Ahsanullah University of Science & Technology

Department of Electrical and Electronic Engineering

Software Project

Course No : EEE-4154

Course Name : Power System-II Laboratory

Project Name : Load Flow Studies Using Power World Simulator

Date of Submission : 01.08.2023

Submitted by

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Year : 4th
Semester : 1st
Section : C2

Objective:

This project aims to analyze the power flow in a given power system using the Power World Simulator and observe the load flow and fault info.

Calculation:

System Base Quantities:

S_{base} = 84 MVA [Last two digit of Student Id]

$V_{base} = \sqrt{84} = 9.16$ kV in the zone of G1

Generator Ratings:

G1: 100 MVA, 13.8 kV, x = 0.12 pu

$X'_{G1} = 0.12 \times (\frac{13.8}{9.16})^2 \times \frac{84}{100} = 0.23\ pu$

G2: 200 MVA, 15 kV, x = 0.12 pu

$X'_{G2} = 0.12 \times (\frac{15}{9.96})^2 \times \frac{84}{200} = 0.114\ pu$

Transformer Ratings:

T1: 100 MVA, 13.8 kV Δ / 230 kV Y, X = 0.1 pu

$X'_{T1} = 0.1 \times (\frac{13.8}{9.16})^2 \times \frac{84}{100} = 0.1\ pu$

T2: 200 MVA, 15 kV Δ / 230 kV Y, X = 0.1 pu

$X'_{T2} = 0.1 \times (\frac{230}{152.6})^2 \times \frac{84}{200} = 0.095\ pu = 0.1\ pu$

Transmission Lines:

All lines 230 kV, z = 0.08 +j 0.5 Ω/km, y = j 3.4×10^{-6} S/km

Maximum MVA = 400

MVA Line lengths: L1 = 15 km, L2 = 25 km, L3 = 40 km, L4 = 15 km, L5 = 50 km

Base Impedance = $\frac{(230\times10^3)^2}{84\times10^6}$ = 629.76 Ω

$X'_{L1} = (0.08 + j0.5) \times \frac{15}{629.76} = 0.00190 + 0.0119j$ pu

$X'_{L2} = (0.08 + j0.5) \times \frac{25}{629.76} = 0.00317 + 0.0198j$ pu

$X'_{L3} = (0.08 + j0.5) \times \frac{40}{629.76} = 0.00508 + 0.0317j$ pu

$X'_{L4} = (0.08 + j0.5) \times \frac{15}{629.76} = 0.00190 + 0.0119j$ pu

$X'_{L5} = (0.08 + j0.5) \times \frac{50}{629.76} = 0.00635 + 0.0396j$ pu

Base Admittance = $\frac{84\times10^6}{(230\times10^3)^2}$ = 1.58×10^{-3} S

$Y'_{L1} = j\ 3.4\times10^{-6} \times \frac{15}{1.58\times10^{-3}} = 0.0322j$ pu

$Y'_{L2} = j\ 3.4\times10^{-6} \times \frac{25}{1.58\times10^{-3}} = 0.0537j$ pu

$Y'_{L3} = j\ 3.4\times10^{-6} \times \frac{40}{1.58\times10^{-3}} = 0.0860j$ pu

$Y'_{L4} = j\ 3.4\times10^{-6} \times \frac{15}{1.58\times10^{-3}} = 0.0322j$ pu

$Y'_{L5} = j\ 3.4\times10^{-6} \times \frac{50}{1.58\times10^{-3}} = 0.1075j$ pu

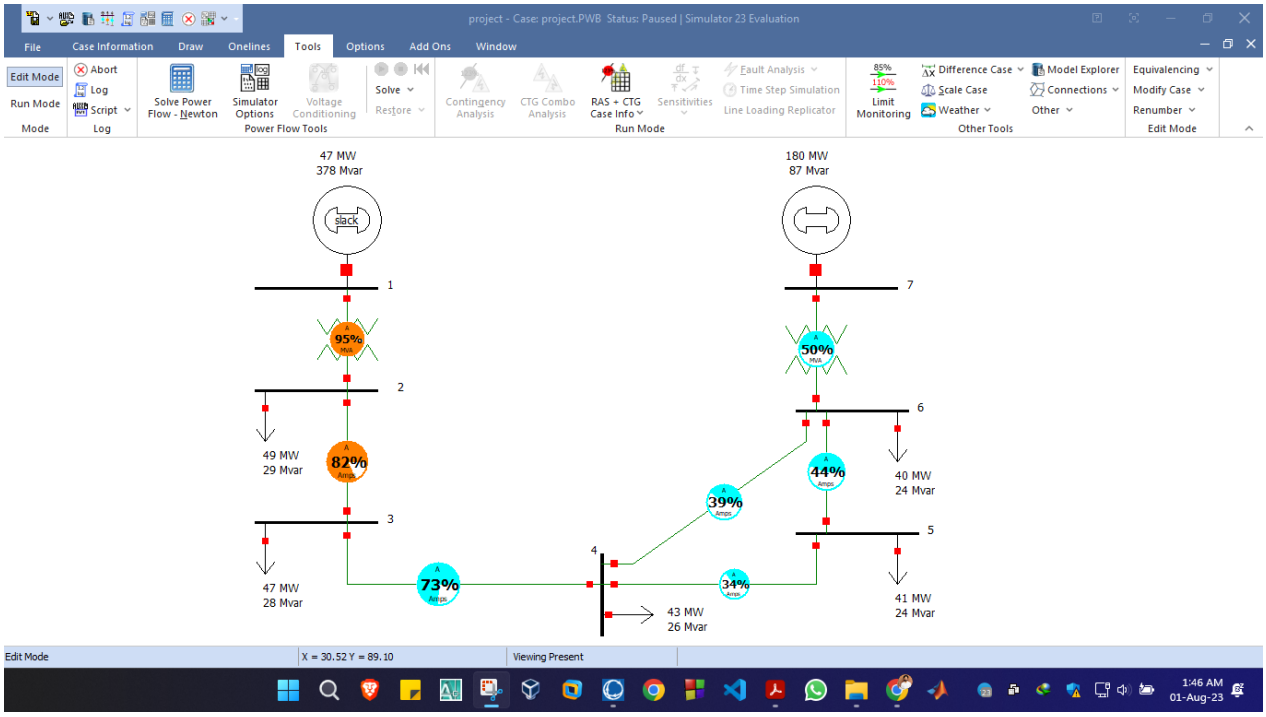
<u>Power Flow Data:</u>

Bus 1: Swing bus, V1 = 13.8 kV, δ1 = 0 deg.

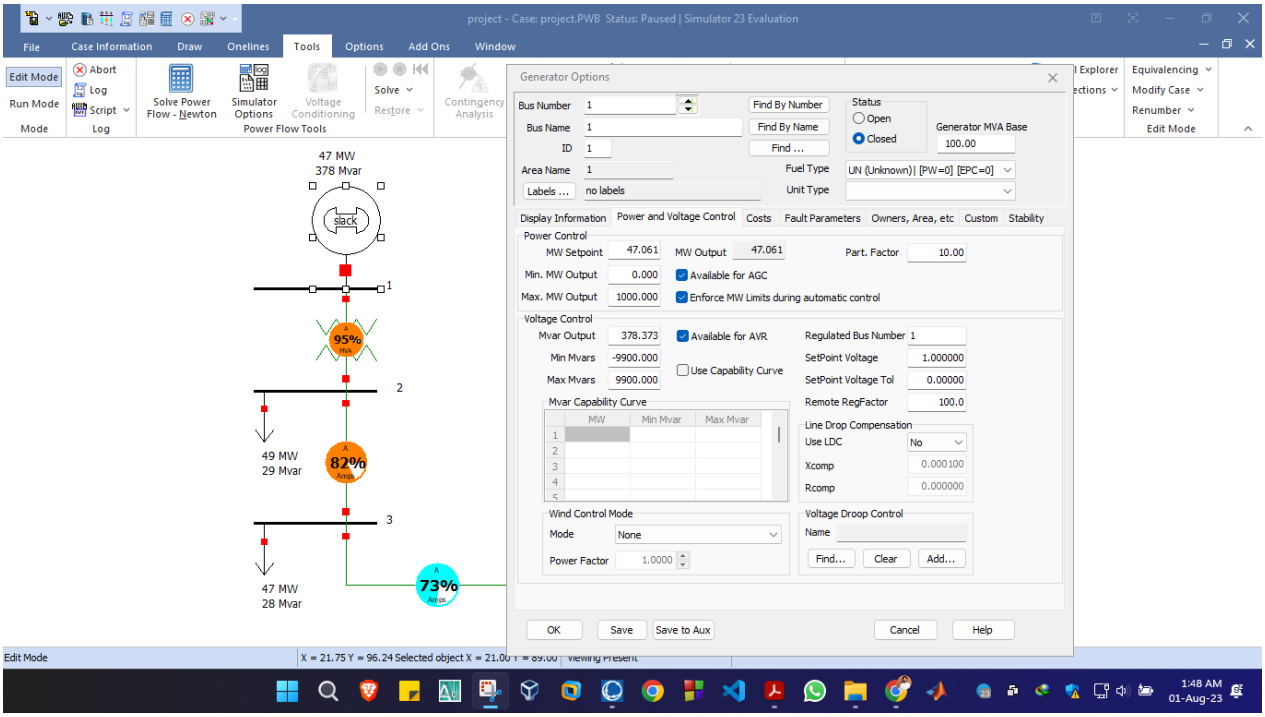
Bus 2, 3, 4, 5, 6: Load buses.

