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EXPERIMENT # 1

Introduction to Power World Simulator. Symmetrical and Unsymmetrical Fault analysis in Power world Simulator.

Objective:

At the end of this lab session students will be able to

- To design Electric Power Transmission system in in Power World Simulator.
- To observe power flow in power System.
- To analyse different types of faults.

Introduction:

Power World is a great and “powerful” utility for solving power flows. Solving a power system is a little different from circuit analysis. Instead of being given voltages at certain nodes or impedances, you are often given load and generator powers. This makes solving the circuit difficult to do by hand, but easy using a tool like Power World. Most utilities use Power World or similar programs for solving their systems, such as PSS/E.

Adding Power World to your CAE Start Menu:

1. Add Power World to your CAE start menu. In a CAE computer lab, click Start -> CAE Applications ->Add Applications to Start Menu, and search for Power World.
2. Launch Power World.

Mode of Operations:

There are two modes of operations.

- Run Mode
- Edit Mode

Edit Mode of Operation:

In edit mode of operation the network is designed. All changings of network is done in this mode of operation. The window of draw network is in Edit mode of operation in which options of drawing all components are presents.

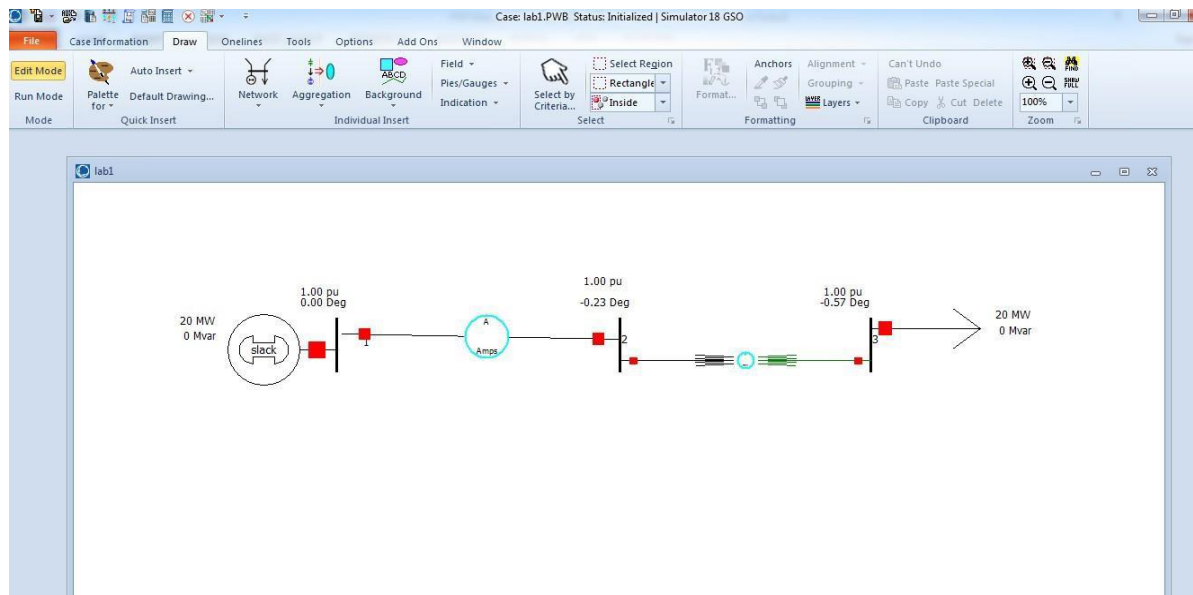


Figure No: 1

Run Mode:

In run mode system power flow is analysed. Active and reactive power at each bus is analysed. All fault analysis can be done in run mode of operation.

