POWER SYSTEM DESIGN AND MODELLING USING ERACS

By

RUSDEE AZEEM BIN MOHAMAD RUSLI

FINAL PROJECT REPORT

Submitted to the Electrical & Electronics Engineering Programme
in Partial Fulfillment of the Requirements
for the Degree
Bachelor of Engineering (Hons)
(Electrical & Electronics Engineering)

Universiti Teknologi Petronas
Bandar Seri Iskandar
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Perak Darul Ridzuan

CERTIFICATION OF APPROVAL

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June 2009

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and the original work contained herein have not been undertaken or done by unspecified sources or person.

RUSDEE AZEEM MOHAMAD RUSLI

ABSTRACT

Power system analysis means verifying the adequacy of the power distribution system and its components. It also studies the data analysis and power system as the basic improving system performance and power quality, reducing operating costs,and providing a reliable supply pf power system during operation. As for the result, the objective of this project was to determine the performance of an electrical power system . Several testing technique such as Short Circuit Study and Load Flow Study was perform .In order to make the system analysis more reliable, the studies will be conducted by using special power system analysis tools software, ERACS. By using this software, the design and modeling a power system was carried out in order to determine system operate based on different scenarios. This technique was applied not only in new system but also used in the analysis of existing power system that study the effect of change or extension in the system.

ACKNOLEDGEMENTS

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1.1 Background of study

Power system analysis basically consists of three main categories that need to focus such as power generation, transmission, and distribution. These three categories are also known as power system components. The ability to design and model a power system analysis using certain software is important nowdays in order to determine the best operation and expansion of the power system. It is also necessary to carry out study to be able to design and model a power system with minimum interruptions.

In order to get a good system, there are several factors that need to be consider when performing power system analysis such as load flow study. The power system load flow study was performed in order to determine the steady-state operation of an electric system. It also calculates the voltage drop on each feeder, the voltage at each bus, and also the power flow in all branch and feeder circuits. As for a result, it also calculates the losses in each branch and total power system losses.

A short circuit testing technique was also performed where by to determine the maximum current that will present during disturbance. Short circuit currents are computed for each relay and circuit breaker location and for various system-operating conditions such as lines or generating units out of services, in order to determine minimum and maximum fault current.

1.2 Problem Statement

The electric utility is the largest and most complex industry in the world today. The electrical engineers encounter challenging problems in designing future power system to deliver increasing amounts of electrical energy in a safe, clean, and economical manner. Many calculations need to be done and for certain cases, the manual calculation makes power system analysis tedious and waste of time. In order to assist the engineer, digital computers and highly developed computer software programs are used. During this project, ERACS software was used in order to design and model a power system that would perform short circuit and load flow study testing techniques.

1.3 Objective

The objectives of the project are as follows:

- Investigate and understand the power system generation, transmission and distribution in Malaysia.
- To design and develop a prototype of the distribution real system using proper software, ERACS.
- To perform a certain performance testing techniques such as short circuits and load flow study.

CHAPTER 2
LITERITURE REVIEW

2.1 Power system analysis

Power system analysis is basically divided into three major components which was generation, transmission and distribution. All of these three stage have their different voltage level and task. A good knowledge about power system components is needed in order to model and design a certain power system.

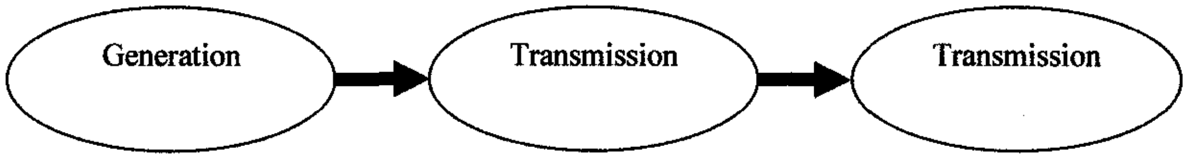

Figure 1: Power System Components

2.1.1 Generation

Electric generation is basically the process of converting a non-electrical energy to electrical energy. This is the first steps in order to delivery the electricity to the consumer. The power generation in Malaysia is derived from a combination of oil fired thermal, hydro, gas turbine, diesel, and combined cycle plants. With the exception of the small diesel and mini hydro plants the rest are interconnect via a high voltage transmission line which is known as National Grid Network. Beside of this, there are also many and new technologies to generate the electricity such as solar photovoltaics.

2.1.2 Transmission

The purpose of the transmission network is to transfer electric energy from generating units at various locations to the distribution system which ultimately supplied load. In the other words, it is the movement of energy from its generation to a location where it is applied to performing a useful work. Transmission voltage is alternating that can be easily stepped up by a transformer in order to minimize resistive loss in the conductors used to transmit power over great distance.

In United state, American National Standard Institute (ANSI) has set the standard of transmission voltages that have to follow. The transmission line that operating more than 60kV are standardize at 69kV, 115kV, 138kV, 161kV, 230kV, 345kV, 500kV and 765kV line to line. Transmission lines above 230kV are usually referred to extra-high voltage (EHV). EHV was basically are terminated at the station known as substation or called high voltage substation, receiving substations, or primary substation. Some of the substation functions are act as a switching circuit in and out of service or known as switching stations. The voltage is then step down to a value that is needed at the primary substations for the next distribution to the different loads.

A sub-transmission is referred as the portion of the transmission system that connects the high voltage substation through step-down transformer to the distribution system. The voltage range of sub-transmission is about 60 to 138kV and some of the industrial may be serve from this sub-transmission. As for the result, capacitor banks and reactor banks are usually installed in the substations for maintaining the transmission line voltage.

The model of the transmission line and busbar can be representing by using short transmission line that is shown below:

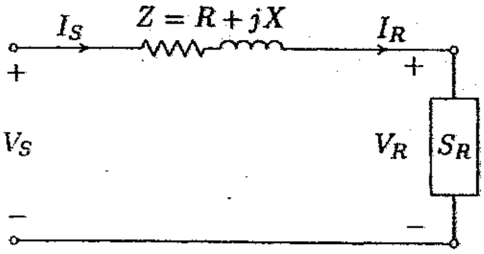

Figure 2: Short Transmission Line

From the above, the short line model can be as below;

$$Z = (r + j\omega L)l$$
$$= R + jX$$

Vs and Is are the phase voltage and current at the sending end of the line, and Vr and Ir are the phase voltage and current at the receiving end of the line. There are two type that needed to know such as the voltage regulation (Vr) and transmission line efficiency (η).Voltage regulation is the percentage change in voltage at the receiving end of the line in going from no-load to full-load.

$$\%VR = \frac{[V_{R(NL)}] - [V_{R(FL)}]}{V_{R(FL)}}$$

Where,

$V_{R(NL)} = V_S$

The transmission line efficiency is given by :

$$\eta = \frac{P_{R(3\phi)}}{P_{S(3\phi)}}$$

$P_{R(3\phi)}$ and $P_{S(3\phi)}$ = total real power at receving enf and sending end of line

2.1.3 Distribution

A distribution system connects the distribution substation to the customer service entrance equipment. It involves a medium voltage(less than 50kV) power lines, electrical substation and pole mounted transformer, low-voltage (less 1000V) distribution wiring and sometimes electricity meters. The secondary distribution networks reduce the voltage for commercial and residential consumers (240V). The length of lines and cable are not exceeding a few hundred feet which is then deliver to the consumers.

Distribution power nowadays is carried out by 2 ways which are overhead and underground. The growth of the underground has been extremely rapid and as much as 70 percent new residential constructions are served underground.

2.2 Malaysia Electricity Supply System

Malaysia electricity supply system is known as National Grid Network. Its is the primary transmission network that links from the generation, transmission, distribution and consumption in Malaysia. Tenaga Nasional Berhad(TNB) an electricity utility company in Peninsular Malaysia promotes generation, transmission and distribution of electrical energy with a view to encourage the economic development of states of Peninsular Malaysia.

As transmission and distribution system is highly exposed to the environment, external protections are provided on every part and piece of equipment to avoid being damaged during fault. The major fault rate in Peninsular Malaysia is due to lightening.

