
ASPEN

OneLiner

Version 10

User's Manual



Advanced Systems for Power Engineering, Inc.

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1.1 ONELINER FEATURES

ASPEN OneLiner is a PC-based short circuit and relay coordination program for relay engineers. *OneLiner* is a productivity tool. It relieves the engineer from the tedious and time-consuming tasks of leafing through stacks of printouts and plotting and re-plotting relay curves and one-line diagrams. *OneLiner* works very quickly under the control of the engineer. The engineer can change the relay settings and network configuration and see the results of the change immediately. The following are some highlights of *OneLiner*:

- **Native Microsoft Windows program with easy-to-use interactive graphics interface under Windows 98, ME, NT, 2000, and XP with built-in PC network support.**
- **Accurate modeling of 2- and 3-winding transformers, phase shifters, lines, switches, series capacitors and reactors, dc lines, generators, loads, shunts and zero-sequence mutual coupling.**
- **Detailed modeling of fuses, reclosers, and overcurrent and distance relays. Comes with extensive relay library that can be edited by the user (See Appendix D).**
- **Built-in short circuit program that simulates all classical fault types (bus faults, and line-end, line-out and intermediate faults), as well as simultaneous faults.**
- **Virtually unlimited system size with modest memory requirement.**
- **Lightning fast solution speed**
- **Advanced analysis tools: boundary equivalence, bus fault summary, voltage sag analysis, fault location, and more.**
- **Graphical display of post-fault solution and relay operating time on the one-line diagram and the phasor diagram (figures 1.1, 1.2 and 1.3).**
- **Automatic checking of overcurrent and distance relay coordination (figure 1.4), plus automatic checking of overcurrent relays' pickup and instantaneous settings.**
- **Automatic plotting of overcurrent and distance relay characteristics on the screen (figures 1.5 and 1.6).**
- **High-quality printed outputs on a large variety of printers and plotters (figures 1.7 and 1.8).**
- **Data importing facilities for short circuit data in ANAFAS, CYME, Electrocon, GE, PTI (PSS/E and PSS/U), Transmission-2000 and other formats.**
- **Data exporting in PTI PSS/E, ANAFAS, and GE data formats.**
- **Exporting of fault data for relay testing in COMTRADE, Doble and other formats.**
- **Built-in scripting language using the BASIC programming language.**

Proven reliability at major utilities in the U.S. and abroad.

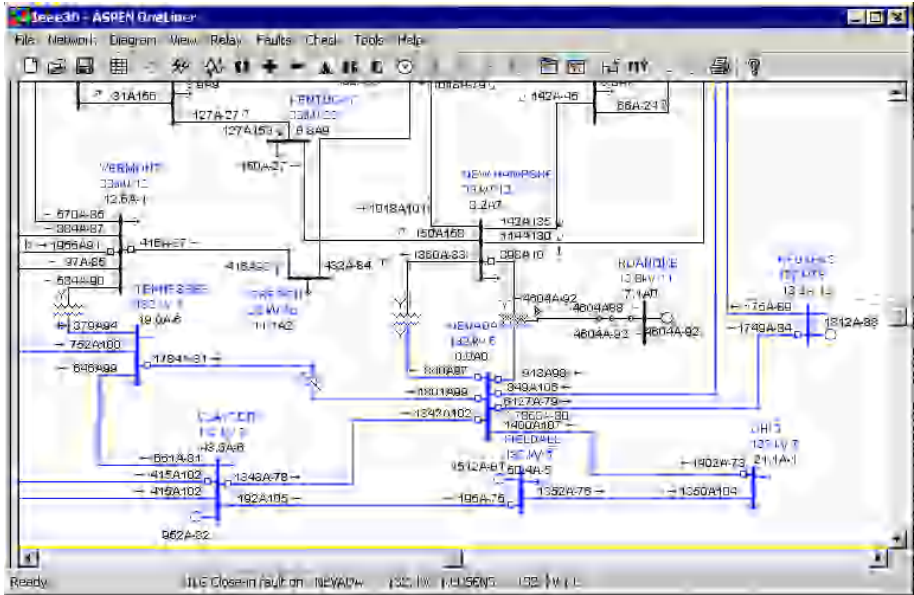


Figure 1.1: *OneLiner* shows the post-fault voltages and currents on the one-line diagram for the fault described in the status bar at the bottom of the window. The branch currents shown in this case are Ia in amps. The phase angles in degrees are shown after the 'A' symbol. The phase-A bus voltages in kV, line-to-ground, are shown under the bus names.

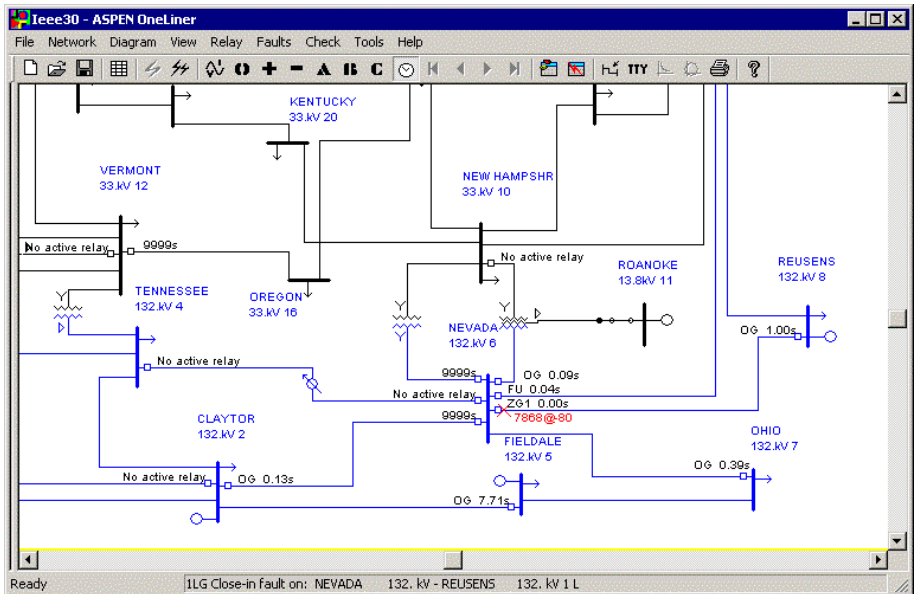


Figure 1.2: *OneLiner* displays the relay operating time for the fault indicated on the status line. The relay operating time is shown next to each relay group. The time in seconds is preceded by OP if it is from an overcurrent phase relay, OG if from an overcurrent ground relay, FU if from a fuse, ZPn if from a distance phase relay (n is the zone number) and ZGn if from a distance ground relay.



Figure 1.3: A “probe” feature allows the user to see readily the voltage and current phasors at any point in the one-line diagram. This picture clearly shows that in this line-to-line fault, the current in phase 'c' leads the quadrature voltage $V_a - V_b$.

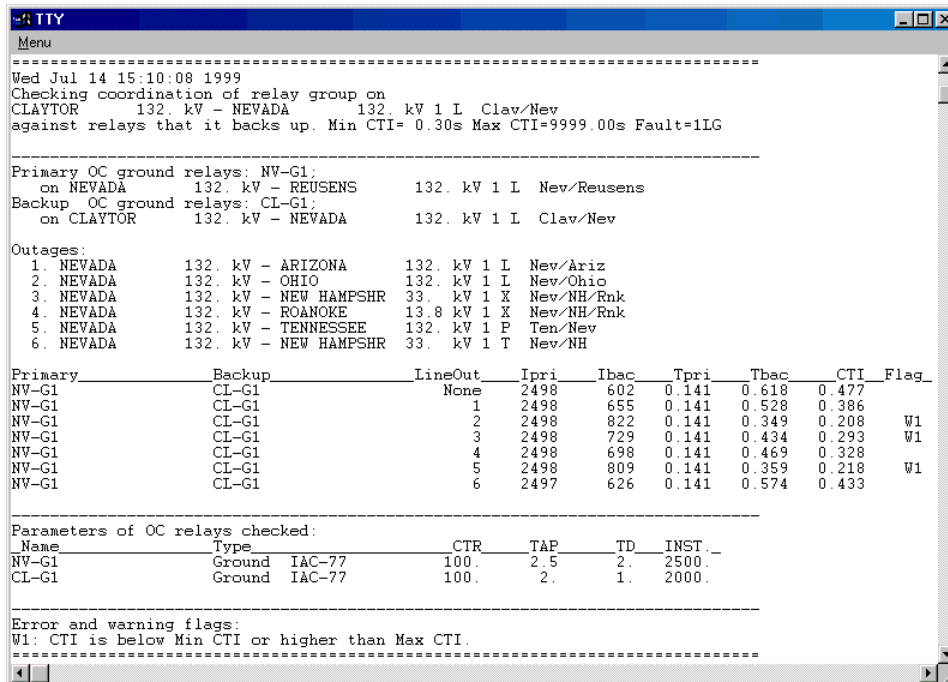


Figure 1.4: The TTY Window shows the results of a relay-coordination checking run. The program flags the cases in which the coordination time interval is outside the range of acceptable values.

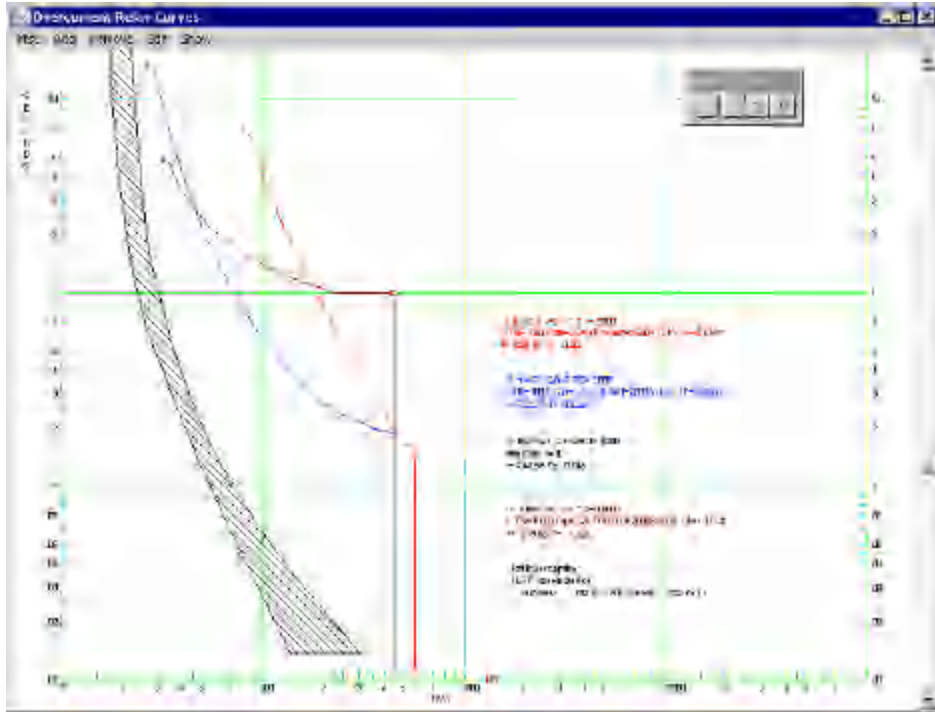


Figure 1.5: OneLiner displays overcurrent characteristics for a fault. The relay current and operating time is shown in text and as points on the relay curves. The user has the option of having the curves shifted automatically or manually. The user can also store a series of curve collections in a binary file for later recalling.

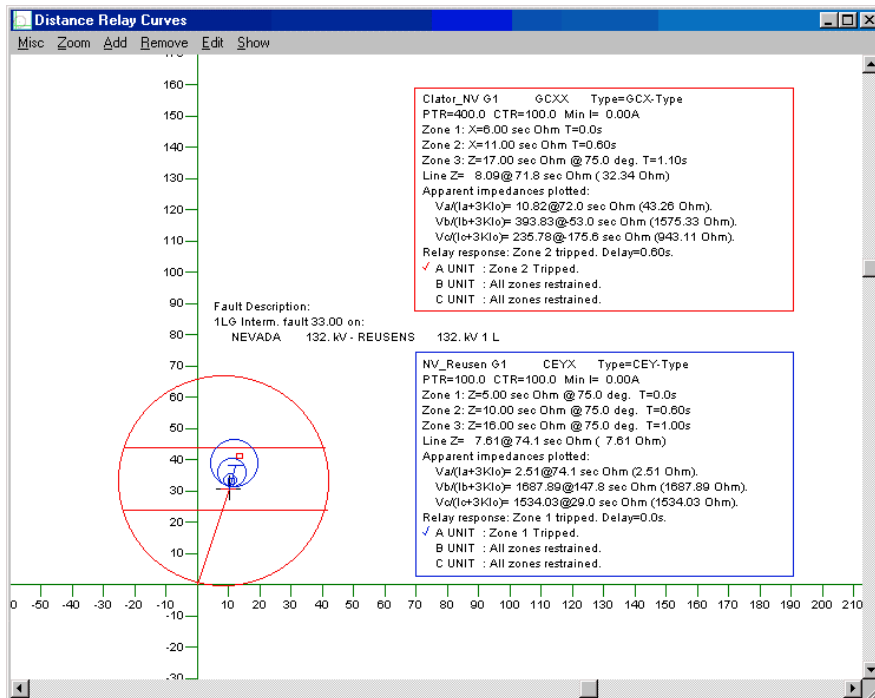


Figure 1.6: OneLiner displays the characteristics of two distance relays on the same graph in primary ohms. The impedance of the transmission line is shown as a slanted line from the origin. The fault impedance V_a/I_a is plotted as a point on the complex plane.