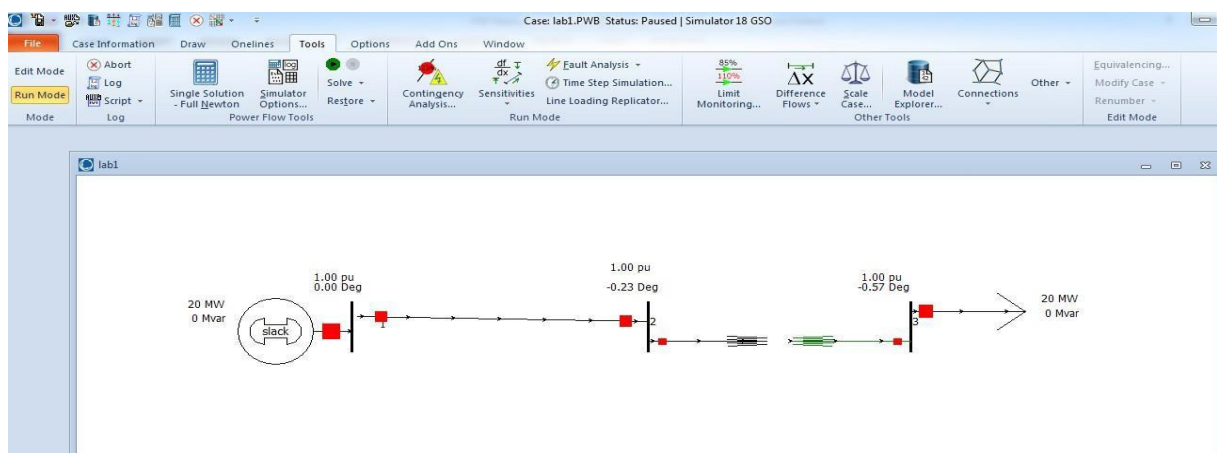


Figure No: 2

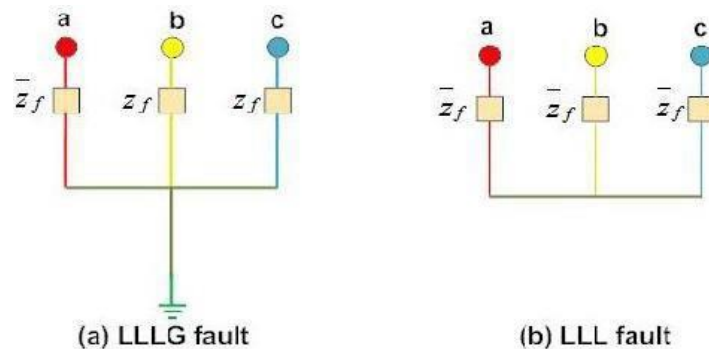
Fault Analysis:

Electrical fault is the deviation of voltages and currents from nominal values or states. Under normal operating conditions, power system equipment or lines carry normal voltages and currents which results in a safer operation of the system.

But when fault occurs, it causes excessively high currents to flow which causes the damage to equipment's and devices. Fault detection and analysis is necessary to select or design suitable switchgear equipment, electromechanical relays, circuit breakers and other protection devices.

Symmetrical faults:

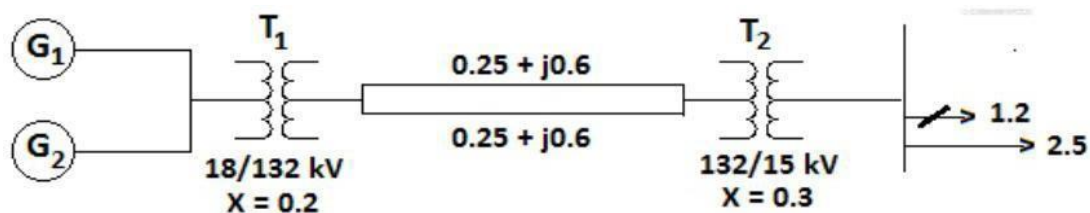
These are very severe faults and occur infrequently in the power systems. These are also called as balanced faults and are of two types namely line to line to line to ground (L-L-L-G) and line to line to line (L-L-L).



Unsymmetrical faults

These are very common and less severe than symmetrical faults. There are mainly three types namely line to ground (L-G), line to line (L-L) and double line to ground (LL-G) faults.

Lab Task:



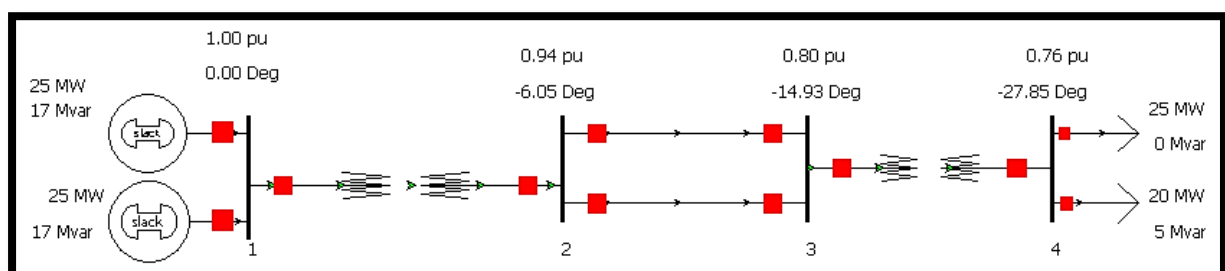
Generator 1 MW output: 30, -5 MVar

Generator 2 MW output: 35, -5 Mvar

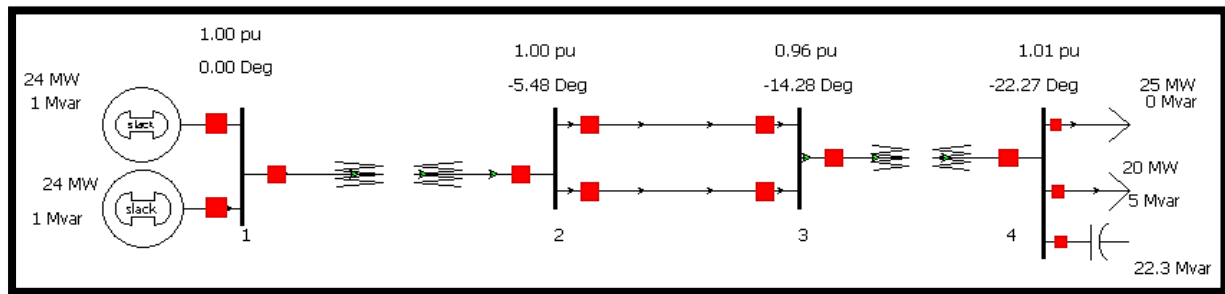
Load 1: 25 M, Load 2: 20 MW and 5 Mvar

A power system on 100 MVA base is shown in fig. below; the generators real power, real and reactive loads, transformer reactance and transmission line parameters are all shown in per unit. Simulate the system using **Power World Simulator** and show the following quantities.

