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

LAB5
MULTIPLE AC CONTINGENCY CALCULATION REPROTS

Power Systems Simulations
Colorado State University

Purpose of the lab:

This lab was designed to show the student how to adjust one-line diagram file (sample.sld) and then solve to reach better power flow with no overloads. The student is supposed to add another line (Branch) between bus 153 and bus 154. Then, solve the system and do the necessary adjustment to fix the overload in the system. This lab will explain how the Multiple AC Contingency calculation report feature of PSS®E creates a single report with multiple ACCCs into one file. This lab will introduce the following aspects:

- Add line in the data file (*.sav)
- Add branch to the slider file (*.sld)
- Create ACCC files
- Run ACCC
- Run Multiple ACCC

Important definition for better comprehension to this lab:
·   **Sample.sld file: (described in lab 2)**
*.sld – Slider file (Single Line Diagram) This file allows for performing network analysis studies on the grid. Sliders are visual displays of the grid. It includes buses, branches, lines, loads, generators, transformers etc... All components should be color coded based on voltage flow. The slider file can also show the operational ratings (power flowing across the component relative to the capacity) of the listed components. This network can be divided on several zones and areas based on the need of the user.

🞡 **The following steps are to guide student through this lab and assure them learning the skills of creating Multiple ACCC reports supposed to provide:**

1. Start **PSS®E** as it was shown in lab1.
2. Open the sample.sav file from your PSSE Labs folder as it was shown in lab1.
3. Open the sample.sld file from your PSSE Labs folder as it was shown in lab2.
4. Create a new folder in your PSSE Labs folder and name it "Lab5"
5. Once both files are opened, Go to the sample.sav file and click on the Branch tab as shown below.

| Bus | Plant | Machine | Load | Fixed Shunt | Switched Shunt | **Branch** |
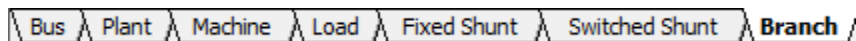
🞡 **Add Line to Sample.sav:**
A. From the far left of the sample.sav table click on the row which shows the branch from bus #153 to bus #154 as shown.

	152	MID500	500.00		3004	WEST	500.00	1	0.003000	0.030000	2.500000	☑
▶	153	MID230	230.00		154	DOWNTN	230.00	2	0.006000	0.054000	0.150000	☑
	153	MID230	230.00		3006	UPTOWN	230.00	1	-0.000000	0.000100	0.000000	☑

B. Right click and select copy

153	MID230	230.00	154	DOWNTN	230.00	2	0.006000	0.054000	0.150000	☑

| Copy | Ctrl+C | 0.00 | 3006 | UPTOWN | 230.00 | 1 | -0.000000 | 0.000100 | 0.000000 | ☑ |
| Paste | Ctrl+V | 230.00 | 155 | FACTS TE | 230.00 | 1 | 0.005000 | 0.045000 | 0.100000 | ☑ |

C. Right click on the empty bottom row of the table and select paste

*							☑
Copy	Ctrl+C						
Paste	Ctrl+V						

D. The new branch created between BUS#153 to BUS#154.

	3008	CATDOG	230.00	3009	URBANWEST1 230.00	1	0.003000	0.025000	0.060000	☑
	153	MID230	230.00	154	DOWNTN	230.00	2	0.006	0.054	0.15	☑

E. **Id** Code has to be changed to 3 according to how many branches between the two buses. Arrow Up will sort automatically below the original one.

▶	153	MID230	230.00	154	DOWNTN	230.00	2	0.006000	0.054000	0.150000	☑
	153	MID230	230.00	154	DOWNTN	230.00	3	0.006000	0.054000	0.150000	☑

F. To save the new sample file press on your keyboard *Ctrl+S* and a save network data widow will open on the screen. Under the Case Data tab navigate to Lab5 folder and type "*sampleL5*" then Click OK using the pictures below:

Save Network Data				
Optimal Power Flow Data			Machine Impedance Data	
Transaction Data		IEEE Format Power Flow Data	UCTE Data	
Case Data	Power Flow Raw Data	Power Flow Raw Data, Previous Versions	Sequence Data	

Destination

U:\PSSE Labs\LAB5\sampleL5.sav [...]