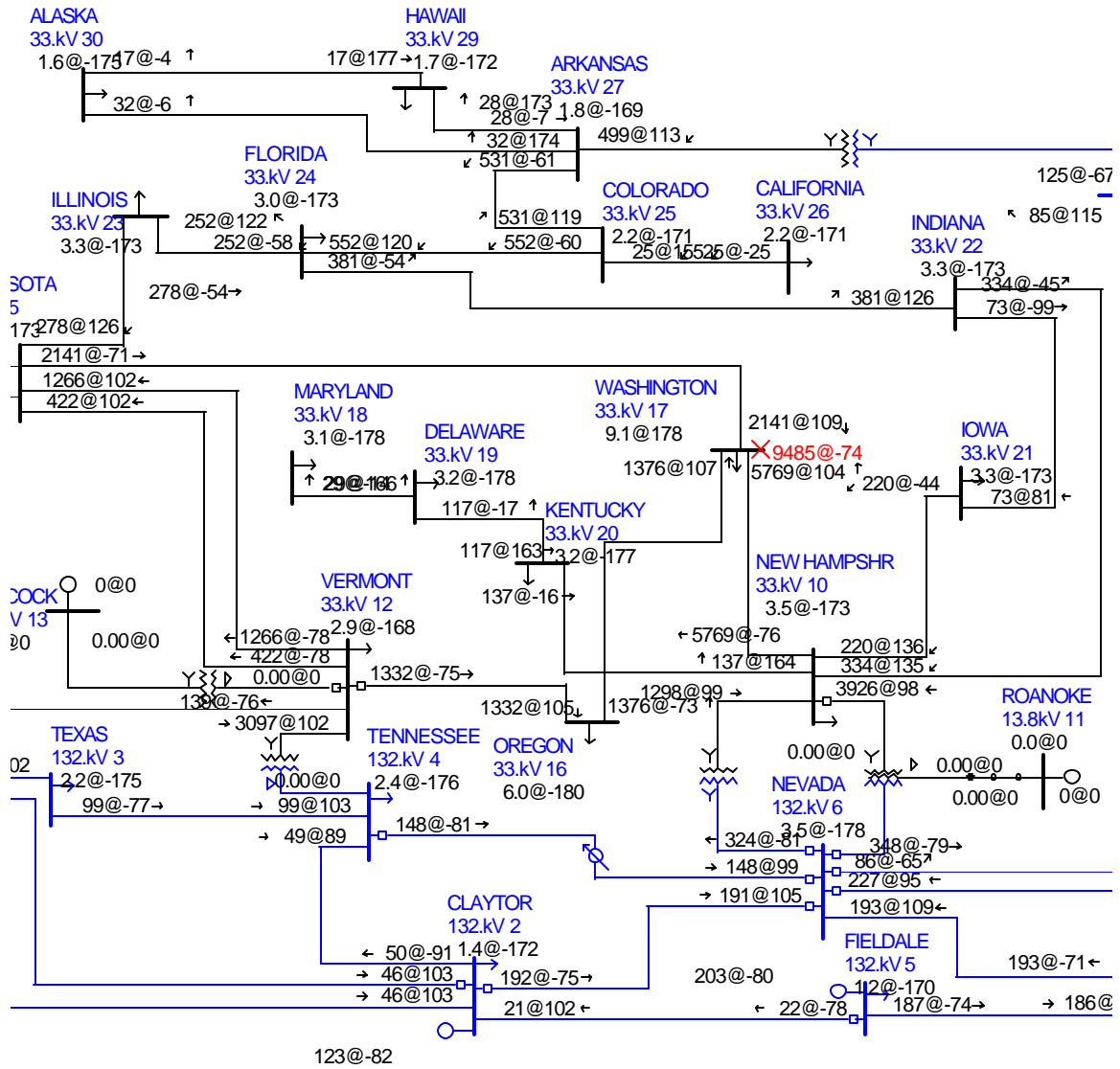


Figure 1.7: An unretouched printed output from *OneLiner* showing the zero-sequence post-fault currents ($3I_0$) and voltages for a single-line-to-ground fault at bus WASHINGTON 33kV (near the center).

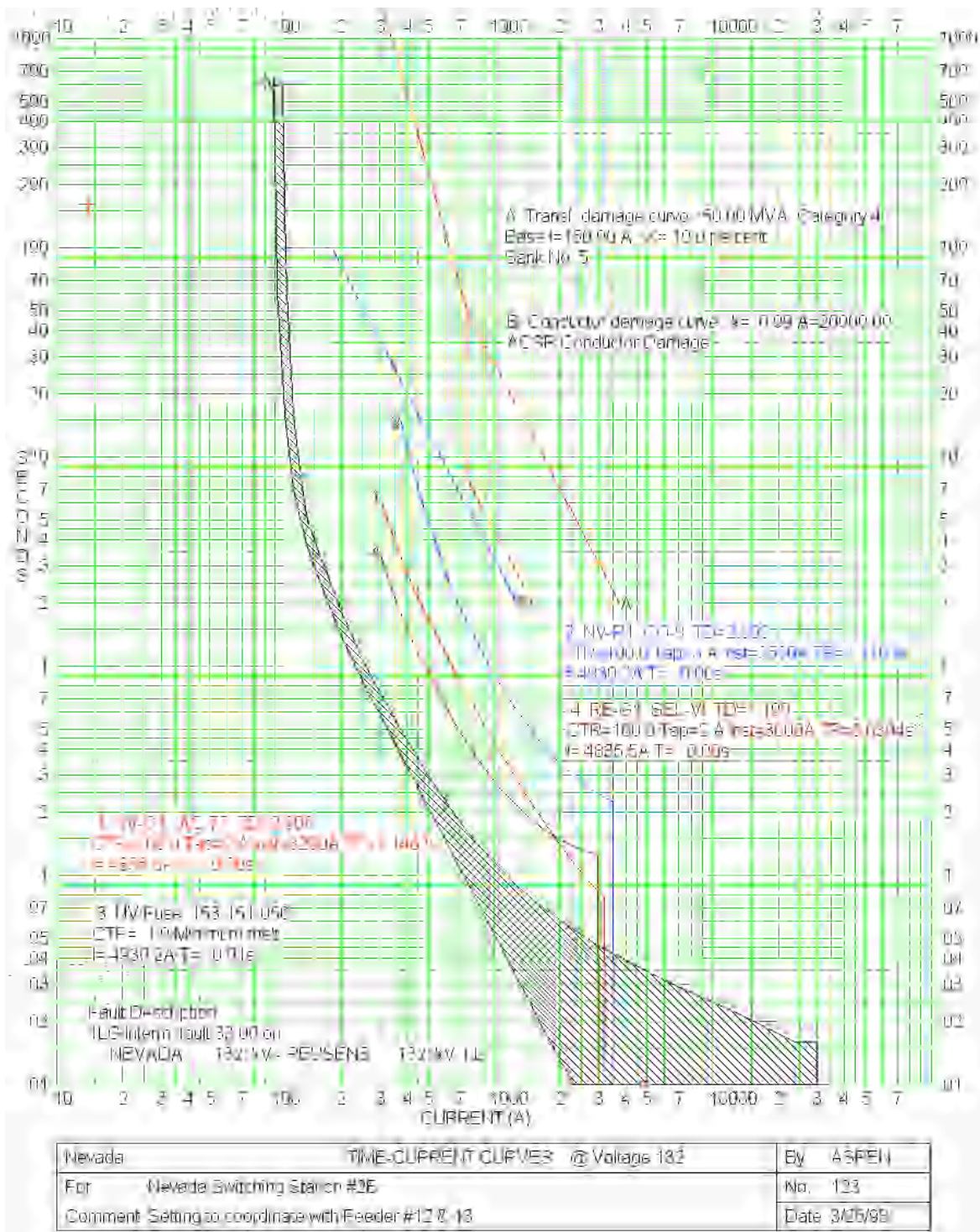


Figure 1.8: An untouched printed output from *OneLiner* showing overcurrent relay curves and damage curves. The relay current and operating time is shown both as points on the curves and as text within the description boxes. The fault description on the left indicates that the voltages and currents were taken from an intermediate fault on a transmission line.

1.2 HARDWARE AND SOFTWARE REQUIREMENTS

Hardware Requirements

OneLiner runs on Intel Pentium-based PCs and compatibles. Other hardware requirements include:

- A 800-by-600 or better color monitor.
- Memory: 256 Mbytes minimum. 512 Mbytes recommended.
- 60 Mbytes of available hard-disk space.
- A 2- or 3-button mouse.
- Any graphics-capable printer or plotter that works under Windows.

Software Requirements

Microsoft Windows 98, ME, NT, 2000, and XP.

1.3 NETWORK SUPPORT

OneLiner lets any PC on a local area network (LAN) execute the program as long as the number of simultaneous executions does not exceed the license limit. The network configuration is a cost-effective way to share the *OneLiner* software among different engineers in the company.

OneLiner supports IPX/SPX, NetBIOS and TCP/IP protocols. It works in LANs and WANs with servers running Windows NT, 2000 or XP, Novell NetWare, and others.

1.4 SYSTEM SIZE LIMITATION

OneLiner can handle power systems with up to about 30,000 buses. The 100-bus version has an artificial limit of 100 buses.

1.5 BATCH SHORT CIRCUIT MODULE

The *Batch Short Circuit Module* works much the same way as a classical short circuit program. It automatically simulates a large number of faults and outputs the results to a text file. It effectively complements *ASPEN OneLiner*, which is designed to simulate faults and relay operations on a case-by-case basis. The *Batch Short Circuit Module* is a valuable tool for users who need text output for a large number of fault simulations. It is also a time saver for engineers who routinely perform breaker-rating studies, or voltage sag analysis for voltage sensitive customers.

The input to the *Batch Short Circuit Module* can be either a text data or a binary data file. The program simulates bus faults, line-end faults and line-out faults with all the classical phase connections: 3-phase, 2-line-to-ground, single-line-to-ground, and line-to-line. The user can apply the selected fault types and phase connections to all the buses in the system or apply them selectively to all buses in an area or a zone, or to all buses whose nominal kV, bus number and bus name are within a certain range.

The program also computes the ANSI X/R ratio, which is an important value for determining the short-circuit duty of circuit breakers. The program can give you a summary of bus faults, line-end faults and line-out faults, plus their ANSI X/R ratios, in a tabular form.

You can use the program to compose a text command file and frequently execute the file later without further user input. The command file specifies the file name, output options and a series of faults to be simulated.

The output of the *Batch Short Circuit Module* is a text file that is identical in format to that generated by the Fault | Solution Report command in *OneLiner*. The output file can be printed on any 132-column printer.

The *Batch Short Circuit Module* is a standard part of *ASPEN OneLiner*.

1.6 BREAKER RATING MODULE

The *Breaker Rating Module* is designed to streamline the otherwise tedious work of checking the rating of circuit breakers against the short circuit currents they need to interrupt. *The Breaker Rating Module* is self-contained: It simulates the faults, computes the ANSI X/R ratios, and compares the fault currents to the rating of the breakers. The output is a text report showing the fault current as a percentage of the rating. The report calls attention to those breakers that are operating at or near their short circuit ratings and therefore warrants closer scrutiny by the protection engineers. Additional information on this module is available in the on-line help file labeled “Breaker Rating Help” in the *OneLiner* folder.

The *Breaker Rating Module* is not a standard part of *OneLiner* and must be purchased separately.

1.7 RELAY DATABASE

The *ASPEN Relay Database* is designed to store the *physical* data of relays and circuit breakers. By *physical* data we mean the actual knob and dip-switch settings of the physical device. This is contrast to the *electrical* data required by *OneLiner* for short circuit simulation. Examples of the physical data of a relay include the characteristic angle and zone impedances.

The *ASPEN Relay Database* is ideal for keeping settings and maintenance records of relays and breakers, but it is not necessary to run *OneLiner*. For this reason, the *Relay Database* is not a standard part of *OneLiner* and must be purchased separately.