- Sending voltage in per unit and in kV
- Receiving end voltage in per unit and in kV
- Sending end power factor
- Receiving end power factor



Part B: Determine the amount of shunt compensation at the receiving end such that the receiving end voltage remains within 0.99 to 1.01 per unit

**Part C:****i. Three phase solid fault at bus no. 1**

Single Fault

Calculate Clear Clear/Close

Choose the Faulted Bus

Sort by ☐ Name ☒ Number

1 (1) [18.0 kV]
2 (2) [132 kV]
3 (3) [132 kV]
4 (4) [15.0 kV]

Fault Location

☒ Bus Fault ☐ In-Line Fault

Location % 0

Fault Impedance

R : 0.00000

X : 0.01000

Fault Type

☐ Single Line-to-Ground ☒ 3 Phase Balanced

☐ Line-to-Line ☐ Double Line-to-Ground

Fault Current

Scale Current By: 1.00000

If Magnitude: 2.332 p.u.

If Scaled Mag: 2.332 p.u.

If Angle: -78.33 deg.

Units ☒ p.u. ☐ Amps

Subtransient Phase Current

	p.u.	deg.
A	2.332	-78.33
B	2.332	161.67
C	2.332	41.67

Bus Records Lines Generators Loads Switched Shunt Buses Y-Bus Matrices

	Number	Name	Phase Volt A	Phase Volt B	Phase Volt C	Phase Ang A	Phase Ang B	Phase Ang C
1	1	1	0.02332	0.02332	0.02332	11.67	-108.33	131.67
2	2	2	0.02195	0.02195	0.02195	5.30	-114.70	125.30
3	3	3	0.01874	0.01874	0.01874	-4.26	-124.26	115.74
4	4	4	0.01805	0.01805	0.01805	-17.50	-137.50	102.50

ii. Three phase fault at bus no. 2 with the fault impedance of 0.5 per unit

Single Fault

Calculate Clear Clear/Close

Choose the Faulted Bus

Sort by ☐ Name ☒ Number

1 (1) [18.0 kV]
2 (2) [132.0 kV]
3 (3) [132.0 kV]
4 (4) [15.0 kV]

Fault Location

☒ Bus Fault ☐ In-Line Fault

Location % 0

Fault Impedance

R : 0.5

X : 0.00000

Fault Type

☐ Single Line-to-Ground ☒ 3 Phase Balanced

☐ Line-to-Line ☐ Double Line-to-Ground

Fault Current

Scale Current By: 1.00000

If Magnitude: 1.039 p.u.

If Scaled Mag: 1.039 p.u.

If Angle: -47.24 deg.

Units ☒ p.u. ☐ Amps

Subtransient Phase Current

	p.u.	deg.
A	1.039	-47.24
B	1.039	-167.25
C	1.039	72.76

Bus Records Lines Generators Loads Switched Shunt Buses Y-Bus Matrices

	Number	Name	Phase Volt A	Phase Volt B	Phase Volt C	Phase Ang A	Phase Ang B	Phase Ang C
1	1	1	0.57642	0.57642	0.57642	-20.74	-140.74	99.26
2	2	2	0.51950	0.51950	0.51950	-47.24	-167.24	72.76
3	3	3	0.49999	0.49999	0.49999	-56.05	-176.05	63.95
4	4	4	0.52186	0.52186	0.52186	-64.03	175.97	55.97

iii. Three phase fault on the line 2-3 at the location of 20% from the generation bus

Single Fault

Calculate Clear Clear/Close

Choose the Faulted Line

Sort by ☐ Name ☒ Number

Search For Near Bus Select Far Bus, CKT

1 (1) [18.00 kV]	1 (1) [18.00 kV] CKT 1
2 (2) [132.0 kV]	3 (3) [132.0 kV] CKT 1
3 (3) [132.0 kV]	3 (3) [132.0 kV] CKT 2
4 (4) [15.00 kV]	

Location % 20

Fault Impedance
R: 0.00000
X: 0.01000

Fault Type
☐ Bus Fault
☒ In-Line Fault
☐ Single Line-to-Ground
☒ Line-to-Line
☐ 3 Phase Balanced
☐ Double Line-to-Ground

Fault Current
Scale Current By: 1.00000
If Magnitude: 1.238 p.u.
If Scaled Mag: 1.238 p.u.
If Angle: -166.23 deg.

Subtransient Phase Current
p.u. deg.
A 0.000 0.00
B 1.238 -166.23
C 1.238 13.77

Units ☒ p.u. ☐ Amps

Bus Records Lines Generators Loads Switched Shunt Buses Y-Bus Matrices

	Number	Name	Phase Volt A	Phase Volt B	Phase Volt C	Phase Ang A	Phase Ang B	Phase Ang C
1	1	1	1.00000	0.60217	0.67652	0.00	-138.71	144.03
2	2	2	0.93804	0.49619	0.49041	-6.05	-168.11	155.78
3	3	3	0.79709	0.40255	0.40400	-14.93	173.87	156.30
4	4	4	0.75712	0.38237	0.38375	-27.86	160.95	143.37
5	5	FaultPt	0.90828	0.45192	0.45643	-7.61	173.12	171.67

iv. Three phase fault on the line 2-3 at the mid-point

Single Fault

Calculate Clear Clear/Close

Choose the Faulted Line

Sort by ☐ Name ☒ Number

Search For Near Bus Select Far Bus, CKT

1 (1) [18.00 kV]	1 (1) [18.00 kV] CKT 1
2 (2) [132.0 kV]	3 (3) [132.0 kV] CKT 1
3 (3) [132.0 kV]	3 (3) [132.0 kV] CKT 2
4 (4) [15.00 kV]	

Location % 50

Fault Impedance
R: 0.00000
X: 0.01000

Fault Type
☐ Bus Fault
☒ In-Line Fault
☐ Single Line-to-Ground
☒ Line-to-Line
☐ 3 Phase Balanced
☐ Double Line-to-Ground

Fault Current
Scale Current By: 1.00000
If Magnitude: 1.066 p.u.
If Scaled Mag: 1.066 p.u.
If Angle: -164.44 deg.

