SIEMENS POWER SYSTEM SIMULATION FOR ENGINEERS® (PSS/E)

LAB1
INTRODUCTION TO SAVE CASE (*.sav) FILES

Power Systems Simulations
Colorado State University

The purpose of ECE Power labs is to introduce students to fundamentals of power flow analysis utilizing PSS®E. Electrical engineers use PSS®E to analyze, design and run simulation on bulk electric system models. PSS®E has a large library of analysis tools and optional modules, including, but not limited to:

- **Power Flow**
- **Optimal Power Flow**
- **Balanced or Unbalanced Fault Analysis**
- **Dynamic Simulation**
- **Extended Term Dynamic Simulation**
- **Open Access and Pricing**
- **Transfer Limit Analysis**
- **Network Reduction**

These labs will introduce the user to the application and develop the basics of power flow analysis.

Introduction to PSS®E

The lab manuals that will be considered throughout the duration of this course will be primarily focused on power flow, rather than dynamic simulations. PSS®E uses a graphical user interface that is comprised of all the functionality of state analysis; including load flow, fault analysis, optimal power flow, equivalency, and switching studies. A common line interface is also available and students are encouraged to explore this method. It will not be covered in these labs.

PSS®E provides the user with a wide range of assisting programs for installation, data input, output, manipulation and preparation. More importantly, PSS®E allows the user of having a control over the applications of these computational tools.

Power Flow

In the Electric Utility Industry, power flow analysis is used for real time system analysis as well as planning studies. The user should be able to analyze the performance of power systems in both normal operating conditions and under fault (short-circuit) condition. The study in normal steady-state operation is called a power-flow study (load-flow study) and it targets on determining the voltages, currents, and real and reactive power flows in a system under a given load conditions. The purpose of power flow studies is to plan ahead and prepare for “system normal minus one” (N-1) contingencies.

The PSS/E interface supports a variety of interactive facilities including:

• Introduction, modification and deletion of network data using a spreadsheet
• Creation of networks and one-line diagrams
• Steady-state analysis (load flow, fault analysis, optimal power flow, etc.)
• Presentation of steady-state analysis results.

I. Create a folder

1- Create a folder in your U drive. Name it **PSSE Labs**.
2- Go to the ECE461 class website: http://www.engr.colostate.edu/ECE461/course_info.shtml
3- Download the following files to your **PSSE Labs** folder:

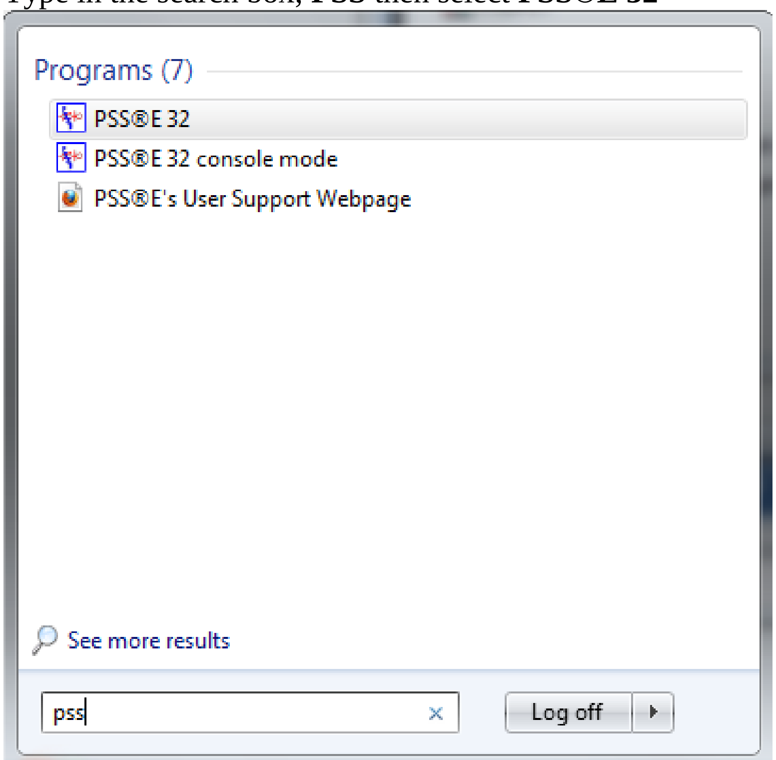
a. Sample.sav
b. Sample.sld
c. exercise1.sld

