APPENDICES A

Power distribution system modeling with DIgSILENT PowerFactory

A.1 DIgSILENT PowerFactory program

DIgSILENT PowerFactory or PowerFactory program is a program used to create the model. To analyses power supply system, all models can be created in the form of pictures or writing. The program writing in the form of a Text File also has the ability to analysis power supply system. A wide variety of power flow analysis, problem analysis and short circuit. The Analysis of protection systems, power loss analysis system analysis and reliability. A system for using DIgSILENT PowerFactory program in this thesis will be used the program to Version 15.1 in DIgSILENT PowerFactory [14] modelling and analysis of the issue.

A.1.1 The structure of the program PowerFactory

The structure of the program, there are several PowerFactory sections on this topic will be discussed. The specific structure of the highlights includes a data management structure for the various electrical systems. It created and stored in the program window's components PowerFactory Main Window.

1) The management structure of data in the program PowerFactory

The information management program will be located in the Data window PowerFactory. Manager, which shows the folder structure to store data in a Database as shown in Figure A.1.

1.1 Main Library Folder contains the Types and Models of various standards programs PowerFactory.

1.2 System Folder contains the o bject used within the PowerFactory which, if you want to update in the User must Log on Edit. Only Administrator's Account and what should be done under the guidance from DIgSILENT customer support because it will affect the operation of the program.

1.3 User Account Folders contains a folder of the Project and Setting. Normal User-defined according to various examples is the Aksacksy User.

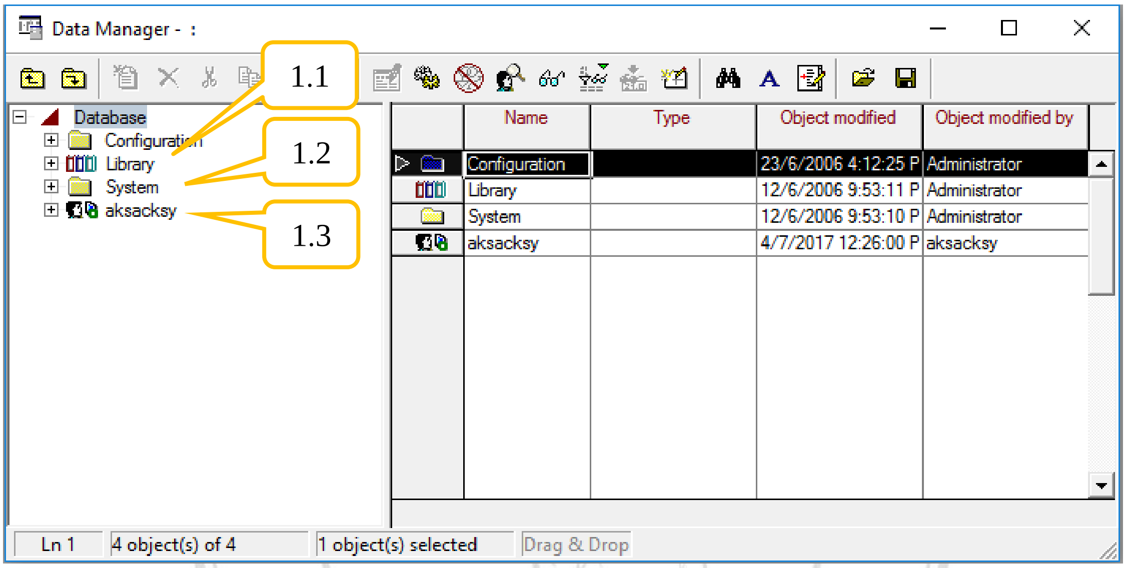

Figure A.1 Shows the Data Window Manager the data storage structure

2) The various components of the Main Window.

Components of the Main window, the Window contain the 10 key components as shown in Figure A.2.

2.1 Title Bar is the bar shows the name and Version of the program.

2.2 Menu Bar is the main command bar of the program.

2.3 A Main Tool Bar button is used instead of the main Menu Bar in command, which can be activated immediately.

2.4 Drawing Tool Bar buttons that are used to create the device, an electrical system in a different model.

2.5 Data Manager Window is a window that displays a Data structure to store all of the data.

2.6 Context Menu is the window that is displayed when you right-click the folder in the Object Data Manager.

2.7 Output Window is a window that displays the results of calculations or display Error.

2.8 Output Tool Bar is the Tool Bar which works attributed to the Output Window.

2.9 Workspace is the area that is used to create the Single Line Diagram.

2.10 Status Bar displays the status on the workpiece that is Active.

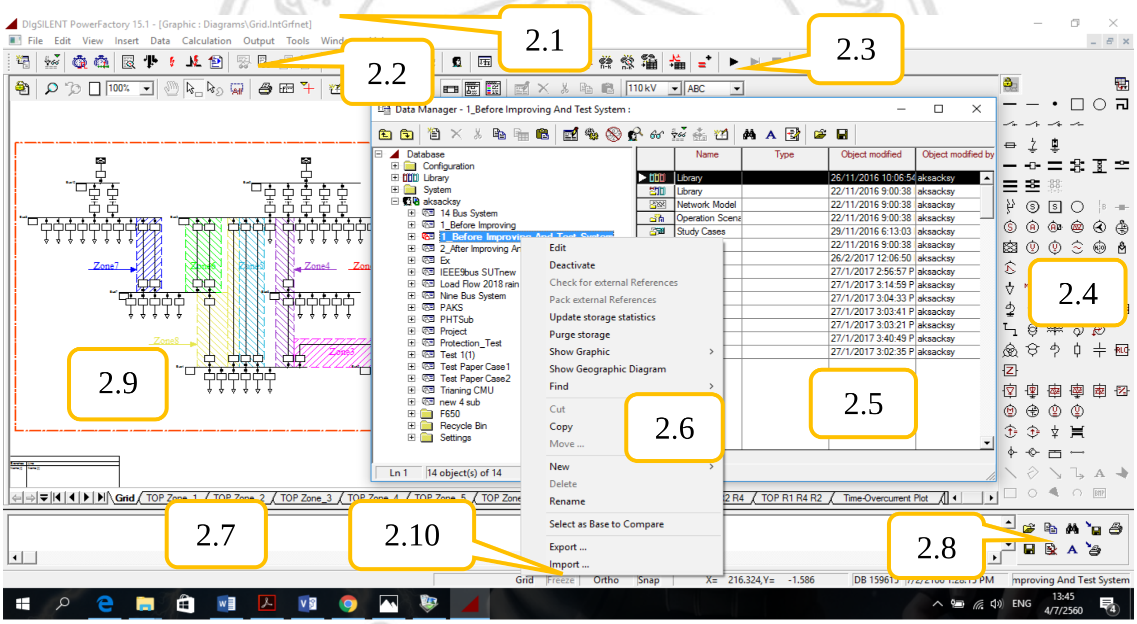

Figure A.2 The components of the Main Window

A.1.2 Modelling a system test 4 buses

Test system for model 4 bus to make it as a model system to test. IEEE standards information to create it as a reference by IEEE Bus Feeder 4 Test Cases [12].

1) Creating a node or a bus (Creating Terminal)

Clicking on the bus (Terminal) or node (Point Terminal) on the Drawing Toolbar on the right side, then placed in the Workspace by moving areas. Mouse to where you want to create the node, or a bus, then left click 1 time to paste. Equipment (create a vertical bus, right-click, and then select the Clockwise or Counter Clockwise Rotate) bus as shown in Figure A.3. To cancel create the Drawing mode, the device, press and hold the Esc or right-click 1 time, then it will be able to choose a different image to create the device.

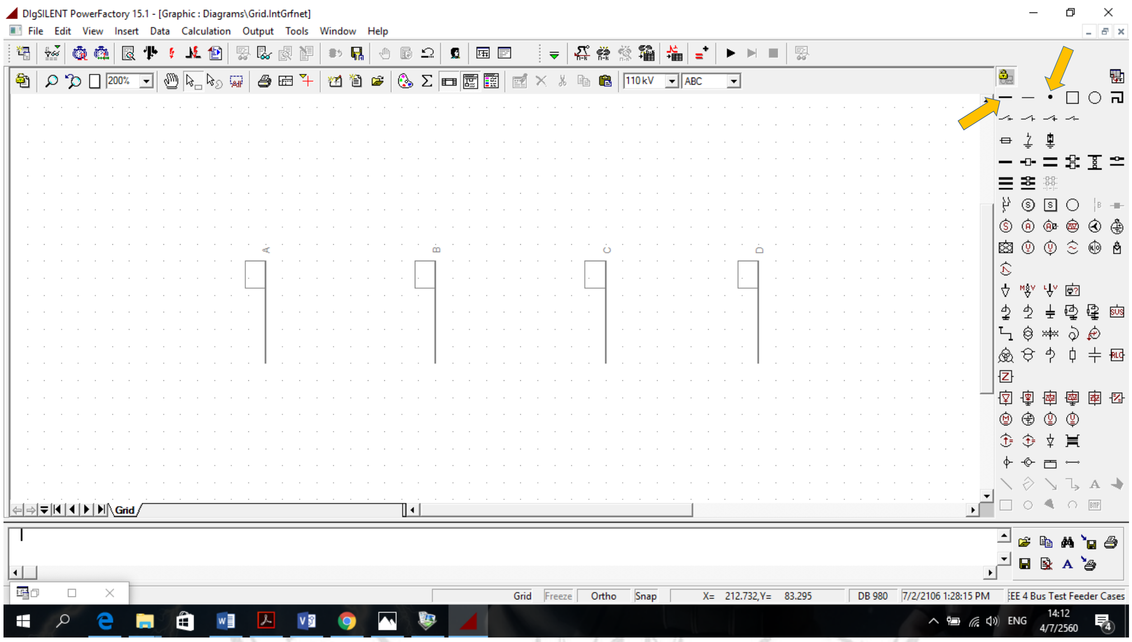

Figure A.3 Create the Drawing the bus on the Workspace

Input data bus can do so by double-clicking the bus appears Dialog Box of a loud bus as shown in Figure A.4. Each window of analysis will provide different input. In this case study, data input as shown in Table A.1.

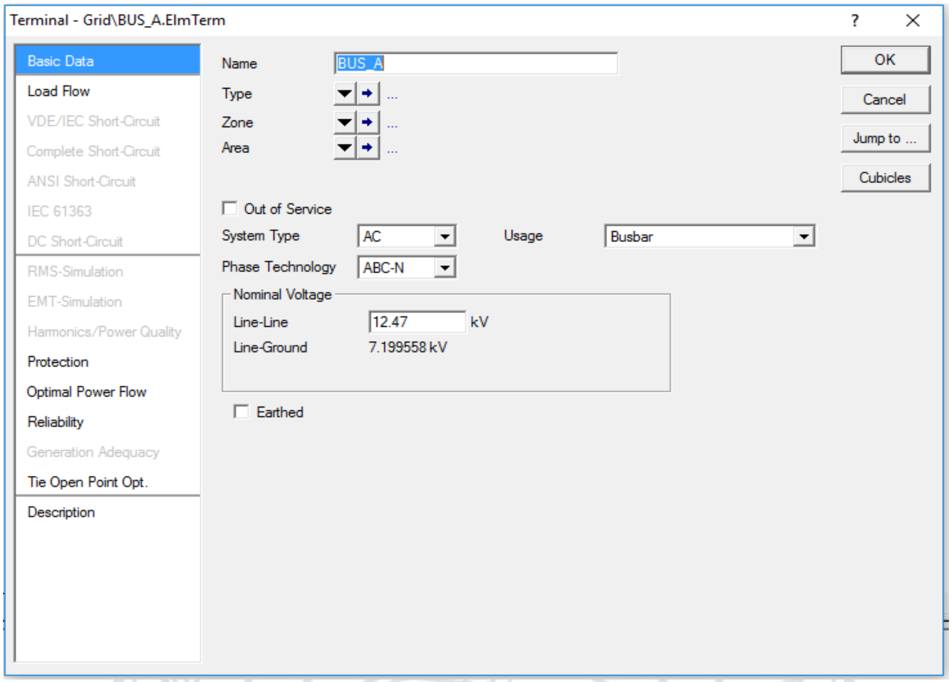

Figure A.4 The input data bus or node

Table A.1 Data on that bus

Name	Phase Technology	Line to Line Voltage	Voltage Type
BUS_A	ABC-N	12.47 kV	AC
BUS_B	ABC-N	12.47 kV	
BUS_C	ABC	4.16 kV	
BUS_D	ABC	4.16 kV	

2) To build the transmission line (Line)

Select a device line ⮡ (Line) from the Drawing Toolbar on the right side, then placed in the Workspace area by clicking on one of the bus first and then come. Click on another bus that you want to connect to the transmission line will be the link between the two, such as a bus. Create a link between the bus line 1 and 2 by selecting the line from the Drawing Toolbar and then click on the bus 1 first and then click on the bus 2 as shown in Figure A.5.

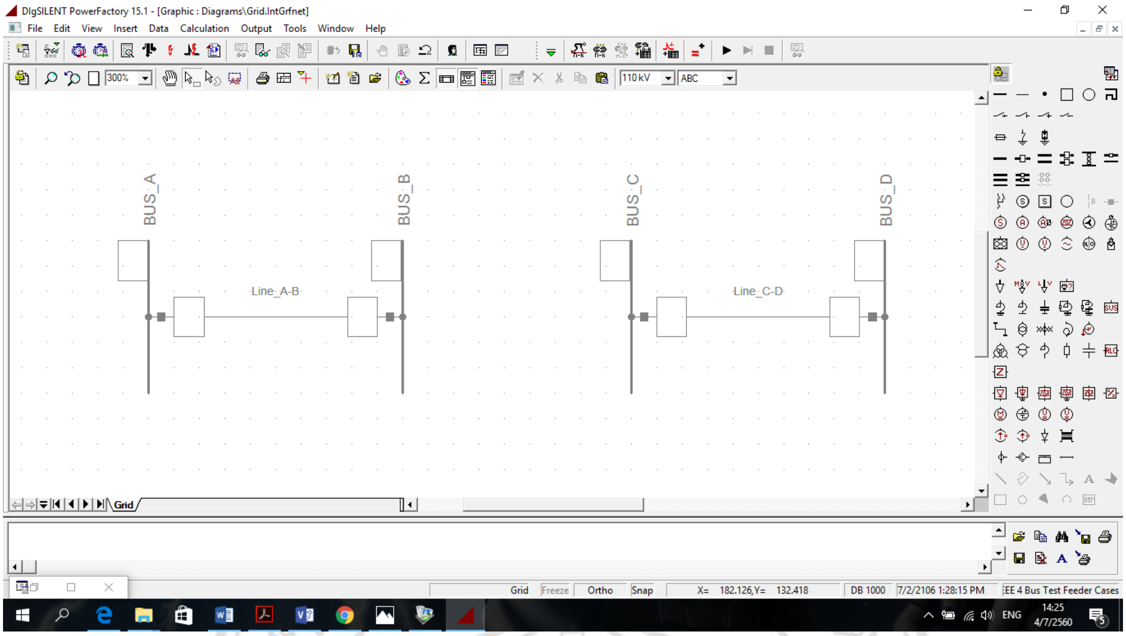

Figure A.5 Create the building transmission line

Input data transmissions made by double-clicking on a line will appear on the Dialog Box on the line as shown in Figure A.6. Then the input data of the transmission line as shown in Table A.2.

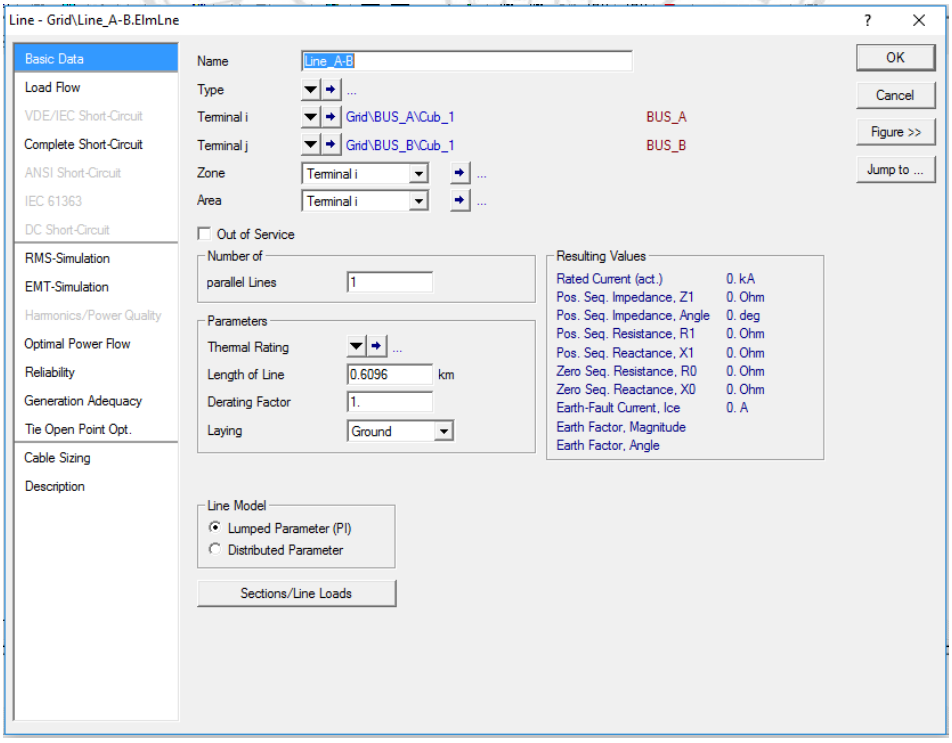

Figure A.6 The input data of transmission line

Table A.2 Data on the transmission line

Name	Terminal Connect to BUS		Type of Line	Length (km)
	I	j		
Line A-B	A	B	Line A-B Type	0.6096
Line C-D	C	D	Line C-D Type	0.762

Then determine the type of transmission line for the case study, this will create a kind of new Type Tower cables by selecting New Project Type => Tower Type as shown in Figure A.7.

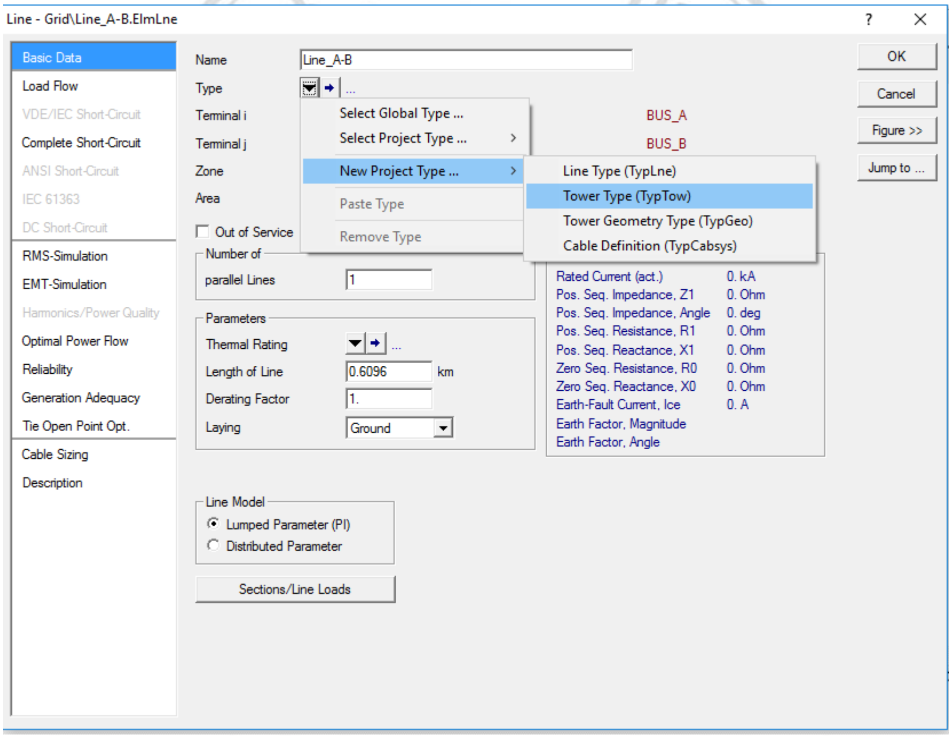

Figure A.7 The input data of transmission line

A Dialog Box will appear in the input data of transmission line. Tower model Type, as shown in Figure A.8.

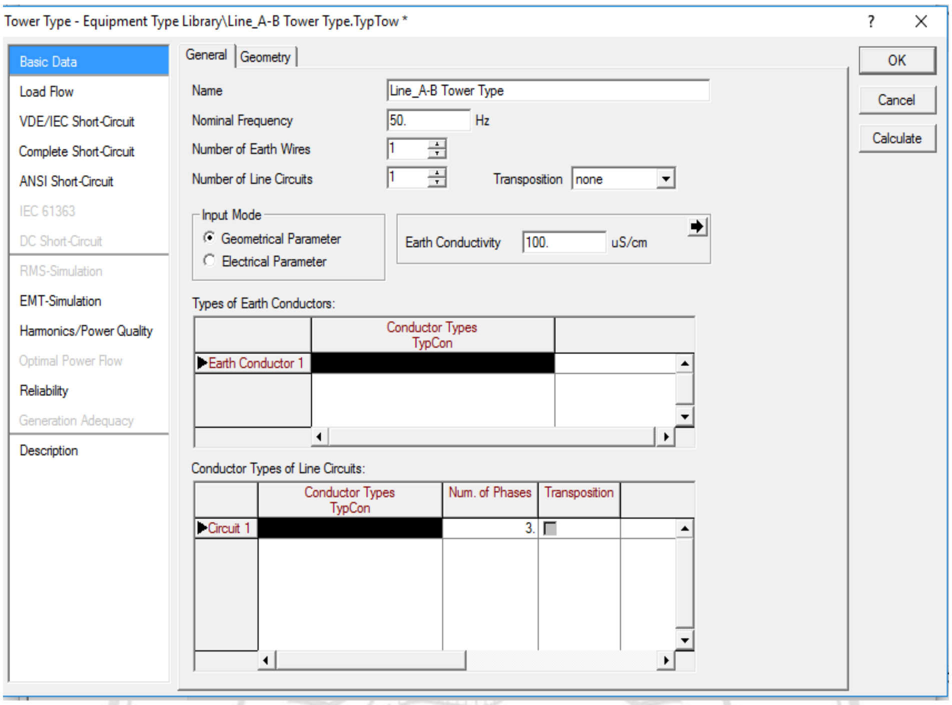

Figure A.8 To create a data transmission of a Tower Type

To choose a Mode Input Electrical Parameter and then creating the replica of the phase line by double-clicking on a space in the first column of the first row. Type of Conductor Line Circuits as shown in Figure A.9.