Subtransient Phase Current
p.u. deg.
A 0.000 0.00
B 1.065 -164.44
C 1.065 15.56

Units ☒ p.u. ☐ Amps

Bus Records Lines Generators Loads Switched Shunt Buses Y-Bus Matrices

	Number	Name	Phase Volt A	Phase Volt B	Phase Volt C	Phase Ang A	Phase Ang B	Phase Ang C
1	1	1	1.00000	0.66406	0.72716	0.00	-133.38	138.41
2	2	2	0.93798	0.53833	0.54608	-6.06	-155.70	144.06
3	3	3	0.79693	0.40098	0.41350	-14.93	177.17	153.34
4	4	4	0.75690	0.38084	0.39273	-27.86	164.24	140.40
5	5	FaultPt	0.86487	0.43015	0.43477	-10.13	170.51	169.24

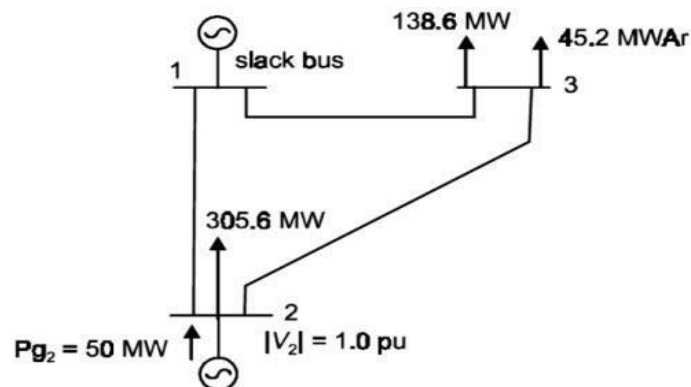
v. Mismatches of the buses

	Number	Name	Area Name	Type	Mismatch MW	Mismatch Mvar	Mismatch MVA
1	4	4	1	PQ	0.00	-0.07	0.07
2	3	3	1	PQ	0.00	-0.00	0.00
3	2	2	1	PQ	0.00	0.00	0.00
4	1	1	1	Slack	0.00	0.00	0.00

Bus mismatches display lists the real and reactive mismatches at each bus. In power system, bus mismatches are defined as the difference between power entering the bus and power leaving the bus. A power flow case is considered solved when all the bus mismatches are below the convergence tolerance (a measure for determining when the inner power flow loop of the Power Flow Solution process has reached an acceptable solution).

Home Assignment:

Fig. below shows the one-line diagram of a simple three-bus power system with generation at bus 1.



Scheduled generation and loads and assumed bus voltage for sample power system

Table 1

Bus code <i>i</i>	Assumed bus voltage	Generation		Load	
		MW	MVar	MW	MVar
1 (slack bus)	$1.05 + j0.0$	—	—	0	0
2	$1 + j0.0$	50	30	305.6	140.2
3	$1 + j0.0$	0.0	0.0	138.6	45.2

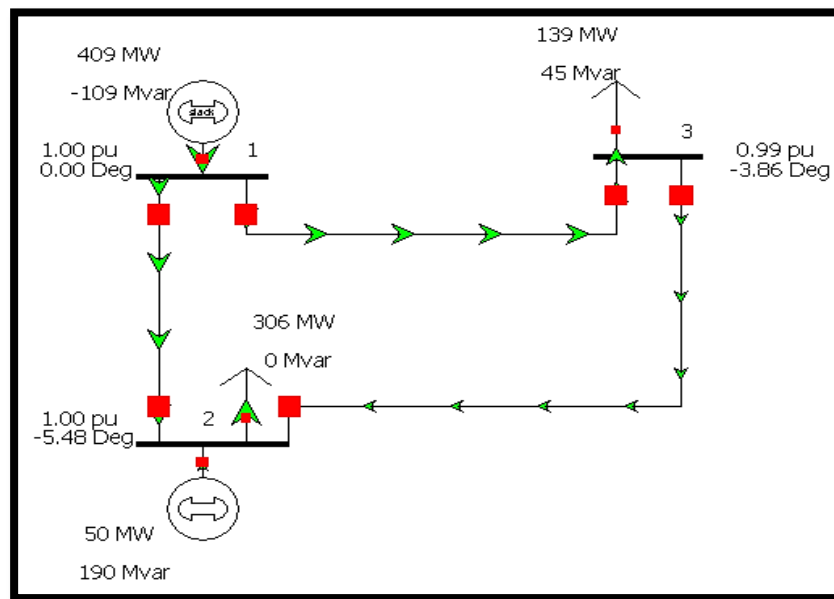
Base MVA = 100

Table 2 Line impedances

Bus code <i>i - k</i>	Impedance Z_{ik}
1-2	$0.02 + j0.04$
1-3	$0.01 + j0.03$
2-3	$0.0125 + j0.025$