Bus 7: Generator bus, |V7| = 5 kV, PG7 = 180 MW, -87 Mvar < QG7 < + 87 Mvar

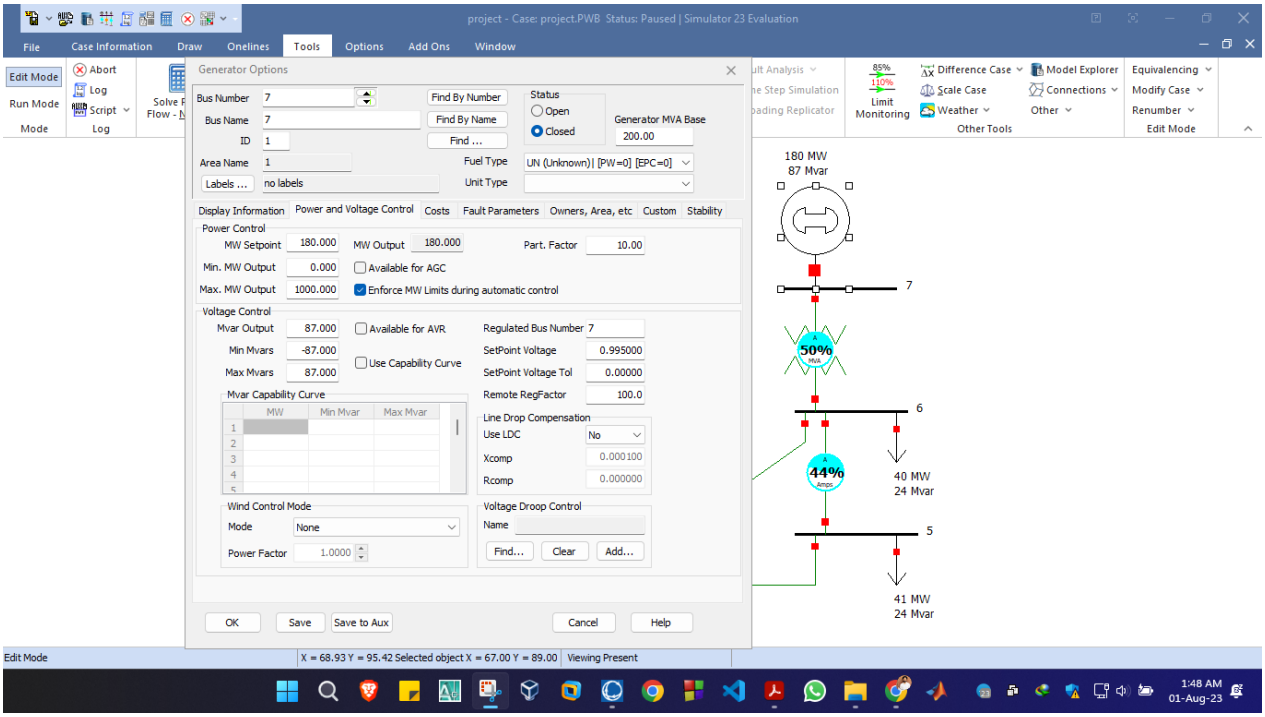
System Design:



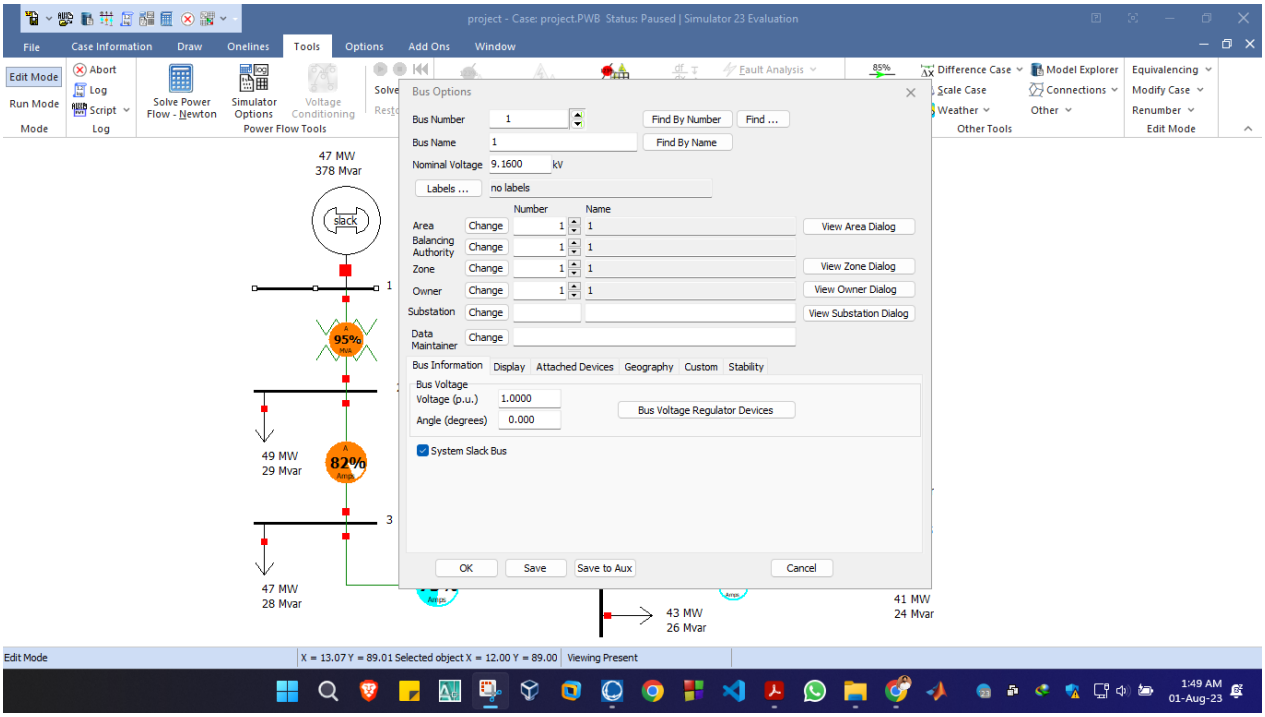
Generator 1:



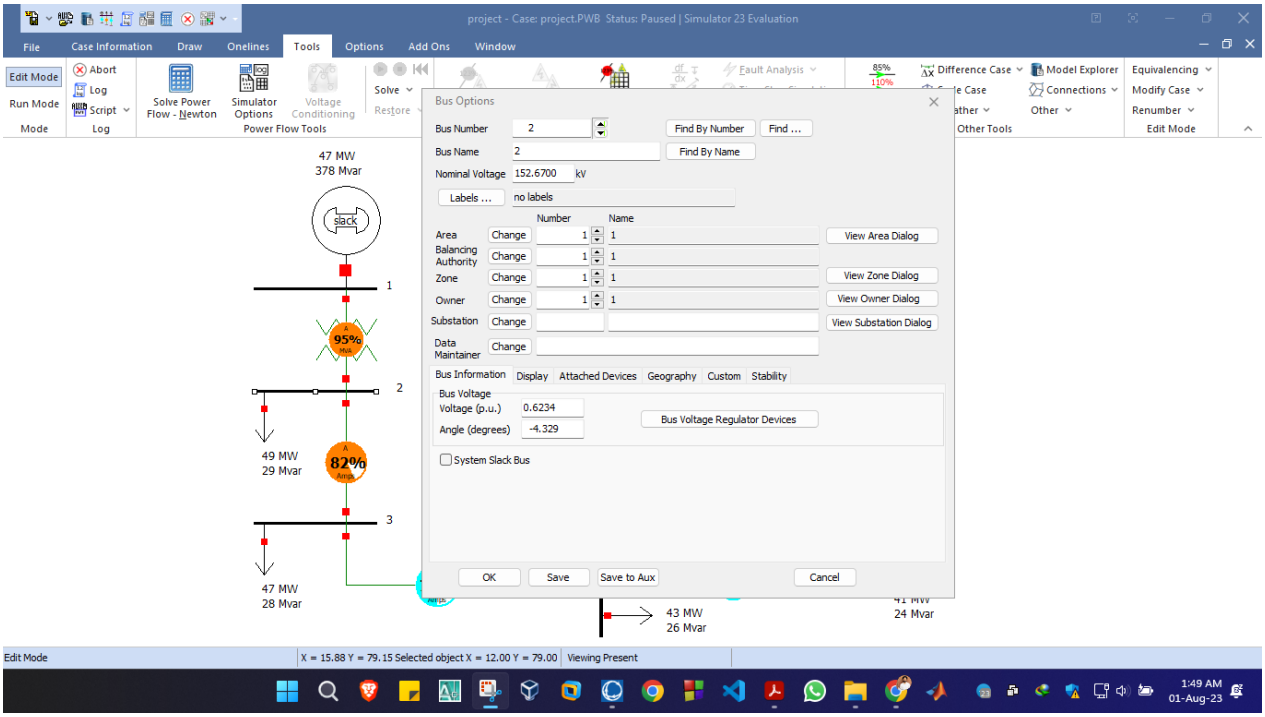
Generator 2:



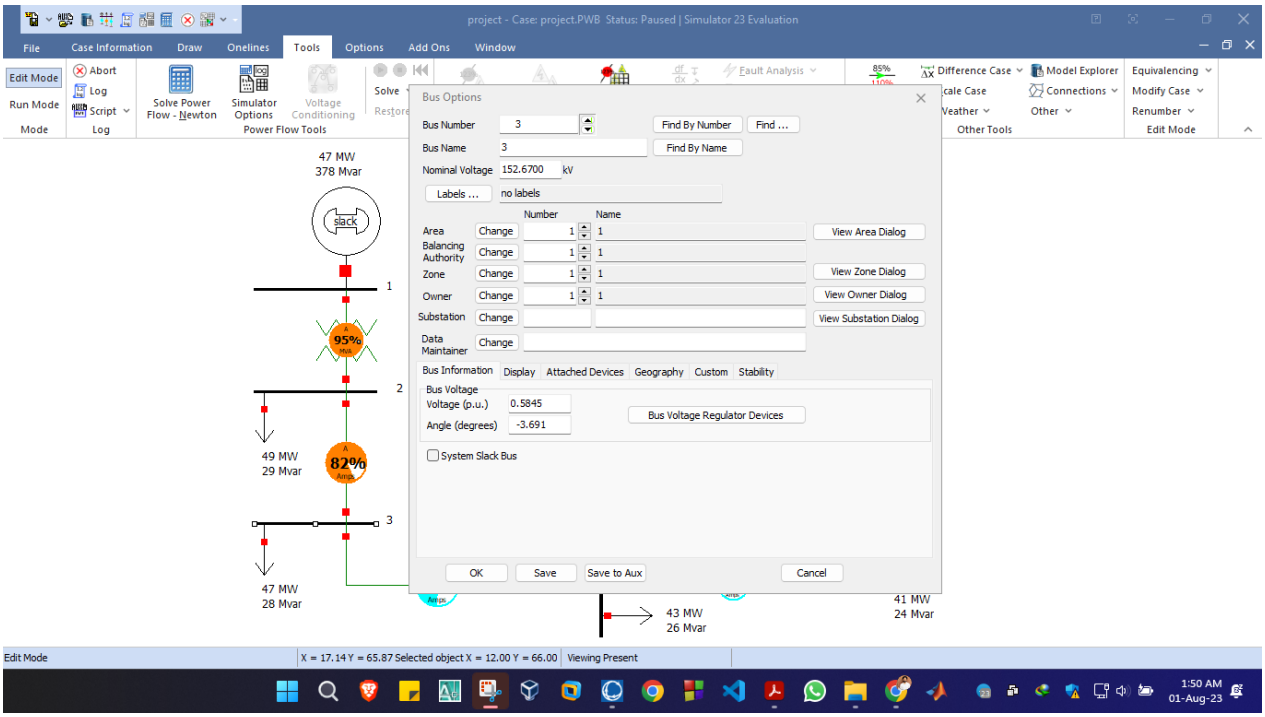
Bus 1:



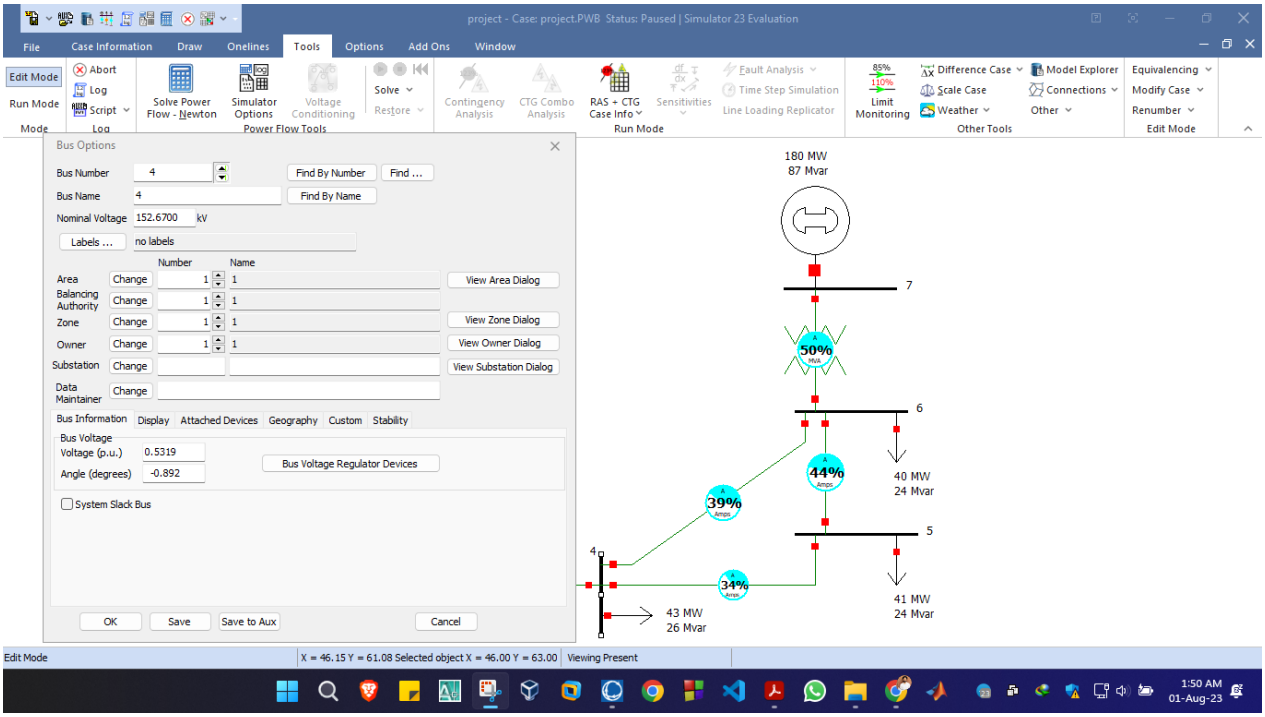
Bus 2:


project - Case: project.PWB Status: Paused | Simulator 23 Evaluation
Bus Options
Bus Number 2
Bus Name 2
Nominal Voltage 152.6700 kV
Bus Voltage
Voltage (p.u.) 0.6234
Angle (degrees) -4.329
System Slack Bus
47 MW
378 Mvar
49 MW
29 Mvar
47 MW
28 Mvar
43 MW
26 Mvar
41 MW
24 Mvar
X = 15.88 Y = 79.15 Selected object X = 12.00 Y = 79.00
Viewing Present
1:49 AM
01-Aug-23

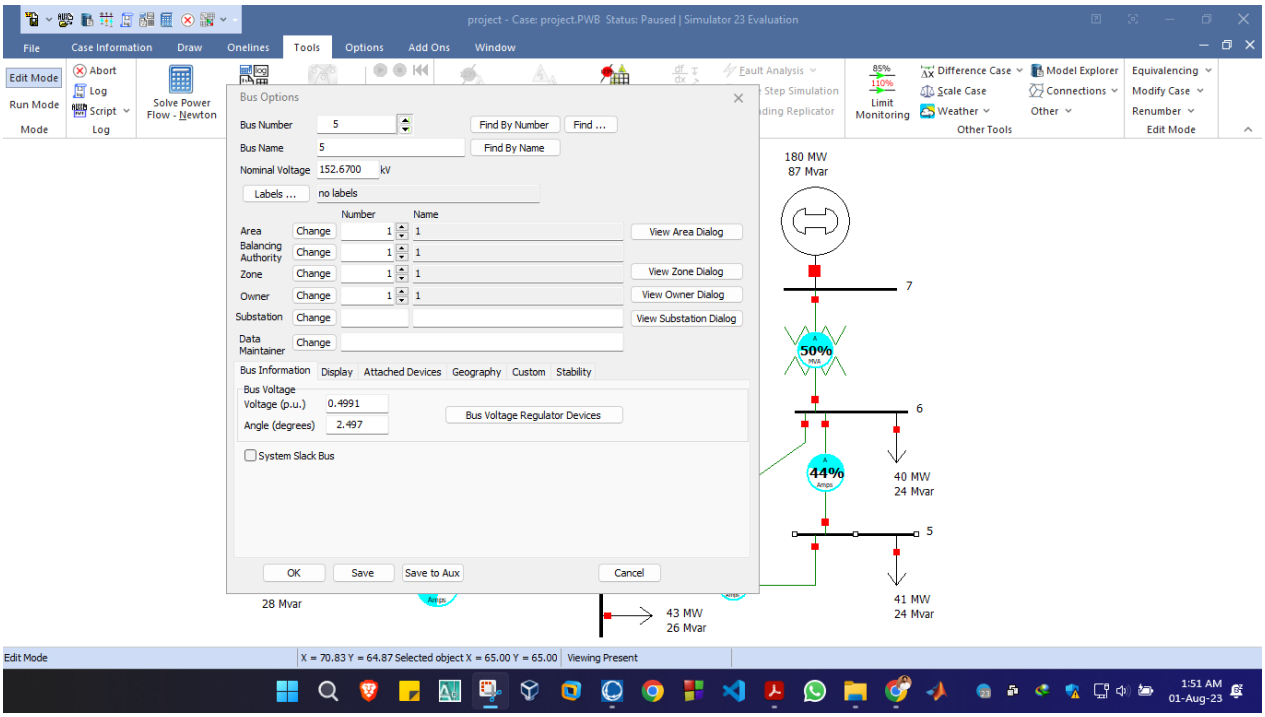
Bus 3:


project - Case: project.PWB Status: Paused | Simulator 23 Evaluation
Bus Options
Bus Number 3
Bus Name 3
Nominal Voltage 152.6700 kV
Bus Voltage
Voltage (p.u.) 0.5845
Angle (degrees) -3.691
System Slack Bus
47 MW
378 Mvar
49 MW
29 Mvar
47 MW
28 Mvar
43 MW
26 Mvar
41 MW
24 Mvar
X = 17.14 Y = 65.87 Selected object X = 12.00 Y = 66.00
Viewing Present
1:50 AM
01-Aug-23