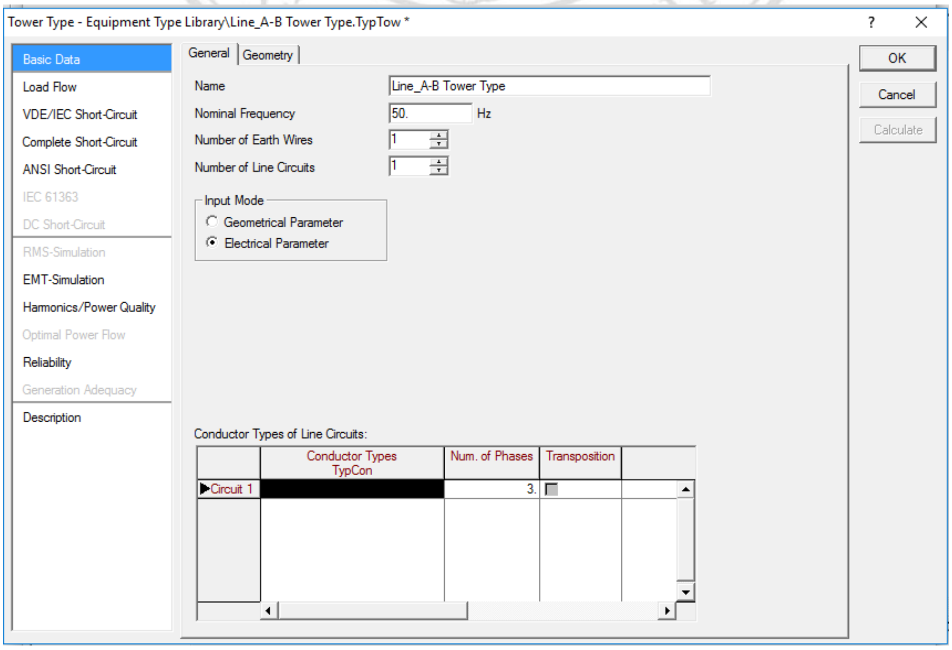

Figure A.9 Setting conductors of the phase line

Appears next to the Data Manager for the select or create the Guide, click on the Menu Bar, as shown in Figure A.10, to make the line a new phase.

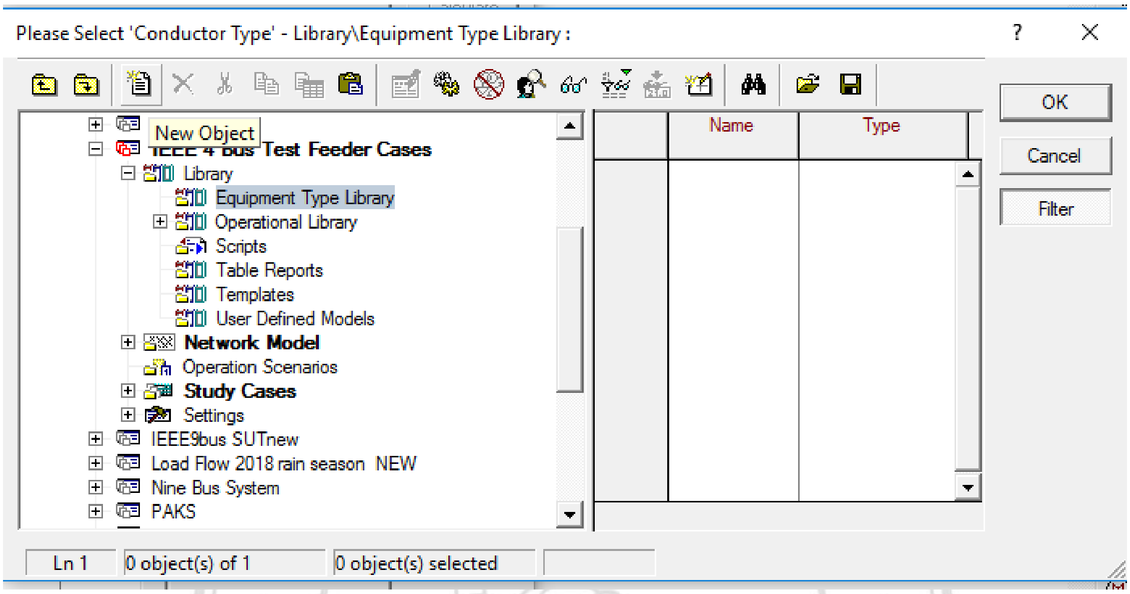

Figure A.10 Modelling conductors of the phase line.

A Dialog Box window appears, as shown in Figure A.11 for data input as conductor. Phase wiring for in this case study, the data input as shown in Table A.3, when input data is finished, press OK.

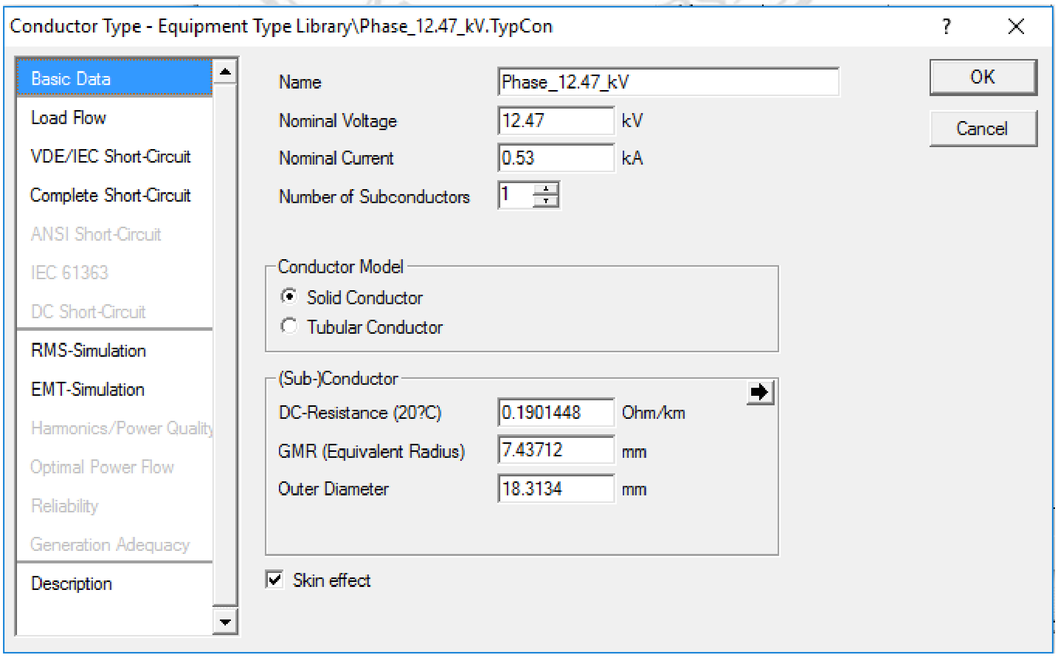

Figure A.11 To input data, a leading cable system test phase 4 buses

Table A.3 Data transmission line conductor

Name	Nominal Voltage (kV)	Nominal Current (kA)	DC Resistance (20C) (Ohm/km)	GMR (mm)	Outer Diameter (mm)
Phase_12.47_kV	12.47	0.53	0.190139585	7.43712	18.3134
Neutral_12.47 kV	12.47	0.34	0.36786180326	2.481072	14.3002
Phase_4.16 kV	4.16	0.53	0.190139585	7.43712	18.3134

Then came a Load Flow Resistance and Reactance values for input of the transmission line and then input the values as shown in Table A.4, as shown in Figure A.12.

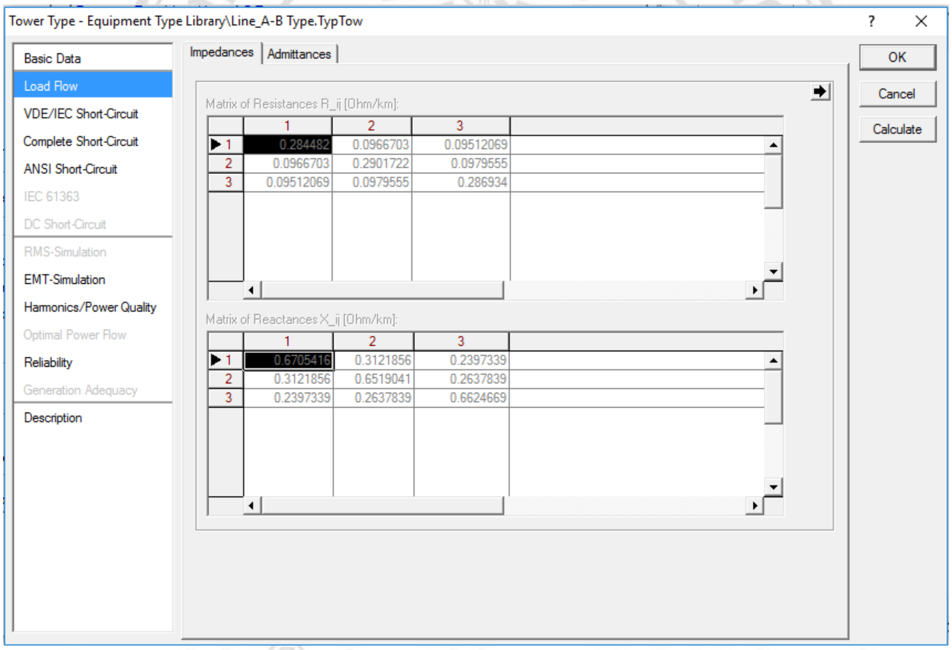

Figure A.12 Input Resistance and Reactance values of line test system 4 bus

Table A.4 The Resistance and Reactance data of transmission line

Name of Lines		Matrix of Resistances R_ij (Ohm/km) 1	2	3	Matrix of Reactance X_ij (Ohm/km) 1	2	3
Line A-B	1	0.284482	0.0966703	0.09512069	0.6705416	0.3121856	0.2397339
	2	0.0966703	0.2901722	0.0979555	0.3121856	0.6519041	0.2637839
	3	0.09512069	0.0979555	0.286934	0.2397339	0.2637839	0.6624669

Table A.4 The Resistance and Reactance data of transmission line (Continued)

Name of Lines		Matrix of Resistances R_ij (Ohm/km)			Matrix of Reactance X_ij (Ohm/km)		
		1	2	3	1	2	3
Line C-D	1	0.2485279	0.0579578	0.05795723	0.8794718	0.5304363	0.452805
	2	0.0579578	0.2485279	0.05795761	0.5304363	0.8794718	0.4861183
	3	0.05795723	0.05795761	0.2485279	0.452805	0.4861183	0.8794718

Then, back to the Basic window, select the Data Input Mode is a Geometrical Parameter, then it will make the modelling of conductor neutral by double Click on the gap in the first row of the first column of Type Earth Conductor as shown in Figure A.13.

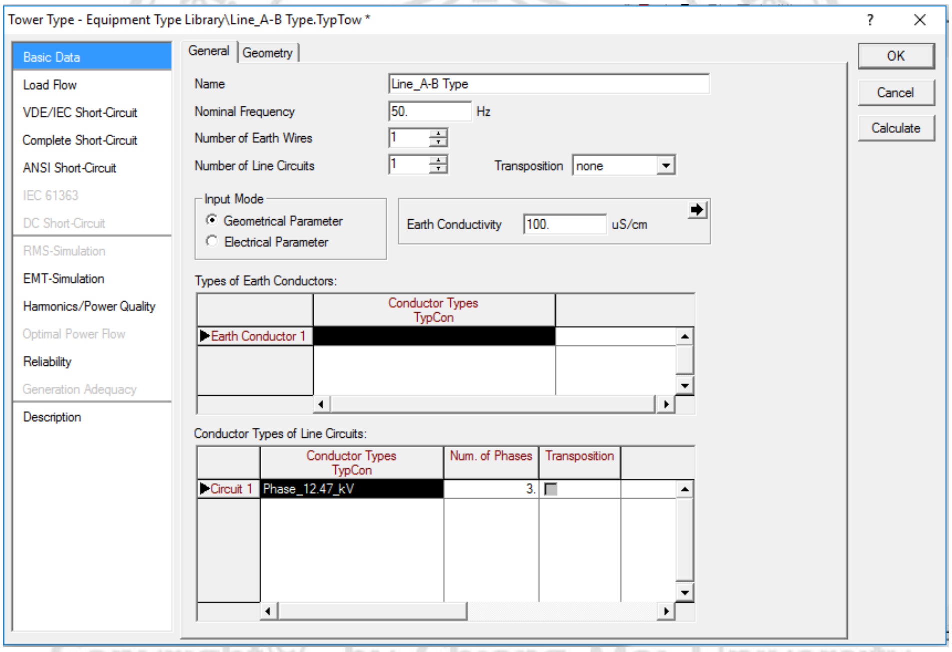

Figure A.13 Modelling line conductor of the Neutral

Data appears next to the Data Manager for the select or create the leading neutral, click. On the Menu Bar to create a new line neutral, guide will appear. Window, Dialog Box, for data input line neutral, for in this case study, the data input as shown in Table A.5, as shown in Figure A.14 when the input data is finished, press OK.

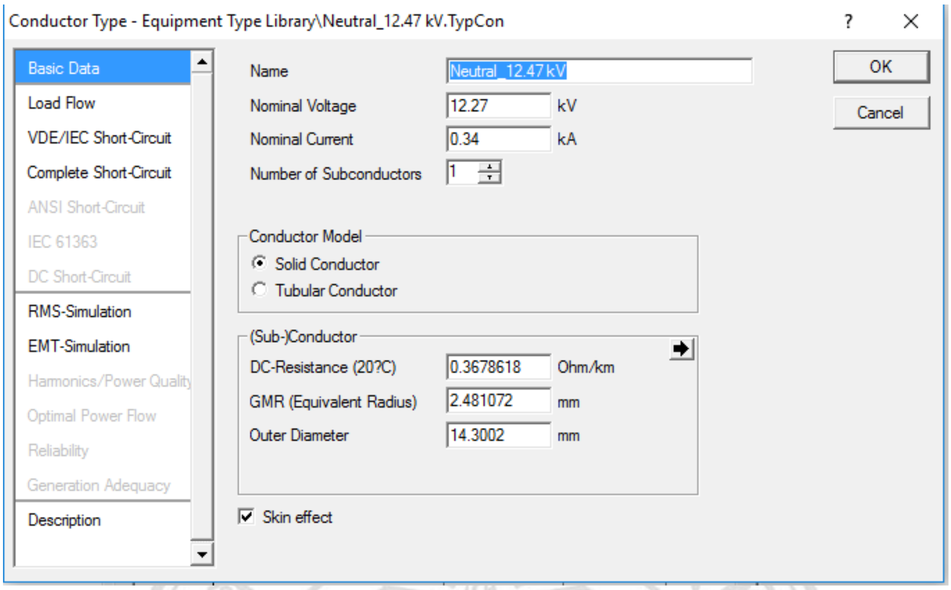

Figure A.14 Data input of line neutral for test system 4 bus

Then, click on the symbol to define the values of the transmission line Pole Configuration, as shown in Figure A.15 and then input the values in Pole Configuration case study, this input value is Pole Configuration as shown in Table A.5, as shown in Figure A.16.

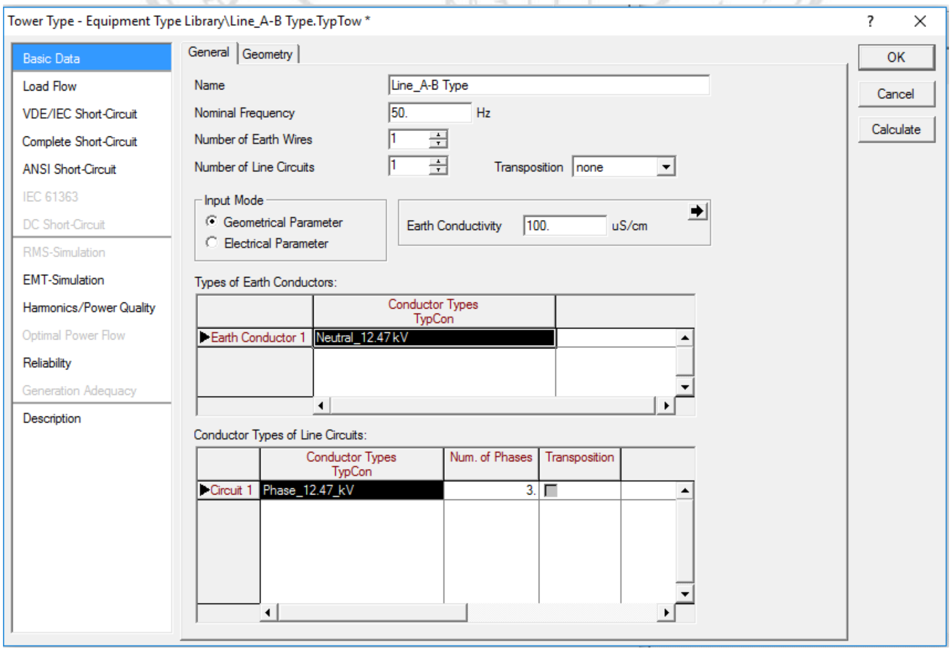

Figure A.15 The input of Pole Configuration value

Table A.5 The data pole configuration

Name	Coordinate of Earth Conductor [m]		Coordinate of Line Circuits [m]					
	X	Y	X			Y		
	1	2	1	2	3	1	2	3
Line A-B	0.1524	7.3152	1.0668	0.3048	1.0668	8.5344	8.5344	8.5344
Line C-D	-	-	1.0668	0.3048	1.0668	8.5344	8.5344	8.5344

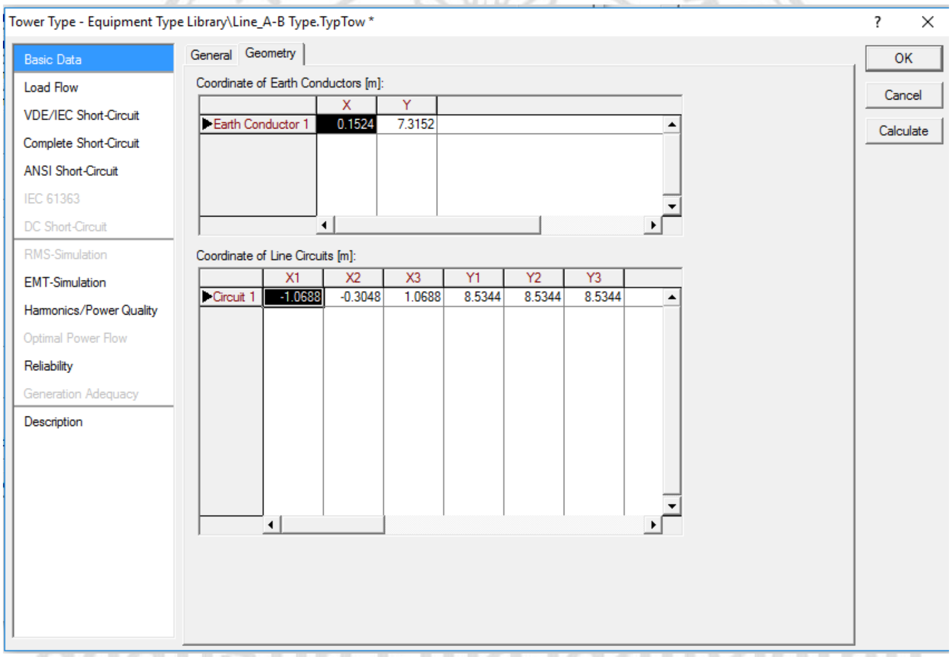

Figure A.16 The input Pole Configuration for test system 4 bus

When the value data input Pole Configuration, click on the symbol shown in Figure A.17 will be returned to the window for input data Basic Data again, as shown in Figure A.18, do as shown in Table A.6 data inputs.

