00]    -0.6549E-04     0.5431E-04
  1     27.368    101 [NUC-A       21.600]     0.8421E-03     0.2604E-02
  2      7.667    154 [DOWNTN      230.00]     0.6340E-03    -0.4312E-03
  3      5.687    154 [DOWNTN      230.00]     0.1903E-03     0.5359E-03
  4      4.206    154 [DOWNTN      230.00]     0.3479E-03    -0.2365E-03
  5      3.110    154 [DOWNTN      230.00]     0.1040E-03     0.2931E-03
  6      2.298    154 [DOWNTN      230.00]     0.1900E-03    -0.1291E-03
  7      1.697    154 [DOWNTN      230.00]     0.5671E-04     0.1600E-03
  8      1.254    154 [DOWNTN      230.00]     0.1037E-03    -0.7044E-04
  9      0.926    154 [DOWNTN      230.00]     0.3092E-04     0.8725E-04
```

Progress

Figure 21.28. Example of LSYSAN Matrix-Building Output

Additional Information
PSS® E Program Operation Manual, Building a State Variable Matrix for Linear Dynamic Analysis (LSYSAN)

Chapter 22
Dynamic Simulation PlotPackage

22.1. PlotPackage Overview

The results of Dynamic Simulations are the plot channels of various PSS®E quantities that are selected prior to performing the Dynamic Simulation. The plot channels captured during a Dynamic Simulation are contained in a plot channel output file which is in a binary form. These can be viewed either using the auxiliary program PSSPLT or the PlotPackage that was introduced in PSS®E-31. The PSS®E PlotPackage (or PlotPackage for brevity), unlike PSSPLT, is not an auxiliary program. Using PlotPackage, the channels captured during the dynamic simulation can be viewed and plotted directly from within PSS®E. The initial version of PlotPackage that was released with PSS®E-31 had support for some of the PSSPLT features. In future releases the full functionality of PSSPLT will be incorporated into PlotPackage. Until then both PSSPLT as well as PlotPackage will be shipped with PSS®E.

This chapter describes the various steps in viewing the dynamic simulation results using PlotPackage and provides a description of the various PlotPackage Operations (for a description of the PSSPLT, refer to the PSSPLT Program Manual).

22.2. Viewing Dynamic Simulation Results using PlotPackage

PlotPackage is an integral part of PSS®E. This can be accessed from within PSS®E by clicking the Plot Data tab in the PSS®E *[Tree]* view and can be used to view the plots of results contained in the dynamic simulation channel output files.

The steps involved in viewing dynamic simulation results using PlotPackage are as follows:

- Create a PlotBook
- Open the Channel output file
- Drag and drop the required channels for which the plot is to be generated

Details of each of the above steps are given below.

22.2.1. PlotBook

The PlotBook signifies a book of plots. The PlotBook (similar to a note book) can contain several pages. Each page (also called a PlotPage) can contain several plots. Each plot can contain one or more curves or trace.

The PlotBook is configured like an Excel® Worksheet, with multiple pages, each capable of containing multiple Plots (see Figure 22.1, "PlotBook with Two PlotPages", which shows a PlotBook with two PlotPages; Page 1 contains two plots).

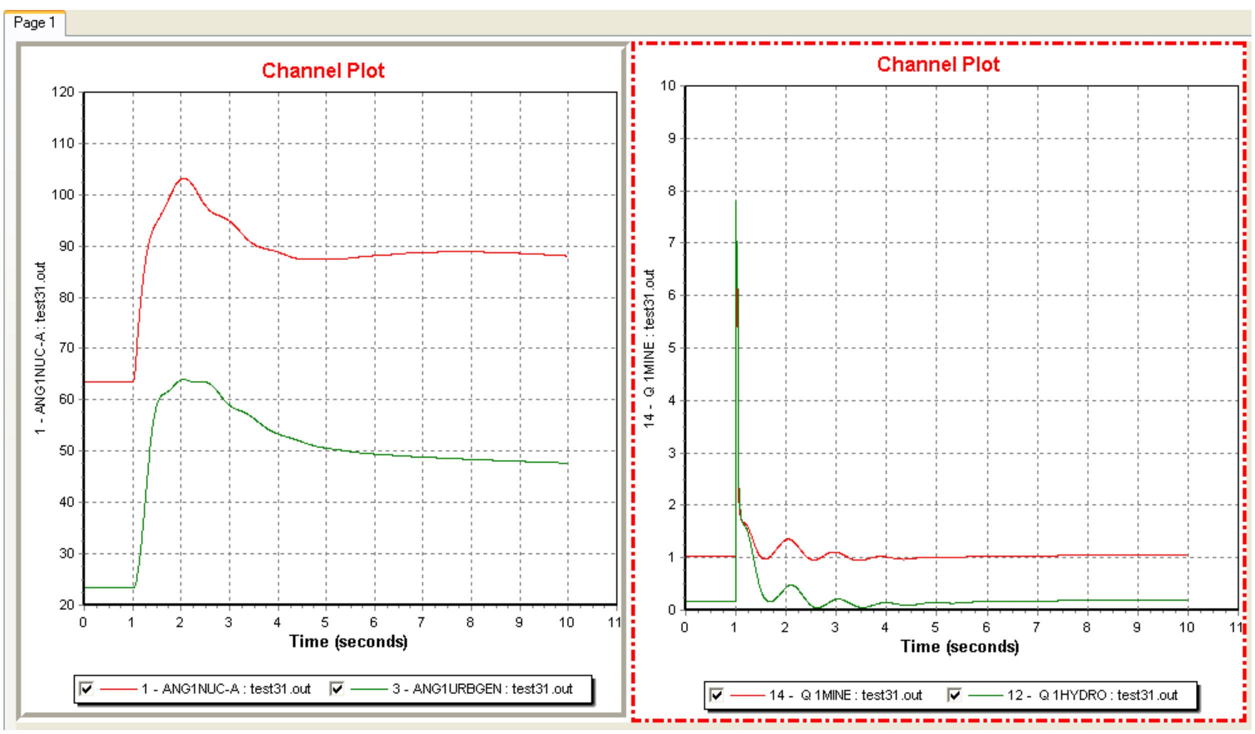


Figure 22.1. PlotBook with Two PlotPages

When a new PlotBook is opened, one page (Page 1) with one plot, as shown in Figure 22.2, "Default PlotBook Layout", is created by default.

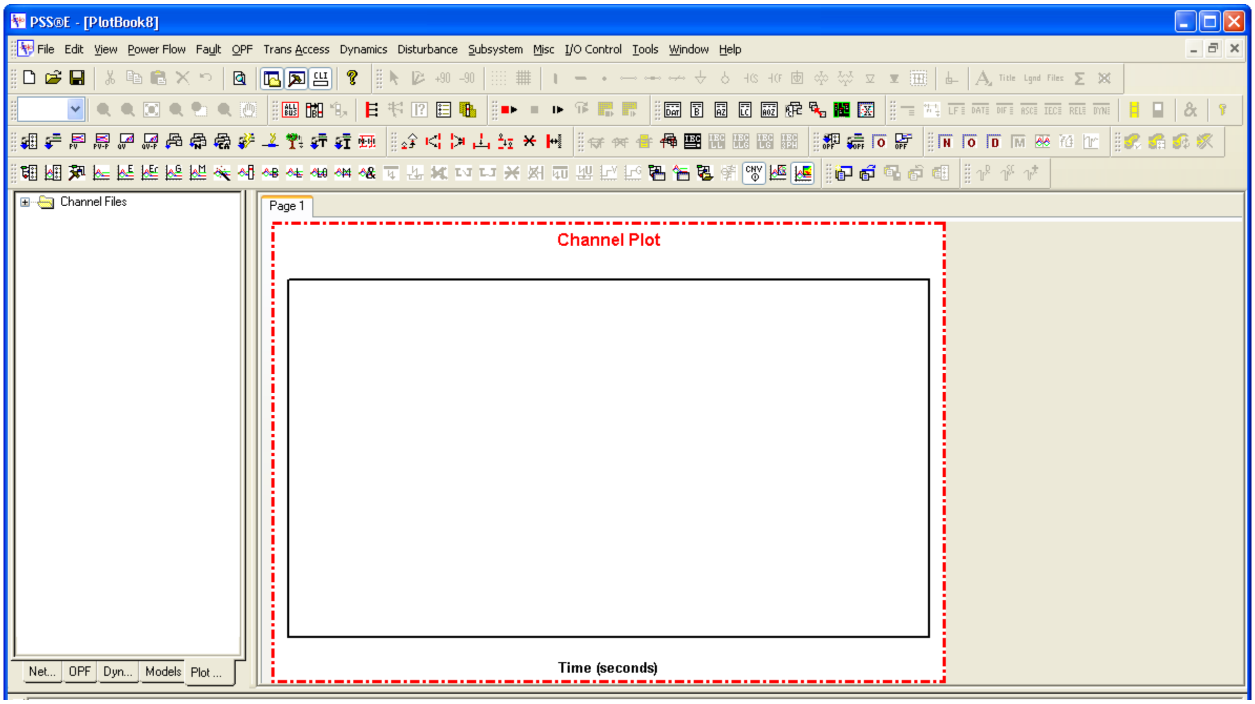


Figure 22.2. Default PlotBook Layout

Additional pages can be inserted using the command *Edit > Insert Page*. Additional plots can be inserted using the command *Edit > Insert Plots*.

By default each page can have up to four plots per row. The active plot (in the selected page) is designated by a red border (see Figure 22.1, "PlotBook with Two PlotPages" and Figure 22.2, "Default PlotBook Layout").

The configuration of the PlotBook (i.e., the number of pages, number of plots in each page, the number of plots in each row, etc.), is determined by the user. A plot configuration file can be created to pre-configure a PlotBook whenever one is opened. For details of various customization operations, refer to Section 22.3, "PlotPackage Operations".

A PlotBook is opened by clicking on *File > New* and selecting the Plot Book radio button as shown in Figure 22.3, "New PlotBook Dialog".

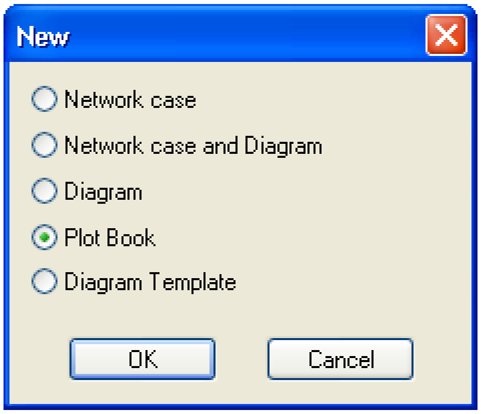


Figure 22.3. New PlotBook Dialog

After a PlotBook is created, the next step is to open a channel output file.

22.2.2. Channel Output File

The channel output file contains the dynamic simulation results and can be opened by selecting *File > Open Channel File – Binary* or *File > Open*. The *File > Open* method displays a file selector dialog. In the file selector dialog, under File type, select Channel Output file (*.out), and then select the channel output file, as shown in Figure 22.4, "Opening a Channel Output File"b.

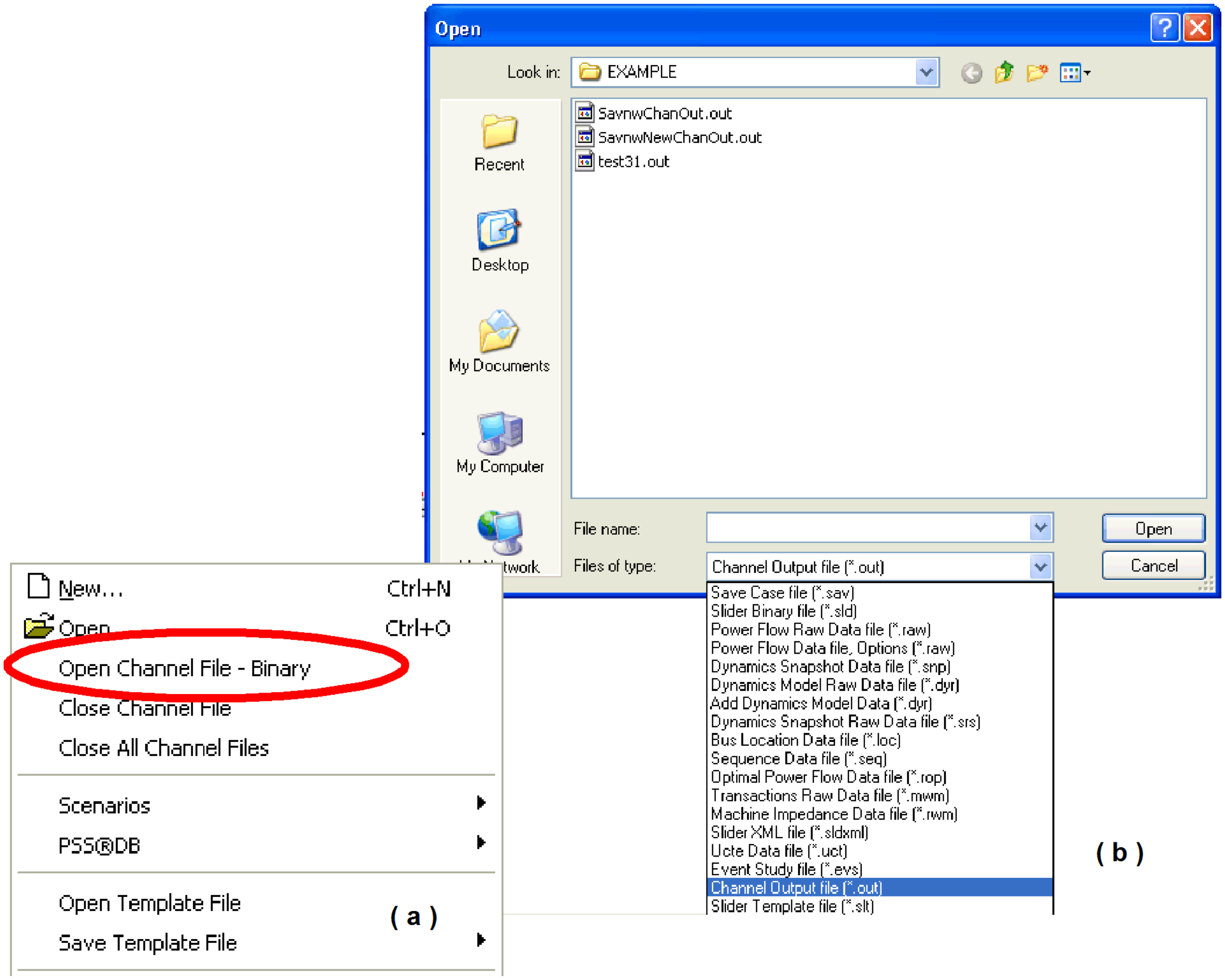


Figure 22.4. Opening a Channel Output File

An alternative method, which combines the creation of PlotBook and the opening of a channel output file is to do the following: select *File* > *Open*, in the file selector dialog under the File type select the Channel Output file (*.out), and then select the channel output file as shown in Figure 22.4, "Opening a Channel Output File"b.

In order to open multiple channel output files, *File* > *Open* or *File* > *Open Channel File – Binary* has to be repeated for each file. The names of all the open channel output file(s) appear in *[Tree]*, which, when expanded, displays all the channel outputs that were selected prior to the Dynamic Simulation run.

22.2.3. Drag and Drop Channels

After a PlotBook is created, any channel (from any of the channel output files in *[Tree]* can be viewed by dragging and dropping into the desired plot in the selected page. Multiple channels can be dropped into the same plot.

Many of the interactions involved in creating and customizing the PlotBook, in opening the channel output files, and in creating the required plots are recordable and can be played back through the use of automation files. In future releases, all interactions in using the PlotPackage will be recordable and available for playback.

22.3. PlotPackage Operations

The following sections outline the various operations that the user could perform in the PlotPackage using the Edit and File menus, and the Plot Editor.

22.3.1. File Menu Operations

The complete plot File menu is shown in Figure 22.5, "PlotPackage File Menu".

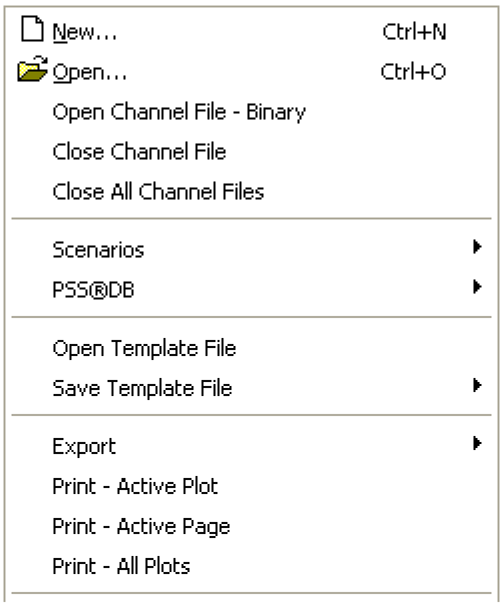


Figure 22.5. PlotPackage File Menu

The various operations that can be performed using the File menu are described below.

Creating a PlotBook

The use of any of the PlotBook functions first requires the creation of the PlotBook. This is done by selecting *File > New > PlotBook* in the dialog. A new PlotBook with one Plot Page and one Plot on the page is created. Details of creating a PlotBook are described in Creating a PlotBook.

Opening a Channel File

An existing channel file is opened by selecting *File > Open Channel File - Binary*. The selected channel file appears as a named folder in the Channel Files tree. This channel file folder may be expanded to show the channels defined in that file.

Closing a Channel File

Open channel files may be closed in several ways. A single channel file can be selected in the Plot Data Tab Tree View and then closed by selecting *File > Close Channel File*. Selecting *File > Close All Channel Files*. You may also close a channel file by selecting it in the Plot Data *[Tree]*, bringing up the context menu (the context menu is accessed through the secondary mouse button - this is usually the right mouse button, although it can be configured to be the left), and selecting Close.

Exporting a Plot

The active Plot may be exported to several different file formats by selecting *File > Export* and then selecting the desired format from the popup menu. A standard file save window appears, prompting for the name and location of the exported Plot. Currently, four file formats are available for export, Windows Metafile, Bitmap, JPEG, and PDF. Future releases will add other graphic formats.

Printing a Plot

PlotBooks may be printed in several ways. Selecting *File > Print All Plots* prints every Plot on every Plot Page in the PlotBook. Selecting *File > Print Active Plot Page* prints every Plot on the active Plot Page. Selecting *File > Print Active Plot* prints the active Plot on the Plot Page.

Plot Templates

Plot Attribute Dialogs can be used to modify the look and feel attributes of the PlotBook. The attributes available in these dialogs can be saved for later reuse via the Save Template Functionality.

A template file is a binary file with the .plt extension that is used for storing plot look and feel attributes.

Further details of Template Open and Save functionalities are given below.

Open Template File

A plot template file can be opened from the Open Template File (*File > Open Template File*) menu item when a PlotBook is active. By opening a template file, the attributes stored in it are restored for the entire PlotBook. These include among others, the number of pages in the Plotbook, the number of plots on each page, and the background color of each plot.

Save Template File

A Plot Template file is saved by using the Save Template File (*File > Save Template File*) menu item under the File menu when a PlotBook is the active view. Three different types of files can be saved depending on the level of granularity needed: PlotBook templates, Page Templates, and Plot Templates. All three types have the same .plt extension but include information to determine what type of template is represented.

PlotBook Template	The PlotBook template saves and restores the look and feel attributes for the entire PlotBook. This includes information modified via the following dialogs: • PlotBook Setup • Plot Title • Plot Legend • Plot Background

	More attributes will be added to the template file format in future releases.
Active Page Template	The Active Page template saves attributes for the active page including all the plots on the page. When restoring, this type of template is applied to the current page. Several active page templates can be combined to create a PlotBook template.
Active Plot Template	The Active Plot Template saves attributes for the currently selected plot (highlighted by a red dashed line). Several active plot templates can be combined to create an Active Page Template.

22.3.2. Edit Menu Operations

The Edit menu is shown in Figure 22.6, "PlotPackage Edit Menu".

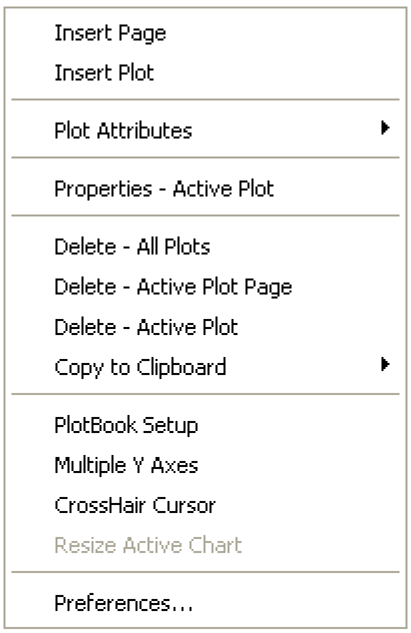


Figure 22.6. PlotPackage Edit Menu

The Edit entry on the menu bar is used to define the PlotBook Setup and to access all the plotting specific functions of PSS®E. Plotting functions can be accessed and run whenever the PlotBook is the active view. The various operations that be performed using the Edit menu are explained below.

PlotBook Setup Dialog

The *[PlotBook Setup]* dialog (Figure 22.7, "Plot Preference Dialog, PlotBook Setup") is available when a PlotBook is the active view; to open, select *Edit* > *PlotBook Setup*. It is used to set up general characteristics of a PlotBook that a user might want to use often. Attributes modified in this dialog are saved to the PlotBook template file (via *File* > *Save Template*).

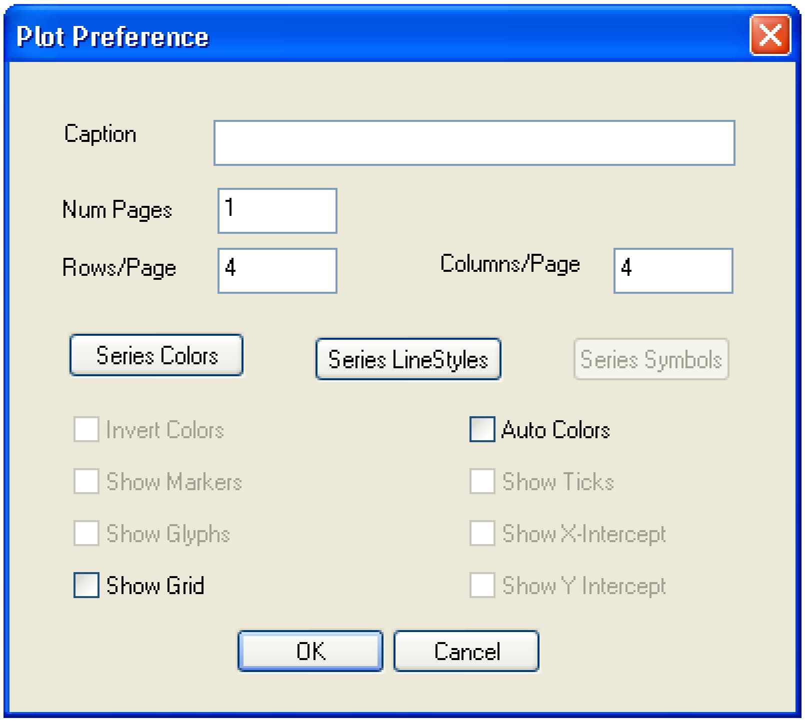


Figure 22.7. Plot Preference Dialog, PlotBook Setup

Creating a Plot Page

A new Plot Page is created in a PlotBook by selecting *Edit > Insert Page*. The new Plot Page automatically becomes the active Plot Page.

Creating a Plot

A new Plot is created on the active Plot Page by selecting *Edit > Insert Plot*. The new Plot automatically becomes the active Plot.

Changing Plot Properties

Selecting *Edit > Properties - Active Plot* displays a Plot Editor dialog that can be used to modify the properties of the active Plot on the Plot Page.

Deleting Plots

Plots may be deleted from the PlotBook in several ways. Selecting *Edit > Delete - All Plots* deletes every Plot on every Plot Page in the PlotBook. Selecting *Edit > Delete - Active Plot Page* deletes every Plot on the active Plot Page. Selecting *Edit > Delete - Active Plot* deletes the active Plot on the Plot Page.

Copying Plots to the Clipboard

The active Plot can be copied to the system clipboard for use in creating reports in other applications. Several formats, Windows MetaFile and Bitmap, are supported. To copy the active Plot to the clipboard, select *Edit > Copy to Clipboard* and select the desired format. The active Plot is then placed in the system clipboard, in the selected format, for use elsewhere.

Plot Attribute Dialogs

The Plot Editor is provided to modify hundreds of plot look and feel attributes and view data content. However a simpler way of editing the most common features is possible by using separate Plot Attribute Dialogs. These are described below (Section 22.3.3, "Plot Editor Operations"). The attributes modified using these dialogs can be saved in plot template files for future reuse.

Plot Title Dialog

The *[Plot Title]* dialog (Figure 22.8, "Plot Title Dialog") is available when a PlotBook is the active view; to open, select *Edit > Plot Attributes > Title*. It can also be displayed by right clicking on a plot and then selecting Plot Title.

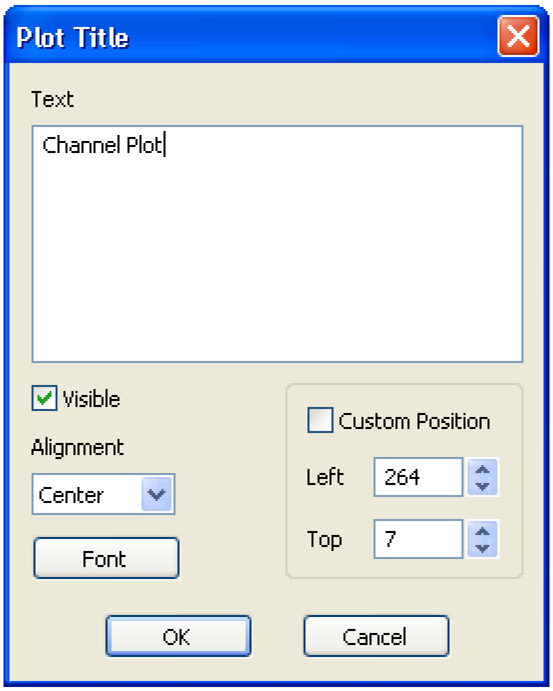


Figure 22.8. Plot Title Dialog

The various options that are available in this dialog are explained in Table 22.1, "Description of Options in Plot Title Dialog".

Table 22.1. Description of Options in Plot Title Dialog

Option	Description
Text	The title contents can be modified in the Text box. The plot is updated when the user clicks *[Ok]*.
Visible	The Visible checkbox can be used to turn the title on or off. Checking the box displays the title.
Alignment	The title can be aligned at the top center, left, or right of the plot area.

Option	Description
Font	Click *[Font]* to display a Font Editor (Figure 22.9, "Font Dialog"). The Font type, style, color and size can be modified here.
Custom Position	The Custom Position checkbox is used to modify the location of the title.
Left, Top	When the Custom Position checkbox is selected, the Left value specifies the horizontal position and the Right value specifies the vertical position of the title.

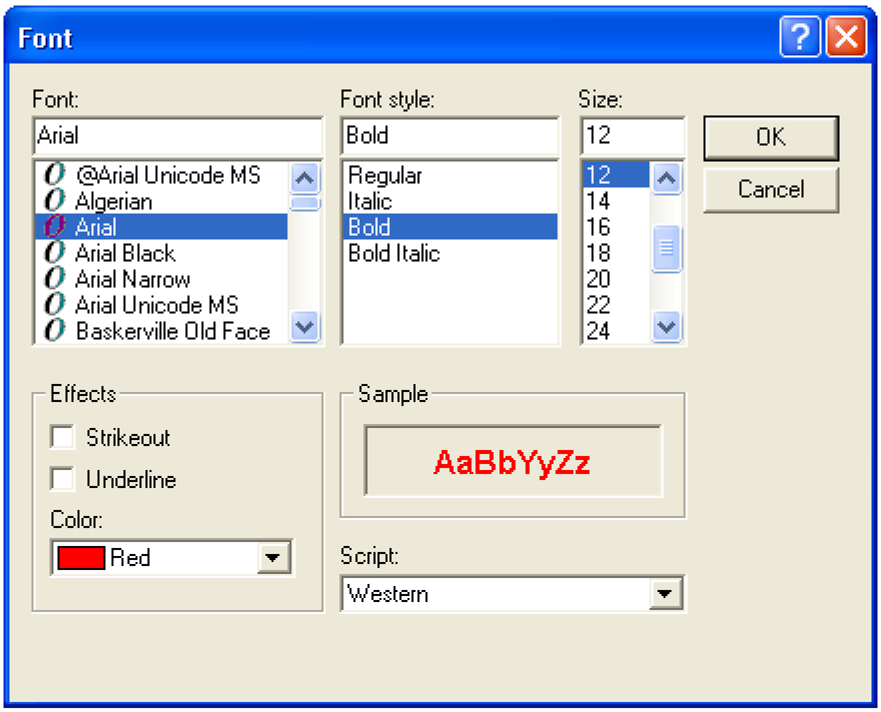


Figure 22.9. Font Dialog

Plot Legend Dialog

The Plot Legend dialog (Figure 22.10, "Plot Legend Dialog") is available when a PlotBook is the active view; to open, select *Edit > Plot Attributes > Legend*. It can also be displayed by right clicking on a plot and selecting Plot Legend. It is used to modify attributes of the plot legend.

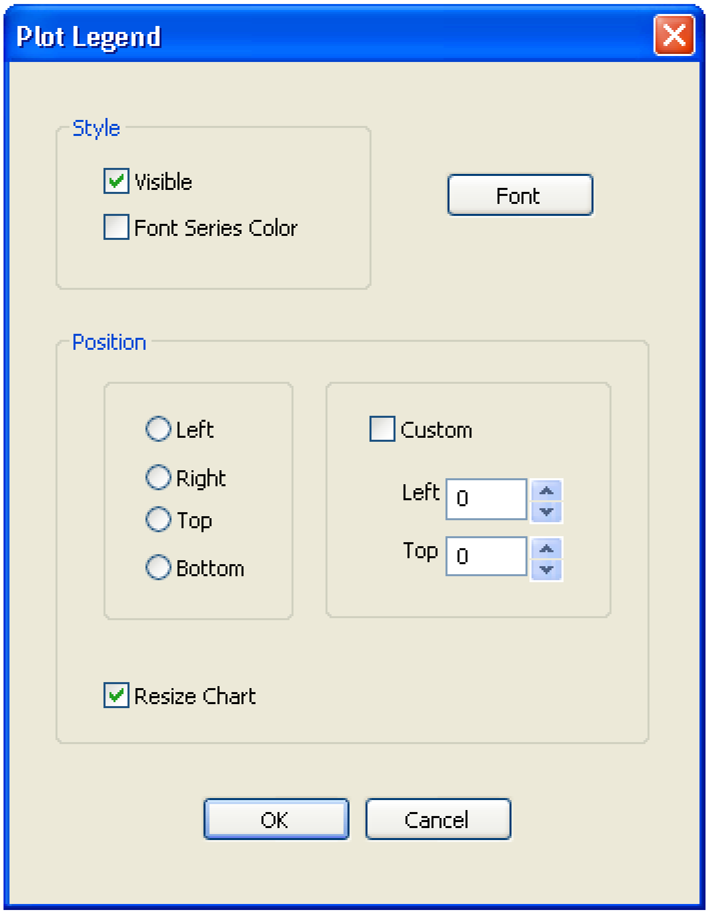


Figure 22.10. Plot Legend Dialog

The various options that are available in this dialog are explained in Table 22.2, “Description of Options in Plot Legend Dialog”.

Table 22.2. Description of Options in Plot Legend Dialog

Option	Description
Visible	The Visible checkbox can be used to turn the legend on or off. Checking the box displays the legend.
Font Series Color	When the Font Series Color checkbox is selected, the legend displays the channel name with the same color as the channel on the plot.
Font	Click *[Font]* to invoke the Font Editor described above. Font characteristics for the legend text can be modified here.
Position	The Position group determines the placement of the legend within the plot display area.
Custom	When selected, the Custom checkbox allows the user to modify the position of the legend.

Option	Description
Left, Right, Top, Bottom	When the Custom checkbox is NOT selected, the legend is automatically placed to the left, right, top, or bottom of the plot.
Custom Left, Custom Top	When the Custom checkbox is selected, the Left value specifies the location of the left edge and the Top value specifies the location of the top edge of the legend.

Plot Series Dialog

The Plot Series dialog (Figure 22.11, "Plot Series Dialog") is available when a PlotBook is the active view; to open, select *Edit* > *Plot Attributes* > *Series*. It can also be displayed by right clicking on the plot and selecting Plot Series. It is used to edit properties of the series (a curve or trace is referred to as a series) present on the plot.

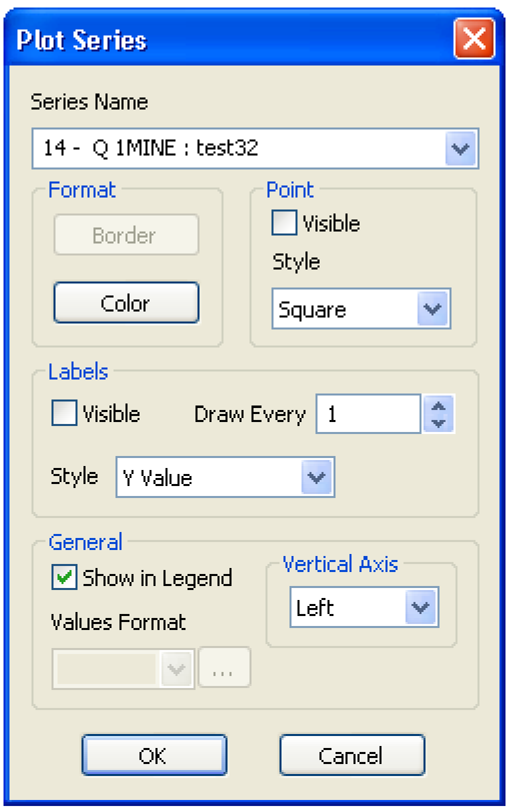