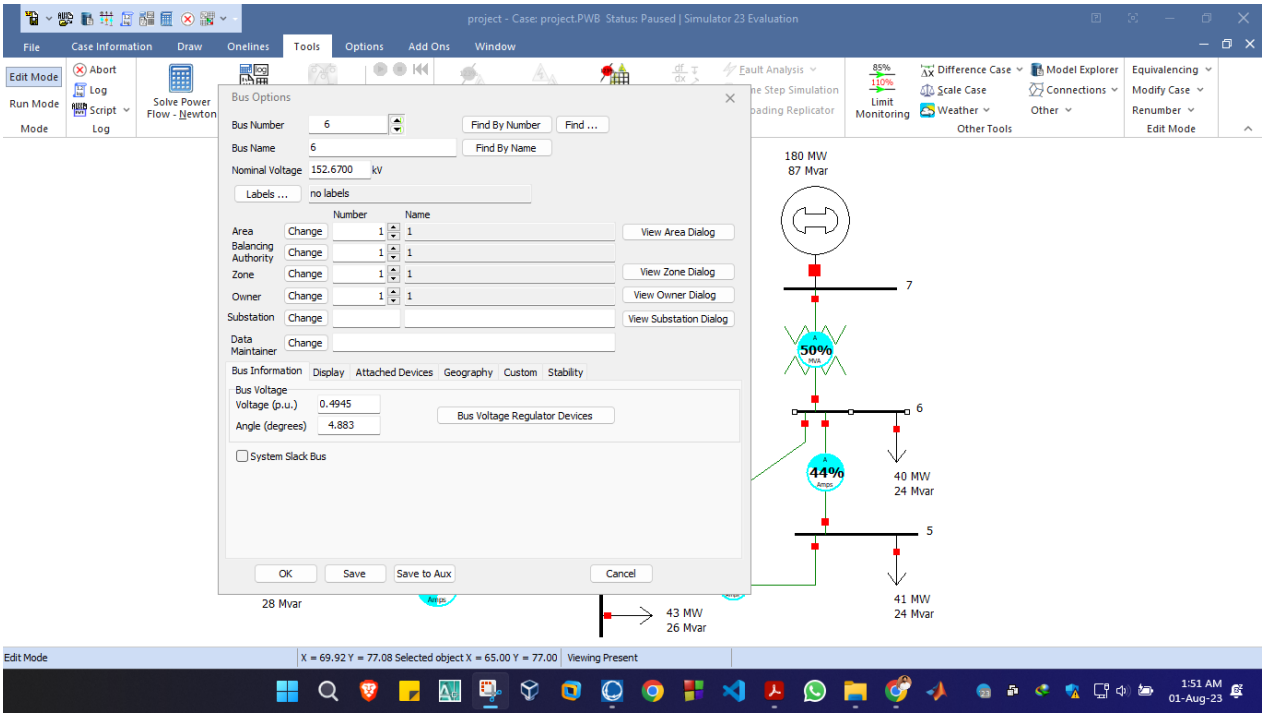
Bus 4:


project - Case: project.PWB Status: Paused | Simulator 23 Evaluation
Bus Options
Bus Number 4
Bus Name 4
Nominal Voltage 152.6700 kV
Bus Voltage (p.u.) 0.5319
Angle (degrees) -0.892
180 MW
87 Mvar
50%
44%
39%
34%
40 MW
24 Mvar
41 MW
24 Mvar
43 MW
26 Mvar
X = 46.15 Y = 61.08 Selected object X = 46.00 Y = 63.00
Viewing Present
1:50 AM
01-Aug-23

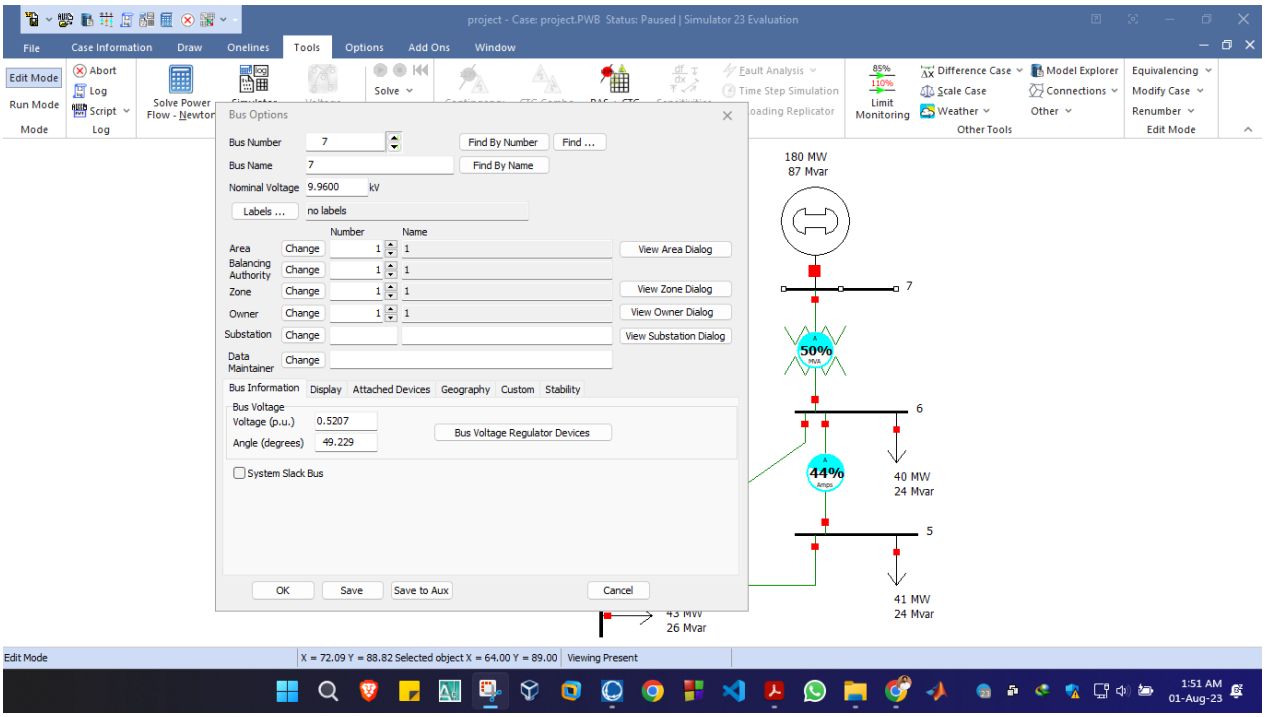
Bus 5:


project - Case: project.PWB Status: Paused | Simulator 23 Evaluation
Bus Options
Bus Number 5
Bus Name 5
Nominal Voltage 152.6700 kV
Bus Voltage (p.u.) 0.4991
Angle (degrees) 2.497
180 MW
87 Mvar
50%
44%
40 MW
24 Mvar
41 MW
24 Mvar
43 MW
26 Mvar
28 Mvar
X = 70.83 Y = 64.87 Selected object X = 65.00 Y = 65.00
Viewing Present
1:51 AM
01-Aug-23