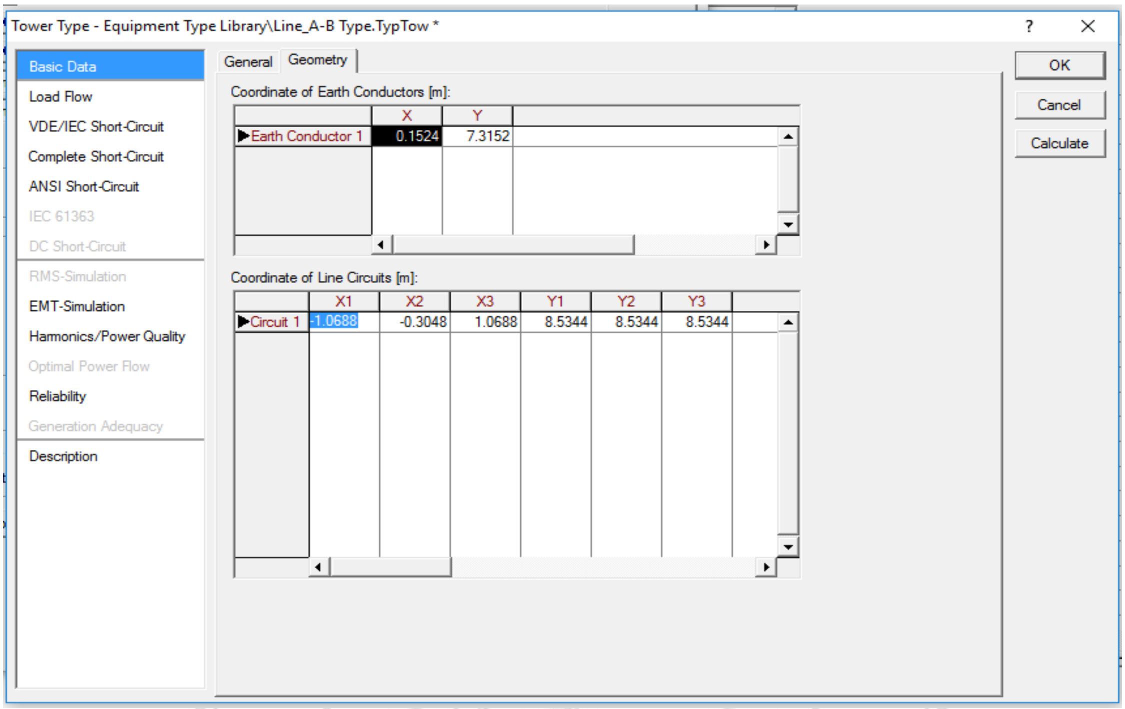

Figure A.17 The window Basic Data to input data, the type of transmission line

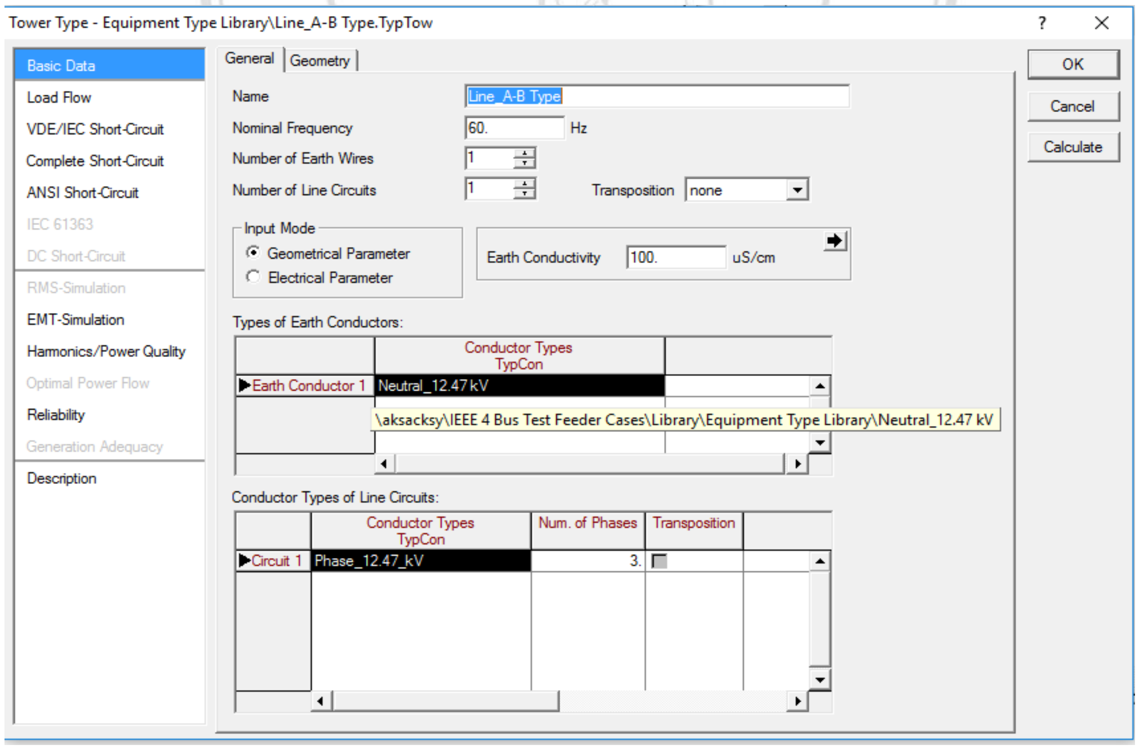

Figure A.18 Window of Basic Data to input data, the type of transmission line

Table A.6 Type of data transmission

Name	Number		Conductor Types			Nominal Frequency (Hz)
	Earth Wires	Line Circuits	Phases	Neutral	NUM. of Phases	
Line A-B Type	1	1	Phase 12.47 kV	Neutral 12.47 kV	3	60
Line C-D Type	0	1	Phase 4.16 kV	-	3	60

When building a transmission line A-B successfully, creating a cable line C-D, using the same methods to create the cable line A-B.

3) To create the transformers

To create a transformer made by selected symbols transformers. On the Drawing Toolbar Placed in the Workspace area, click Mouse at any bus. One of the first, and then come and click on the bus to make a connection to the transformer model. As shown in Figure A.19 then the input data transformer by Double click that Dialog Box will contain a transformer of transformer appears. Then create the type of transformer. By selecting the check box, Type-a New Project => Type, as shown in Figure A.20.

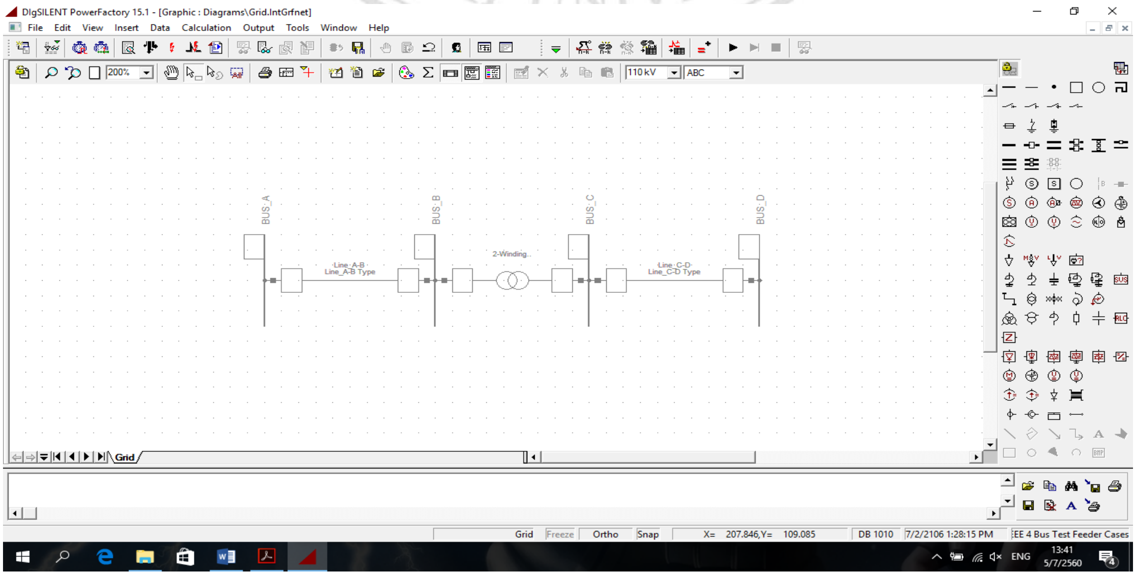

Figure A.19 To create the transformers

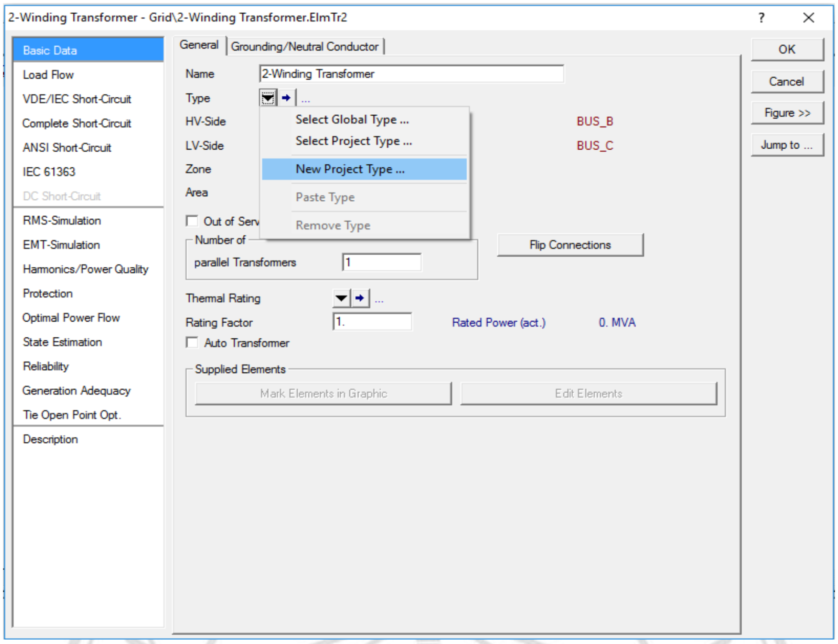

Figure A.20 To input the data of transformer

Dialog Box will appear for the data input of the transformer. For the transformers in case studies, this Technology is a Three Phase Transformer which means. A three-phase transformer and then click on the Positive Sequence Impedance check box is selected in Resistance and Reactance p.u. in p.u. as shown in Figure A.21, then press OK, and configure other parameters the Table A.7 will get parameter values, as shown in Figure A.22 and when the configuration parameters until you hit OK.

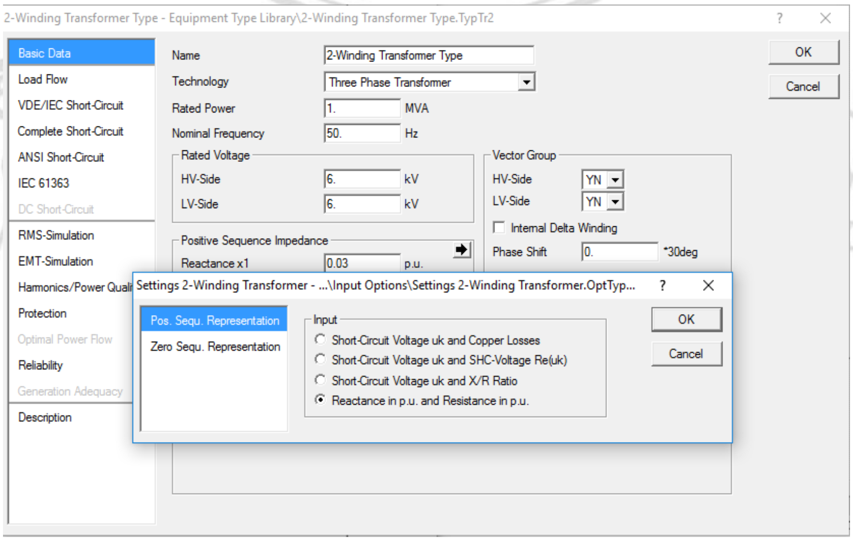

Figure A.21 Select Reactance in p u and Resistance in p u

Table A.7 Data of transformers

Rated Power (MVA)	Rated Voltage (kV)		Positive Sequence Impedance (p u)		Vector Group		Nominal Frequency (Hz)
	High Voltage Side	Low Voltage Side	Resistance r1	Reactance x1	High Voltage Side	Low Voltage Side	
6	12.47	4.16	0.01	0.06	YN	D	60

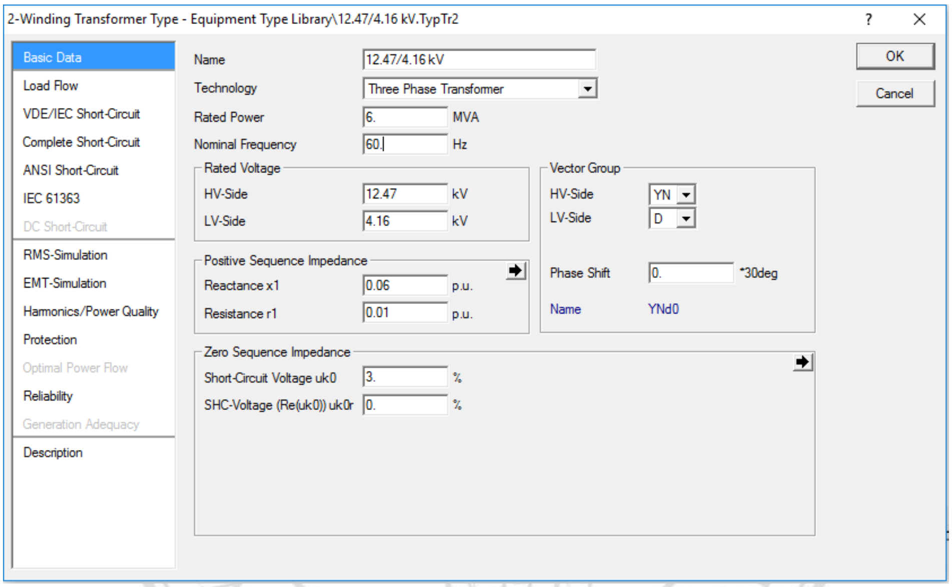

Figure A.22 Input data of the transformer

4) To create supply

To create supply (External Grid) by clicking to select the device on the Drawing window supply Toolbar, then select the desired bus connection. Such a device would be a model as shown in Figure A.23 supply in this case studies. To make a connection to the supply into the bus at 1, and then double-click the device supply. The Dialog Box has been created will appear as shown in Figure A.24. Then go to the window, Load Flow. As shown in Figure A.25, and define the Type as SL Bus, which refers to the. Slack Bus Voltage in this case study will define the Set point is equal to 1 when the input parameter values window p.u. Load Flow and the VDE/IEC.Short-Circuit as shown in Figure A.26 and then configure a Power Short-Circuit Short-Circuit Power Sk max and "Ik" min. in the study assigned Short-Circuit Current max Ik ", which equal to 100 MVA and Short-Circuit Power Sk" min. Equal to 100 MVA, then press OK.

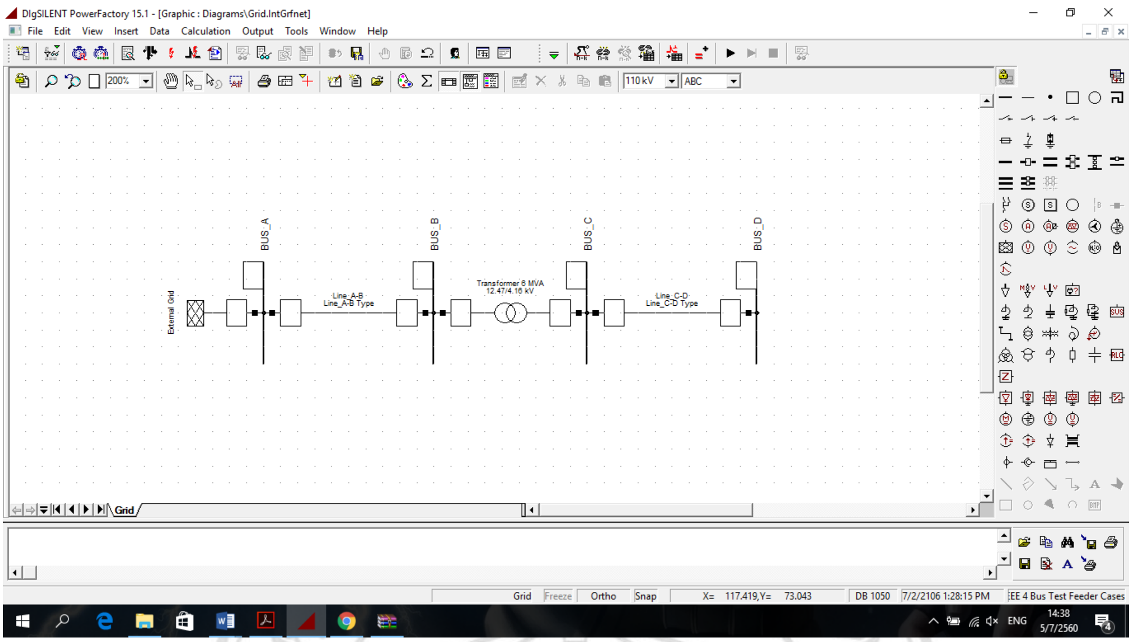

Figure A.23 To create supply

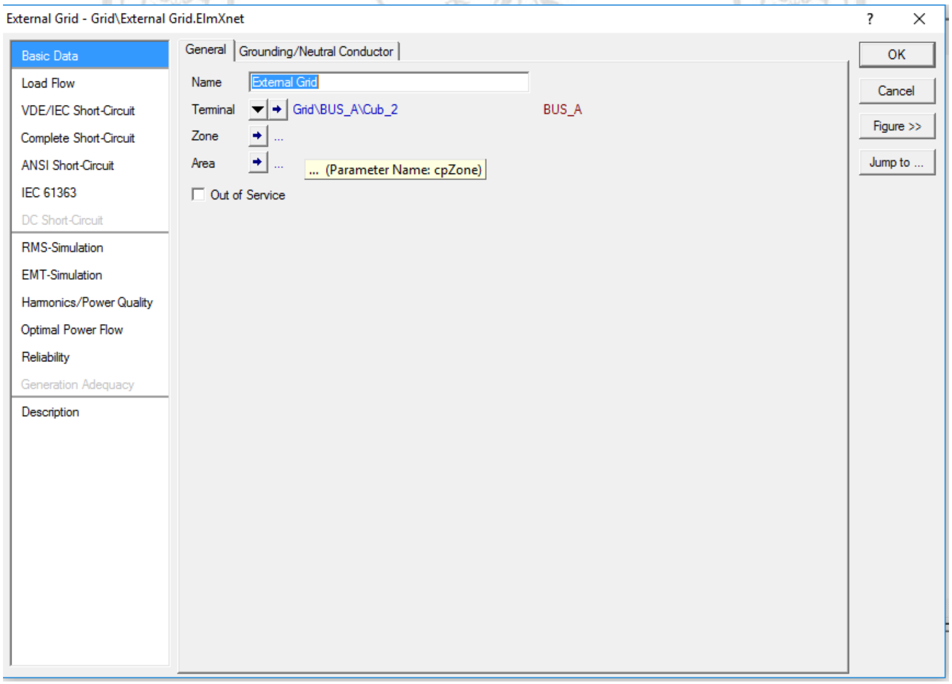

Figure A.24 Input Data Basic of Supply

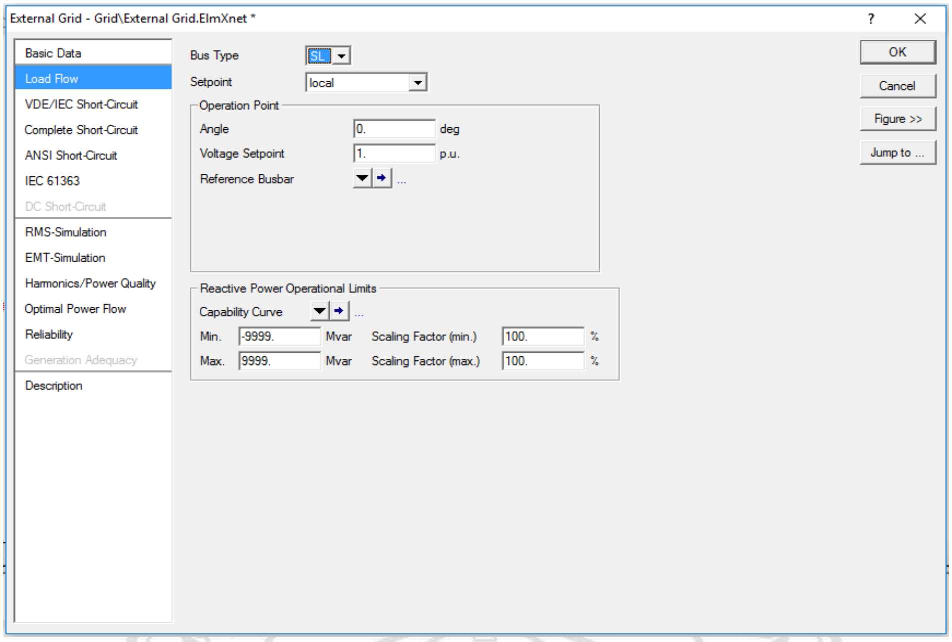

Figure A.25 Input data Load Flow of supply

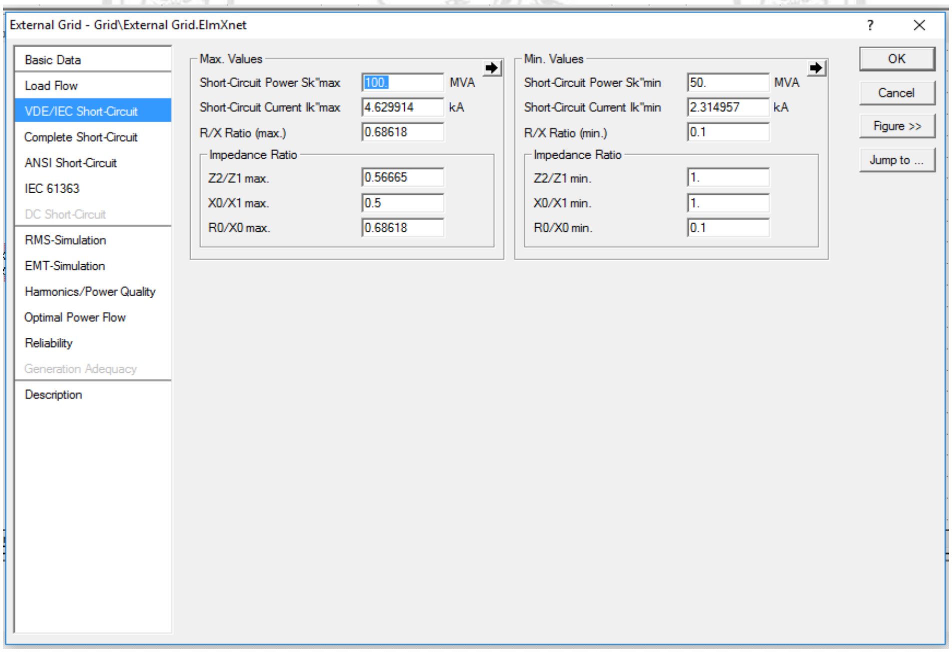

Figure A.26 Input data Short-Circuit of Supply

5) To create load

Creating the load (Load General) start to build by selecting the model of your load on the Drawing Toolbar, and then select the bus that you want to connect to a replica. In this case study will make a connection where data input 4 bus makes your load by. Double-click the load will be a replica of the load, as shown in Figure A.27 will appear. Dialog Box of the load, then creates the type of load. By selecting the Project Type New-Type = > General Load Type, as shown in Figure A.28. A Dialog Box will appear, determine the type of Technology, as shown in Figure A.29, 3PH-D then press OK.