If you have *OneLiner* and the *Relay Database* installed on the same computer, you can enable direct transfer of relay and breaker data from the *Relay Database* to *OneLiner*. In future version of *OneLiner* this link will work in both directions.

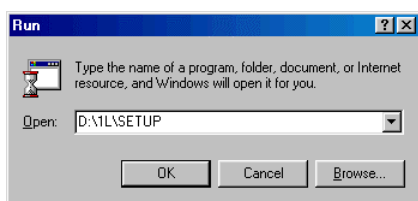
Several versions of the *ASPEN Relay Database* are available, including an Unlimited Version that utilizes MS Access tables and two Client/Server versions that utilize MS Sql Server and Oracle engines.

SECTION 2 INSTALLATION AND TUTORIAL

2.1 INSTALLING THE WORKING MODEL

The installation of the Working Model will only take a few minutes.

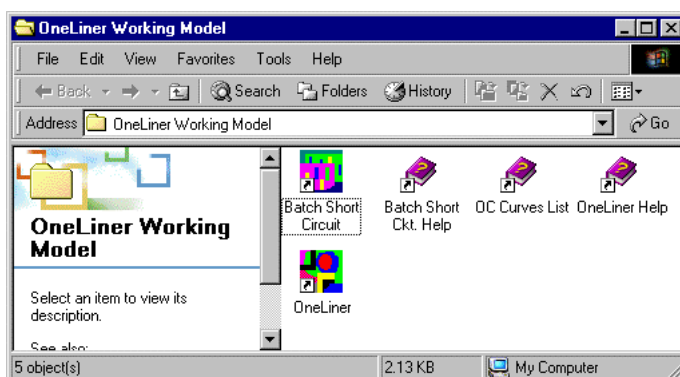
1. **Insert the Working Model CD into your CD-ROM drive.**
2. **Click on Start, then on Run. A dialog box will appear.**



3. **In the edit box labeled Command Line type D:\1L\SETUP.** (We assume your CD driver is d:). **Click on OK.** The installation program will start.

Follow the instructions on the screen. The working model requires about 6 Mbytes of free space. The default directory is C:\ASPENWM1

When the setup program finishes, you will see a Windows program group called "OneLiner Working Model". When you open it, it should look something like this:



4. **Proceed to Section 2.2 to start the working model.**

Note: When you are done with the working model, you can uninstall it using the Add/Remove Program icon within the Control Panel.

2.2 STARTING THE WORKING MODEL

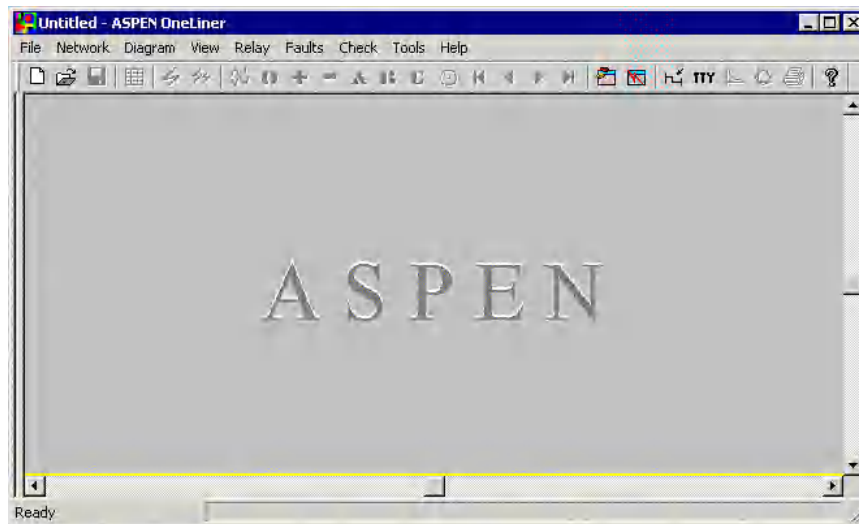
Start Up the Working Model:

1. **On the Windows desktop, look for a program group called *OneLiner Working Model*. Double click on the *OneLiner* icon to start the program.**

The first time you start the Working Model a dialog box will appear asking for a name and a numeric key.

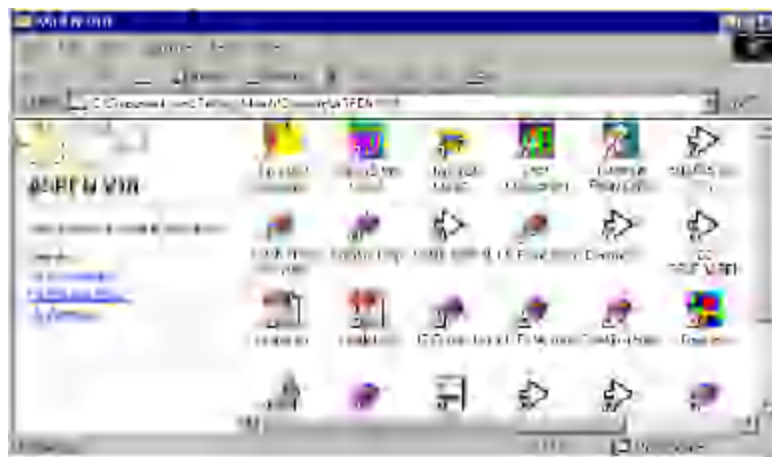
Consult the printed Working Model Manual for the Name and Key that you need to enter, and press OK.

The Main Window will appear when the program starts up.



2.3 INSTALLING THE PRODUCTION VERSION

The instructions to install the Production version are in a separate document entitled, *Getting Started with ASPEN OneLiner & Power Flow V10*. When you have finished installing the program, you will see a folder labeled "ASPEN V10" on your Windows desktop. The contents of this folder look like this:

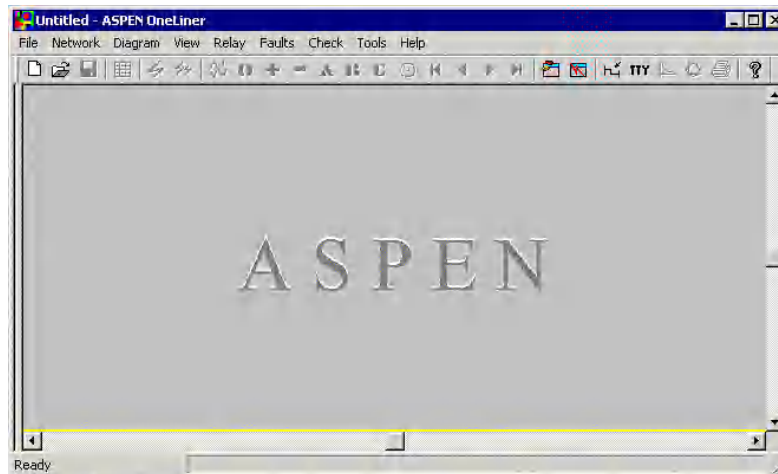


2.4 STARTING THE PRODUCTION VERSION

START UP ONELINER:

1. On the Windows desktop, look for a program group called ASPEN V10. Double click on the OneLiner icon to start the program.

You will see the Main Window when the program starts up.



2. Enlarge the window by clicking the mouse once on the maximize box at the upper-right corner.

The Main Window will take up the entire screen and be ready for your commands.

2.5 FILES

This section describes all the input and output files of *ASPEN OneLiner*. The input data files are these:

- **Binary data files with .OLR extension.** These are binary files that contain the system parameters as well as graphical and relay information. You can read in an OLR file with the File | Open Binary Data File command.
- **Text data files with .DXT extension.** These are text files that contain the network data. Most commonly, text data files came from one of the many data conversion programs. Text data files can be imported into the program with the File | Open Text Data File command in the Main Window and saved as *OneLiner* binary data files. *OneLiner* can also add the contents of a text data file to an existing binary data file with the File | Add Network command in the Main Window. The text data file format is described in Section 5.
- **Relay data files with .RAT extension.** These are text files with relay data created by the Relay | Export Relay command in the Main Window. Relay data files can be imported into *OneLiner* using the Relay | Import Relay command. The relay data format is described in Section 7.
- **Change files with .CHF or .ANA extension.** This is one of the outputs of the *ASPEN Case Comparison Program* when you compare two data files. Change file contains commands that will make the network and relay data of one of the files to be the same as the other. The .CHF change file format is very similar to that described in Sections 5 and 7. The .ANA change file is compatible with ANAFAS software, which is used widely in many Brazilian utilities. See Appendix F for more information on the *Case Comparison Program*.
- **Overcurrent Relay libraries *.RLY.** *OneLiner* reads these relay libraries to get the curve parameters for overcurrent relays and fuses. You can use *Overcurrent Relay Editor* to edit the existing curves, create new curves, and to copy curves from other relay libraries. The full path name of the relay library folder used by

OneLiner is stored in the Window registry under "LibraryPath=" entry in the [OneLiner] section. You can specify the location of the Overcurrent Relay Library Directory by running the *OneLiner/Power Flow Configuration Program*, CFGILEXE.

NOTE: *The curves in the relay libraries were created by users of OneLiner. ASPEN collects the relay curves periodically and distributes them to all the users. The correctness of the relay curves has not been verified by ASPEN. It is important for users to check these curves against the manufacturers' specifications before applying them.*

- **Distance Relay Library ASPEN.DRL (or other names you specified).** *OneLiner* reads this library to get the type names, the method name and parameter list for distance relays. You can use the *Distance Relay Editor* to edit the existing relay types and to create new types. The full path name of the distance relay library referenced by *OneLiner* is stored in the Window registry under "DSLlibrary=" entry in the [OneLiner] section. You can specify the name and location of the default relay library by running the *OneLiner/Power Flow Configuration Program*, CFGILEXE.

Note: *It is important for users to check the distance relay models against the manufacturers' specifications before applying them.*

- **Previous Curve Collection Files with .PCC extension.** These are binary files created by *OneLiner* within the Curve Collection dialog box. When you recall a previous curve collection, the program displays the curves, descriptions and annotation in the exact position as before.
- **Lines Table Files with .LTB extension.** These are text files containing electrical parameters of various types of lines and cables. The program reads this file when it begins execution. The full path name of the line table file used by *OneLiner* is stored in the Window registry under "LineTable=" entry in the [OneLiner] section. You can specify the name and location of the default line table file by running the *OneLiner/Power Flow Configuration Program*.
- **PowerScript files with .BAS extension.** These are text files containing programs written in the Basic programming language. You can create a script file with the Script Editor in *OneLiner* or with any text editor.

OneLiner generates the following files:

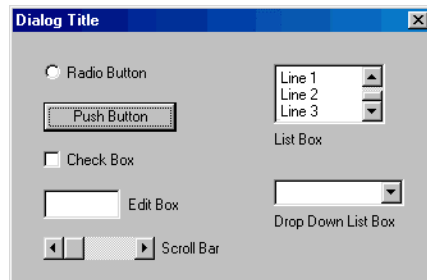
- **Log file ASPEN.LOG.** These are text files that contain a list of errors when you:
 1. Import a text data file with the File | Open Text File command in the Main Window,
 2. Execute changes in a change file with the File | Read Change File command in the Main Window.
- **Output files with .OUT extension.** These are text files that contain the short circuit solutions in the traditional text form. The output files are generated when you invoke the Faults | Solution Report command of the Main Window. The description of the output file is given in Section 8.
- **Report files with .REP extension.** These are text files that contain a report of the network or relay data in the traditional text form. The report files are generated when you invoke the following commands:
 1. The Network | Report command in the Main Window,
 2. The Relay | Report command in the Main Window,
 3. The Menu | Save Selected Text command in the TTY Window.
- **Temporary files with .TMP extension and names that begin with ~1L.** While it is running, *OneLiner* creates a temporary file in the root directory or in the temporary directory (usually c:\windows\temp). *OneLiner* deletes the temporary files automatically at the end of each session. In the event the program bombs out before the end of a session, the temporary files will be left behind on the disk. If you see any of the temporary files on the directory when *OneLiner* is not running, you can reclaim the disk space by deleting them. DO NOT delete these files while *OneLiner* is running.
- **Text Data Files with .DXT extension.** Text data files contain system parameters but no graphical or relay information. You can generate a text data file with the File | Export Network command.

- **Relay data files with .RAT extension.** These are text files that contain the relay data. Relay data files can be exported using the File | Export Relay command. The relay data format is described in Section 7.
- **Previous Curve Collection Files with .PCC extension.** These are binary files created by *OneLiner* within Curve Collection dialog box. This file stores a series of overcurrent relay collections for later recalling.
- **Backup files with .BAK extension.** When you update an existing binary data file using the File | Save or File | Save As commands, *OneLiner* saves the original data file under the .BAK extension. This file serves as a backup in case you want to revert back to the original file.
- **Windows metafiles with .WMF extension.** When you execute the File | Export One-Line Diagram command, *OneLiner* creates a Window Metafile or Enhanced Window Metafile with extensions .WMF or .EMF that corresponds to the current state of the one-line diagram. The metafiles are vector-graphic files that can be imported to other Windows programs, such as Word and AutoCAD.