Figure 22.11. Plot Series Dialog

The options available in this dialog are shown in Table 22.3, "Description of Options in Plot Series Dialog".

Table 22.3. Description of Options in Plot Series Dialog

Option	Description
Series Name	The Series Name dropdown list displays all the channels present on the plot. All the attributes displayed refer to the channel selected in this list.
Color	Click *[Color]* to display a Color Selector. This is used to draw the channel on the plot.
Point Visible	The Visible checkbox is used to turn the display of data points on/off. Each channel data point is represented by a symbol chosen from the Point Style list.
Point Style	The Style dropdown list allows the user to customize the type of symbol used to display data points when the Visible checkbox is selected.
Labels Visible	The Visible checkbox turns the label markers on/off. The labels can display X Values, Y values, or the X and Y values of the channel data points.
Labels Style	The Style dropdown list allows the user to select the type of label displayed at each of the channel data points.
Labels/Draw Every	The Draw Every edit box determines the interval used to draw labels. Drawing labels at every data point could clutter the plot when there are hundreds of points. Draw Every gives the user finer control over the frequency of the displayed labels.
Show in Legend	The Show in Legend checkbox turns the series on or off. When selected, the series (channel) appears in the legend.
Vertical Axis	Determines the Y axis associated with the series.

Plot Axis Dialog

The *[Plot Axes]* dialog (Figure 22.12, “Plot Axes Dialog”) is available when a PlotBook is the active view; to open, select *Edit > Plot Attributes > Axis*. It can also be displayed by right-clicking on the plot and selecting Plot Axis from the popup menu. It is used to edit axis properties.

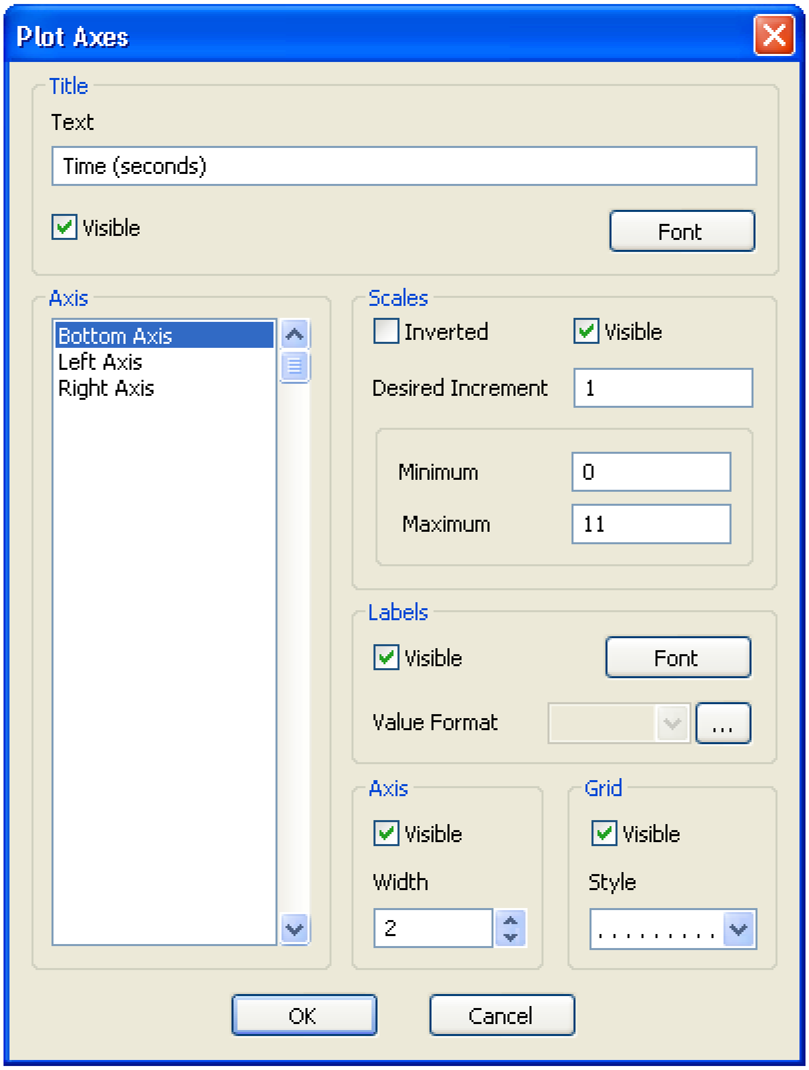


Figure 22.12. Plot Axes Dialog

Table 22.4, "Description of Options in Plot Axis Dialog" displays the options available in the Plot Axis Dialog.

Table 22.4. Description of Options in Plot Axis Dialog

Option	Description
Axis	The listbox contains a list of the 3 basic axes (bottom, left, right) as well as any custom axes that might be added to the plot. Information displayed in the dialog pertains to the axis selected in this list. To change the selection, click on the desired axis.
Scales: Inverted	The Inverted checkbox determines if the range of the axis is inverted, going from larger to smaller values along the length of the axis.

Option	Description
Scales: Visible	This checkbox determines whether the axis scale is displayed.
Desired Increment	This value is used as the increment for the scale of the selected axis.
Minimum	The value in the edit box is used as the minimum for the axis.
Maximum	The value in the edit box is used as the maximum for the axis.
Title	The edit box is used to input text for the axis title.
Title Visible	This checkbox determines if the axis title is visible or not.
Font	The font button displays the *[Font]* dialog (Figure 22.9, “Font Dialog”) that can be used to modify the color, style, size and type of font used for the axis title.
Labels: Visible	This checkbox determines if the labels are visible or hidden.
Labels: Font	The font button displays the *[Font]* dialog (Figure 22.9, “Font Dialog”) that can be used to modify the color, size, style and type of font used to display labels for the axis.
Axis Visible	This checkbox determines if the axis border is displayed or not.
Axis Width	The value in the axis width determines the width of the axis border, if it is visible.
Grid Visible	The visible checkbox determines if the grid lines are visible or not.
Grid Style	The style field is used to set the type of line used to display the major grid for the axis.

Plot Background Dialog

The *[Plot Background]* (or Plot Panel) dialog (Figure 22.13, “Plot Background Dialog”) is available when a PlotBook is the active view; to open, select *Edit* > *Plot Attributes* > *BackGround*. It is also displayed by right clicking on the plot and selecting PlotBackground. It is used to determine background characteristics of the plot display area.

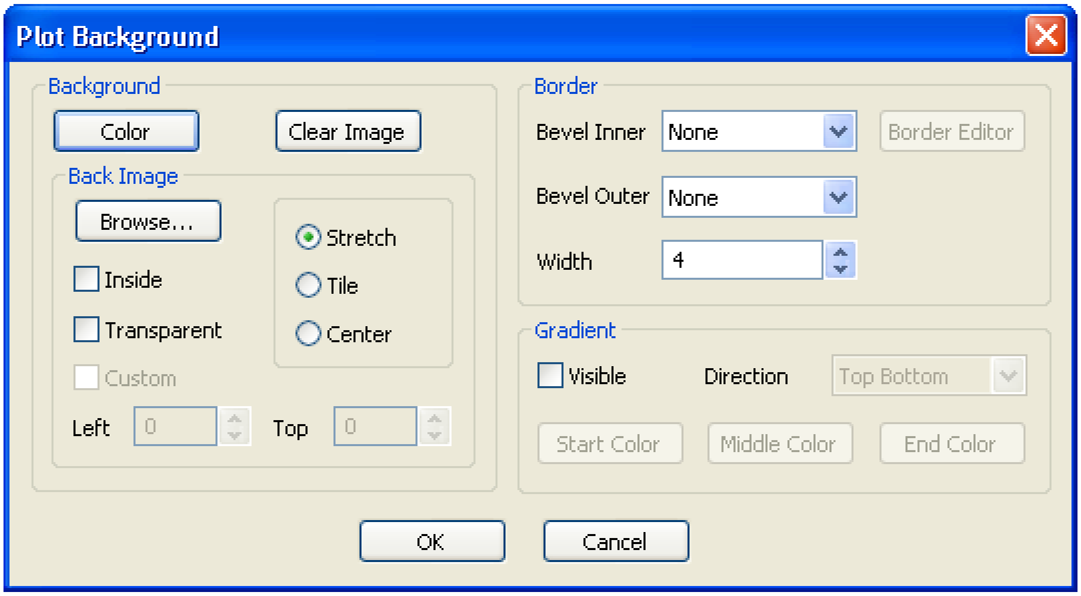


Figure 22.13. Plot Background Dialog

Table 22.5, "Description of Options in Plot Background Dialog" displays the options available in the Plot Background Dialog.

Table 22.5. Description of Options in Plot Background Dialog

Option	Description
Color	Click *[Color]* to display a color selector, used to modify the background color of the plot.
Browse (Back Image)	Click *[Browse]* to display a file selector that is used to place an image file on the plot. Any commonly used image format is acceptable.
Inside	The Inside checkbox, when selected, causes the image to be placed inside the area enclosed by the plot axes.
Transparent	The Transparent checkbox, when selected, causes the image on the plot to appear transparent if the image supports transparency.
Stretch	The Stretch radio button, when checked, causes the image to be stretched so as to fit the entire display area for the plot.
Tile	The Tile radio button, when checked, causes the image to be tiled across the plot display area.
Center	The Center button, when selected, centers the image within the plot display area.
Bevel Inner	The Bevel Inner dropdown list gives the user several choices that, together with Bevel Outer, determine the appearance of the plot border. The choices are None, Lowered and Raised.

Option	Description
Bevel Outer	The Bevel Outer dropdown list in conjunction with Bevel Inner determines the appearance of the plot border. The choices are None, Lowered and Raised.
Width	Width determines the size of the bevel border, if one is present.
Gradient Visible	The Visible checkbox, when selected, specifies the plot background color to be displayed as a shaded color gradient.
Start, Middle, End Colors	If *Gradient Visible* is selected, the Start Color begins a horizontal gradient at the bottom of the Plot and the End Color appears at the top.

Plot Annotation Dialog

The *[Plot Annotation]* dialog (Figure 22.14, "Plot Annotation Dialog") is available when a PlotBook is the active view; to open, select *Edit* > *Plot Attributes* > *Plot Annotation*. It can also be displayed by right clicking on the plot and selecting Plot Annotation. It is used to add text to the plot.

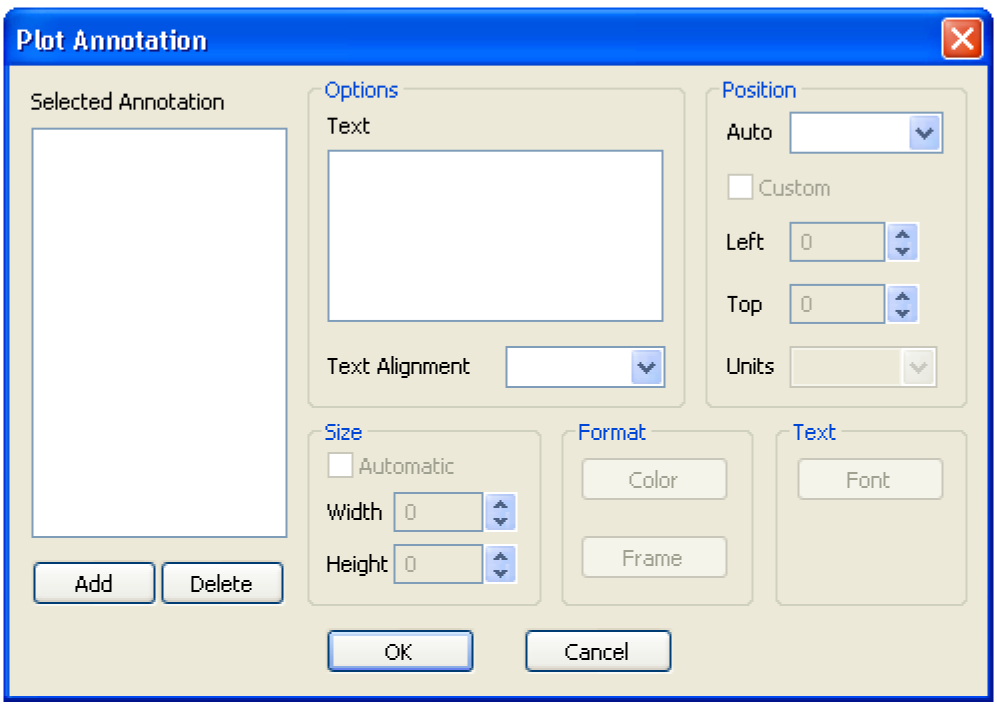


Figure 22.14. Plot Annotation Dialog

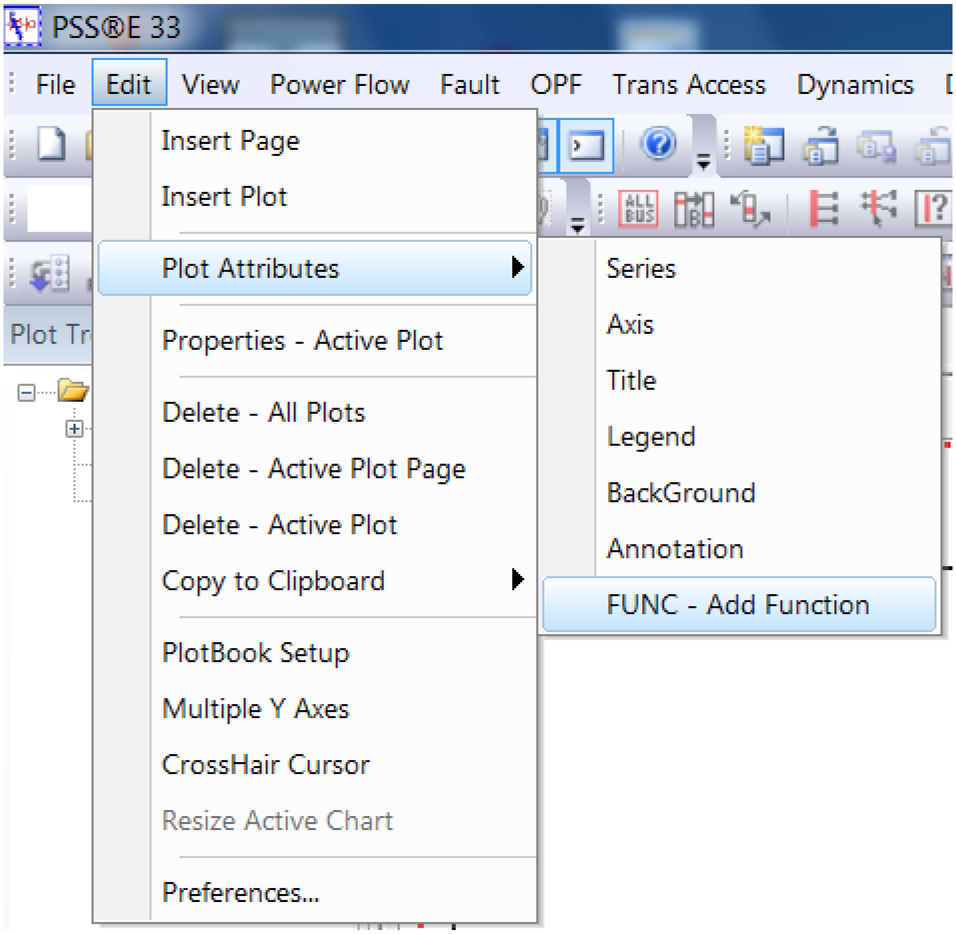
Table 22.6, "Description of Options in Plot Annotation Dialog" displays the options available in the Plot Annotation Dialog.

Table 22.6. Description of Options in Plot Annotation Dialog

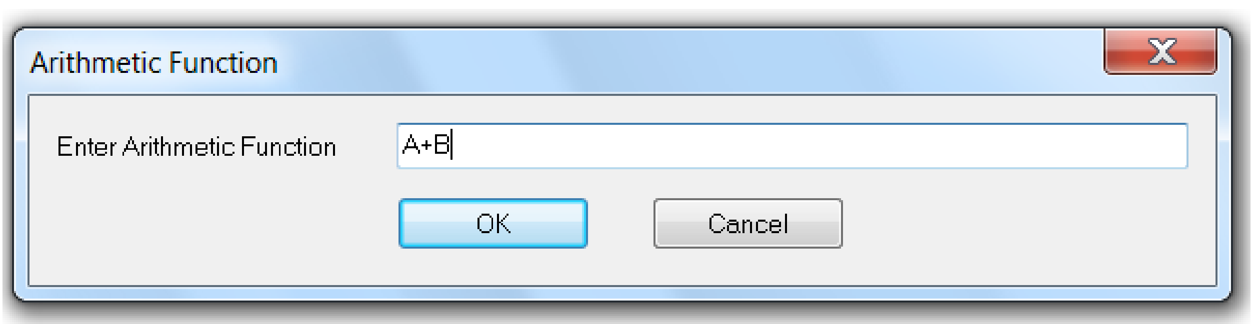
Option	Description
Selected Annotation ListBox	This is a list of all annotation currently present on the plot. In order to modify add or delete an entry, select an annotation in the list box.
Text	The text field contains the text of the selected annotation that will be added to the plot.
Add/Delete of Selected Annotation	Use Add to add the selected annotation to the plot. Use Delete to delete the selected annotation from the plot.
Text Alignment	The alignment dropdown list specifies text alignment to the left, right or center of the annotation frame.
Position Auto	The position auto dropdown list allows the user to select from one of four preset positions, Left Bottom, Left Top, Right Bottom, Right Top, relative to the plot boundaries.
Format Color	Click *[Color]* to display a color selector. The selected color is used for the text background.
Text Font	The font button displays the *[Font]* dialog (Figure 22.9, "Font Dialog") used to set the type, size and style of the text.

FUNC - Add Function

The FUNC option is selected to add a user defined arithmetic expression to the plot. It is available from Edit -> Plot Attributes -> FUNC - Add Function.



Once selected, the FUNC dialog is displayed.

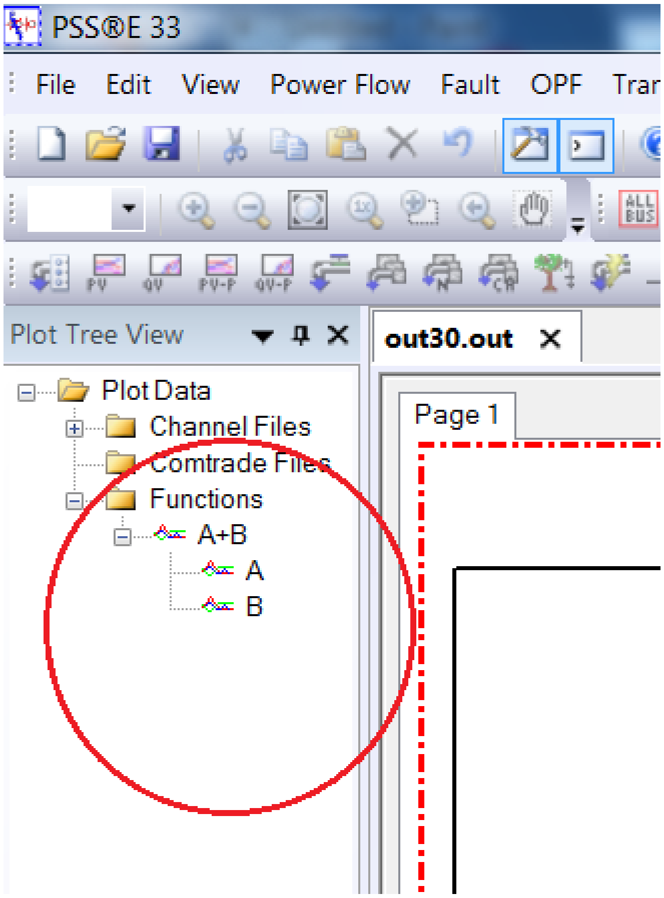


A user defined arithmetic expression consists of arithmetic operators and variables represented by single alphabetic characters. The following restrictions have been lifted from arithmetic expressions used previously in PSSPLT:

1. The variables in the expression need not be in alphabetical order.

2. The use of lower case alphabetic characters is allowed.

Once entered, the expression appears as a node in the Plot Tree. The child nodes of the function are the variables contained in the expression.



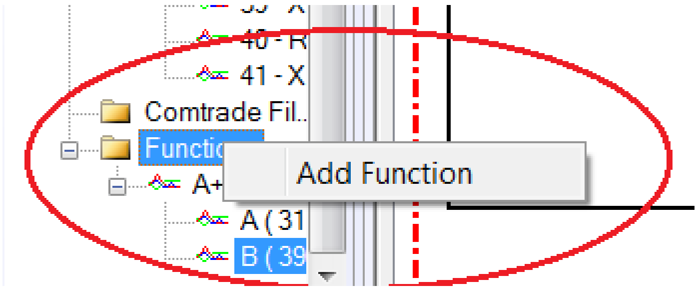
Channels can be assigned to variables in two different ways:

1. Drag and Drop channels from the channel tree onto the function variables.

2. Right click on the desired channel name in the channel tree and select "Copy to Function." Then right click on the function variables and select "Paste Channel."

Once all variables have been assigned channels, the function is added to the plot by dragging it onto the active chart.

Alternatively, the Arithmetic function dialog can also be invoked by right clicking on the "Function" node in the Plot Tree.



Multiple Y Axes

The Multiple Y Axes menu item found under the Edit menu (Figure 22.15, “Multiple Y Axes in Edit Menu”) enables and disables the addition of multiple vertical axes. The default setting is to enable the property. When checked, each new channel added to the plot is associated with a new vertical axis.

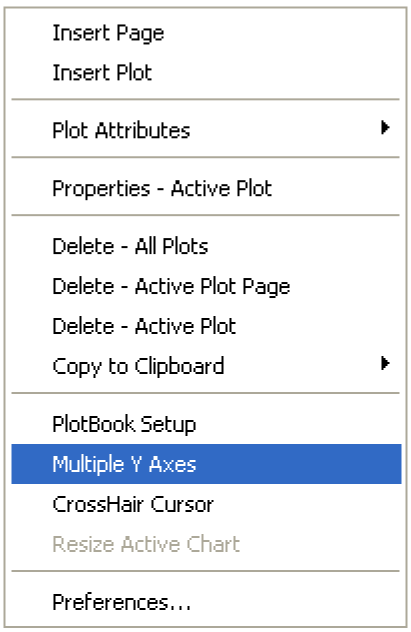
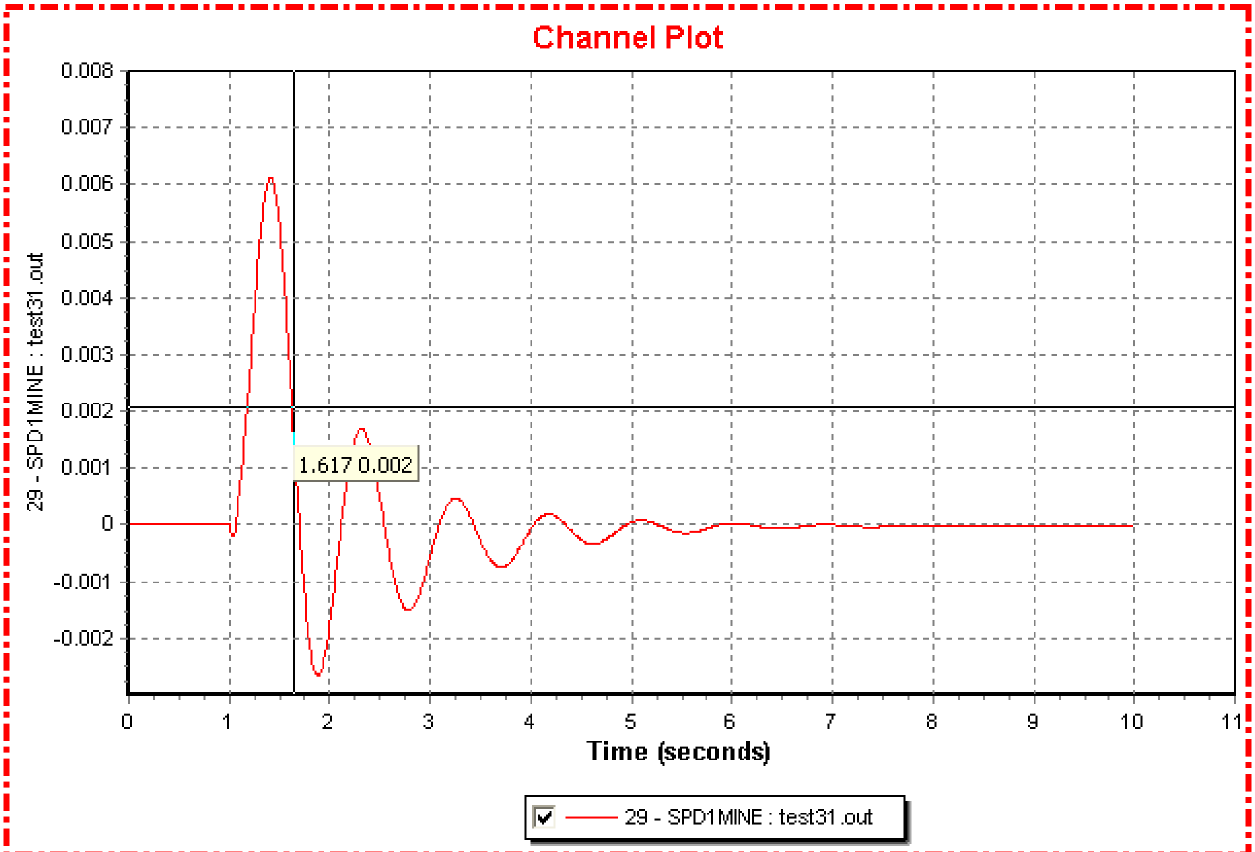


Figure 22.15. Multiple Y Axes in Edit Menu

CrossHair Cursor

The crosshair cursor menu item under the Edit menu (Figure 22.15, “Multiple Y Axes in Edit Menu”) enables and disables the cross hair cursor. When the cursor is enabled and the user clicks on a data point within the channel, its X, Y value is displayed. The default setting is crosshair cursor disabled.



Displaying CrossHair on a Plot

22.3.3. Plot Editor Operations

One method to change the plot look and feel attributes is via separate dialogs provided under the Edit menu operation described above. An alternate method to change the plot look and feel attributes and to view the data contents is through the use of Plot Editor.

This editor is accessed by bringing up the context menu (right or left mouse click) in the active Plot and selecting Show Editor (see Figure 22.16, "Accessing Plot Editor via Context Menu").

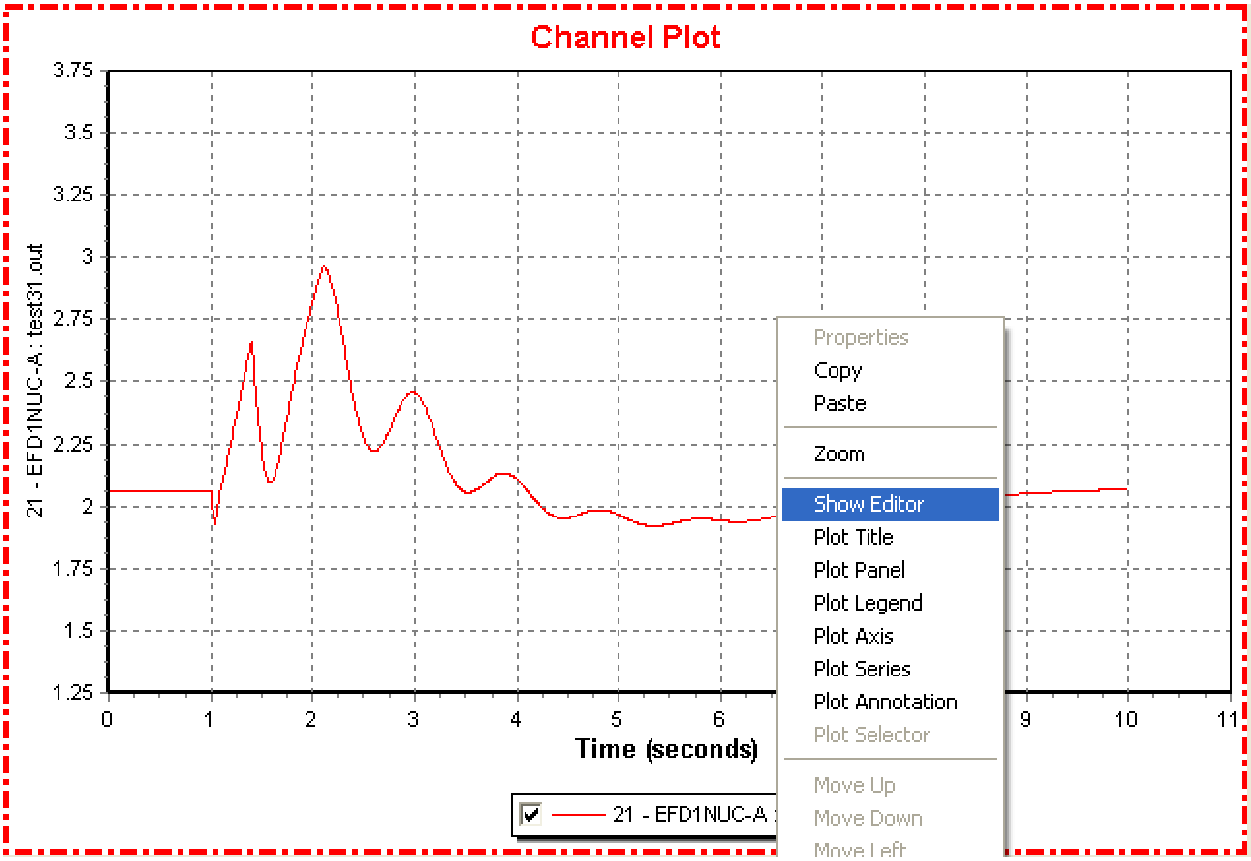


Figure 22.16. Accessing Plot Editor via Context Menu

The *[Editing]* dialog allows the configuration of various properties of the Plot, such as axis, titles, legend, colors, etc. (see Figure 22.17, “Plot Editor”).

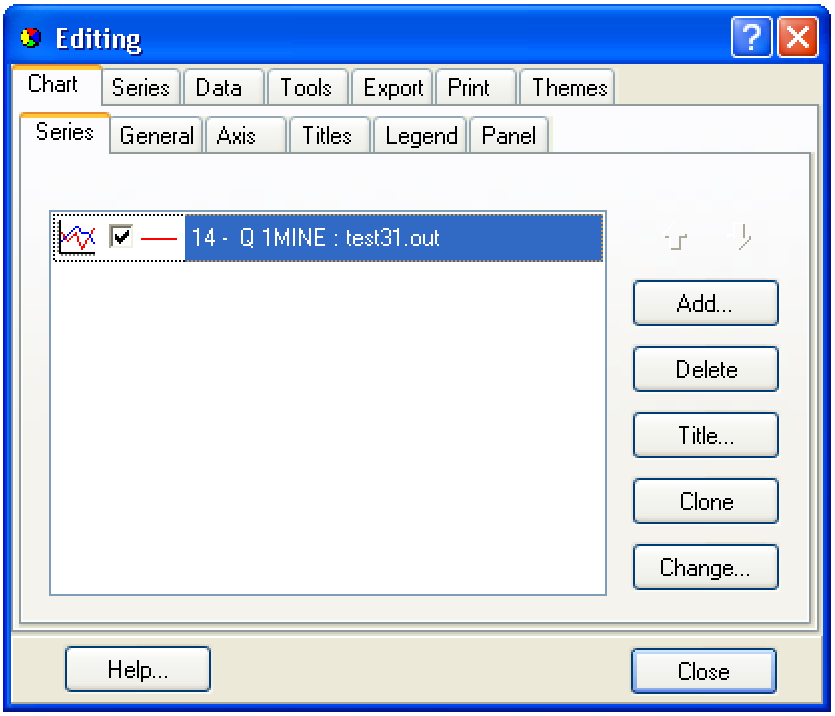


Figure 22.17. Plot Editor

There are several controls in the Plot Editor, not all of which may be of use in for PSS®E plots. Only those Plot Editor controls that are deemed to be of interest to PSS®E users are described below. In a future PSS®E release, the Plot Editor Controls will be simplified to provide access to only the required controls, thus making the editor more intuitive with fewer mouse clicks.

Chart / Series Controls

The Series tab for the Chart *[Editing]* dialog provides two controls that would be of interest to PSS®E users, the [Delete] and *[Title]* buttons.

[Delete] supports deletion of the selected series. Selecting [Delete] removes the plot of the selected series from the PlotPage.

[Title] allows the user to modify the series title (see Figure 22.18, “Change Series Title”).

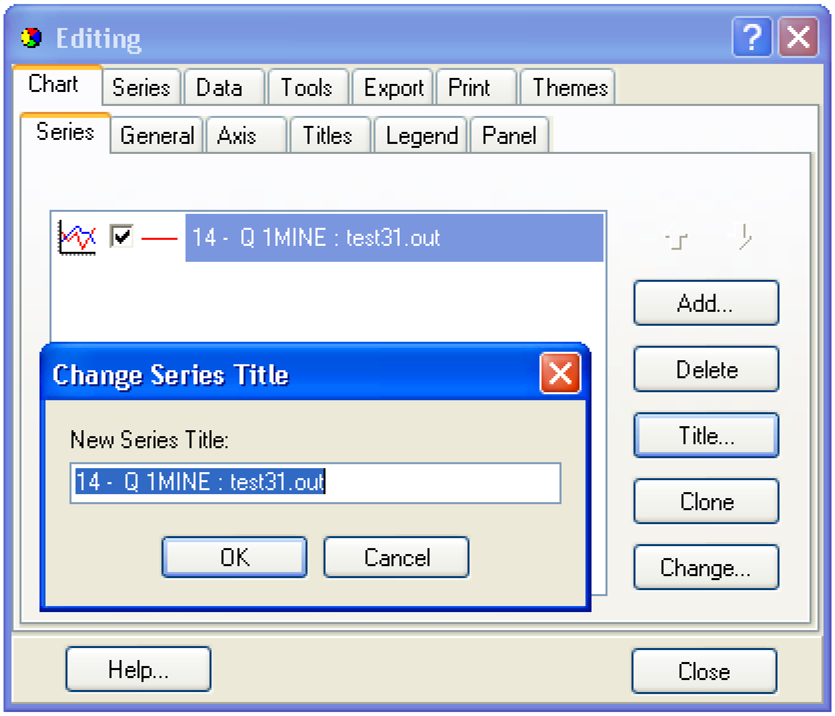


Figure 22.18. Change Series Title

Chart / Axis Controls

The Scales subtab of the Axis tab on the Chart *[Editing]* dialog supports scale changes (axis increment, and the minimum and maximum values) of the X and Y axis (see Figure 22.19, “Change Scales of Axis”).

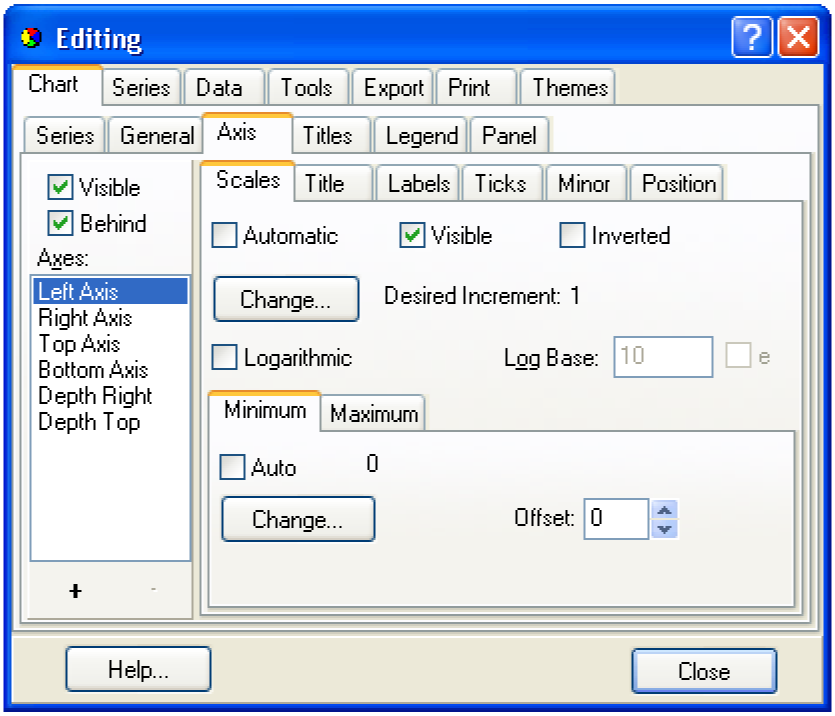


Figure 22.19. Change Scales of Axis

It is possible to have several Y-axes. These are called Left Axis, Right Axis, etc. The X-axis is called the Bottom Axis.

Selecting *[Grid]* from the Ticks subtab, Axis tab on the Chart *[Editing]* dialog (see Figure 22.20, "Add or Remove Axis Grid") permits removal of the grids on the selected axes (Left Axis, Bottom Axis, etc.).

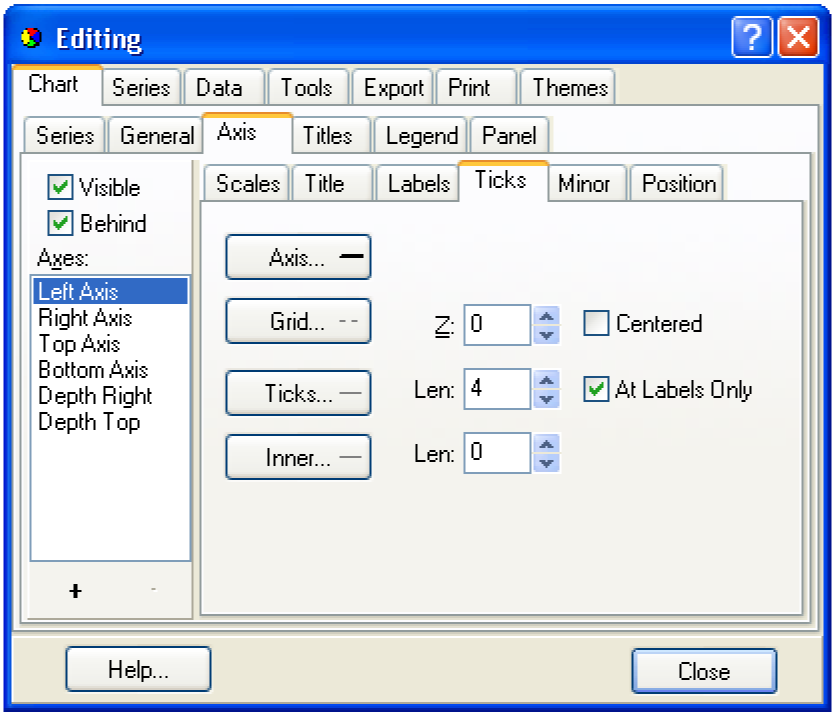


Figure 22.20. Add or Remove Axis Grid

Chart / Titles Controls

The Titles tab on the Chart *[Editing]* dialog supports changes to the plot titles (see Figure 22.21, "Chart / Titles Editing Dialog"). The title position, format, and text font can be changed. A para may also be added.

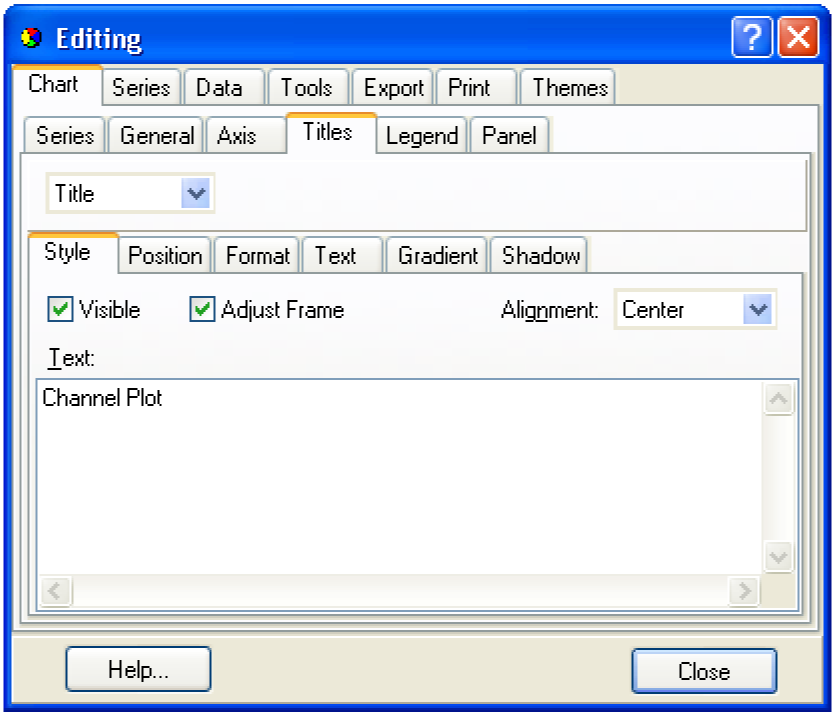
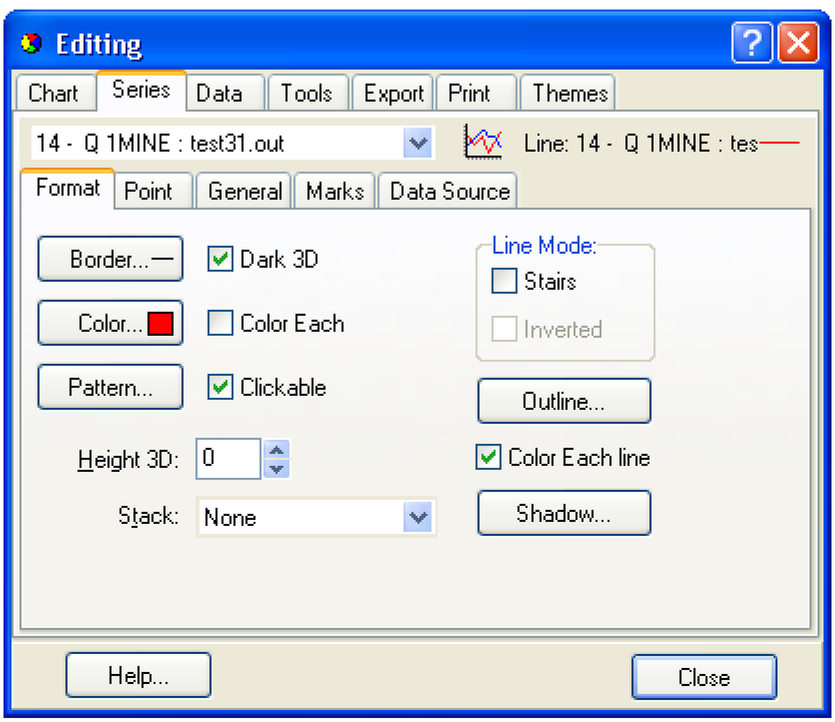


Figure 22.21. Chart / Titles Editing Dialog

Series Controls

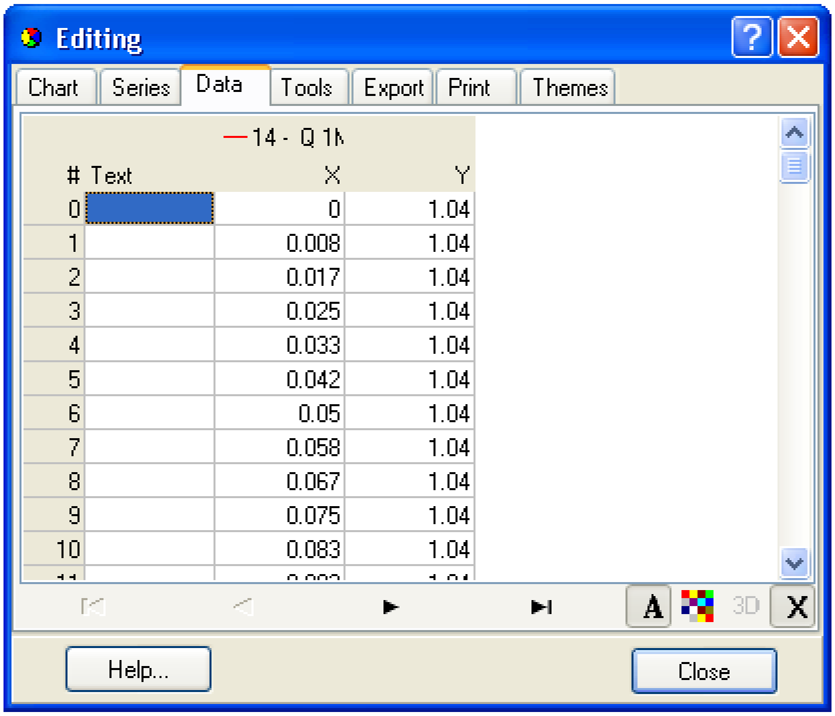
Selecting *[Color]* from the Format tab on the Series *[Editing]* dialog supports changing the plot color.



Format Tab for Series Editing Dialog

Data Control

The X and Y values for every curve/trace in the selected Plot can be displayed by selecting the Data tab in the Plot Editor. This is a useful feature for the visual inspection of the X and the corresponding Y values.



Getting Plot X and Y Values from Data Tab

Export / Picture Control

One method of exporting the active Plot to several different file formats, as explained earlier, is via the Plot Editor. Use the Picture subtab of the Export *[Editing]* dialog (Figure 22.22, “Export Picture using Plot Editor Export”).

Another method of exporting is by selecting *File* > *Export* and then selecting the desired format from the popup menu.

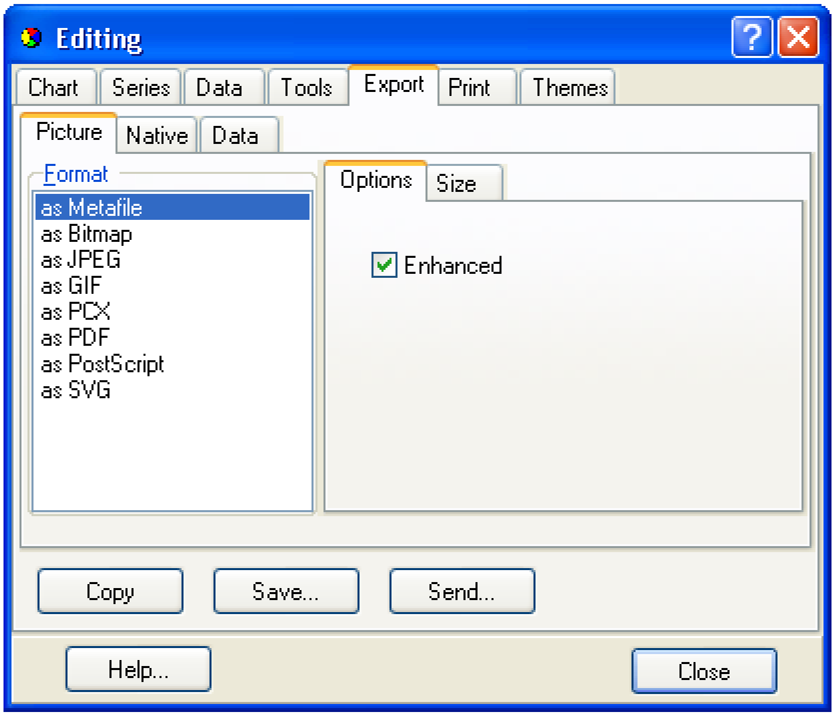
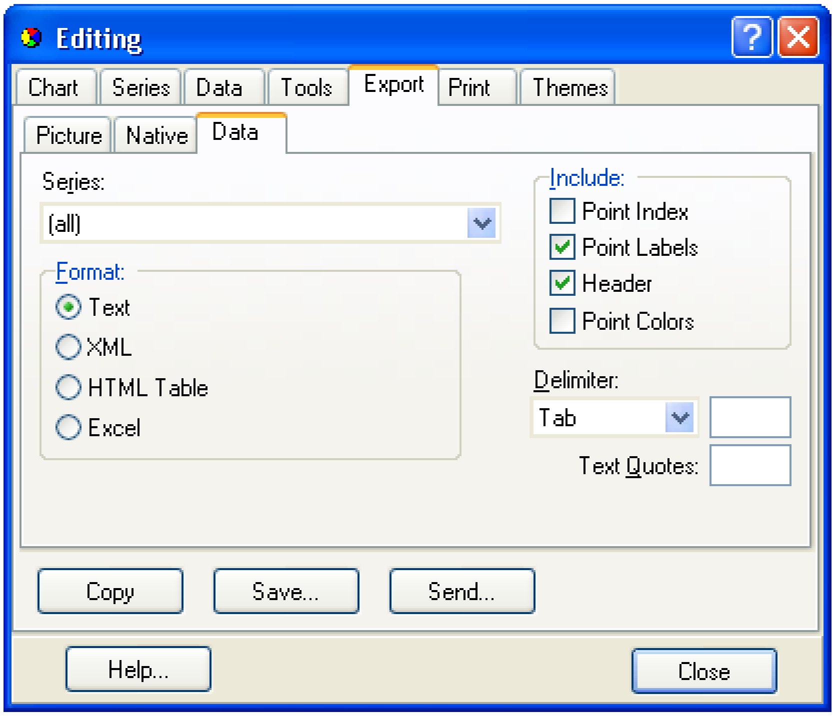


Figure 22.22. Export Picture using Plot Editor Export

Currently, four file formats are available for export, Windows Metafile, Bitmap, JPEG, and PDF. Future release will add other graphic formats.

Export / Data Control

The Data subtab of the Export *[Editing]* dialog supports the export of data points to text, Excel® spread sheet, or other formats. The export could be for either all the curves/traces in a plot (select all), or it could be the export of just the selected curve.



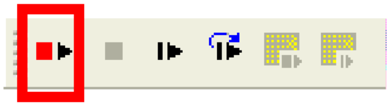
Export Data to Excel® File

In order to Export it to, for example, an Excel® file, select the series, click *[Save]*, and specify the filename.

Chapter 23
Program Automation

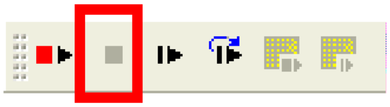
23.1. Reproducing User Actions

A sequence of PSS®E actions for batch commands may be recorded in a Python script (*.py, *.pyc, or *.pyw) or Response file (*.idv). See Section 23.2, "Creating Program Automation Files" for details on specific types of files.



I/O Control > Start recording...

A file selector window opens for specification of the type of file to record and the file name.



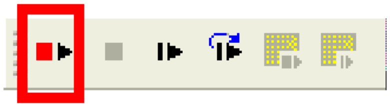
I/O Control > Stop recording

When done recording, select *I/O Control > Stop recording* to close the file.

23.2. Creating Program Automation Files

23.2.1. Response File

IDEV



I/O Control > Start recording...

An experienced user can create a response file using a text editor. The simplest and most robust way, however, is to select the *I/O Control > Start recording* option. Note that this is equivalent to executing activity ECHO in previous versions of PSS®E.

Having selected a file, the user executes the required sequence of activities or operations using the menu and toolbar functions in the interface. The resulting response file will contain, in Response File form, a series of commands reflecting the user's sequence of activities. The user can to tailor this basic Response File for subsequent runs by editing the created response file by changing some of the filenames and bus numbers specifying faulted nodes, switched branches, and so on.

As an example it can be assumed that, using the *savnw.sav* power flow case, the user wishes to open one circuit between buses 151 and 152, solve the case, and then display the power flow results for bus 151.

Using the interface:

- Right-click the branch in *[Diagram]* and select *Switch* from the pop-up menu.
- Employ the *Power Flow > Solution > Solve* option or the *Solve* toolbar button.
- Select the *Bus Based Output* toolbar button and, subsequently, bus number 151.

If this series of operations were recorded, a response file would be constructed (see Figure 23.1, "Created Response File").