Save case data file

« PSSE Labs ▶ LAB5   ▾ ↵ Search LAB5

Organize ▾   New folder

Favorite
Deskt
Down
Recer

Librarie

Compu

Networ

Name	Date modified	Type	S
sampleL5.sav	4/21/2013 5:25 PM	IDLbinaryFile	

File name: sampleL5.sav   ▾   Save Case file (*.sav) ▾

Open   Cancel

G. Solve the system on the toolbar shown below:

The following window will appear, make sure that you solve the system using the steps stated below:
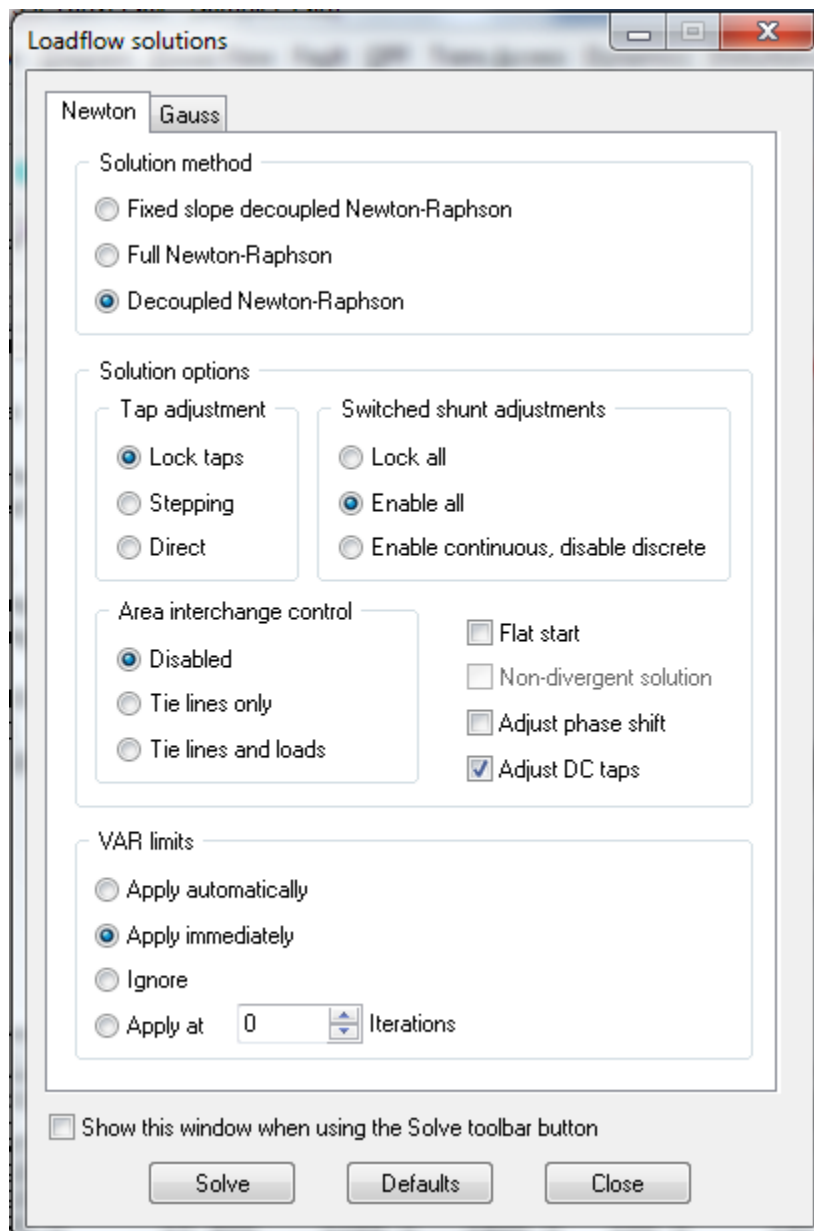
i.   Switched shunt adjustments, Choose **Enable All**
ii.   VAR limits, Choose **Apply immediately**
iii. Click **Solve**

iv. Switched shunt adjustments, Choose ***Lock All***

v. Keep VAR limits as ***Apply immediately*** then click ***Solve***

Image of the progress window with minimum number of iterations

```
REACHED TOLERANCE IN   1 ITERATIONS

LARGEST MISMATCH:     0.00 MW    -0.01 MVAR      0.01 MVA AT BUS     153 [MID230       230.00]
SYSTEM TOTAL ABSOLUTE MISMATCH:                   0.04 MVA

SWING BUS SUMMARY:
  BUS# X-- NAME --X BASKV      PGEN      PMAX      PMIN      QGEN      QMAX      QMIN
   301 NORTH       765.00    2990.6    3033.0     963.0     898.6    2130.0  -1850.0
   401 COGEN-1     500.00     321.0     350.0      25.0     142.3     600.0   -100.0
   402 COGEN-2     500.00     321.0     351.0      26.0     142.3     610.0   -110.0
  3011 MINE_G       19.400   1288.1    1400.0     100.0     146.9     620.0   -120.0
```