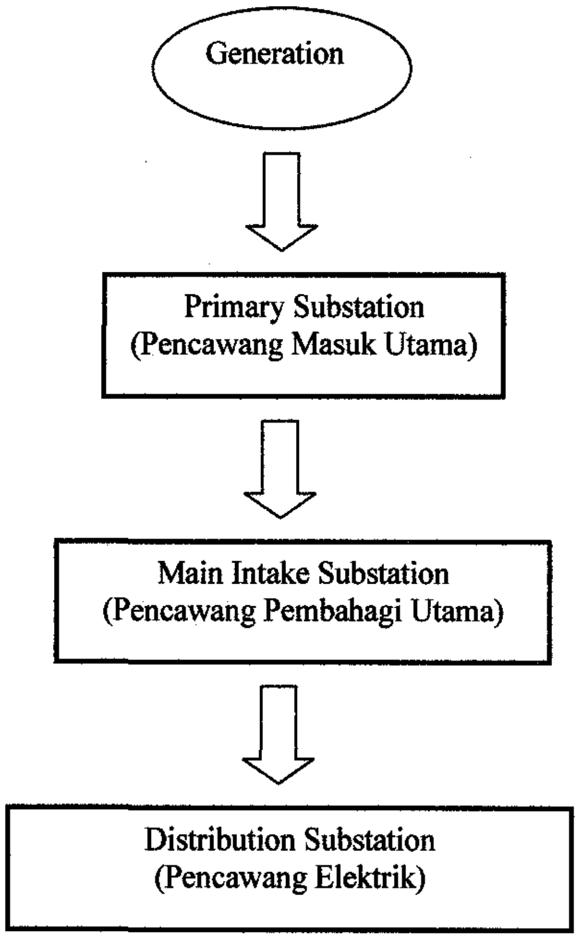

Figure 3: TNB basic power distribution system

2.3 Load Flow Study

Power flow study or load flow study is referred to a valuable system which involves multiple loads. The reason that this study will be conduct through out the project is in order to analysis the system capability to adequate supply the connected load. Load flow studies are performed in order to determine the steady-state operation of an electric power system. Its will calculate the voltage drop on each feeder, power flow at all branch, voltage at each bus and feeder circuits. The other type, such as the losses in each branch and the total system loses are also calculated.

Like all system studies, it determines if system voltages remain within specified limits under various contingency conditions, and whether equipment such as transformers and conductors are overloaded. The reason that we conduct this performing testing technique is to identify the need for additional generation, capacitive, or inductive VAR support, or the placement of capacitors in order to maintain system voltages within specified limits. Power flow is the backbone of power system analysis and design which will be use full for operation, planning, economic scheduling and exchange power between utilities. Theoretically, there are two common ways to solve nonlinear algebraic equation which is Gauss-Seidel and Newton-Raphson methods.

Gauss-Seidel Method

$$Vi_{(k+1)} = \frac{\frac{Pisch - jQsch}{Vi(k)} + \sum_{j=1}^{n} y_{ij} V_j^{(k)}}{\sum_{j=0}^{n} y_{ij}}$$

Newton-Raphson Method

This method is mathematically superior to the Gauss-Seidel method. Newton-Raphson are used for a large power system because more efficient and practical.

Elements of Jacobian matrix are partial derivative and can be written below:

$$\begin{bmatrix} \Delta P \\ \Delta Q \end{bmatrix} = \begin{bmatrix} J_1 J_2 \\ J_3 J_4 \end{bmatrix} \begin{bmatrix} \Delta\delta \\ \Delta[V] \end{bmatrix}$$

The diagonal and off-diagonal elements of J1 are

$$\frac{\partial Pi}{\partial \partial i} = \sum_{j \neq i} [Vi][Vj][Yij] \sin(\theta ij - \partial i + \partial j)$$

$$\frac{\partial Pi}{\partial \partial i} = -[Vi][Vj][Yij] \sin(\theta ij - \partial i + \partial j), j \neq i$$

The diagonal and off-diagonal elements of J2 are

$$\frac{\partial Pi}{\partial [Vi]} = 2[Vi][Yii] \cos \theta ii + \sum_{j \neq i} [Vj][Yij] \cos(\theta ij - \partial i + \partial j)$$

$$\frac{\partial Pi}{\partial [Vi]} = [Vi][Yij] \cos(\theta ij - \partial i + \partial j)$$

The diagonal and off-diagonal elements of J3 are

$$\frac{\partial Qi}{\partial \partial i} = \sum_{j \neq i} [Vi][Vj][Yij] \cos(\theta ij - \partial i + \partial j)$$

$$\frac{\partial Qi}{\partial \partial i} = -[Vi][Vj][Yij] \cos(\theta ij - \partial i + \partial j), j \neq i$$

The diagonal and off-diagonal elements of J4 are

$$\frac{\partial Qi}{\partial [Vi]} = -2[Vi][Yii] \sin \theta ii - \sum_{j \neq i} [Vj][Yij] \sin(\theta ij - \partial i + \partial j)$$

$$\frac{\partial Qi}{\partial [Vi]} = -[Vi][Yij] \sin(\theta ij - \partial i + \partial j)$$

2.4 Short Circuit Study

Short circuit study is where by the study of abnormal condition that involve in one or more phases unintentionally coming contact with the ground or each other. The connection of the positive, negative and zero sequence networks for each of the following short circuits faults is described as below:

a) Single Phase to Earth
b) Phase to Phase
c) Two Phase to Earth

As expansion of the power system nowdays, loads maybe move or larger ones are added, which will cause increased levels of available short circuit currents.

A) Single Phase to Earth

The single phase to earth fault, is assume to be between phase A and earth, this can shown in the figure 3 with the connection of the sequence networks.

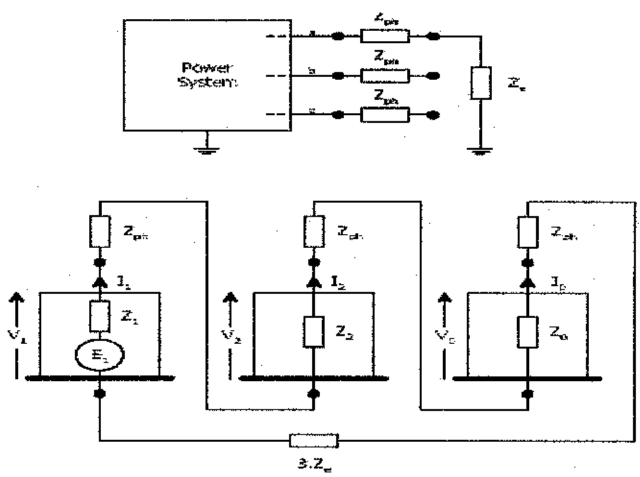

Figure 4: Single Phase to Earth

B) Phase to phase fault

For the phase to phase fault, the short circuit is assume to be between phase B and phase C, this is shown as figure above:

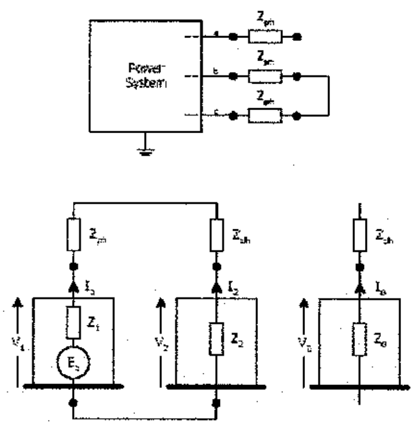

Figure 5: Phase to Phase Fault

C) Two phase to earth fault

In two phase to earth fault, its assume to be between phase B, phase C and earth this is shown in figure above:

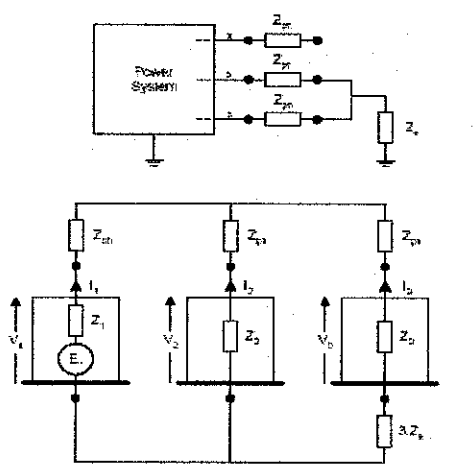

Figure 6: Two phase to earth fault

2.5 Transformer

A transformer is a device that changes ac electric power at one voltage level to ac electric power at another voltage level through the action of a magnetic field. It was consists of two or more coils of wire wrapped around a common ferromagnetic core. These coils are not directly connected. The only one connection between the coils is the common magnetic flux present within the core [2].