Using the **Power World Simulator**, calculate the fault currents and bus fault voltages using **fault analysis** for the following cases

Circuit Diagram:



i. Three phase solid fault at bus no. 3

Single Fault

Calculate Clear Clear/Close

Choose the Faulted Bus

Sort by ☐ Name ☒ Number

1 (1)	[138.0 kV]
2 (2)	[138.0 kV]
3 (3)	[138.0 kV]

Fault Location

☒ Bus Fault ☐ In-Line Fault

Location %

Fault Impedance

R : X :

Fault Type

☐ Single Line-to-Ground ☒ 3 Phase Balanced ☐ Line-to-Line ☐ Double Line-to-Ground

Fault Current

Scale Current By:

If Magnitude: p.u.

If Scaled Mag: p.u.

If Angle: deg.

Units ☒ p.u. ☐ Amps

Subtransient Phase Current

	p.u.	deg.
A	4.881	-34.21
B	4.880	-154.21
C	4.880	85.79

Bus Records Lines Generators Loads Switched Shunt Buses Y-Bus Matrices

	Number	Name	Phase Volt A	Phase Volt B	Phase Volt C	Phase Ang A	Phase Ang B	Phase Ang C
1	1	1	0.09142	0.09142	0.09142	55.61	-64.39	175.61
2	2	2	0.06482	0.06482	0.06482	6.25	-113.75	126.25
3	3	3	0.00000	0.00000	0.00000	178.74	58.74	-61.26

ii. Three phase fault at bus no. 2 with the fault impedance of 0.5 per unit

Single Fault

Calculate Clear Clear/Close

Choose the Faulted Bus

Sort by ☐ Name ☒ Number

1 (1) [138.0 kV]
2 (2) [138.0 kV]
3 (3) [138.0 kV]

Fault Location

☒ Bus Fault
☐ In-Line Fault

Location %

Fault Impedance

R :
X :

Fault Type

☐ Single Line-to-Ground
☐ Line-to-Line
☒ 3 Phase Balanced
☐ Double Line-to-Ground

Fault Current

Scale Current By:

If Magnitude: p.u.
If Scaled Mag: p.u.
If Angle: deg.

Units ☒ p.u. ☐ Amps

Subtransient Phase Current

	p.u.	deg.
A	1.470	-13.55
B	1.470	-133.55
C	1.470	106.45

Bus Records Lines Generators Loads Switched Shunt Buses Y-Bus Matrices

Number	Name	Phase Volt A	Phase Volt B	Phase Volt C	Phase Ang A	Phase Ang B	Phase Ang C
1	1	0.73271	0.73271	0.73271	-5.77	-125.77	114.23
2	2	0.73508	0.73508	0.73508	-13.55	-133.55	106.45
3	3	0.72517	0.72517	0.72517	-10.85	-130.85	109.15

iii. Three phase fault on the line 1-2 at the location of 20% from the generation bus

Single Fault

Calculate Clear Clear/Close

Choose the Faulted Line

Sort by ☐ Name ☒ Number

Search For Near Bus Select Far Bus, CKT

1 (1) [138.0 kV]	2 (2) [138.0 kV] CKT 1
2 (2) [138.0 kV]	3 (3) [138.0 kV] CKT 1
3 (3) [138.0 kV]	

Location %

Fault Impedance

R :
X :

Fault Type

☐ Bus Fault
☒ In-Line Fault

Fault Type

☐ Single Line-to-Ground
☐ Line-to-Line
☒ 3 Phase Balanced
☐ Double Line-to-Ground

Fault Current

Scale Current By:

If Magnitude: p.u.
If Scaled Mag: p.u.
If Angle: deg.

Units ☒ p.u. ☐ Amps

Subtransient Phase Current

	p.u.	deg.
A	4.851	-33.59
B	4.850	-153.59
C	4.850	86.41

Bus Records Lines Generators Loads Switched Shunt Buses Y-Bus Matrices

Number	Name	Phase Volt A	Phase Volt B	Phase Volt C	Phase Ang A	Phase Ang B	Phase Ang C
1	1	0.03349	0.03349	0.03349	50.54	-69.46	170.54
2	2	0.06758	0.06758	0.06758	-14.64	-134.64	105.36
3	3	0.04562	0.01952	0.02610	0.00	180.00	180.00
4	4 FaultPt	0.00000	0.00000	0.00000	0.00	180.00	180.00

iv. Three phase fault on the line 2-3 at the mid-point

Single Fault

Calculate Clear Clear/Close

Choose the Faulted Line

Sort by ☐ Name ☒ Number

Search For Near Bus Select Far Bus, CKT

1 (1) [138.0 kV]	1 (1) [138.0 kV] CKT 1
2 (2) [138.0 kV]	3 (3) [138.0 kV] CKT 1
3 (3) [138.0 kV]	4 (FaultPt) [138.0 kV] CKT 1

Fault Location

☐ Bus Fault ☒ In-Line Fault

Location % 50

Fault Impedance

R : 0.00000

X : 0.00000

Fault Type

☐ Single Line-to-Ground ☒ 3 Phase Balanced ☐ Line-to-Line ☐ Double Line-to-Ground

Fault Current

Scale Current By: 1.00000

If Magnitude: 4.924 p.u.