H. Now go to the Subsystem menu and select Area. Move "*Central*" to selected areas on the right side of the box.

I. Click Apply and close.
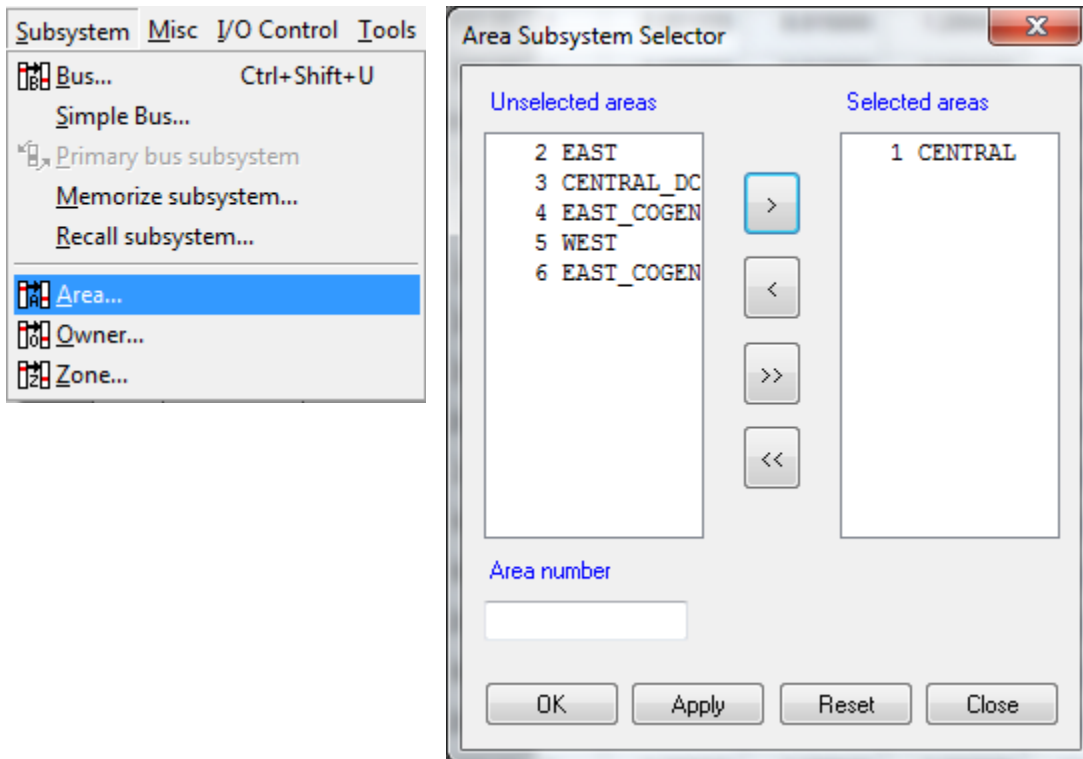
Add Branch to sample.sld:

1. Go to the **sample.sld** and find bus number 153
2. Click on Bus#153
3. Once the bus selected use right click on the bus to open the list below.

4. Scroll down to Grow N levels – make sure that the number of level on the next box will be one and hit OK.
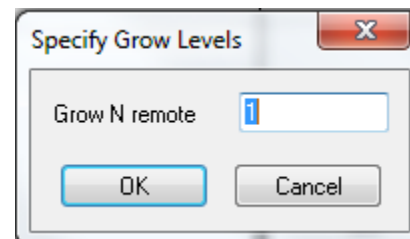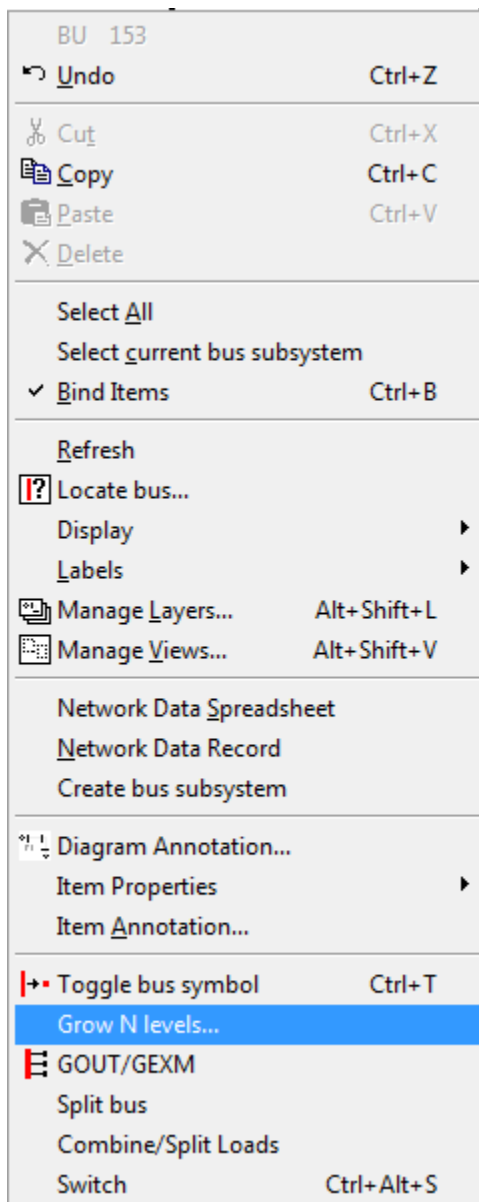
5. An image of the adjusted slider file is provided below; it shows that the added line is kind of hidden behind another element Zoom in.
6. Rearrange the branch to be visible.