II. How to access PSS®E

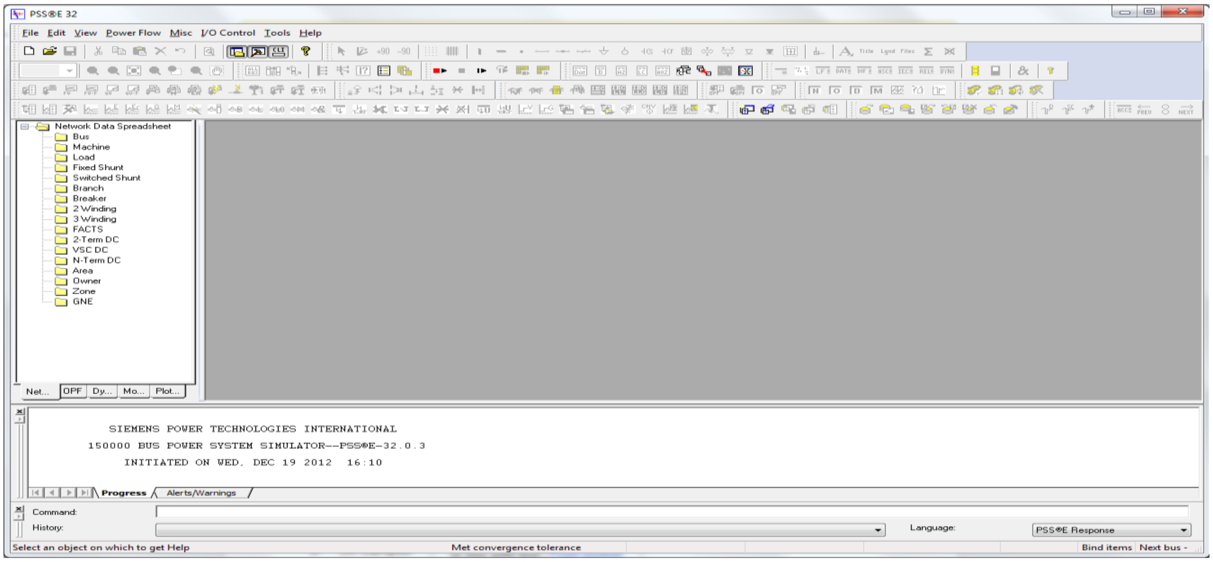
There are two ways to access PSS®E:

1- ***On campus Computers:***

a. Log onto Eng. Account computer.
b. Click on Start icon.
c. Type in the search box, **PSS** then select **PSS®E 32**

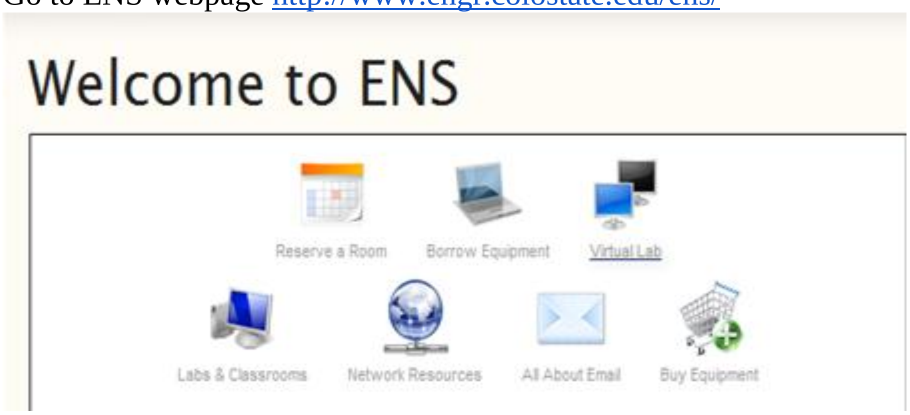


d. The window below appears:

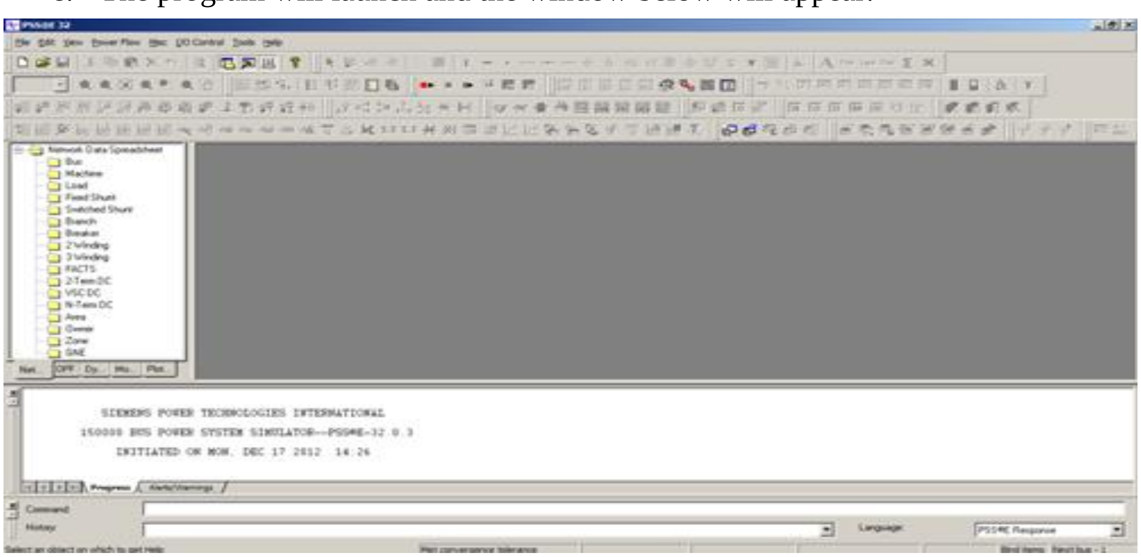


2- ***Off Campus:***

a. Go to ENS webpage http://www.engr.colostate.edu/ens/



b. Choose **Virtual Lab** icon
c. Then, **follow** the instructions in virtual lab page.
d. Once it’s opened, click on **Start** and Type **PSS** in the search box.
e. The program will launch and the window below will appear.