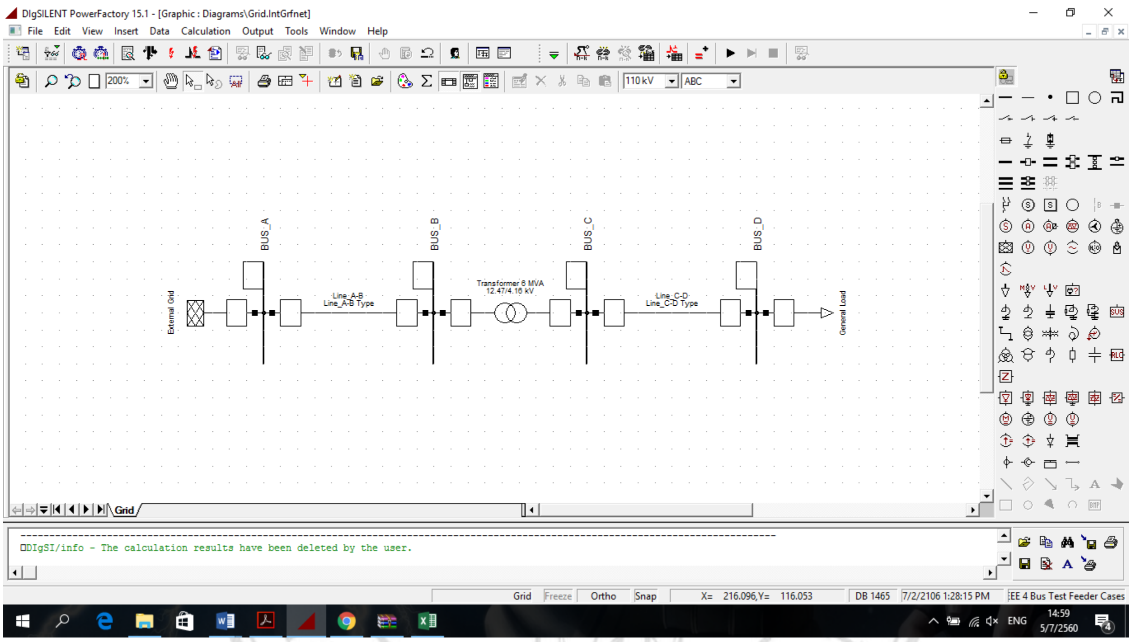

Figure A.27 Modeling of the load

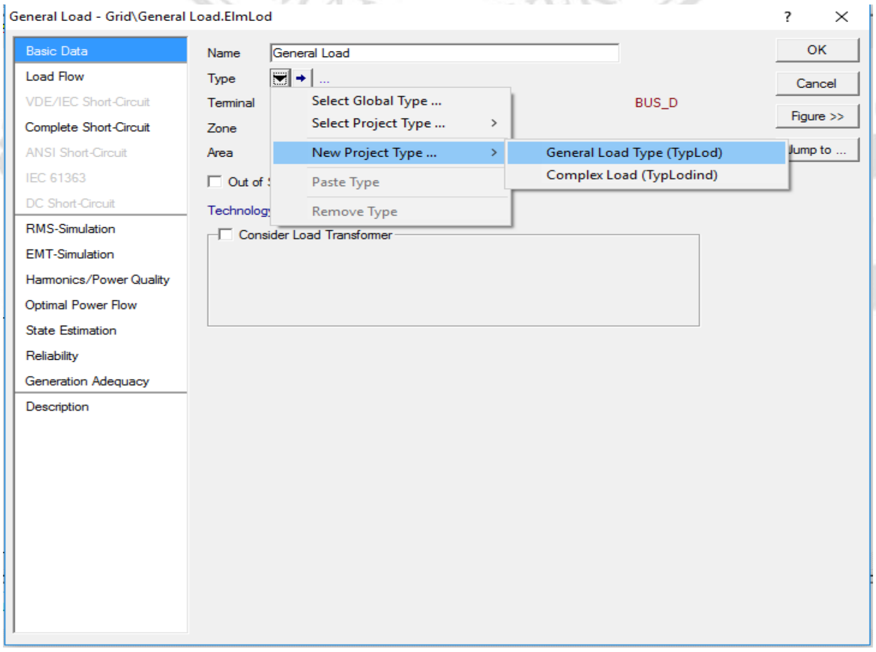

Figure A.28 Input data of the load

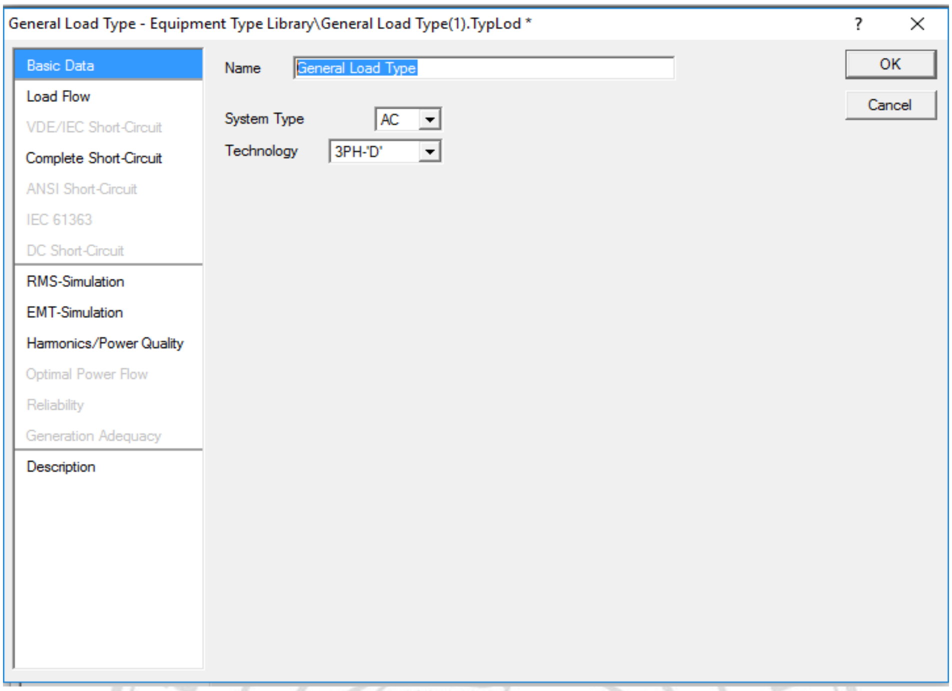

Figure A.29 Select the type of load

Then go to the window, Load Flow, make the data input as shown in Table A.8. Because the system test 4 test system is used for transformer tests. So, a very large load size, therefore, to test the transformer in case of overload. When analyzing health system. Parties may need to reduce the size of the load. In this case it drops just 50 percent of the reloading of all defined spaces direct Scaling Factor equal to 0.5 shown at in Figure A.30.

Table A.8 Data of load

Input Model	Balanced/Unbalanced	Phase A		Phase B		Phase C	
		Active Power (MW)	Reactive Power (Mvar)	Active Power (MW)	Reactive Power (Mvar)	Active Power (MW)	Reactive Power (Mvar)
Default	Balanced	1.8	0.8717	1.8	0.8717	1.8	0.8717
Default	Unbalanced	1.275	0.79017	1.8	0.87178	2.375	0.78052

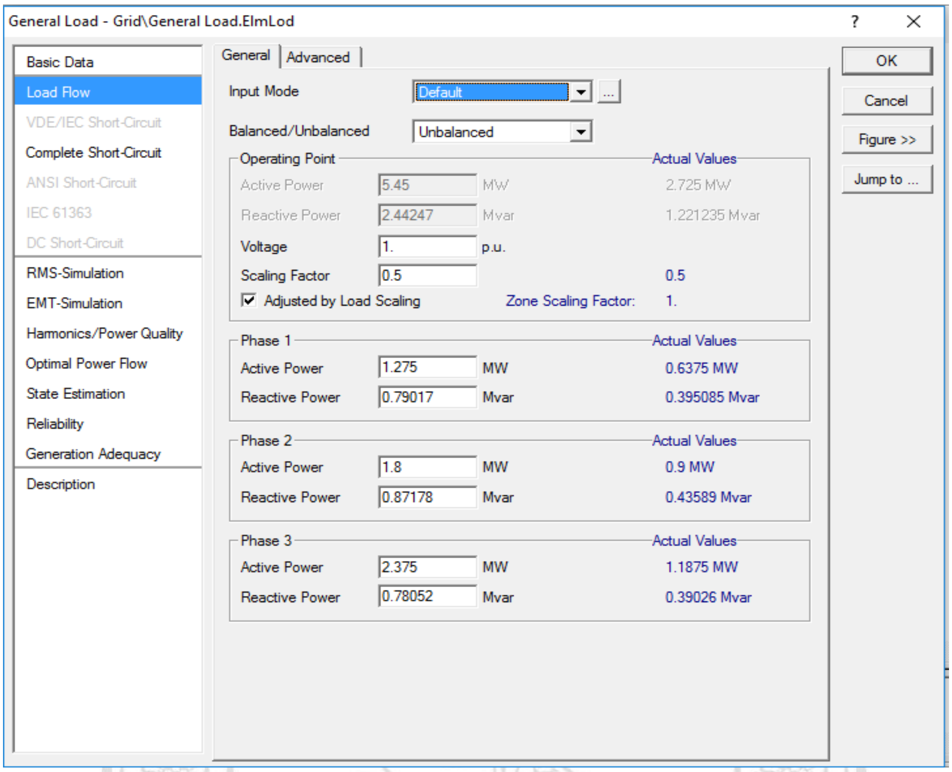

Figure A.30 Input the size of the load

When finished, the system will be tested the system 4 bus, as shown in Figure A.31.

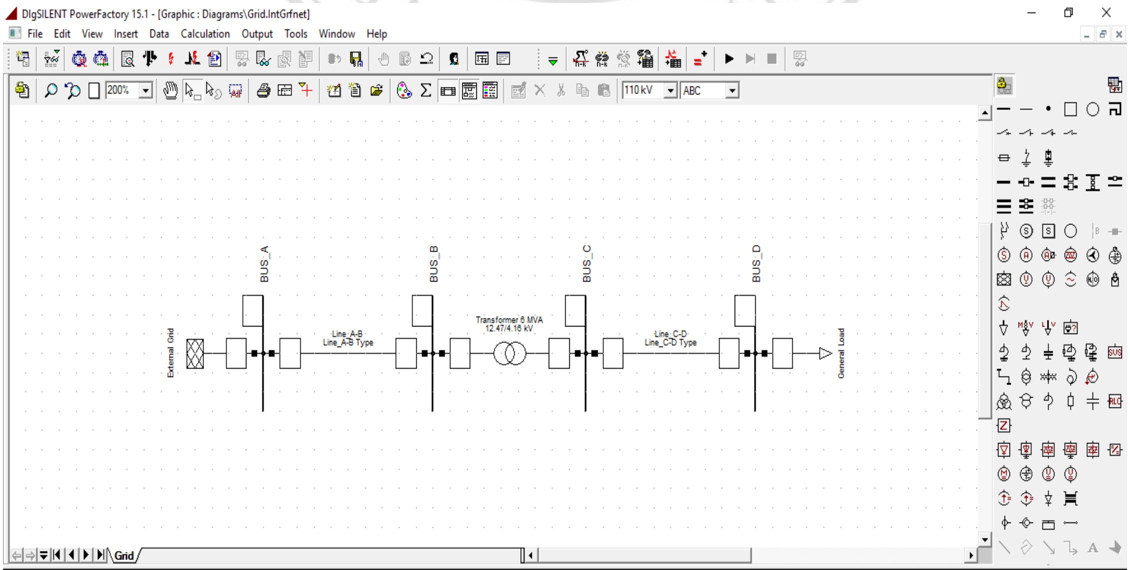

Figure A.31 Circuit tested the system 4 bus

A.2 To create the replica of the relay

A.2.1 Selecting the use relay.

Selecting the use, a relay which has a step is used, as shown in Figure A.32.

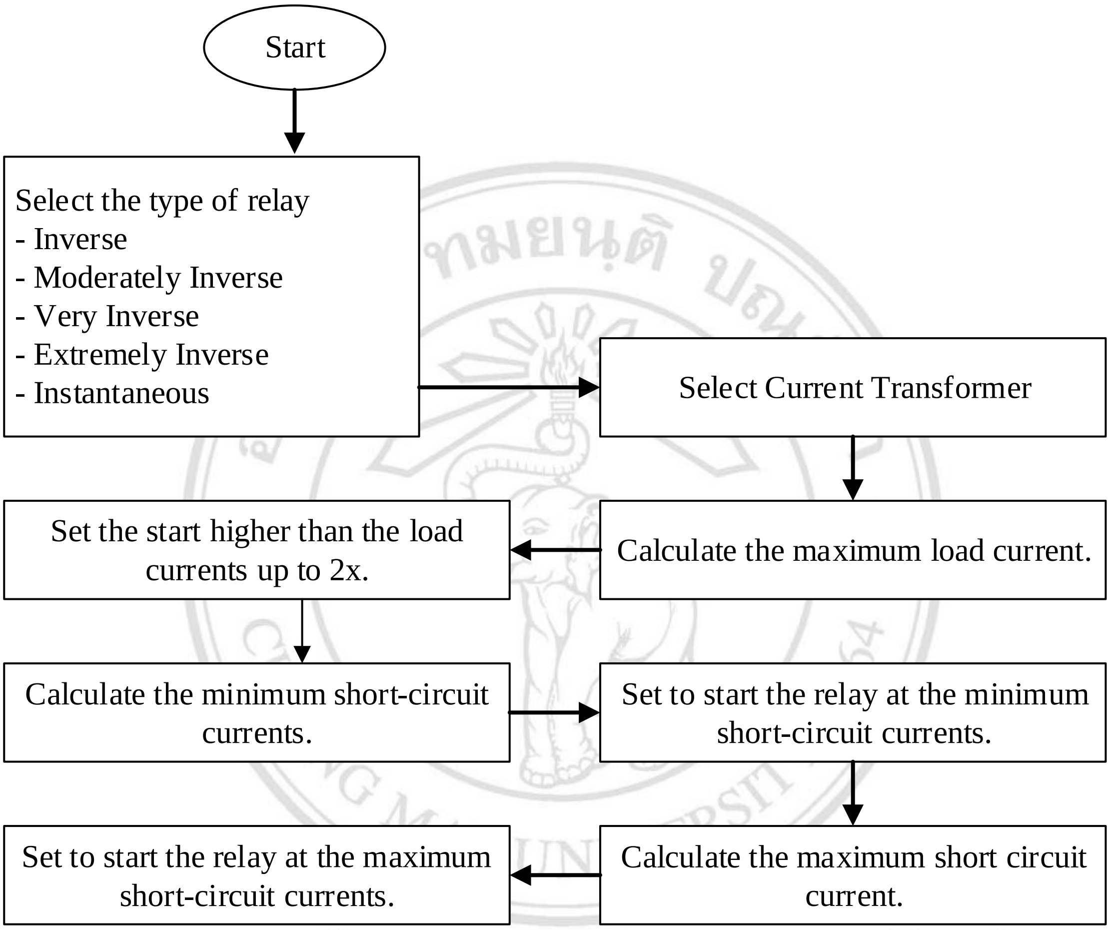

Figure A.32 Selecting the use relay

1) To select the type of relay

- ❖ Inverse
- ❖ Moderately Inverse
- ❖ Very Inverse
- ❖ Extremely Inverse
- ❖ Instantaneous

2) The maximum load flow analysis, then adjusts the flow starts, set higher than the maximum load current 2 x.

3) Analysis, find the minimum short-circuit current by making an analysis, three-phase short circuit current at the position the installation end of relay, and then adjusts the flow setting, work during the minimum short circuit current.

4) Analysis, find the maximum short-circuit current by making an analysis, three-phase short circuit current at the position the load end of the cable, and then adjusts the flow setting, work during the maximum short circuit current.

A.2.2 To create the replica of the relay

To create the replica, the relay will be built on the grounds of origin, transmission line, right-click the area of the source line and then choose New Devices=> Relay Model. As in the picture Dialog Box in Figure A.33 window appears, as shown in Figure A.34.

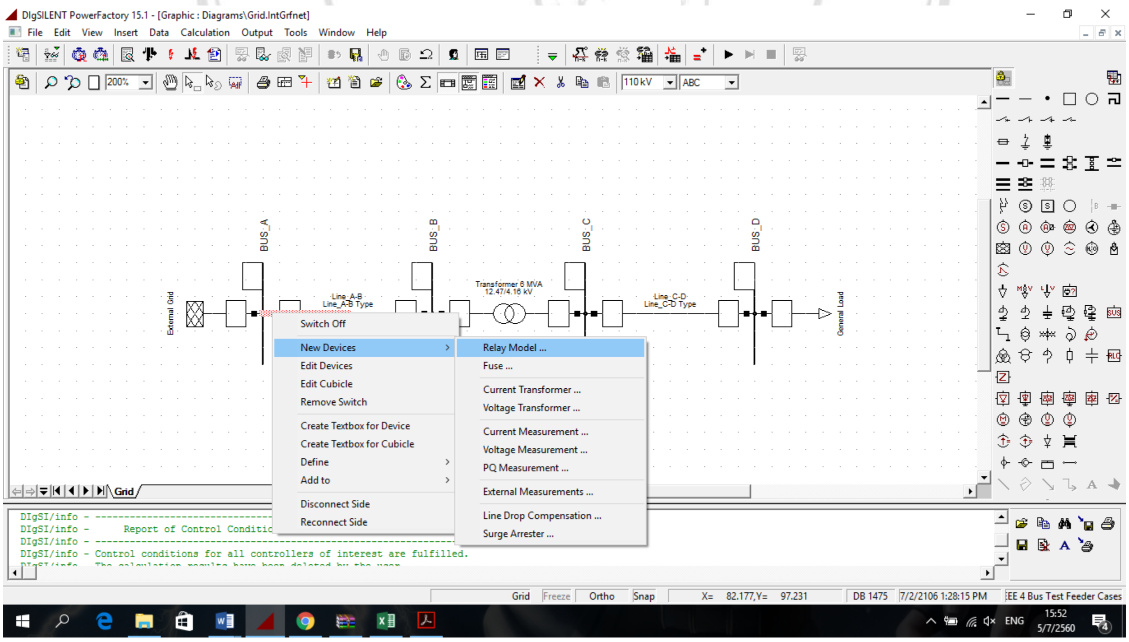

Figure A.33 To create the replica of the relay.

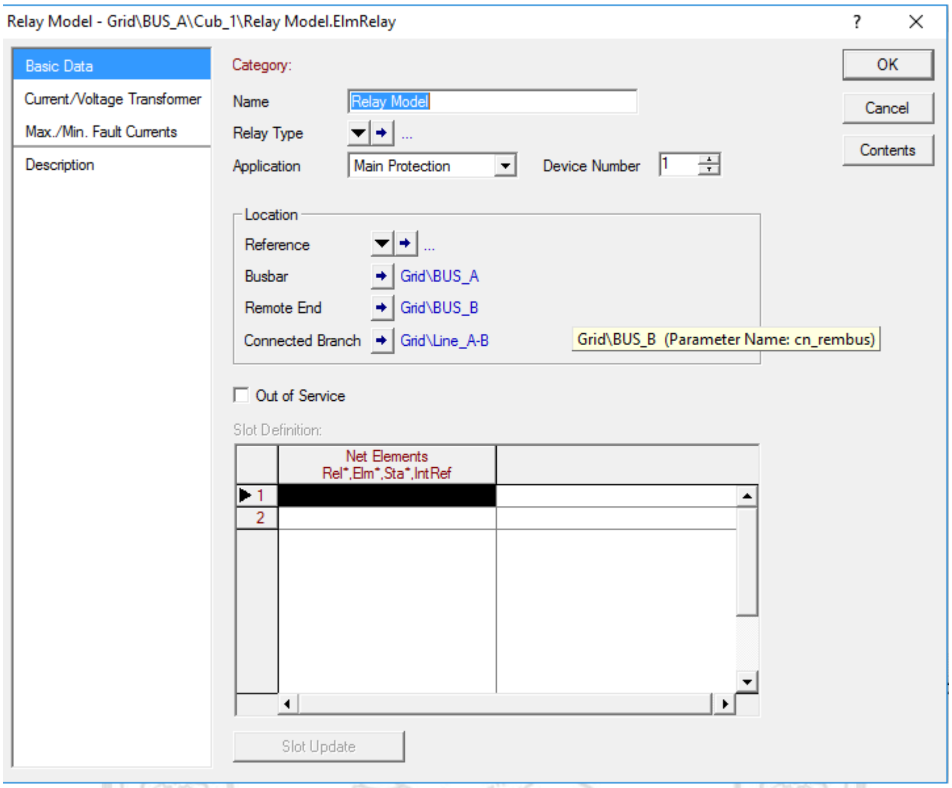

Figure A.34 Dialog box for data input relays

Then select the type of relay by clicking the Select Project Type-Relay => Type, as shown in Figure A.35 and then press OK.