Changing the position of the line

The added line is hidden!!

The added line appears here
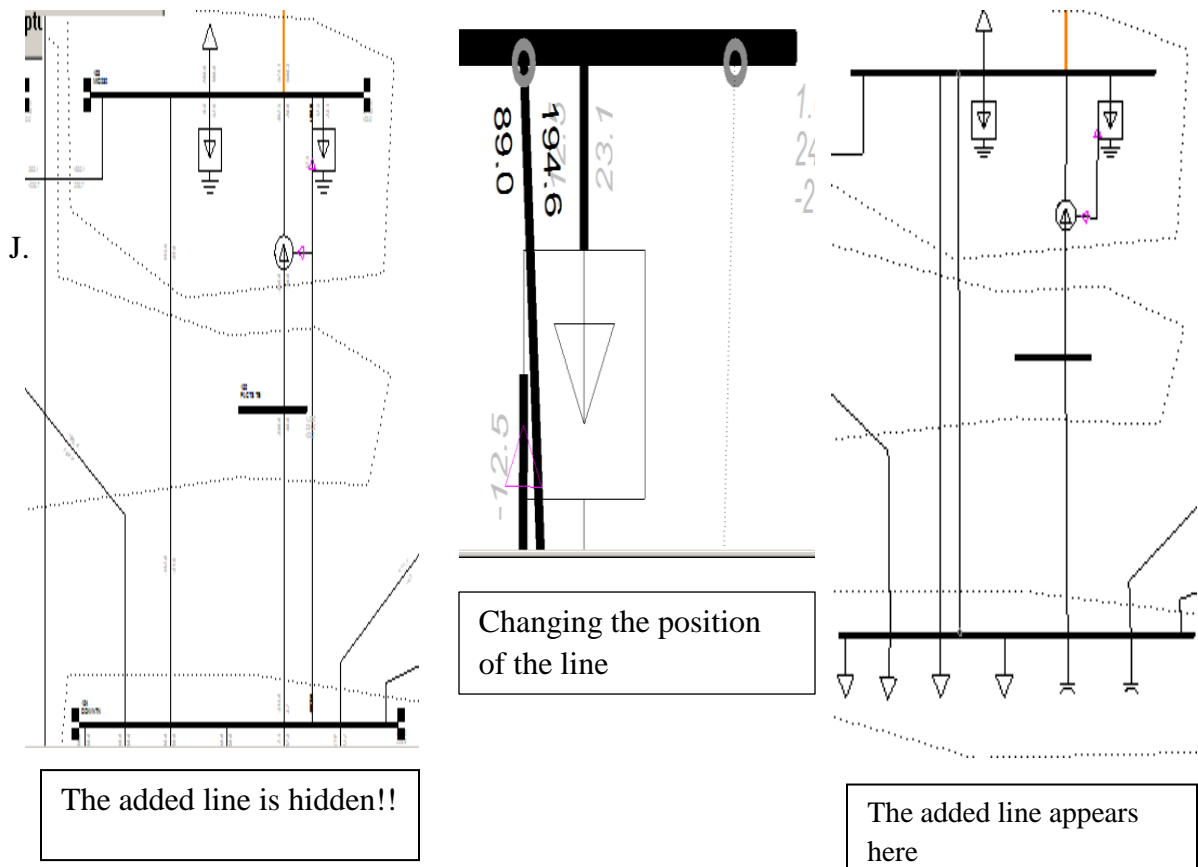
7. Save the new slider file and name it **SampleL5.sld**

➕ Create ACCC files:
** Refer to LAB4 under Notepad section:
- ➤ Create subsystem file and name it **"area1c.sub"**
- ➤ Create monitor file and name it **"area1c.mon"**
- ➤ The files *Must* be exactly the same as lab4.
- ➤ Create and Modify contingency file and name it **"area1c.con"**
- ➤ Add the branch code Bus#153 to Bus#154 to *area1c.con.*
- ➤ Save and close.