```
@! File:"C:\Program Files\PTI\PSSE30\EXAMPLE\forguide.idv"
BAT_OPENDIAGFILE,'C:\Program Files\PTI\PSSE30\EXAMPLE\savnw.sld'
BAT_SETDIAGRESTYPEPFLOW,;
BAT_BRANCH_DATA,151,152,'1',0,,,,,,,,,,,,,,,,,,,,,;
BAT_MSLV,0,0,0,1,1,0
BAT_BSYS,1,0,0.0,0.0,0,1,151,0,0
BAT_POUT,1,0
```

Figure 23.1. Created Response File

It can be seen that the Response file contains PSS®E batch (BAT_) commands. Consequently, the manual creation of a Response File, which could be done with the text editor, requires an intimate familiarity with the PSS®E batch commands. These commands are described in the *PSS®E API Manual*.

Additional Information
PSS®E Program Operation Manual, Section 16.12, Running a Response File

23.2.2. Python and IPLAN Files

The process described in the previous section for creating a Response file can also be used to create a Python file (**.py*) by selecting this file type instead of the Response file type (**.idv*). The file type is selected. The program records the sequence of events selected by the user in the same manner.

Alternatively the user can create a Python file using the Python programming language. This will facilitate a more sophisticated control of PSS®E by enabling looping and decision making based on results of analyses. Standard concepts such as looping and subroutine calling are available. For details on the Python programming language refer to a Python reference book or http://www.python.org.

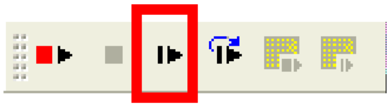
It is not possible to construct an IPLAN file using the PSS ®E recording facility. The file must be created manually and compiled. It is very beneficial to be familiar with at least one programming language and the standard programming concepts such as assignment statements, looping and subroutine calls.

For details on the IPLAN programming language, the IPLAN language interface to the PSS®E working case and dynamics data, and the IPLAN compiler, refer to the *IPLAN Program Manual*.

Additional Information
PSS®E Program Operation Manual, Python Programs

23.3. Executing Automation Files

23.3.1. Run Automation File



I/O Control > Run program Automation file...

Existing Python scripts (*.py), Response files (*.idv), IPLAN programs (*.irf) and PSAS/PSEB (*.psa/*.pse) command files may be executed from within the user interface. PSS®E will open a file selector window and prompt for the appropriate filename to execute. Figure 23.2, "Select Program Automation File Dialog" shows the dialog for selecting an Automation File:

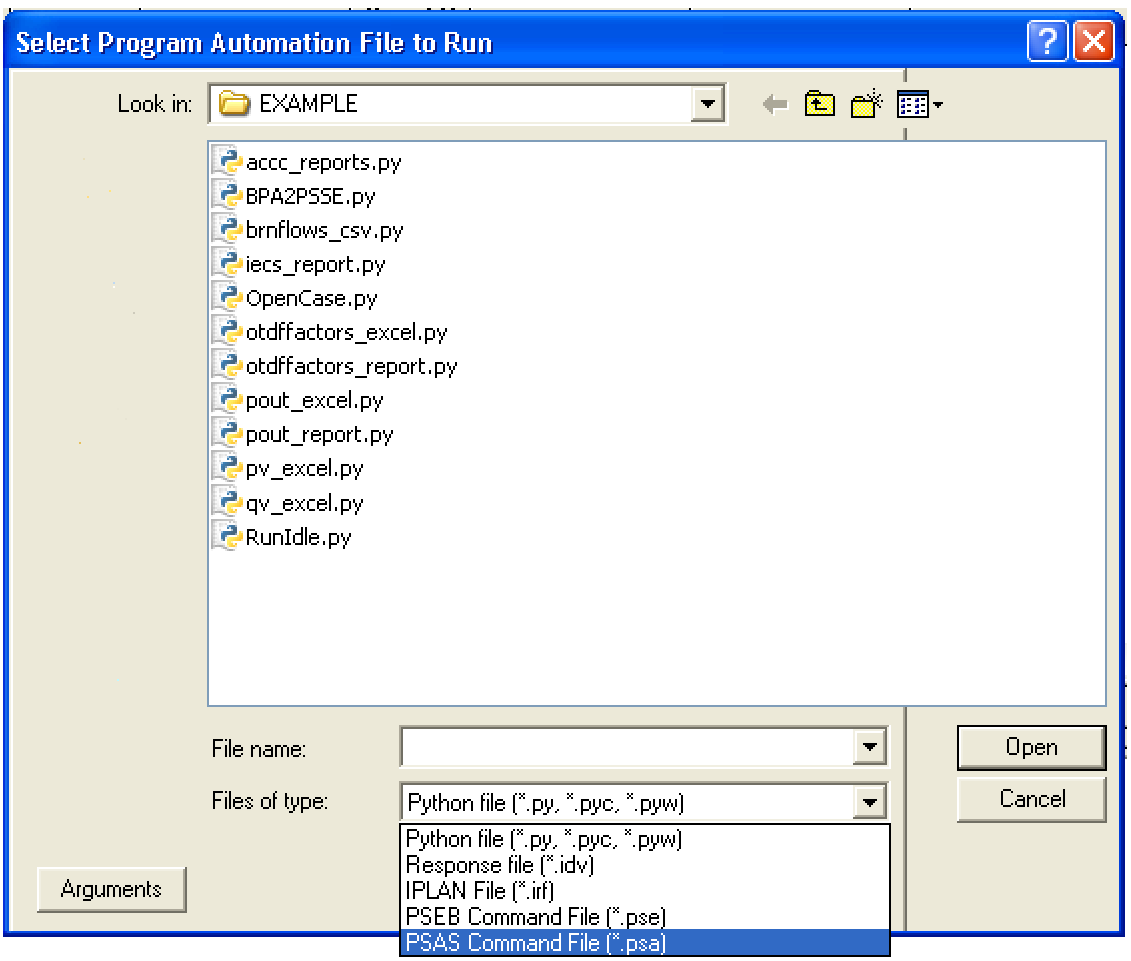


Figure 23.2. Select Program Automation File Dialog

Only five file types are shown. This is because command line input and batch commands can be assembled in the same file, so the Response File file type (*.idv) is used for either (or both). When the selected file is opened, the processes packaged in the Response file or programmed into the IPLAN or Python file will be initiated.

A *[Terminal Read]* dialog (Figure 23.3, “Terminal Read Dialog for Automated Activity”) allows specification of data output to a file. Clicking [OK] without specifying a filename sends the data to a Report tab.

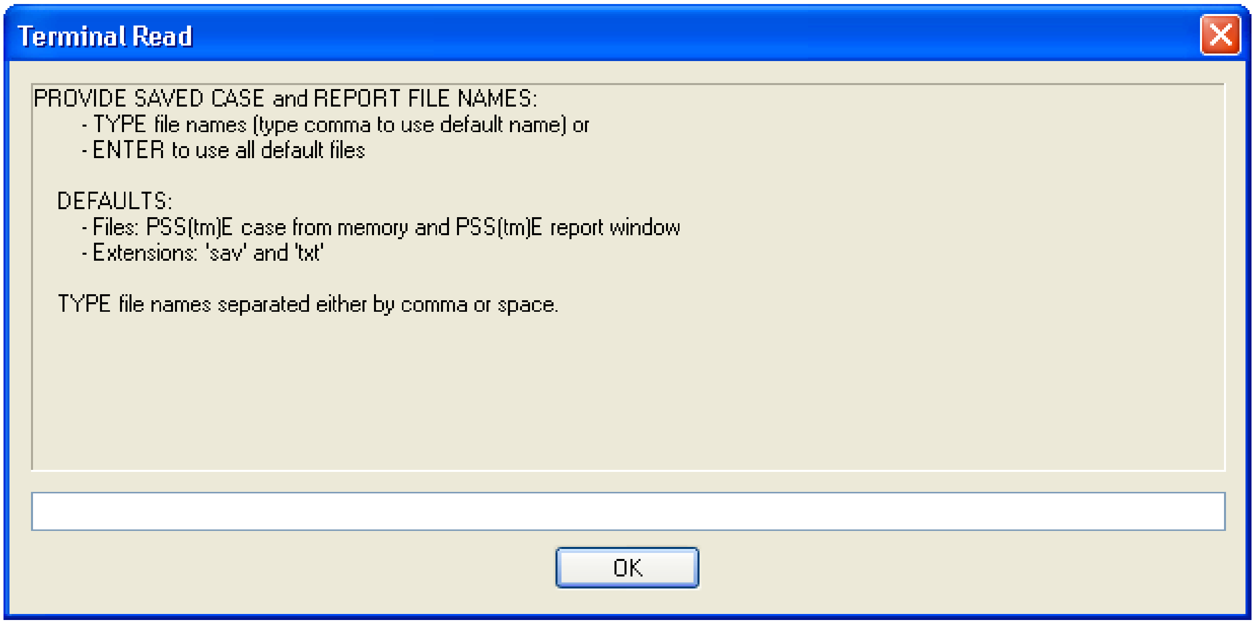


Figure 23.3. Terminal Read Dialog for Automated Activity

23.3.2. IPLAN Program File

EXEC

Requirements / Prerequisites
IPLAN Executable Program File generated by IPLAN language compiler program.

Select the desired IPLAN File (*.irf) from *[Select Program Automation File to Run]*.

For details on the IPLAN programming language, the IPLAN language interface to the PSS®E working case and dynamics data, and the IPLAN compiler, refer to the *IPLAN Program Manual*.

Additional Information
PSS®E Program Operation Manual, Launching an IPLAN Program File

23.3.3. PSEB Command File, Power Flow Calculation

PSEB

Requirements / Prerequisites
PSEB Command file (*.pse)

Select the desired PSEB Command File (*.pse) from *[Select Program Automation File to Run]*.

Additional Information
PSS®E Program Operation Manual, Building a Response File, Power Flow Calculation

23.3.4. PSAS Command File, Dynamic Simulation

PSAS

Requirements / Prerequisites
PSAS Command file (*.psa)

Select the desired PSAS Command File (*.psa) from *[Select Program Automation File to Run]*.

Additional Information
PSS®E Program Operation Manual, Building a Response File, Dynamic Simulation

23.3.5. Argument Passing

These actions allow arguments to be passed to a response file. Highlight the desired file on *[Select Program Automation File to Run]* (Figure 23.2, "Select Program Automation File Dialog"). Click *[Arguments]*. The *[Automation Arguments]* dialog (Figure 23.4, "Automation Arguments Dialog ") allows a single line of arguments to be input.

Enter the argument string in the text box provided, and click *[OK]*. Click *[Open]* to run the automation file. The response file will be executed within the PSS®E user interface with results being displayed appropriately to *[Spreadsheet]* and *Report* and *Progress* tabs.

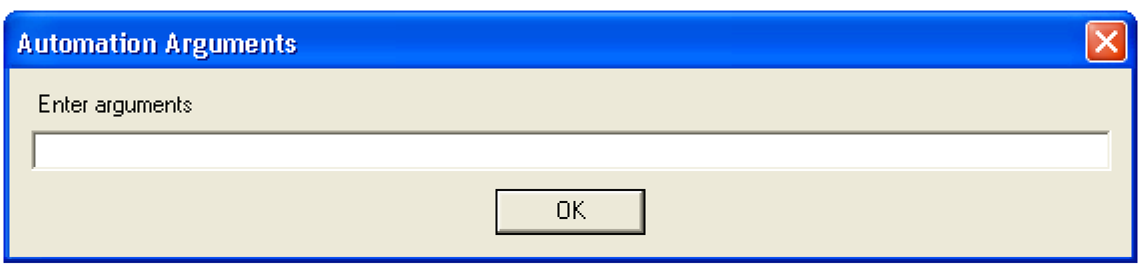
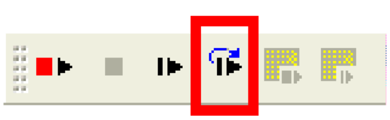


Figure 23.4. Automation Arguments Dialog

Additional Information
PSS®E Program Operation Manual, Arguments in Python Files Arguments in Response Files Arguments in IPLAN Files

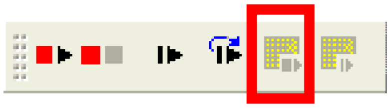
23.3.6. Re-Run Last Automation File



I/O Control > Re-run program Automation file...

When the re-run option is selected, the last-run automation file will run again without reselecting it from a file selector window. The *[Terminal Read]* dialog (Figure 23.3, “Terminal Read Dialog for Automated Activity”) allows specification of data output to a file. Clicking [OK] without specifying a filename sends the data to a Report tab.

23.4. Editing an Automation File



I/O Control > Edit last recorded program Automation file

If a text editor has been defined in the *[Preferences]* dialog (see Changing Program Preferences), selecting this option will display the last Automation file recorded by the program. If this is selected, the text editor will display the file as it is created. You may have to refresh the view in the text editor to see the changes in the file.

I/O Control > Edit last run program Automation file

If a text editor has been defined in the *[Preferences]* dialog, selecting this option will display the last Automation file run by the program. If this is selected, the text editor will display the last Automation file run by the program. Selecting this item will re-run the last selected program automation file without forcing you to re-select it.

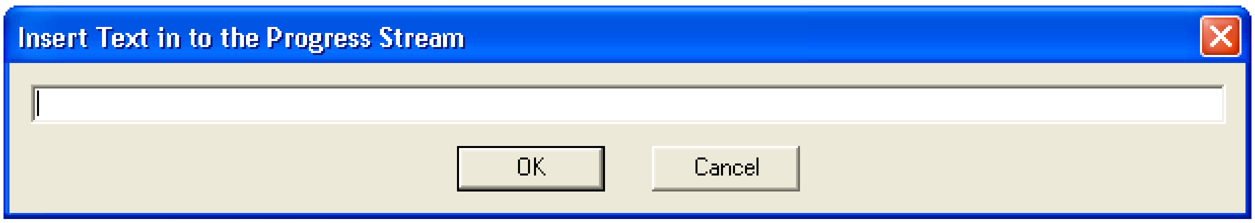
Additional Information
PSS®E Program Operation Manual, Recording User Actions

23.5. Inserting Comments into the Progress Output

TEXT

Misc > Insert text into the Progress stream (TEXT)

During the operation of PSS®E, a variety of information is sent to the *Progress* tab. This function provides a mechanism for inserting descriptive comments. Comments can be directed to any output device selected for recording the work session (see OPEN). A comment or message is entered directly into the input field in the dialog.



Insert Text into the Progress Stream Dialog

Additional Information
PSS® E Program Operation Manual, Inserting Comments into the Progress Output

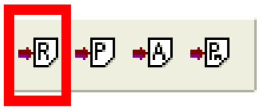
Chapter 24
Output Controls

24.1. Directing Solution Output

Output from an interactive session in PSS®E is typically directed to *[Output]* view. Since lists and reports can be lengthy, the user may direct the output to alternative devices.

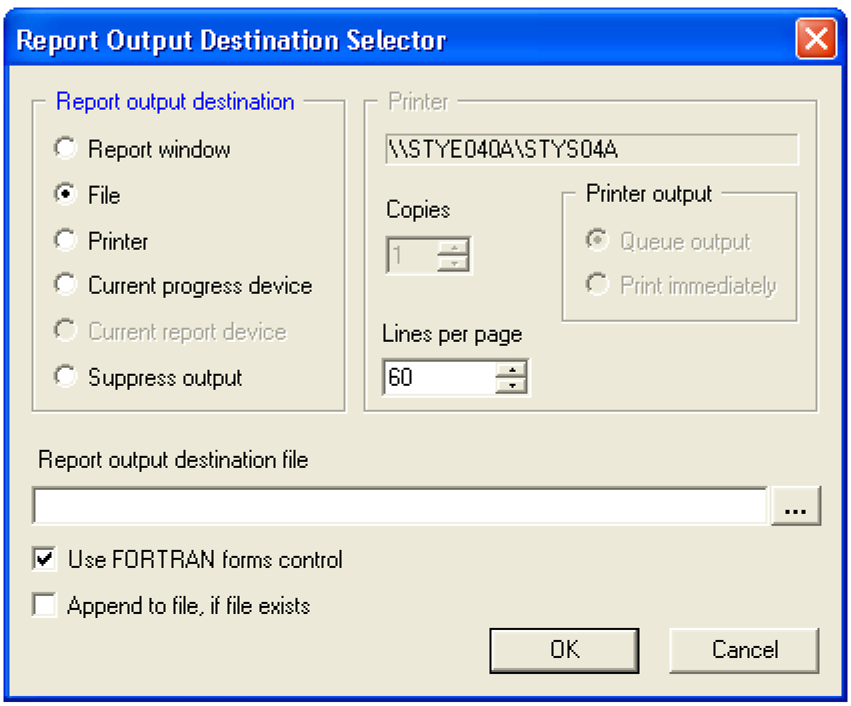
24.1.1. Global Report Destination

OPEN



I/O Control > Direct Report output (OPEN)...

By default, reports are sent to the *Report* tab in *[Output]* view. Options are available for redirecting reports to a file, printer, or to the current progress device. The option also exists for suppressing all reporting output. Report and progress destinations can be the same.



Report Output Destination Selector

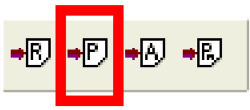
If the Printer option is selected, the user further specifies the printer and printing options. If file output is selected, the user must enter a filename in the *Report output destination file* field. Fortran forms control can be enabled if either file or printer output is specified.

The *Append to file, if file exists* option may be selected if file output is selected. If enabled, then any new report output will be appended to the specified file instead of overwriting it.

Additional Information
PSS® E Program Operation Manual, Selecting Report Output Destination

24.1.2. Progress Destination

PDEV



I/O Control > Direct Progress output (PDEV)...

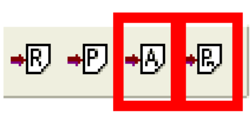
This option can be used to direct *Progress* output to an alternative device. Specification for the *[Progress Output Destination Selector]* dialog is essentially the same as that described for directing *Report* output. The only difference is that the default output destination is the *Progress* tab.

Additional Information
PSS® E Program Operation Manual, Selecting Progress Output Destination *PSS® E Program Operation Manual*, Virtual Output Devices

24.1.3. Alerts and Prompts Destination

ODEV

Requirements / Prerequisites
None, although in practice, activity ODEV would be executed only from a Response File or an IPLAN program. Response File (*.idv)



PSS®E generated alerts and prompts are sent to *Alerts/Warnings* tab in *[Output]* view. The *I/O Control > Direct Alert output...* and *I/O Control > Direct Prompt output...* options direct these outputs to an alternate destination or suppress output. The dialogs are similar to those used for redirecting *Progress* and *Report* output.

Additional Information
PSS® E Program Operation Manual, Selecting Prompt Output Destination *PSS® E Program Operation Manual*, Virtual Output Devices

24.2. Setting the Path for Use with & Filenames

PATH

I/O Control > Set path for use with "&" filenames (PATH)...

This function allows you to specify a directory path name that can later be represented by an ampersand (e.g., &myfile). This shorthand method for specifying a path name can be used by PSS®E file accessing activities. A filename prefixed by this ampersand will be obtained from the directory specified in the path setting.

Select the directory path to be accessed by the & short-hand method by clicking any file in the desired directory (see Figure 24.1, "Define PATH Dialog").

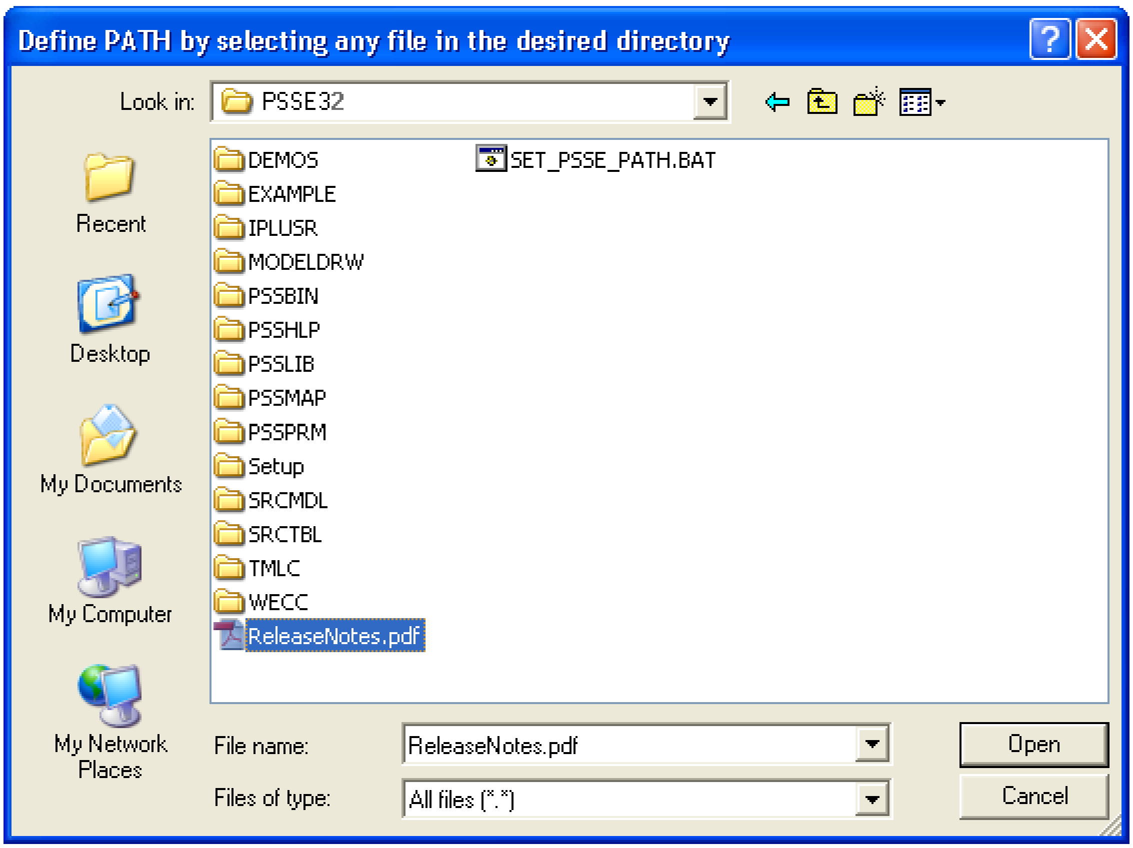


Figure 24.1. Define PATH Dialog

Additional Information
PSS® E Program Operation Manual, Setting the Path for Use with & Filenames *PSS® E Program Operation Manual*, PSS®E Data Files

Chapter 25
Event Studies

25.1. Creating an Event Study

Highlight the *Event Studies* folder in *[Dynamics Tree]* and right-click to select *Add Event Study*. This action opens the selection window for the required *Event Study file* (*.evs). After entering a filename, click *[Open]* to open the *[Event Study Properties]* dialog (Figure 25.1, "Event Study Properties Dialog").

For dynamics event studies, modify the study *Parameters* from the default settings, as desired, select a channel file for the event study, if desired, and click *[OK]*. The event study is listed in the *Event Studies* folder in *[Dynamics Tree]*, and the event study activity buttons become activated in the toolbar. Double-clicking the title in *[Dynamics Tree]* or right-clicking and selecting *Edit* re-opens *[Event Study Properties]* for modification.

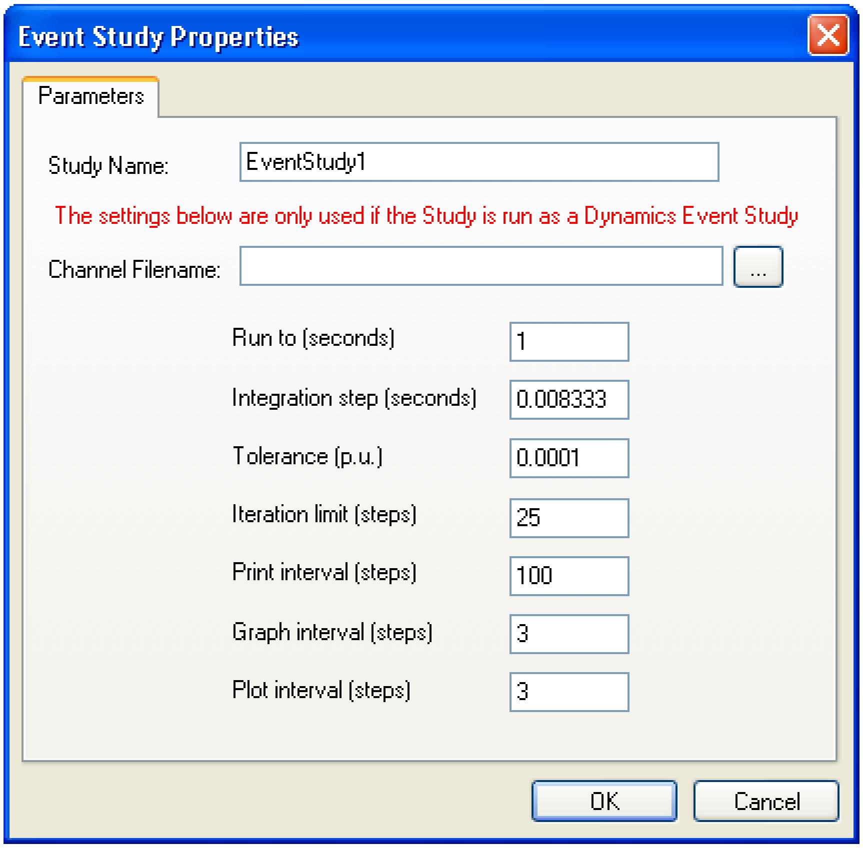


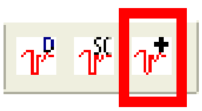
Figure 25.1. Event Study Properties Dialog

Additional Information
PSS®E Program Operation Manual, Event Studies

25.2. Adding an Event Item

25.2.1. Dynamics Event Studies

Requirements / Prerequisites
Validly specified power flow case, solved to an acceptable mismatch level. Dynamics data must exist in dynamics working memory. Reading Dynamics Model Data Event Study File (*.evs) Creating an Event Study



[Dynamics Tree] > highlight *Event Study* > right-click > *Add Event Item*

The *[Event Item Properties]* dialog (Figure 25.2, “Event Item Properties Dialog”) provides the means to configure an event study file with faults or disturbances. The following table displays the matrix of choices available.

Network Item	Event Types
Bus	• Unbalanced Bus Fault • Bus Fault • Disconnect Bus • Connect Bus
Load	• Disconnect Load • Connect Load
Machine	• VREF Change • Disconnect Machine • Connect Machine • GREF Change
Branch	• Unbalanced Line Fault • Line Fault • Line Trip • Close Line

Network Item	Event Types
3-Winding Transformer	• Unbalanced Line Fault • Line Fault • Line Trip • Close Line

A *Clear Fault* option is available to reset an event item.

The Run Automation File option is not associated with any network item. It runs the specified automation file when the event item is executed. It is useful when doing pre/post processing in dynamic event studies.

Click *[Select]* to open the appropriate selection dialog to specify the event.

Click *[Add]* to add the event item to the event study and open a new *[Event Item Properties]* dialog for the next item.

[Dynamics Tree] displays an index of the event study as it is built (Figure 25.2, "Event Item Properties Dialog"). The event items are marked with an icon of the *Event Type* and the time. You may delete the event item using the right-click menu. *[Network Tree]* alters the network item icon with a red indicator, for example,

.

An *[Event Study Spreadsheet]* is also built as the event study is built. The *Channel Identifier (event name)* and Channel IPrint *(time)* cells may be edited, and the event item may be de-activated or re-activated from this spreadsheet.

You will need to click *[Close]* to end this activity.

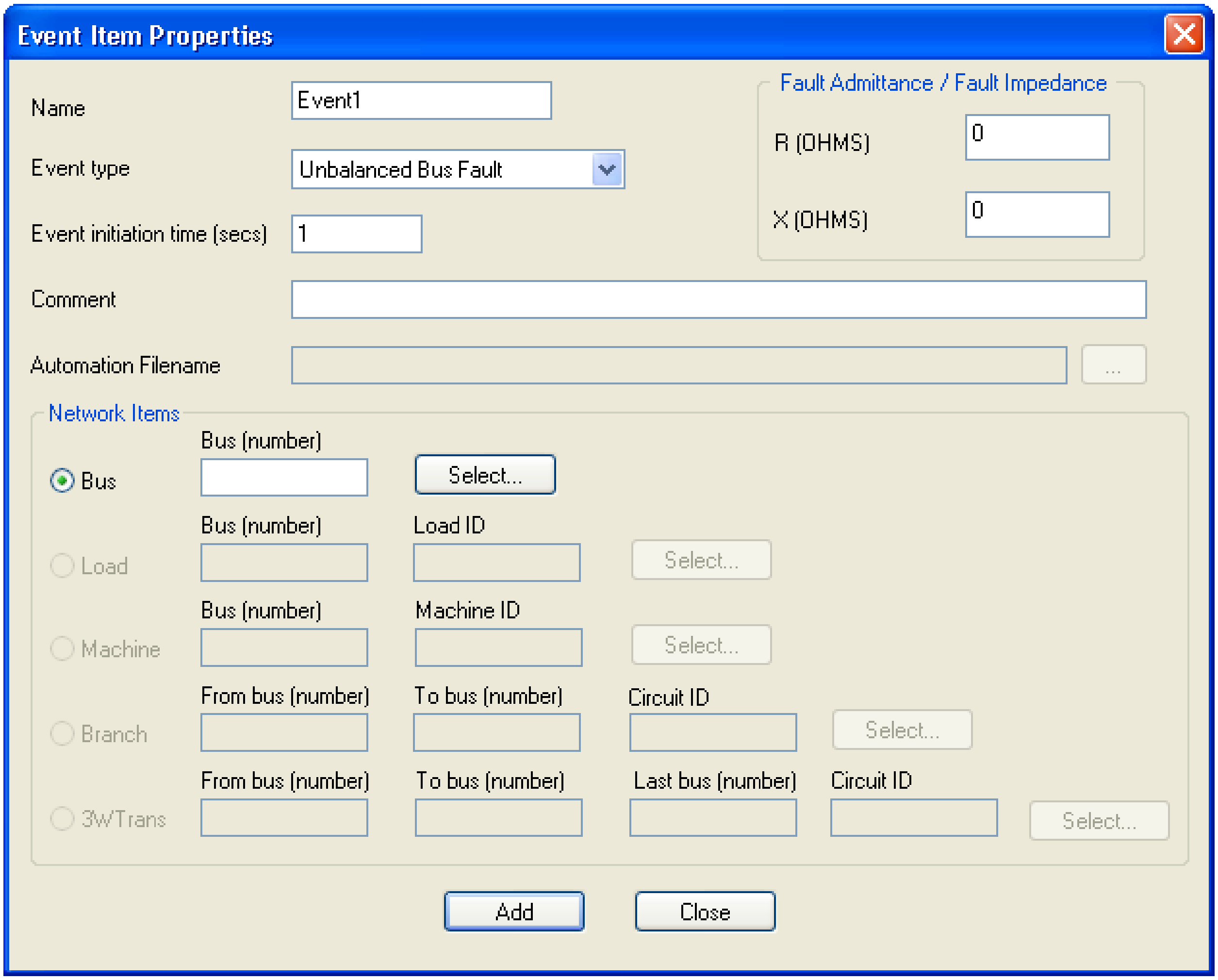
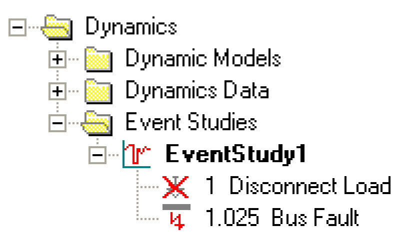


Figure 25.2. Event Item Properties Dialog



Example of Event Study Item List

Event study items may be added to a Dynamics Event Study using the method described in Section 25.2.2, “Short Circuit Event Studies”.

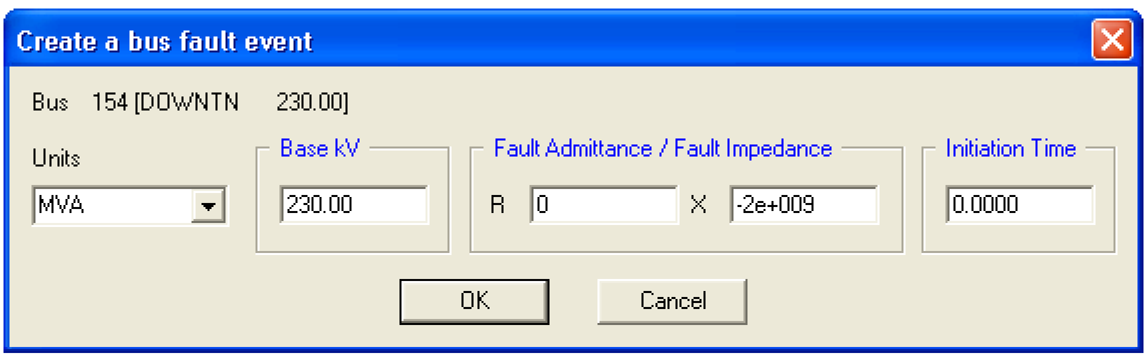
Event items may be copied or moved among event studies by using drag/drop in *[Dynamics Tree]*. To move an event item from one study to another, drag the event item to the destination study. To copy an event item, hold the *[Ctrl]* key while dragging the item.

25.2.2. Short Circuit Event Studies

Requirements / Prerequisites
Validly specified power flow case, solved to an acceptable mismatch level.
Event Study file (*.evs) Creating an Event Study

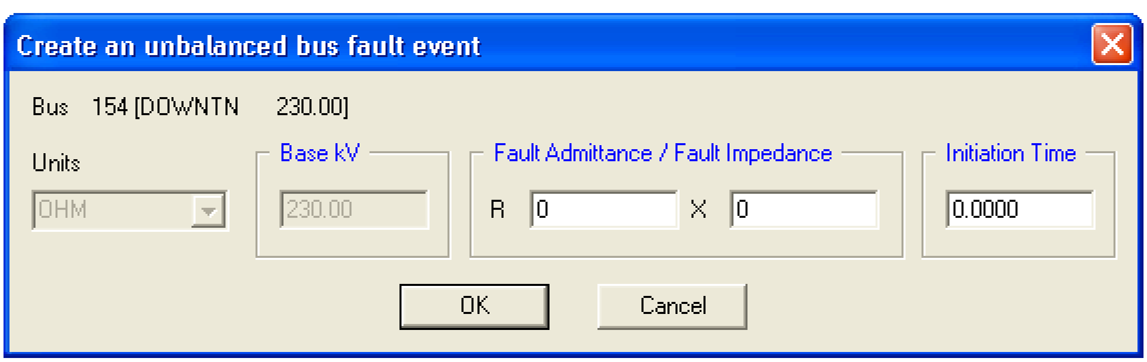
Adding an event item from the *[Network Tree]* view requires higlighting the desired network element. A right-click displays a menu with an *Add Event...* option, if you have created an Event Study file. Depending upon the network element and event type selected, one of the following dialogs is opened for your specification.

[Network Tree] > *Bus* > right-click > *Add Event...* > *Create a bus fault event*



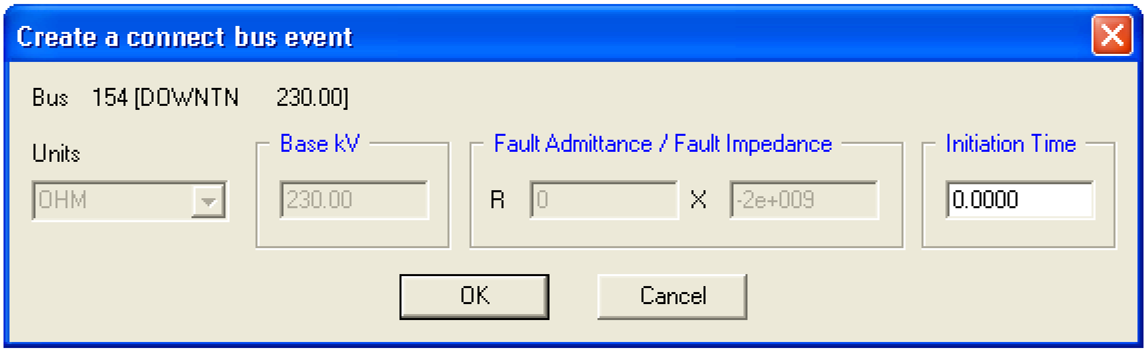
Create a Bus Fault Event Dialog

[Network Tree] > *Bus* > right-click > *Add Event...* > *Create an unbalanced bus fault event*



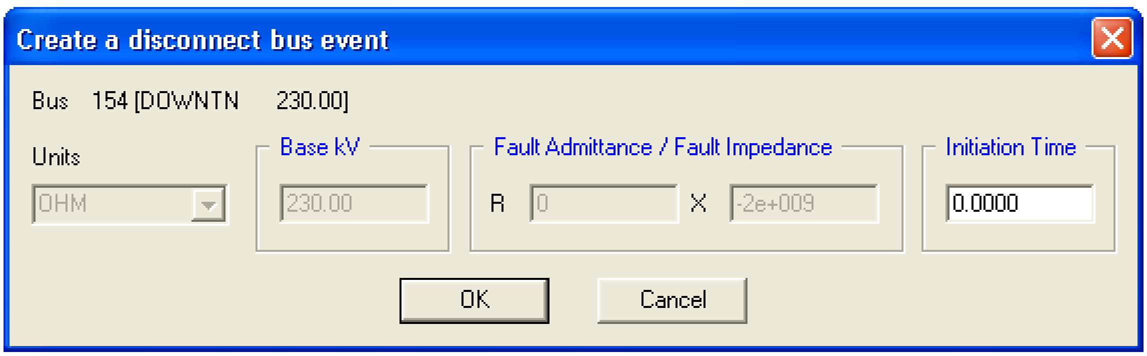
Create an Unbalanced Bus Fault Event Dialog

[Network Tree] > *Bus* > right-click > *Add Event...* > *Create a connect bus event*



Create a Connect Bus Event Dialog

[Network Tree] > *Bus* > right-click > *Add Event...* > *Create a disconnect bus event*

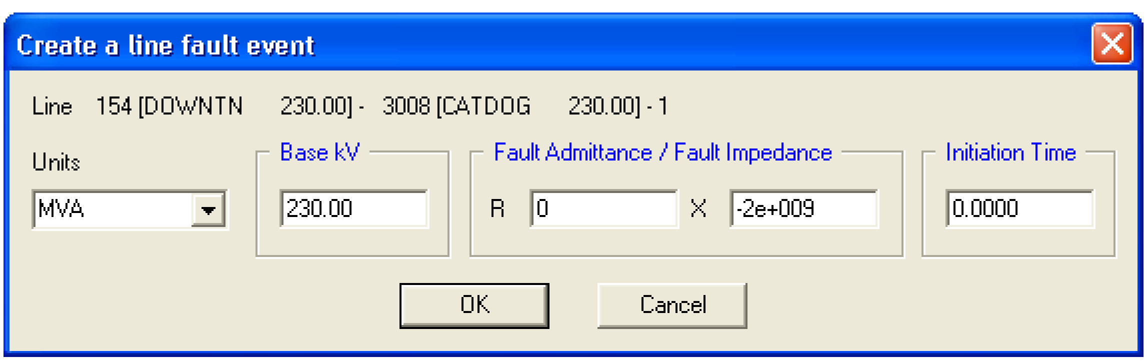


Create a Disconnect Bus Event Dialog

[Network Tree] > *Branch* > right-click > *Add Event...* > *Create a line fault event*

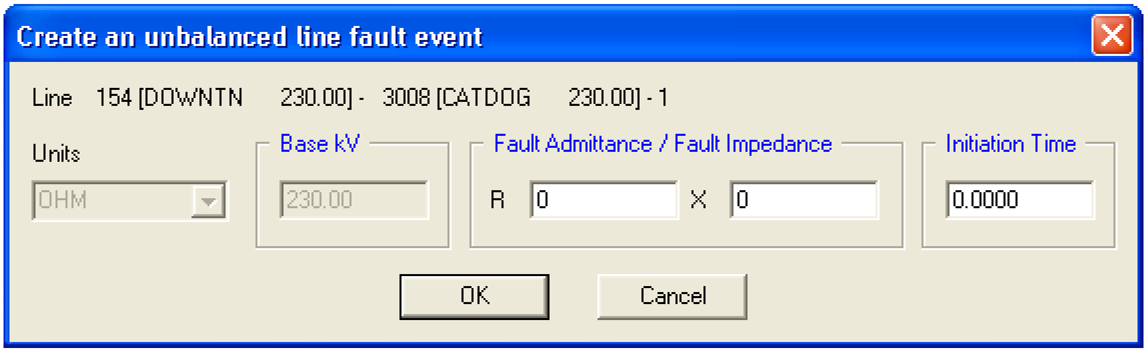
[Network Tree] > *2-WindingTransformer* > right-click > *Add Event...* > *Create a line fault event*

[Network Tree] > *3-WindingTransformer* > right-click > *Add Event...* > *Create a line fault event*



Create a Line Fault Event Dialog

[Network Tree] > *Branch* > right-click > *Add Event...* > *Create an unbalanced line fault event*

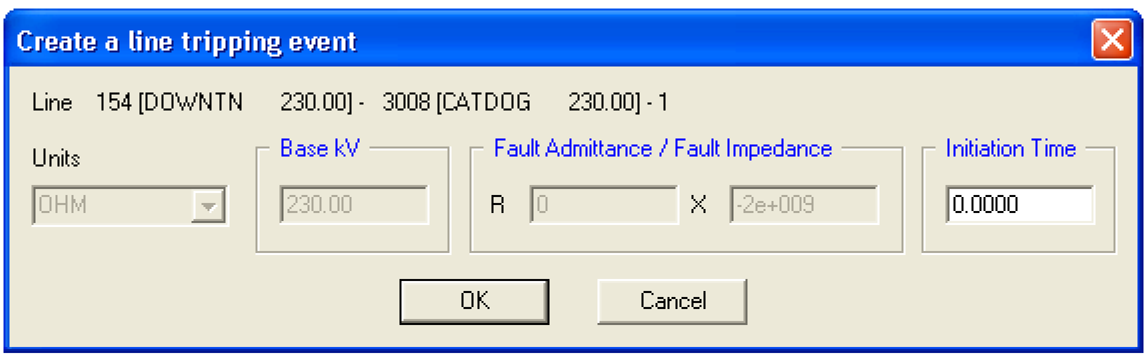


Create an Unbalanced Line Fault Event Dialog

[Network Tree] > *Branch* > right-click > *Add Event...* > *Create a line tripping event*

[Network Tree] > *2-WindingTransformer* > right-click > *Add Event...* > *Create a line tripping event*

[Network Tree] > *3-WindingTransformer* > right-click > *Add Event...* > *Create a line tripping event*

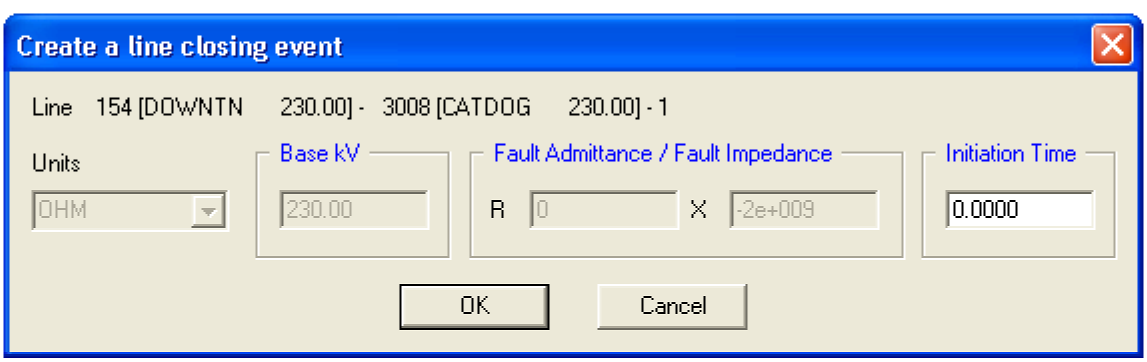


Create a Line Tripping Event Dialog

[Network Tree] > *Branch* > right-click > *Add Event...* > *Create a line closing event*

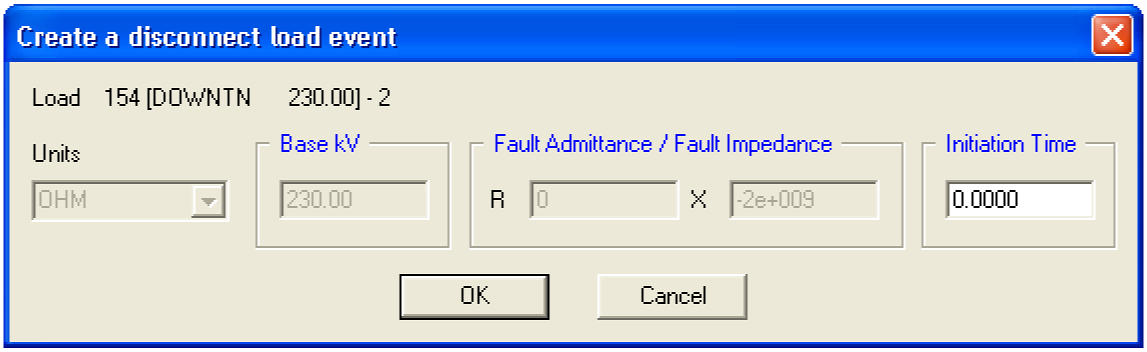
[Network Tree] > *2-WindingTransformer* > right-click > *Add Event...* > *Create a line closing event*

[Network Tree] > *3-WindingTransformer* > right-click > *Add Event...* > *Create a line closing event*



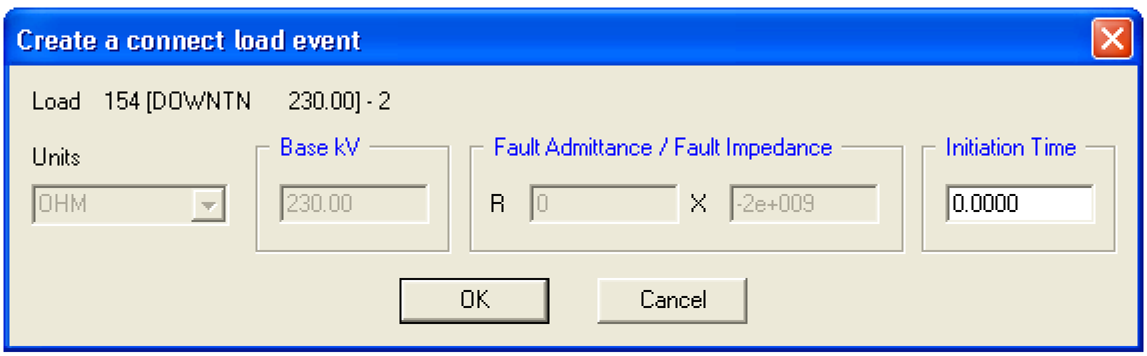
Create a Line Closing Event Dialog

[Network Tree] > highlight *Load* > right-click > *Add Event...* > *Create a disconnect load event*



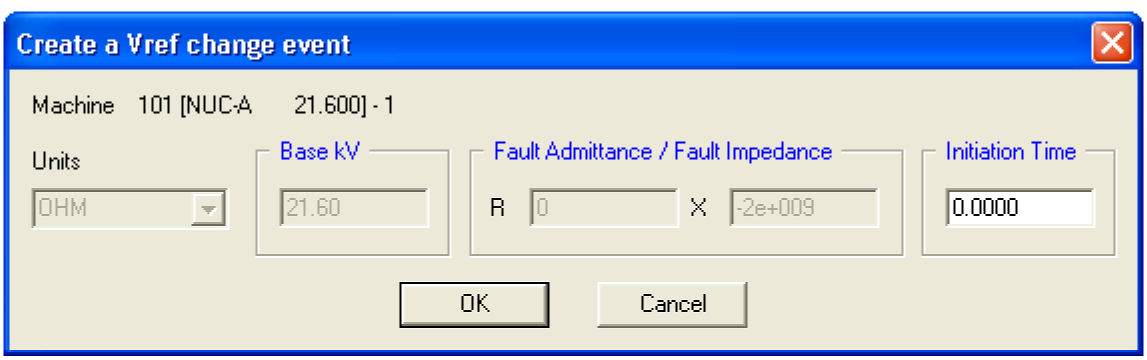
Create a Disconnect Load Event Dialog

[Network Tree] > highlight *Load* > right-click > *Add Event...* > *Create a connect load event*



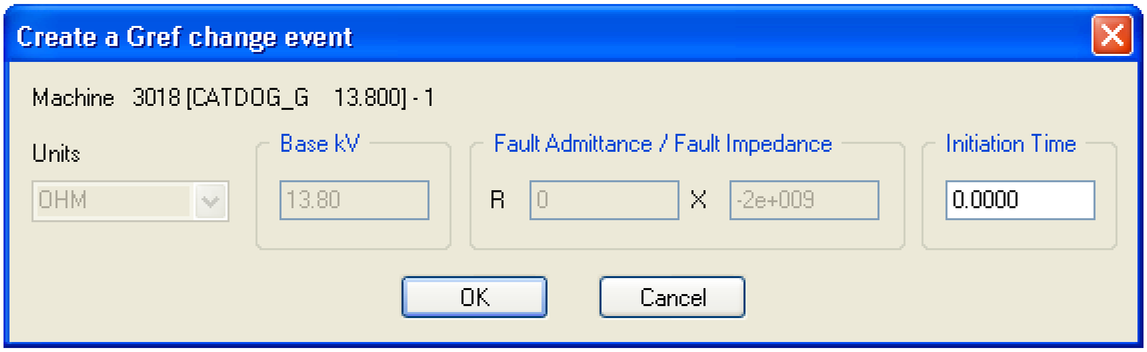
Create a Connect Load Event Dialog

[Network Tree] > highlight *Machine* > right-click > *Add Event...* > *Create a Vref change event*



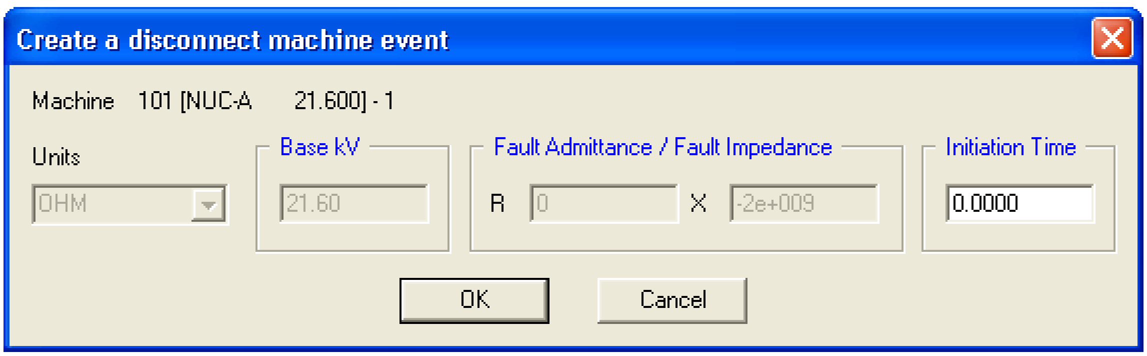
Create a Vref Change Event Dialog

[Network Tree] > highlight *Machine* > right-click > *Add Event...* > *Create a Gref change event*



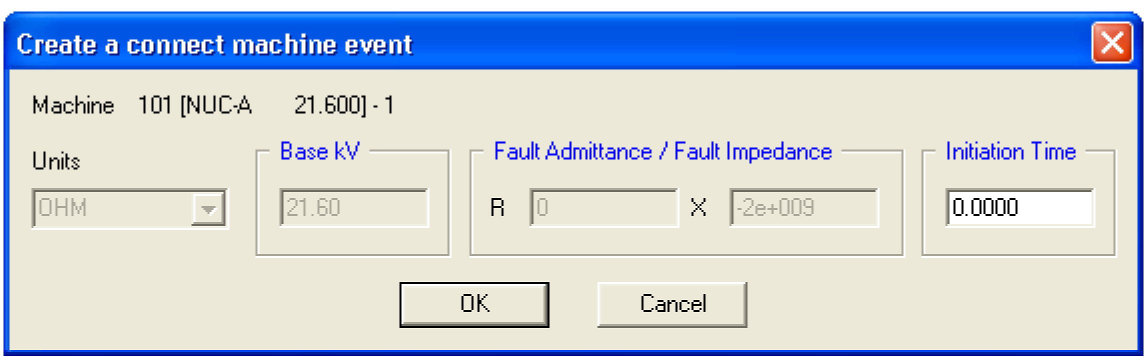
Create a Gref Change Event Dialog

[Network Tree] > highlight *Machine* > right-click > *Add Event...* > *Create a disconnect machine event*



Create a Disconnect Machine Event Dialog

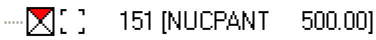
[Network Tree] > highlight *Machine* > right-click > *Add Event...* > *Create a connect machine event*



Create a Connect Machine Event Dialog

Click *[OK]* to add the event item to the event study.

[Dynamics Tree] displays an index of the event study as it is built (Figure 25.2, "Event Item Properties Dialog"). The event items are marked with an icon of the *Event Type* and the time. You may delete the event item using the right-click menu. *[Network Tree]* alters the network item icon with a red indicator, for example,



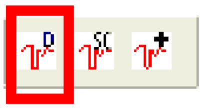
.

An *[Event Study Spreadsheet]* is also built as the event study is built. The *Event Name* and *Time* cells may be edited, and the event item may be de-activated or re-activated.

Additional Information
PSS®E Program Operation Manual, Adding an Event Item

25.3. Running a Dynamic Event Study

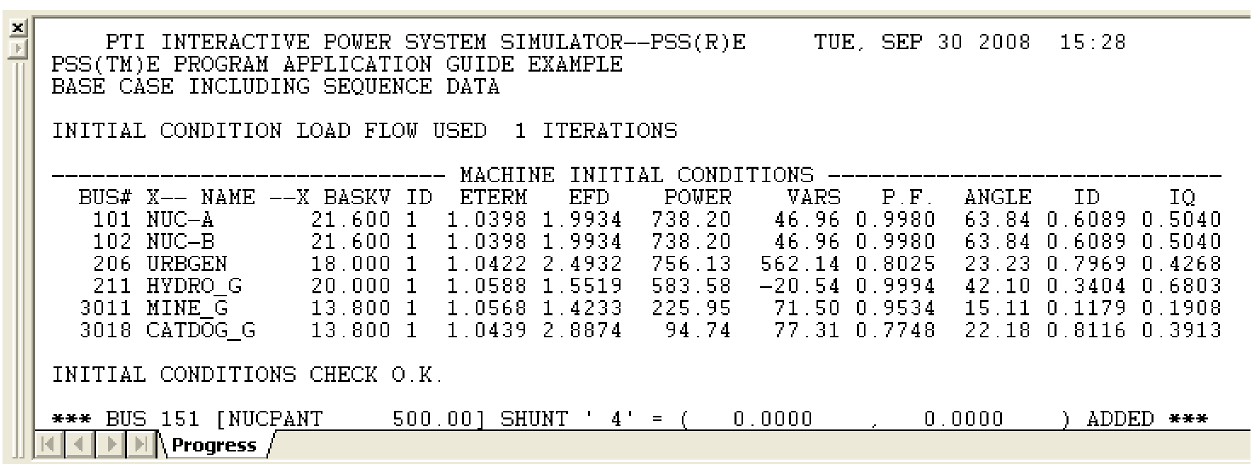
Requirements / Prerequisites
Validly specified power flow case, solved to an acceptable mismatch level. Dynamics data must exist in dynamics working memory. Reading Dynamics Model Data Converting Loads and Generators



[Dynamics Tree] > highlight *Event Study* > right-click > *Run Dynamic Event Study*

The Event Study must be active to run; the one last created or edited is considered active. If the study that you wish to run is not the active study, highlight the desired study, right-click, and select *Make Active Study*.

The Event Study is run without further action on your part. A summary of conditions is routed to the *Progress* tab (Figure 25.3, "Example of Running a Dynamic Event Study").