If Scaled Mag: 4.924 p.u.

If Angle: -34.58 deg.

Units ☒ p.u. ☐ Amps

Subtransient Phase Current

	p.u.	deg.
A	4.924	-34.58
B	4.924	-154.58
C	4.924	85.42

Bus Records Lines Generators Loads Switched Shunt Buses Y-Bus Matrices

Number	Name	Phase Volt A	Phase Volt B	Phase Volt C	Phase Ang A	Phase Ang B	Phase Ang C
1	1 1	0.10398	0.10398	0.10398	58.76	-61.24	178.76
2	2 2	0.04182	0.04182	0.04182	11.19	-108.81	131.19
3	3 3	0.01925	0.01211	0.03136	0.00	0.00	180.00
4	4 FaultPt	0.00000	0.00000	0.00000	180.00	0.00	0.00

v. Mismatches of the buses

	Number	Name	Area Name	Type	Mismatch MW	Mismatch Mvar	Mismatch MVA ▼
1	2 2	1	PV	-0.00	-0.00	0.00	
2	3 3	1	PQ	0.00	-0.00	0.00	
3	1 1	1	Slack	0.00	0.00	0.00	

vi. Admittance matrix of the system

	Number	Name	Bus 1	Bus 2	Bus 3
1	1	1	20.00 - j50.00	-10.00 + j20.00	-10.00 + j30.00
2	2	2	-10.00 + j20.00	26.00 - j52.00	-16.00 + j32.00
3	3	3	-10.00 + j30.00	-16.00 + j32.00	26.00 - j62.00

Same analyses are done for Single Line to Ground Fault and Line to Line Fault

Single line to ground fault:

i. Single line to ground Fault at bus no.3

Single Fault

Calculate Clear Clear/Close

Choose the Faulted Bus

Sort by ☐ Name ☒ Number

1 (1) [138.0 kV]
2 (2) [138.0 kV]
3 (3) [138.0 kV]

Fault Location

☒ Bus Fault ☐ In-Line Fault

Location %

Fault Impedance

R :
X :

Fault Type

☒ Single Line-to-Ground ☐ 3 Phase Balanced
☐ Line-to-Line ☐ Double Line-to-Ground

Fault Current

Scale Current By:

If Magnitude: p.u.
If Scaled Mag: p.u.
If Angle: deg.

Subtransient Phase Current

	p.u.	deg.
A	3.599	-67.66
B	0.000	-92.04
C	0.000	-92.04

Units ☒ p.u. ☐ Amps

Bus Records Lines Generators Loads Switched Shunt Buses Y-Bus Matrices

Number	Name	Phase Volt A	Phase Volt B	Phase Volt C	Phase Ang A	Phase Ang B	Phase Ang C
1	1	0.09909	1.51165	1.00054	38.15	-125.10	150.32
2	2	0.09071	1.52913	0.95647	-19.61	-128.86	146.11
3	3	0.00000	1.53089	0.98483	-174.64	-128.67	148.69

ii. Single line to ground fault at bus no. 2 with the fault impedance of 0.5 per unit

Single Fault

Calculate Clear Clear/Close

Choose the Faulted Bus

Sort by ☐ Name ☒ Number

1 (1) [138.0 kV]
2 (2) [138.0 kV]
3 (3) [138.0 kV]

Fault Location

☒ Bus Fault ☐ In-Line Fault

Location %

Fault Impedance

R :
X :

Fault Type

☒ Single Line-to-Ground ☐ 3 Phase Balanced
☐ Line-to-Line ☐ Double Line-to-Ground

Fault Current

Scale Current By:

If Magnitude: p.u.
If Scaled Mag: p.u.
If Angle: deg.

Subtransient Phase Current

	p.u.	deg.
A	1.513	-26.31
B	0.000	-10.46
C	0.000	-10.46

Units ☒ p.u. ☐ Amps

Bus Records Lines Generators Loads Switched Shunt Buses Y-Bus Matrices

Number	Name	Phase Volt A	Phase Volt B	Phase Volt C	Phase Ang A	Phase Ang B	Phase Ang C
1	1	0.73824	1.19683	0.82518	-18.09	-115.20	128.13
2	2	0.75649	1.20072	0.80886	-26.31	-119.89	122.37
3	3	0.74292	1.18753	0.80115	-23.71	-118.43	124.19

iii. Single line to ground fault on the line 1-2 at the location of 20% from the generation bus

Single Fault

Calculate Clear Clear/Close

Choose the Faulted Line

Sort by ☐ Name ☒ Number

Search For Near Bus Select Far Bus, CKT

Near Bus	Far Bus, CKT
1 (1) [138.0 kV]	2 (2) [138.0 kV] CKT 1
2 (2) [138.0 kV]	3 (3) [138.0 kV] CKT 1
3 (3) [138.0 kV]	

Location % 20

Fault Impedance
R : 0.0000
X : 0.00000

Fault Type
☒ Single Line-to-Ground ☐ 3 Phase Balanced
☐ Line-to-Line ☐ Double Line-to-Ground

Fault Current
Scale Current By: 1.00000
If Magnitude: 3.637 p.u.
If Scaled Mag: 3.637 p.u.
If Angle: -65.37 deg.