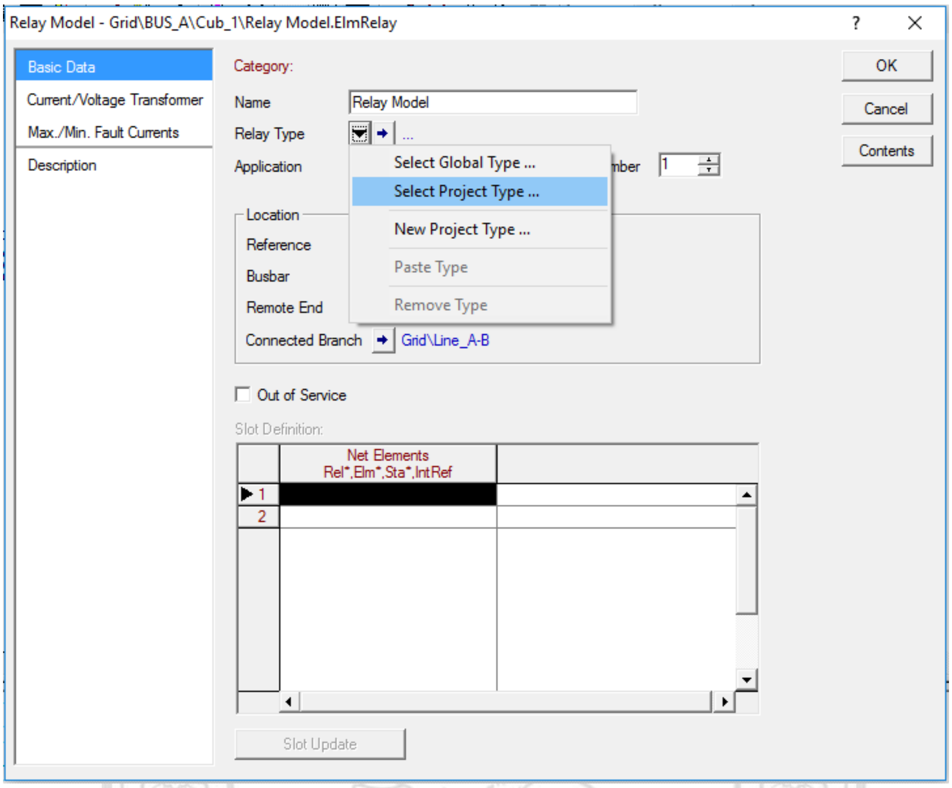

Figure A.35 Selecting the type of relay

Data Manager Window appears for the selected type of the relay. For a case study, this will select the Inverse Time Overcurrent relay from the Main Library of the Program by clicking on the Library-> Relays-Overcurrent Relays => General Electric-IAC >=> 60Hz => Series-Long-Time Inverse => IAC66B51A => as shown in Figure A.36.

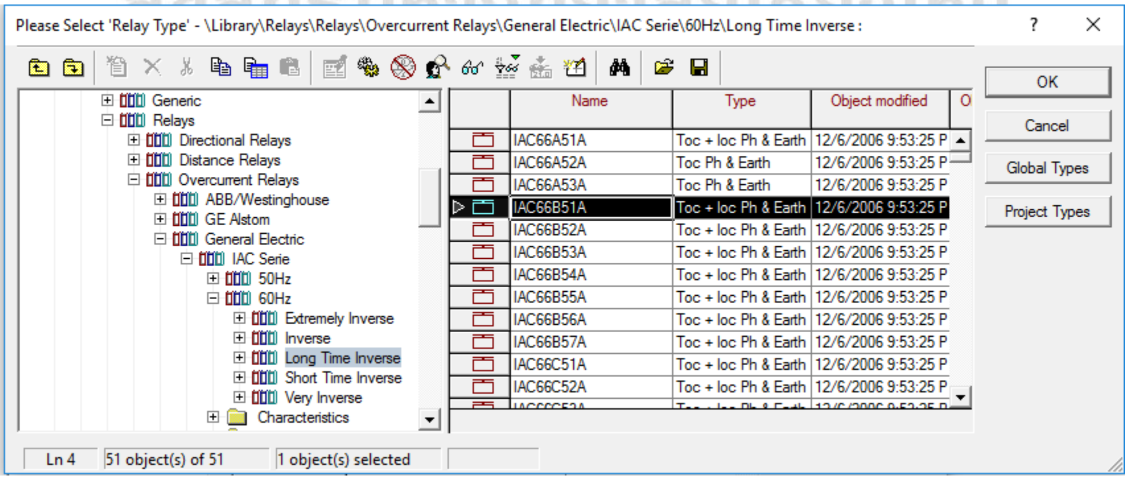

Figure A.36 Selecting the type of relay from the Library

Then it will be created by clicking the Create CT current transformer, as shown in Figure A.37.

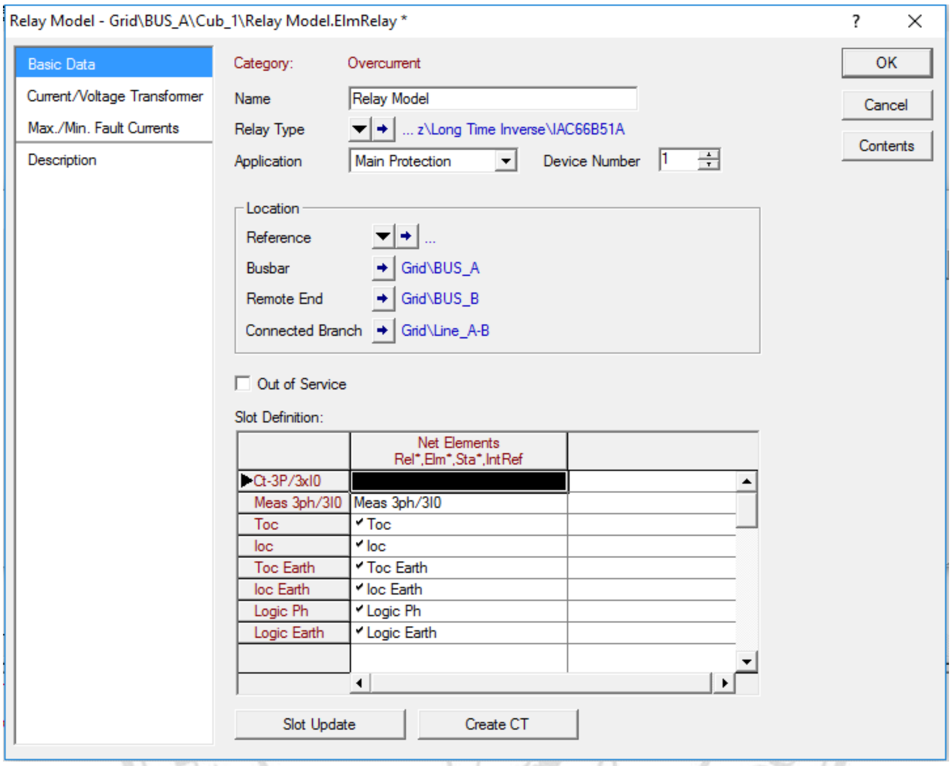

Figure A.37 To select of current transformer

Dialog box window appears for the input data, current transformer, then select it by clicking on the current transformer. Type-Select Project Type => as shown in Figure A.38.

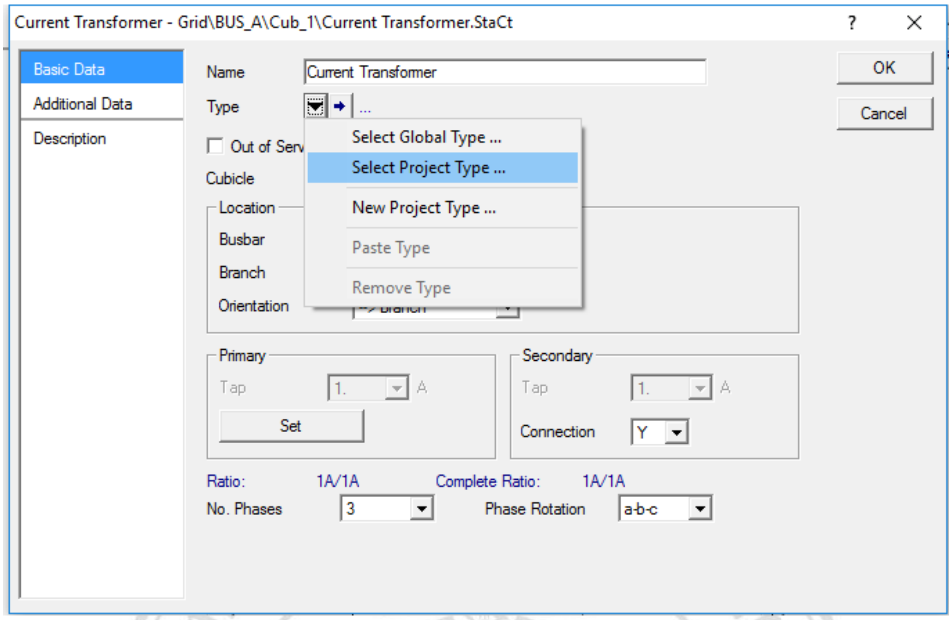

Figure A.38 To create a current transformer

Data Manager for window appears, select the type of current transformer for this case study will select type current transformer CT 120-1000/1A from the Main Library of the. Program by clicking on the Library => Relays => CTs-120 CT-1000/1A => shown in Figure A.39.

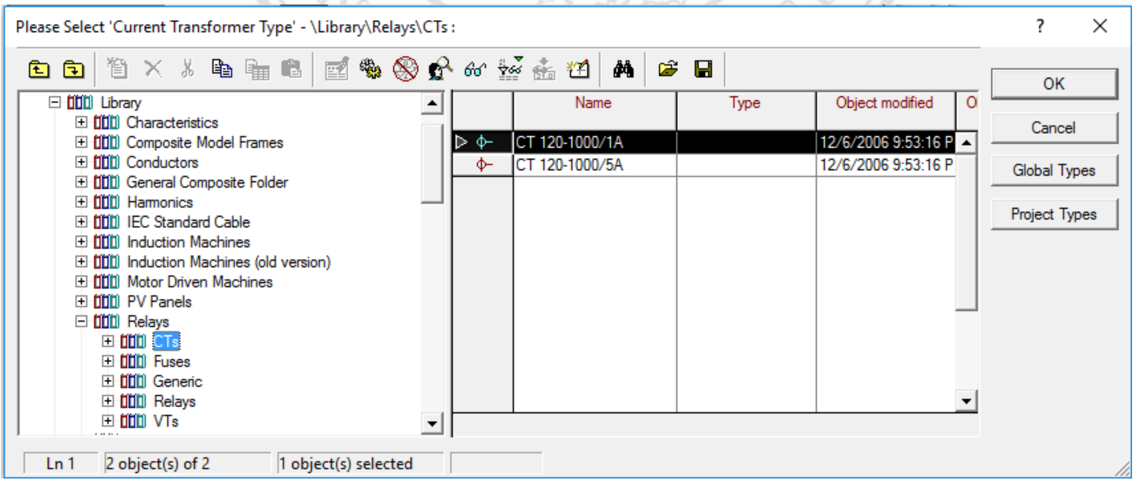

Figure A.39 To select the type of current transformer from the Library

Then set the tap flows of current transformer for a case study, this will set up the primary-side current tap kept at 1000 A. Secondary and therefore 1A as shown in Figure A.40.

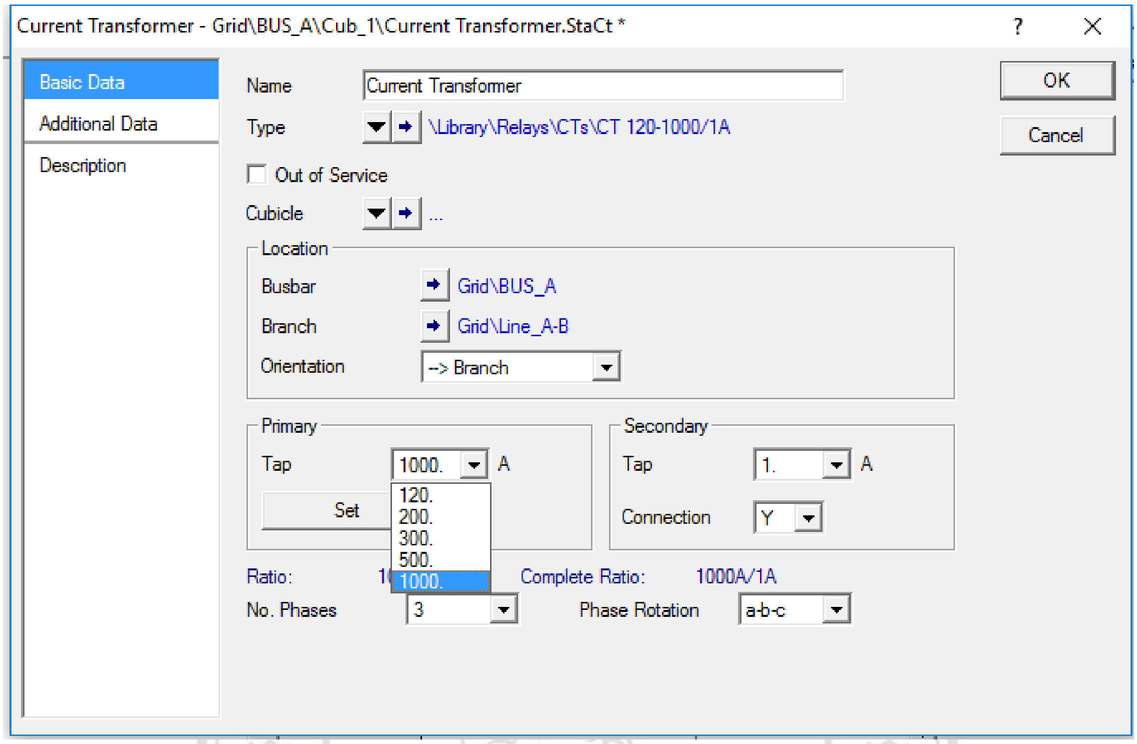

Figure A.40 To settings tap current of current transformer

After creating the replica, the relay and current transformer, it will set the stream starts. And the value of the multiplier value is set at the time of the relay for convenience. User can settings the time current curve (TCC) graph Curve with a set by the source, right-click the area of the line creating the replica relay. Then choose Create Time-Overcurrent Plot (TOP) as shown in Figure A.41. TOP window appears as shown in Figure A.42.

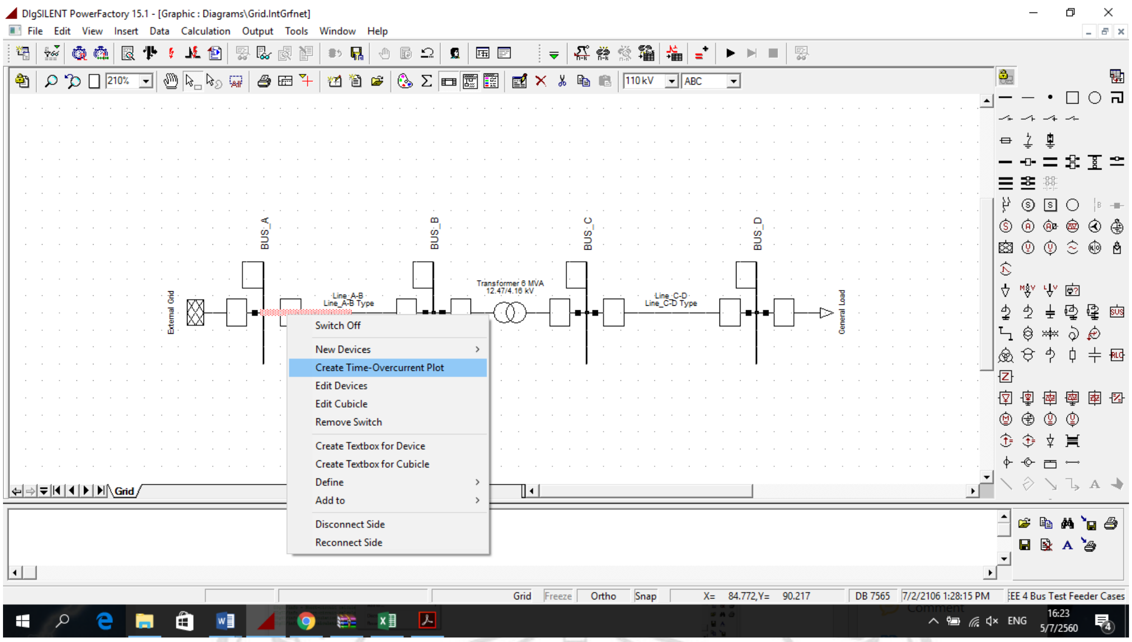

Figure A.41 Shows TCC graphs

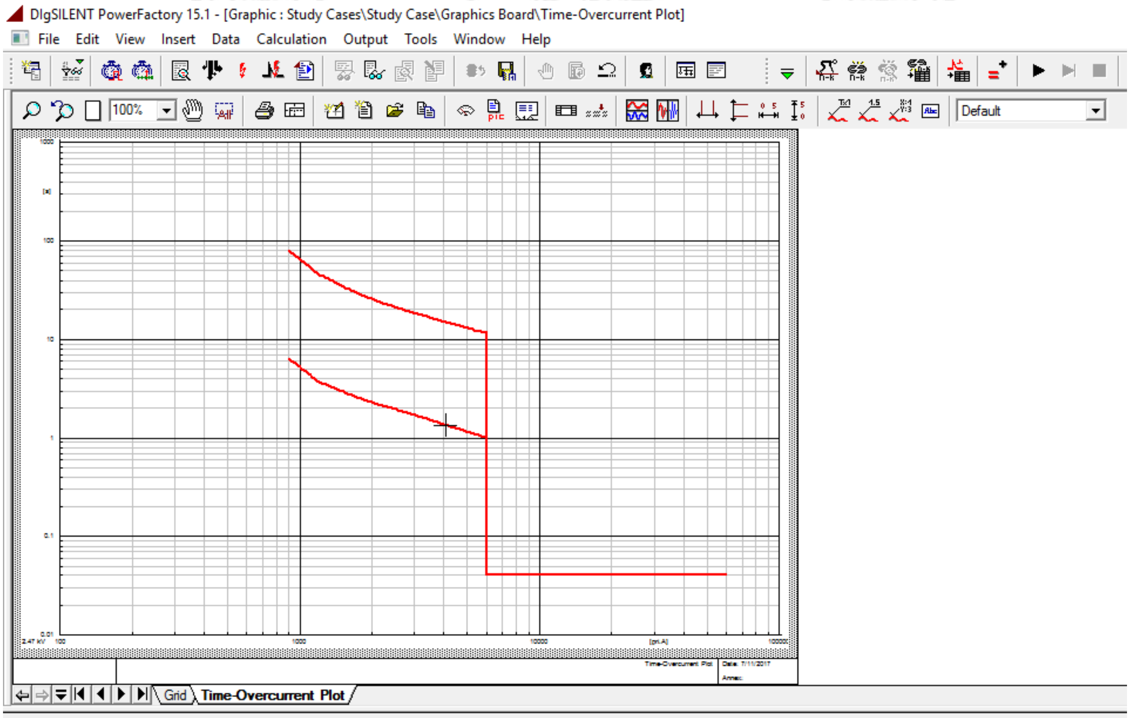

Figure A.42 Shows the TCC

Then double-click the graph area that resembles a curve Dialog box window appears. For a start, and the currents set up the multiplier relay timing type Inverse Overcurrent Relays. Dialog box without Shows that curves that make double-clicking away it is a relay which type curves (number 51 is the Inverse Overcurrent Relays). And are used to protect phase or ground, as shown in Figure A.43.

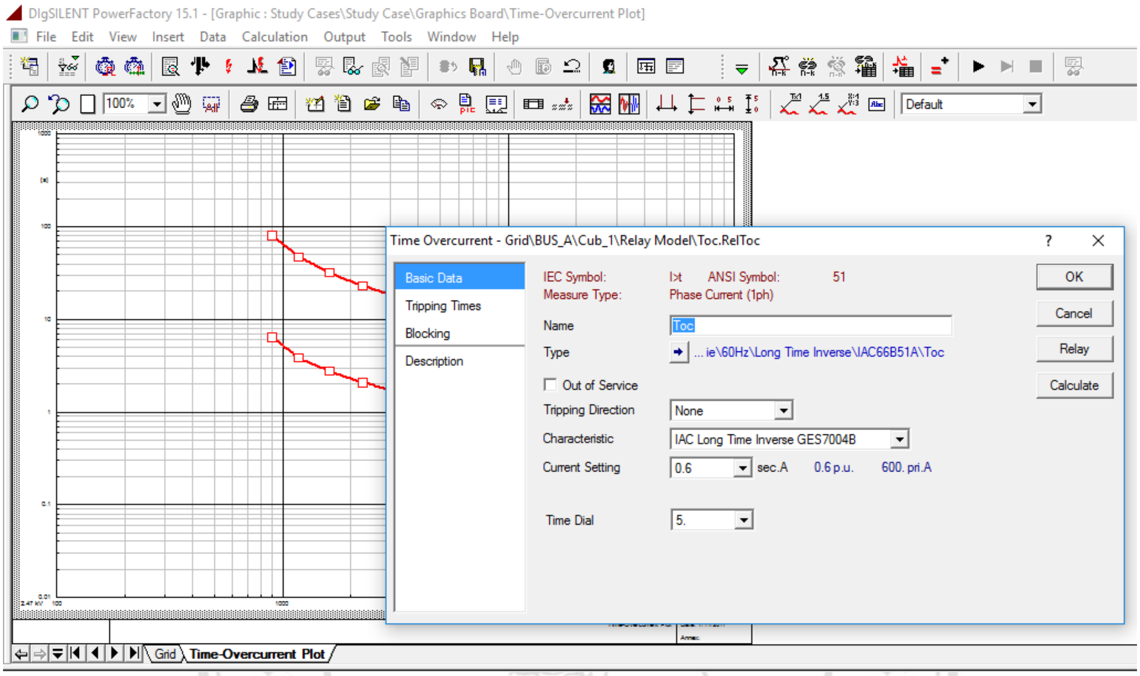

Figure A.43 Dialog box set a multiplier to adjust Inverse Overcurrent Relays type

If you double-click the graph area that resembles a straight-line Dialog box window appears. For setting the stream start relay-type Instantaneous Overcurrent. Dialog box without Relays will indicate whether the curves that make double-clicking away it is a relay which type curves (number 50 is the Instantaneous Overcurrent. Relays) and anti-phase or ground, as shown in Figure A.44.