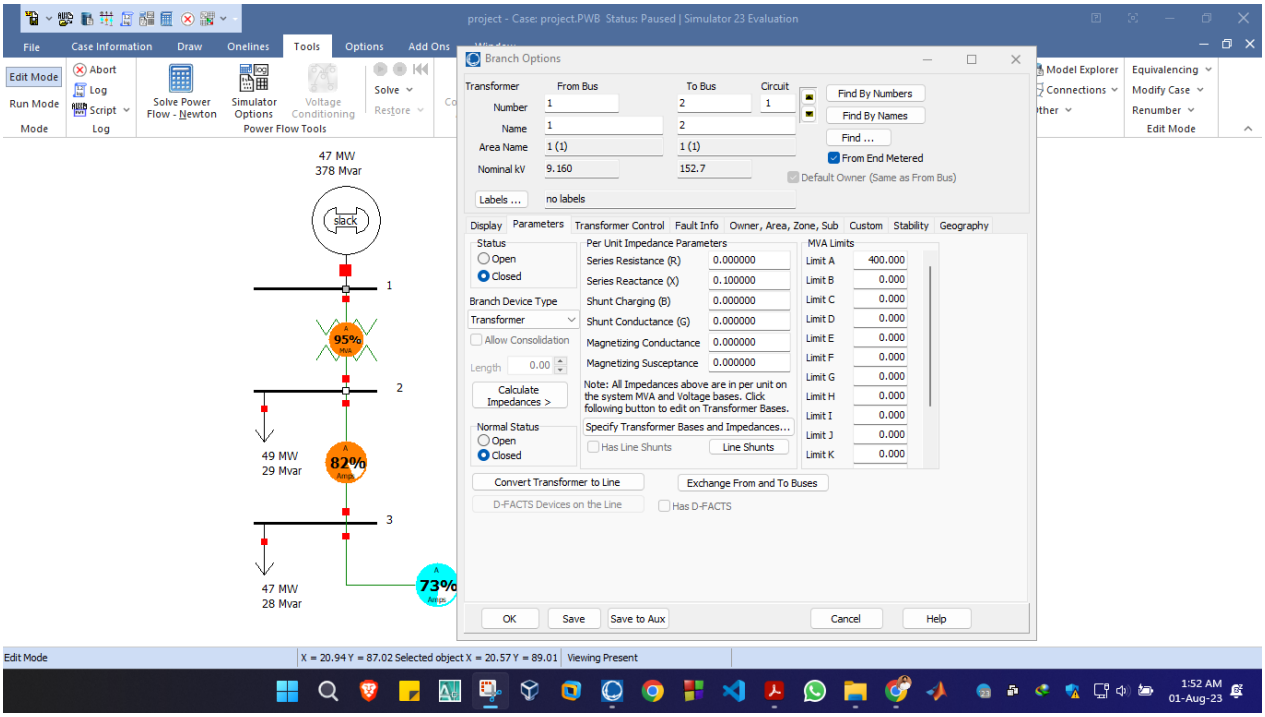
Bus 6:


project - Case: project.PWB Status: Paused | Simulator 23 Evaluation
Bus Options
Bus Number 6
Bus Name 6
Nominal Voltage 152.6700 kV
Bus Voltage
Voltage (p.u.) 0.4945
Angle (degrees) 4.883
180 MW
87 Mvar
50%
44%
40 MW
24 Mvar
41 MW
24 Mvar
43 MW
26 Mvar
28 Mvar
X = 69.92 Y = 77.08 Selected object X = 65.00 Y = 77.00
Viewing Present
1:51 AM
01-Aug-23

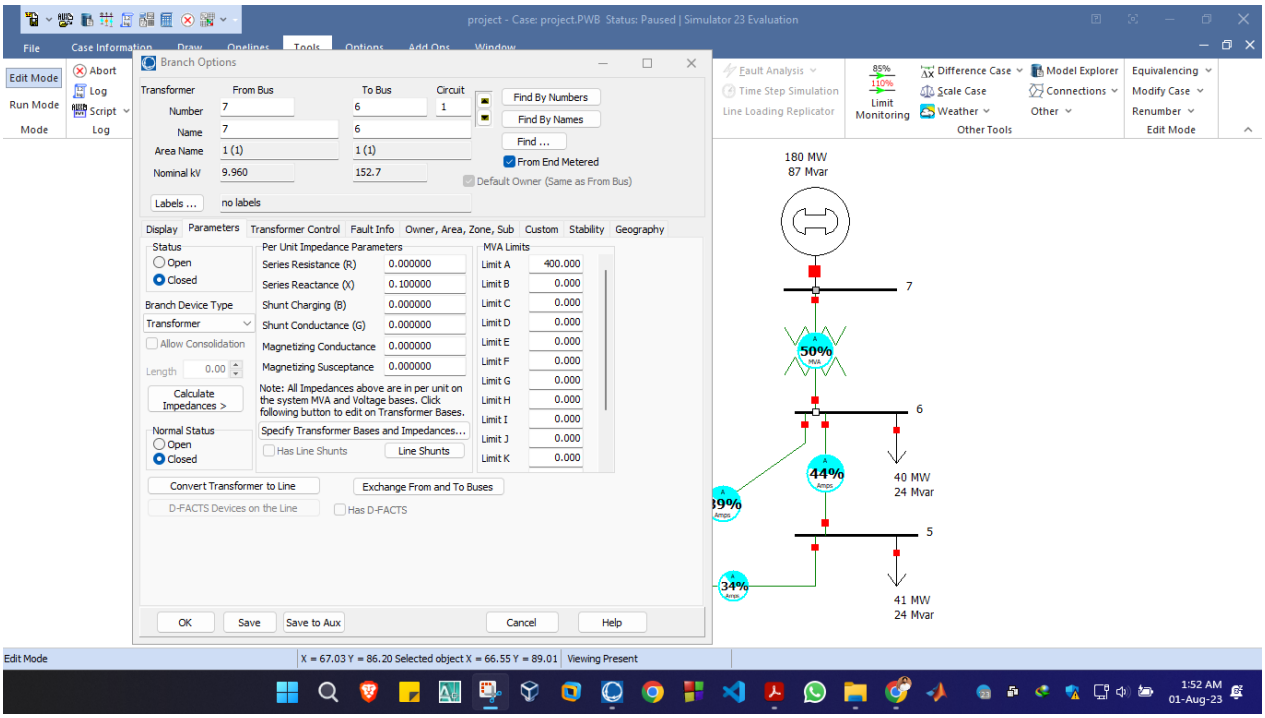
Bus 7:


project - Case: project.PWB Status: Paused | Simulator 23 Evaluation
Bus Options
Bus Number 7
Bus Name 7
Nominal Voltage 9.9600 kV
Bus Voltage
Voltage (p.u.) 0.5207
Angle (degrees) 49.229
180 MW
87 Mvar
50%
44%
40 MW
24 Mvar
41 MW
24 Mvar
X = 72.09 Y = 88.82 Selected object X = 64.00 Y = 89.00
Viewing Present
1:51 AM
01-Aug-23

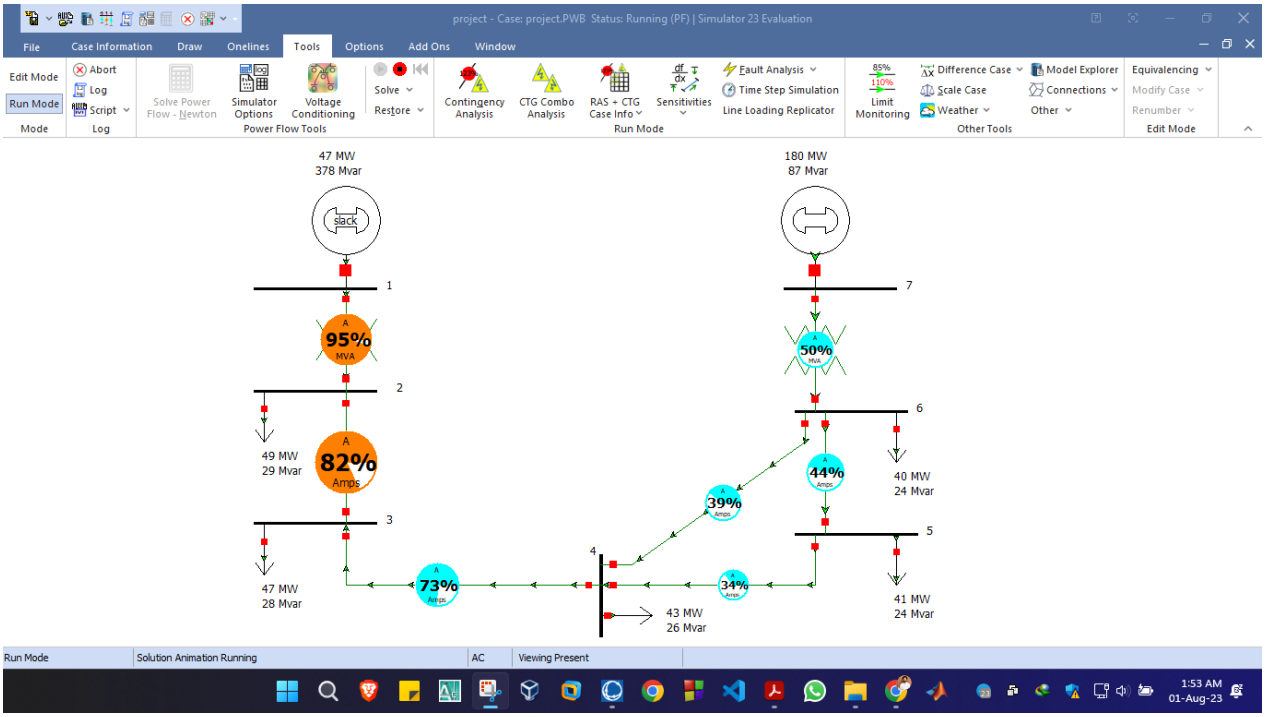
Transformer 1:



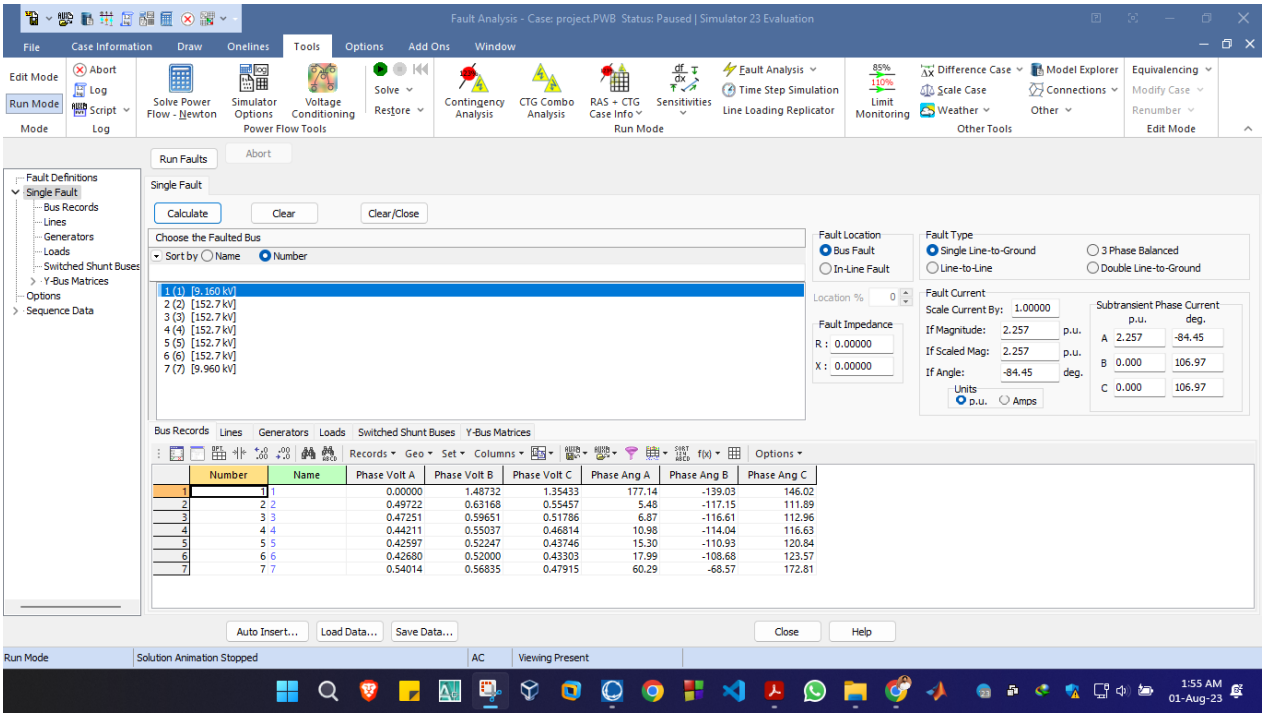
Transformer 2:



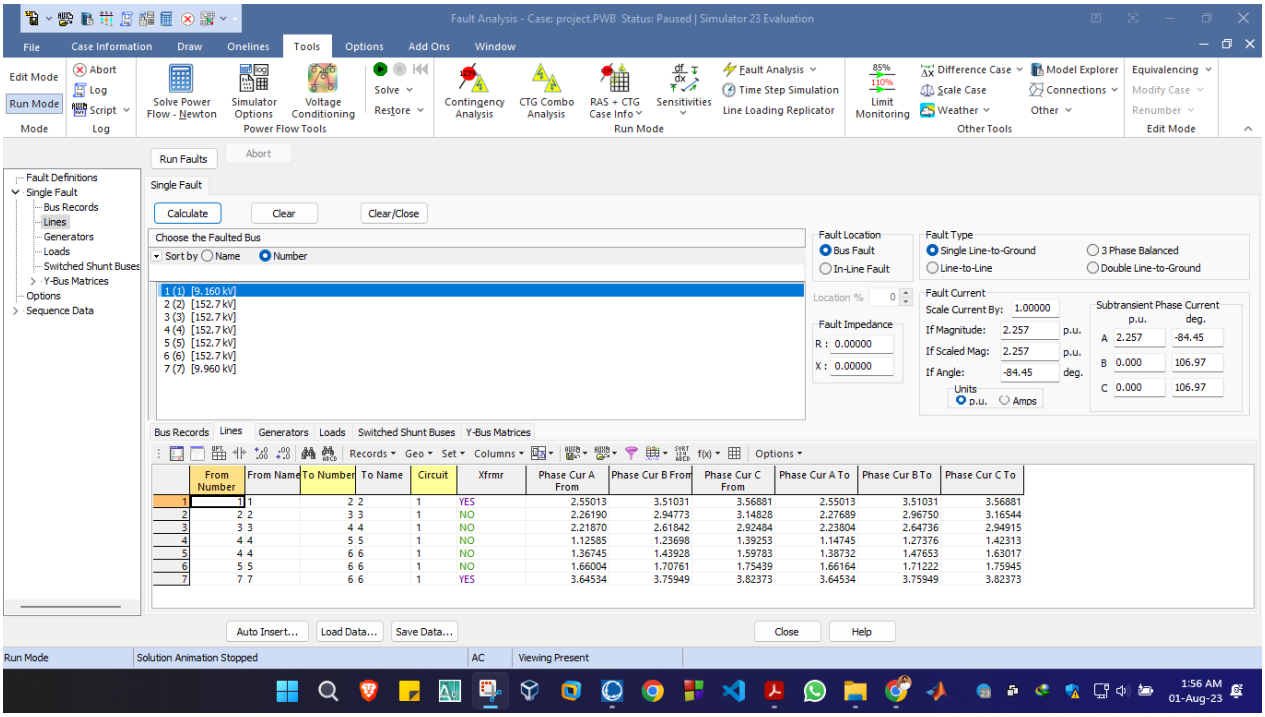
Simulation:



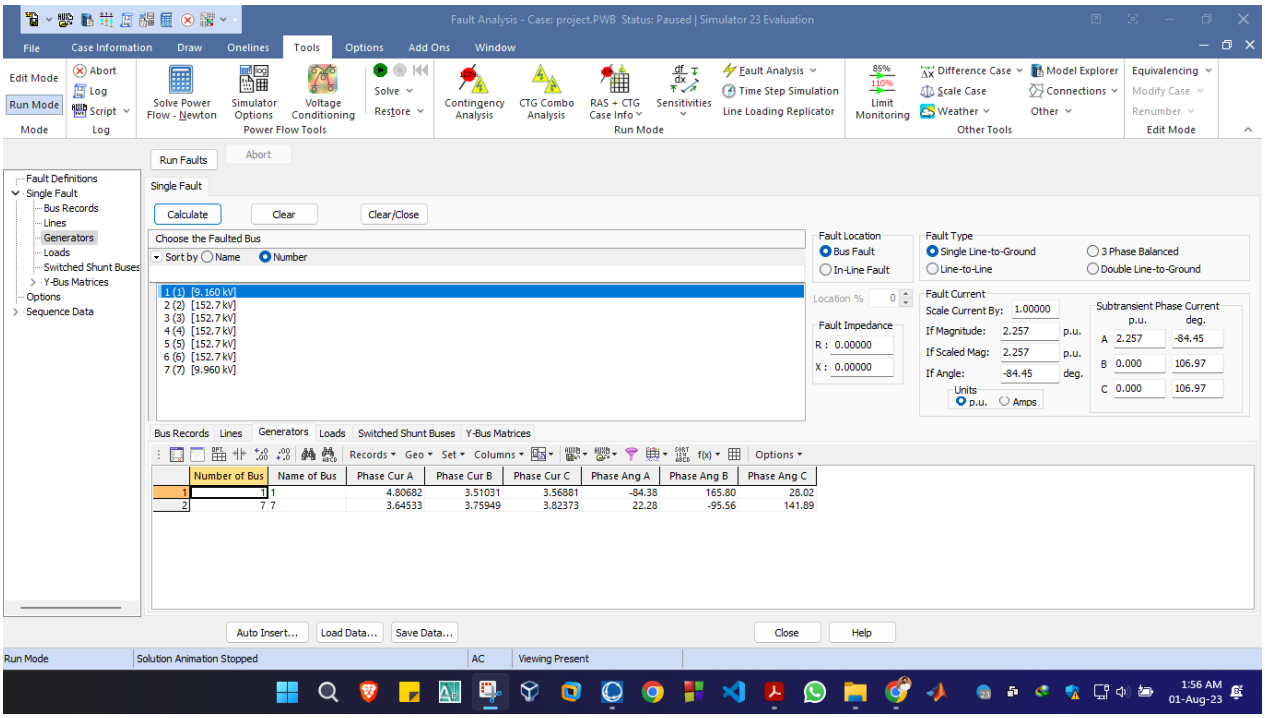
Bus Records Calculation:



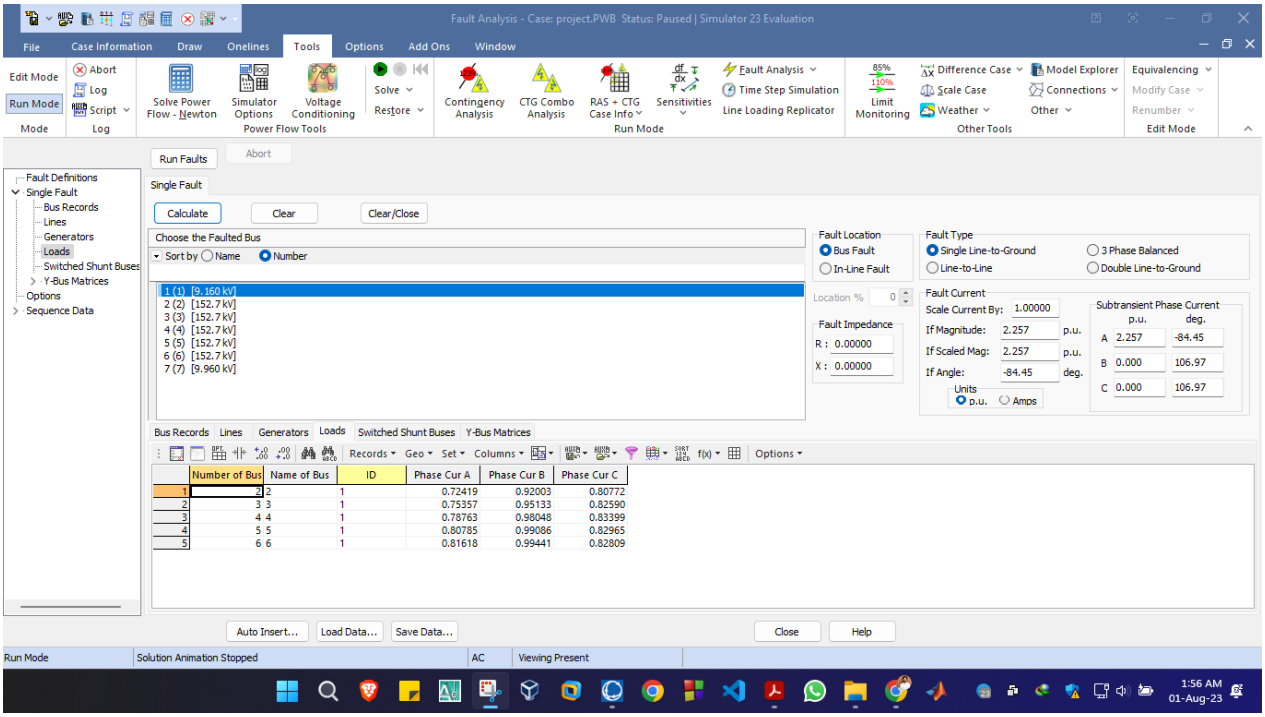
Lines Calculation:



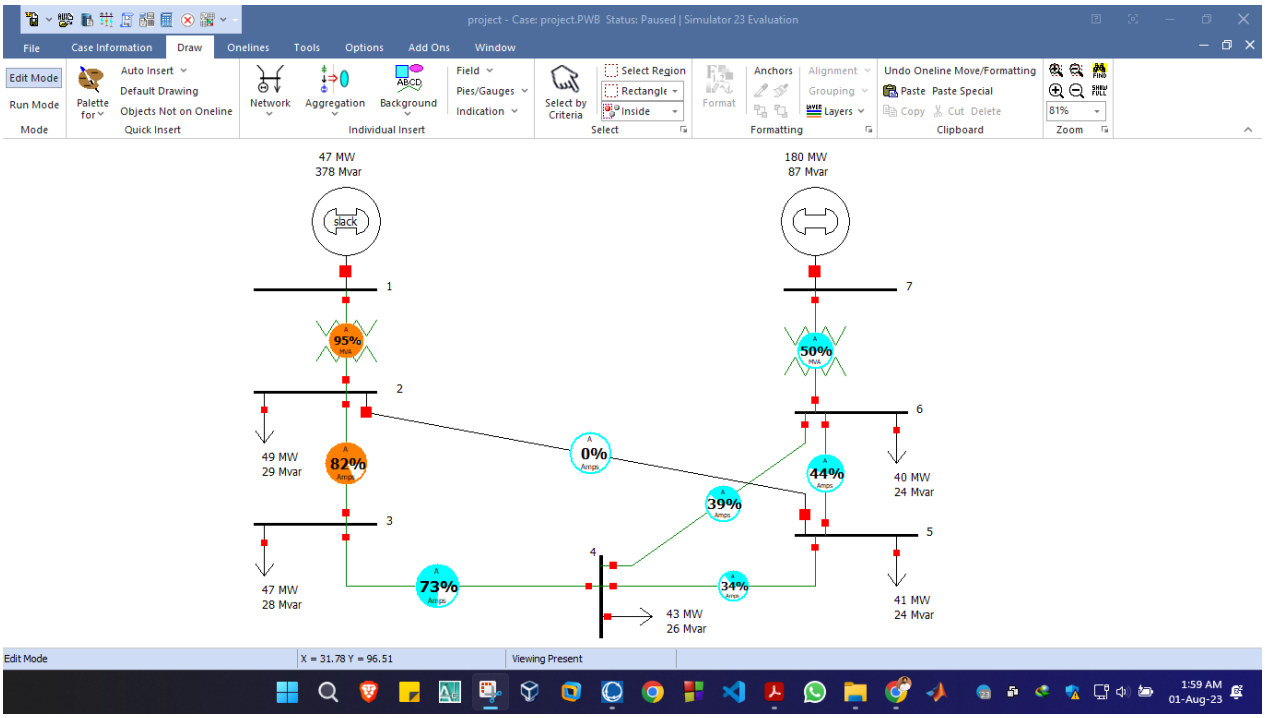
Generators Calculation:



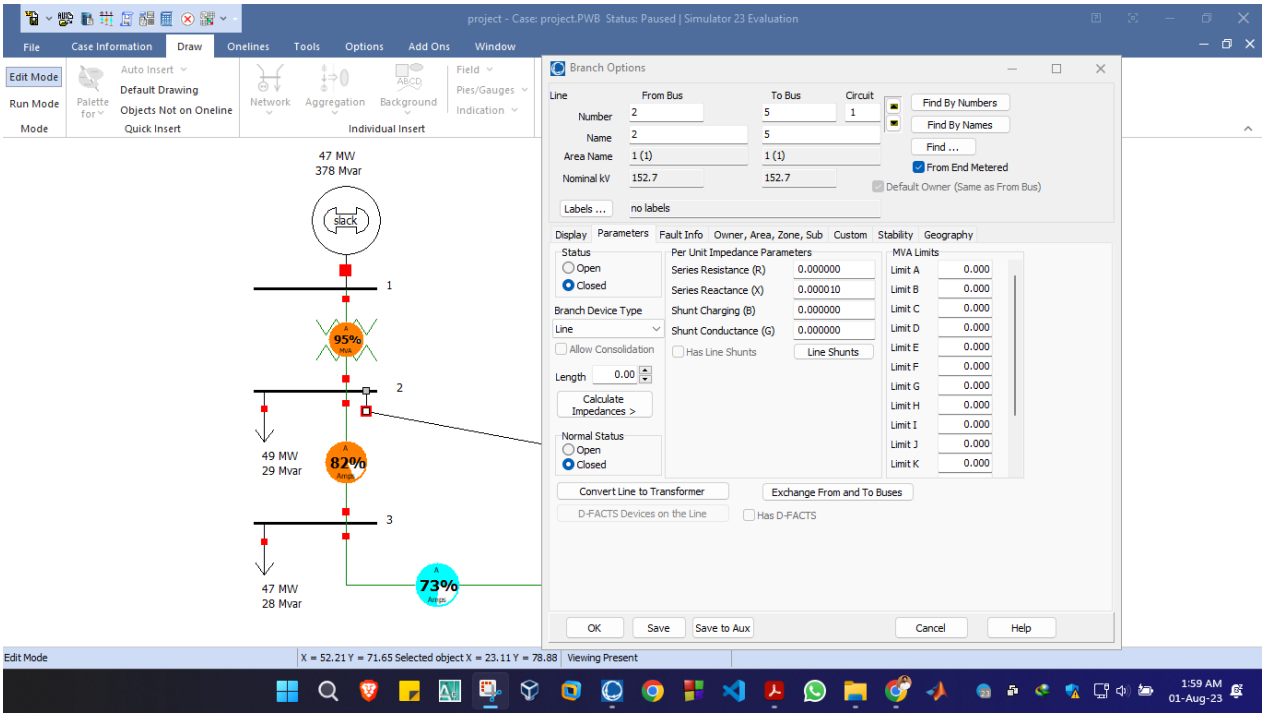
Loads Calculation:



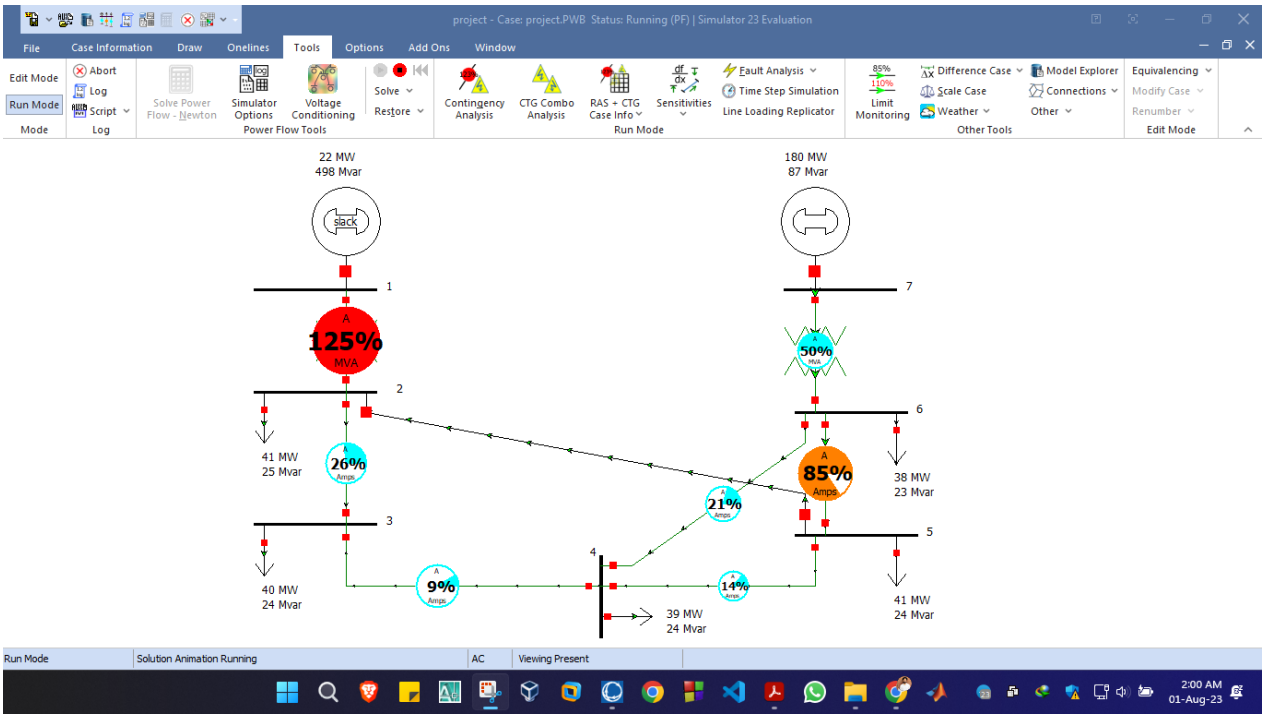
Line to Line Fault Bus-2 to Bus-5 System:



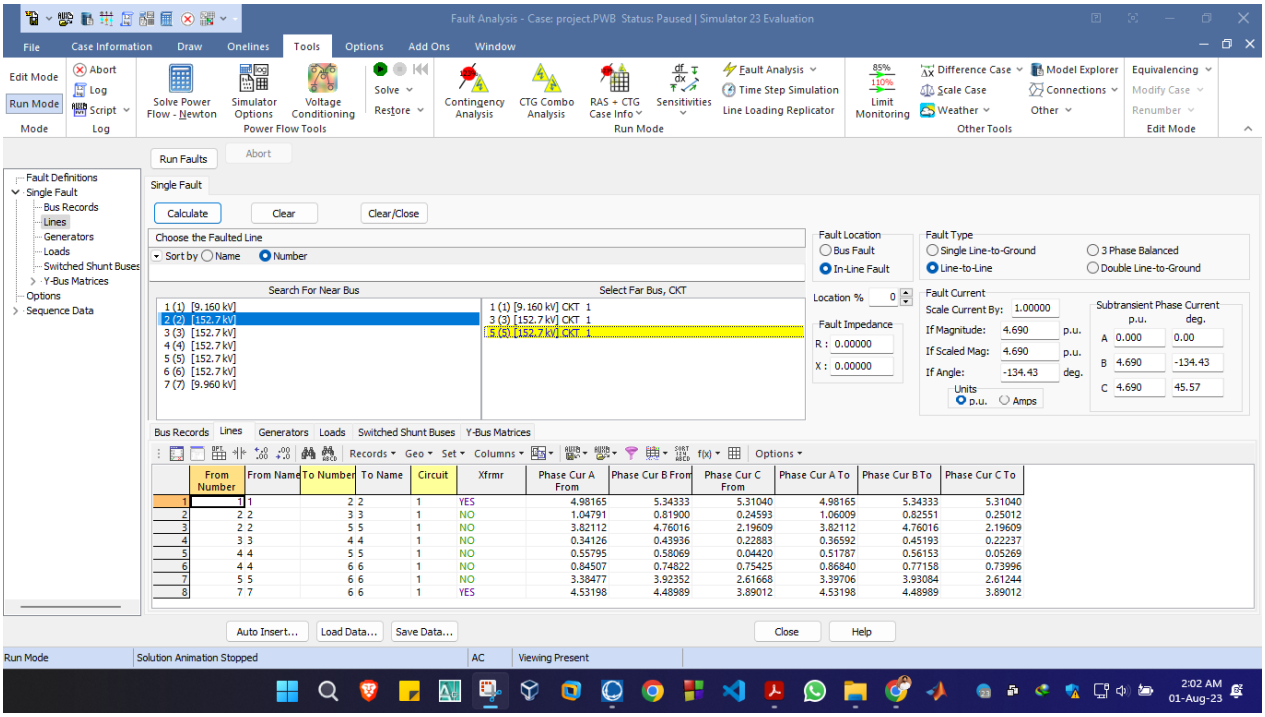
Line to Line Fault Bus-2 to Bus-5 System Line Values:

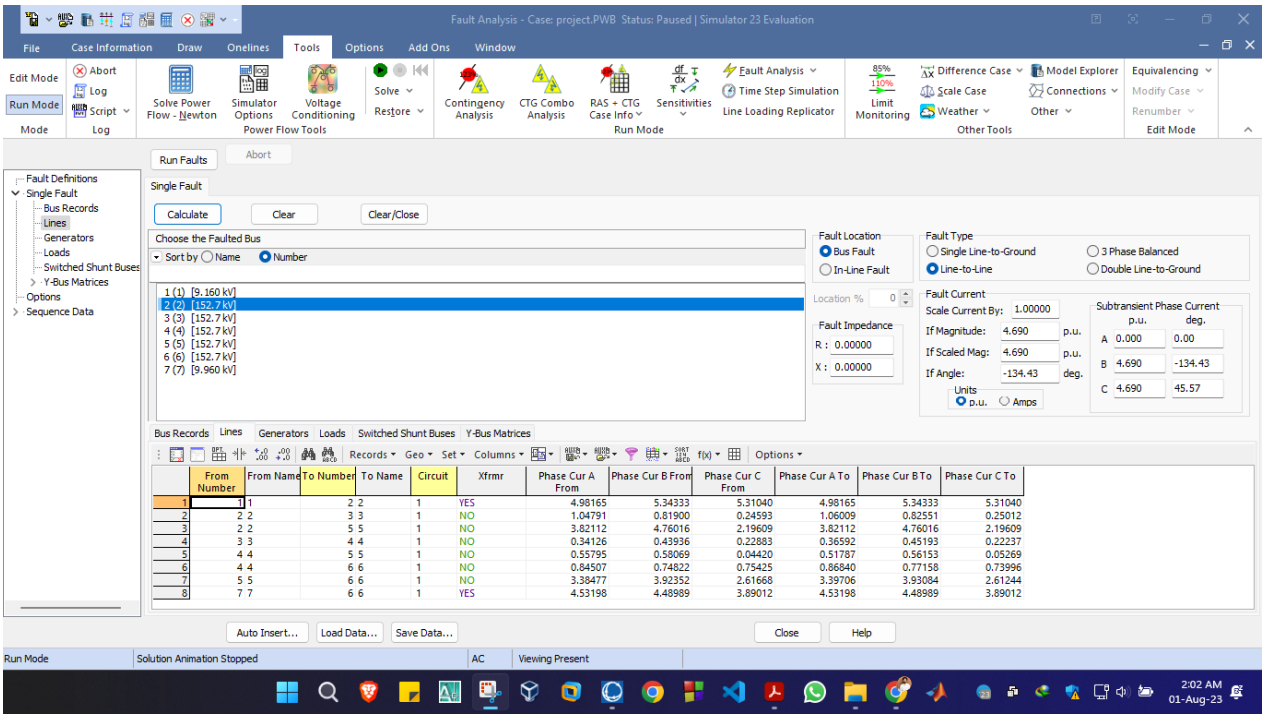


Line to Line Fault Bus-2 to Bus-5 System Simulink:



Line to Line Fault Bus-2 to Bus-5 System Calculation:





Discussion

In this project, I have implemented a power system having two generator, two transformer, seven buses and four loads. I have used bus 1 as swing bus and bus 2, 3, 4, 5, 6 as load bus and bus 7 as generator bus. First I have calculated all the values and entered the values in the power world software to design the required system. Completing the system, I have analyzed bus records, lines, loads, generator values from the calculator. After this, I made a line to line fault by connecting a transmission line from bus 2 to bus 5 and analyzed the values from the fault analysis calculator.