Subtransient Phase Current

	p.u.	deg.
A	3.637	-65.37
B	0.000	91.38
C	0.000	91.38

Units ☒ p.u. ☐ Amps

Bus Records Lines Generators Loads Switched Shunt Buses Y-Bus Matrices

Number	Name	Phase Volt A	Phase Volt B	Phase Volt C	Phase Ang A	Phase Ang B	Phase Ang C
1	1	0.03261	1.51861	0.98240	29.03	-124.39	150.83
2	2	0.10700	1.52467	0.92603	-40.78	-127.72	145.97
3	3	0.05420	0.91023	0.79508	0.00	180.00	180.00
4	4 FaultPt	0.00000	0.88580	0.85272	0.00	180.00	180.00

iv. Single line to ground fault on the line 2-3 at the mid-point

Single Fault

Calculate Clear Clear/Close

Choose the Faulted Line

Sort by ☐ Name ☒ Number

Search For Near Bus Select Far Bus, CKT

Near Bus	Far Bus, CKT
1 (1) [138.0 kV]	1 (1) [138.0 kV] CKT 1
2 (2) [138.0 kV]	3 (3) [138.0 kV] CKT 1
3 (3) [138.0 kV]	4 (FaultPt) [138.0 kV] CKT 1

Location % 50

Fault Impedance
R : 0.0000
X : 0.00000

Fault Type
☒ Single Line-to-Ground ☐ 3 Phase Balanced
☐ Line-to-Line ☐ Double Line-to-Ground

Fault Current
Scale Current By: 1.00000
If Magnitude: 3.659 p.u.
If Scaled Mag: 3.659 p.u.
If Angle: -68.25 deg.

Subtransient Phase Current

	p.u.	deg.
A	3.659	-68.25
B	0.000	86.27
C	0.000	86.27

Units ☒ p.u. ☐ Amps

Bus Records Lines Generators Loads Switched Shunt Buses Y-Bus Matrices

Number	Name	Phase Volt A	Phase Volt B	Phase Volt C	Phase Ang A	Phase Ang B	Phase Ang C
1	1	0.10535	1.51680	1.00266	42.26	-125.17	150.61
2	2	0.05646	1.54038	0.96782	-17.37	-129.24	146.71
3	3	0.02256	0.95348	0.83833	0.00	180.00	180.00
4	4 FaultPt	0.00000	0.97670	0.83643	180.00	180.00	180.00

v. Mismatches of the buses

Model Explorer: Mismatches

Explore Fields

- DC Transmission Lines
- Generators
 - Impedance Correct
 - Line D-FACTS Device
 - Line Shunts
- Loads
- Mismatches
- Multi-Terminal DC
- Switched Shunts
- Three-Winding Transformer
- Transformer Control
- Voltage Control Group
- Voltage Droop Control
- VSC DC Transmission
- Aggregations
 - Areas
 - Balancing Authority
 - Bus Pairs
 - Data Maintainers
 - Injection Groups
 - Interfaces
 - Islands
 - Multi-Section Lines

Open New Explorer

Mismatches

Number	Name	Area Name	Type	Mismatch MW	Mismatch Mvar	Mismatch MVA
1	2	1	PV	-0.00	-0.00	0.00
2	3	1	PQ	-0.00	-0.00	0.00
3	1	1	Slack	0.00	0.00	0.00

Search Search Now Options

vi. Admittance matrix of the system

Model Explorer: YBus

Explore Fields

- Super Areas
- Tielines between A
- Tielines between B
- Tielines between Z
- Transfer Directions
- Zones
- Solution Details
 - Bus Zero-Impedance
 - Fast Decoupled BP
 - Fast Decoupled BPI
 - Mismatches
 - Outages
 - Post Power Flow Sc
 - Power Flow Jacobian
 - Remotely Regulate
 - Time Step Actions
 - YBus
- Case Information and
- Contingency Analysis
- Optimal Power Flow
- Tools and Add Ons
- Transient Stability
- User-Defined

Open New Explorer

YBus Buses

Filter Advanced Bus

Find... Remove Quick Filter

	Number	Name	Bus 1	Bus 2	Bus 3
1	1	1	20.00 - j50.00	-10.00 + j20.00	-10.00 + j30.00
2	2	2	-10.00 + j20.00	26.00 - j52.00	-16.00 + j32.00
3	3	3	-10.00 + j30.00	-16.00 + j32.00	26.00 - j62.00

Search Search Now Options

Line to Line fault:

i. Line to line fault at bus no. 3

Single Fault

Calculate Clear Clear/Close

Choose the Faulted Bus

Sort by ☐ Name ☒ Number

1 (1) [138.0 kV]
2 (2) [138.0 kV]
3 (3) [138.0 kV]

Fault Location

☒ Bus Fault ☐ In-Line Fault

Location % 0

Fault Impedance

R : 0.00000

X : 0.00000

Fault Type

☐ Single Line-to-Ground ☒ Line-to-Line ☐ 3 Phase Balanced ☐ Double Line-to-Ground

Fault Current

Scale Current By: 1.00000

If Magnitude: 4.227 p.u.

If Scaled Mag: 4.227 p.u.

If Angle: -124.21 deg.