Run ACCC:

Use the three files created in the previous section to create DFAX file **"area1c.dfx"** and name the ACCC reports **"area1c.acc"**

- ➢ Area1c.sub
- ➢ Area1c.mon
- ➢ Area1c.con

```
<---------------- MULTI-SECTION LINE ----------------> <------------- MONITORED BRANCH -------------------> CONTINGENCY   RATING    FLOW      %
                                                        152*MID500    500.00     153 MID230   230.00 T3 BASE CASE    800.0    867.0   108.4
                                                        152*MID500    500.00     153 MID230   230.00 T3 NUC-MID-1    800.0    820.7   102.6
                                                        152*MID500    500.00     153 MID230   230.00 T3 NUC-MID-2    800.0    820.0   102.5
                                                        152*MID500    500.00     153 MID230   230.00 T3 NUC-HYD-1    800.0    969.8   121.2
                                                        152*MID500    500.00     153 MID230   230.00 T3 MID-EAS-1    800.0   1014.6   126.8
                                                        152*MID500    500.00     153 MID230   230.00 T3 MID-WES-1    800.0    827.8   103.5
                                                        152*MID500    500.00     153 MID230   230.00 T3 MID-UPT-1    800.0    977.9   122.2
                                                        152*MID500    500.00     153 MID230   230.00 T3 DOW-EAS-1    800.0    896.6   112.1
                                                        152*MID500    500.00     153 MID230   230.00 T3 DOW-CAT-1    800.0    926.6   115.8

MONITORED VOLTAGE REPORT:
SYSTEM                    CONTINGENCY    <-------- B U S --------->   V-CONT    V-INIT    V-MAX     V-MIN
'CENTRAL_1A '          RANGE BASE CASE     153 MID230      230.00   1.05119   1.05119   1.05000   0.95000
'CENTRAL_1A '          RANGE MID-EAS-1     153 MID230      230.00   1.05181   1.05119   1.05000   0.95000