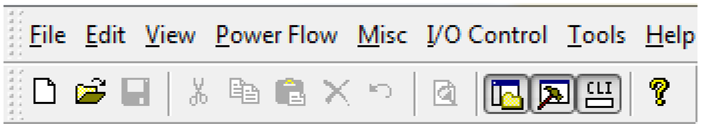


III. Loading a *.sav file.

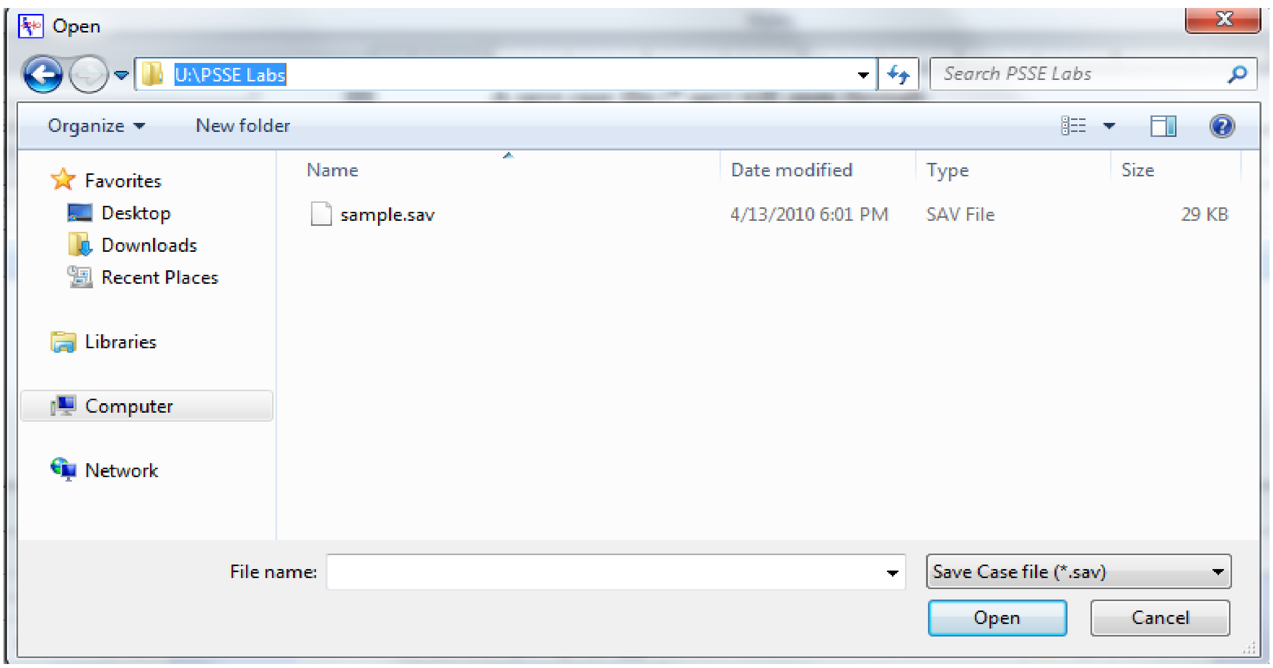
The save case file (*.sav) is a binary image of the load flow working case. To conserve disk space and minimize the time required for storage and retrieval, save cases (*.*sav*) are compressed in the sense that unoccupied parts of the data structure are not stored when the system model is smaller than the capacity limits of the program.

A save case file (*.sav) will open through:

a. Go to second toolbar. Click on  or Go to File, **Open**



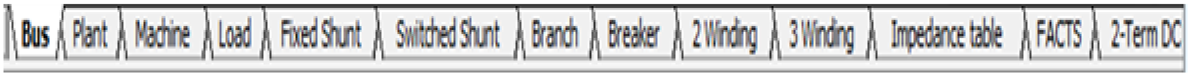
b. Navigates to your PSSE Labs folder. The window will appear. Choose **Sample.sav** file. Make sure the description in the right box are **Save Case File*.sav).**