Transformer Configuration

Power transformer has one or two type of cores. One type of cores consists of very simple rectangular laminated steel with transformer winding wrapped around two sides of rectangle. The primary and secondary winding is wrapped one on top of the other because of below reason:

A) Simplified problem insulating HV winding from core.

B) Less leakage

Power transformer has a variety of names that used in power system nowdays depending on the voltage itself. A unit transformer is a transformer that coming from the generator and was used to step-up the voltage to transmission level (110kV above). At the end of the transmission line, the voltage is then step-down and this transformer are called *substation transformer*(132kV to 11kV).The last transformer that takes the lower voltage or LV(415V and 240 V) are called distribution transformer.

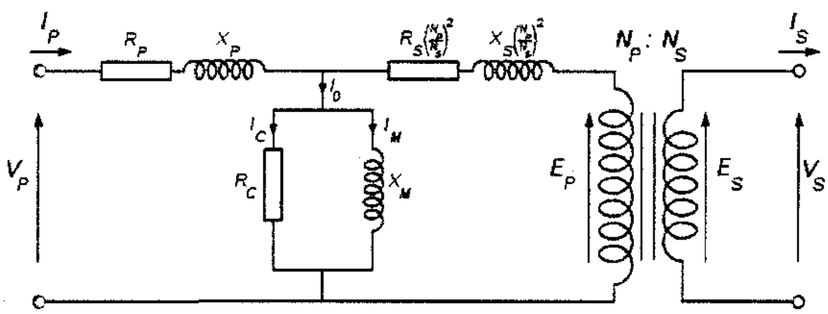

Figure 7: Equivalent Circuit

Ideal Transformer

Consider the transformer was an ideal transformer. Which is the transformer having a lossless device at input winding and output winding. The relation ship between input and output voltage, current input and output are shown below

$$\frac{V_{P(t)}}{V_{S(t)}} = \frac{N_P}{N_S} = \frac{i_{S(t)}}{i_{P(t)}} = a \quad \text{a is define as turn ratio}$$

VP(t)= Voltage at primary side
VS(t)= Voltage at secondary side
NP=turns of wire at primary side
NS= turns of wire at secondary side

In an ideal transformer, the power supply by the primary circuit is given by

$$P_{in} = V_P I_P \cos\theta_P \quad \theta_P = \text{angle between primary voltage and current}$$

At the secondary transformer, the power is given by

$$P_{out} = V_S I_S \cos\theta_S \quad \theta_S = \text{angle between secondary voltage and current}$$

Relationship between input and output power is the output power is equal to input power and given by

$$P_{out} = V_P I_P \cos\theta_P = P_{in}$$

The same relationship also apply to the reactive power Q and apparent power S,

$$Q_{in} = V_P I_P \sin\theta = V_S I_S \sin\theta = Q_{out} \quad \text{and}$$

$$S_{in} = V_P I_P = V_S I_S = S_{out}$$

2.6 Induction Motor

Induction machine is a machine that has amortisseur windings and the rotor voltage is induced in rotor windings rather than being physically connected wires. The best describe of induction machine is that it doesn't have dc field current connected to it in order to run the machine. Industrial nowdays used many three phase induction in a standard workhorse for high power application. The speed of the Magnetic field rotation is given by

$$N_{sync} = \frac{120 f_e}{P} \qquad \begin{aligned} f_e &= \text{system frequancy} \\ P &= \text{number of poles} \end{aligned}$$

Voltage in rotor depends on speed of the rotor relative to the magnetic fields. There are 2 term to define the relative motion of rotor and magnetic field which is slip speed and slip. The slip speed and slip equation is given by

$$n_{slip} = n_{sync} - n_m$$

$$s = \frac{n_{slip}}{n_{sync}} \times 100\%$$

The rotor frequency **fr**, torque **T**, and power **P** is ;

$$f_r = s f_e$$

$$T = \frac{P}{W_m} = \frac{60P}{2 p n_m}$$

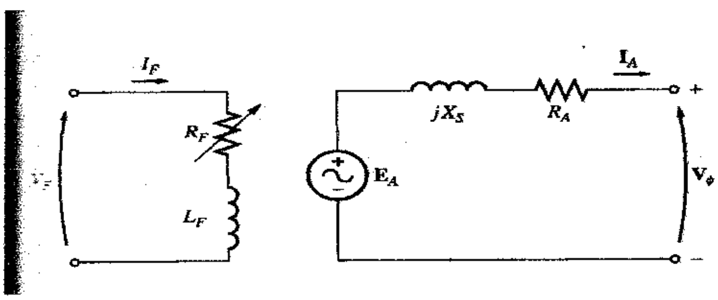

Figure 8: Equivalent Circuit Induction Motor

2.7 Synchronous Generator

Synchronous generator is basically a synchronous machine that used to convert mechanical power to electrical power. Dc power supply is used on the rotor winding that will induce a magnetic field in rotor. The rotor itself will turn by a prime mover that will also produce a rotating magnetic field that will produce 3 phase voltage. There are 2 winding which is field winding (rotor) and armature (stator) winding. Below is basically the equivalent circuit of synchronous generator:

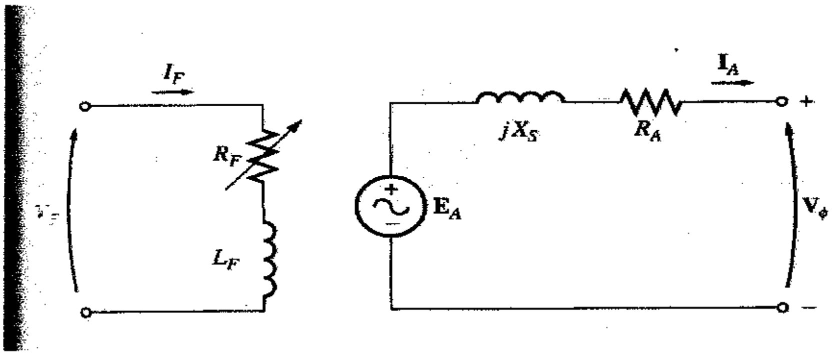

Figure 9: Equivalent Circuit Synchronous Generator

The rotation of the magnetic field in this machine is related to the stator electrical frequency which is:

$$fe = \frac{n_m P}{120}$$

The frequency that used in Malaysia is about 50 Hz, so the generator will turn at fix speed depending on the number of poles. The magnitude of the voltage induced in stator is:

$$Ea = K\phi\omega \quad \text{K = constant}$$

The armature induced voltage phase is given by

$$V_\phi = E_A - jXI_A$$

The final equation

$$V_\phi = E_A - jXI_A - R_A I_A$$

2.8 Quality Of Supply

The quality of electricity supply is based on the quality of the voltage provided to customers that can be affected various ways. The irregularities are sudden change in voltage, rapid fluctuation or unbalance of 3 phase voltage. The factor that affects the quality of supply is the actual value of supply voltage, which needed to be kept within a given range for correct application to customers. When the voltage is outside the range, it can badly damage the appliances. Extreme high voltage is usually due to failure on voltage control equipment, or over voltage.

Customer voltage regulation

In order to determine the voltage variation, maximum and minimum loading must be known. The other factor also need to be taken such as due to transformer tap changer position and the transmission and distribution network must all be taken into account.

Low Voltage Supply

In normal condition, voltage terminal shall not vary from system nominal voltage of 400/240 Volt by more than +10% to 6%

Under contingency condition, where one or more busbar are on outages, the steady state voltage at all point in distribution system shall be maintained at 400/230 V (+10% to -10%).

Medium Voltage Supply

Normal condition- voltage to customers shall not vary from several nominal voltage of 11 kV by more than +5% to -5%.

Contingency conditions- one or more busbar are outages, steady state voltage at all point shall be planned to maintained at 11 kV within +10% to -10% of nominal voltage.