```
    PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS(R)E     TUE, SEP 30 2008   15:28
PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE
BASE CASE INCLUDING SEQUENCE DATA

INITIAL CONDITION LOAD FLOW USED   1 ITERATIONS

----------------------------- MACHINE INITIAL CONDITIONS -----------------------------
  BUS# X-- NAME --X BASKV ID  ETERM   EFD    POWER    VARS   P.F.   ANGLE   ID     IQ
   101 NUC-A        21.600 1  1.0398 1.9934  738.20   46.96 0.9980  63.84 0.6089 0.5040
   102 NUC-B        21.600 1  1.0398 1.9934  738.20   46.96 0.9980  63.84 0.6089 0.5040
   206 URBGEN       18.000 1  1.0422 2.4932  756.13  562.14 0.8025  23.23 0.7969 0.4268
   211 HYDRO_G      20.000 1  1.0588 1.5519  583.58  -20.54 0.9994  42.10 0.3404 0.6803
  3011 MINE_G       13.800 1  1.0568 1.4233  225.95   71.50 0.9534  15.11 0.1179 0.1908
  3018 CATDOG_G     13.800 1  1.0439 2.8874   94.74   77.31 0.7748  22.18 0.8116 0.3913

INITIAL CONDITIONS CHECK O.K.

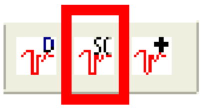
*** BUS 151 [NUCPANT     500.00] SHUNT ' 4' = (    0.0000     ,     0.0000      ) ADDED ***
Progress
```

Figure 25.3. Example of Running a Dynamic Event Study

Additional Information
PSS®E Program Operation Manual, Running an Event Study

25.4. Running Short Circuit Event Study

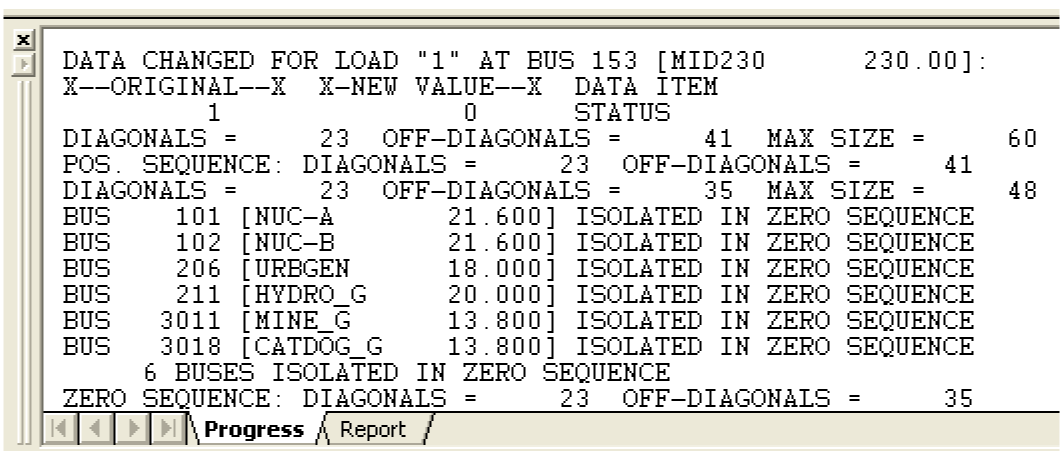
Requirements / Prerequisites
Validly specified power flow case with sequence data appended to it. Reading Sequence Data for Fault Analysis



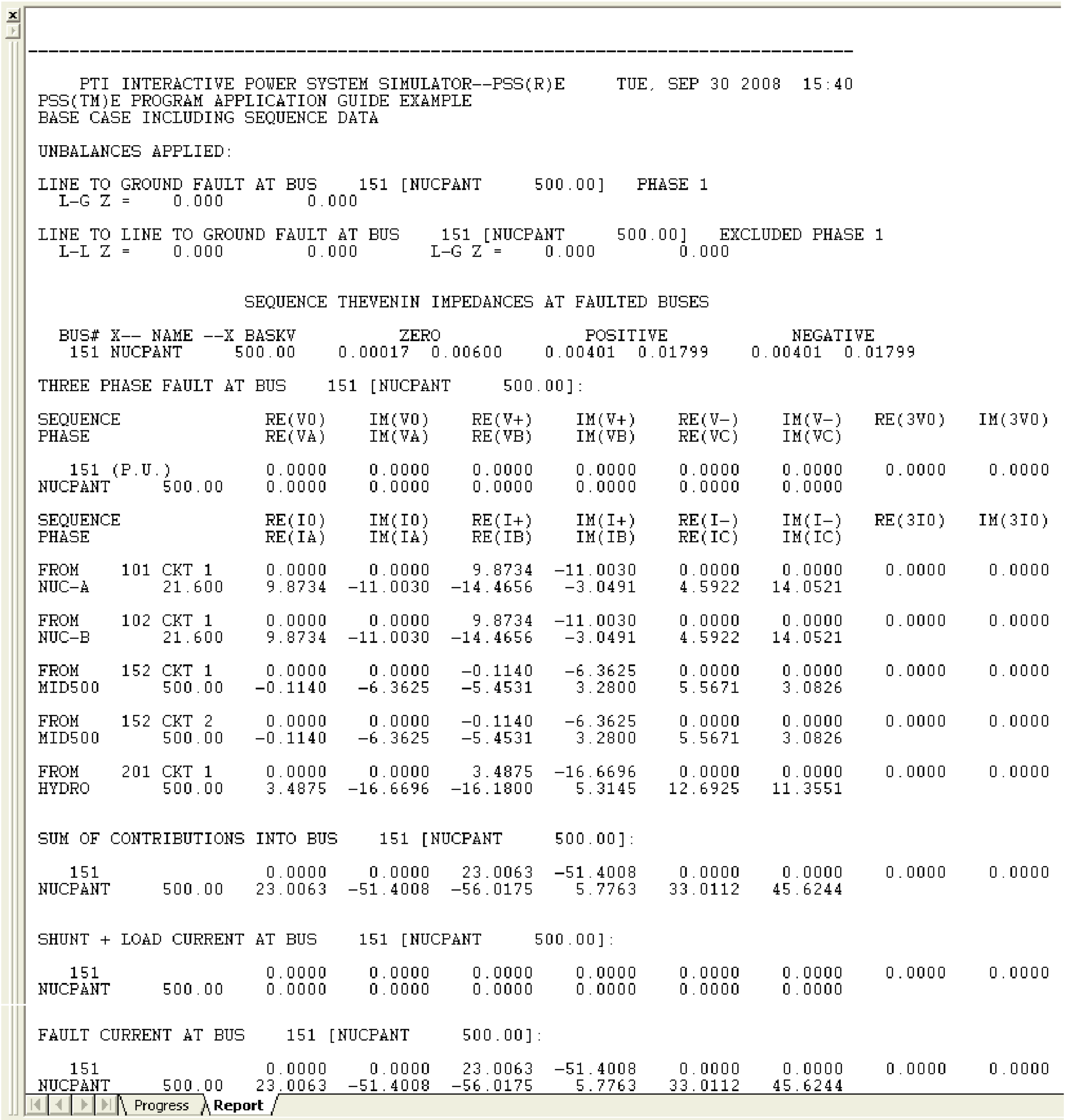
[Dynamics Tree] > highlight *Event Study* > right-click > *Run Short Circuit Event Study*

The Event Study must be active to run; the one last created or edited is considered active. If the study that you wish to run is not the active study, highlight the desired study, right-click, and select *Make Active Study*.

The Event Study is run without further action on your part. A summary of conditions is routed to the *Progress* tab (Figure 25.4, "Example of Running a Short Circuit Event Study"). A full report is routed to the *Report* tab (Figure 25.4, "Example of Running a Short Circuit Event Study").



Example of Short Circuit Event Study Summary



```
--------------------------------------------------------------------------------

    PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS(R)E     TUE, SEP 30 2008  15:40
 PSS(TM)E PROGRAM APPLICATION GUIDE EXAMPLE
 BASE CASE INCLUDING SEQUENCE DATA

 UNBALANCES APPLIED:

 LINE TO GROUND FAULT AT BUS     151 [NUCPANT     500.00]   PHASE 1
   L-G Z =     0.000         0.000

 LINE TO LINE TO GROUND FAULT AT BUS    151 [NUCPANT     500.00]   EXCLUDED PHASE 1
   L-L Z =     0.000         0.000        L-G Z =     0.000         0.000


                     SEQUENCE THEVENIN IMPEDANCES AT FAULTED BUSES

   BUS# X-- NAME --X BASKV          ZERO             POSITIVE            NEGATIVE
    151 NUCPANT      500.00    0.00017  0.00600    0.00401  0.01799    0.00401  0.01799

 THREE PHASE FAULT AT BUS    151 [NUCPANT     500.00]:

 SEQUENCE                  RE(V0)    IM(V0)    RE(V+)    IM(V+)    RE(V-)    IM(V-)   RE(3V0)   IM(3V0)
 PHASE                     RE(VA)    IM(VA)    RE(VB)    IM(VB)    RE(VC)    IM(VC)

    151 (P.U.)             0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
 NUCPANT      500.00       0.0000    0.0000    0.0000    0.0000    0.0000    0.0000

 SEQUENCE                  RE(I0)    IM(I0)    RE(I+)    IM(I+)    RE(I-)    IM(I-)   RE(3I0)   IM(3I0)
 PHASE                     RE(IA)    IM(IA)    RE(IB)    IM(IB)    RE(IC)    IM(IC)

 FROM     101 CKT 1        0.0000    0.0000    9.8734  -11.0030    0.0000    0.0000    0.0000    0.0000
 NUC-A        21.600       9.8734  -11.0030  -14.4656   -3.0491    4.5922   14.0521

 FROM     102 CKT 1        0.0000    0.0000    9.8734  -11.0030    0.0000    0.0000    0.0000    0.0000
 NUC-B        21.600       9.8734  -11.0030  -14.4656   -3.0491    4.5922   14.0521

 FROM     152 CKT 1        0.0000    0.0000   -0.1140   -6.3625    0.0000    0.0000    0.0000    0.0000
 MID500       500.00      -0.1140   -6.3625   -5.4531    3.2800    5.5671    3.0826

 FROM     152 CKT 2        0.0000    0.0000   -0.1140   -6.3625    0.0000    0.0000    0.0000    0.0000
 MID500       500.00      -0.1140   -6.3625   -5.4531    3.2800    5.5671    3.0826

 FROM     201 CKT 1        0.0000    0.0000    3.4875  -16.6696    0.0000    0.0000    0.0000    0.0000
 HYDRO        500.00       3.4875  -16.6696  -16.1800    5.3145   12.6925   11.3551


 SUM OF CONTRIBUTIONS INTO BUS     151 [NUCPANT     500.00]:

    151                    0.0000    0.0000   23.0063  -51.4008    0.0000    0.0000    0.0000    0.0000
 NUCPANT      500.00      23.0063  -51.4008  -56.0175    5.7763   33.0112   45.6244


 SHUNT + LOAD CURRENT AT BUS    151 [NUCPANT     500.00]:

    151                    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
 NUCPANT      500.00       0.0000    0.0000    0.0000    0.0000    0.0000    0.0000


 FAULT CURRENT AT BUS    151 [NUCPANT     500.00]:

    151                    0.0000    0.0000   23.0063  -51.4008    0.0000    0.0000    0.0000    0.0000
 NUCPANT      500.00      23.0063  -51.4008  -56.0175    5.7763   33.0112   45.6244
```

Progress / Report

Figure 25.4. Example of Running a Short Circuit Event Study

Additional Information
PSS®E Program Operation Manual, Running an Event Study

Chapter 26
Scenarios

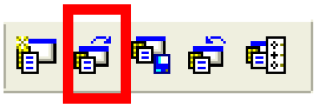
PSS®E studies are made up of a myriad number of files. Keeping track of these files has always been the responsibility of the PSS®E user. A scenario file collects in one place all the files that are used in the study and can be used to automatically open files and perform automated operations upon open and close. A new facility allows the scenario editor to collect all the files contained in the scenario file into a zip archive file. This zip file, which contains all the files identified as being part of the study, can easily be exchanged and the whole study setup recreated on another users machine. When a scenario file is open, accessing files not currently in the scenario will automatically add them to the scenario.

26.1. Creating a Scenario File

File > Scenarios > New Scenario...

When a new Scenario is created through the GUI, the *root path* will be set to the current working directory. While not necessary, it is recommended that this path is changed to the root of the tree that contains the files to be added to the Scenario. Also upon creation, a default group will be added to the Scenario to facilitate the adding of files to the Scenario. This group will automatically be set as the *active group* and the *startup group*.

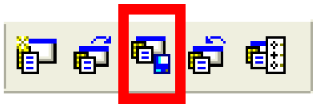
26.2. Opening an Existing Scenario File



File > Scenarios > Open Scenario...

A Scenario can be in different forms, with each form having a different effect on the opening procedures. If a Zip Archive Scenario is opened Scenario Manager will search the archive for a Scenario XML file and, if found, extract it and read in. No other actions can be taken from this point other than closing the Scenario or extracting all of the files from the Zip Archive. If the file type opened is a Scenario XML file, then the Scenario Manager will look to see if a *startup group* is defined, and if one is, then the files that are specified to load in that group will be opened in an order based on all of the file load attributes in the group. This group will also be designated as the *active group*. If there is no *startup group* then no files will be opened and no group will be designated as the *active group*.

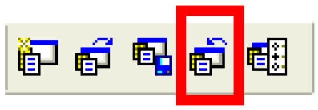
26.3. Saving a Scenario



File > Scenarios >Save Scenario...

While the Scenario is running from a Scenario XML file the Scenario can be saved after any change has been made to it. The Scenario will be saved to the same file it was opened from unless the Scenario was newly created without a file name specified. In this case the user will be prompted for a file name and the user can choose to save the Scenario as a Scenario XML file or a Zip Archive file.

26.4. Closing a Scenario File



File > Scenarios > Close Scenario...

Closing the Scenario file will close/unload all files specified in the current *active group* in the Scenario file and then close the Scenario file itself. Before any files are closed the Scenario Manager will first look for any automation files designated to load last, which are designated by the load order of -1. If found this automation file will be executed, which allows the automatic execution of any automation file that performs study post-processing before any files are closed.

Additional Information
PSS® E Program Operation Manual, Chapter 25, Scenarios

26.5. The Scenario Editor

File > Scenarios > Edit Scenario...

The Scenario Editor is the main tool for modifying Scenarios through the GUI. From this editor all attributes of a Scenario can be managed. Files can be added and removed, organizational groups can be added and removed, attributes of each file can be modified, and comments can be made for each File, Group, and for the Scenario as a whole. The user can also pack up a Scenario XML file and all files listed in the XML file into a Zip Archive file or unpack a Zip Archive file to a Scenario XML file and all other files in the Scenario. The title bar of the Scenario Editor will display the name of the currently open Scenario and the name of the active group, if one exists.

If the user attempts to use the Scenario Editor while no Scenario is currently open the user will be prompted for a Scenario file to open. The startup group of the selected Scenario file, if defined, will be ignored through this method of operation.

26.5.1. The Basic Editor

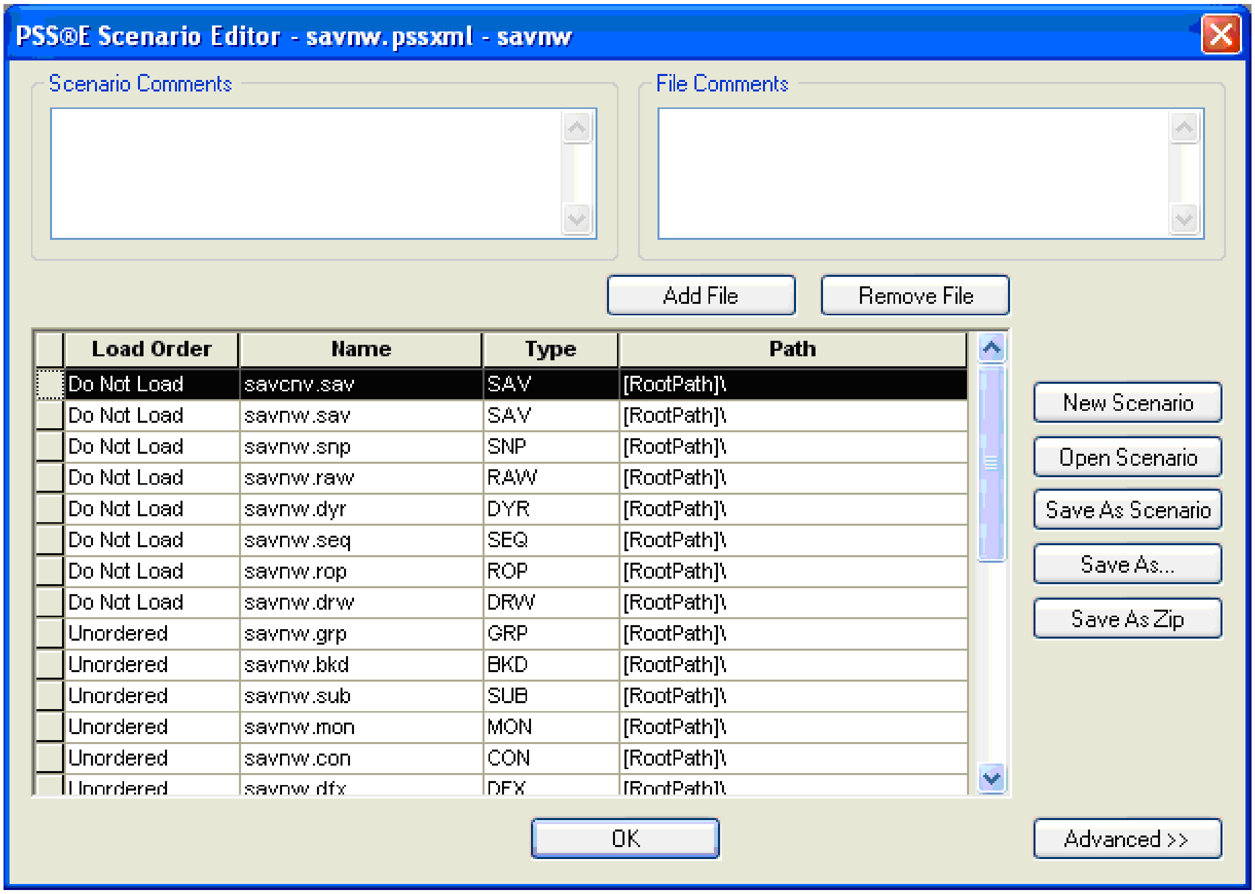


Figure 26.1. The Basic Scenario Editor

The Basic Editor, Figure 26.1, "The Basic Scenario Editor", gives the user a streamlined editor that focuses on the core Scenario Manager functionality. All Group features are removed from this editor along with the Scenario attribute fields. The main focus of this dialog is the file operations, and moving in and out of zip mode. Since no Group information is present in this dialog, if multiple Groups are present in the current Scenario then the group that is shown will be the active group. If there is no active group then the startup group will be displayed. Finally, if no startup group is defined the first Group in the Scenario will be displayed.

If the user attempts to add Files in the Basic Editor when no Group is currently in the Scenario a default Group will be added and the Files will be added to that Group. This Group is the same as the Group that would be added by default when a new Scenario is created.

26.5.2. The Advanced Editor

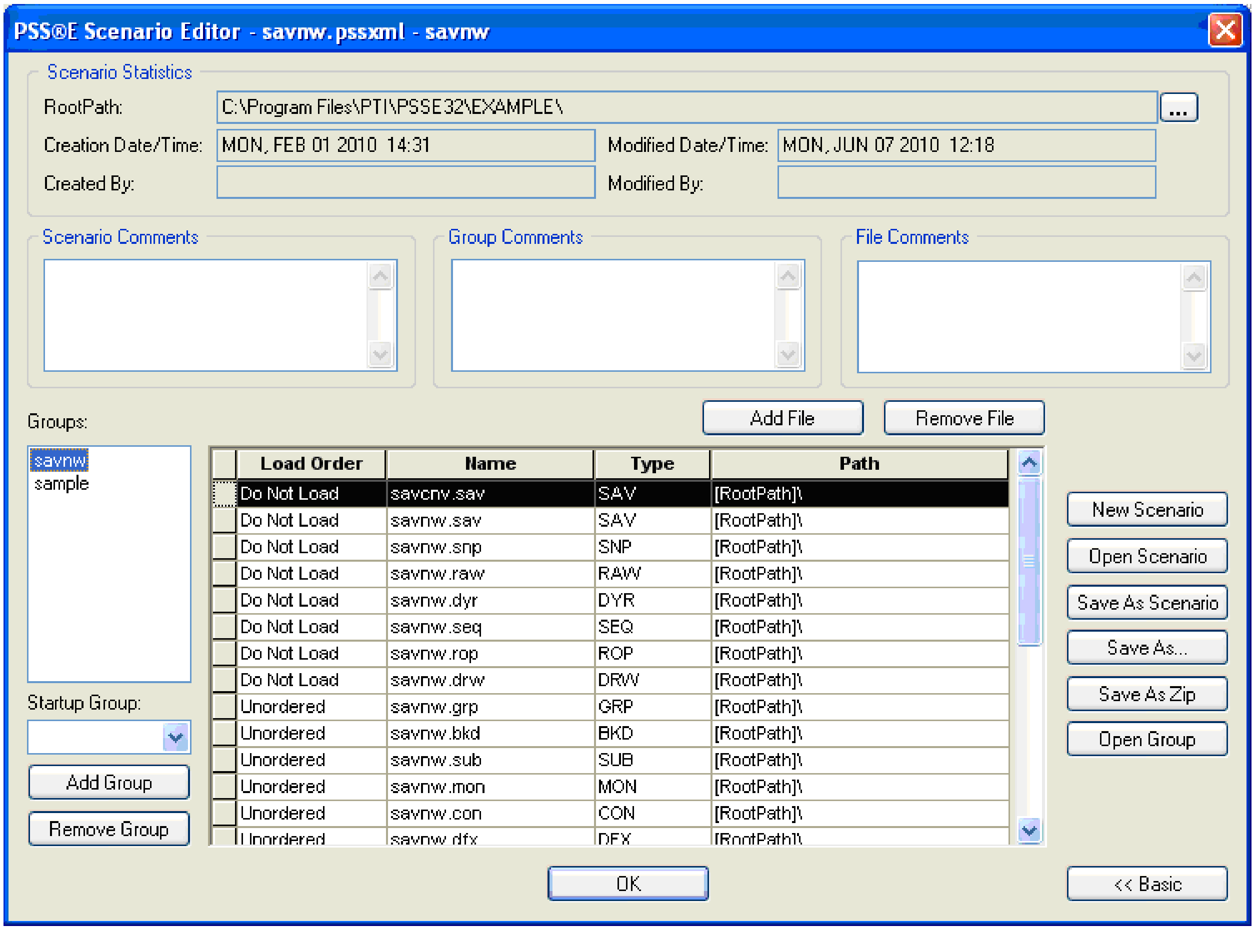


Figure 26.2. The Advanced Scenario Editor

The Advanced Secnario Editor Figure 26.2, “The Advanced Scenario Editor” gives the user access to all methods for modifying a Scenario. Along with all of the functions that are present in the Basic Editor, the Advanced Editor gives the user quick methods of manipulating groups and changing the root path. This editor also allows the user to see other statistics about the current Scenario and gives the user an ability to change the active group by using the "Open Group" button.

26.5.3. Scenario Statistics section

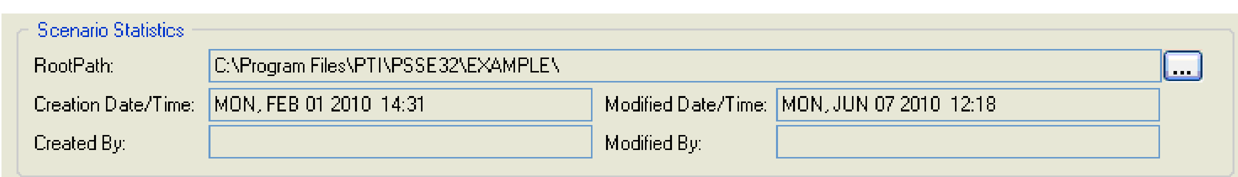


Figure 26.3. Scenario Statistics

The Scenario Statistics section, shown in figure Figure 26.3, “Scenario Statistics”, is only found on the Advanced Editor. This section allows the user to view and modify the root path of the Scenario. Clicking on the selector button will result in a directory selection dialog that the user can use to select a new root path. Alternatively the user may type a new path into the field, if the entered directory does not exist the user will be prompted.

Also in this section is the user names of the creator and last modifier, and the dates associated with these actions. These values cannot be changed from the editor.

26.5.4. Comments

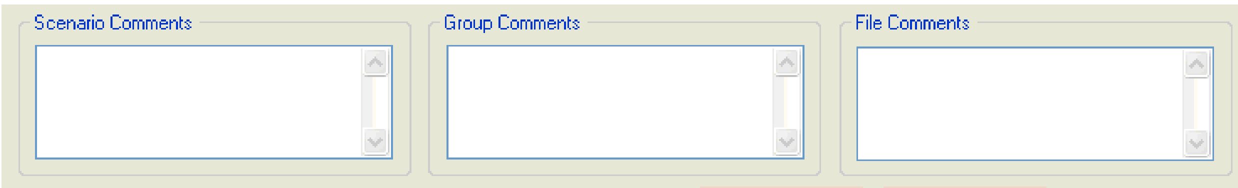


Figure 26.4. Scenario Comments

The comments section, shown by Figure 26.4, “Scenario Comments”, allows the user to add notes about a particular file, group, or the Scenario as a whole. Each group will always have its own set of comments, however if a file exists in two different groups, changing the comments for that file in one of the groups will result in the same change being made for the same file in the other group. In the Basic Editor the Group Comments section is not present.

26.5.5. Group List

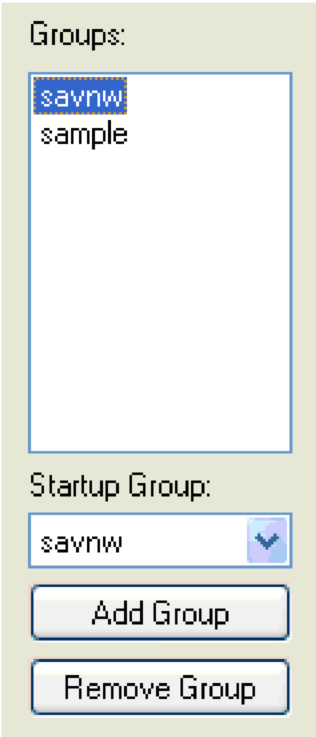


Figure 26.5. Group Selector

The group section is only found under the Advanced Editor. This section of the editor, shown in Figure 26.5, "Group Selector", allows the user to create and delete groups as well as allowing the user to pick which group will be designated as the startup group.

From the group list the user can easily copy the contents of one group to another, move the contents of one group to another, or create clones of a group using click and drag. If the user drags one group item in the list onto another destination group, and then holds [Ctrl] while releasing the mouse button, all files in the group being dragged will be copied to the destination group. Any copy that would result in the duplication of a file in the destination group will be ignored. If, instead of releasing the mouse over a destination group, the mouse is released over white space in the group list while the user holds [Ctrl], then a clone of the group being dragged will be made. If the user holds down [Shift] while releasing the mouse button over a destination group then all files in the group being dragged will be copied to the destination group and the group being dragged will be removed. No action is taken for a [Shift] being held when releasing over white space since this would be equivalent to creating a clone then deleting the original.

Files from the file grid or files and directories from an explorer window may also be dragged into the group list. If the user is dragging selected files and/or folders from a Windows Explorer window and the mouse is release over an item in the group list, then the items being dragged will be added to that group. If the release is over white space in the group list then the user will be prompted for a group name and the files will be added to a new group with a name given by the previous dialog box entry. When a directory is added all files in that directory's tree will be added.

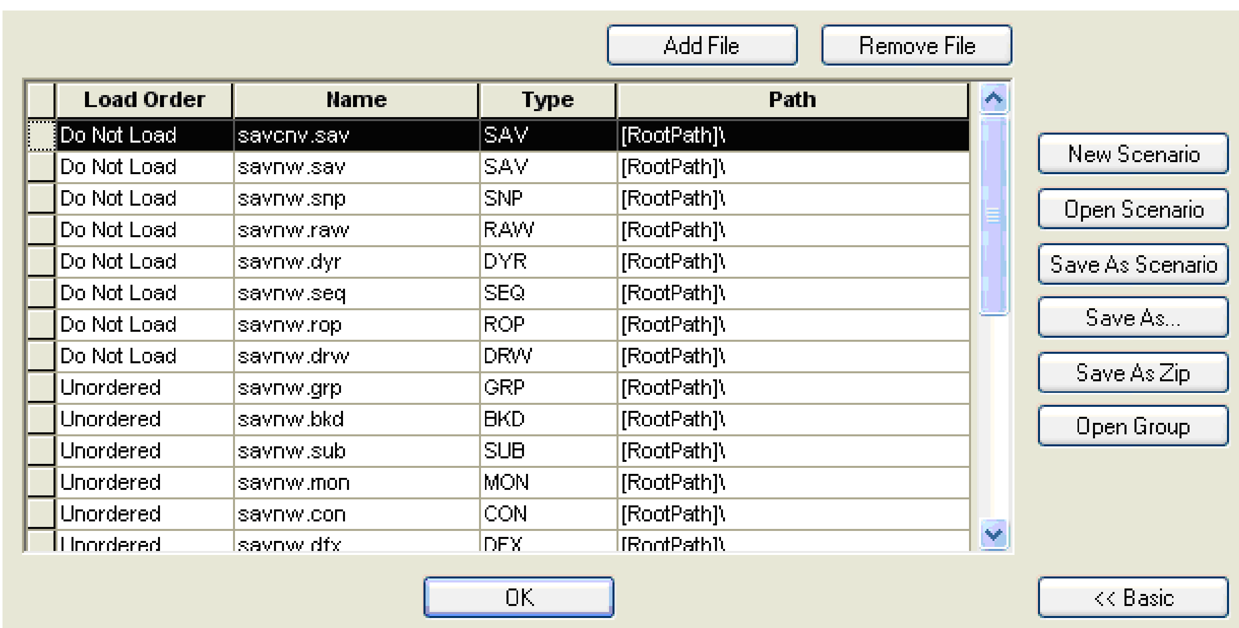
The Startup Group combo box allows the user to specify which group to use as the startup group. The combo box will have an entry for each group in the Scenario as well an entry for "(none)" which is used to specify the Scenario has no startup group.

The Add Group button will result in the user being prompted, show in Figure 26.6, “Add New Group Dialog”, for a group name and a new group being created with that name.

Figure 26.6. Add New Group Dialog

Pressing the Remove Group button will result in the deletion of the currently highlighted group in the group list.

26.5.6. File Grid and Buttons



Scenario Editor File Grid and Buttons

This section of the dialog is the same between the Advanced and Basic editor save the Open Group button and the label of the "<< Basic" / "Advanced >>" button.

The file spreadsheet is used to list all files in the currently selected group in the case of the advanced editor, or the active group / startup group / first group in the Scenario in the case of the basic editor.

The "Load Order" column in the file spreadsheet lists the order in which the files will be loaded or ordered. The user can change the values in the column to change how the files are loaded when the group is opened, or how the files are ordered when the file selector fields are pre-populated. Automation files will also have an option to be designated as "Load Last" which means the file will be executed upon closing of the group.

The "Name" and "Path" columns give the name and location of the file. These files represent where the Scenario Manager looks for these files. Changing these fields will not change the name or location of the file, instead it will change the file name Scenario Manager will look for and the path the Scenario Manager will look in to find said file.

The "Type" column shows which PSS®E file type the listed file is associated with. Type associations can be changed in the editor in the event a group of files were added and some of the files did not have the default extensions used by PSS®E. A blank entry in the column represents no file association, which can occur when files not used in PSS®E are added to the Scenario.

The "Arguments" column is used to display the current argument list that will be used when opening the file automatically. To set these values double click on the arguments field for the file to be modified and a dialog will come up if that file has additional arguments. After entering in the appropriate arguments an argument string for the file will be generated and will be shown in the "Arguments" column.

The [Add File] button brings up a file selector dialog which allows the user to select multiple files to add to the Scenario

The [Remove File] button will remove the currently highlighted file in the file grid. If more that one file is highlighted, then the topmost highlighted file is removed.

Pressing the [New Scenario] button will result in the creation of a new Scenario. If the current Scenario contains unsaved changes, the user will be prompted to save those changes before the current Scenario is closed.

Clicking the [Open Scenario] button will cause the user to be prompted for a file to open. Again if the current Scenario contains unsaved changes, the user will be prompted to save those changes.

The [Save As Scenario] button serves two functions, but always results in saving the current state of the Scenario in a PSSXML file. If the Scenario is already in PSSXML mode then the PSSXML file the Scenario was opened from will be updated with whatever changes were made. If the Scenario is in ZIP mode, then the archive will be unzipped according to the placement and conflict options settings. After the unzipping is complete the Scenario will be in PSSXML mode. The resultant PSSXML file will have the same name as the ZIP file, but with the PSSXML file extension, which by default is ".pssxml".

Using the [Save As...] will bring up a dialog that allows the user to save the Scenario by a different name and select what mode to save the Scenario in. Currently this is only available when the Scenario is in PSSXML mode.

The [Save As Zip] will result in the Scenario being saved to a ZIP file. If the Scenario was not in previously in ZIP mode it will switch into that mode and the resultant ZIP file will have the same name as the PSSXML file, but with the ZIP file extension, which by default is ".zip".