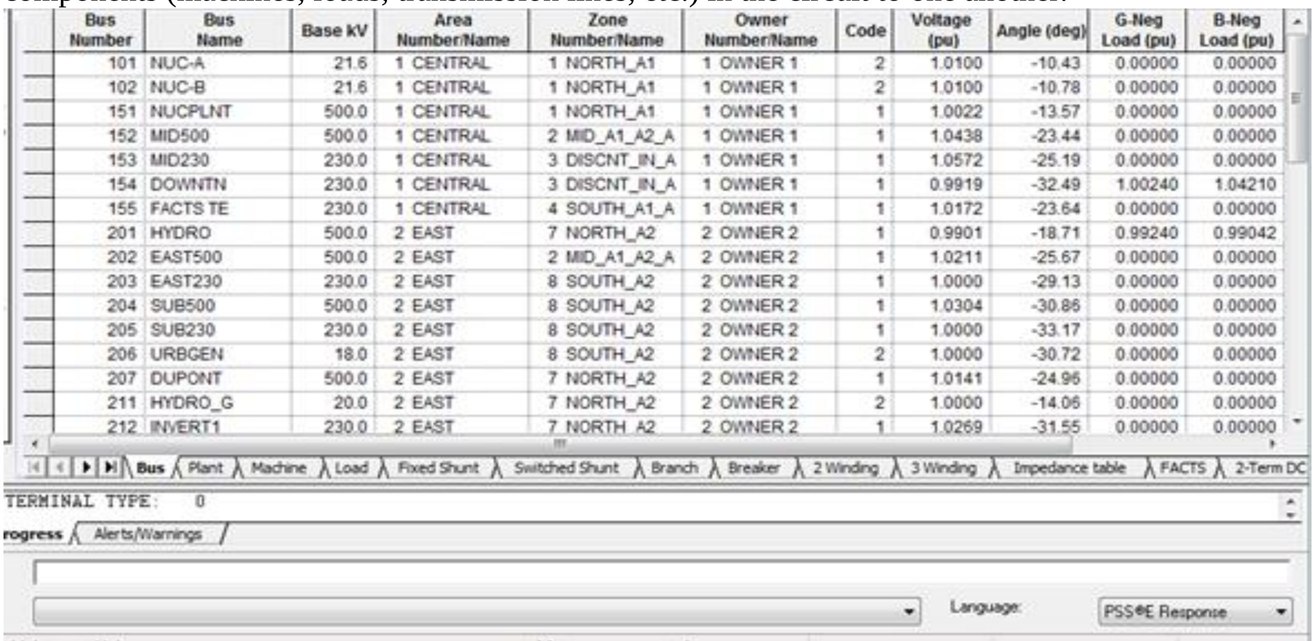
IV. Explanations of Tabs

Once the **sample.sav** file is opened, there are 19 tabs to choose from at the bottom of the data file (shown below). Each tab can be accessed by clicking the tab. There are six tabs that will be focused on in this section:

Busses:

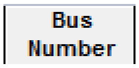


It is a node (remember in Circuit Theory Applications or in Basic Circuit Analysis) Busses connects components (machines, loads, transmission lines, etc.) in the circuit to one another.

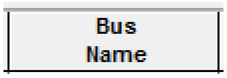


Bus Number	Bus Name	Base kV	Area Number/Name	Zone Number/Name	Owner Number/Name	Code	Voltage (pu)	Angle (deg)	G-Neg Load (pu)	B-Neg Load (pu)
101	NUC-A	21.6	1 CENTRAL	1 NORTH_A1	1 OWNER 1	2	1.0100	-10.43	0.00000	0.00000
102	NUC-B	21.6	1 CENTRAL	1 NORTH_A1	1 OWNER 1	2	1.0100	-10.78	0.00000	0.00000
151	NUCPLNT	500.0	1 CENTRAL	1 NORTH_A1	1 OWNER 1	1	1.0022	-13.57	0.00000	0.00000
152	MID500	500.0	1 CENTRAL	2 MID_A1_A2_A	1 OWNER 1	1	1.0438	-23.44	0.00000	0.00000
153	MID230	230.0	1 CENTRAL	3 DISCNT_IN_A	1 OWNER 1	1	1.0572	-25.19	0.00000	0.00000
154	DOWNTN	230.0	1 CENTRAL	3 DISCNT_IN_A	1 OWNER 1	1	0.9919	-32.49	1.00240	1.04210
155	FACTS TE	230.0	1 CENTRAL	4 SOUTH_A1_A	1 OWNER 1	1	1.0172	-23.64	0.00000	0.00000
201	HYDRO	500.0	2 EAST	7 NORTH_A2	2 OWNER 2	1	0.9901	-18.71	0.99240	0.99042
202	EAST500	500.0	2 EAST	2 MID_A1_A2_A	2 OWNER 2	1	1.0211	-25.67	0.00000	0.00000
203	EAST230	230.0	2 EAST	8 SOUTH_A2	2 OWNER 2	1	1.0000	-29.13	0.00000	0.00000
204	SUB500	500.0	2 EAST	8 SOUTH_A2	2 OWNER 2	1	1.0304	-30.86	0.00000	0.00000
205	SUB230	230.0	2 EAST	8 SOUTH_A2	2 OWNER 2	1	1.0000	-33.17	0.00000	0.00000
206	URBGEN	18.0	2 EAST	8 SOUTH_A2	2 OWNER 2	2	1.0000	-30.72	0.00000	0.00000
207	DUPONT	500.0	2 EAST	7 NORTH_A2	2 OWNER 2	1	1.0141	-24.96	0.00000	0.00000
211	HYDRO_G	20.0	2 EAST	7 NORTH_A2	2 OWNER 2	2	1.0000	-14.06	0.00000	0.00000
212	INVERT1	230.0	2 EAST	7 NORTH_A2	2 OWNER 2	1	1.0269	-31.55	0.00000	0.00000

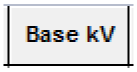
All equipment information and characteristics associated with each bus in the system can be obtained by accessing the buses tab. In the buses tab there will be several parameters that can be set or adjusted. The important parameters will be described below:



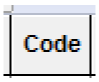
Displays the number of each bus (1 through 999997).



Displays the name of each bus.



The voltage of each bus in KV unit.