CHAPTER 3
METHODOLOGY

3.1 Analysis Technique

With rapid increase in population and industries, the electric distribution has grown in size and the number of the interconnection also has increased that make the system complex. For the better result, the study in this project was carried out by using computational simulation and modeling analysis software which are available in the EE department (ERACS software). The several advantages that ERACS has been chosen is:

a) Competitive price against specification
b) Low cost hardware platform
c) User friendly interface
d) Reliability
e) Preparation of the data
    - multiple data input format
    - system MVA base
    - absolute unit
f) Error checking of system configuration is simplified

3.2 Procedure Identification

The projects begin with the research work on previous journals and books that have been published for the reference through out the project. A certain timeline was also been established in order to make the project flow smoothly. The first stage was to understand and identify the power system components in order to design and model a good power system. The working procedure mostly was on overview, investigation and research through the analysis. The workflow is shown below:

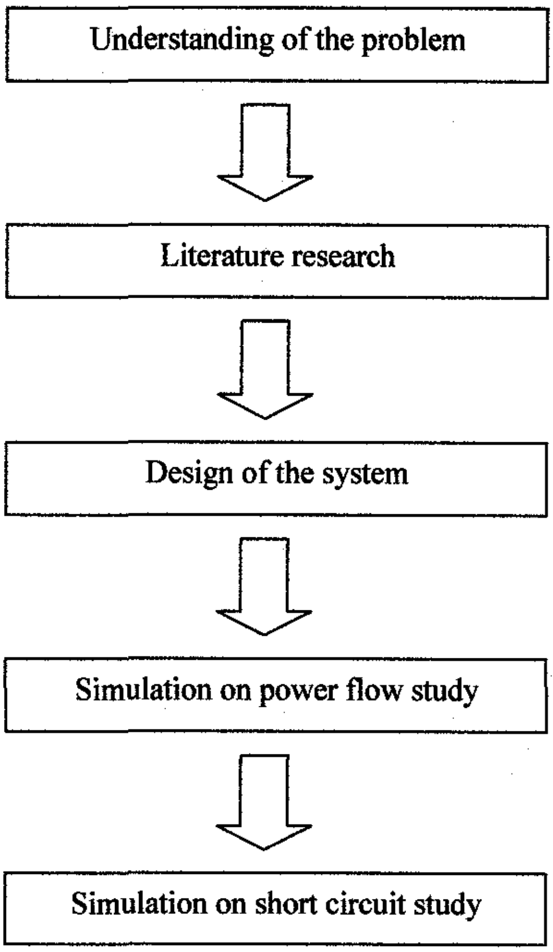

Figure 10: Project process

Phase 1 : Literature Research

At this process, all the previous research and journals are studied which is the fundamental of the power system analysis and also the testing technique. Understanding the computer tools that will be using is also conducted during this stage, which is ERACS software.

Phase 2 :Design and modeling

All the data that are required are compile together from others sources. It is very important to obtain the accurate data since it will be effect the equipment and electric power system of the distribution system. Assign a rite value which is acceptable.

Phase 3 : Simulation On Power Flow Study

In order to perform this kind of testing technique. Several condition have been make and at this process, it will determine the actual value of the network voltage, current, real and reactive power.

Phase 4 : Simulation on Short Circuit Study

This simulation is to determine the maximum current at the busbar of the network such as transformer and all major critical equipments.

Gantt chart for FYP

No.	Detail/ Week	1	2	3	4	5	6	7	8	9	Mid-semester break	10	11	12	13	14	15
1	Project Simulation				●												
2	Submission of Progress Report 1																
3	Project Work									●							
4	Submission of Progress Report 2																
5	Seminar									●							
6	Submission of Poster																
7	Project Work													●		●	●
8	Submission of Softbound Dissertation																●
9	Oral Presentation																
10	Submission of Hardbound Dissertation																

●	Suggested Progress
	Suggested Milestone

CHAPTER 4
RESULT AND FINDINGS

4.1 Design Criteria

Design and modeling power system is very important where the design enable the specified properties of the analysis to be obtained. A good design and the best practice at every stage, starting from the contractual framework and the consideration of the supply option is also being studied. While designing a power system, other criteria also have to be considered besides on the technical view, such as a comprehensive economic assessment of every project must be consider at the same time. As for the consequences, it must be unsure that the project proposed is technically sound and cost effective. Following studies are done during power system analysis:

<u>An Industrial Viewpoint</u>

A) Feasibility studies- to ensure that the load flow and fault level proposal are acceptable and also the system has dynamic performance such as starting large drive, is needed.
B) Detail design – undertaken when the project has been review. It will study the distribution system under all design loading requirement such as limiting reactance value on transformer and generator and also the starting current of the large motor.

Inside this system, the first incoming voltage, 132 kV is coming from 2 grid that somehow interconnect each other. The 132 kV voltage is then step down to 11 kV which is most of the system is then distributed using 11 kV voltage level that there is not much power losses if using lower voltage. The 11 kV systems are then stepdown again using transformer to the 415 V, which is then deliver to the customer. The network also consist of 1unit of generator that will generate it own electricity supply system. Network can be divided into heavy industrial load, industrial, and commercial and residential load. The, load itself are consisted of various PQ load, admittance and impedance load.
Below is the listing the basic elements that are using inside this system:

1) Busbar
2) 2 grid
3) 1 synchronous generator
4) Induction Motor
5) Neutral earthing
6) Line
7) Cable
8) Transformer
9) Shunt Load

Attached beside **(Figure 11)** is the design and modeling of the system under **normal condition.** See **Appendix A** for the power system component data sheet.