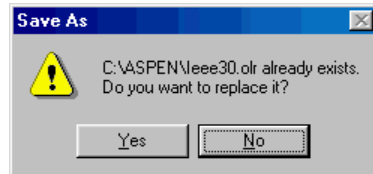
2.6 TERMS AND DEFINITIONS

You need to be familiar with a few basic terms that are used throughout this manual.

- Click:** Quickly press and release the mouse button.
- Drag:** Hold down the mouse button while moving the mouse.
- Double click:** Click the mouse button twice in rapid succession.
- Dialog box:** A pop-up window used for various purposes. The picture below illustrates several common components of a dialog box.



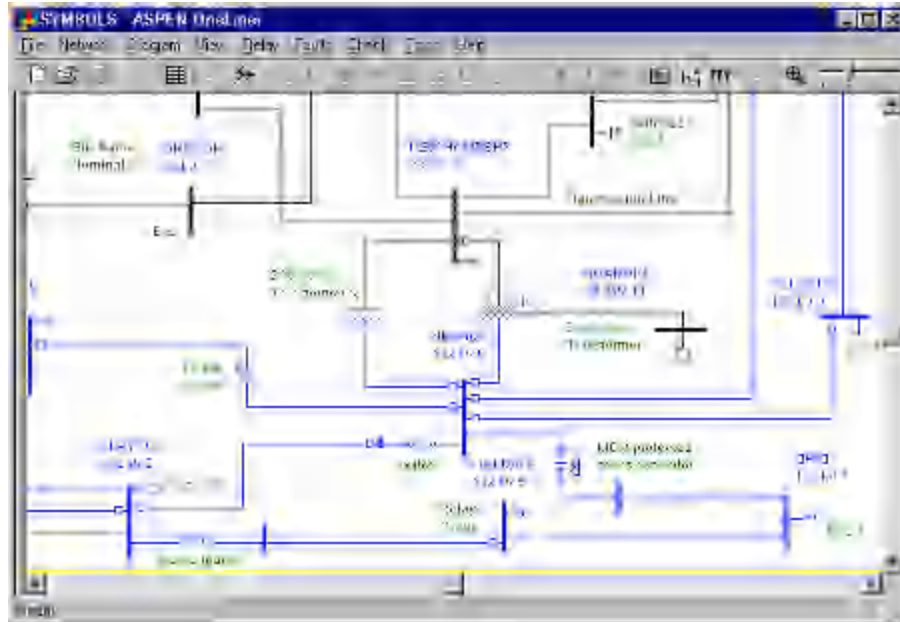
- Message box:** A simple dialog box that contains a message.



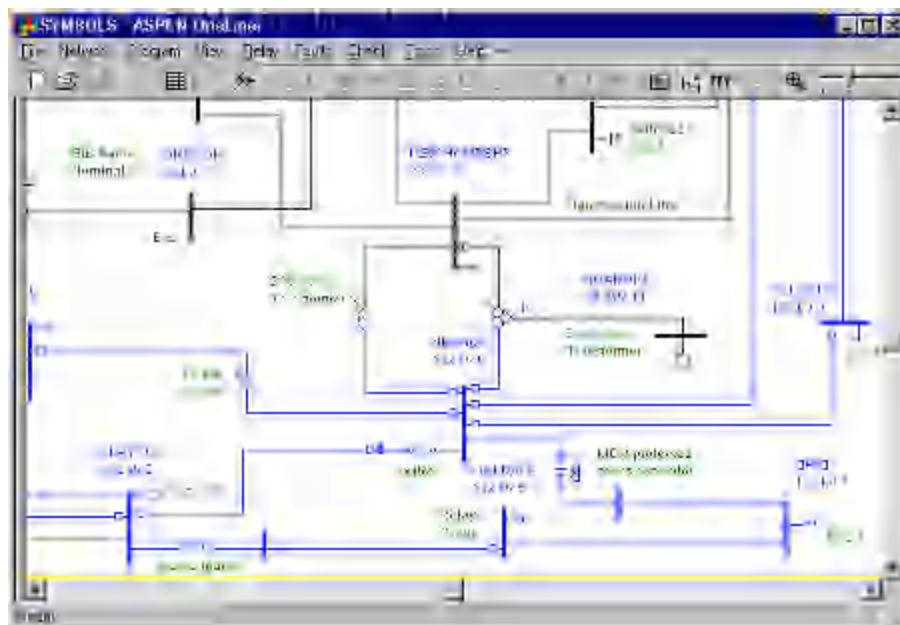
2.7 ONE-LINE SYMBOLS

The one-line diagram symbols are labeled in the figures below. The program uses the American transformer symbol by default (top figure). If you prefer the European symbol (bottom figure), you can easily change it by (1) selecting the Options command from the Diagram menu and then (2) selecting 'European' in the Transformer Symbol group box and clicking on "OK".

WITH AMERICAN TRANSFORMER SYMBOLS



WITH EUROPEAN TRANSFORMER SYMBOLS



2.8 ONELINER QUICK TUTORIAL

This tutorial is designed to acquaint new users with the basic functions of *OneLiner*. We assume you have installed *OneLiner* (Section 2.1 or 2.3) and started the program (Section 2.2 or 2.4). If not, do so now. This tutorial will take about an hour to complete.

OPENING A BINARY DATA FILE

A 30-bus system is used in most of this tutorial. You will now open its binary data file.

1. **Select the File | Open Binary Data File command.**

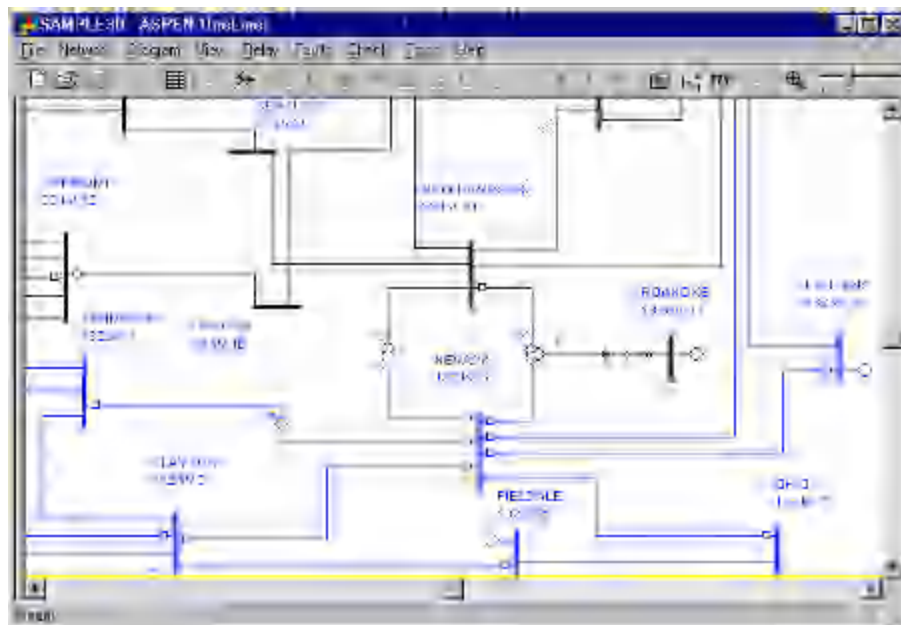
Note: To select this command you first click the left mouse button on 'File' to open its pull down menu. Then click the left mouse button on 'Open Binary Data File'.

A dialog box will appear asking you for the name of the binary data file that you want to open.

2. **Open the file SAMPLE30.OLR as follows.**

Click once on the file name 'SAMPLE30.OLR' in the list box. The name will appear in the File Name edit box. **Click on the "Open" button.**

The dialog box will disappear. After a short time the one-line diagram of the 30-bus system will appear in the Main Window.



Note: See Section 2.7 if you are unsure of the meanings of the various symbols.

MOVING SYMBOLS ON THE ONE-LINE DIAGRAM

You can manipulate the symbols on the one-line diagram by dragging them with the mouse. You never have to type in x-y coordinates. Try it now!

Note: “Dragging” means to first click the left mouse button on the symbol you want to move and then move the mouse while you continue to hold down the mouse button. When you release the mouse button, the move will be completed.

- 1. Move a transmission line, transformer, or phase shifter by dragging the symbol.**

The horizontal segments can be moved vertically and vertical segments can be moved horizontally. Segments attached to a bus are constrained by the extent of the bus symbol.

- 2. Move a bus by dragging the bus symbol.**

The bus symbol can be moved anywhere. The bus name and all the equipment attached to the bus will automatically move with the bus symbol.

- 3. Move a bus name by dragging the name.**

The bus name will be replaced by a rectangle while it is being moved. The bus name can only be moved within a certain distance of the bus symbol.

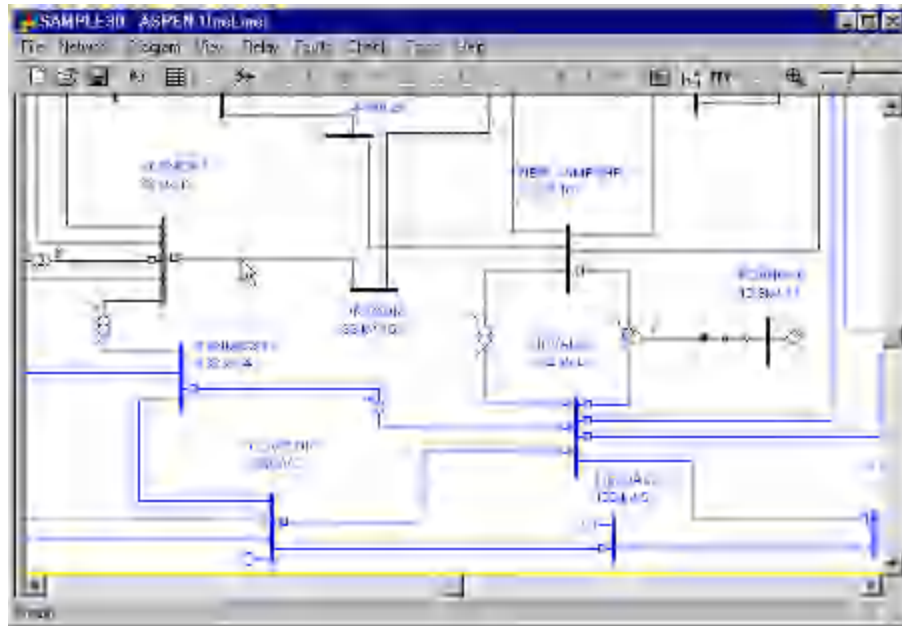
- 4. Move a generator, load, or shunt by dragging the symbol.**

The symbol can be moved to either side of the bus symbol.

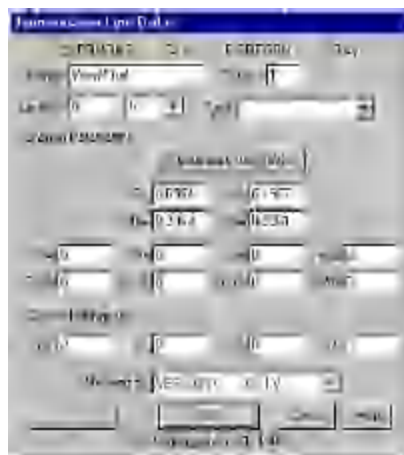
REVIEWING AND EDITING EQUIPMENT PARAMETERS

You can review and edit the parameters of any piece of equipment by pointing and clicking with the mouse. The procedure below is for a transmission line. The same procedure can be used to review and edit other types of equipment, except for relays (which will be covered next).

1. Double click the **LEFT** mouse button on the transmission line between VERMONT 33 kV and OREGON 33 kV as indicated by the arrow cursor.



The line symbol will turn dotted red. A dialog box for this line will appear.