'CENTRAL_1A '          RANGE MID-DOW-2     153 MID230      230.00   1.05721   1.05119   1.05000   0.95000
'CENTRAL_1A '          RANGE MID-DOW-3     153 MID230      230.00   1.05721   1.05119   1.05000   0.95000
'CENTRAL_1A '          RANGE MID-UPT-1     153 MID230      230.00   1.06462   1.05119   1.05000   0.95000
'CENTRAL_1A '          RANGE DOW-FAC-1     153 MID230      230.00   1.05455   1.05119   1.05000   0.95000
'CENTRAL_1A '          RANGE DOW-EAS-1     153 MID230      230.00   1.05078   1.05119   1.05000   0.95000

CONTINGENCY LEGEND:
LABEL           EVENTS
NUC-MID-1    : OPEN LINE FROM BUS 151 [NUCPLNT     500.00] TO BUS 152 [MID500      500.00] CKT 1
NUC-MID-2    : OPEN LINE FROM BUS 151 [NUCPLNT     500.00] TO BUS 152 [MID500      500.00] CKT 2
NUC-HYD-1    : OPEN LINE FROM BUS 151 [NUCPLNT     500.00] TO BUS 201 [HYDRO       500.00] CKT 1
MID-EAS-1    : OPEN LINE FROM BUS 152 [MID500      500.00] TO BUS 202 [EAST500     500.00] CKT 1
MID-WES-1    : OPEN LINE FROM BUS 152 [MID500      500.00] TO BUS 3004 [WEST        500.00] CKT 1
MID-DOW-2    : OPEN LINE FROM BUS 153 [MID230      230.00] TO BUS 154 [DOWNTN      230.00] CKT 2
MID-DOW-3    : OPEN LINE FROM BUS 153 [MID230      230.00] TO BUS 154 [DOWNTN      230.00] CKT 3
MID-UPT-1    : OPEN LINE FROM BUS 153 [MID230      230.00] TO BUS 3006 [UPTOWN      230.00] CKT 1
DOW-FAC-1    : OPEN LINE FROM BUS 154 [DOWNTN      230.00] TO BUS 155 [FACTS TE    230.00] CKT 1
DOW-EAS-1    : OPEN LINE FROM BUS 154 [DOWNTN      230.00] TO BUS 203 [EAST230     230.00] CKT 1
DOW-SUB-1    : OPEN LINE FROM BUS 154 [DOWNTN      230.00] TO BUS 205 [SUB230      230.00] CKT 1
DOW-CAT-1    : OPEN LINE FROM BUS 154 [DOWNTN      230.00] TO BUS 3008 [CATDOG      230.00] CKT 1
```
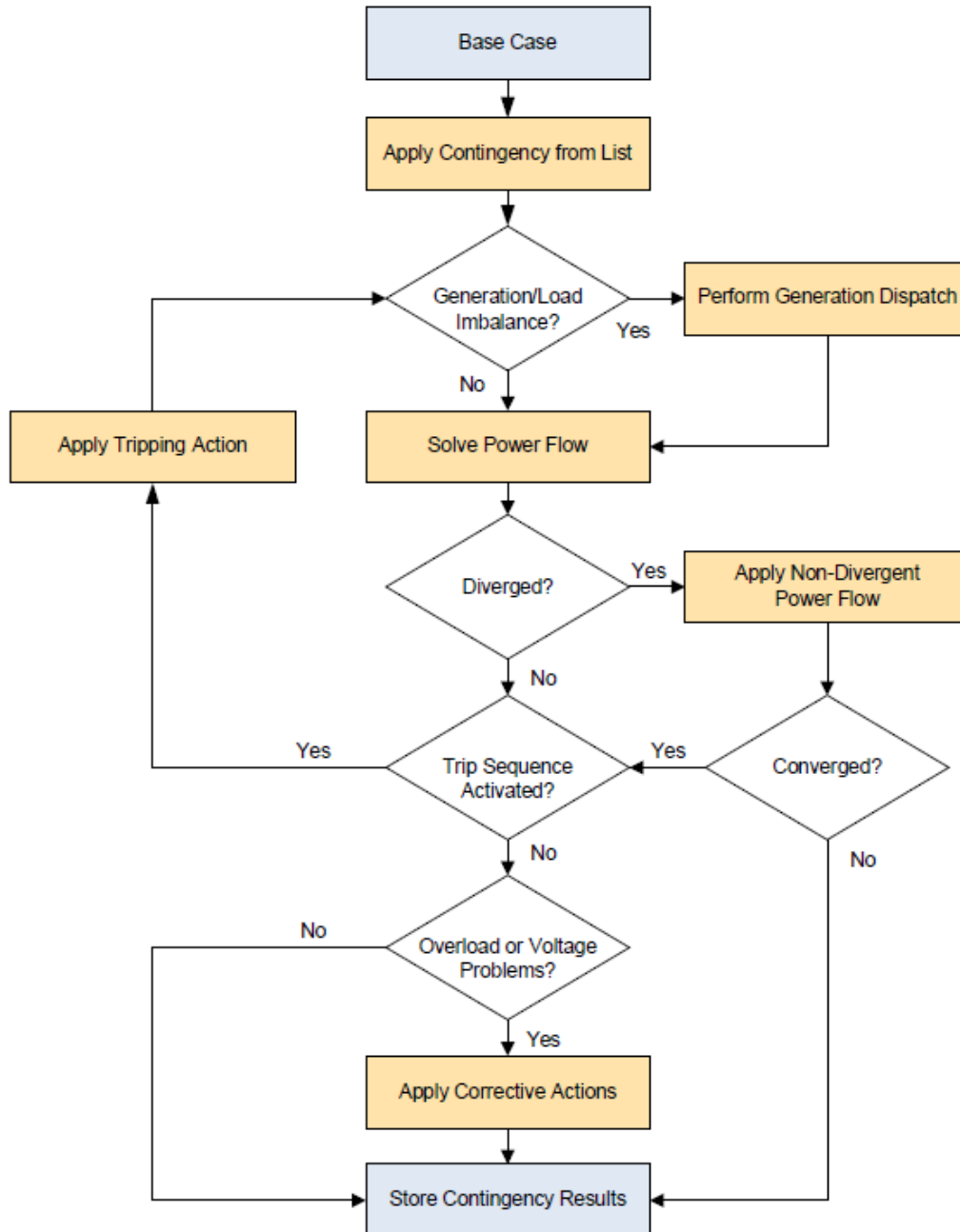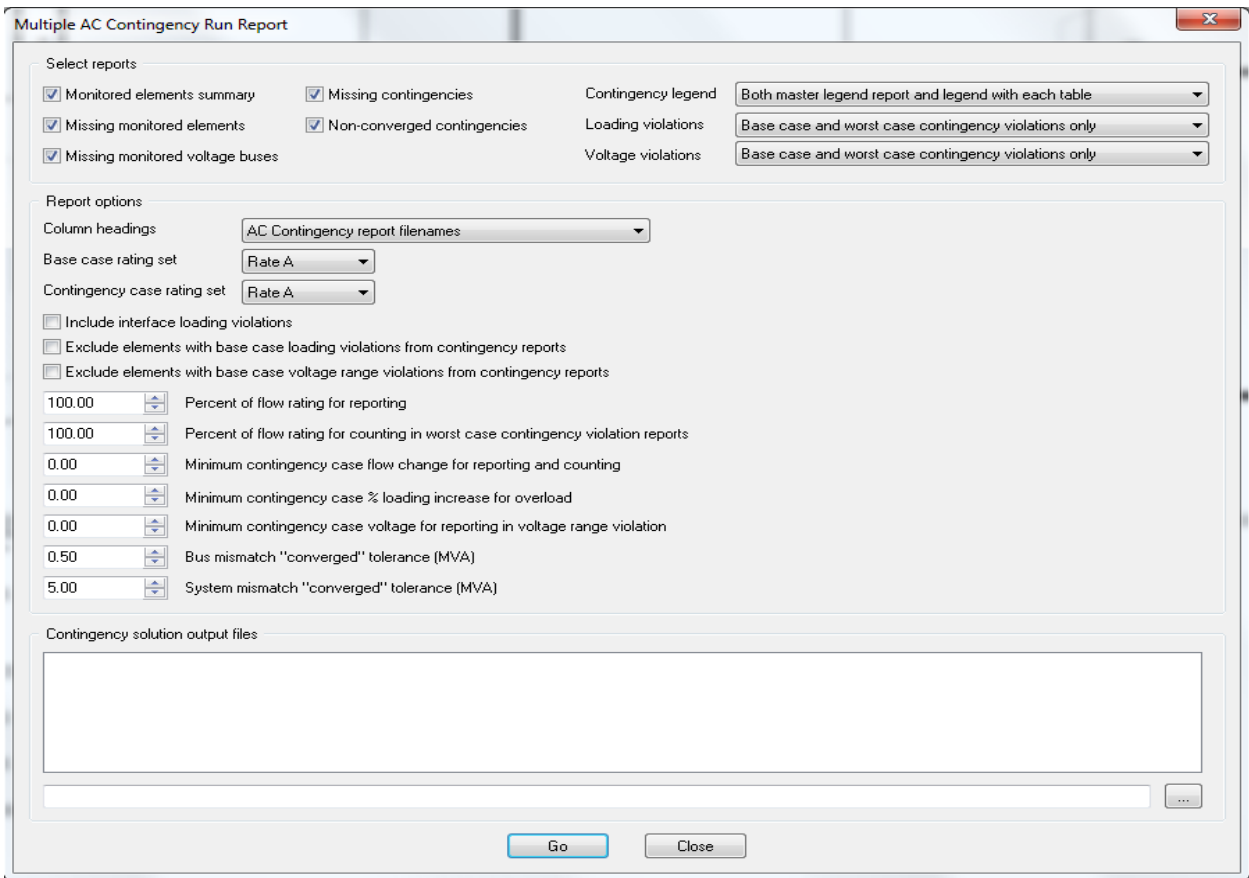
✚ Run Multiple ACCC reports:

The PSS®E Multiple AC Contingency reports feature can be used to perform. The multiple allows running ACCC reports contingencies within one run and compares up to nine contingency runs(Multiple *.acc) . This is a very powerful tool when side by side study comparisons are needed. Computational procedures in a contingency analysis shown in the diagram below:

```
                        ┌──────────────────┐
                        │    Base Case     │
                        └──────────────────┘
                                  │
                        ┌──────────────────────┐
                        │ Apply Contingency     │
                        │ from List             │
                        └──────────────────────┘
                                  │
                    ╱ Generation/Load ╲        ┌───────────────────────────┐
                   ╱  Imbalance?        ╲──Yes─▶│ Perform Generation Dispatch│
                    ╲                   ╱        └───────────────────────────┘
                       No                                 │
  ┌─────────────────┐              ┌──────────────────┐   │
  │ Apply Tripping  │              │ Solve Power Flow │◀──┘
  │ Action          │              └──────────────────┘
  └─────────────────┘                       │
                            ╱ Diverged? ╲──Yes──▶ ┌────────────────────┐
                            ╲           ╱          │ Apply Non-Divergent│
                               No                  │ Power Flow         │
                                │                  └────────────────────┘
              Yes  ╱ Trip Sequence ╲  Yes          │
            ◀─────╲ Activated?     ╱◀───── ╱ Converged? ╲
                     No                     ╲           ╱
                      │                        No
               ╱ Overload or Voltage ╲
          No──╲ Problems?            ╱
                      │ Yes
              ┌──────────────────────┐
              │ Apply Corrective     │
              │ Actions              │
              └──────────────────────┘
                      │
              ┌──────────────────────┐
              │ Store Contingency    │
              │ Results              │
              └──────────────────────┘
```