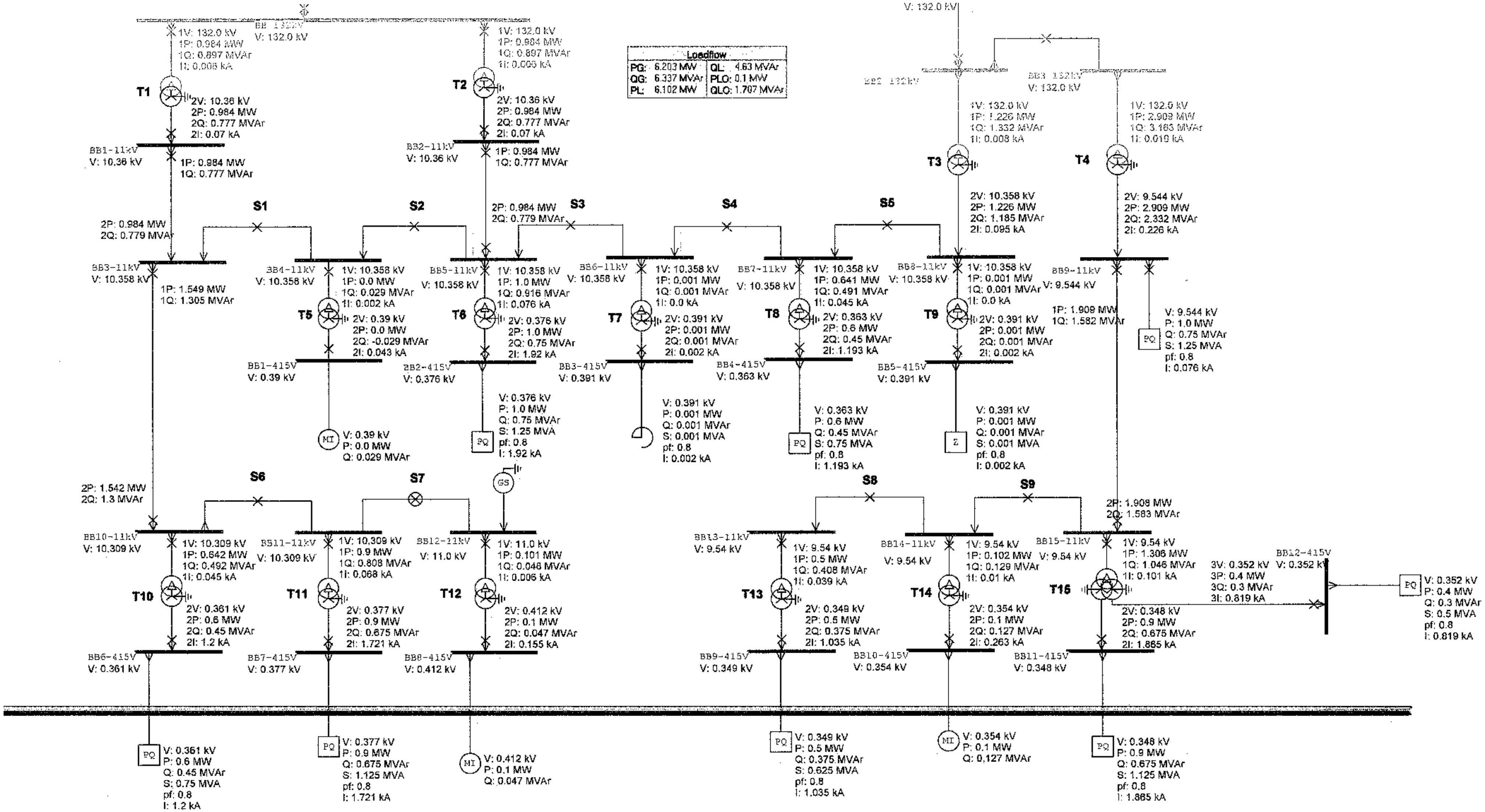

Figure11:Normal

Grid Infeed

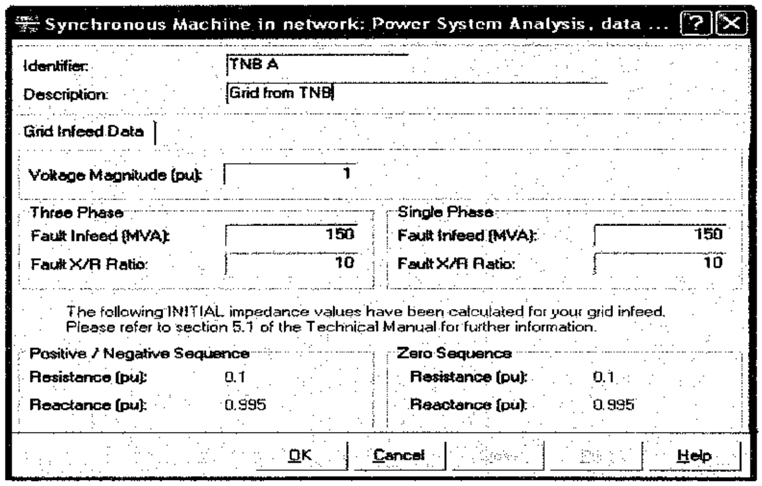

Figure 12: Input for Grid Infeed

Above figure show grid networks that are unaffected to the network. The grid infeed is model as an voltage behind an impedance. The three phase fault (MVA) and X/R ratio are used by the load flow to determine the initial impedance of the grid. ERACS is develop in UK, therefore it is common practice inside this software to specify MVA or kA.

Busbar

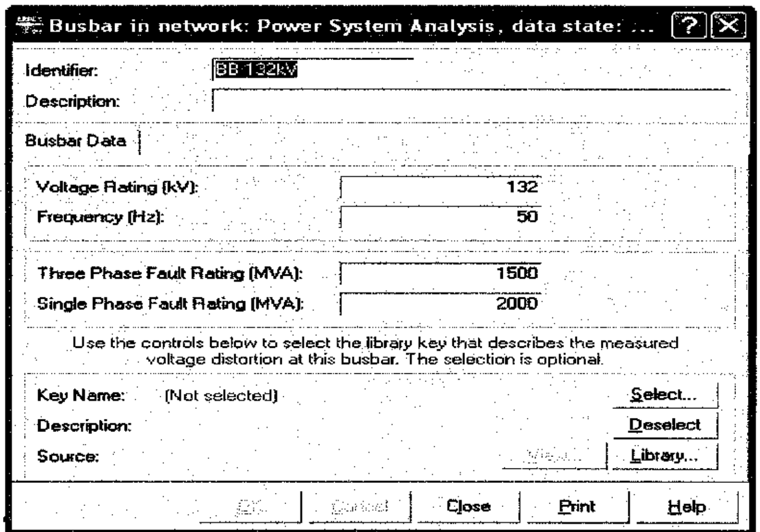

Figure 13: Input for Busbar Data

Figure show the basic element of the busbar data. The main data that need to be inserted is the busbar voltage rating in kV and frequency (Hz). ERACS will automatically calculate the value of three phase fault rating (MVA) and single phase fault rating (MVA).

Transformer

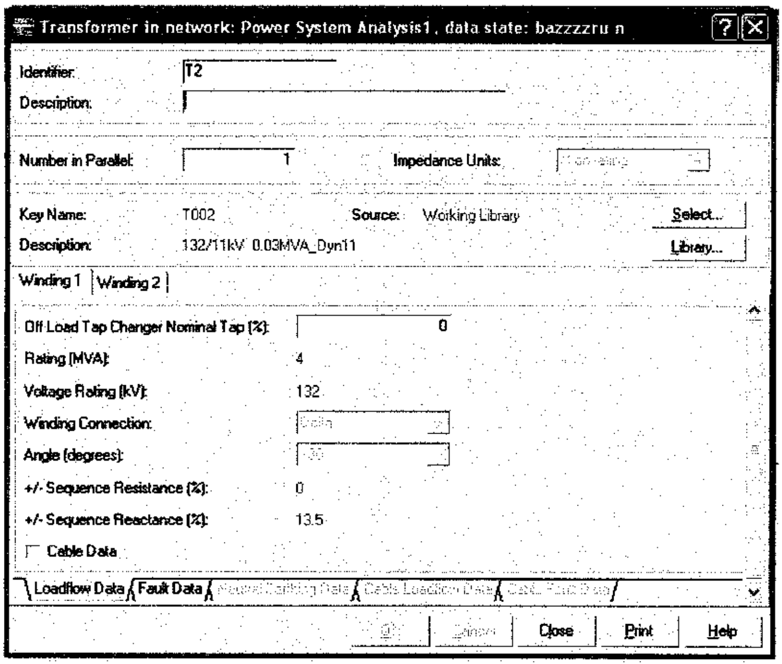

Figure 14: Input for Transformer Data

Induction Motor

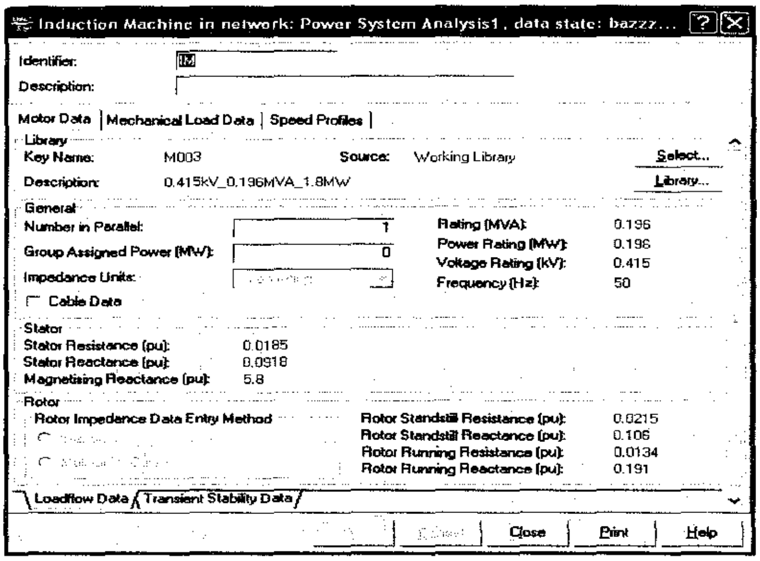

Figure 15: Input for Induction Motor Data

Shunt Load

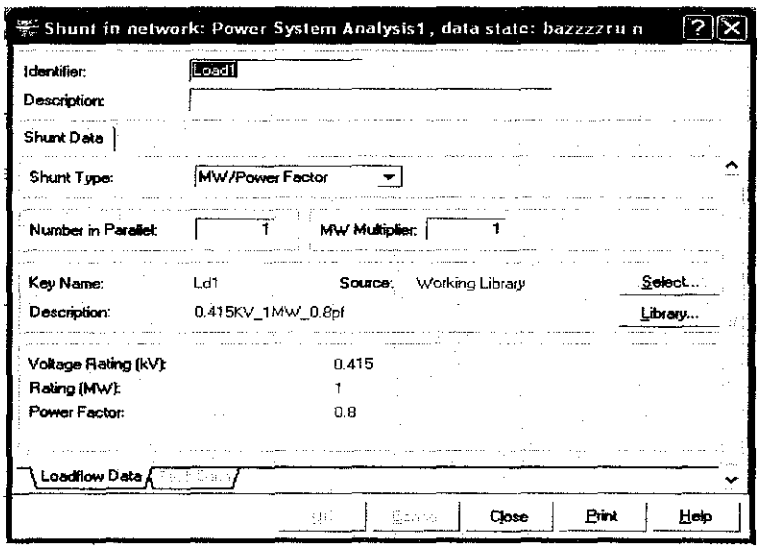

Figure 16: Input for Shunt Data

Inside the ERACS software, there are various type of load such as PQ load, admittance, constant current and impedance load.