2. Edit the transmission line parameters.

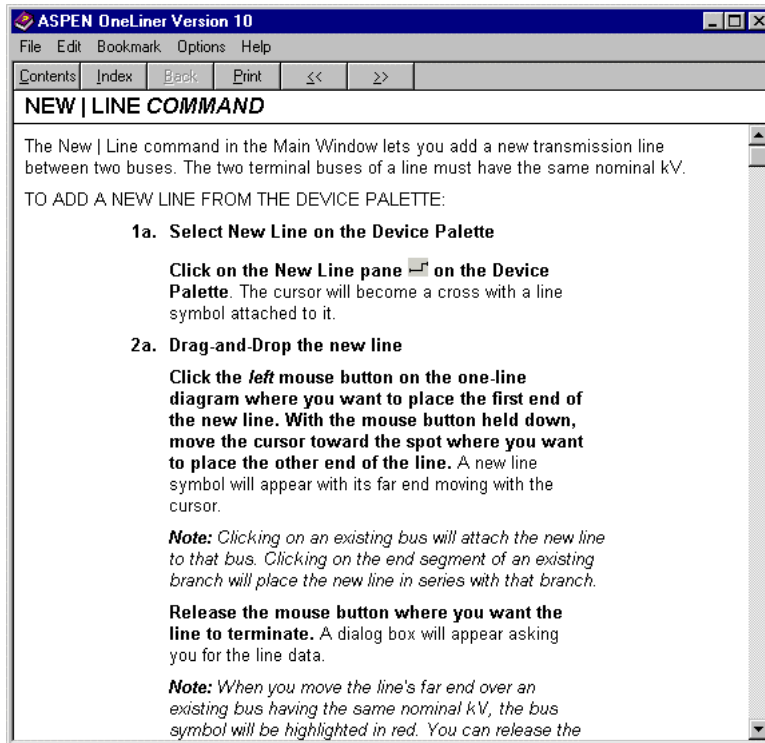
The text cursor (a blinking vertical bar) will initially be in a box labeled Name.

Move the text cursor to the edit box labeled “X=” with the <Tab> key.

Type “0.03” to change the positive-sequence reactance to 0.03.

3. Click on the "Help" button at the lower right corner.

The on-line help window will appear. The help topic is set automatically for this dialog box.



4. Select the File | Exit command to close the on-line help window.

The on-line help window will disappear.

5. Click on the "OK" button to close the line dialog box.

The dialog box will disappear.

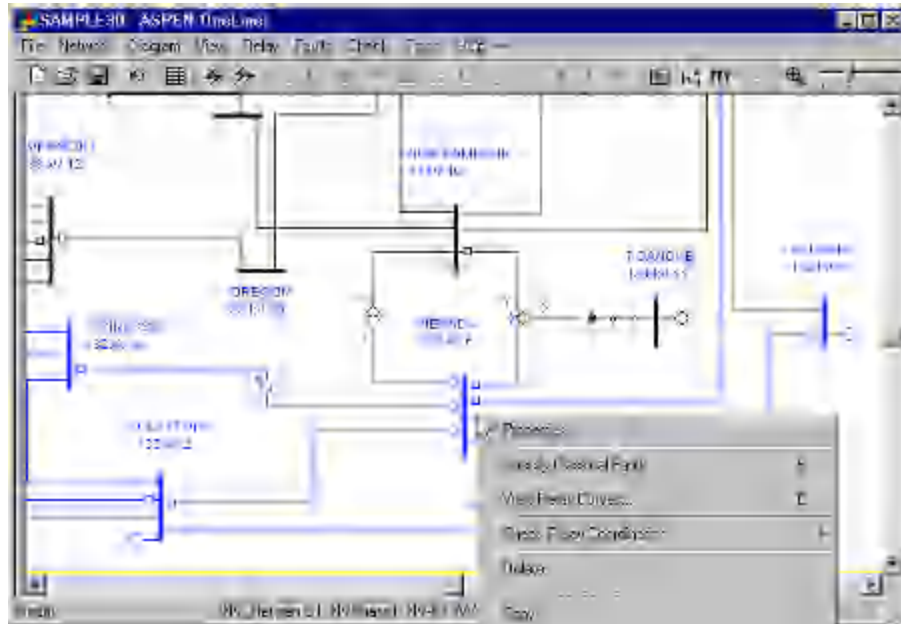
REVIEWING AND EDITING RELAY PARAMETERS

You can model both distance and overcurrent relays in *OneLiner*. The relays are stored in an object called the relay group. The symbol for a relay group is a small rectangle that looks like the traditional circuit breaker symbol. Relay groups are placed on terminal of branches that are protected by relays.

You can review and edit the parameters of any relay by pointing and clicking with the mouse.

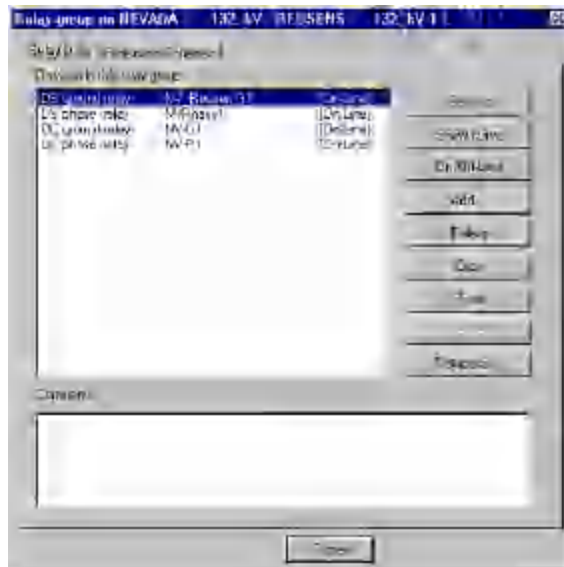
1. Click the *right* mouse button on the third relay group on the right hand side of the bus labeled NEVADA as indicated by the arrow cursor.

The relay group symbol will turn dotted red, and a floating menu will appear. Repeat this step if the bus or the entire line turns dotted red.



2. Click on the *Properties* command.

The following relay-group dialog box will appear. The list box near the top lists all the relays and fuses that are in this relay group.



3. Click on the overcurrent relay labeled 'OC ground relay NV-G1' in the list box and click on the "Get Info" button.

Note: OC stands for overcurrent and DS stands for distance.

A dialog box with the parameters of this overcurrent ground relay will appear.



The relay parameters are explained in Section 6.2, 'Overcurrent Ground Relays' in the On-Line Help.

4. Click on the "Cancel" button to close the dialog box.
The relay parameters dialog box will disappear.
5. Have a look at the dialog box for a distance relay by repeating steps 3 and 4 for the distance relay labeled 'DS ground relay NV_Reusen G1'.
6. Click on the "Done" button to close the Relay Group dialog box.

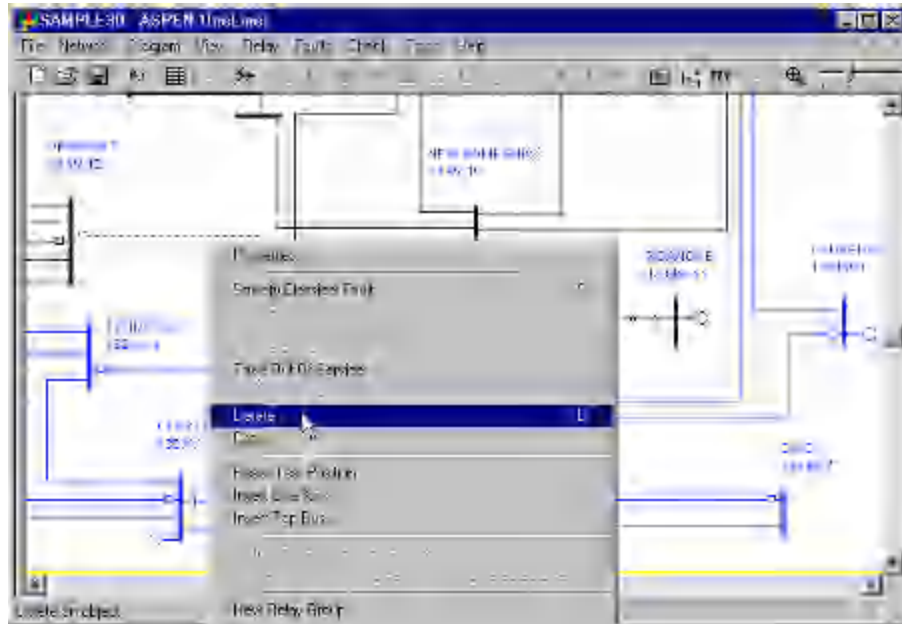
DELETING AND RESTORING EQUIPMENT

You can delete any piece of equipment by pointing and clicking with the mouse. The equipment you deleted is kept in a buffer until the end of the session. You may restore any deleted equipment later if you choose to do so. The procedure below is for a transmission line. Similar procedure works for other types of equipment.

DELETING A TRANSMISSION LINE:

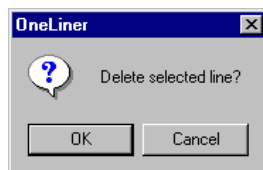
1. Click the *right* mouse button on the transmission line between Vermont 33.0 kV and Oregon 33.0 kV.

The line symbol will become dotted red, and a floating menu will appear. Repeat this step if the line does not turn dotted red.



2. Click on the Delete command.

A message box will appear asking you to confirm the deletion.



3. Click on the "OK" button in the message box.

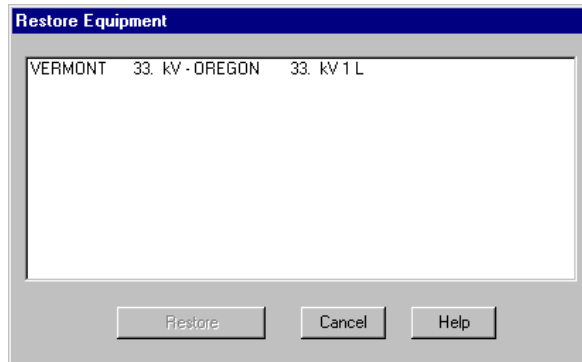
The selected transmission line will disappear from the one-line diagram. *OneLiner* will automatically update the system model.

RESTORING A DELETED TRANSMISSION LINE:

1. **Select the Network | Restore | Branch command.**

Note: To select this command you (1) click the left mouse button on 'Network' to open its pull down menu, (2) click the left mouse button on 'Restore' to open its second level menu, and (3) click the left mouse button on 'Branch'.

A dialog box will appear. The list box will display in alphabetical order all of the branches that can be restored. In this case, there is only the one line you just deleted.



2. **Click on the line identifier in the list box.**

The line identifier will become highlighted.

3. **Click on the "Restore" button.**

The line you deleted will reappear on the one-line diagram. *OneLiner* will update the system model automatically.

Note: The "Take Out of Service" and "Put In Service" commands are very similar to the "Delete" and "Restore" commands, except that out-of-service equipment remains visible on the screen (in dotted black line) and is kept in the data file when you save the file.

Note: You can also use the Tools | Undo command to restore deleted equipment. However, the "Undo" command works only for the last eight commands you executed.

ADDING EQUIPMENT

You can add new equipment to the system by selecting the equipment type from the device palette and dropping a new device on the diagram. You will learn in the following how to create new buses and lines. Similar procedures apply to other types of equipment.

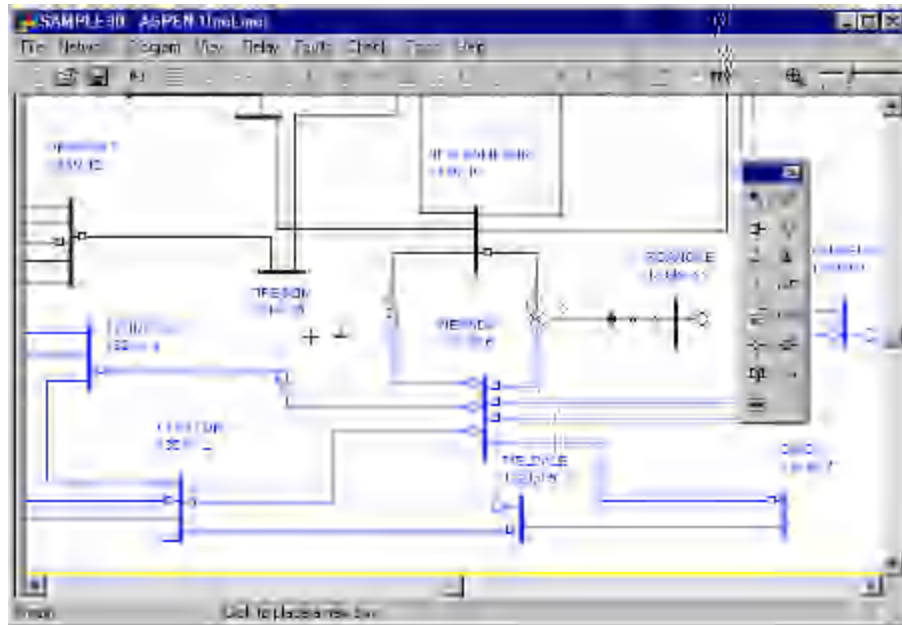
ADDING A NEW BUS:

1. **Select command View | Device Palette to show the Device Palette if it is not already visible**

Click the New bus button  on the Device Palette.