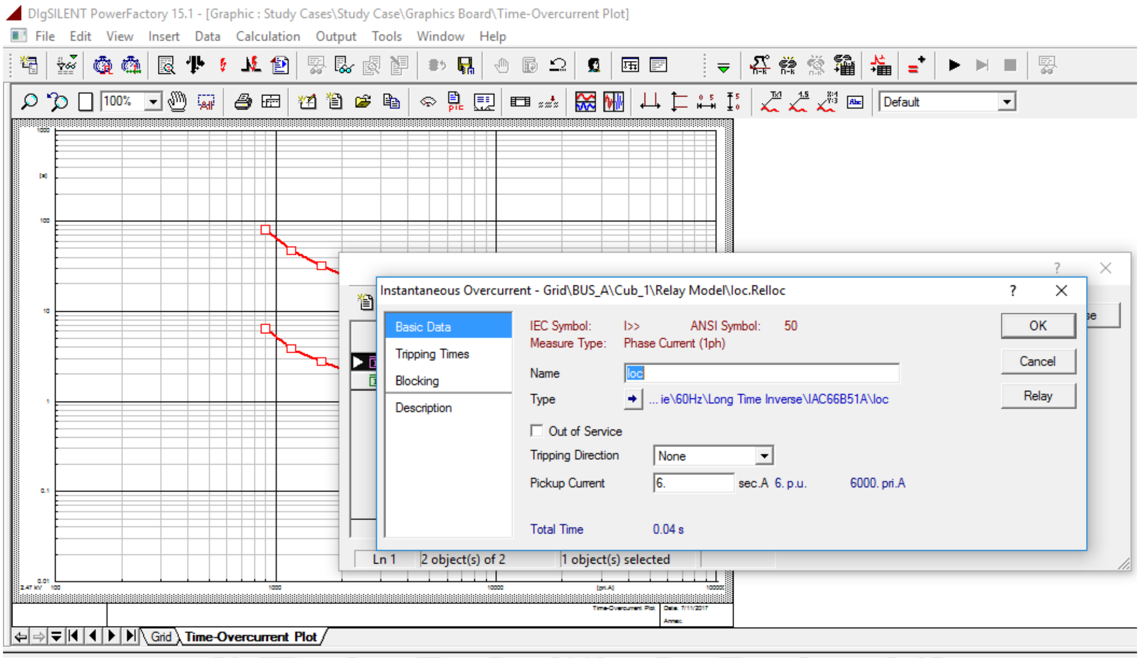

Figure A.44 Dialog box for setting Instantaneous Overcurrent Relays type

In case of need to use the Inverse Type Overcurrent relays only one type, make a click in the Relay as shown in the picture Dialog box window appears of relay as shown in Figure A.45.

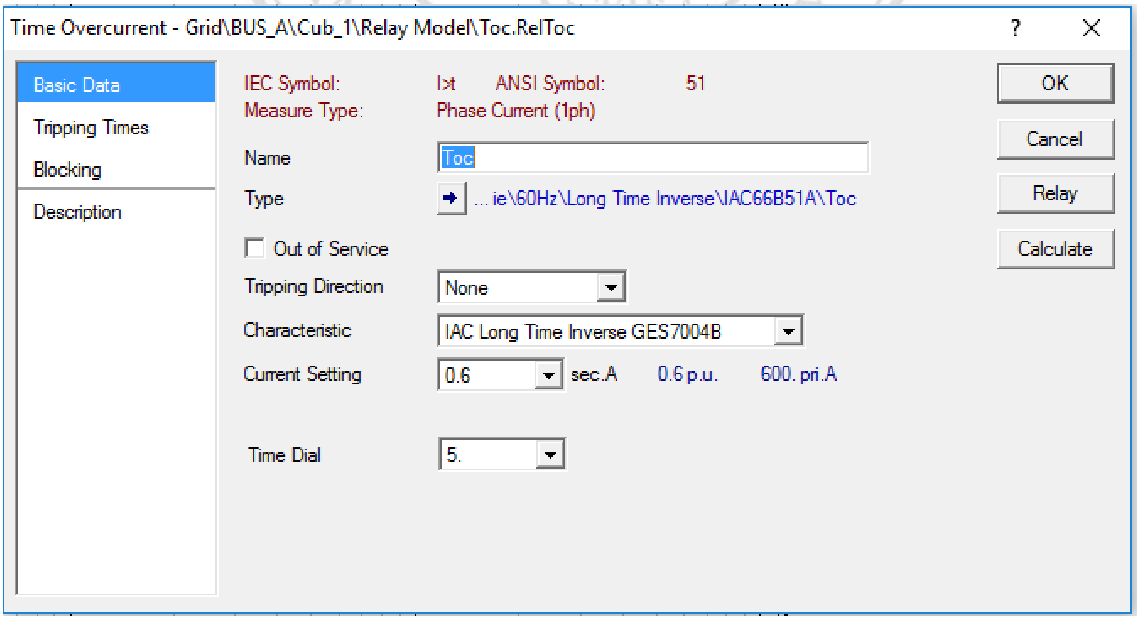

Figure A.45 To access the Dialog box window of the relay

Then double-click on the Ioc in the Slot Definition, as shown in Figure A.46 Dialog box window appears of Instantaneous Overcurrent Relays.

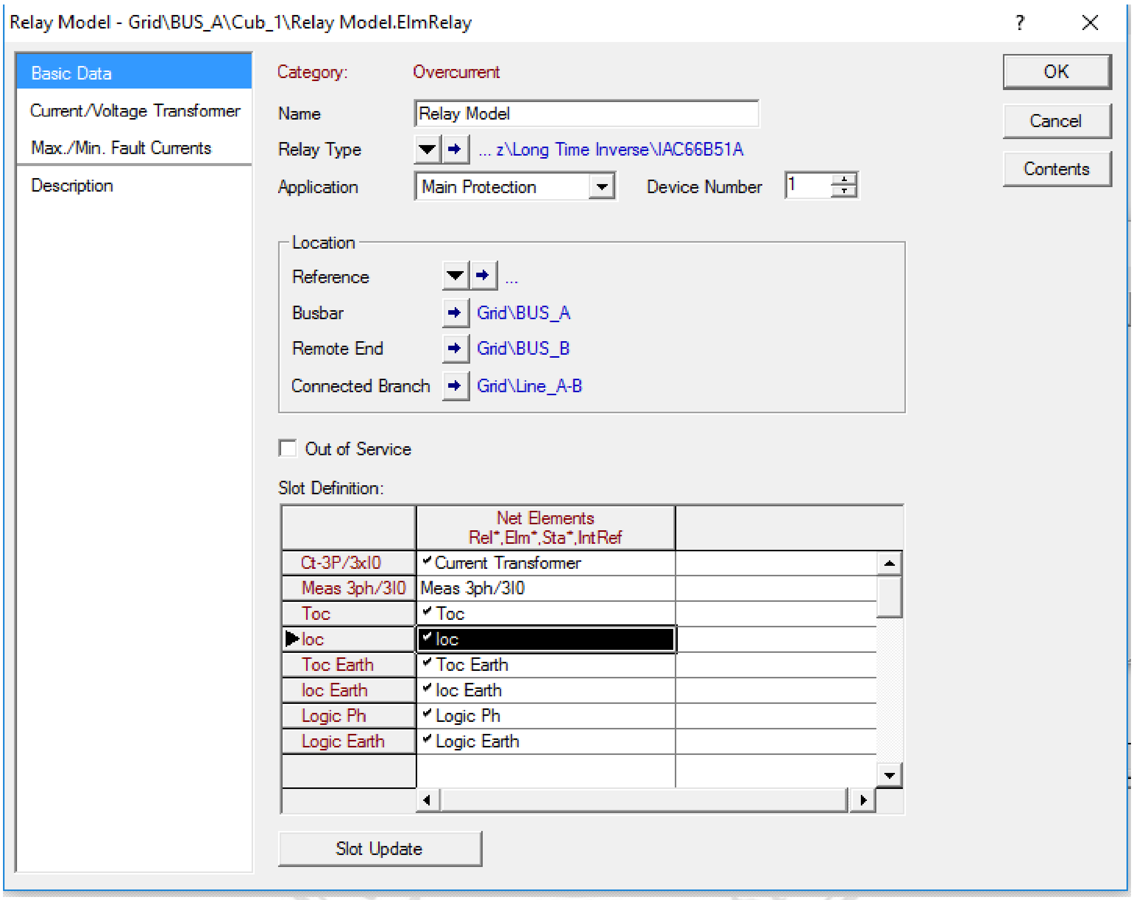

Figure A.46 Dialog box window of the Instantaneous Overcurrent Relays type

Make click on Out of Service as shown in Figure A.47 then click then OK change the double-clicking working Definition Earth in Ioc Slot, click the Out of Service. Similarly, and for the consideration in this case is only a short-circuit style phase (Phase Fault). So, do double-click in Toc Earth Slot Definition. Make click on Out of Service as well.

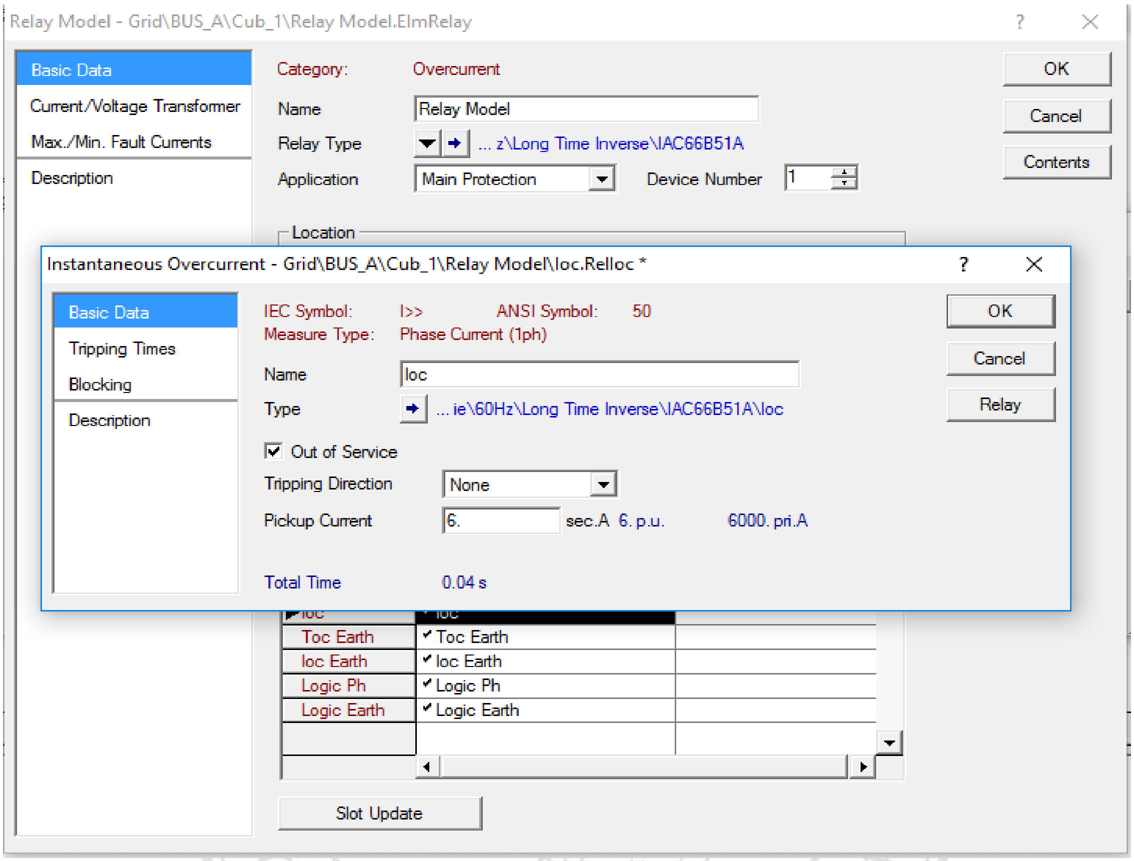

Figure A.47 Working out of Service with Instantaneous Overcurrent Relays type

Then adjusts the flow setting start relay, start relay without work is higher than the maximum load current coordinates. And relays must be active during the short circuit current and maximum flow. The minimum short circuit in the area of the scope of health. Parties of the relay, which maximum load current can be obtained from the analysis of power flow. By clicking on the symbols on the Main Tool Bar will appear the window Load Flow Calculation,  as shown in Figure A.48, select the set-up parameters that are used in the calculation. If the system is used as a load balancing load (Load Balanced), select the Calculation Method as an AC Load. Flow, Balanced, positive sequence, but if the system is used to load a load balancing (Unbalanced Load), select the Calculation Method as the Unbalanced Load Flow, AC, 3-phase (ABC), and then click the Execute button. To have the program calculate as configured.

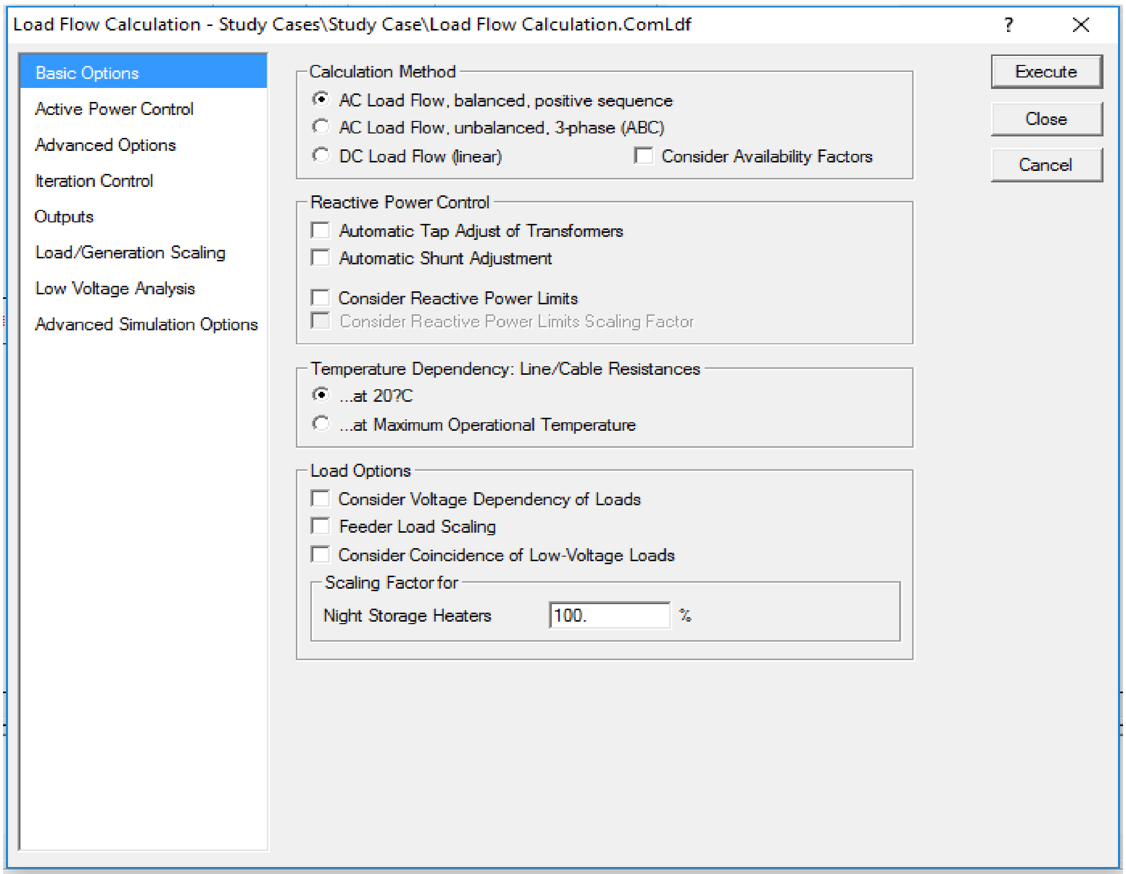

Figure A.48 In the configuration window, Load Flow Calculation in order to analyze, find the maximum load current

Notice that the graph Curve if TCC during the relay, maximum load current, as shown in Figure A.49, adjust settings, stream relay starts up by double-clicking away. Graph line, then adjust the Current Setting to a higher value, as shown in Figure A.50.

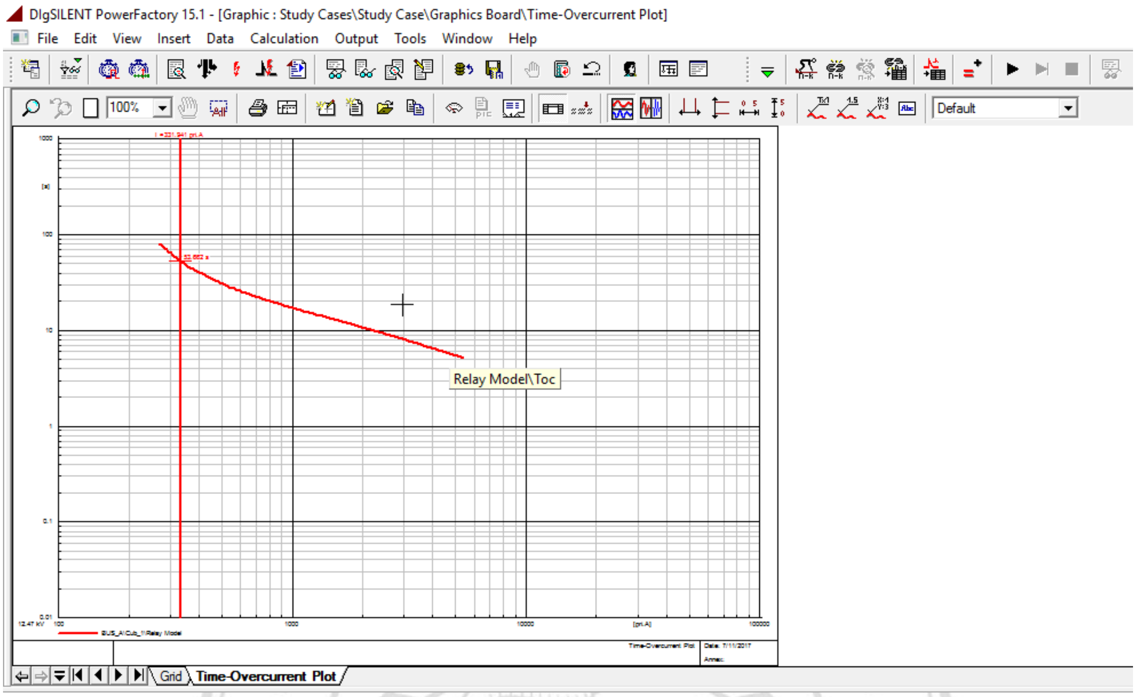

Figure A.49 The relay operates during the peak load currents

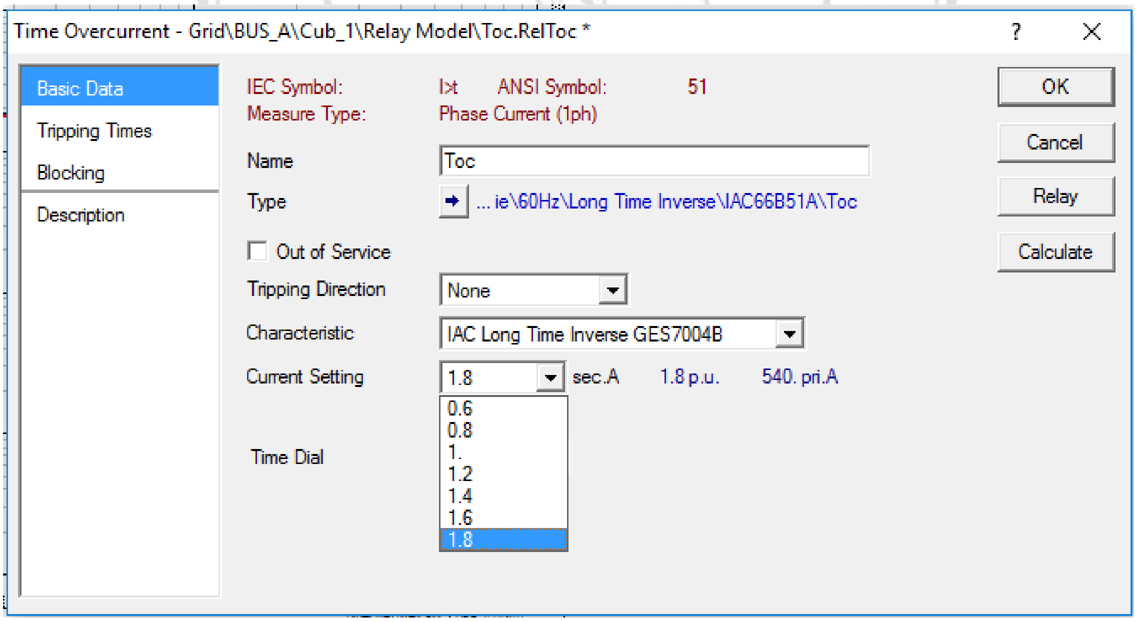

Figure A.50 Configuring the current setting starts

When setting is complete, try to analyze the flow of electro. Again, if relay is not working during high load current. Curve graphs will be shown in Figure A.51.