4.2 Load Flow Study

The load flow study is being conducted with three contingency which are case 1: under normal, case 2: one busbar open, case 3: two busbar open, case 4: three busbar open which may occur due to maintenance or installation new equipment. Refer to the **Appendix B** for the load flow full result under case 1. For the case 2, busbar BB11-11kV was open **(Figure 17)**. Load flow simulation have been perform and attached to **Appendix C.**

In case 3, busbar BB11-11kV and BB13-11kV was open **(Figure 18)**. Refer to **Appendix D** for load flow simulation result. While in case 4, three busbar was open which are BB11-11kV, BB13-11kV and BB7-11kV **(Figure 19)** and refer to **Appendix E** for full result.

Below is the data for case study under normal and 3 contingency:

CASE	PG (MW)	QG (MVAr)	PL (MW)	QL (MVAr)	PLO (MW)	QLO (MVAr)
1	6.203	6.337	6.102	4.630	0.100	1.707
2	5.292	5.314	5.202	3.956	0.090	1.358
3	4.791	4.610	4.702	3.589	0.089	1.021
4	4.151	4.027	4.102	3.14	0.049	0.887

Table 1: Load Flow Result

From the table above, we can conclude that as increase in number of busbar open, the power generated also will tend to decrease. This is because to the decreasing of loads and line were shut down.

PG=Total Real Power Generated, QG=Total Reactive Power Generated,PL=Total Real Power Load ,QL=Total Reactive Power Load, PLO=Total Real Power Losses, QLO= Total Reactive Power Losses