The [Open Group] button is only present in the advanced dialog. This button is used to open the currently highlighted group in the group list. The group that is opened will also become the active group.

The [<< Basic / Advanced >>] button is used to switch between the Basic and Advanced Scenario Editor dialogs.

26.6. Scenario File Open/Save Dialog

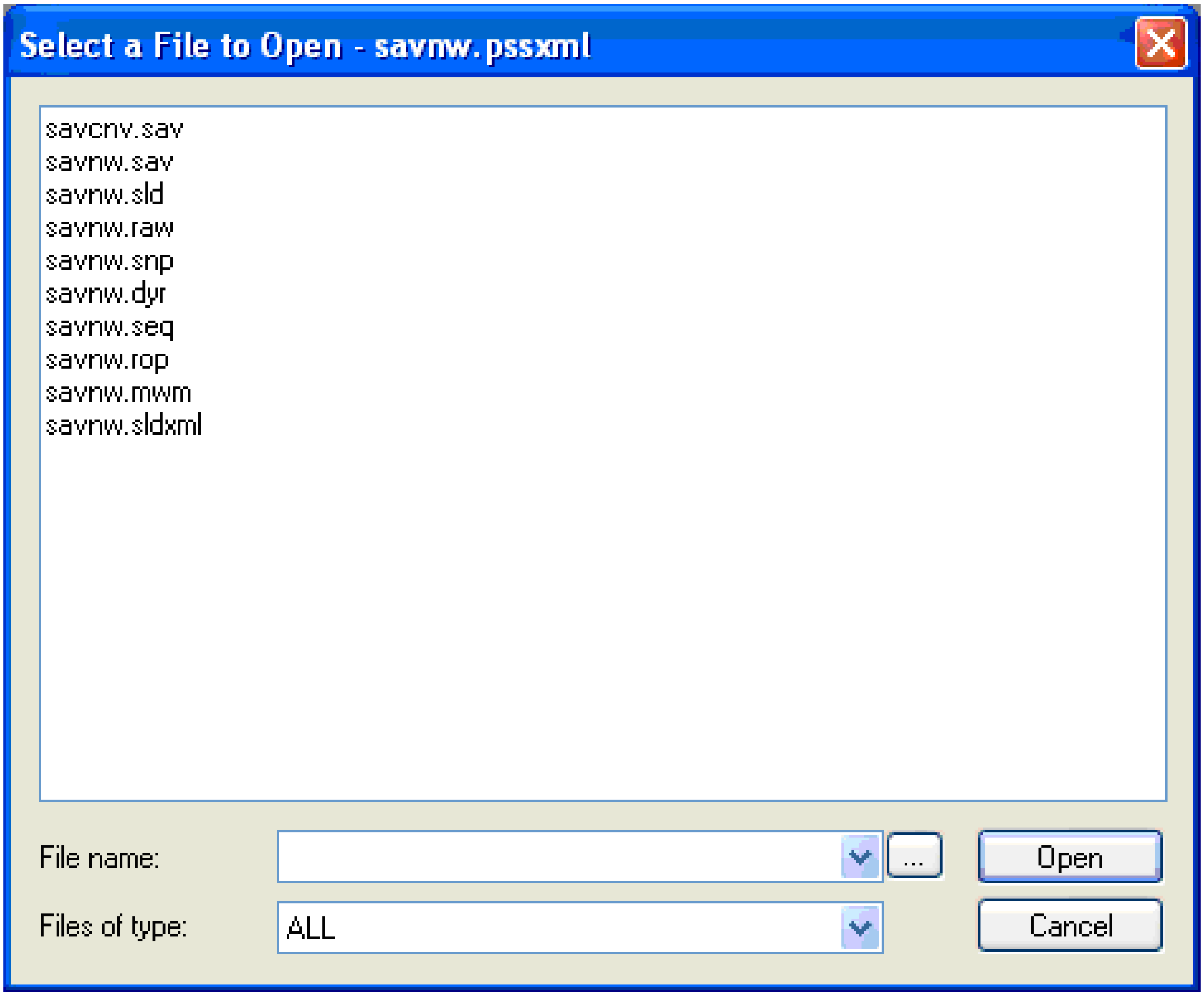


Figure 26.7. Scenario File Open/Save Dialog

The Scenario File Open/Save dialog, shown in Figure 26.7, “Scenario File Open/Save Dialog”, is used to display all files in the current active group that can be opened in PSSE thought the File->Open function in a single dialog, allowing the user to skip browsing through the file system if their file is already in the Scenario. The old file selection dialog can still be accessed by clicking the [...] button.

26.7. Selection in Activity Dialogs

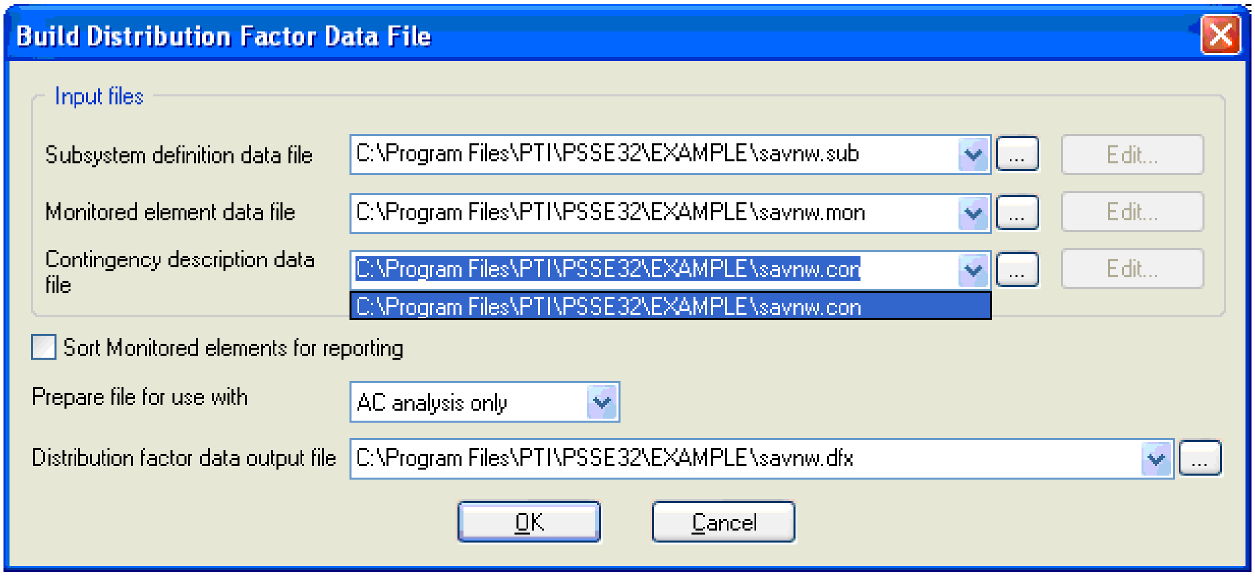


Figure 26.8. File Selection in Activity Dialogs

When a valid Scenario is open in PSS®E the file selector fields in the various dialogs in PSS®E will have a list of files to choose from based on the files in the Scenario. Each file in the Scenario that is associated with the file type that is desired by the file selector field will be added to the list to allow the user to quickly choose which file to use without needing to go through the file system. The file system can still be accessed by pressing the [...] buttons. Figure 26.8, "File Selection in Activity Dialogs" shows an example file selector field in the "Build Distribution Factor Data File" dialog whose file list is shown to contain the CON file in the Scenario.

26.8. Scenario Options Dialog

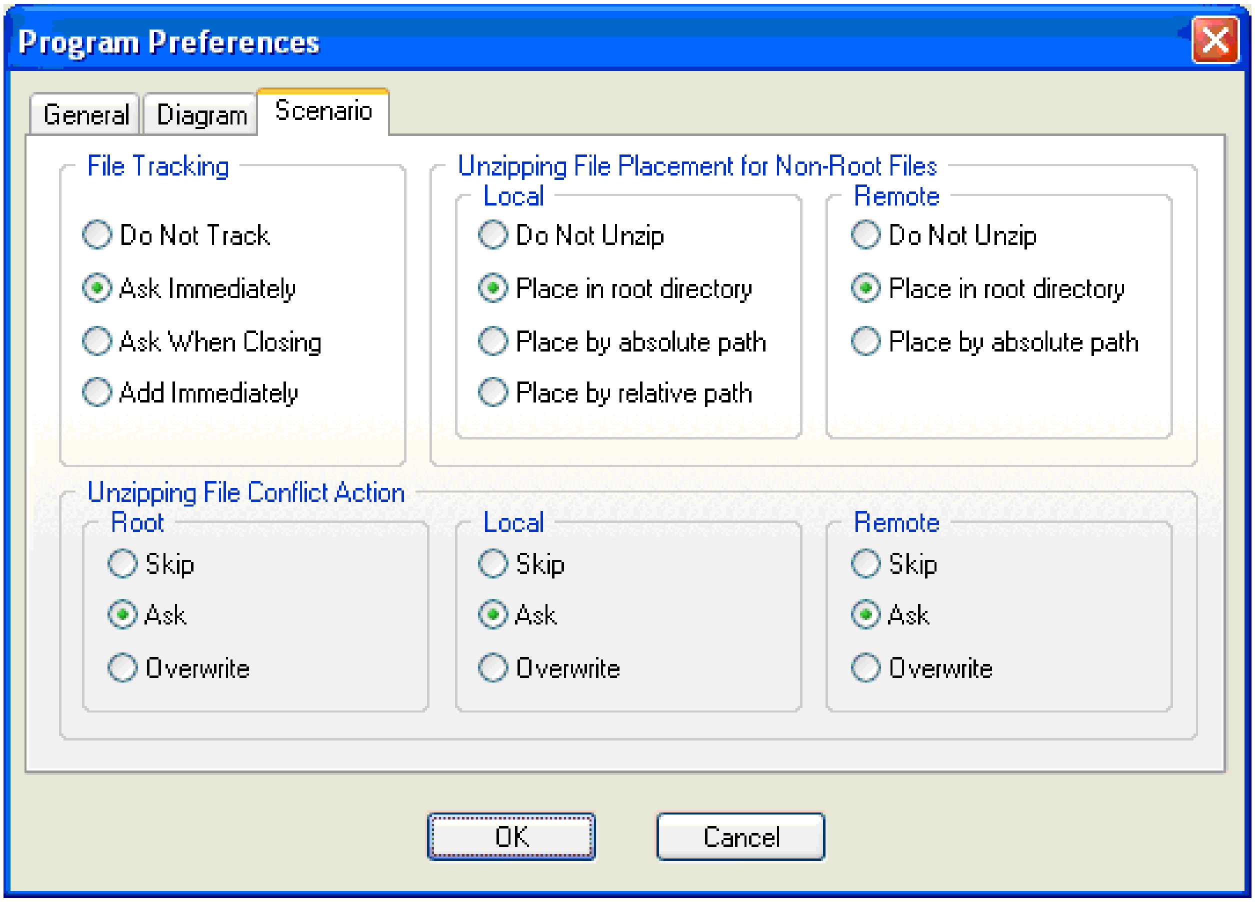


Figure 26.9. Scenario Options Dialog

The Scenario Options Dialog, shown in Figure 26.9, “Scenario Options Dialog” with the default settings selected, is used to specify how specific Scenario features will function. This dialog can be accessed by going to Edit->Preferences... and then click on the Scenario tab.

There are four options for the File Tracking setting. When the "Do Not Track" option is selected PSS®E will act like no file tracking is taking place. The user will not be informed of what files are being tracked and no tracked files will be added to the active group. PSS®E will, however, continue to track files in the background in case the user decides to change the File Tracking setting.

If the user chooses the "Ask Immediately" option the user will be prompted whenever a new file is being tracked when PSS®E is idle. If a script is currently running then the user will not be prompted until the script is complete.

Choosing the "Ask When Closing" option will tell the tracking feature to hold off on prompting the user until the active group is being closed, which will happen when either a new group is being opened or the Scenario is being closed.

The "Add Immediately" option tells the tracking system to skip the tracking step and just add any files that would be tracked to the active group without prompting the user.

The next option set if for configuring the unzipping function for Scenario files. The "Unzipping File Placement for Non-Root Files" is used to choose where the unzipping function will attempt to extract "Local" and "Remote" files to.

When the user selects the "Do Not Unzip" option for one of the file location types, then that file location type will not be extracted from the Scenario Zip Archive files.

If the user chooses the "Place in rood directory" option, then all file of that file location type will be extracted to the root path.

If the "Place by absolute path" option is chosen, then all files of that file location type will be extracted to the path they were located at before being zipped up.

Local files also have an option to "Place by relative path" when being extracted. This means they will be extracted to the same path they were in relative to the root path before they were zipped up.

The last group of options allows the user to configure how the unzipping routine will handle any conflicts that arise when a Scenario Zip Archive file is extracted. The user can choose to have different actions for Root files, Local files, and Remote files.

A selection of "Skip" for one of the location types will tell the unzipping tool to automatically not extract any file of that location type that conflicts with a file or folder that is at the destination path for the file being extracted.

Selecting the "Ask" option will instruct the unzipping tool to prompt the user about any conflicts that occur for that particular location group so that the user may choose a course of action if there are any problems.

The last choice of "Overwrite" tells the unzipping tool that if there is a conflict for a file in that location type, the file on disk is to be deleted and replaced with the file that is being extracted. The user will sill be prompted if there is a conflict with a folder.

26.9. Scenario Tracking Dialog

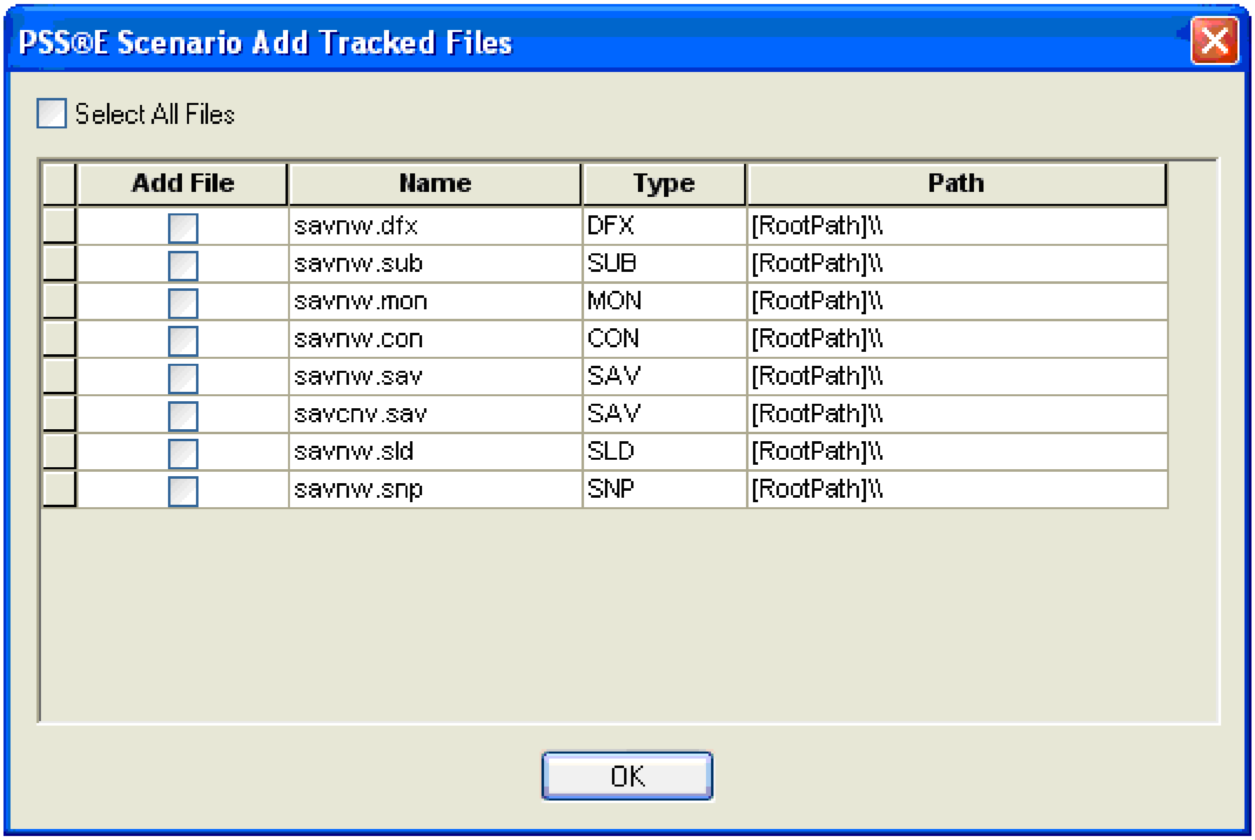


Figure 26.10. Scenario Tracking Dialog

The Scenario Tracking Dialog, shown in Figure 26.10, "Scenario Tracking Dialog" after several files were opened that were not currently in the active group, is used to show the user what files they have used that are not currently in the active group. From this dialog the user can choose which, if any, files they would like to add to the active group. This dialog will automatically come up based on the scenario file tracking option.

The files being tracked are displayed in a spreadsheet with each file in a different row. The first column labeled "Add File" is used to specify if the file should be added to the Scenario. The column labeled "Name" shows what the name of the file is while the column labeled "Path" shows the directory the file is in. If the file is at or below the root path the label "[RootPath]" will be substituted for the full root path. The "Type" column shows what file type the file is associated.

To quickly add all files, the user can click the "Select All Files" check bock to add checks to all check boxes in the "Add File" column. Unchecking this check box will also uncheck all check boxes in the "Add File" column.

26.10. Scenario Unzip Error Dialog

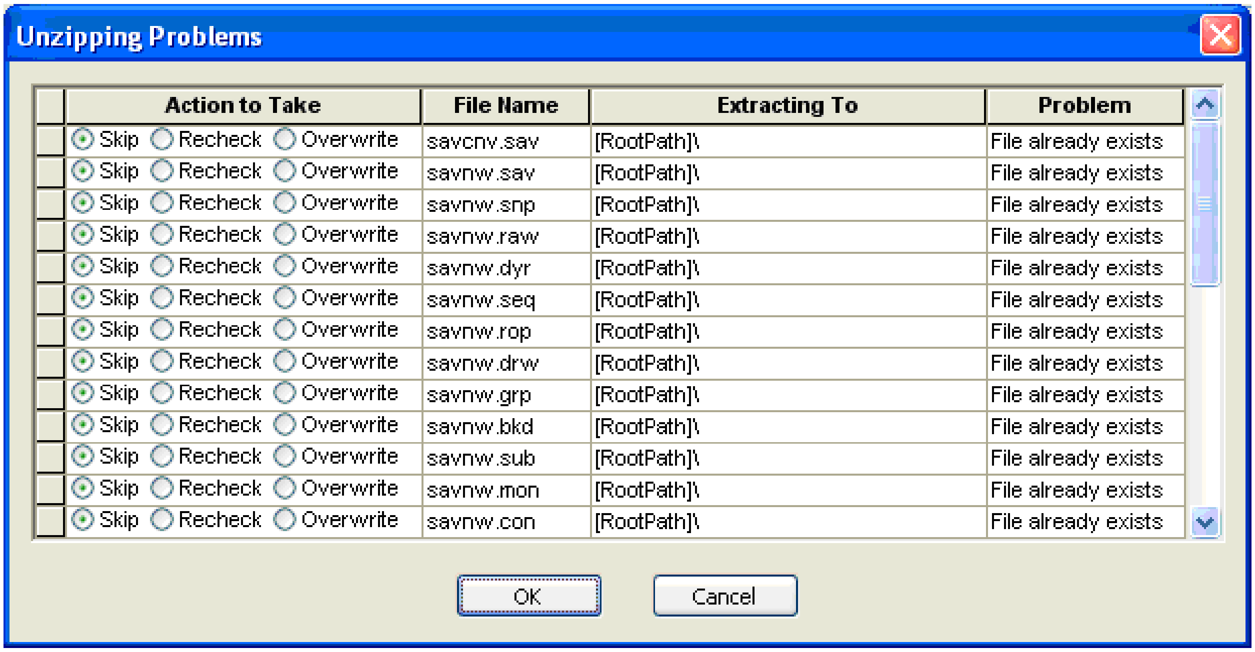


Figure 26.11. Scenario Unzip Error Dialog

The Scenario Unzip Error Dialog, shown in Figure 26.11, “Scenario Unzip Error Dialog” after attempting to unzip a Scenario whose files were already unzipped, is used to alert the user of any problems that occurred when attempting to unzip the Scenario. The user can then use this dialog to act on these problems.

The "Action to Take" column allows the user to choose to take the action of "Skip", "Recheck", or "Overwrite" in an attempt to correct the problem that occurred. A selection of "Skip" instructs PSS®E to skip the extraction of the file, which will always result in the resolution of the stated problem, though the problem may occur again if an attempt is made to unzip the same Scenario again. A selection of "Recheck" instructs PSS®E to attempt to extract the file again and if the user made any changes in the "File Name" or "Extract To" columns those changes will be used in the next attempt. A choice of "Overwrite" will result in PSS®E replacing whatever item that is already present at the destination, however if the problem was due to an invalid path this choice will not solve the problem.

The "File Name" column lists all of the file names for each file that had errors when PSS®E attempted to extract it from the archive. The value of this field can be changed in order to extract the file with a different name. If the user changes the value of this field the "Action to Take" will automatically be set to "Recheck"

The "Extract To" column lists the destination directories of all files that had problems when being extracted. These values can also be changed just like in the "File Name" column. The value of the "Action to Take" field will also be automatically set to "Recheck" when a change is made. If the destination path is on or at the root path, the root path portion of the path will be replaced by "[Root Path]" just like in the Scenario Editor.

The "Problem" column gives a short description of the problem that occurred. The possible problems are "File already exists", "Path does not exist", "File specified does not exist in the archive", and "A directory with the specified file name already exists".

After the user submits the proposed solutions by pressing the OK button, PSS®E will apply the potential fixes and then re-prompt the user if any new conflicts are found. If the user chooses to Cancel out of the dialogs, all files that were previously extracted will remain extracted and any current problems will be ignored.

Chapter 27
Measurement Interface

27.1. Overview

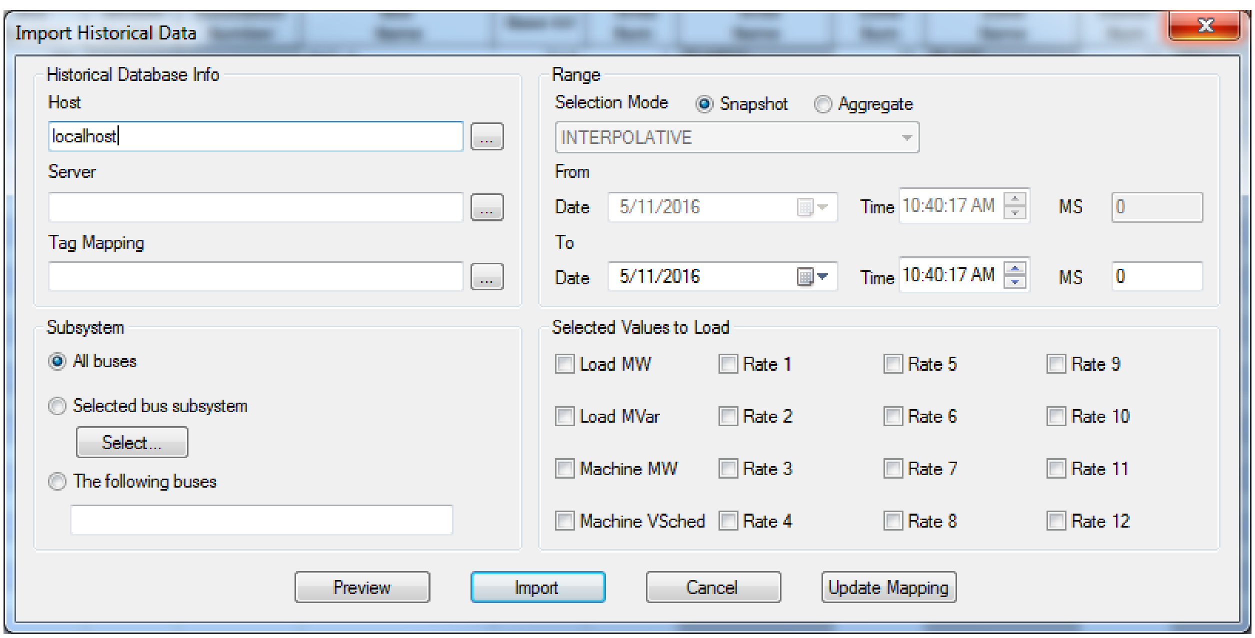
PSS®E has the ability to connect to a Historical Database and import historical data retrieved from the Database into the current case. Connecting to the Database requires proper configuration of DCOM if the Database is located on a remote machine. In order to transfer the data to the correct items in the case, a mapping file is required. PSS®E can generate a template mapping file that can be populated with the Historical Database Tags that identify the items in the Database.

27.2. Dialog Items Overview

The Measurement Interface Dialog can be accessed by going to [*File->Import->Historical Data*]. Listed below are the dialog elements and their significance followed by the dialog itself.

Table 27.1. Import Historical Data Dialog Element Descriptions.

Host	The machine that hosts the server (Name or IP)
Server	The name of the server on the host machine
Tag Mapping	The Mapping file PSS®E uses to match database tags with case elements
Subsystem	Standard PSS®E subsystem selection
Selection Mode	When using Snapshot, PSS®E will request data for a single time. When using Aggregate, PSS®E will request data for a time range and specify the aggregate selected below to get data for each case element. The aggregates available are a function of the historical database server.
From Data	The time from which to start collecting data for the selected aggregate. This is not used if the Selection Mode is Snapshot.
To Date	The time to end collecting data for the selected aggregate if the Selection Mode is Aggregate. If the Selection Mode is Snapshot, this field specifies the timestamp to use to get the data.
Selected Values to Load	This field of check boxes is used to select what types of value will be retrieved.



Import Historical Data Dialog

27.3. Creating a Mapping File

The first step to importing historical data is creating the mapping file. Open the [*Import Historical Data*] dialog by going to [*File->Import->Historical Data*]. Fill in the [*Tag Mapping*] field and [*Subsystem*] selection and the select *[Update Mapping]* highlighted in Figure 27.1, "Elements for generating a Mapping File". This will generate the excel file specified in the [*Tag Mapping*] field with entries for all item in the specified subsystem. Examples of filling in the Mapping file can be seen in Figure 27.2, "Sample Mapping File Load Sheet"

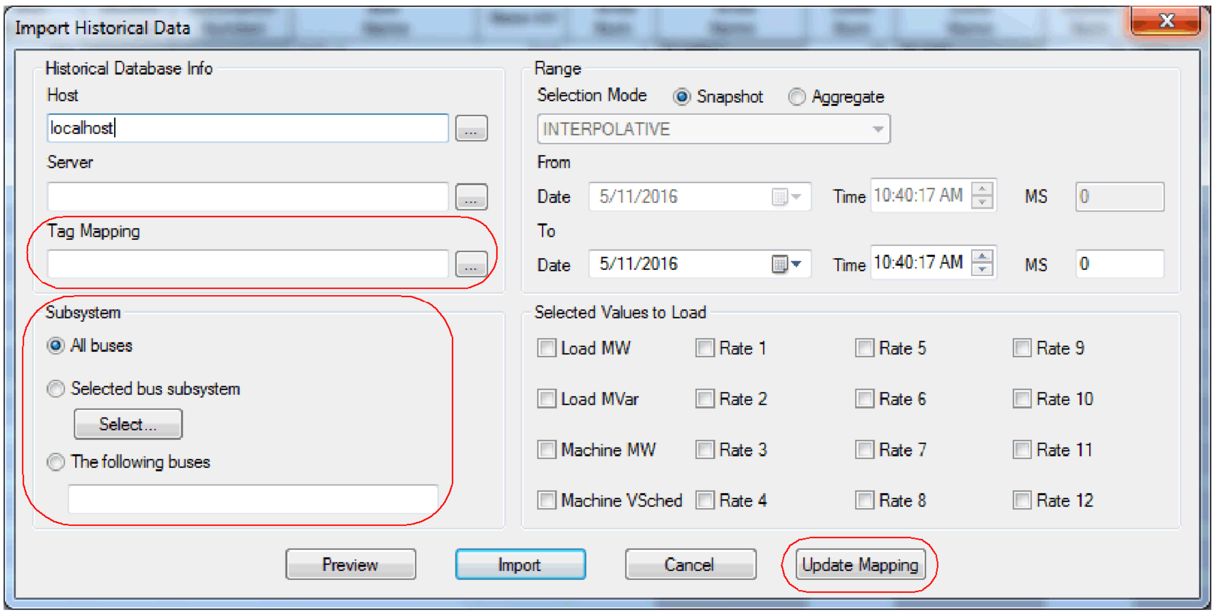


Figure 27.1. Elements for generating a Mapping File

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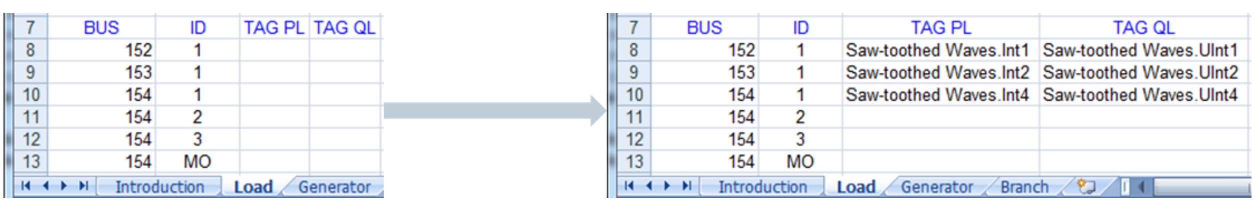


Figure 27.2. Sample Mapping File Load Sheet

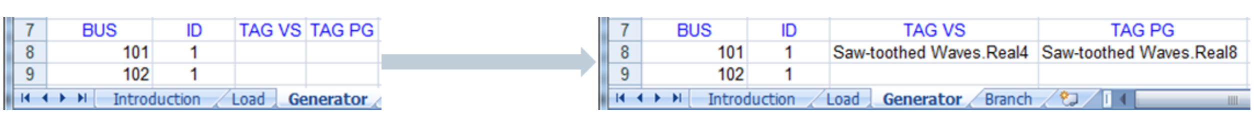
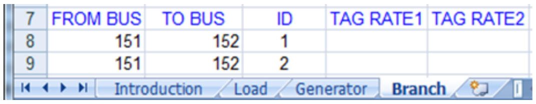
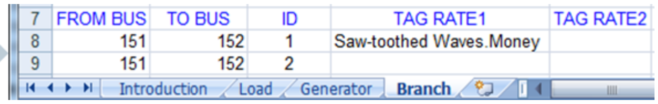


Figure 27.3. Sample Mapping File Generator Sheet



7	FROM BUS	TO BUS	ID	TAG RATE1	TAG RATE2
8	151	152	1		
9	151	152	2		

Introduction Load Generator **Branch**



7	FROM BUS	TO BUS	ID	TAG RATE1	TAG RATE2
8	151	152	1	Saw-toothed Waves.Money	
9	151	152	2		

Introduction Load Generator **Branch**

Sample Mapping File Branch Sheet

27.4. Importing Data

Once all fields have been filled in, the user has two options. If they wish, the user can select [*Preview*], which will generate an excel file similar to the Mapping File, but this time with the data filled in. This allows the user to review the data that will be brought into PSS®E to confirm the data looks correct. Figure 27.4, "Sample Preview File Load Sheet" shows examples of what the preview excel file will look like.

7	BUS	ID	CASE PL	PI PL	CASE QL	PI QL
8	152	1	1200	12	360	12
9	153	1	200	6	100	6
10	154	1	400	235658	200	267534
11	154	2	250		200	
12	154	3	250		100	
13	154	MO	100		80	

Introduction | Load | Generator | Branch

Figure 27.4. Sample Preview File Load Sheet

7	BUS	ID	CASE VS	PI VS	CASE PG	PI PG
8	101	1	1.01	89.12698	750	59.97096
9	102	1	1.01		650	

Introduction | Load | Generator | Branch

Sample Preview File Generator Sheet

7	FROM BUS	TO BUS	ID	CASE RATE1	PI RATE1	CASE RATE2
8	151	152	1	1200	-679888300	1100
9	151	152	2	1205		1105

Introduction | Load | Generator | Branch

Sample Preview File Branch Sheet

If the user is happy with the data or does not wish to preview the import, the user can select the [*Import*] button to bring the data into PSS®E from the historical database. Once the data has been imported, the case is now ready for whatever studies the user would like to run.

Chapter 28
Third-Party Integrations

28.1. Overview

PSS®E supports several Third-Party products that are launched directly from the PSS®E GUI. These products can be found under the Integrations menu (see Figure 28.1, “Third Party Integrations”). If the Third-Party product has been installed on the system, the corresponding item will be enabled in the menu. If the Third-Party product has not been installed on the system, the menu item will be disabled and not selectable. Selecting an enabled item will launch the Third-Party product.

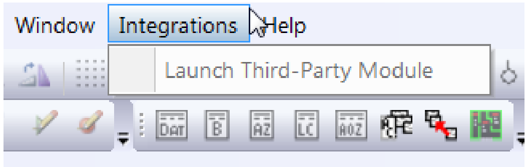
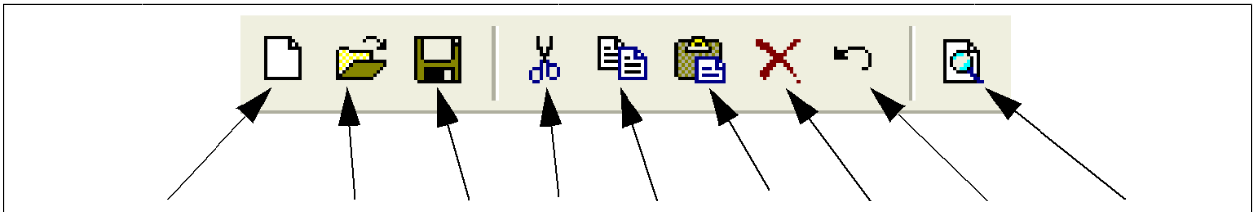


Figure 28.1. Third Party Integrations

Chapter 29

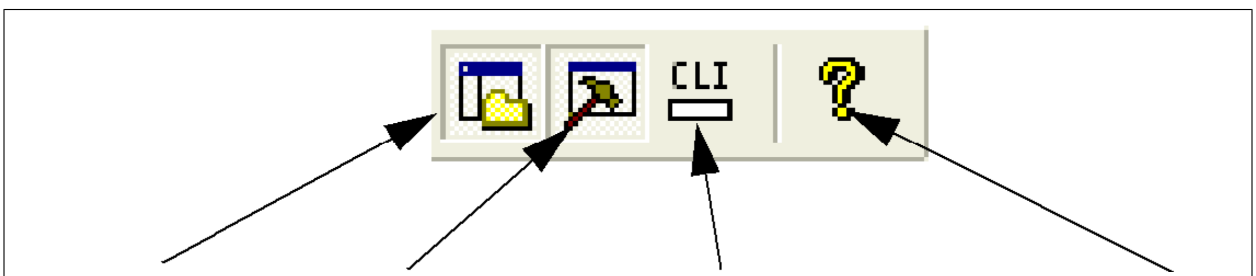
Appendix A - Summary of Toolbar Selections

File



New Case / Diagram	Open	Save	Cut	Copy	Paste	Delete	Undo	Print Preview

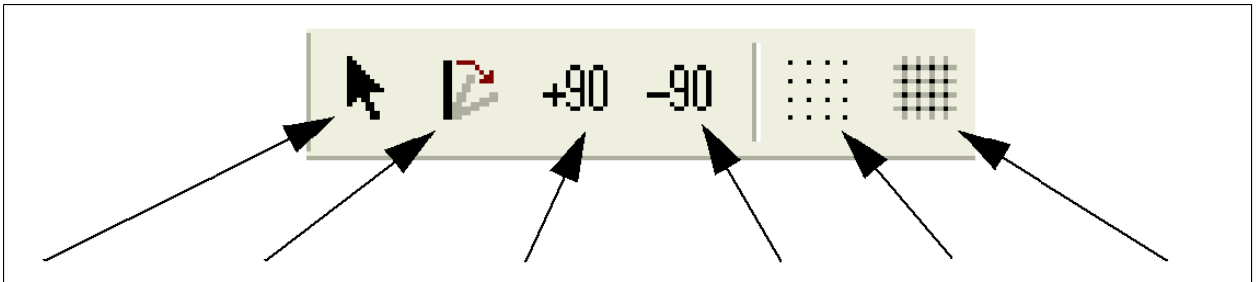
New Case / Diagram	Create a new case or diagram.
Open	Open an existing file.