a- Go to Toolbar and click on Power Flow menu
b- Scroll down to Reports.
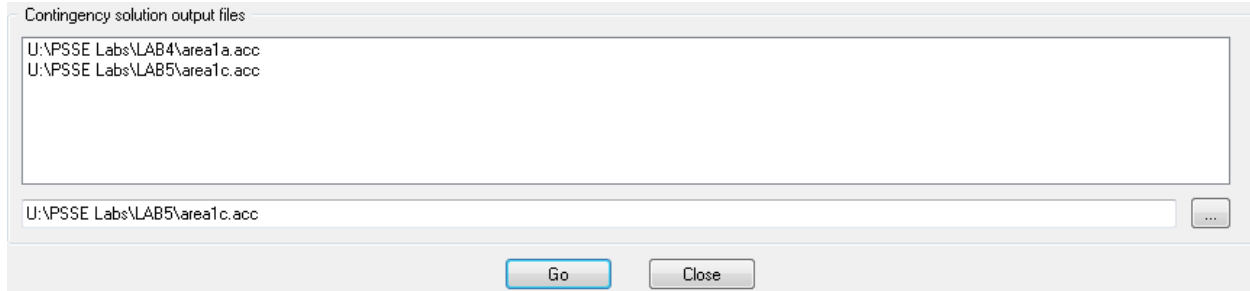c- Under Reports click on Multiple AC Contingency run report…
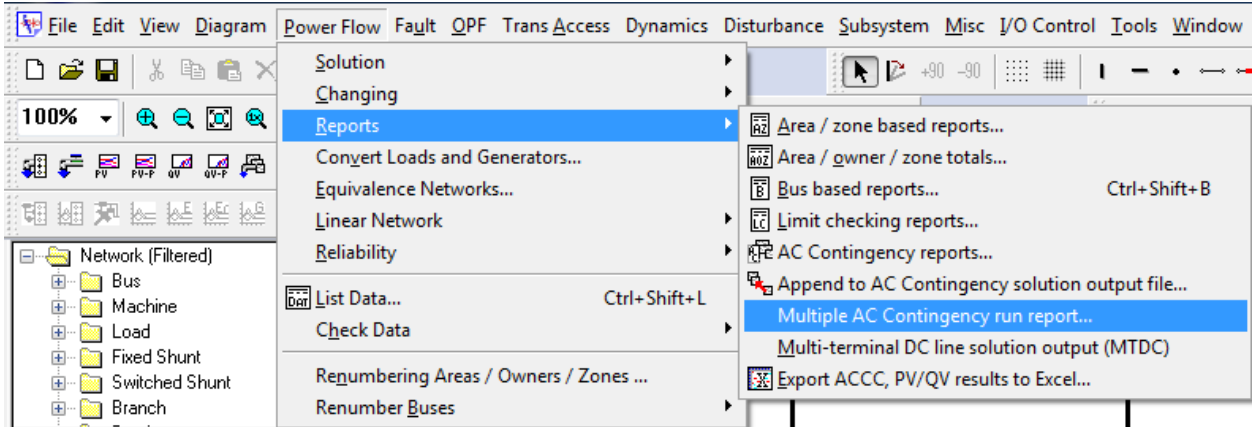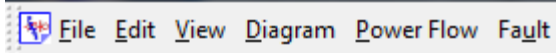
This window will appear:

d- Go to Contingency solution output box and click [...]

e- Navigate to your LAB4 folder and choose area1a.acc

f- Navigate to your LAB5 folder and choose area1c.acc

```
Contingency solution output files
┌─────────────────────────────────────────────────────────────────────┐
│ U:\PSSE Labs\LAB4\area1a.acc                                          │
│ U:\PSSE Labs\LAB5\area1c.acc                                          │
│                                                                       │
│                                                                       │
│                                                                       │
│                                                                       │
└─────────────────────────────────────────────────────────────────────┘
 U:\PSSE Labs\LAB5\area1c.acc                                      [ ... ]

                          [   Go   ]    [  Close  ]
```

g- Hit Go.

The Multiple ACCC reports display in the report window that contains 15 pages. Go to page 9 and check the changes on the Added line.

```
·································································································
·           PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS®E      FRI, MAY 10 2013  21:39           PAGE 9 ·
·                                                                                               ·
·                      AC CONTINGENCY REPORT FOR 2 AC CONTINGENCY CALCULATION RUNS               ·
·                                                                                               ·
·        CONTINGENCY CASE MONITORED BRANCHES LOADED ABOVE 100.0% OF RATING SET A - WORST CASE VIOLATIONS ·
·             % LOADING VALUES ARE % MVA FOR TRANSFORMERS AND % CURRENT FOR NON-TRANSFORMER BRANCHES ·
·             THRESHOLD FOR THE COUNT OF CONTINGENCIES CAUSING OVERLOADING IS 100.0% OF RATING SET A ·
·································································································
```

X--- MONITORED ELEMENT ----X	X---LABEL--X	...\LAB4 \area1a. acc	...\LAB5 \area1c. acc
152 MID500 500.00 153 MID230 230.00 T3	MID-EAS-1	112.5% 900MVA (3x)	
153 MID230 230.00 154 DOWNTN 230.00 2	DOW-CAT-1	129.2% 448MVA (4x)	100.8% 351MVA (1x)
153 MID230 230.00 154 DOWNTN 230.00 3	DOW-CAT-1		100.8% 351MVA (1x)

```
CONTINGENCY LEGEND:
X--LABEL---X  EVENTS
MID-EAS-1   : OPEN LINE FROM BUS 152 [MID500     500.00] TO BUS 202 [EAST500     500.00] CKT 1
DOW-CAT-1   : OPEN LINE FROM BUS 154 [DOWNTN     230.00] TO BUS 3008 [CATDOG      230.00] CKT 1
```

PSSE Lab # 5 Questions:

1) Print out the Multiple ACCC report "area1c.acc"?
2) After the impact of the contingencies and loads, explain how it affects area1?
3) Add transformer between Bus#152 and Bus#153, follow the same method of adding line in this lab and name the contingency output solution "area1T.acc". Show the ACCC report "area1T.acc"?
4) Print and compare the three contingency report area1a.acc, area1c.acc, and area1T.acc in one report?