# ASPEN Software - Introduction

ASPEN is a very user-friendly software package that is capable of doing load-flow and short-circuit studies, as well as relay application and coordination. Its simple graphical user interface allows you to quickly draw the system one-line on the screen, and supply system parameters by simply clicking on the bus, generator, line, transformer, fuses, or circuit breaker of interest. Relays are associated with circuit breakers. One or more relays can be added on either side of the circuit breaker – they monitor current flow through the circuit breaker and the voltage at that side of the circuit breaker.

One of my graduate research assistants has recently learned ASPEN from scratch. His instructions for first-time users are given on the following page.

A sample screen of a 9-bus system (Aspen9.olr) is given below.
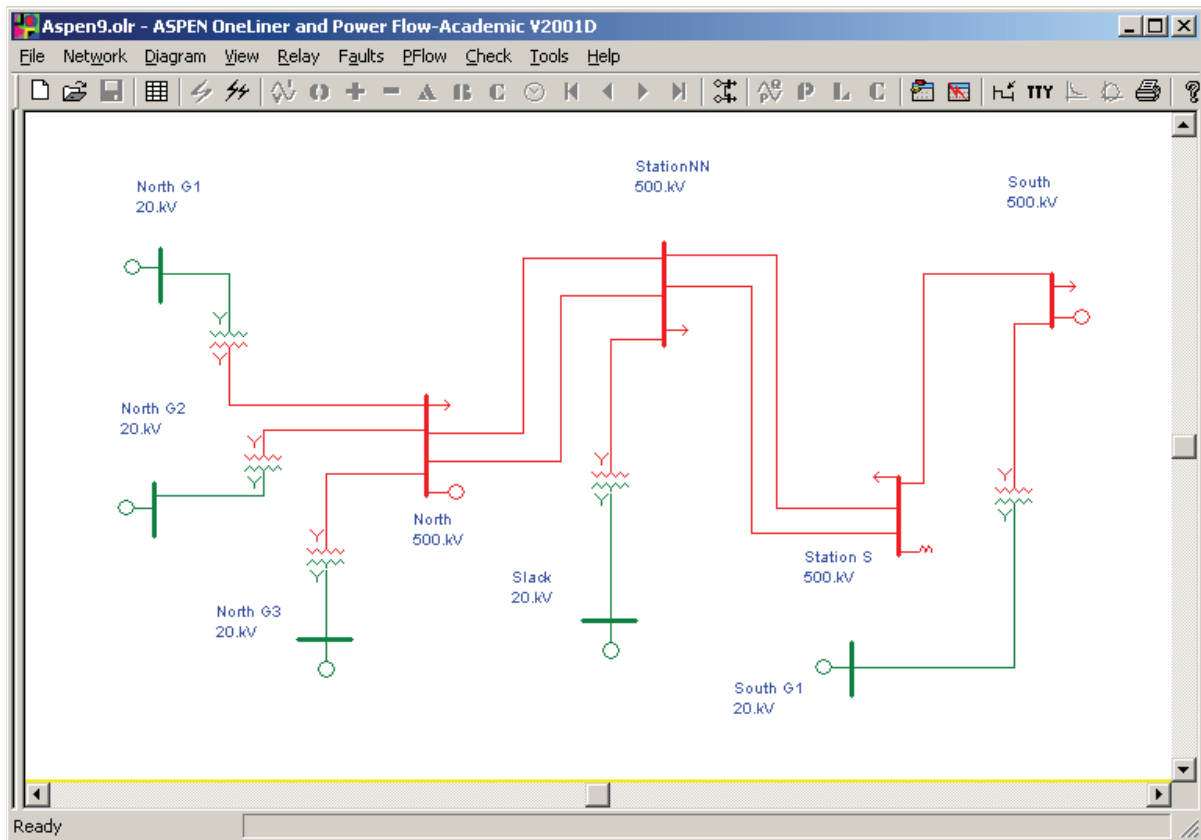
Note: Aspen 2019 (academic version 14.8) has been installed on the MTU remote server, i.e. remote.mtu.edu (you will need to establish VPN connection). It is also directly installed in EE5224 lab station PCs in EERC 134.

Quick Start - Basic Procedure:

1. The shortcut icon is "OneLiner and Power Flow" and it will appear in the Aspen program group. When you locate it, you may create a shortcut to it on your own desktop.

2. Help topics are available online. Click on Help | OneLiner Help Contents | 2.8 One-Liner Quick Tutorial to learn how to draw and edit the one-line diagrams and use the GUI to enter parameters and run simulations. Full set of V14 user manuals in PDF format can be found on ASPEN website at: www.aspeninc.com/download/manuals/1L_v14/manuals

3. All command references are at page 3-1 in the printed manuals, which will provide you with step-by-step instructions for drawing a system and editing parameters. On-line help is found in Section 3 of the help menu. Three sample systems can be opened and examined: **tempest.olr**, **Sample09.olr** and **Aspen9.olr.**

4. To begin a simple OneLiner diagram, we start with drawing a bus. Right click once and select the '**new bus**' commands input value on the bus names the nominal kV and choose '**real bus**'.

5. To add a generator on the bus, right click on the bus, choose '**new**' then '**generator**'. Enter the parameters of the generator, click ok and done.