They show up in numbers to 5 and it is usually set to 1 by default
Here what each number means:
1 - Load bus (no generator boundary condition)

2 - Generator or plant bus (either voltage regulating or fixed MVar)
3 - Swing bus
4 - Disconnected (isolated) bus
5 – Same as type 1, but located on the boundary of an area in which an equivalent is to be constructed.

Voltage (pu) — Per unit voltage which is 1.0 by default.

Bus data input is terminated with a record specifying a bus number of zero.

Branches:

Bus | Plant | Machine | Load | Fixed Shunt | Switched Shunt | **Branch** | Breaker | 2 Winding | 3 Winding | Impedance table

Branches represent transmission lines and they are characterized by impedance.

From Bus Number	From Bus Name	To Bus Number	To Bus Name	Id	Line R (pu)	Line X (pu)	Charging (pu)	In Service	Metered	Rate A (I as MVA)	Rate B (I as MVA)	Rate C (I as MV
151	NUCPLNT 500.00	152	MID500 500.00	1	0.002600	0.046000	3.500000	☑	☐ From	1200.0	1100.0	1000
151	NUCPLNT 500.00	152	MID500 500.00	2	0.002610	0.046100	3.510000	☑	☐ From	1205.0	1105.0	1005
151	NUCPLNT 500.00	201	HYDRO 500.00	1	0.001000	0.015000	1.200000	☑	☐ From	1206.0	1106.0	1006
152	MID500 500.00	202	EAST500 500.00	1	0.000800	0.010000	0.950000	☑	☑ From	1207.0	1107.0	1007
152	MID500 500.00	3004	WEST 500.00	1	0.003000	0.030000	2.500000	☑	☐ From	0.0	0.0	0
153	MID230 230.00	154	DOWNTN 230.00	2	0.006000	0.054000	0.150000	☑	☐ From	350.0	0.0	0
153	MID230 230.00	3006	UPTOWN 230.00	1	-0.000000	0.000100	0.000000	☑	☐ From	0.0	0.0	0
154	DOWNTN 230.00	155	FACTS TE 230.00	1	0.005000	0.045000	0.100000	☑	☑ From	400.0	0.0	0
154	DOWNTN 230.00	203	EAST230 230.00	1	0.004000	0.040000	0.100000	☑	☐ From	400.0	0.0	0
154	DOWNTN 230.00	205	SUB230 230.00	1	0.000330	0.003330	0.090000	☑	☐ From	600.0	0.0	0
154	DOWNTN 230.00	3008	CATDOG 230.00	1	0.002700	0.022000	0.300000	☑	☐ From	800.0	0.0	0
201	HYDRO 500.00	202	EAST500 500.00	1	0.002000	0.025000	2.000000	☑	☐ From	1200.0	0.0	0
201	HYDRO 500.00	207	DUPONT 500.00	C1	0.001500	0.015000	1.250000	☑	☐ From	1200.0	0.0	0
203	EAST230 230.00	205	SUB230 230.00	1	0.005000	0.045000	0.080000	☑	☑ From	200.0	0.0	0
204	SUB500 500.00	207	DUPONT 500.00	C2	0.001500	0.015000	1.250000	☑	☐ From	1200.0	0.0	0
205	SUB230 230.00	212	INVERT1 230.00	1	-0.000000	0.010000	0.000000	☑	☑ From	1250.0	0.0	0
205	SUB230 230.00	214	LOADER 230.00	2	0.002000	0.025000	2.000000	☑	☐ From	1200.0	0.0	0
205	SUB230 230.00	216	URBANEAST1 230.	3	0.005000	0.045000	0.080000	☑	☐ From	200.0	0.0	0

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

Each ac network branch to be represented in PSS/E as a branch is introduced by reading a branch data record. The important branch data records that will be considered are:

From Bus Number | From Bus Name — Shows number, name and KV voltage of each bus that is branching from.

To Bus Number | To Bus Name — Shows number, name and KV voltage of each bus that is branching to.

Line R (pu) — Branch resistance; entered in per unit. A value of R must be entered for each branch.

Line X (pu) — Branch reactance; entered in per unit. A nonzero value of X must be entered for each branch.

Charging (pu)

Total branch charging susceptance (imaginary part of admittance); entered in per unit. B = 0.0 by default.

Rate A (I as MVA)

First power rating; entered in MVA. Rate A = 0.0 (bypass check for this branch) by default.

Rate B (I as MVA)

Second power rating; entered in MVA. Rate B = 0.0 by default.

Rate C (I as MVA)

Third power rating; entered in MVA. Rate C = 0.0 by default.

Length

Line length; entered in user-selected units. All lengths are in miles for the purpose of this lab.

Branch data input is terminated with a record specifying a "*from bus*" number of zero.

Loads: loads are the elements which consume power, loads in AC systems consume real and reactive power.

Bus | Plant | Machine | **Load** | Fixed Shunt | Switched Shunt | Branch | Breaker | 2 Winding | 3 Winding

Data entered in the spreadsheet view will be entered in the load flow working case (*.sav file). The source data records may be input from a Machine Impedance Data File or from the dialog input device (console keyboard or Response File). The machines tab can be used to:

1. Add machines at an existing generator bus (i.e., at a plant).
2. Enter the specifications of machines into the working case.
3. To divide and distribute the total plant output power limits proportionally among the machines at the plant.