The cursor will change into a cross with a bus symbol attached to it.

2. **Click on an empty space in the diagram to place the new bus.**



A dialog box will appear showing the parameters of the new bus.

3. **Modify the bus data.**

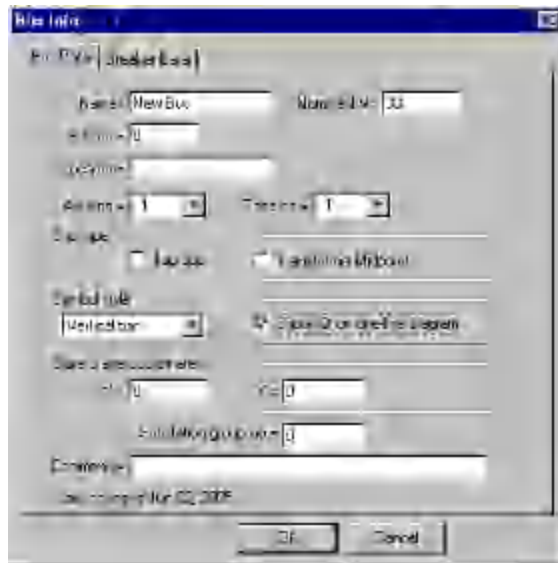
Type “New Bus” in the edit box labeled 'Name'.

Type “33” in the edit box labeled 'Nom. kV'.

Select ‘Vertical bar’ for the symbol style.

Mark the ‘Show ID on one-line diagram’ check box.

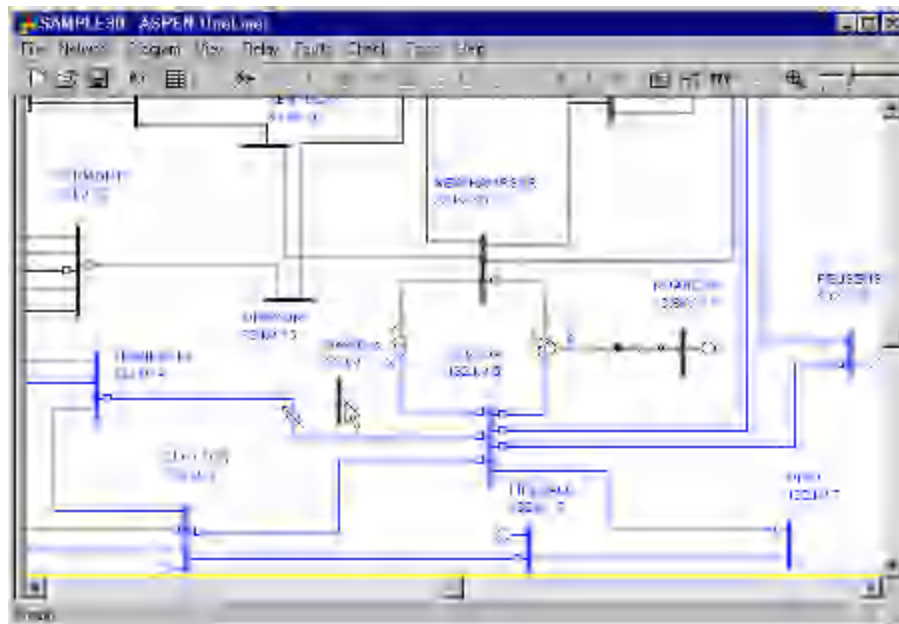
The Bus dialog box should look like this.



Note: The second page of the bus dialog box (not visible), labeled 'Breaker Data', is for circuit breaker information. The breaker data are used by the ASPEN Breaker Rating Module (an optional module of ASPEN OneLiner) to evaluate the adequacy of the breaker interrupting rating.


4. Click on the "OK" button.

The dialog box will disappear and a new bus will appear at the location you selected in step 2.

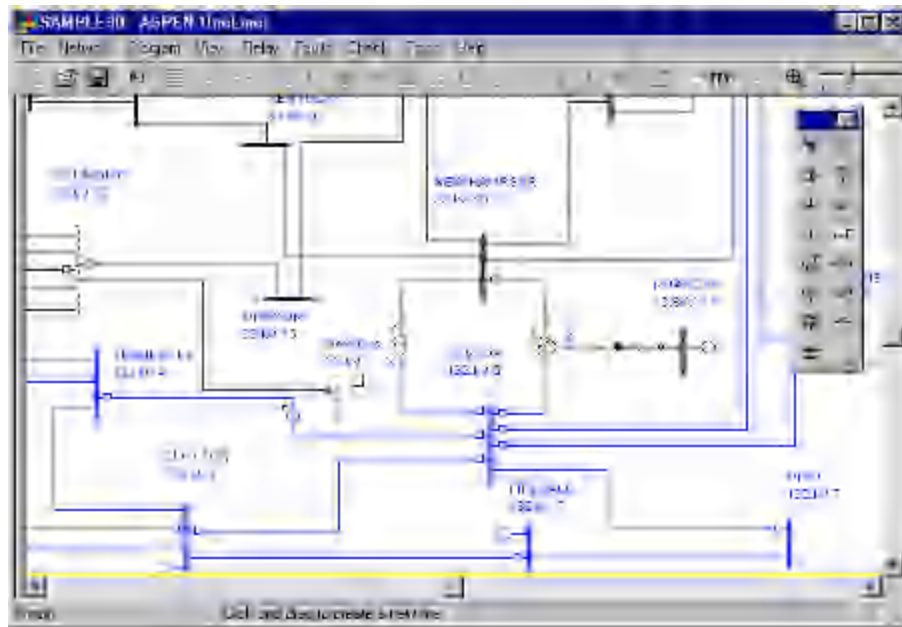


ADDING A TRANSMISSION LINE:

You will now add a new transmission line between the new 33 kV bus and the Vermont 33 kV bus.

1. Click the New line button  on the Device Palette.
The cursor will change into a cross with a line symbol attached to it.
2. Click the left mouse button on the Vermont 33 kV bus. Without releasing the left button, move the mouse toward the “New Bus”. A line symbol will appear with one end attached to Vermont 33 kV bus. The other end of the line will move with the cursor.

When the cursor is near the “New Bus 33kV” bus, the bus symbol will turn dotted red. Release the mouse button.



A dialog box will appear showing the data of the new line.

Transmission Line Data

12 VERMONT 33. kV - 0 New Bus 33. kV

Name= Ckt ID= 1

Length= 0. kt Type

Branch Parameters

R= 0.0662 X= 0.1304
R0= 0.1986 X0= 0.3912

G1= 0. B1= 0. G2= 0. B2= 0.
G10= 0. B10= 0. G20= 0. B20= 0.

Current Ratings (A)

A: 0. B: 0. C: 0. D: 0.

Metered at: VERMONT 33. kV

Last changed Jun 03, 2005

By default, the line data is set equal to that of the previous line object. That is why the line impedances are already set to a nonzero value. (You can change this behavior in the Network | Options dialog box.)

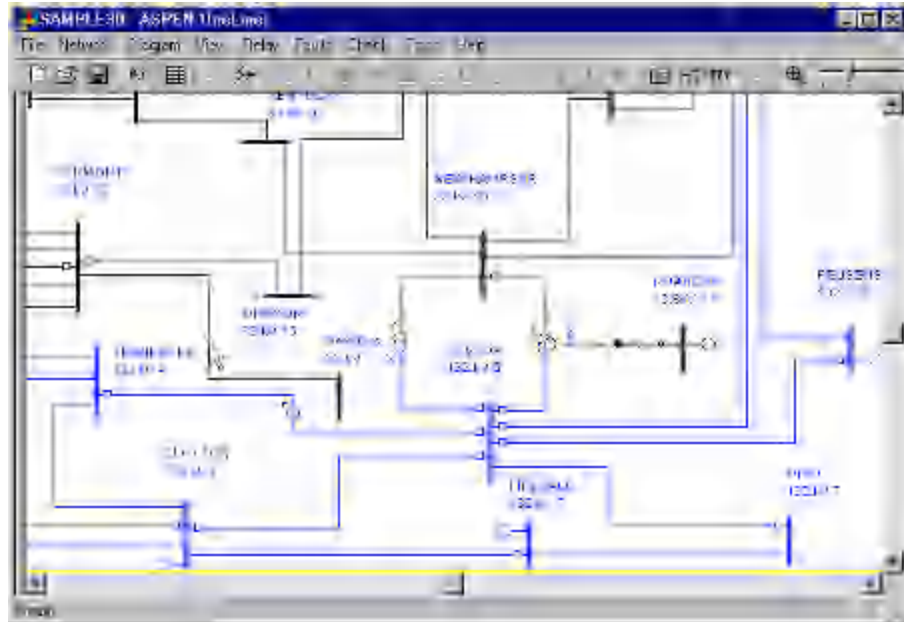
3. Give this line a reactance of 0.1 per-unit in the positive sequence and 0.3 per-unit in the zero sequence.

Type "0.1" in the edit box labeled 'X'.

Type "0.3" in the edit box labeled 'X0'.

4. Click on the "OK" button.

A new line will appear between the selected buses.



5. Press the <Esc> key on your keyboard to exit from the Add-Equipment mode.

The mouse cursor will change back to the normal arrow cursor.

GETTING AROUND

Your computer monitor usually can display only a portion of your system's one-line diagram. *OneLiner* has several features that let you to navigate from one part of the system to another:

- **Find Bus:** Move the viewport to the location of a given bus. This can be accomplished by using either the bus name or number.
- **Scroll:** Move the viewport horizontally or vertically.
- **Zoom:** Show the one-line diagram in the viewport with different magnifications.
- **Split Screen:** View the one-line diagram in two different panes at the same time.

These features are described in the following sections.

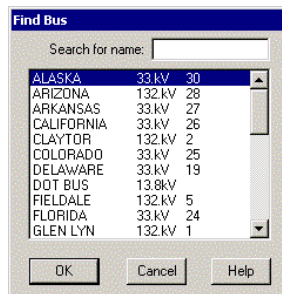
FINDING A BUS BY NAME:

1. **Click the *right* mouse button in a vacant section of the screen.**

A floating menu will appear.

2. **Click on the Find Bus By Name command.**

A dialog box will appear showing an alphabetical listing of all the buses in the network.



Note: You can also press the F key on the keyboard to bring up this dialog box.

3. **Click on the name "California 33. kV 26" in the list box.**

The number 26 is the bus number.

4. **Click on the "OK" button.**

The selected bus will appear at the center of the screen.

Note: You can locate a bus by its number by selecting the Find Bus By Number command in step 2.

SCROLLING TO VIEW DIFFERENT SECTIONS OF THE NETWORK:

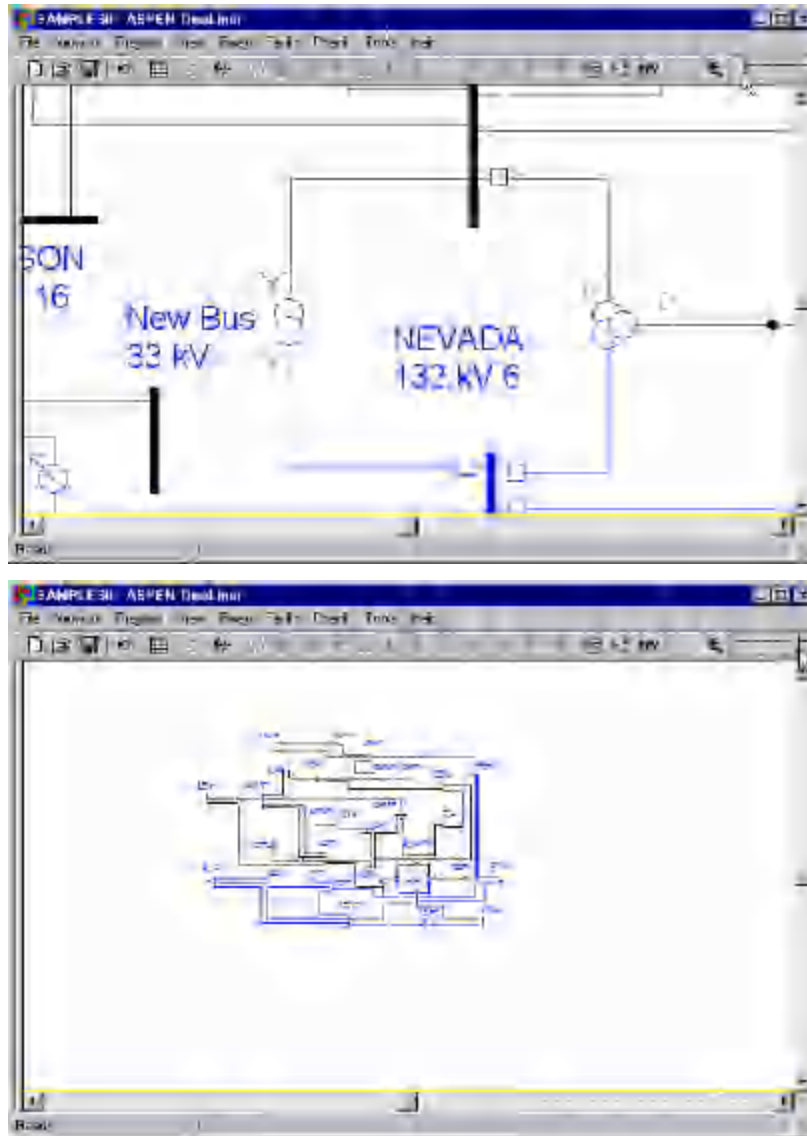
1. **Scroll the one-line diagram vertically and horizontally by clicking the mouse on the scroll bars of the window or by dragging the scroll bar button.**

If you have a mouse with a wheel, rotating the wheel will scroll the one-line diagram vertically. Also, moving the mouse with the wheel pressed down will cause the viewport to move with the mouse.