6. Adding a line would require at least two buses. Click on one of the buses then with the **Shift** key held down, **right click** on the terminal bus. You will see a popup menu, choose '**new line**'. Input the parameter of the line, then click ok. You can always change the properties by double click on it.

7. Right click on the transmission line, choose '**new relay group**'. Depends on what kind of relay you want to insert to the line, '**OC**' for overcurrent relay and '**DS**' is for distance relay.

8. A fault can be placed on the transmission line. **Right click** on the **relay** that is connected with the desired fault location, the relay should be highlighted in red. Note that you **shouldn't** include the line when highlighting. Then choose '**Specify fault**'. You should have a menu of fault specification. Enter the desired fault, then click '**simulate**'

9. We can view currents and voltages in sequence or phase by clicking on the icons at the tools bar.

Assignment #6:

Two time-overcurrent relays protect adjacent sections of a radial system. Bus 3 is at the end of the radial line. Approximately 7000 amps of fault current will flow for a close-in fault at point A and approximately 5000 amps of fault current will flow for a line-end fault at point B. Load current at bus 2 is 100A and load current at bus 3 is 350A. Both load currents are at unity power factor. Model this situation using ASPEN One Liner software and simulate the aforementioned faults. Observe the relay curves and the trip times. Investigate the phase and sequence voltages and currents for each bus and line after simulating both faults.
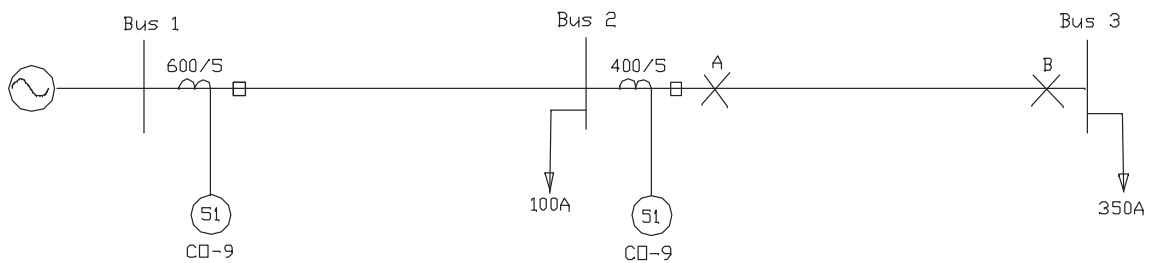
Procedure:

Setup:
- In the file menu, choose New to start a new project. Choose 100 MVA as the system base.
- Right click in the workspace and choose New Bus. The Bus Info pop-up menu should   appear. Fill in the Name as Bus 1, the Bus no. as 1, and the Nom. KV as 41.6. The buses can be moved by dragging them around the workspace. Do this again for buses 2 and 3.
- Click on Bus 1, hold down the shift key, and right click on Bus 2. Choose New Line. The Transmission Line Data menu should appear. Fill in the following spaces:

Name=Line 1
Length=10 mi
X=0.10025
X0=0.1.

Leave everything else the same.
Repeat this for the line between buses 2 and 3, which will be called line 2. However, use X=0.0774. Everything else should be the same as line 1.
- Right click on line 1 near Bus 1 and choose New Relay Group. On the menu that appears, click on the Add OC Phase Relay button. Fill the spaces as follows:

ID=Relay 1
CT ratio=120
Time dial=4
Tap unit=GC2
Pickp=4
Curve=CO-9

Make sure the directional option is NOT selected. Click OK, then Done. Do the same for line 2 near Bus 2, except for the following.

ID=Relay 2
CT ratio=80
Tap unit=GC2
Time dial=0.5
Pickup=5
Curve=CO-9

- Make sure directional option is NOT selected.
- Right click on Bus 1. Choose new, then generator. The parameter menu for the generator will automatically appear. Use R=0 and X=0.1 for each impedance, include neutral impedance. The unit rating should be 100 MVA and the scheduled generation should be 100 MW. Leave the rest the same. Click OK, then Done.
- Right Click on Bus 2. Choose New, then Load. The parameter menu for the load will automatically appear. Enter 0 MW for constant power, 7.2 MW for constant current, and 0 MW for constant Impedance. Repeat for Bus 3, except use 25.22 MW of constant current.

Simulation:
- Right click on the relay 2 and choose Specify Fault. Choose Close-in-Fault, no outage. Choose the 3LG phase connections. Deselect all other phase selections, since here we are only interested in a balanced 3-phase fault. Click Simulate.
- On the toolbar, click on the clock icon to see the relay operating time and the fault current.
- Repeat this for a line end fault with no outage. Make sure to de-select close-in-fault.

Analysis:
- By holding down the control key and double clicking on a line or bus, a graphical representation of the voltages and currents can be seen.
- To see a text file of simulation results, click on TTY icon on the toolbar.
- After simulating a fault, right click on the relay near Bus 1. Choose View Relay Curves and click OK. A graph of the time-overcurrent curve for relay 1 should appear. On the curve graph, click on the Add menu and select Relay Curves in Vicinity. Select Relay 2 from the window that appears and hit OK. The overcurrent curve for both relays should now be on the same graph. To see when the relays tripped, go into the Show menu and select Relay Operations for All Faults.

Bus 1
41.6kV 1

Bus 2
41.6kV 2

Bus 3
41.6kV 3