Bus Number	Bus Name	Id	Area Number/Name	Zone Number/Name	Owner Number/Name	In Service	Scalable	Pload (MW)	Qload (Mvar)	IPload (MW)	IQload (Mvar)	YPload (MW)	YQload (Mvar)
152	MID500 500.00	1	1 CENTRAL	1 NORTH_A1	1 OWNER 1	☑	☑ Yes	1200.0000	360.0000	868.3400	360.5020	837.7940	-351.3380
153	MID230 230.00	1	1 CENTRAL	1 NORTH_A1	1 OWNER 1	☑	☑ Yes	200.0000	100.0000	0.0000	0.0000	0.0000	0.0000
154	DOWNTN 230.00	1	1 CENTRAL	1 NORTH_A1	1 OWNER 1	☑	☑ Yes	400.0000	200.0000	0.0000	0.0000	0.0000	0.0000
154	DOWNTN 230.00	2	1 CENTRAL	1 NORTH_A1	1 OWNER 1	☑	☑ Yes	250.0000	200.0000	0.0000	0.0000	0.0000	0.0000
154	DOWNTN 230.00	3	1 CENTRAL	1 NORTH_A1	1 OWNER 1	☑	☑ Yes	250.0000	100.0000	0.0000	0.0000	0.0000	0.0000
154	DOWNTN 230.00	MO	1 CENTRAL	1 NORTH_A1	1 OWNER 1	☑	☑ Yes	100.0000	80.0000	0.0000	0.0000	0.0000	0.0000
203	EAST230 230.00	1	2 EAST	2 MID_A1_A2_A5	2 OWNER 2	☑	☑ Yes	500.0000	250.0000	0.0000	0.0000	0.0000	0.0000
205	SUB230 230.00	1	2 EAST	2 MID_A1_A2_A5	2 OWNER 2	☑	☑ Yes	1800.0000	600.0000	0.0000	0.0000	0.0000	0.0000
205	SUB230 230.00	B	2 EAST	2 MID_A1_A2_A5	2 OWNER 2	☑	☑ Yes	90.0000	5.0000	110.0000	25.0000	20.0000	10.0000
205	SUB230 230.00	C	2 EAST	2 MID_A1_A2_A5	2 OWNER 2	☑	☑ Yes	60.0000	15.0000	45.0000	5.0000	35.0000	30.0000
214	LOADER 230.00	1	2 EAST	2 MID_A1_A2_A5	2 OWNER 2	☑	☑ Yes	500.0000	75.0000	0.0000	0.0000	0.0000	0.0000
215	URBANEAST1 18.0	U1	2 EAST	4 SOUTH_A1_A5	2 OWNER 2	☑	☑ Yes	0.0000	140.0000	0.0000	0.0000	0.0000	0.0000
216	URBANEAST1 230.	U1	2 EAST	4 SOUTH_A1_A5	2 OWNER 2	☑	☑ Yes	0.0000	12.0000	0.0000	0.0000	0.0000	0.0000
217	URBANEAST1 230.	U1	2 EAST	4 SOUTH_A1_A5	2 OWNER 2	☑	☑ Yes	0.0000	10.0000	0.0000	0.0000	0.0000	0.0000
218	URBANEAST1 230.	U1	2 EAST	4 SOUTH_A1_A5	2 OWNER 2	☑	☑ Yes	0.0000	9.0000	0.0000	0.0000	0.0000	0.0000
3005	WEST 230.00	1	5 WEST	5 ALL_A3	5 OWNER 5	☑	☑ Yes	100.0000	50.0000	0.0000	0.0000	0.0000	0.0000
3007	RURAL 230.00	1	5 WEST	5 ALL_A3	5 OWNER 5	☑	☑ Yes	200.0000	75.0000	0.0000	0.0000	0.0000	0.0000
3008	CATDOG 230.00	1	5 WEST	5 ALL_A3	5 OWNER 5	☑	☑ Yes	200.0000	75.0000	0.0000	0.0000	0.0000	0.0000
3009	URBANWEST1 230.	1	5 WEST	4 SOUTH_A1_A5	5 OWNER 5	☑	☑ Yes	1.1000	0.9000	0.0000	0.0000	0.0000	0.0000
3010	URBANWEST2 21.6	1	5 WEST	4 SOUTH_A1_A5	5 OWNER 5	☑	☑ Yes	12.0000	5.0000	0.0000	0.0000	0.0000	0.0000
						☑	☑ Yes						

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

The important parameters for the machines tab are described below:

Bus Number | **Bus Name** It shows the bus's (number, name and KV voltage) where the machine is located.

Id This is a one, or two, character uppercase, nonblank, alphanumeric machine identifier. It is used to distinguish among multiple machines at a plant (i.e., at a generator bus). At buses in which there is a single machine present, ID =1

In Service A check mark indicates that a certain machine at a "Bus Number/Name" is fully operational. If for any reason a certain machine at a "Bus Number/Name" needs to be taken out of service, simply un-check that particular one and click the line above or below to make your changes final.

Pload (MW) This shows how much active power of particular load is connected to this bus.

Qload (Mvar) This shows how much reactive power of particular load is connected to this bus.