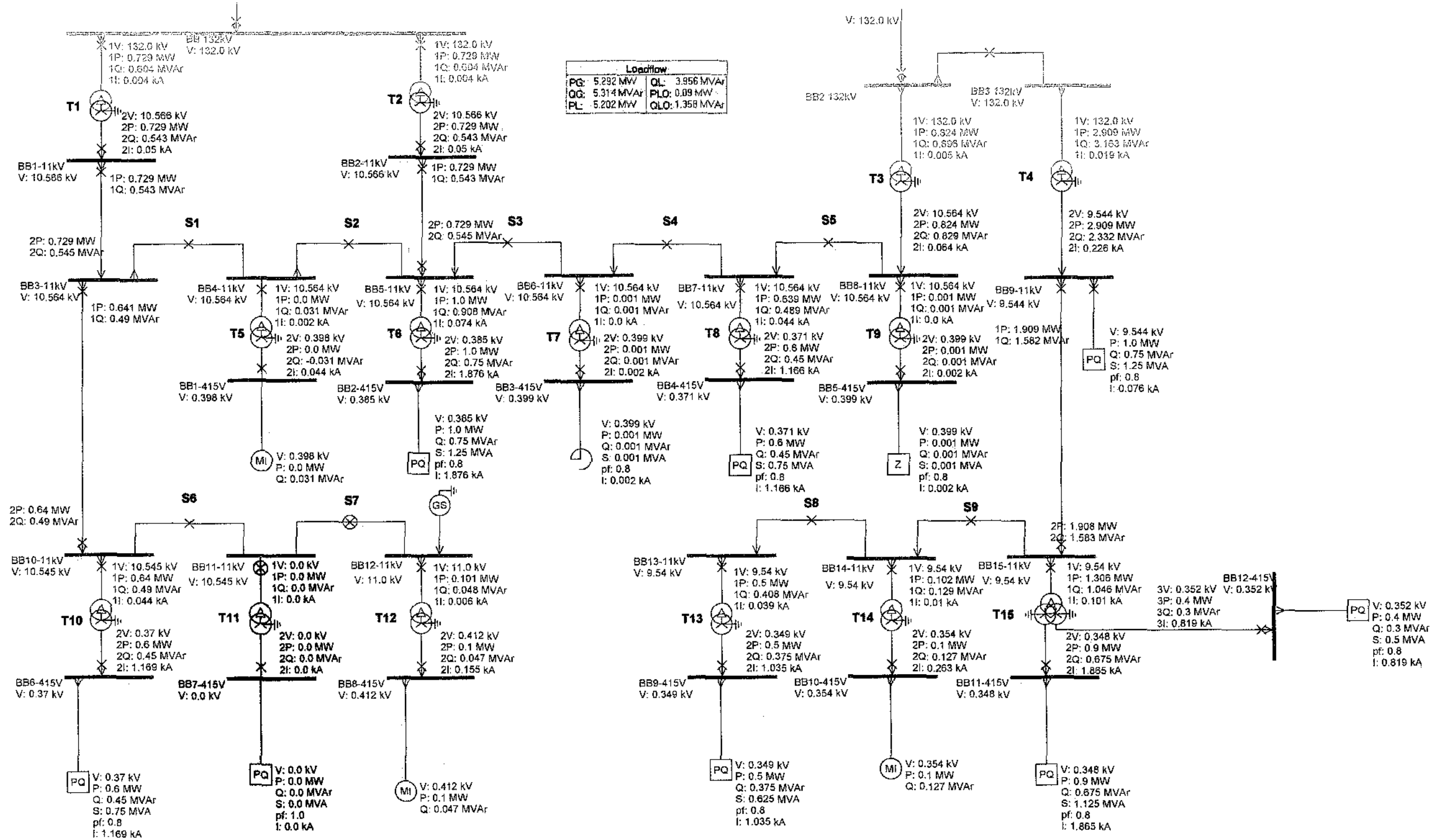

Figure 17: Busbar BB11-11kV OPEN

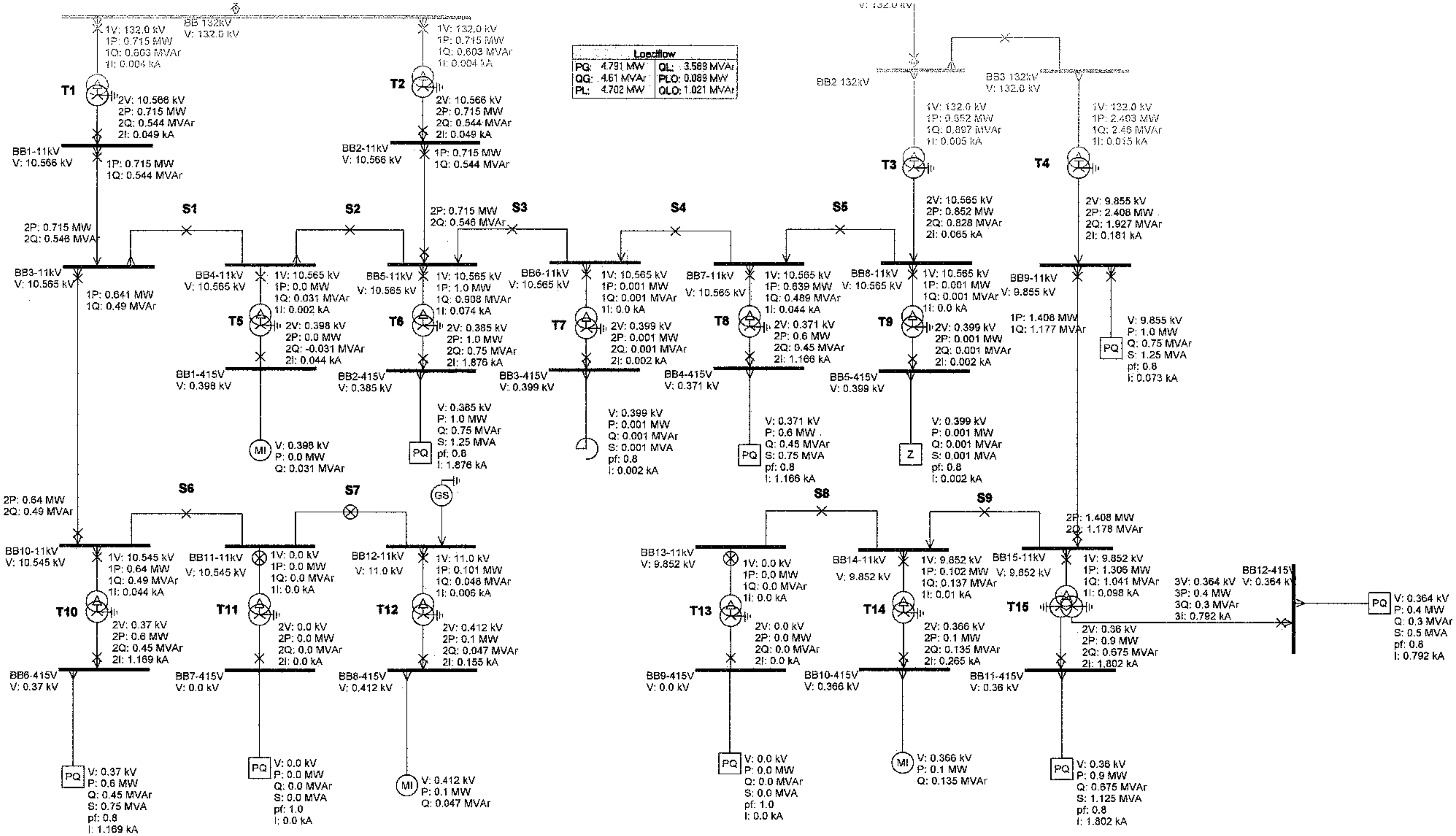

Figure 18: Busbar BB11-11kV and BB13-11kV OPEN

4.2.1 Cost Evaluation

Bus Selection Open	Real Power Generated (MW)	Reactive Power Generated (MVAr)	Real Power Loaded (MW)	Reactive Power Losses (MVAr)	Real Power Losses (MW)
S1	6.208	6.463	6.102	4.631	**0.106**
S2	6.208	6.465	6.102	4.627	**0.106**
S3	6.204	6.48	6.102	4.628	**0.101**
S4	6.203	6.480	6.102	4.628	**0.101**
S5	6.217	6.789	6.102	4.627	**0.115**
S6	5.292	5.314	5.202	3.956	**0.090**
S8	5.702	5.634	5.602	4.263	**0.100**
S9	5.600	5.430	5.502	4.128	**0.098**

Table 2 :Load Flow Summary Result

Load Characteristic:

60%- Domestic Area
40%- Industrial Area

Taking from TNB Tariff

Tariff A- Domestic Tariff
RM 0.28 per kW

Tariff E1- Medium Voltage General Industrial Tariff
RM 0.38 per kW

For the Real Power Losses = 0.101MW

$$60\% \times 0.101MW = 60.600kW - domestic$$
$$40\% \times 0.101MW = 40.400kW - industrial$$

For domestic tariff:

$$60.600kW \times RM0.28 / kW = RM16.968$$

Medium Voltage General Industrial:

$40.400kW \times RM0.30 / kW = RM12.12$

Total Losses ,

RM 16.968 + RM 12.12 = **RM 29**

For Real Power Losses = 0.106 MW

$$60\% \times 0.106MW = 63.600kW - domestic$$
$$40\% \times 0.106MW = 42.400kW - industrial$$

For domestic tariff:

$63.600kW \times RM0.28 / kW = RM17.808$

Medium Voltage General Industrial:

$42.400kW \times RM0.30 / kW = RM12.72$

Total Losses,

RM 17.808 + RM 12.72 = **RM 31.58**

For Real Power Losses = 0.115 MW

$$60\% \times 0.115MW = 69.000kW - domestic$$
$$40\% \times 0.115MW = 46.000kW - industrial$$

For domestic tariff:

$69.000kW \times RM0.28 / kW = RM19.32$

Medium Voltage General Industrial:

$46.000kW \times RM0.30 / kW = RM13.60$

Total cost,

RM 19.32 + RM 13.80 = **RM 33.12**

BUS SELECTION	TOTAL LOSS(RM)
S1	**RM 31.58**
S2	**RM 31.58**
S3	**RM 29.00**
S4	**RM 29.00**
S5	**RM 33.12**

Table 3: Total Amount Of Losses

From the table above, S3 and S4 yields the lowest amount of losses(in RM) to the system. Thus, it would be preferable to switch off S3 and S4.Noted that S6, S8 and S9 not chosen because when the bus selection turn off, it will not supply electricity to some of busbar, , thus it is not applicable in this study.

4.3 Short Circuit Study

In this case, end result was obtained from the simulation is to confirm that whether the existing busbar short circuit ratings are sufficient to withstand and interrupt the fault current. This also in order to verify that future loads will be available to the system. There are various type of fault such as :

- Three Phase
- Phase to earth
- Phase to phase
- Two Phase to earth

This study conduct under normal condition with several number of busbar are being perform the short circuit study

Short Circuit Study Setup

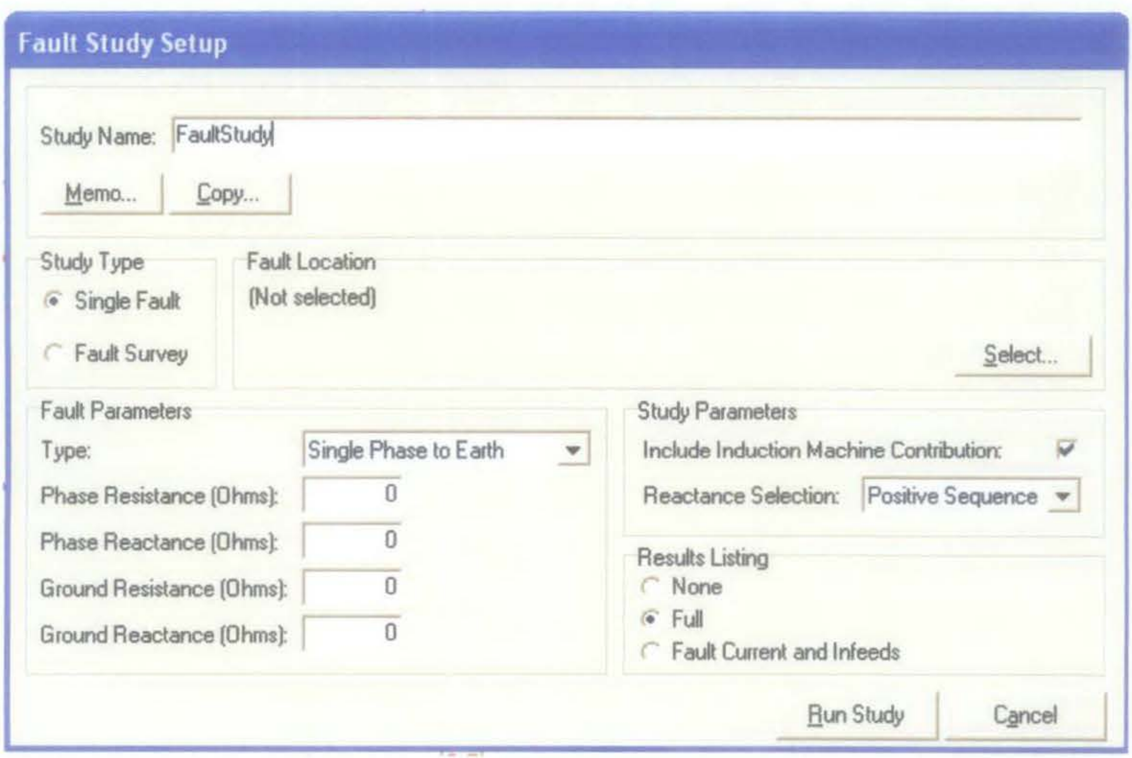

Figure 20: Short Circuit Study Setup Menu

4.3.1 Three Phase Short Circuit

Busbar	Ir(kA)	Iy(kA)	Ib(kA)
BB1-415V	14.694	14.694	14.694
BB2-415V	12.703	12.703	12.703
BB3-415V	16.242	16.242	16.242
BB4-415V	13.806	13.806	13.806
BB5-415V	16.240	16.240	16.240
BB6-415V	13.498	13.498	13.498
BB7-415V	12.500	12.500	12.500
BB8-415V	17.665	17.665	17.665
BB9-415V	12.579	12.579	12.579
BB10-415V	15.655	15.655	15.655
BB11-415V	18.923	18.923	18.923
BB12-415V	18.797	18.797	18.797