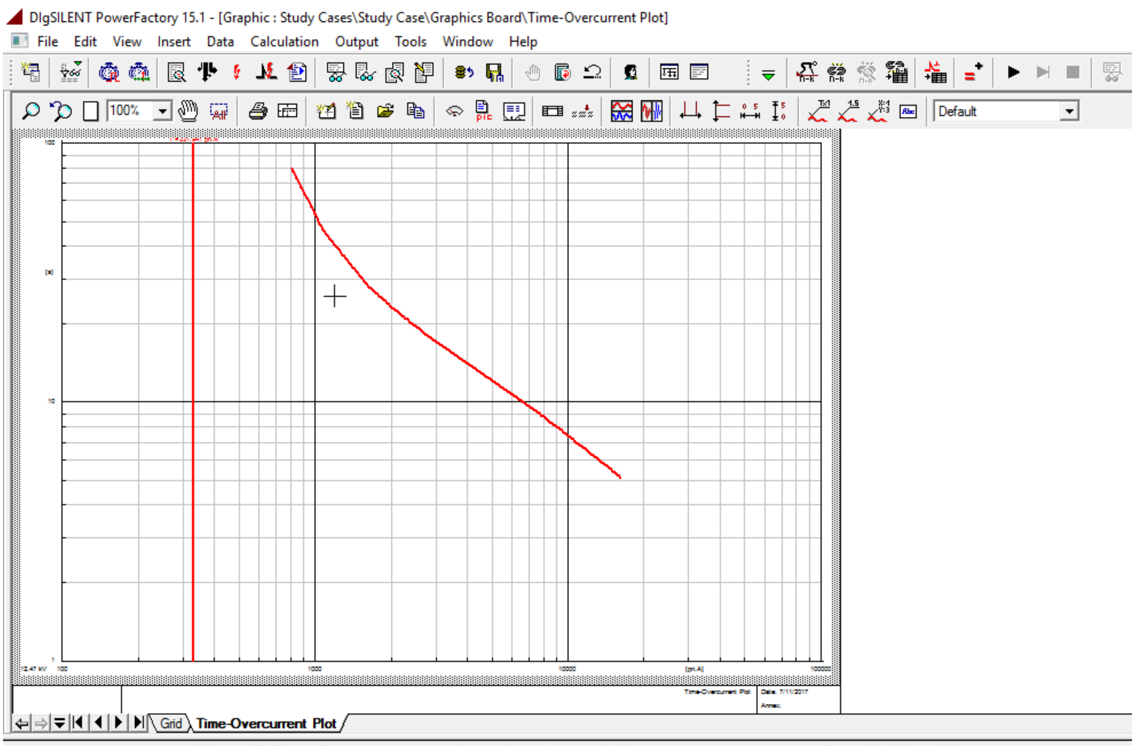

Figure A.51 Relay is not working in the current maximum load after setting the current starts

For the minimum short-circuit current can be obtained from the analysis of short circuit if the current position is a bus node connected load ends. The cable sent by bus or position. The node is attached to the load area. It is outside the scope Pro. Parties of the relay by right-clicking the node or the bus. Select the Calculate => Short-Circuit, as shown in Figure A.52.

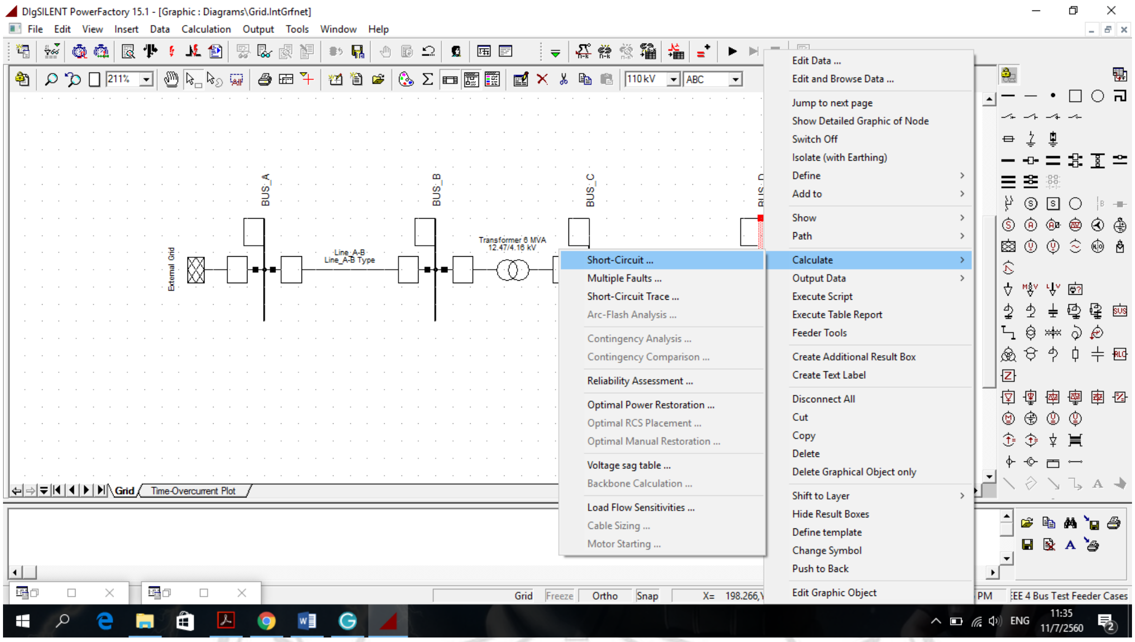

Figure A.52 Analysis of short circuit, if the current position is a minimum bus node connected to the load line ends

Short-Circuit Calculation window appears, set the Calculate a Min. Short-Circuit Currents, which refers to the analysis if the minimum short-circuits current, then click on Execute As shown in the Figure A.53.

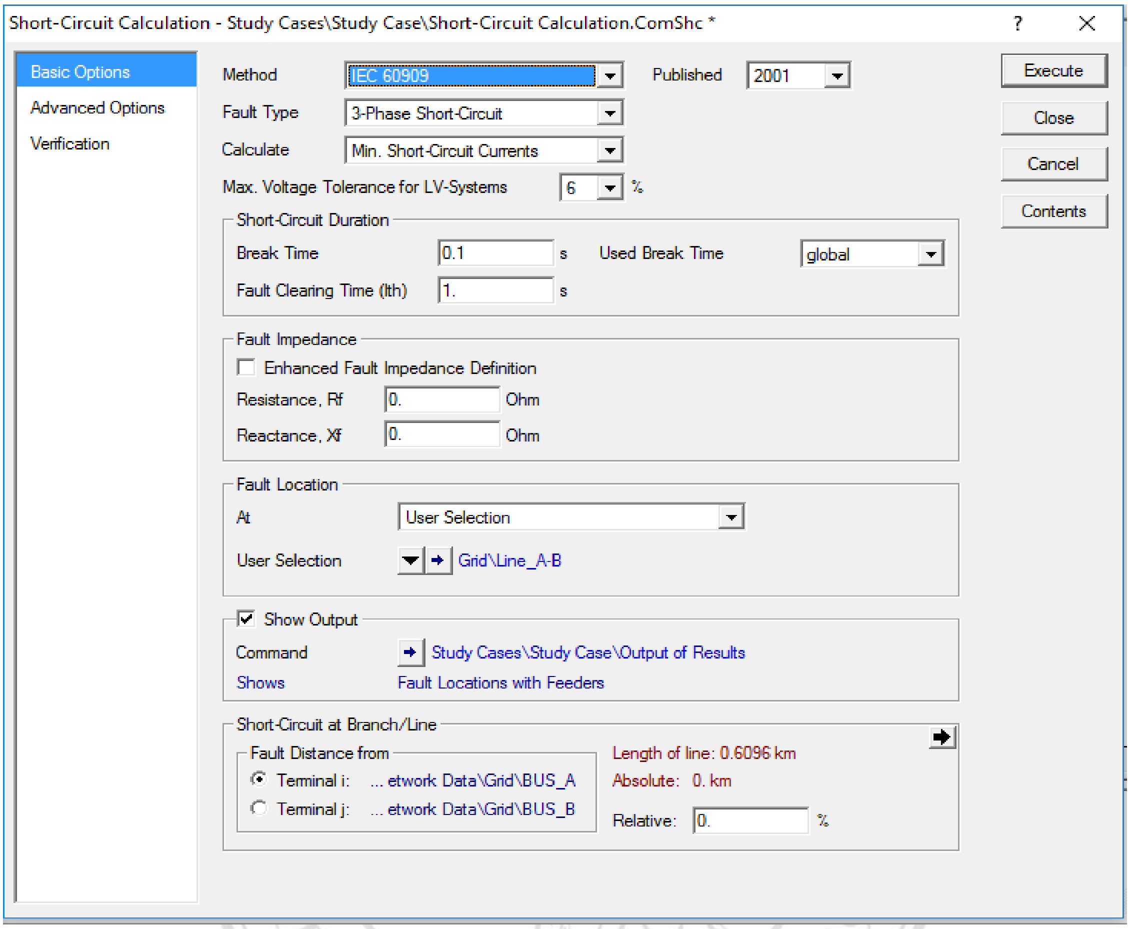

Figure A.53 In the configuration window to Short-Circuit Calculation. For analysis find the maximum short circuit current

Notice that the graph Curve if TCC relay does not work in the minimum short-circuit current, as shown in Figure A.54, adjust settings, stream relay starts up by double. Click on the graph line, then make adjustments to higher Current Setting as shown in Figure A.55, when tuning is complete, try to do the analysis. Find the short circuit current again. If the relay is working on the maximum short circuit current. The graph will be shown in Figure A.56.

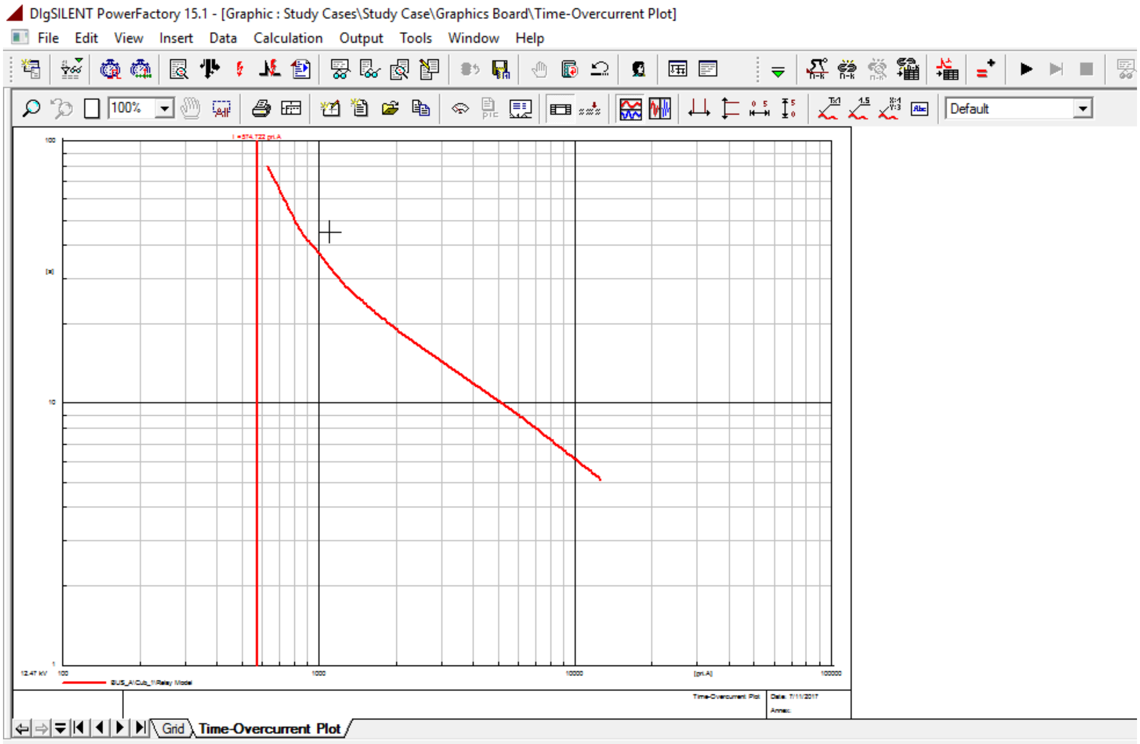

Figure A.54 Relay will not working during short circuit current low

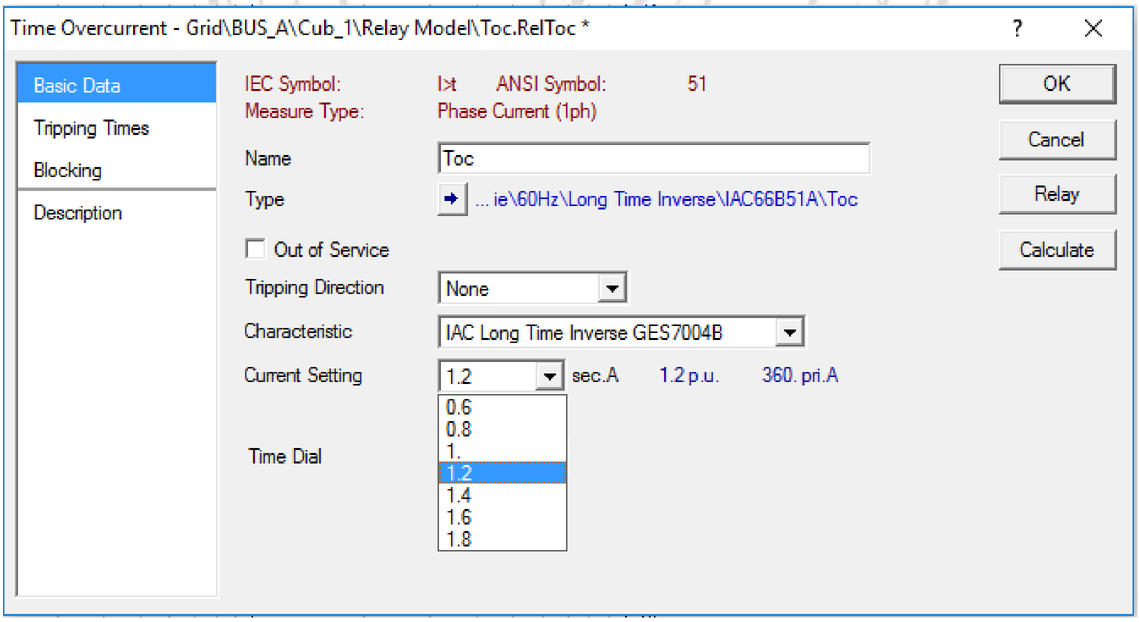

Figure A.55 Setting the current starts

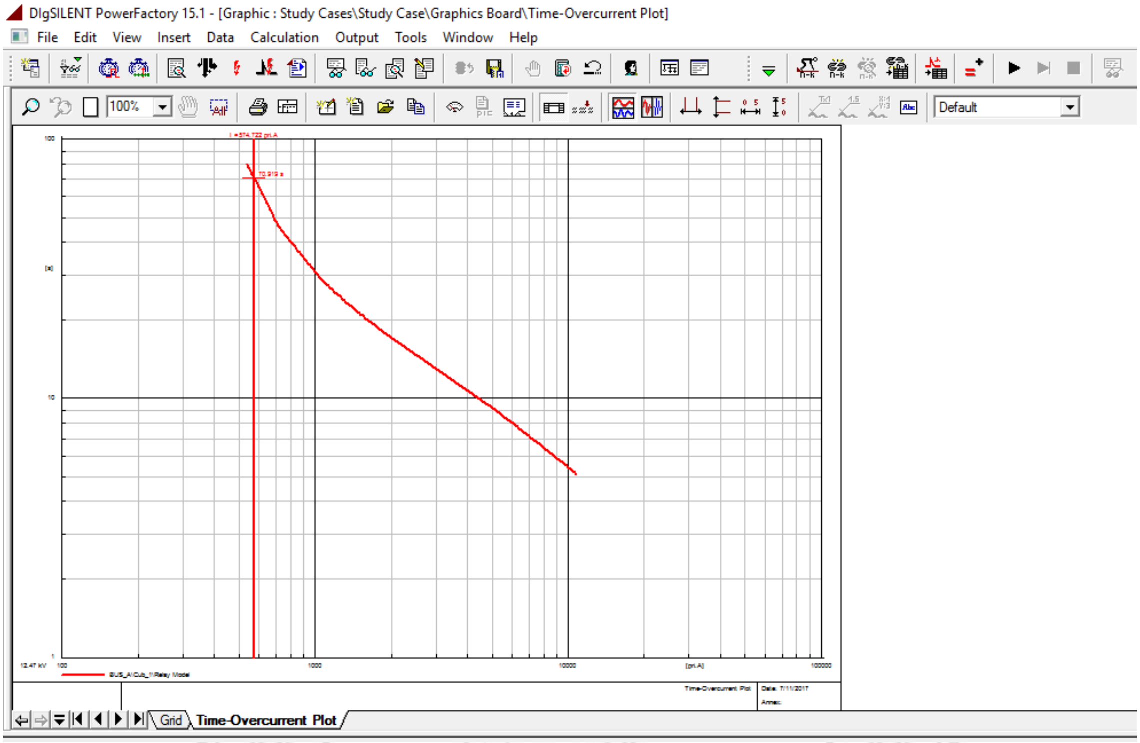

Figure A.56 The relay will be work during the relay of current low, after setting the current setting starts

When setting relay in the circuit minimum, analyze, find the short circuit current Max. Maximum flow was mostly short circuit can be obtained from the. Short circuit current for transmission line position area to create a source replica relay to remove them. By right-clicking the line creating the replica relay to remove them. Select the Calculate => Short-Circuit, as shown in Figure A.57.

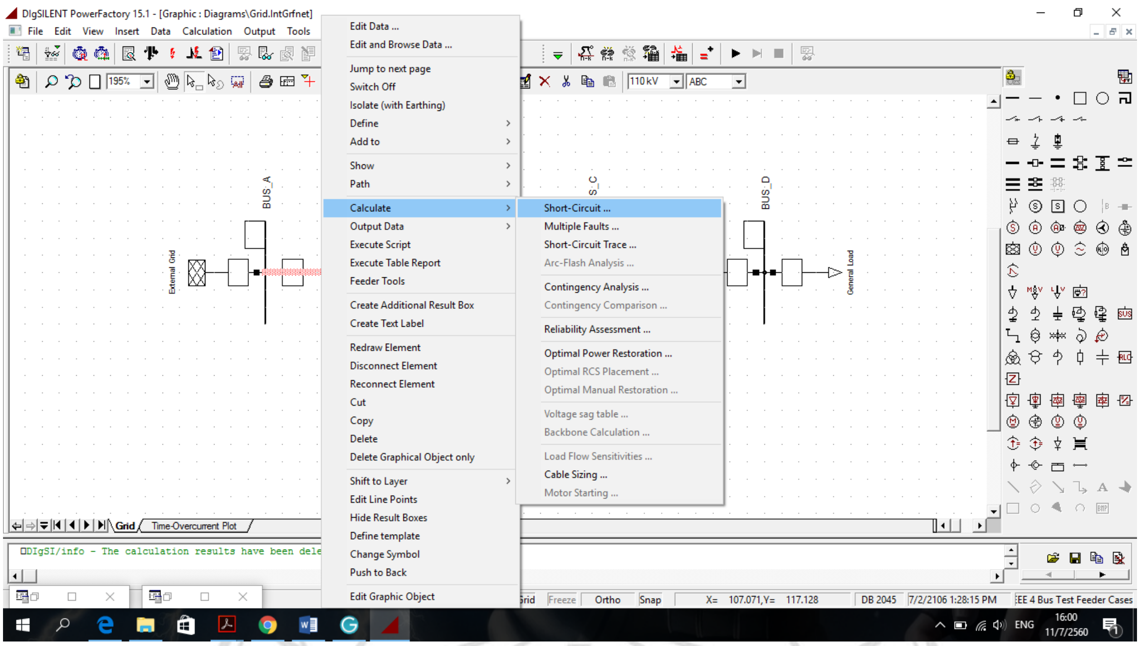

Figure A.57 Analysis area, find the maximum short-circuit current source of transmission line

Short-Circuit Calculation window appears, set the Calculate a Max. Short-Circuit Currents, which refers to the analysis, finding the maximum short-circuit current assigned relative 0 to 100%, which means for Short circuit current at the beginning of the line area, and then click Execute, as shown in Figure A.58.

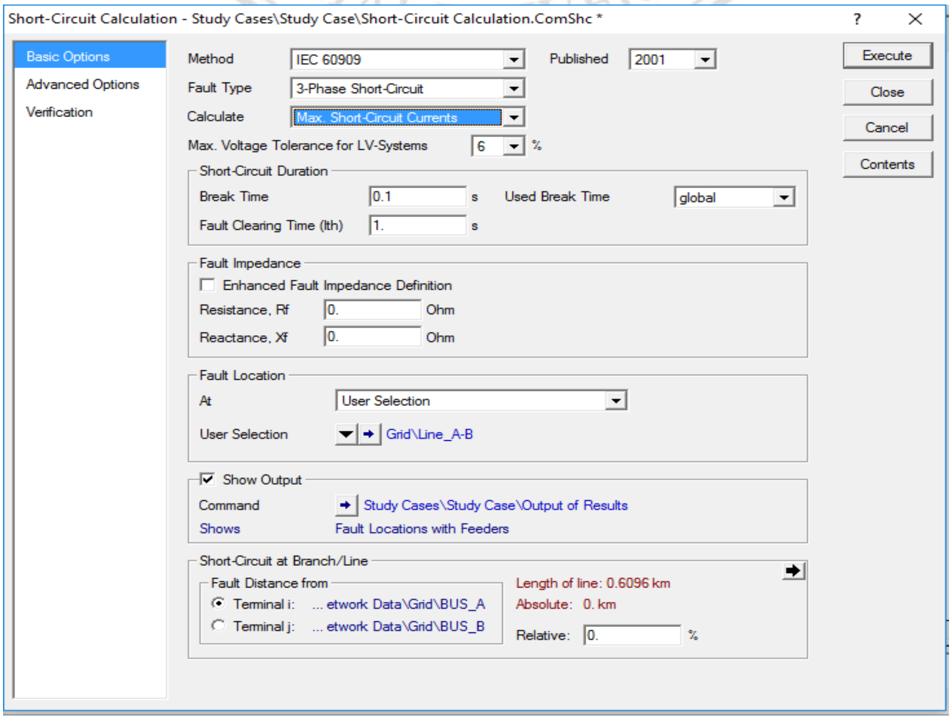

Figure A.58 In the configuration window to Short-Circuit Calculation.For analysis find the maximum short circuit current

Notice that the graph TCC Curve if the relay works in the maximum circuit shown in Figure A.59 then it is not necessary to adjust the flow setting start relay. If relay is not working at the maximum short-circuit current range, adjust the set flow relay starts up. But it must not exceed the minimum short-circuit current range.