Note: If the network disappears, use the Find Bus command mentioned above.

ZOOMING TO VIEW DIFFERENT SECTIONS OF THE NETWORK:

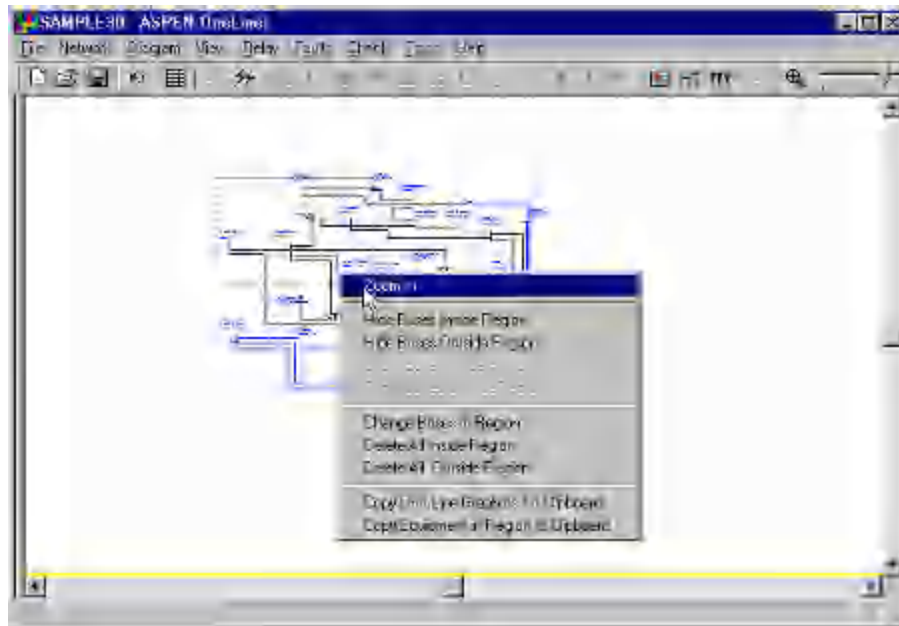
1. Change the zoom setting by dragging the zoom slider control on the tool bar.



2. Zoom into a specific area on the one-line diagram.

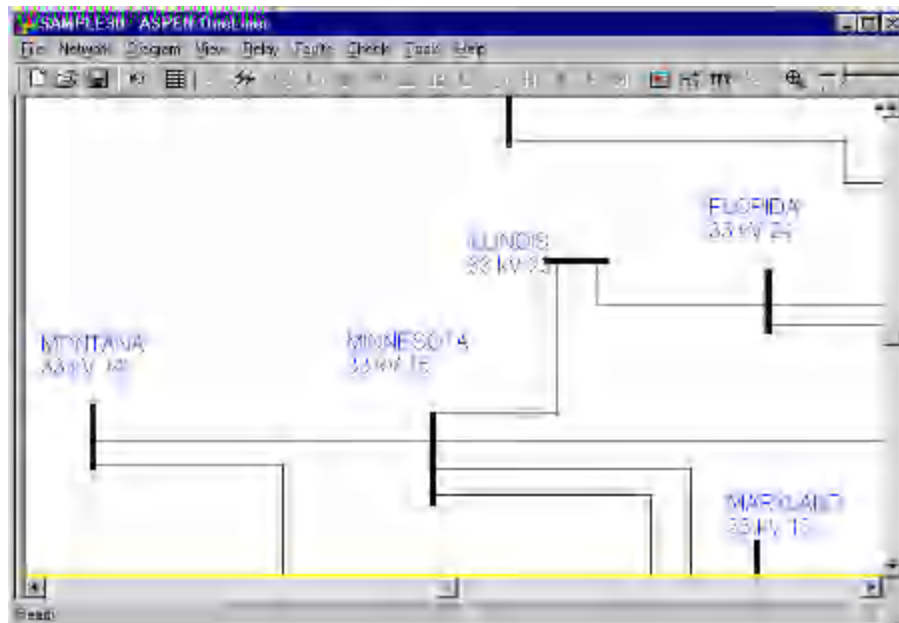
Click the *right* mouse button at a location. While still holding the *right* mouse button, drag the mouse to delineate a rectangular area that you wish to magnify. Release the mouse button.

A floating menu will appear. Your screen will look like this.



3. Click on the "Zoom In" command.

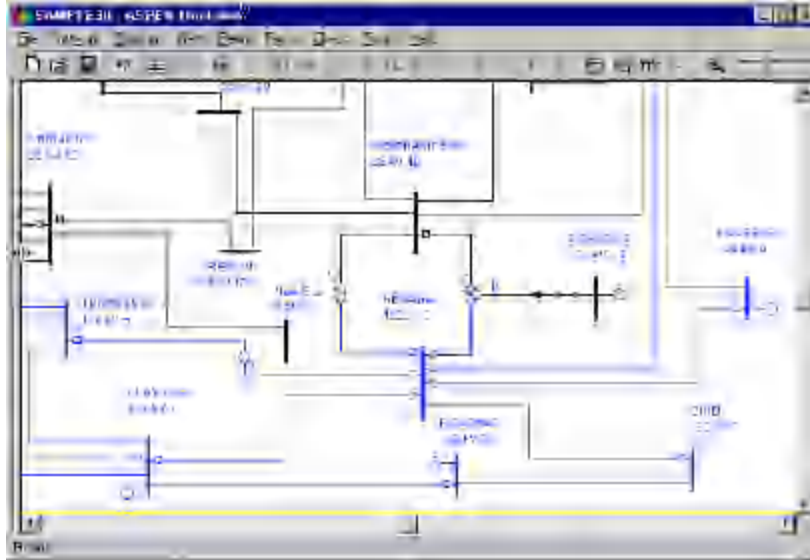
The screen will show a detailed view of the network that was enclosed in the dotted rectangle.



USING THE SPLIT SCREEN OPTION:

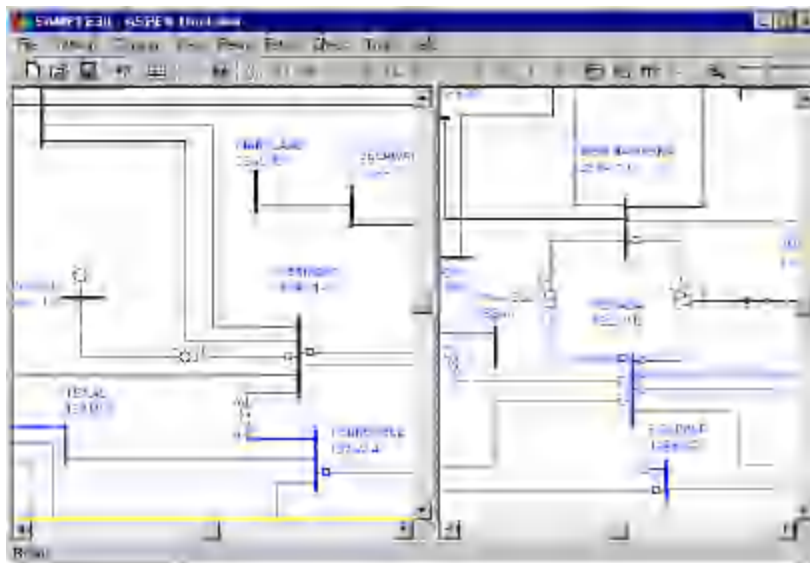
You can split the main one-line window into two panes. The two panes have independent zoom and scroll controls, and may display different quantities. You can edit the one-line in either pane. The other pane is updated automatically. The split window view greatly improves the ease of use: When you are coordinating the relays at two ends of a branch, you can position the split window to see what is happening at both ends at the same time. You can also view in the two panes the fault currents and relay operating times at the same time. The possibilities are endless.

1. Move the arrow cursor over to the left side of the viewport until it turns into two double bars with arrows pointing inward, as shown below.



2. Now while holding the *left* mouse button down, drag the double bars to the center of the screen.

The viewport will now be split into two panes.



The active pane will have a yellow tint at the bottom of the screen. You can now scroll the two sections and modify each independently.

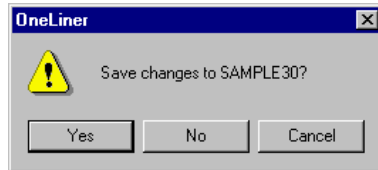
CLOSE AND RE-OPEN THE BINARY DATA FILE:

1. Close the file.

Select the **File | Close** command.

If you are running the working model, the file will close now. **Proceed to step 2.**

If you are running the production version, a dialog box will appear asking you whether you want to save the changes.



Click on the "No" button.

The current example file will be closed. The Main Window of *OneLiner* will show the word "ASPEN" on a gray background.

2. Re-Open the file SAMPLE30.OLR.

Click on the **File** menu to display the menu items.

At the bottom of the menu, just above the Exit command, you will see the file name of the last four files you opened. The name SAMPLE30.OLR should be among the files listed.

Click on the menu item "SAMPLE30.OLR" to open the file.

After a short time, the Main Window will again show the one-line diagram of the 30-bus system.

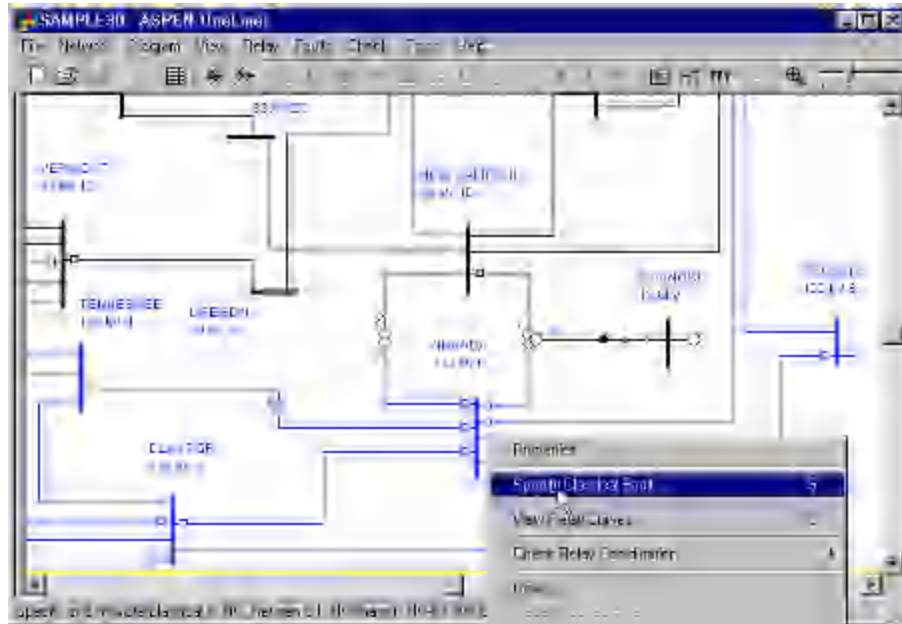
Drag the splitter bar back to the left edge so that only one pane is visible.

SIMULATING AND DISPLAYING FAULTS

The following instructions show you how to simulate faults in the vicinity of a relay group.

1. Click the *right* mouse button on the third relay group on the right hand side of the bus NEVADA 132kV.

The relay group symbol will turn dotted red, and a floating menu will appear. Repeat this step if the bus or the entire line turns dotted red.



2. Click on the Specify Fault command.

A dialog box will appear asking you to specify the faults to be simulated.



Note there are four fault types within the Phase Connection group box:

3LG: Three-phase fault. **1LG:** Single phase to ground fault.
2LG: Two phase to ground fault. **L-L:** Line to line fault.

The "1LG" check box should already be marked.