Save	Save the active documents.
Cut	Cut the selection and put it on the clipboard.
Copy	Copy the selection and put it on the clipboard.
Paste	Insert clipboard contents.
Delete	Delete selected items.
Undo	Undo the previous action.
Print Preview	Print preview.



Tree View	Output Window	Command Line Interface	About PSS®E

Tree View	Show or hide the network tree.
Output Window	Show or hide *[Output]*.
Command Line Interface	Show or hide *[Command Line]*.
About PSS®E	Display program information, version number and copyright.

Diagram

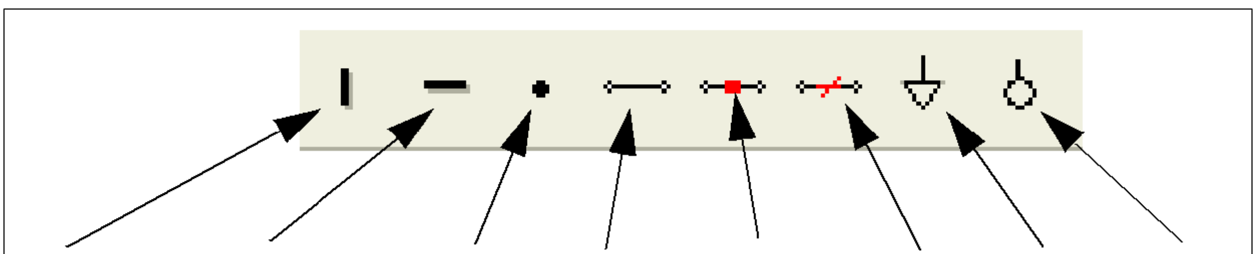


Select	Rotate Symbols	Rotate +90°	Rotate -90°	Show Grid	Snap to Grid

Select	Select diagram items in *[Diagram]*. Items can be selected using common selection techniques (e.g., dragging a rectangle around several objects, clicking an item and then holding down the *[Ctrl]* key to add more selections to the selection list). The selected items can then be manipulated [a] in many ways.
Rotation	Rotate diagram items. If the rotation item is selected, and then a diagram item is selected, the cursor changes to a circular arrow. Holding down the left mouse button while dragging the cursor will rotate the selected item around its center.
Rotate +90°	Rotate a selected item positive 90 degrees.
Rotate -90°	Rotate a selected item negative 90 degrees.
Show Grid	Toggle on or off the display of a grid in *[Diagram]*.
Snap to Grid	Toggle on or off the feature that causes the location of any newly created [b] diagram item to snap to the nearest grid point in *[Diagram]*.

[a]Manipulation implies that an existing [Diagram] can be modified subsequent to its construction or during its development.

[b]Creation implies that diagram items, network items or simple annotation items, are selected from the Diagram Toolbar for construction of a new network diagram. This can imply the construction of a new power flow case if the diagram items are bound to network items.

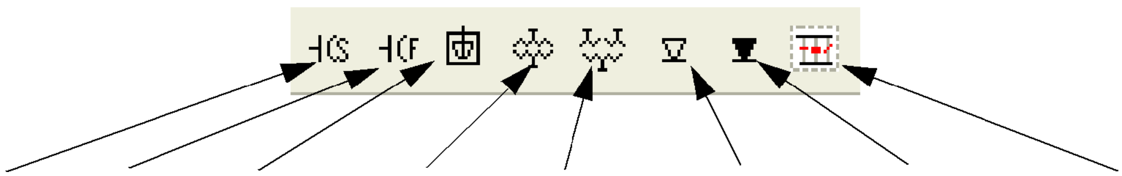


Sizable Busbar	Horizontal Sizable Busbar	Bus Node	Branch	Breaker	Switch	Load	Generator

Sizable Busbar	The basic building block of a PSS®E case and *[Diagram]*. Buses need to exist in a *[Diagram]* before any lines or equipment can be drawn. Buses have a number of discrete ports arranged along both sides of the busbar. When connecting lines and equip-

	ment to a bus, the connection point will snap to the nearest port.
Horizontal Sizable Busbar	The same as a regular bus, except that when drawn on the *[Diagram]* it is placed horizontally across the screen instead of vertically.
Bus Node	Select when busbar representation of the bus is not desired. The bus node has a number of ports stacked in the center of the node. When connecting lines or equipment to a bus node, the connection point will snap to the center.
Branch [a]	Select to create a line between two buses. When the branch element is selected, the cursor changes to a crosshair. The branch is started by placing the cross-hair on the from bus and clicking. Any number of intermediate kneepoints may then be created by clicking the towards the to bus. Clicking the to bus will complete the creation of the branch.
Breaker	Select to create a line with a breaker between two buses. When the breaker element is selected, the cursor changes to a crosshair. The line is started by placing the cross-hair on the from bus and clicking. Clicking the to bus will complete the creation of the breaker element.
Switch	Select to create a line with a switch between two buses. When the switch element is selected, the cursor changes to a crosshair. The line is started by placing the cross-hair on the from bus and clicking. Clicking the to bus will complete the creation of the switch element.
Load	Select to create a load on a bus. When the load element is selected, the cursor changes to a crosshair. The load is started by placing the crosshair on the bus and pressing the left mouse button. The mouse is then dragged to where the load symbol is to appear and released.
Generator	Select to create a generator on a bus. When the generator element is selected, the cursor changes to a crosshair. The generator is started by placing the crosshair on the bus and pressing the left mouse button. The mouse is then dragged to where the generator symbol is to appear and released.

[a]At any point during the creation of a branch, breaker, or switch, the element may be canceled and removed by pressing the [Esc] key. The attachment point of an element on a bus may be changed by [Ctrl] clicking the attachment point of the element and then moving it to another port on the bus.

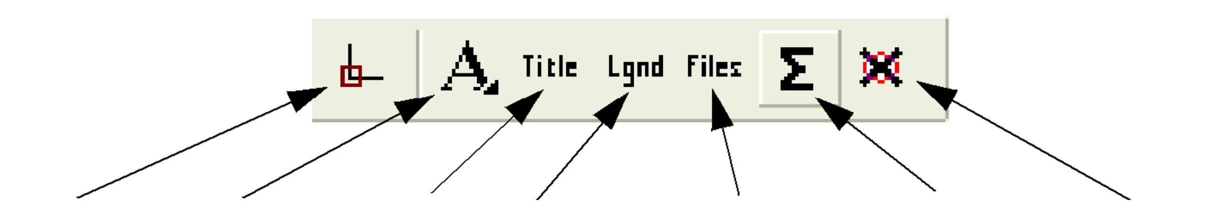


Switched Shunt	Fixed Shunt	FACTS Device	2-Winding Transformer	3-Winding Transformer	2-Terminal dc Line	VSC dc Line	Insert Diagram Template

Switched Shunt	Select to create a switched shunt on a bus. When the switched shunt element is selected, the cursor changes to a crosshair. The switched shunt is started by placing the crosshair on the bus and pressing the left mouse button. The mouse is then dragged to where the switched shunt symbol is to appear and released.
Fixed Shunt	Select to create a fixed shunt on a bus. When the fixed shunt item is selected, the cursor changes to a crosshair. The fixed shunt is started by placing the crosshair on the bus and pressing the left mouse button. The mouse is then dragged to where the fixed shunt symbol is to appear and released.
FACTS Device	Select to create a FACTS device between two buses. The FACTS device is started by selecting one or two buses. One bus is selected to create a shunt element FACTS device. Two buses are selected to create a series element FACTS device. When the FACTS device item is selected, the cursor changes to a crosshair. If a single bus was selected, the FACTS device is started by placing the crosshair on the selected bus and pressing the left mouse button. The mouse is then dragged to where the FACTS device is to appear and released. If two buses were selected, the FACTS device is started by placing the crosshair on the sending bus and clicking. Any number of intermediate kneepoints may then be created by clicking the way to the terminal bus. Clicking the terminal bus will complete the creation of the FACTS device. At any point during the creation of the FACTS device, the FACTS device may be canceled and removed by pressing the *[Esc]* key.
Two-winding Transformer [a]	Used to create a two-winding transformer between two buses. The two-winding transformer is started by placing the crosshair on the from bus and clicking. Any number of intermediate kneepoints may then be created by clicking the way to the to bus. Clicking the to bus will complete the creation of the two-winding transformer.

Three-winding Transformer	Select to create a three-winding transformer between three buses. The three-winding transformer is created by first selecting three buses. The three buses will be regarded as the FROM, TO, and last bus in the order they were initially selected. The three-winding transformer item is then selected, the cursor placed in *[Diagram]* at the desired location for the symbol to be placed, and the left mouse button clicked. Any number of intermediate kneepoints may be added to the links between the symbol and the three buses, or the attachment points modified in the manner described above.
Two-terminal dc Line	Select to create a two-terminal dc line between two buses. When the dc line item is selected, the cursor changes to a crosshair. The dc line is started by placing the crosshair on the from bus and clicking. Any number of intermediate kneepoints may then be created by clicking towards the to bus. Clicking the to bus will complete creation of the dc line.
Voltage Source Converter (VSC) dc Line	Select to create a VSC dc line between two buses. When the VSC dc line item is selected, the cursor changes to a crosshair. The VSC dc line is started by placing the crosshair on the from bus and clicking. Any number of intermediate kneepoints may then be created by clicking towards the to bus. Clicking the to bus will complete creation of the VSC dc line.
Insert Diagram Template	Select to open a dialog that displays a list of available diagram templates.

[a]At any point during the creation of the two-winding transformer, two-terminal dc line, or VSC dc line the two-winding transformer may be canceled and removed by pressing the [Esc] key. The attachment point of an element on a bus may be changed by [Ctrl] clicking the attachment point of the element and then moving it to another port on the bus.

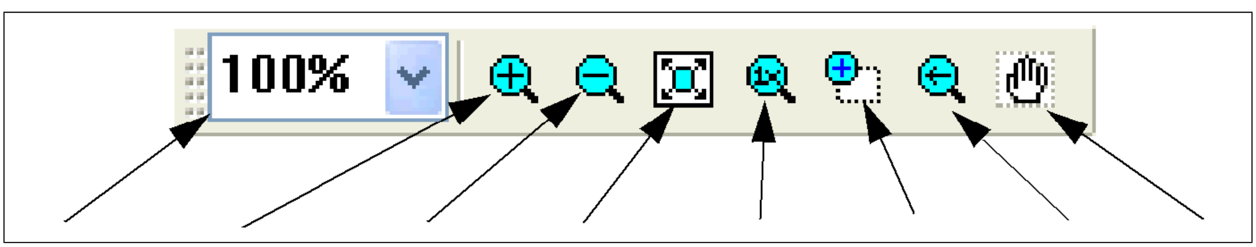


Kneepoint	Annotation Text	Diagram Title	Diagram Legend	Diagram File Block	Summation Label	Report Node Label

Kneepoint	Select to put bends, or kneepoints, in a link that connects two diagram items. Links are used to represent lines, the connections between two- and three-winding transformer symbols and buses, and the connections between equipment and buses. When the kneepoint item is selected the cursor changes to a crosshair. Clicking a link will place a red square on the link. This red square can later be dragged with the select item to achieve the desired

	shape. Kneepoints can be deleted by selecting the kneepoint and pressing the *[Delete]* key.
Annotation Text	Select to place annotation text anywhere on *[Diagram]*. The annotation text item is selected and text can then be placed anywhere in *[Diagram]* by clicking at the location to display the text annotation.
Diagram Title	Select to place a title on *[Diagram]*. The title item displays the two-line diagram title as well as the time and date of the last diagram update on the third line. The time and date is updated on the title item whenever a solution is run and the diagram is open in the application. The title item is selected and titles can then be placed anywhere in *[Diagram]* by clicking the location where the title is to be placed.
Diagram Legend	Select to place a legend on *[Diagram]*. The legend item displays the two-line diagram legend. The legend item is selected and legends can then be placed anywhere in *[Diagram]* by clicking at the location where the legend is to be displayed.
Diagram File Block	Select to place a Diagram File Block on *[Diagram]*. The Diagram File Block contains the current case filename and the current Diagram filename. The files item is selected and file blocks can then be placed anywhere in *[Diagram]* by clicking the location where the file block is to be displayed.
Summation Label	Select to place a summation record on *[Diagram]*. The summation item is selected and summations can then be placed anywhere in *[Diagram]* by clicking. As each summation is placed, the Edit Summation dialog is displayed that allows the setting of the summation records (see Section 3.8.3, "Adding a Summation Record ").
Report Node Label	Select to place a report node record on *[Diagram]*. The report node item is selected and report nodes can then be placed anywhere in *[Diagram]* by clicking. As each report node is placed, the *[Edit Report Node]* dialog is displayed that allows the setting of the report nodes (see Section 3.8.4, "Adding a Report Node ").

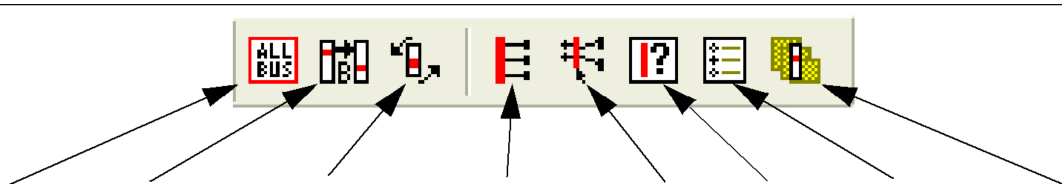
Zoom



Zoom Combo Box	Zoom In	Zoom Out	Zoom Window	Zoom 100%	Zoom Window	Zoom Previous	Pan

Zoom Combo Box	Select a predefined magnification to apply to *[Diagram]*. Click the arrow to the right of the combo box for a pull-down list of predefined magnification from which to choose. You can also type in a desired magnification if it is not found in the list. The *Zoom Combo Box* is automatically reflects the current magnification, which can be changed through the use of the other zoom tools.
Zoom in/Zoom out	Increase/decrease magnification of the diagram.
Zoom Extent	Increase/decrease diagram magnification to fill window.
Zoom 100%	Quickly return *[Diagram]* magnification to actual size.
Zoom Window	Increase/decrease magnification of a selected portion of *[Diagram]*. The user selects this item and then drags a rectangle over *[Diagram]* to encompass the part of *[Diagram]* to be zoomed. The selected part of the *[Diagram]* is then zoomed to fit in the extent of *[Diagram]* window.
Zoom Previous	Quickly return the *[Diagram]* magnification to its previous setting.
Pan	Scroll around the *[Diagram]*. Upon selecting this item, the cursor in *[Diagram]* changes to a hand. *[Diagram]* is then panned by holding down the left mouse button and dragging the hand around the window.

General Task

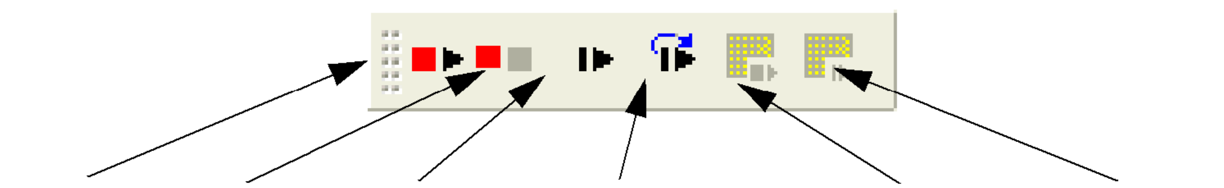


Select All Buses	Create Bus Subsystem	Toggle Bus Subsystems	Bus One-Line Diagram	Auto Draw	Locate Bus	Program Settings	Create/Modify Config Files

Select All Buses	Select all buses.
Create Bus Subsystem	Create a bus subsystem.
Toggle Bus Subsystems	Toggle between the primary bus subsystem and an alternate.
GOUT/GEXM	Create a graphical power flow bus display (GOUT/GEXM).

Auto Draw	Set interaction mode to automatically draw parts of the network.
Locate Bus	Locate and center the selected bus on the Diagram.
Program Settings	Change general program settings.
Create/Modify Config Files	Create or modify SUB, MON, and CON configuration files.

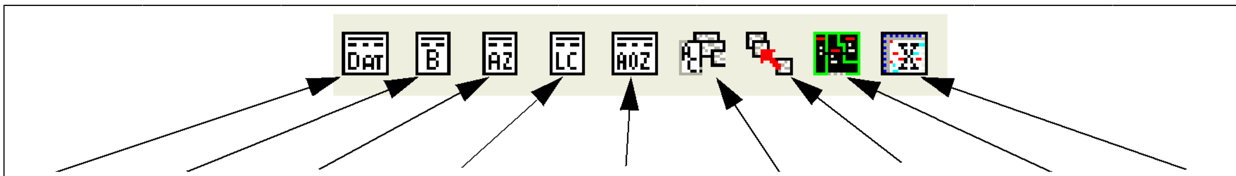
Automation



Start Recording	Stop Recording	Run Automation File	Re-run Automation File	Edit Last Recorded Automation File	Edit Last Run Automation File

Start Recording	Start recording automation file.
Stop Recording	Stop recording automation file.
Run Automation File	Select and run a program automation file.
Re-run Automation File	Run the last used program automation file.
Edit Last Recorded Automation File	Edit the last automation file recorded.
Edit Last Run Automation File	Edit the last program automation file used.

Reporting

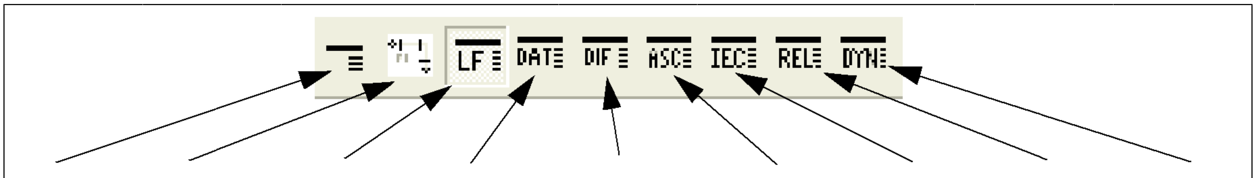


List Data	Bus-Based Reports	Area/Zone Based Reports	Limit Checking Reports	Area/Owner /Zone Totals	AC Reports	Append AC Output File	Graphical Report	Export to Excel

List Data	List Powerflow, sequence and OPF data.
Bus-Based Reports	Generate Bus based reports.
Area/Zone Based Reports	Generate Area/Zone based reports.
Limit Checking Reports	Generate limit checking reports.