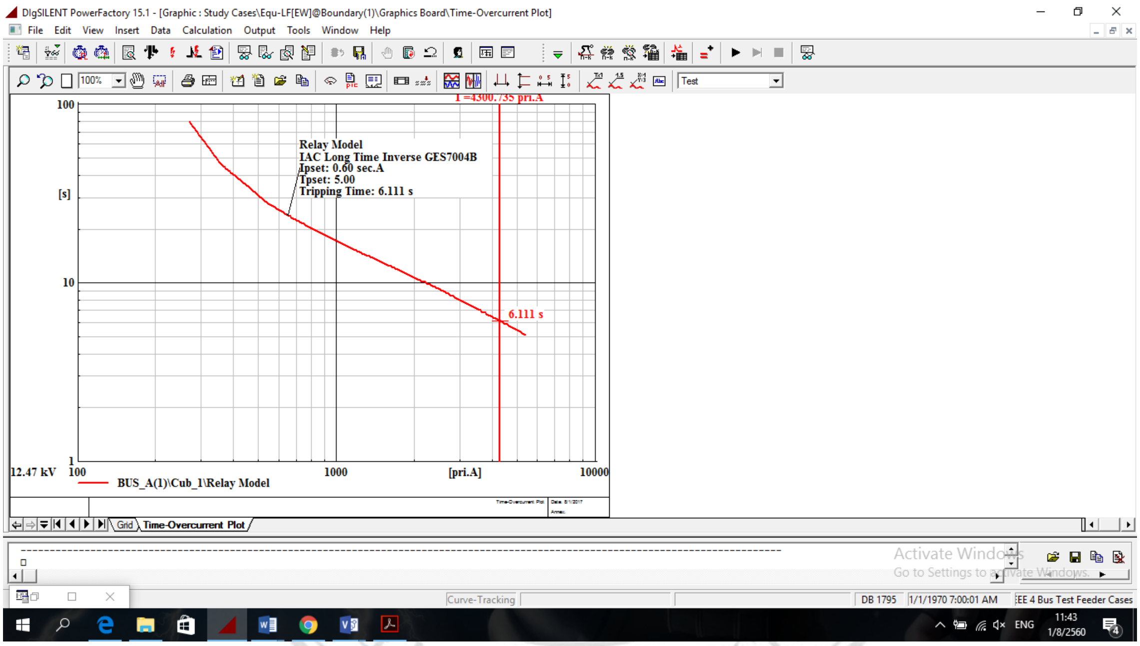

Figure A.59 Relay will be work the during the short circuit current max

A case study for this test system bus 4, adjust the relay as shown in Table A.9.

Table A.9 Data of setting the relay

Relay Name	Relay Type	Curve Name	Current Setting (sec.A)	Time Dial
Relay Model	IAC66B51A	Toc	0.5	5

A.3 Modelling of contingency analysis

A.3.1 Contingency analysis

In general terms, an emergency analysis can be defined an evaluation of the electrical systems and security levels as shown in Figure A.60.

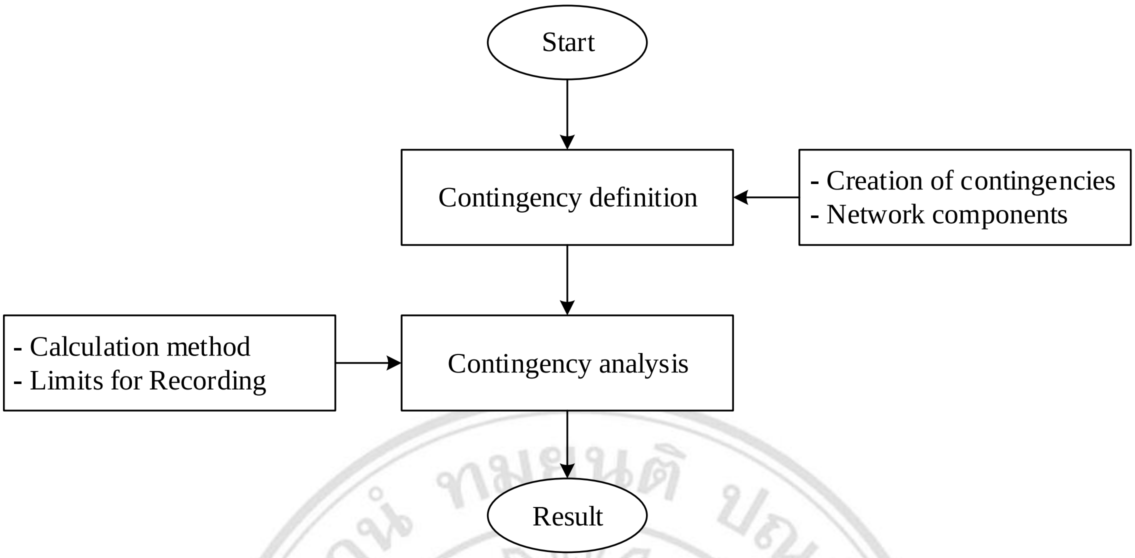

Figure A.60 Processing in contingency analysis

1) Contingency definition

Contingency definition is selected by passing the condition, according to the following as creation of contingencies and network component as shown in Figure A.61.

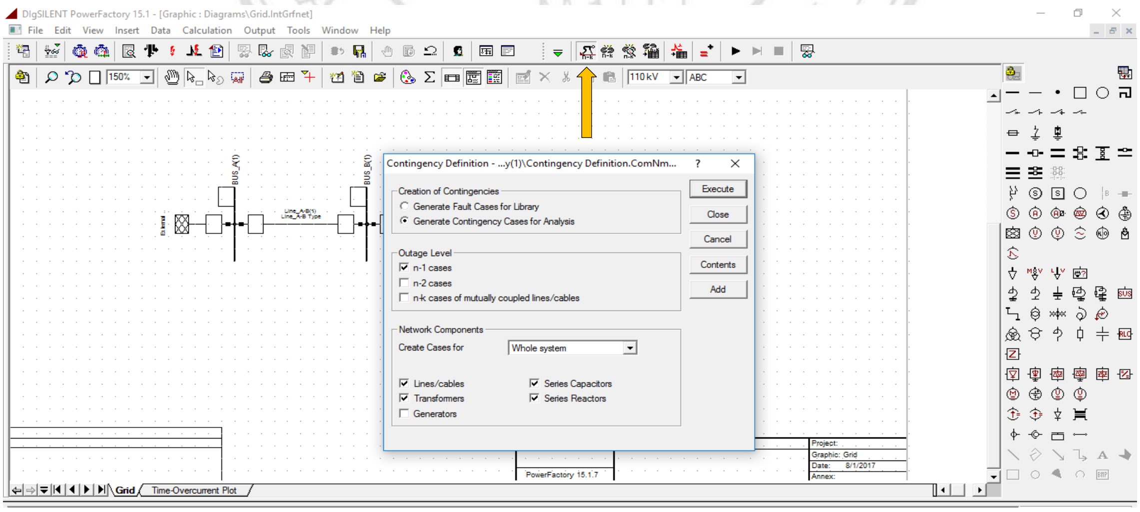

Figure A.61 Contingency definition

After, click on the symbols  on the Main Tool Bar will appear the window Contingency definition, as shown in Figure A.61, select the set-up parameters that are used in the calculation. If the system is used as N-1 Cases, select the Calculation Method as Generate Contingency Cases for Analysis, Create Cases for whole system, Lines/Cables, and then click the Execute button. To have the program calculate as configured.

2) Contingency analysis

A contingency analysis can be defined as the evaluation of the. The level of security of the power system .Contingency analysis generally involves Analysis of abnormal system condition is a major problem both in planning by calculation method and limits for recording as shown in Figure A.62.

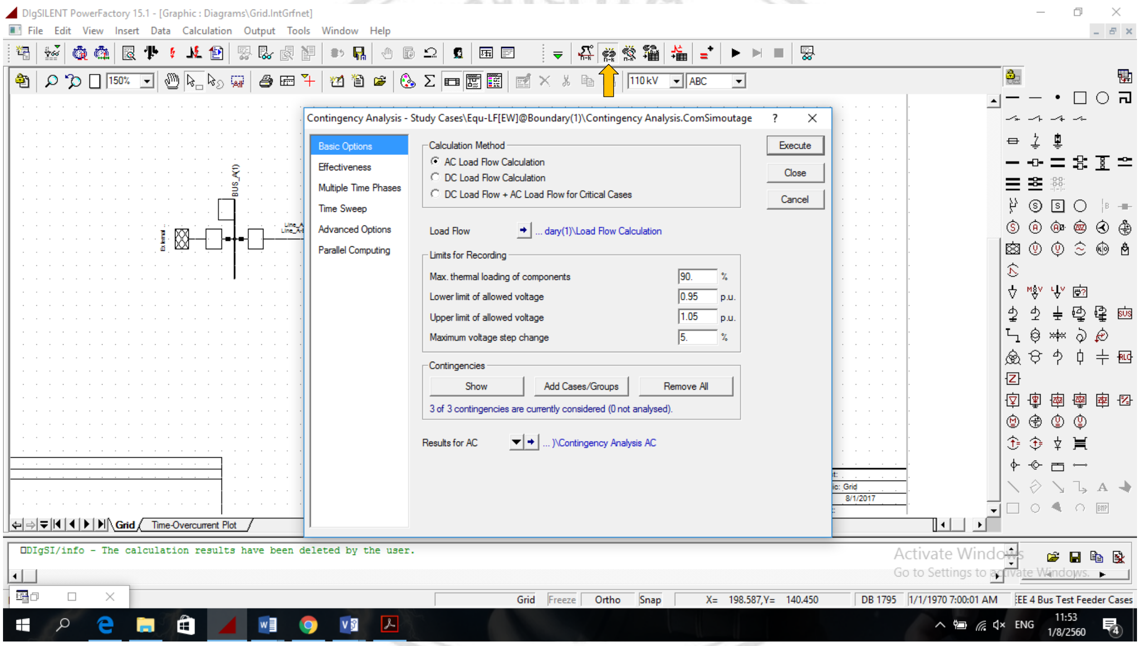

Figure A.62 Contingency analysis

After, click on the symbols  on the Main Tool Bar will appear the window Contingency analysis, as shown in Figure A.62, select the set-up parameters that are used in the calculation. If the system is used calculation method as alternating current (AC) Load Flow, direct current (DC) Load Flow, and DC Load Flow+ AC Load Flow for Critical Cases, select the Calculation Method as AC Load Flow, select the Show button for add cases, and then click the Execute button. To have the program calculate max loading of line as shown in Figure A.63.

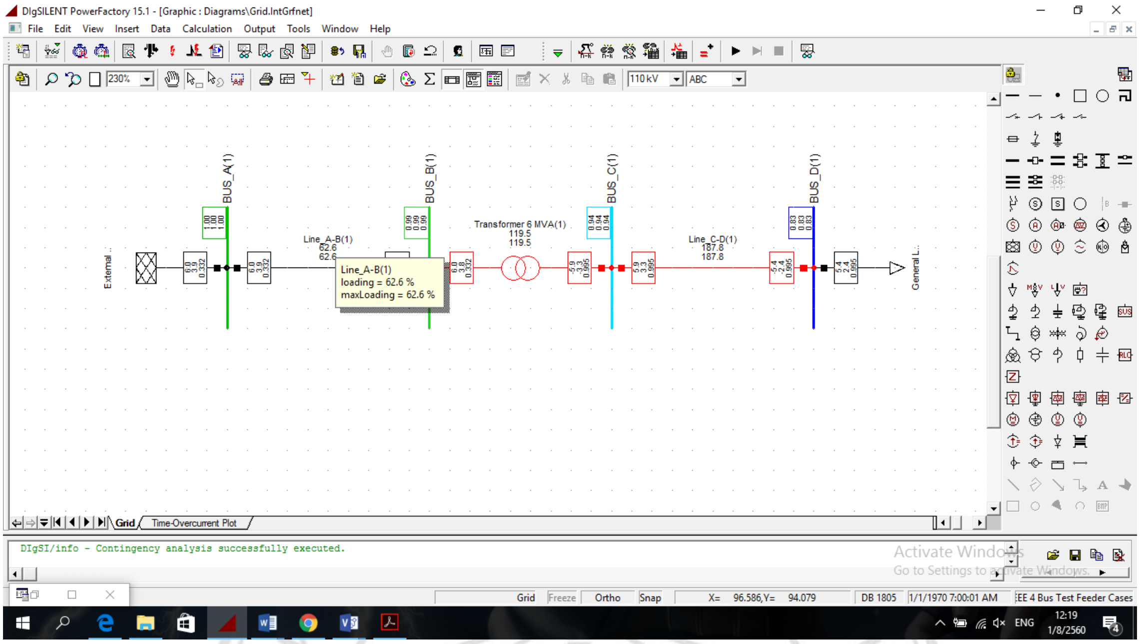

Figure A.63 The program calculate max loading of line

APPENDICES B

DIgSILENT Programming Language (DPL) function

B.1 DPL Command (Script)

B.1.1 Script DPL of contingency analysis

```
object o_con,o_Lines,o_conN;
set set_Lines;
int iCol,iRow;
double a,b,min,max,dValue;
string sName;
EchoOff ();
ClearOutput();
xlStart();
xlSetVisible(1);
xlNewWorkbook();
o_conN=GetCaseObject('ComNmink');
o_con=GetCaseObject('ComSimoutage');
o_con:loadmax=LoadingMax;
o_con:vlmin=LowerVoltage;
o_con:vlmax=UpperVoltage;
o_con:vmax_step=StepVoltage;
```

```
o_con.Execute();
set_Lines = SEL.GetAll('ElmLne');
set_Lines.SortToVar(0,'c:maxLoading');
iRow=5;
iCol=6;
sName='Name of Line';
xlSetValue(iCol,iRow,sName);
iRow=5;
iCol=7;
sName='Overloading (N-1)(%)';
xlSetValue(iCol,iRow,sName);
iRow=6;
for(o_Lines=set_Lines.First();o_Lines;o_Lines=set_Lines.Next()){
printf('Contingency of %s %6f %%',o_Lines:loc_name,o_Lines:c:maxLoading);
iCol=6;
sName=o_Lines:loc_name;
xlSetValue(iCol,iRow,sName);
iCol=iCol+1;
dValue=o_Lines:c:maxLoading;
xlSetValue(iCol,iRow,dValue);
iRow=iRow+1;
```

```
}
iRow=5;
iCol=8;
sName='I (kA)';
xlSetValue(iCol,iRow,sName);
iRow=6;
for(o_Lines=set_Lines.First();o_Lines;o_Lines=set_Lines.Next()){
printf('Contingency of %s %6f %%',o_Lines:loc_name,o_Lines:c:Imax);
dValue=o_Lines:c:Imax;
xlSetValue(iCol,iRow,dValue);
iRow=iRow+1;
}
xlTerminate();
EchoOn ();
TD_zone_1.Execute();
TD_zone_2.Execute();
TD_zone_3.Execute();
TD_zone_4.Execute();
TD_zone_5.Execute();
TD_zone_6.Execute();
TD_zone_7.Execute();
```

59. TD_zone_8.Execute();

60. TD_zone_9.Execute();

B.1.2 Script DPL of coordination time (3 phase and 1 phase fault)

❖ TD_zone_1, 2, 3, 4, 5, 6, 7, 8, and 9.

1. set SCom,Sbus,srelay,SRelay,SRelayCont;

2. object OCom,Obus,OSC,ORelayMain,ORelay_Br,ORelay_Bus,ORelay_BB;

3. object OToc_set,Obusa,Obusb,OLdf;

4. double Fault,DRuT,DRuT_old;

5. int I, IRelay, INRelay,Name,Ih;

6. string Value;

7. ClearOutput();

8. !!!!!!!Point short circuit at the bus!!!!!!!!

9. Sbus= SetBus_Zone1.GetAll('ElmTerm');

10. I = Sbus.Count();

11. if (I=0) {

12. Info('No busbars or terminals selected : nothing to do');

13. exit();

14. }

15. !!!!!!!!!!!!!!Max Short circuit!!!!!!!!!!!!!!

16. Obus= Sbus.First();

17. OSC = GetCaseObject('ComShc');

```
EchoOff() ;
OSC:iopt_shc = '3psc' ;
OSC:iopt_mde= 1 ;
OSC:iopt_cur = 0 ;
OSC:iopt_allbus = 0 ;
OSC:shcobj = Obus ;
OSC.Execute() ;
Fault = Obus:m:Ikss;
printf('Fault current at end of Protection Zone = %f kA',Fault);
!!!!!!!!!!!!!!!!!!!!!!!Relay!!!!!!!!!!!!!!!!!!
SRelay=SetRelays_Zone.GetAll('ElmRelay');
IRelay = SRelay.Count();
OCom=GetActiveProject();
SCom=OCom.GetContents('TD_zone');
OCom=SCom.FirstFilt('TD_zone');
for (INRelay=0;INRelay<IRelay;INRelay=INRelay+1){
OCom.GetVal(Value,'IntExpr',INRelay);
sscanf(Value,'%d',Name);
printf( '%f',Name);
}
I=0;
for (INRelay=0;INRelay<IRelay;INRelay=INRelay+1){
```

```
OCom.GetVal(Value,'IntName',INRelay);
ORelayMain = SRelay.FirstFilt(Value);
printf( '%s',ORelayMain:loc_name);
!!!!!!!!!!!!!!!!!!!!!Relay trip time!!!!!!!!!!!!!
SRelayCont = ORelayMain.GetContents();
ORelay_Br = ORelayMain:cbranch ;
ORelay_BB = ORelayMain:cn_bus ;
Ih = ORelay_Br.VarExists ('r:bus1:r:cpRelays:0:c:yout');
if(Ih = 1)
{
DRuT = ORelay_Br:r:bus1:r:cpRelays:0:c:yout ;
}
if(Ih = 0)
{
DRuT = ORelay_Br:r:bus2:r:cpRelays:0:c:yout ;
}
if(Ih=1){
Obusa=ORelay_Br.GetNode(0);
Obusb=ORelay_Br.GetNode(1);
if(ORelay_BB=Obusa){
DRuT = ORelay_Br:r:bus1:r:cpRelays:0:c:yout ;
}
```

```
if(ORelay_BB=Obusb){
DRuT = ORelay_Br:r:bus2:r:cpRelays:0:c:yout ;
}
}
printf('%s','Operating Time of Relay') ;
printf('%f s',DRuT) ;
printf('%s',' ') ;
if(I>0){
if(DRuT>DRuT_old*0.9){
while(DRuT>DRuT_old*0.9){
if(I=2){
break;
}
OToc_set = SRelayCont.FirstFilt('51PL') ;
OToc_set:Tpset = OToc_set:Tpset - 0.01 ;
OLdf = GetCaseObject('ComLdf');
OLdf:iopt_net = 0;
ResetCalculation();
EchoOff() ;
OLdf.Execute();
OSC.Execute() ;
!!!!!!!!!!!!!!!!!!!Output Result of Relay trip time!!!!!!!!!!!!!!!!!!!
```

```
Ih = ORelay_Br.VarExists ('r:bus1:r:cpRelays:0:c:yout');
if(Ih = 1)
{
DRuT = ORelay_Br:r:bus1:r:cpRelays:0:c:yout ;
}
if(Ih = 0)
{
DRuT = ORelay_Br:r:bus2:r:cpRelays:0:c:yout ;
}
if(Ih=1){
Obusa=ORelay_Br.GetNode(0);
Obusb=ORelay_Br.GetNode(1);
if(ORelay_BB=Obusa){
DRuT = ORelay_Br:r:bus1:r:cpRelays:0:c:yout ;
}
if(ORelay_BB=Obusb){
DRuT = ORelay_Br:r:bus2:r:cpRelays:0:c:yout ;
}
}
printf('%s','New Operating Time of Relay') ;
printf('%f s',DRuT) ;
printf('%s','>>>>>>>>>') ;
```

```
if(OToc_set:Tpset<0.1){
break;
}
}
}
}
DRuT_old = DRuT;
I=I+1;
}
ResetCalculation();
```

CURRICULUM VITAE

Author's Name	Mr. Aksacksy Philavong	
Date/ Year of Birth	18 January 1987	
Place of Birth	Vientiane capital, Lao PDR	
Education	2004 to 2008	Studied in National University of Lao at Faculty of Engineering for a Higher Diploma's degree of Electrical Engineering.
	2008 to 2010	Studied in National University of Lao at Faculty of Engineering for a Bachelor's degree of Electrical Engineering.
	2015 to 2017	Studied at Chiang Mai University (CMU), Thailand, under the Technical and Academic Collaboration Project between Electricity Generating Authority of Thailand (EGAT), Electricité Du Laos (EDL), and Electricité Du Laos -Generation Public Company, and between Electricité Du Laos -Generation Public Company and Chiang Mai University, respectively.
Employment History	2012 to 2015	Word at Safety Office, Electricité Du Laos (EDL).