3. Click on each of the 12 check boxes labeled 'No outage' and 'With outage' to select all the available fault types.

- **Close-in fault:** A fault immediately in front of the selected relay group.
- **Close-in fault with end opened:** A fault immediately in front of the Selected relay group with the far end of the branch disconnected.
- **Remote bus fault:** A bus fault at the far end of the branch.
- **Line-end fault:** A fault at the far end of the branch with the branch disconnected from the remote bus.
- **Intermediate fault (also called a sliding fault):** A fault in the middle of a transmission line. This option is not available to relay groups on transformers or phase shifters.
- **Intermediate fault with end opened:** A fault in the middle of a transmission line with the far end of the branch disconnected.

4. Move the text cursor to the edit box labeled '%' and type in the value 44.

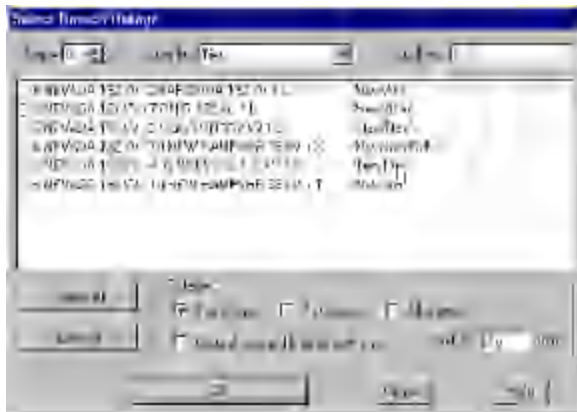
This specifies that the intermediate faults are at 44% of the distance between NEVADA 132 kV and REUSENS 132 kV.

We will leave the phase connection to 1LG, which stands for single line to ground, and the fault impedance to zero ohms. The fault-specification dialog box should look like this.



5. Click on the "Simulate" button.

A dialog box will appear asking you to specify branch outages.

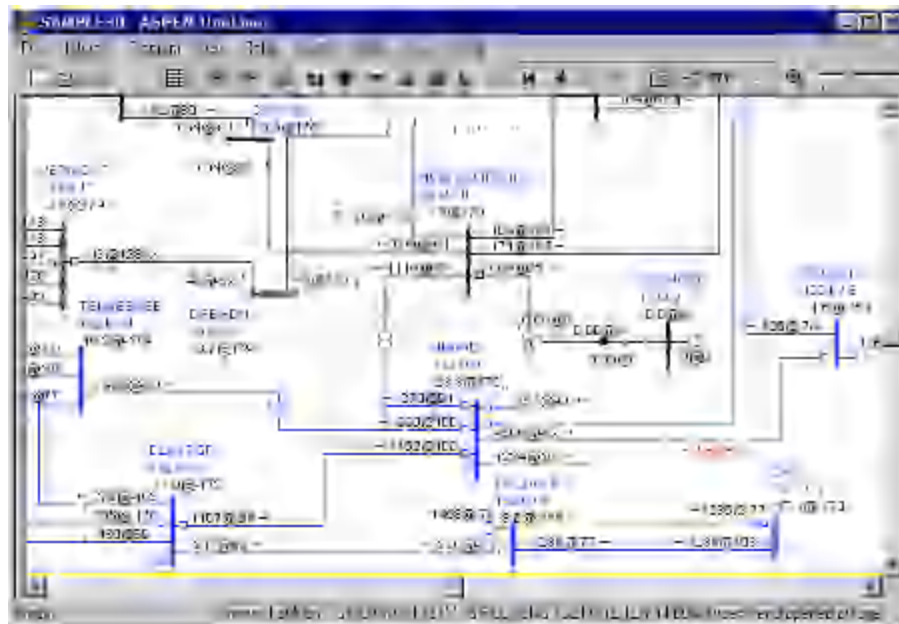


6. In the list box, mark the checkbox for the first entry “6 NEVADA 132. kV – 28 ARIZONA 132. kV 1L” to select a line outage.

This outage will be taken for all the fault types for which the "With outage" check boxes were marked.

7. Click on "OK" to begin the fault simulation.

A dialog box will appear to inform you of the program's progress. At the end of the simulation the dialog box will disappear and the last fault simulated will be displayed on the one-line diagram. You will see a line that reads "1LG Interm. Fault on: 6 NEVADA 132.kV- 6 REUSENS 132.kV 1L 1LG Type=A..." in the status area at the bottom of the Main Window. This is a description of the fault that is being displayed.

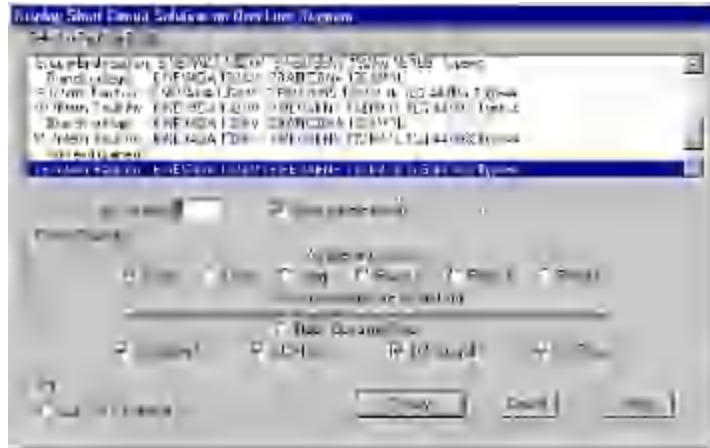


The bus voltages are shown directly beneath the bus names and nominal kV. The branch currents are shown on the branch symbols. Both the voltage and the current will be displayed as complex numbers in polar coordinates. The zero-sequence quantities are displayed by default for a single-line-to-ground fault. The '@' symbol separates the magnitude on the left from the phase angle (in degrees) on the right.

8. View other quantities on the one-line diagram.

Select the Faults | Show Fault Solution on 1-line command.

A dialog box will appear asking you to select the display options. The list box at the top of the dialog box shows the twelve faults that you just simulated. The fault being displayed is selected by default.



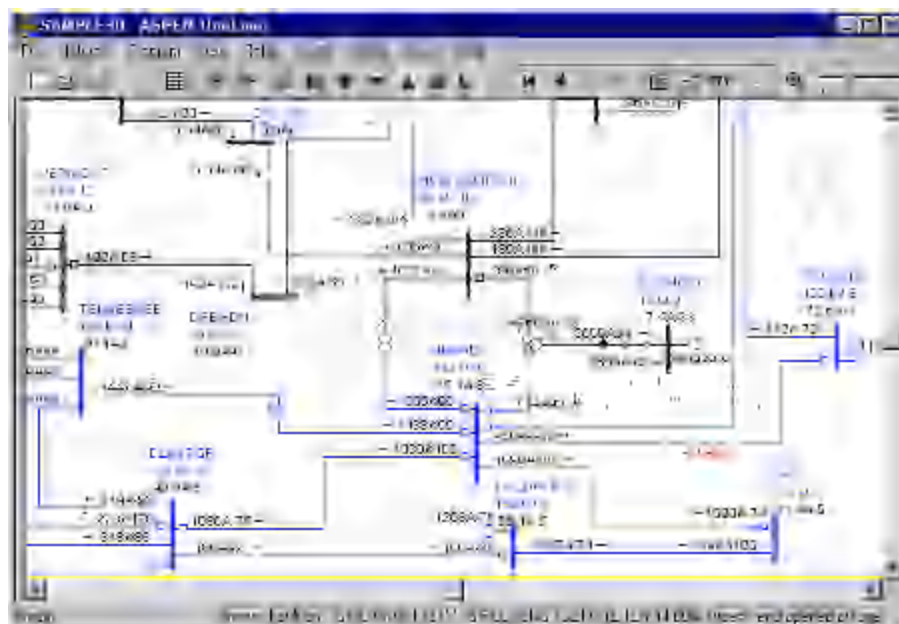
Notice the '3' in the 'No. of tiers' edit box. This tells *OneLiner* that you want to see the solution for all the equipment within three buses back from the fault.

9. Click on the "Phase a" radio button to display the phase 'a' voltages and currents.

The radio button labeled "Physical" at the lower-left corner is highlighted (by default) to indicate that the voltages will be in units of kV line-to-ground, and the currents in amperes.

10. Click on the "Display" button.

The dialog box will disappear. The one-line diagram will be refreshed to show the phase 'a' currents and voltages. Note the letter 'A' between the magnitude and angle of the branch currents.



11. View other quantities using the toolbar buttons.

You may easily display other quantities by clicking on one of the toolbar shortcut buttons.



The '0', '+', and '-' buttons are for displaying the zero-, positive- and negative- sequence quantities, respectively. The 'A', 'B' and 'C' buttons are for displaying the phase 'A', phase 'B' and phase 'C' quantities. The button that resembles a 'clock' is used for displaying the relay operating times.

Click on the 'B' shortcut button to display the phase 'B' quantities.

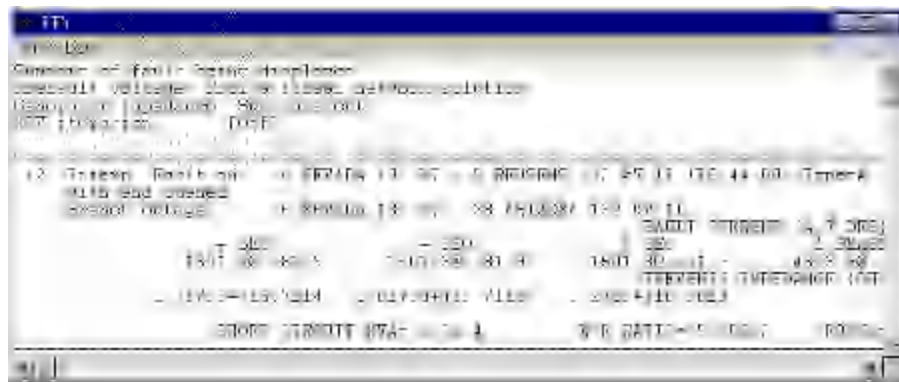
The one-line diagram will be re-drawn showing the phase 'B' quantities.

12. View the fault summary in text.

OneLiner always prepares a summary for the fault being displayed. The summary includes the fault MVA, the fault current, the relay current, the Thevenin impedance, and the voltage at both ends of the relay branch. You can see this summary by opening the TTY Window.

Click on the 'TTY' button on the toolbar.

The TTY Window will appear. You will see the last part of the summary when the window opens. You can click on the scroll bars of this window to bring the other parts of the summary into view.



13. Select the TTY | Close Window command to close the TTY Window.

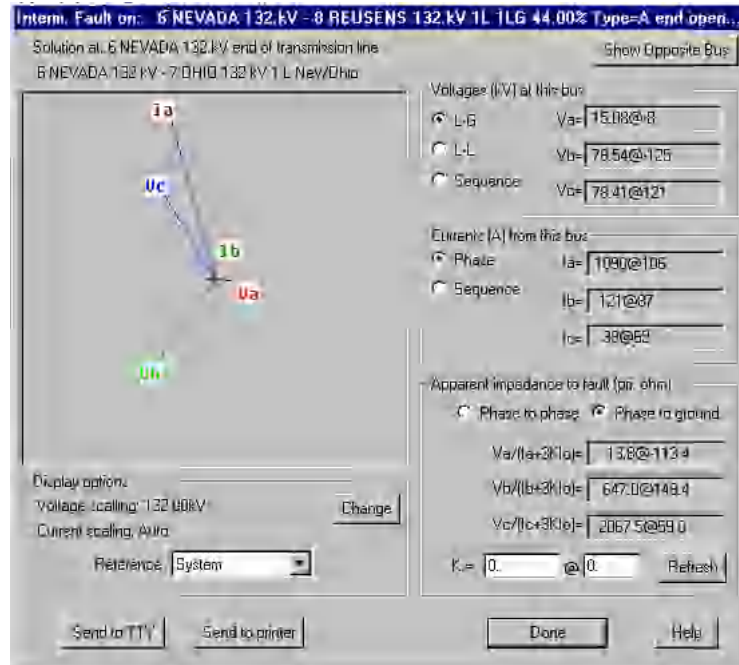
The TTY Window will disappear.

14. Use the Phasor Probe.

Click the *right* mouse button on the transmission line between NEVADA 132 kV and OHIO 132 kV. The line will become highlighted and a floating menu will appear.

Click on the View Phasors command.

A pop-up window will show you the voltage and current phasors at one end of the NEVADA -OHIO line. The words "Solution at NEVADA 132. kV" at the upper left corner tells you that the phasors shown are for the NEVADA end of this line.



Click on Sequence within the “Current from this bus” box to see the current phasors for each of three sequences.

Click on the “Show Opposite Bus” button near the bottom. The phasor at the OHIO end of the selected line will appear.

Click on "Done". The phase-probe dialog box will disappear.