Area/Owner /Zone Totals	Generate Area/Owner/Zone total reports.
AC Reports	Generate ac contingency solution output reports.
Append AC Output File	Append to existing ac contingency solution output file.
Graphical Report	Create a graphical report.

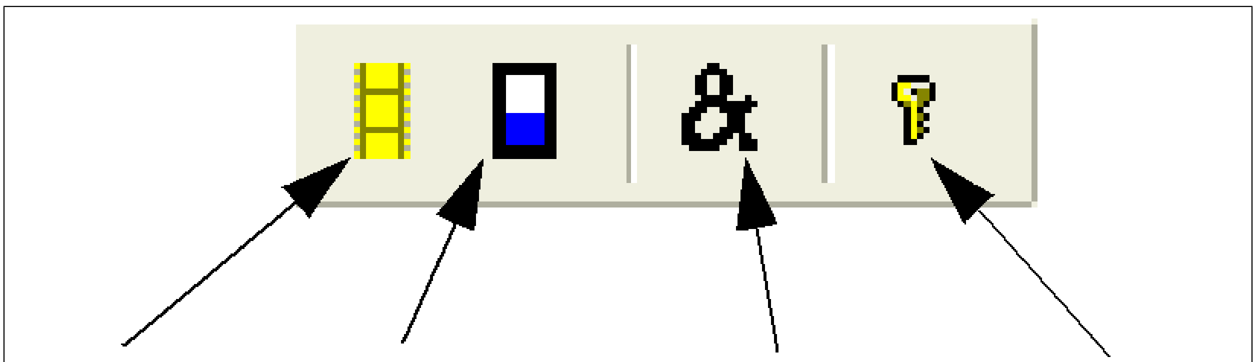
Export to Excel	Export report to an Excel spreadsheet.

Results (Display on Diagram)



Toggle Label	Anno-tation	Power Flow Results	Impedance Data	Case Com-parison	ASCC Fault Analysis	IEC Fault Analysis	Reliability	Dynamics

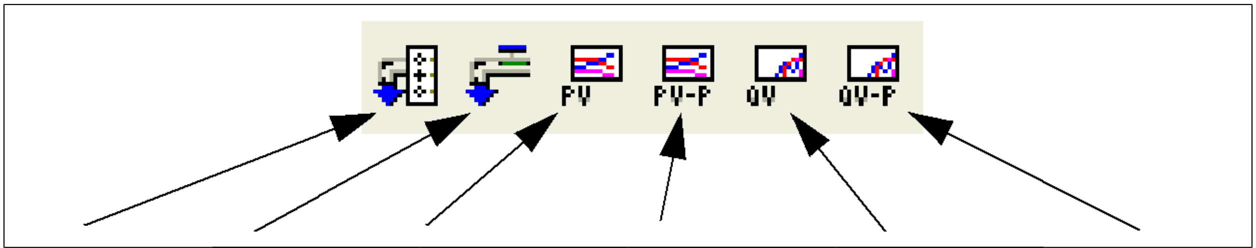
Toggle Labels	Show or hide the display of labels on the active diagram.
Annotation	Edit the diagram annotation on the active diagram.
Power Flow Results	Display power flow results on the active diagram.
Impedance Data	Display power flow impedance data on the active diagram.
Case Comparison	Run graphical case comparison on the active diagram.
ASCC Fault Analysis	Display automatic sequencing fault analysis on the active diagram.
IEC Fault Analysis	Display IEC results on the active diagram.
Reliability	Display reliability results on the active diagram.
Dynamics	Display dynamics results on the active diagram.



Animate Flows	Current Loadings	Multi-Section Line Reporting	Lock Diagram

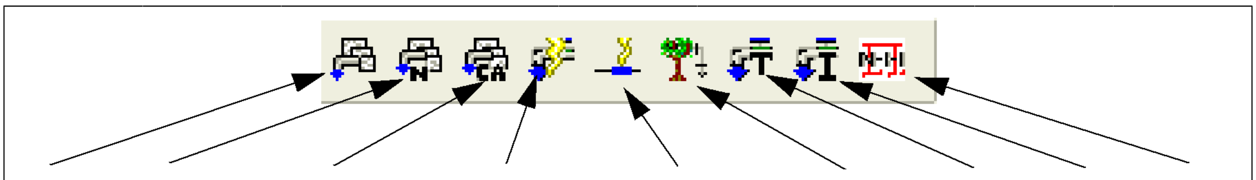
Animate Flows	Animate flows on the active diagram.
Current Loadings	Display current loading bar charts on the active diagram.
Multi-Section Line Reporting	Multisection Line reporting on the active diagram.
Lock Diagram	Lock the diagram.

Analysis



Solution Settings	Solve	PV Analysis	PV Analysis - Previous	QV Analysis	QV Analysis - Previous

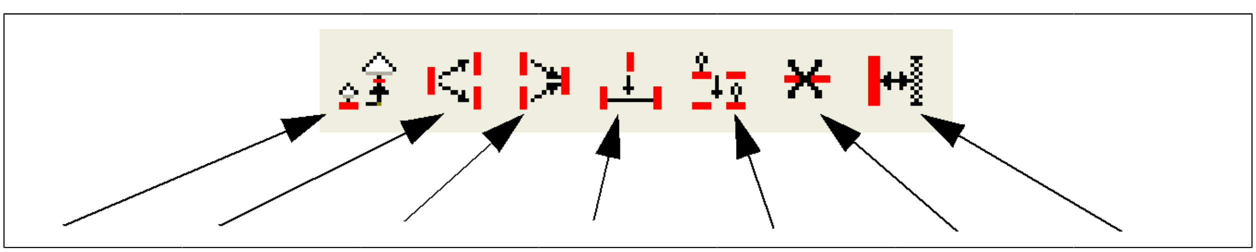
Solution Settings	Change network solution settings.
Solve	Solve.
PV Analysis	Perform a PV analysis.
PV Analysis - Previous	Perform a PV analysis using previous results.
QV Analysis	Perform a QV analysis.
QV Analysis - Previous	Perform a QV analysis using previous results.



ACCC	Multi-ACCC	AC Corrective Actions	Reliability Assessment	Substation Reliability Assessment	Network Connectivity Check	Solve for Switching	Inertial Load Flow	N-1-1 Analysis

ACCC	Perform ac contingency calculation.
Multi-ACCC	Perform multi-level ac contingency calculation.
AC Corrective Actions	Perform ac corrective actions.
Reliability Assessment	Perform reliability assessment.
Substation Reliability Assessment	Perform substation reliability assessment.
Network Connectivity Check	Perform network connectivity check (TREE).
Solve for Switching	Perform switching study (TYSL).
Inertial Load Flow	Perform Newton-Raphson solution with inertial / governor dispatch (INLF).
N-1-1 Analysis	Perform N-1-1 analysis.

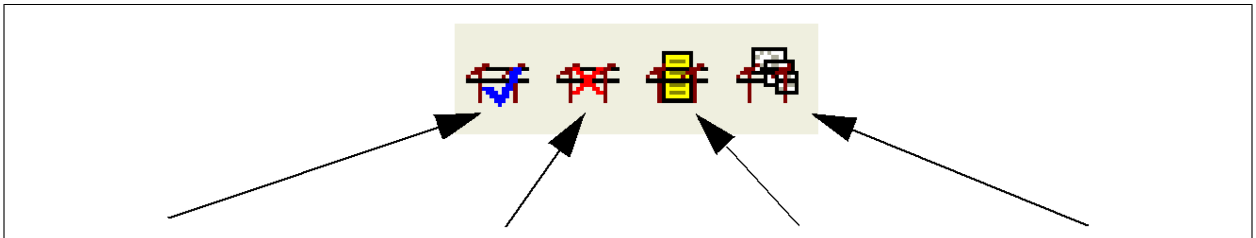
Topology



Scale	Split Bus	Join Buses	Tap Line	Move Network Elements	Delete Network Elements	Disconnect/ Reconnect Bus

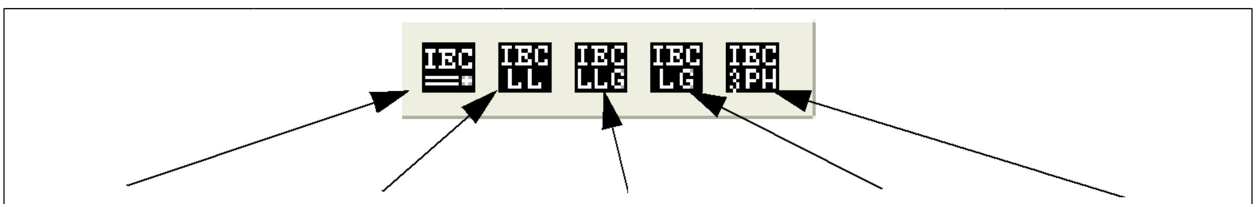
Scale	Scale load, generation, and shunts.
Split Bus	Split a bus into two buses.
Join Buses	Join two buses into one.
Tap Line	Insert another bus into a line.
Move Network Elements	Move equipment /lines between buses.
Delete Network Elements	Delete buses/equipment/lines.
Disconnect/Reconnect Bus	Disconnect/Reconnect bus to network.

Fault Analysis



Set Up Unbalanced Network	Solve Unbalanced Network	Unbalanced Report	Automatic Sequence Fault Calculation

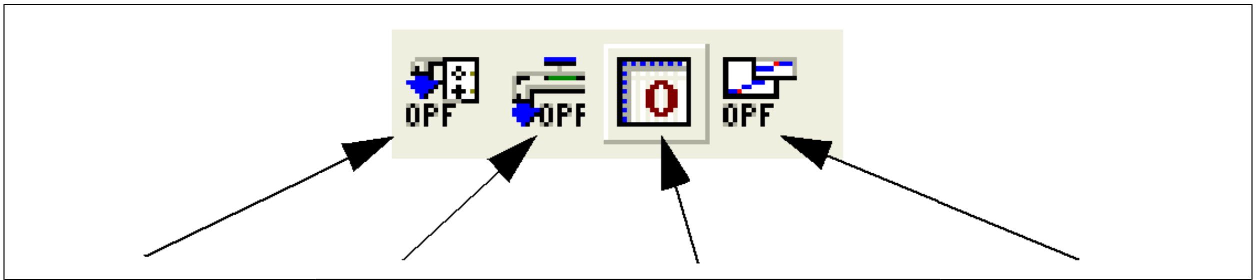
Set Up Unbalanced Network	Setup network for unbalanced solution.
Solve Unbalanced Network	Solve and report network with unbalances.
Unbalanced Report	Unbalanced network report.
Automatic Sequence Fault Calculation	Automatic sequence fault calculation.



IEC 60909 Fault Calculation	IEC 60909 LL Fault Calculation	IEC 60909 LLG Fault Calculation	IEC 60909 LG Fault Calculation	IEC 60909 LLLG Fault Calculation

IEC 60909 Fault Calculation	IEC 60909 fault calculation.
IEC 60909 LL Fault Calculation	Perform an IEC LL fault calculation.
IEC 60909 LLG Fault Calculation	Perform an IEC LLG fault calculation.
IEC 60909 LG Fault Calculation	Perform an IEC LG fault calculation.
IEC 60909 LLLG Fault Calculation	Perform an IEC LLLG fault calculation.

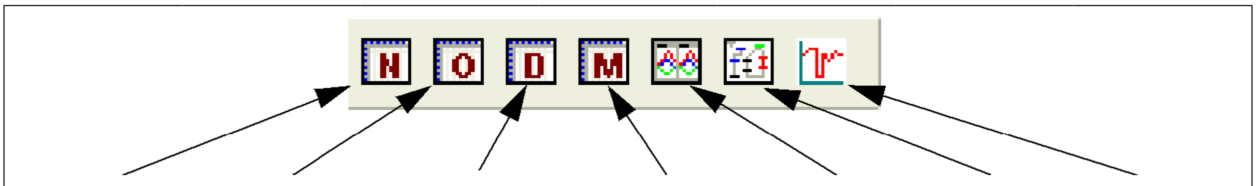
Optimal Power Flow



OPF Solution Settings	Solve OPF	OPF Spreadsheet	OPF Data Tables

OPF Solution Settings	Change OPF solution settings.
Solve OPF	Solve OPF.
OPF Spreadsheet	Make the OPF spreadsheet active.
OPF Data Tables	Create/modify OPF data tables.

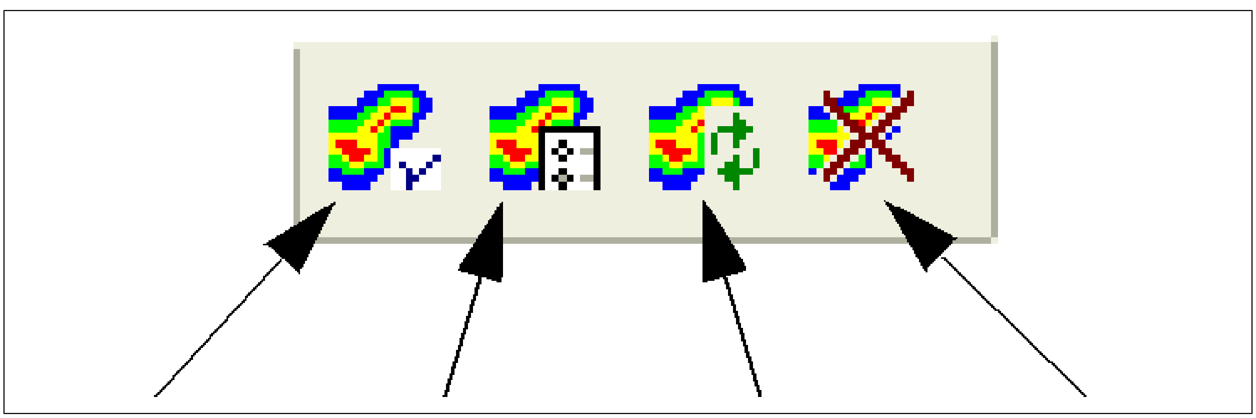
Activation



Network Spreadsheet	OPF Spread-sheet	Dynamics Spreadsheet	Model Spreadsheet	Dynamics Plot Sheet	Slider Di-agram	Event Spreadsheet

Network Spreadsheet	Make the Network spreadsheet active.
OPF Spreadsheet	Make the OPF spreadsheet active.
Dynamics Spreadsheet	Make the Dynamics spreadsheet active.
Model Spreadsheet	Make the Model spreadsheet active.
Dynamics Plot Sheet	Make the Dynamics plot sheet active.
Slider Diagram	Make the Slider Diagram active.
Event Spreadsheet	Make the Event spreadsheet active.

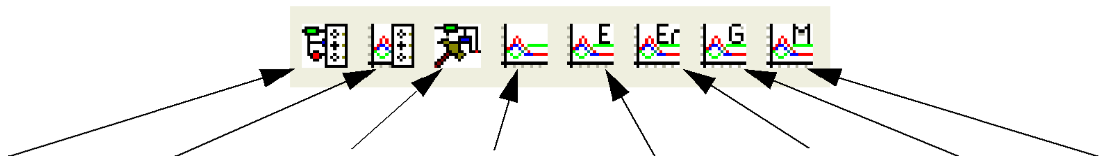
Contour



Enable Contours	Contour Settings	Refresh Contours	Remove Contours

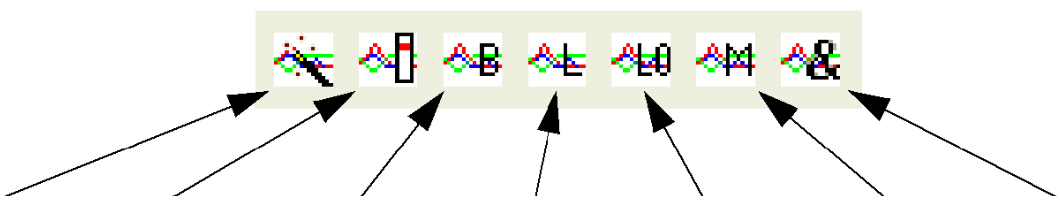
Enable Contours	Enable color contouring.
Contour Settings	Edit contour settings.
Refresh Contours	Refresh contours.
Remove Contours	Remove contours.

Dynamics Simulation



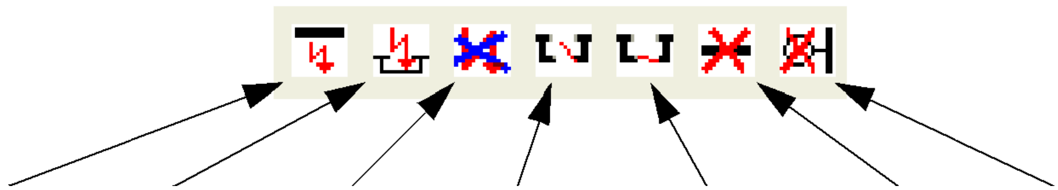
Dynamic Simulation Options	Dynamics Solution Parameters	Model Mainte-nance	Dynamic Simulation	Exciter Sim-ulation	Exciter Re-sponse Simulation	Governor Response Simulation	Extended Term Sim-ulation

Dynamic Simulation Options	Change Dynamic simulation options.
Dynamics Solution Parameters	Change Dynamics solution parameters.
Model Maintenance	Perform network model maintenance functions.
Dynamic Simulation	Initialize and perform a Dynamic simulation.
Exciter Simulation	Initialize and perform an Exciter simulation.
Exciter Response Simulation	Initialize and perform an Exciter response ratio simulation.
Governor Response Simulation	Initialize and perform a Governor Response simulation.
Extended Term Simulation	Initialize and perform an Extended Term simulation.



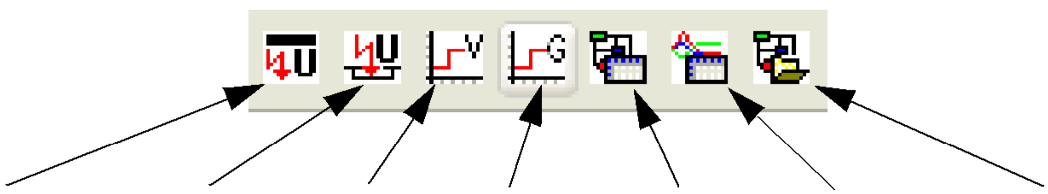
Channel Set-up Wizard	Subsystem Channel Selection	Bus Chan-nel Selection	Line Chan-nel Selection	Load Chan-nel Selection	Machine Channel Selection	VAR/STATE Channel Selection

Channel Setup Wizard	Launch Channel Setup Wizard.
Subsystem Channel Selection	Select channels by subsystem.
Bus Channel Selection	Select bus channels.
Line Channel Selection	Select branch and 3 winding transformer channels.
Load Channel Selection	Select load channels.
Machine Channel Selection	Select machine channels.
VAR/STATE Channel Selection	Select VAR/STATE channels.



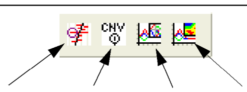
Bus Fault	Line Fault	Clear Fault	Trip Line	Close Line	Bus Dis-connect	Machine Disconnect

Bus Fault	Apply a bus fault.
Line Fault	Apply a line fault.
Clear Fault	Clear a fault.
Trip Line	Trip a line.
Close Line	Close a line.
Bus Disconnect	Disconnect a bus.
Machine Disconnect	Disconnect a machine.



Unbalanced Bus Fault	Branch Un-balance	Change Vref	Change Gref	List Mod-el Data	List Dynam-ics Data	List Mod-el Storage Locations

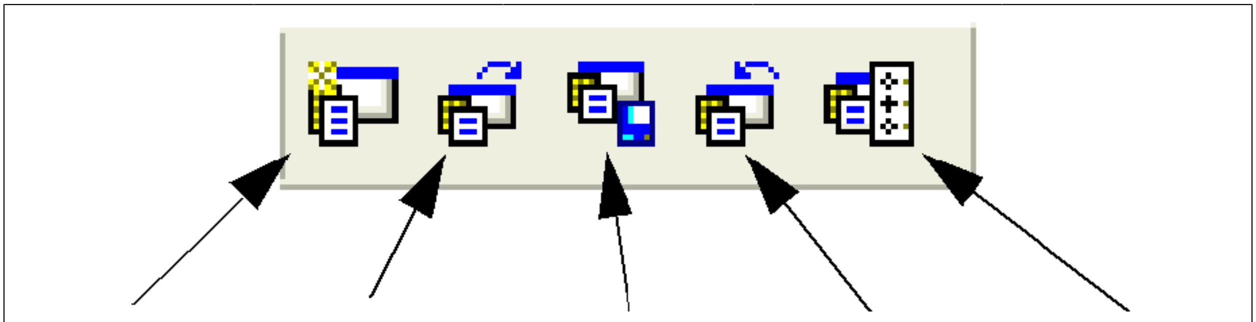
Unbalanced Bus Fault	Calculate and apply an unbalanced bus fault.
Branch Unbalance	Calculate and apply a branch unbalance.
Change Vref	Change or increment Vref.
Change Gref	Change or increment Gref.
List Model Data	List model and data by model type.
List Dynamics Data	List Dynamics variables in network.
List Model Storage Locations	List model storage locations by type and subsystem.



NEVA Eigenvalue Analysis	Force Genera-tor Conversion	Update Plot Book	Update Dynamic Diagram

NEVA Eigenvalue Analysis	Launch NEVA Eigenvalue analysis module.
Force Generator Conversion	Force generator conversion when initializing Dy-namic Simulation.
Update Plot Book	Update Plot Book during Dynamic Simulation if *Plot every <n> time steps* option is specified.
Update Dynamic Diagram	Update Dynamic Diagram during Dynamic Simula-tion if *Plot every <n> time steps* option is specified.

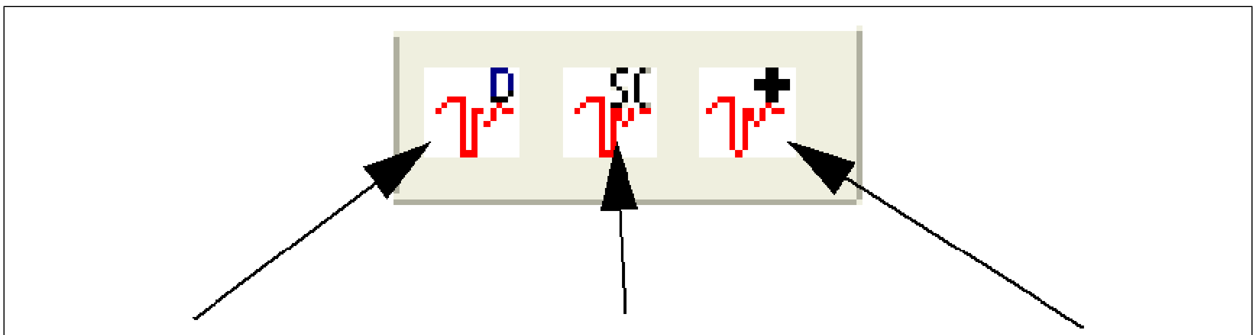
Scenarios



New Scenario	Open Scenario	Save Scenario	Close Scenario	Edit Scenario

New Scenario	Create new scenario.
Open Scenario	Open existing scenario.
Save Scenario	Save open scenario.
Close Scenario	Close open scenario.
Edit Scenario	Edit existing scenario.

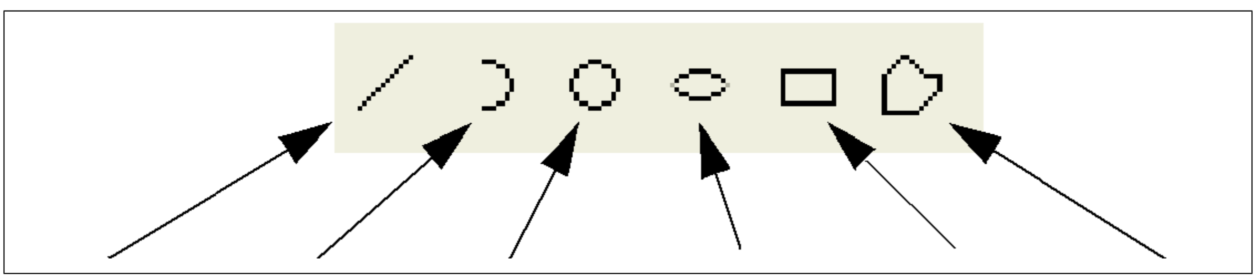
Event Studies



Run Dynamic Event Study	Run Short Circuit Event Study	Add Event Item

Run Dynamic Event Study	Launch dynamic event study.
Run Short Circuit Event Study	Launch short circuit event study.
Add Event Item	Add event item to existing event study.

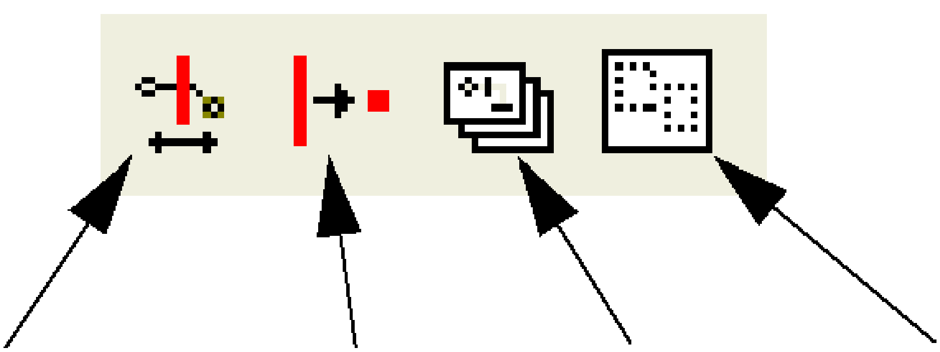
Diagram Primitives



Line Primitive	Arc Primitive	Circle Primitive	Ellipse Primitive	Rectangle Primitive	Region Primitive

Line Primitive	Select to place annotation lines anywhere on *[Diagram]*. The line primitive item is selected and lines can then be placed anywhere in *[Diagram]* by clicking. Be aware, they are not branches!
Arc Primitive	Select to place annotation arcs anywhere on *[Diagram]*. The arc primitive item is selected and arcs can then be placed anywhere in *[Diagram]* by clicking.
Circle Primitive	Select to place annotation circles anywhere on *[Diagram]*. The circle primitive item is selected and circles can then be placed anywhere in the *[Diagram]* by clicking.
Ellipse Primitive	Select to place annotation ellipses anywhere on *[Diagram]*. The ellipse primitive item is selected and ellipses can then be placed anywhere in *[Diagram]* by clicking.
Rectangle Primitive	Select to place annotation rectangles anywhere on *[Diagram]*. The rectangle primitive item is selected and rectangles can then be placed anywhere in *[Diagram]* by clicking.
Region Primitive	Select to place annotation regions anywhere on *[Diagram]*. The region primitive item is selected and multi-segment polygon regions can then be placed anywhere in *[Diagram]* by clicking the end point for each edge of the polygon. The region is complete when the last point clicked is on the first point.

Diagram Options



Toggle Auto-Position	Toggle Bus	Manage Diagram Layers	Manage Diagram Views

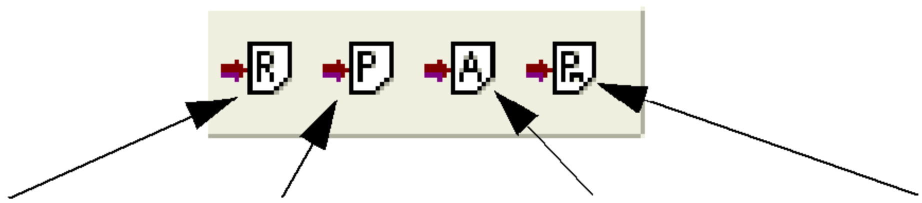
Toggle Auto-Position	Toggle auto-position for selected elements.
Toggle Bus	Toggle bus symbol orientation.
Manage Diagram Layers	Manage order of *[Diagram]* layers.

Manage Diagram Views	Manage *[Diagram]* saved views.

Custom Toolbar

Refer to Section 5.3, "Creating Custom Toolbars" to establish functions for a custom toolbar.

Redirect Output

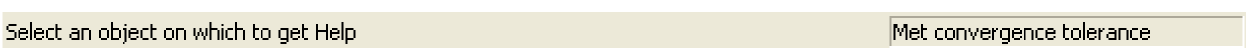


Redirect Report Output	Redirect Progress Output	Redirect Alert Output	Redirect Prompt Output

Redirect Report Output	Redirect reports to a file, printer, or to the current progress device; suppress all reporting output.
Redirect Progress Output	Redirect progress to a file, printer, or to the current progress device; suppress all progress output.
Redirect Alert Output	Redirect alerts to an alert box, file, printer, or to the current progress or reporting device; suppress all alerts output.
Redirect Prompt Output	Redirect prompts and warnings to a prompt window, file, printer, or to the current progress or reporting device; suppress all prompts output.

Status Bar

The *Status* bar fields, when in view, indicate various conditions for the user's reference. Interactions with *[Diagram]* cause updates to items in the fields. The fields are listed below.



Select an object on which to get Help	Pops up tooltip on diagram component under cursor.
Met convergence tolerance	Notification that the last activity run met the specified limits.
Powerflow results	Indicates the type of results currently shown in *[Diagram]*. These include, power flow, impedances, case differences, and short circuit results.
MW/Mvar flow	Indicates units currently in use for the indicated type of results.
4.08, -1.49	The current cursor location in *[Diagram]* is constantly updated in the *Status* bar. The X and Y location

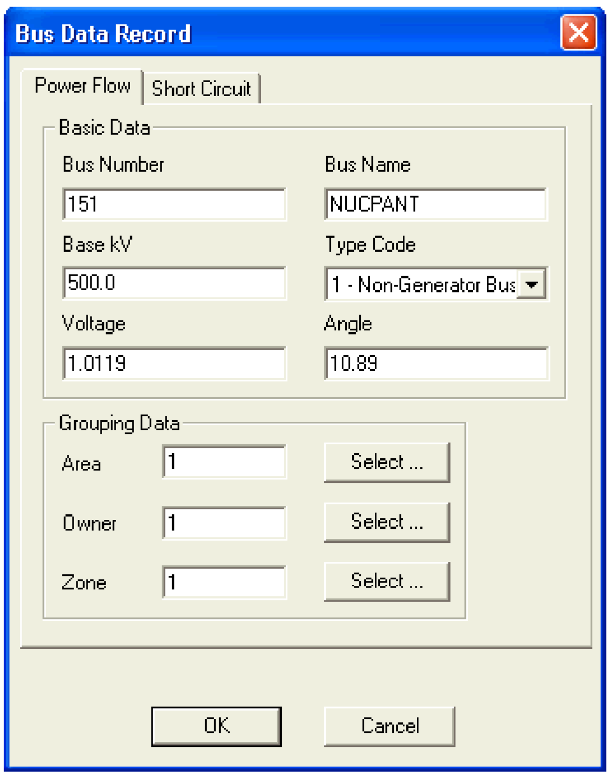
	of the cursor are displayed in the units specified for *[Diagram]* in *[Diagram Settings]*.
Bind items	The current binding mode for new items created in *[Diagram]* is displayed in the *Status* bar. The field displays either *Bind items*, indicating that new network items added to *[Diagram]* will create new data in the working case, or *No binding*, indicating that no data is added to the working case. Items added when this field displays *No binding* will be displayed in the color red, indicating no corresponding case data exists.
Next bus - 1	The next bus number for new buses created in *[Diagram]* is also displayed in the *Status* bar. Autonumbering is handled with the Power Flow Options menu; see Section 11.1, "Specifying Solution Parameters". If autonumbering is on, this field displays the number of the next bus created. If autonumbering is off, this field displays *Autonumber disabled*.

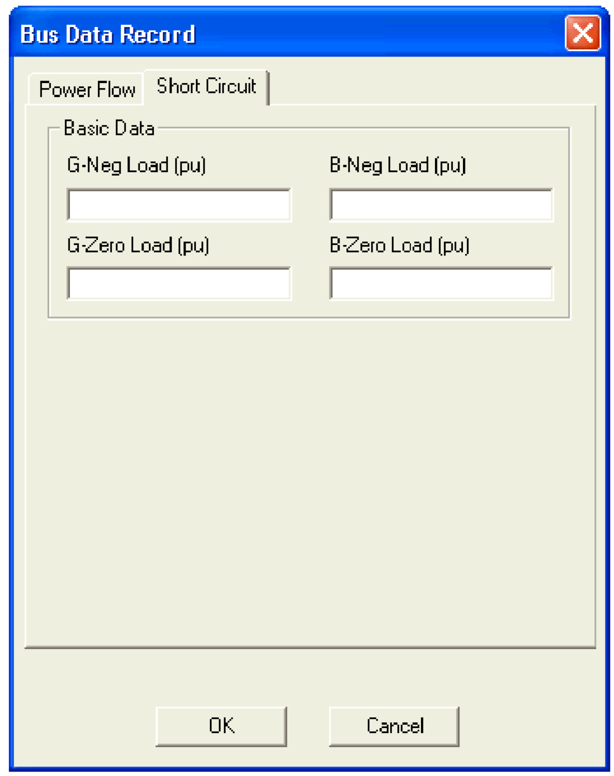
Chapter 30

Appendix B - Network Component Data Records

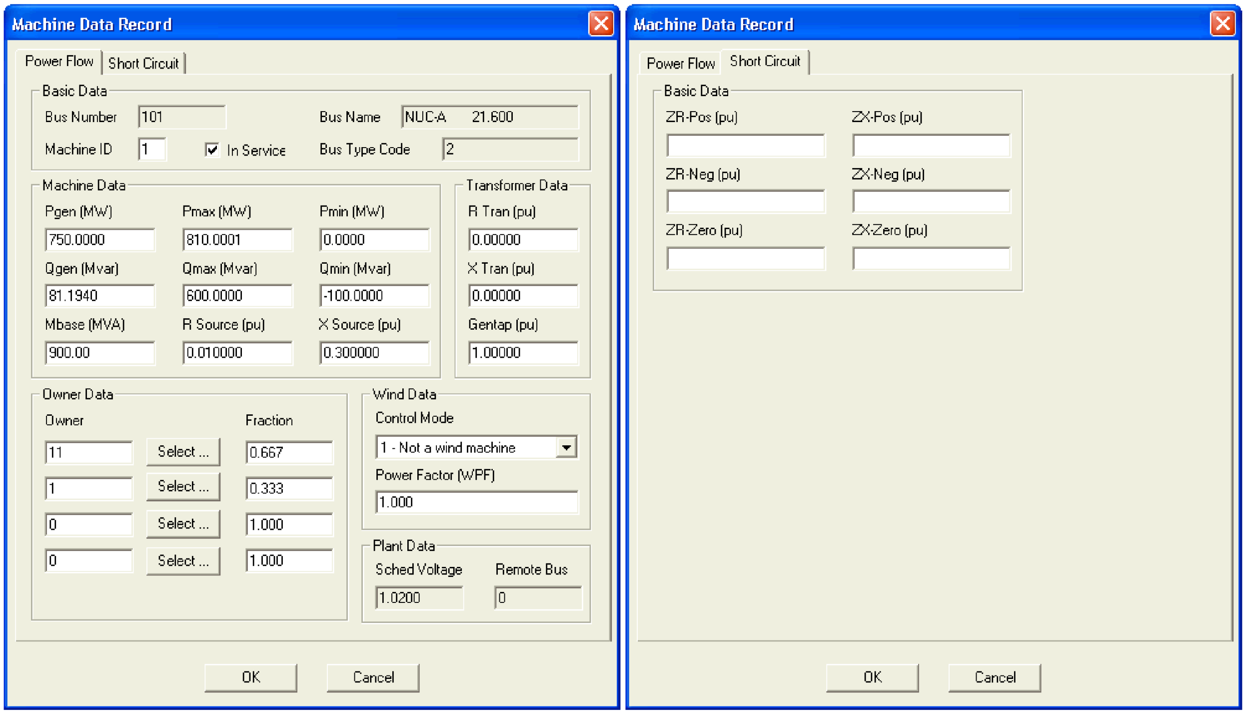
Following are screen captures of the data records available when PSS®E-32.0.0 was released. Since data records are a new feature, other network components may be updated using these dialogs, depending upon the version of PSS ®E you are using.

See Section 3.6.1, Using Data Records for a description of their use.

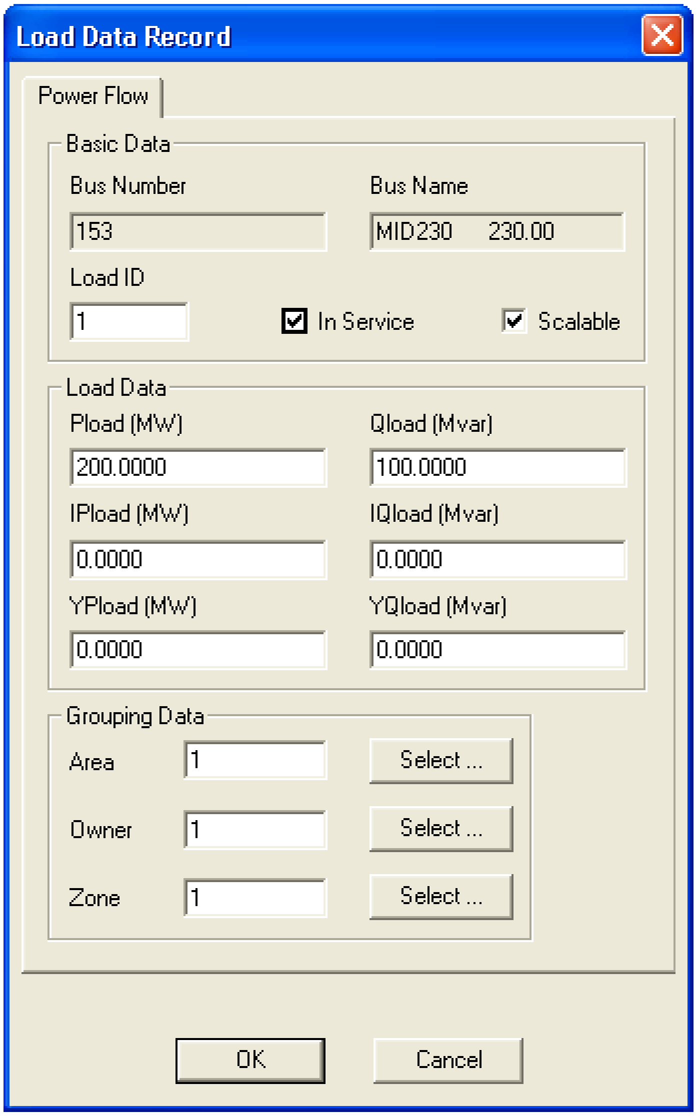




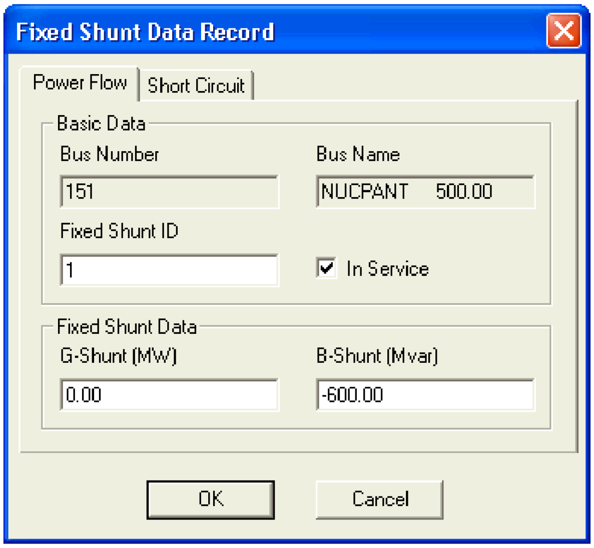
Bus Data Records

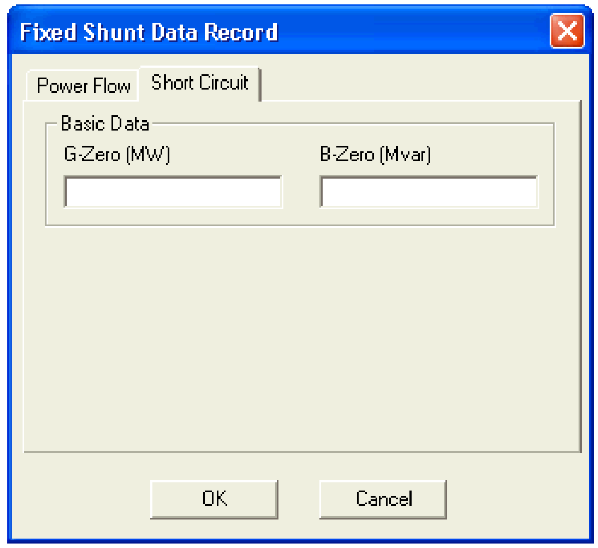


Machine Data Records

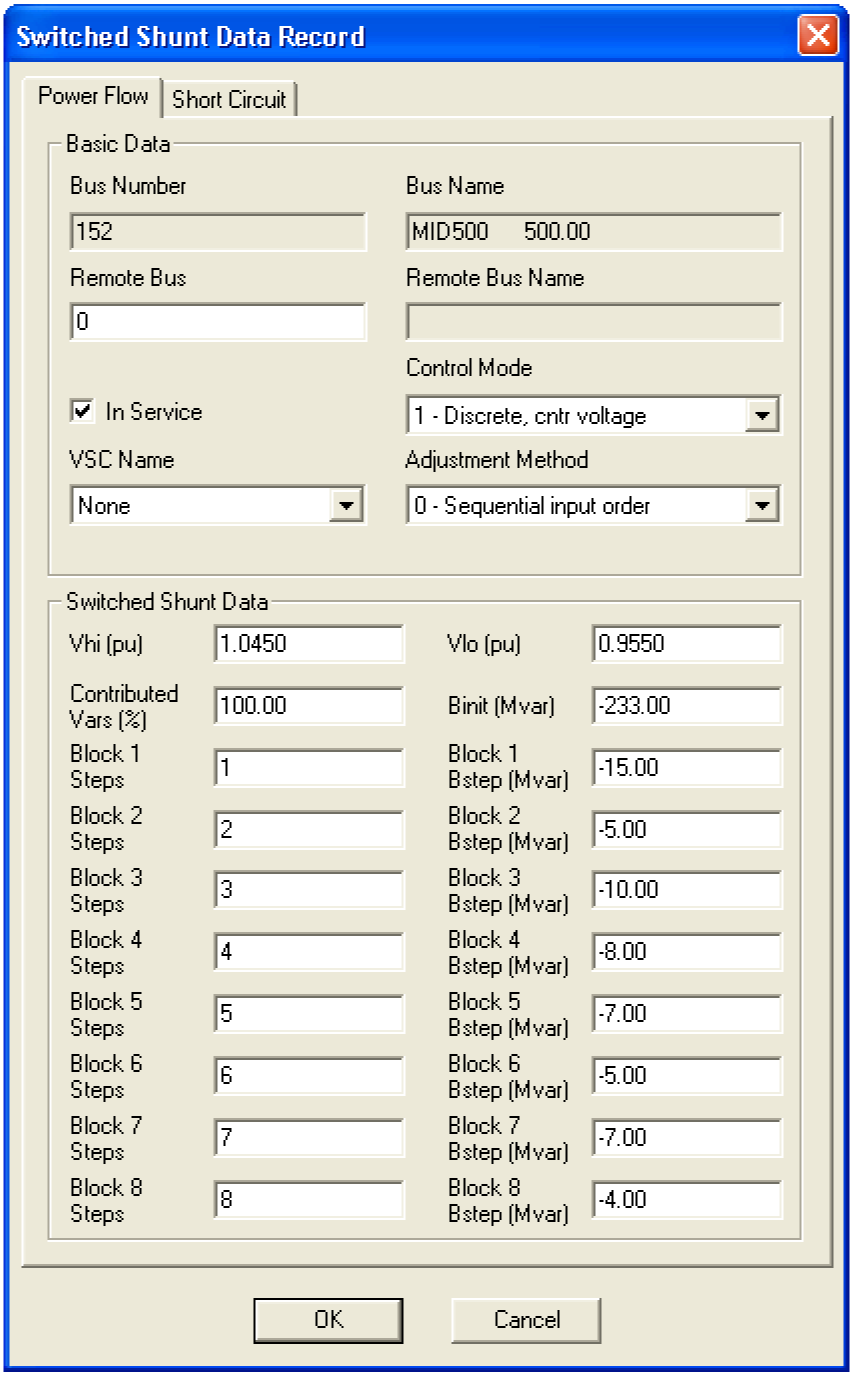


Load Data Record

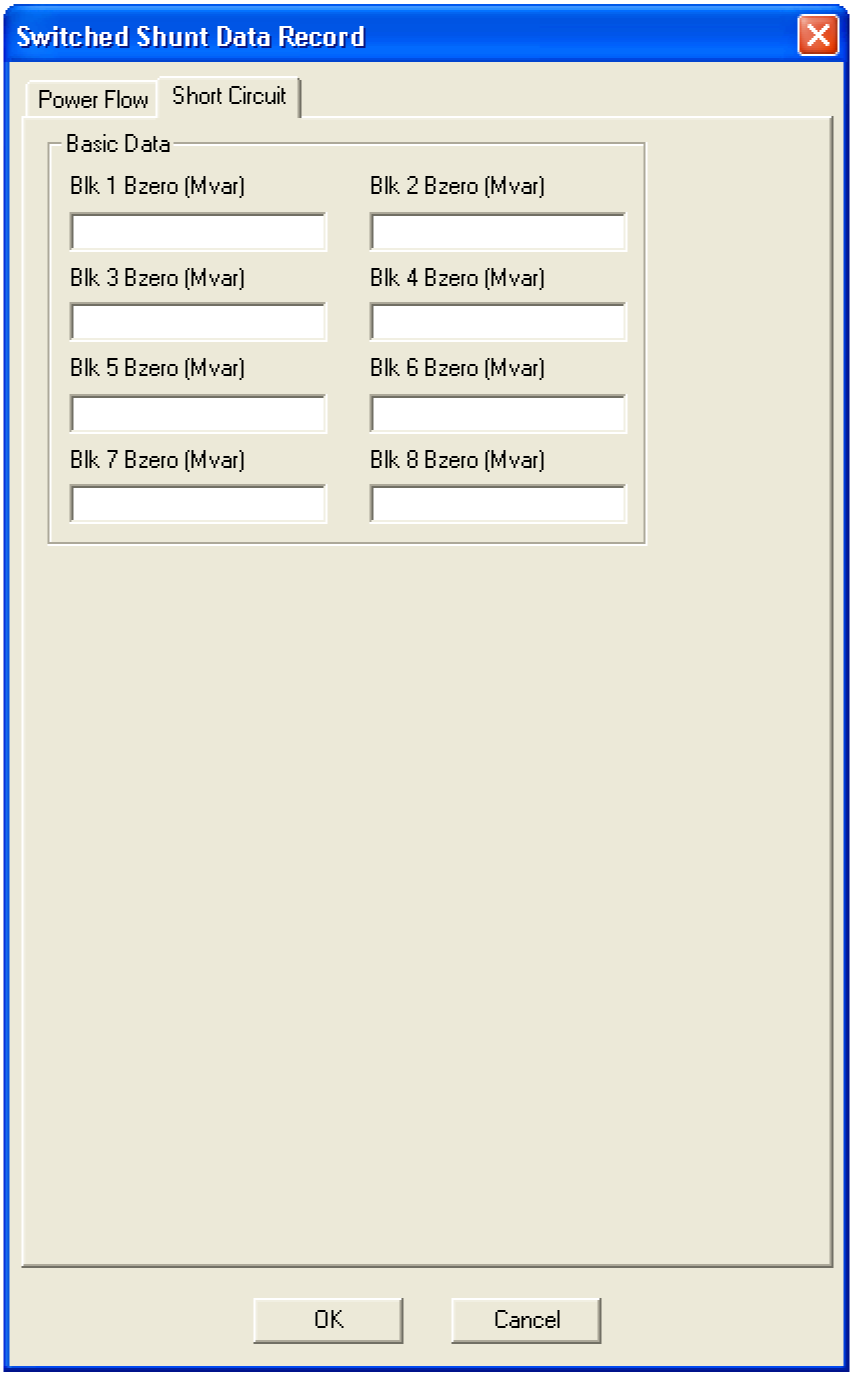




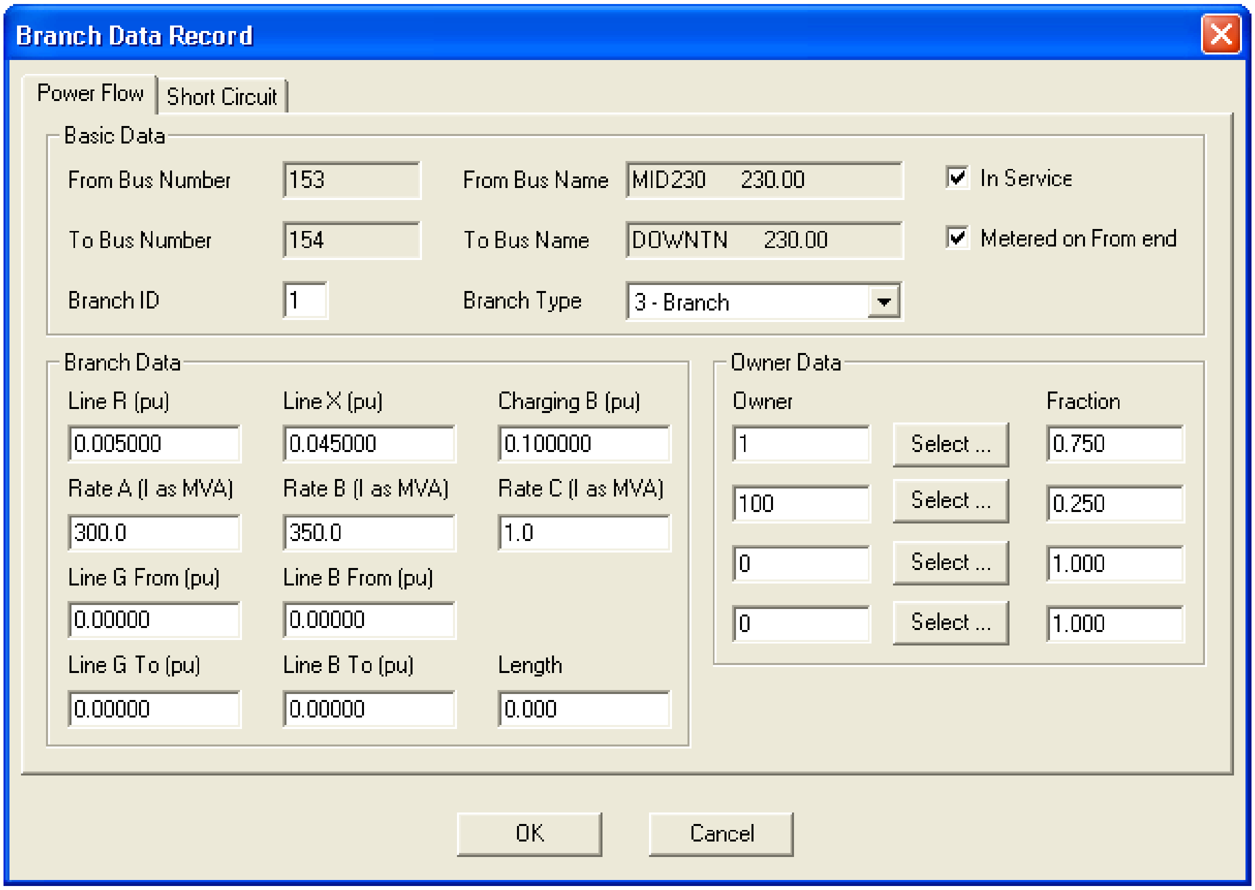
Fixed Shunt Data Records



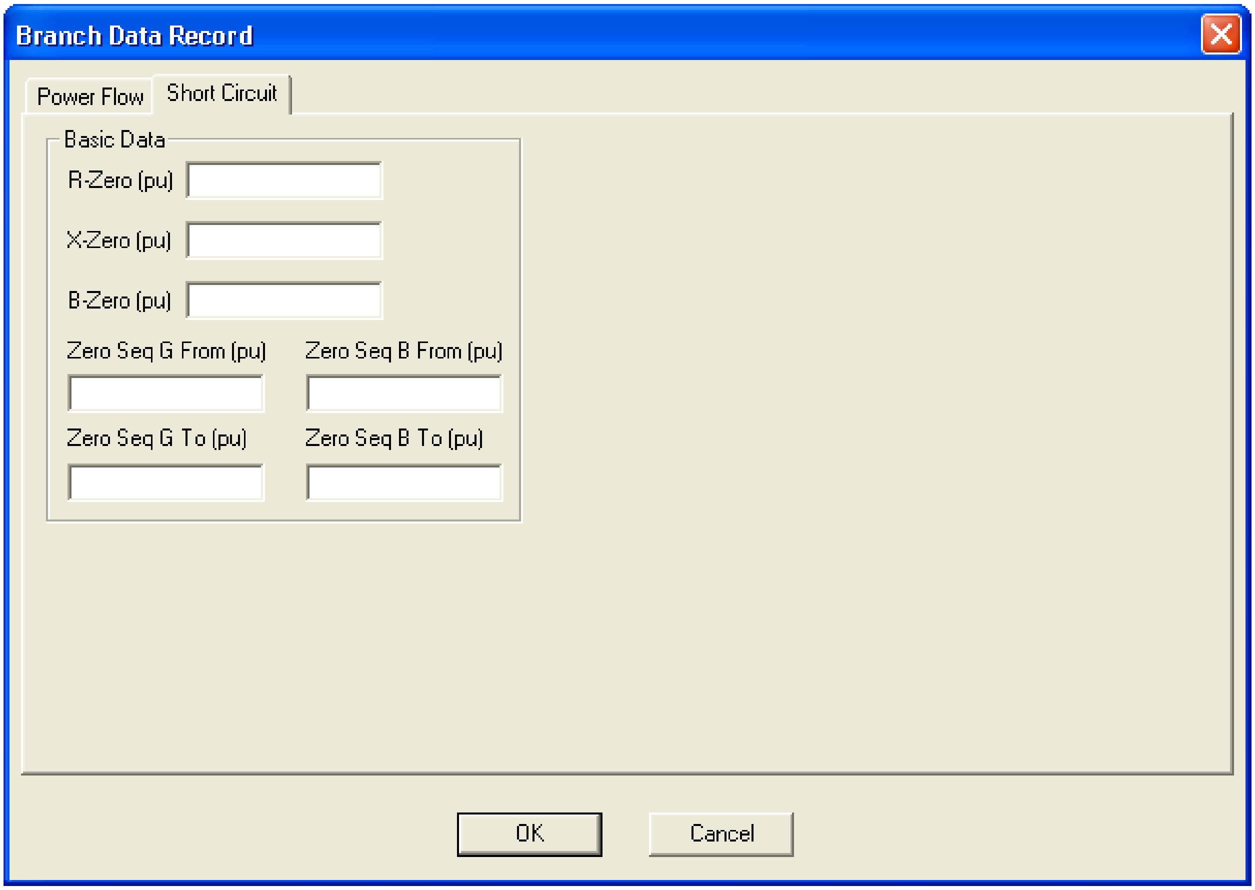
Switched Shunt Data Record, Power Flow



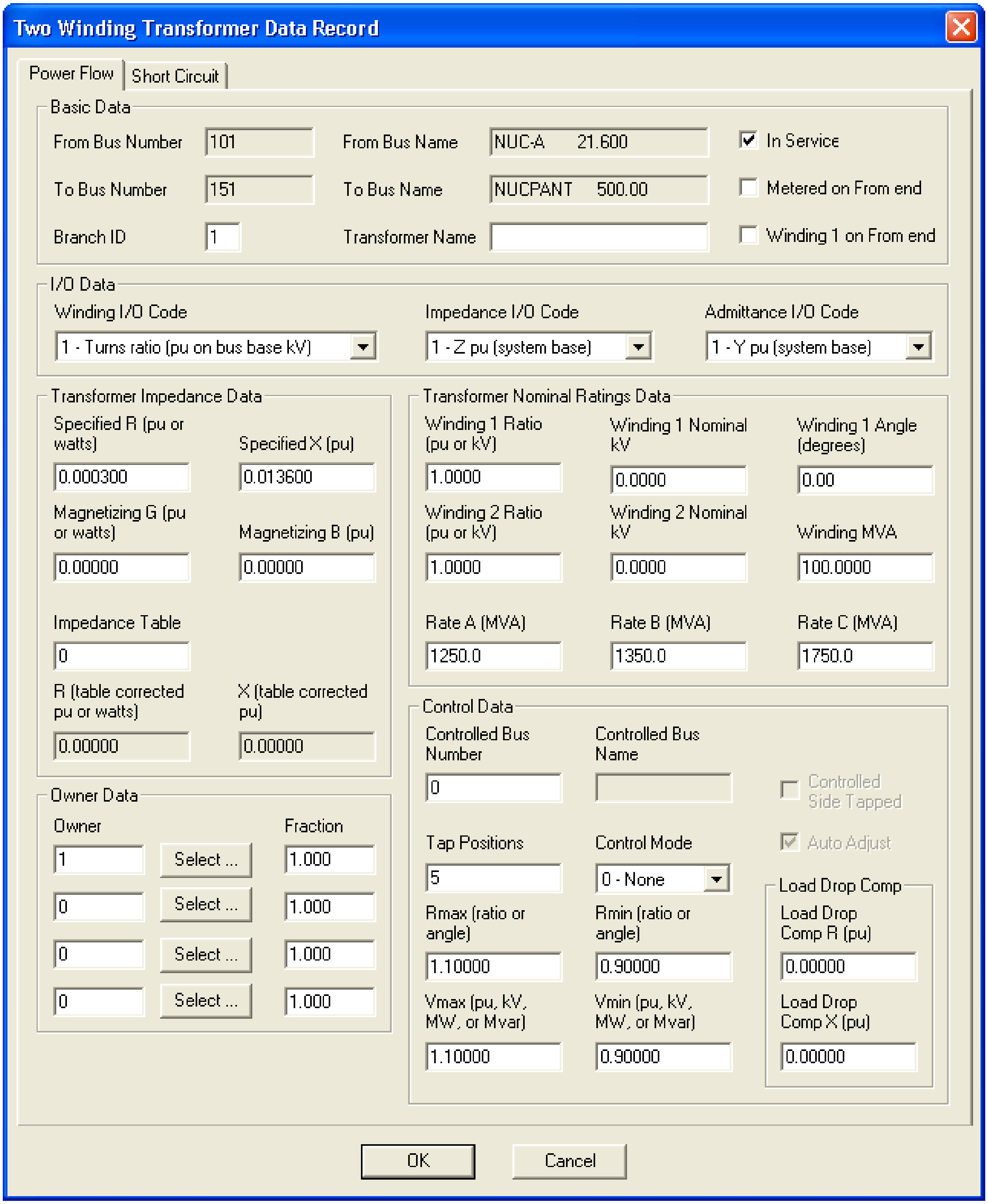
Switched Shunt Data Record, Short Circuit



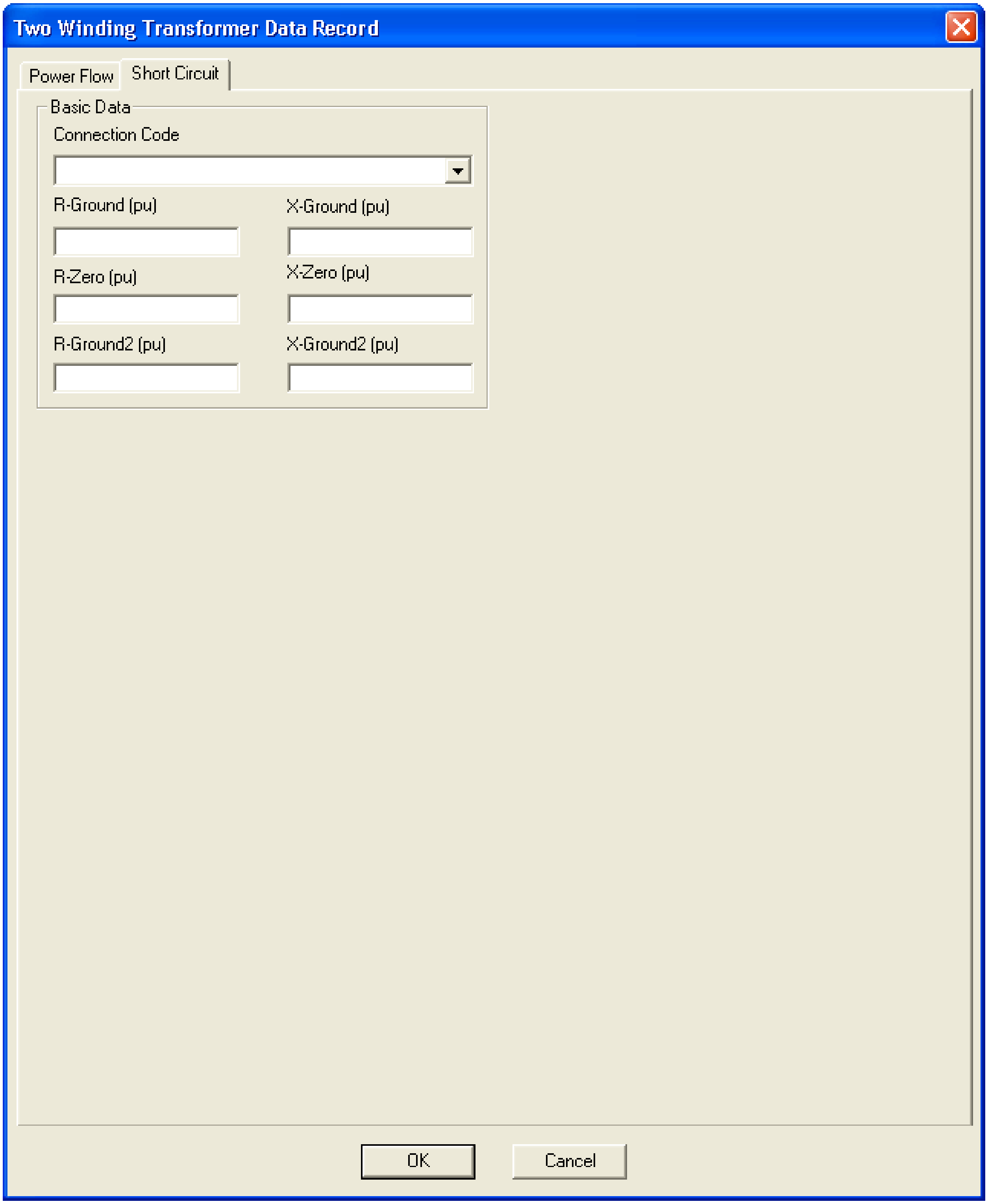
Branch Data Record, Power Flow



Branch Data Record, Short Circuit



Two Winding Transformer Data Record, Power Flow



Two Winding Transformer Data Record,