Units ☒ p.u. ☐ Amps

Subtransient Phase Current

	p.u.	deg.
A	0.000	0.00
B	4.227	-124.21
C	4.227	55.79

Bus Records Lines Generators Loads Switched Shunt Buses Y-Bus Matrices

	Number	Name	Phase Volt A	Phase Volt B	Phase Volt C	Phase Ang A	Phase Ang B	Phase Ang C
1	1	1	1.00000	0.43696	0.56710	0.00	-174.13	175.48
2	2	2	1.00000	0.49167	0.51435	-5.48	-179.06	168.39
3	3	3	0.98776	0.49388	0.49388	-3.86	176.14	176.14

ii. Line to line fault at bus no. 2 with the fault impedance of 0.5 per unit

Single Fault

Calculate Clear Clear/Close

Choose the Faulted Bus

Sort by ☐ Name ☒ Number

1 (1) [138.0 kV]
2 (2) [138.0 kV]
3 (3) [138.0 kV]

Fault Location

☒ Bus Fault

☐ In-Line Fault

Location %

Fault Impedance

R :

X :

Fault Type

☐ Single Line-to-Ground

☒ Line-to-Line

☐ 3 Phase Balanced

☐ Double Line-to-Ground

Fault Current

Scale Current By:

If Magnitude: p.u.

If Scaled Mag: p.u.

If Angle: deg.

Units ☒ p.u. ☐ Amps

Subtransient Phase Current

	p.u.	deg.
A	0.000	0.00
B	1.995	-108.19
C	1.995	71.81

Bus Records Lines Generators Loads Switched Shunt Buses Y-Bus Matrices

Number	Name	Phase Volt A	Phase Volt B	Phase Volt C	Phase Ang A	Phase Ang B	Phase Ang C
1	1	1.00000	0.75250	0.65304	0.00	-139.23	131.19
2	2	1.00000	0.78005	0.62373	-5.48	-146.89	123.26
3	3	0.98776	0.75793	0.62985	-3.86	-144.24	126.03

iii. Line to line fault on the line 1-2 at the location of 20% from the generation bus

Single Fault

Calculate Clear Clear/Close

Choose the Faulted Line

Sort by ☐ Name ☒ Number

Search For Near Bus

1 (1) [138.0 kV]
2 (2) [138.0 kV]
3 (3) [138.0 kV]

Select Far Bus, CKT

2 (2) [138.0 kV] CKT 1
3 (3) [138.0 kV] CKT 1

Fault Location

☐ Bus Fault

☒ In-Line Fault

Location %

Fault Impedance

R :

X :

Fault Type

☐ Single Line-to-Ground

☒ Line-to-Line

☐ 3 Phase Balanced

☐ Double Line-to-Ground

Fault Current

Scale Current By:

If Magnitude: p.u.

If Scaled Mag: p.u.

If Angle: deg.

Units ☒ p.u. ☐ Amps

Subtransient Phase Current

	p.u.	deg.
A	0.000	0.00
B	4.201	-123.59
C	4.201	56.41

Bus Records Lines Generators Loads Switched Shunt Buses Y-Bus Matrices

Number	Name	Phase Volt A	Phase Volt B	Phase Volt C	Phase Ang A	Phase Ang B	Phase Ang C
1	1	1.00000	0.47796	0.52272	0.00	-177.79	177.98
2	2	1.00000	0.51259	0.49407	-5.48	-179.01	167.80
3	3	0.98552	0.48947	0.49605	0.00	180.00	180.00
4	4 FaultPt	0.99909	0.49954	0.49954	0.00	180.00	180.00

iv. Line to line fault on the line 2-3 at the mid-point

Single Fault

Choose the Faulted Line

Sort by ☐ Name ☒ Number

Search For Near Bus Select Far Bus, CKT

1 (1) [138.0 kV]	1 (1) [138.0 kV] CKT 1
2 (2) [138.0 kV]	3 (3) [138.0 kV] CKT 1
3 (3) [138.0 kV]	4 (FaultPt) [138.0 kV] CKT 1

Fault Location

☐ Bus Fault

☒ In-Line Fault

Location %

Fault Type

☐ Single Line-to-Ground

☒ Line-to-Line

☐ 3 Phase Balanced

☐ Double Line-to-Ground

Fault Current

Scale Current By:

If Magnitude: p.u.

If Scaled Mag: p.u.

If Angle: deg.

Units ☒ p.u. ☐ Amps

Subtransient Phase Current

	p.u.	deg.
A	0.000	0.00
B	4.264	-124.58
C	4.264	55.42

Fault Impedance

R :

X :

Bus Records Lines Generators Loads Switched Shunt Buses Y-Bus Matrices

Records Geo Set Columns Options

	Number	Name	Phase Volt A	Phase Volt B	Phase Volt C	Phase Ang A	Phase Ang B	Phase Ang C
1	1	1	1.00000	0.42557	0.57888	-0.00	-173.70	175.37
2	2	2	1.00000	0.49084	0.51157	-5.48	178.57	170.63
3	3	3	0.98552	0.47103	0.51449	0.00	180.00	180.00
4	4	FaultPt	0.99047	0.49524	0.49524	0.00	180.00	180.00

➤ Conclusion:

This lab was about determining two types of faults symmetrical and unsymmetrical faults. We performed two tasks in which we designed two Electric Power Transmission systems in Power World Simulator. We have performed experiment to see power flow in circuit and also checked the fault analysis of the whole system. We have attached a shunt capacitor with the load bus for the purpose of determining shunt compensation at the receiving end. We also observed power transmission system for single line to ground and line to line fault.