** Buses can have more than one load attached to them and designed different by their "Id"

For instance, bus 154 has two loads attached as shown in load tap under **Id**

2 Winding Transformer: two to one Transformer

Bus | Plant | Machine | Load | Fixed Shunt | Switched Shunt | Branch | Breaker | **2 Winding** | 3 Winding

Each transformer to be represented in PSS/E is introduced by reading a transformer data record block. The transformer data record block can be accessed by clicking the 2 Winding Transformer tab. The important parameters for this tab are explained below

From Bus Number	From Bus Name	To Bus Number	To Bus Name	Id	Name	In Service	Metered	Winding 1 Side	Controlled Bus	Controlled Side	Ta Posit
101	NUC-A 21.600	151	NUCPLNT 500.00	T1	NUCA GSU	✓	✓ From	✓ From	101	✓ Tapped	
102	NUC-B 21.600	151	NUCPLNT 500.00	T2	NUCB GSU	✓	✓ From	✓ From	102	✓ Tapped	
152	MID500 500.00	153	MID230 230.00	T3	MID LTC	✓	✓ From	✓ From	154	Tapped	
152	MID500 500.00	3021	WDUM 18.000	T4	WDUM DC	✓	✓ From	✓ From	0	Tapped	
152	MID500 500.00	3022	EDUM 18.000	T5	EDUM DC	✓	✓ From	✓ From	0	Tapped	
154	DOWNTN 230.00	9154	WINDBUS1 4.1600	W1	WTG1XMER	✓	✓ From	✓ From	0	Tapped	
201	HYDRO 500.00	211	HYDRO_G 20.000	T6	HYDRO_G XMER	✓	✓ From	✓ From	0	Tapped	
202	EAST500 500.00	203	EAST230 230.00	T7	EAST PS	✓	✓ From	From	0	Tapped	
204	SUB500 500.00	205	SUB230 230.00	T8	SUB LTC	✓	✓ From	✓ From	205	Tapped	
204	SUB500 500.00	9204	WINDBUS2 0.5750	W2	WTG2XMER	✓	✓ From	✓ From	0	Tapped	
205	SUB230 230.00	206	URBGEN 18.000	T9	URB TX	✓	✓ From	✓ From	0	Tapped	
3002	E. MINE 500.00	93002	WINDBUS3 0.6900	W3	WTG3XMER	✓	✓ From	✓ From	0	Tapped	
3004	WEST 500.00	3005	WEST 230.00	10	WEST TX	✓	✓ From	From	0	Tapped	
3008	CATDOG 230.00	3018	CATDOG_G 13.80	11	CATDOG_XMER	✓	✓ From	✓ From	0	Tapped	
						✓	✓ From	✓ From		Tapped	

Bus | Plant | Machine | Load | Fixed Shunt | Switched Shunt | Branch | Breaker | **2 Winding** | 3 Winding | Impedance table | FACTS

From Bus Number	From Bus Name

This states the first bus number and the bus name with bus kV in their respective columns. It is connected to winding one of the transformers included in the system. The transformer's magnetizing admittance is modeled on winding one. Winding one is the only winding of a two winding transformer whose tap ratio or phase shift angle may be adjusted by the power flow solution activities. No default is allowed.

To Bus Number	To Bus Name

This states the second bus number and the bus name with bus kV in their respective columns. It is connected to winding two of the transformers included in the system. No default is allowed.

In Service

A check mark indicates that a certain two winding transformer between two buses is fully operational. If for any reason a transformer needs to be taken out of service, simply un-check that particular one and click the line above or below to make your changes final. The default is in service.

Switched Shunts: capacitive or inductive to reduce reactive power in the system. We will designate both capacitors and inductors as "Reactive Elements" when speaking in general terms.

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

Shunts are used in the power system to improve the quality of the electrical supply and the efficient operation of the power system. There are two types of shunt compensation; shunt capacitive compensation and shunt inductive compensation. Generally refers to in industry as capacitors or inductors, the shunt capacitive compensation is used to improve the power factor while the shunt inductive compensation is used to maintain the required voltage level, generally in the case of a very long transmission line. Switched shunts are simply shunts that have the ability to be controlled.

	Bus Number	Bus Name	In Service	Control Mode	Adjustment Method	Vhi (pu)	Vlo (pu)	Remote Bus	Remote Bus Name
	152	MID500 500.00	☑	Discrete, cntr voltage (1)	Sequential input order (0)	1.0450	0.9550	0	
	154	DOWNTN 230.00	☑	Discrete, cntr voltage (1)	Sequential input order (0)	1.0448	0.9650	0	
	3005	WEST 230.00	☑	Discrete, cntrl VSC conv Mvar (4)	Sequential input order (0)	0.9800	0.6400	3005	WEST 230.00
	3021	WDUM 18.000	☑	Continuous, cntrl voltage (2)	Sequential input order (0)	1.0000	1.0000	0	
	3022	EDUM 18.000	☑	Continuous, cntrl voltage (2)	Sequential input order (0)	1.0000	1.0000	0	
	93002	WINDBUS3 0.6900	☑	Discrete, cntr voltage (1)	Sequential input order (0)	0.9963	0.9963	0	
*			☑	Locked (0)	Sequential input order (0)				

Bus / Plant / Machine / Load / Fixed Shunt / **Switched Shunt** / Branch / Breaker / 2 Winding / 3 Winding / Impedance table / FACTS / 2-Te

The "Switched Shunts" tab in PSS®E lists all of the shunt compensation in the overall system, both capacitive and inductive, along with all of the pertinent information for the switched shunts:

Bus Number | **Bus Name**

This displays the Bus Number and the bus name with the bus voltage in kV in their respective columns. This is the bus to which the shunt is connected.

Remote Bus

This lists the bus, by number, whose voltage or connected equipment controls this switched shunt. For example, if there is a bus number other than 0 in the remote bus column then that bus number controls the shunt.

Vhi (pu)

This lists the high voltage limits (in per unit) and can be used as a trigger point to control or switch reactive elements. The default for VHI is 1.

Vlo (pu)

This lists the low voltage limits (in per unit) and can be used as a trigger point to control or switch reactive elements.

Binit (Mvar)

This lists the initial surge (or charge) admittance of the connected shunt (in MVAR's at unity voltage). Enter a (+) for capacitance or (-) for inductance.

Blk 1 Steps

Reactive (capacitors or inductors) elements are added incrementally utilizing a Block(#) steps that contain a number of steps per, or, Blk(#) Bstep. For example, if Blk1 has 5 steps containing Bstep of 10 MVar Blk2 has 10 steps containing Bstep of 5 MVar, the user could choose 2 x 10 (Blk1 contribution) + 1 x 5 (Blk2 contribution) MVar for a total 25 MVar of reactive compensation.

Binit (Mvar)	Blk 1 Steps	Blk 1 Bstep (Mvar)	Blk 2 Steps	Blk 2 Bstep (Mvar)	Blk 3 Steps	Blk 3 Bstep (Mvar)	Blk 4 Steps	Blk 4 Bstep (Mvar)	Blk 5 Steps	Blk 5 Bstep (Mvar)	Blk 6 Steps	Blk 6 Bstep (Mvar)	Blk 7 Steps	Blk 7 Bstep (Mvar)
-233.00	1	-15.00	2	-5.00	3	-10.00	4	-8.00	5	-7.00	6	-5.00	7	-7.00
124.00	1	25.00	2	10.00	2	15.00	1	15.00	2	5.00	3	3.00	2	4.00
0.00	1	33.35	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
496.81	2	200.00	1	100.00	2	50.00	4	25.00	0	0.00	0	0.00	0	0.00
597.16	4	100.00	2	50.00	4	25.00	3	20.00	2	20.00	0	0.00	0	0.00

Refer to the highlighted line in the table above, the initial value of reactive compensation is 597.16MVar. Additionally, there are 4 steps of Blk1 with 100 MVar, 2 steps of Blk2 with 50 MVar, 4 steps of Blk3 with 25 MVar, 3 steps of Blk4 with 20 MVar and 2 steps of Blk5 with 20 MVar. In total, the system will have 700 MVar of additional compensation add to the initial 597.16 MVar which makes a total of 1297.16 MVar.

* We will refer reactive element to both Capacitor and Inductor otherwise, we specify Capacitor as Positive or Negative and Inductor as Positive or Negative too.

** Formulas needed to answer Lab1 questions:

$$ApparentPower\ (S)\ MVA = \sqrt{RealPower^2 (P)\ MW + REactivePower^2 (Q)\ MVar}$$

$$PowerFactor = \frac{RealPower\ (P)}{ApparentPower\ (S)}$$

** RealPower = ActivePower

PSSE Lab # 1 Questions:

Open the "***sample.sav***" data file to answer the following questions.

1) Go to the "Bus" tab. Find bus #3008.
a) What is the name of this bus and its rated voltage? ___________________
b) Based on the code number, what type of bus is this? __________________

2) Now go to the "Branch" tab. Find the branch that connects bus #201 to bus #207.
a) What are the names of the buses that are connected and the rated voltage of the branch?

____

b) What is the rated resistance and reactance of this branch (both in [per unit])?

____

____

3) Now go to the "Load" tab. Find load connected to bus #214 (LOADER, 230kV).
a) What are the active (MW) and reactive (MVAR) components of this load?

____

b) Based on the results from above, what is the real power and power factor of this load?

____

4) Now go to the "Machine" tab. Find generator connected to bus #402 (COGEN-2, 500kV).
a) What are the maximum and minimum active power ratings of this generator (in MW)?

____

b) What are the maximum and minimum reactive power ratings of this generator (in MVAR)?

____

5) Now go to the "2 Winding XFMR" tab. Find the transformer connected to bus #204 and bus #205.
a) What are the MVA ratings of this transformer?
Rate A=_________________ Rate B=__________________ Rate C=_________________
b) Is this transformer in service? ________________________
c) What is the High side Voltage? _______kV, What is the Low side Voltage? _______kV

6) Now go to the "Switched Shunt" tab. Find shunt compensator connected to bus #154 (DOWNTN 230.000, 230KV).
a) How many steps are there to the shunt compensator and what is each of their values (in MVAR)?

____

____

b) What type of shunt compensator is this (capacitive, inductive, or mixed)?

7) While you are in the “Switched Shunt” tab, Complete the missing Mvar values using the table below for BUS 3021?

BLK#	**Steps**	**Compensation/Steps#**	**Total in Mvar**
1	2	200	
2		100	
3	2		100
4			
		Subtotal	
	Binit (Mvar)		
		Totals	