Table 4: Three Phase Short Circuit Study on Busbar 415V

Busbar	Ir(kA)	Iy(kA)	Ib(kA)
BB1-11kV	2.38	2.38	2.38
BB2-11kV	2.38	2.38	2.38
BB3-11kV	2.384	2.384	2.384
BB4-11kV	2.384	2.384	2.384
BB5-11kV	2.384	2.384	2.384
BB6-11kV	2.384	2.384	2.384
BB7-11kV	2.384	2.384	2.384
BB8-11kV	2.384	2.384	2.384
BB9-11kV	1.208	1.208	1.208
BB10-11kV	2.235	2.235	2.235
BB11-11kV	2.235	2.235	2.235

BB12-11kV	9.516	9.516	9.516
BB13-11kV	1.207	1.207	1.207
BB14-11kV	1.207	1.207	1.207
BB15-11kV	1.207	1.207	1.207

Table 5: Three Phase Short Circuit Study on Busbar 11kV

Busbar	Ir(kA)	Iy(kA)	Ib(kA)
BB1-132kV	0.705	0.705	0.705
BB2-132kV	0.715	0.715	0.715
BB3-132kV	0.715	0.715	0.715

Table 6: Three Phase Short Circuit Study on Busbar 132kV

The most common short circuit technique to determine the protection equipment setting is a three phase short circuit study.Based on the TNB specification data, the maximum fault current must not exceed the below data:

Supply Voltage Level	Short Circuit Rating
132kV	31.5 kA for Three Phase
11kV	20 kA Three Phase
415V	31.5 kA Three Phase

Table 7:Short Circuit Level for various Voltage Level

4.3.2 Phase to Earth, Two Phase to Earth and Phase to Phase Testing

Busbar BB4-11kV

Fault Type	Ir(kA)	Iy(kA)	Ib(kA)
Phase to Earth	3.273	0	0
Two phase to earth	0	3.325	3.323
Phase to phase	0	2.067	2.067

Table 8: Short Circuit at Busbar BB4-11kV

Busbar BB6-11kV

Fault Type	Ir(kA)	Iy(kA)	Ib(kA)
Phase to Earth	3.273	0	0
Two phase to earth	0	3.325	3.323
Phase to phase	0	2.067	2.067

Table 9: Short Circuit at Busbar BB6-11kV

Busbar BB14-11kV

Fault Type	Ir(kA)	Iy(kA)	Ib(kA)
Phase to Earth	1.582	0	0
Two phase to earth	0	1.528	1.575
Phase to phase	0	1.045	1.045

Table 10: Short Circuit at Busbar BB14-11kV

From the table, when a fault occurs in an electrical power system, high current will be flows thus producing large amounts of unwanted energy in form of heat and magnetic forces. By determine the maximum fault current that would be occur during disturbance, it can ensures that a proper protective device setting that would invent from damage the equipment. The different value at each busbar was different because fault current depends on the internal impedance of the circuit.

CHAPTER 5
CONCLUSION

Based on the literature review and early research, power system analysis essential to the electrical engineer in order to design and modeling a certain system. Study, investigation and simulation need to be done in order to perform a good power system analysis and understanding the basic of the system. In order to get a stabilize system, several testing techniques was perform such as load flow and short circuit study. In order to perform this testing technique, we need to use power system software. Load Flow was a basically numerical analysis that important and the value that obtained from the load flow such as magnitude and angle of the voltage, real and reactive power at each branch and line. The short circuit study is performing in order to know the maximum fault that will be occur during disturbance.

5.1 Recommendation

Simulate using different software such as PSCAD, EDSA and etc. Thus, the result can be compare and improve the accuracy the result obtained.

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   Stephen J. Chapman

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   By E.Lakervi and E.J Holmes

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9. Power System Analysis Software user and technical manual, ERACS

APPENDIX A: POWER SYSTEM COMPONENT

Network Name : CASE4
Data State Name : BB11-11kV & BB13-11kV BB7OPEN

SYSTEM STATISTICS

Study Base MVA	=	100.000
Study Base Frequency (Hz)	=	50.000
Number of Busbars	=	30
Number of Shunts	=	10
Number of Lines	=	4
Number of Cables	=	0
Number of Transformers	=	15
Number of Tap Changers	=	0
Number of Synchronous Machines	=	3
Number of Induction Machines	=	3
Number of Wind Turbine Generators	=	0
Number of Bus Sections	=	10
Number of Series Elements	=	0

STUDY PARAMETERS

Load Power Multiplier	=	1.000000
Load Reactive Multiplier	=	1.000000
Convergence Tolerance	=	0.000005
Convergence Control	=	Method 2
Maximum Iterations	=	25
Overload Flag Level	=	100.0% Of Rating
Automatic Tap Changers		OFF

BUSBAR DATA

Busbar Identifier	Nominal kV	Three Phase Fault MVA	Three Phase Fault kA	Single Phase Fault MVA	Single Phase Fault kA	Transf. Shift Angle (deg.)	Nominal Bus Freq. (Hz)
BB 132kV	132.000	1500.0	6.561	2000.0	8.748	0.0	50.0
BB1-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB3-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB4-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB5-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB6-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB7-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB8-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB9-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB2-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB2 132kV	132.000	1500.0	6.561	2000.0	8.748	0.0	50.0
BB3 132kV	132.000	1500.0	6.561	2000.0	8.748	0.0	50.0
BB10-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB11-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB12-11kV	11.000	500.0	26.243	700.0	36.740	0.0	50.0
BB15-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB14-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB13-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB1-415V	0.415	31.0	43.127	45.0	62.604	60.0	50.0
BB2-415V	0.415	31.0	43.127	45.0	62.604	60.0	50.0
BB3-415V	0.415	31.0	43.127	45.0	62.604	60.0	50.0
BB4-415V	0.415	31.0	43.127	45.0	62.604	0.0	50.0NOT IN USE
BB5-415V	0.415	31.0	43.127	45.0	62.604	60.0	50.0

Run on 04-Jun-2009 by Supervisor from data set up on 04-Jun-2009 by Supervisor

Network Name : CASE4
Data State Name : BB11-11kV & BB13-11kV BB7OPEN

BUSBAR DATA

Busbar Identifier	Nominal kV	Three Phase Fault MVA	Three Phase Fault kA	Single Phase Fault MVA	Single Phase Fault kA	Transf. Shift Angle (deg.)	Nominal Bus Freq. (Hz)
BB6-415V	0.415	31.0	43.127	45.0	62.604	60.0	50.0
BB7-415V	0.415	31.0	43.127	45.0	62.604	0.0	50.0NOT IN USE
BB8-415V	0.415	31.0	43.127	45.0	62.604	30.0	50.0
BB9-415V	0.415	31.0	43.127	45.0	62.604	0.0	50.0NOT IN USE
BB10-415V	0.415	31.0	43.127	45.0	62.604	60.0	50.0
BB11-415V	0.415	31.0	43.127	45.0	62.604	60.0	50.0
BB12-415V	0.415	31.0	43.127	45.0	62.604	60.0	50.0

LINE DATA

First Busbar	Second Busbar	Line Identifier	No.Of Ccts	Line Length	Library Key	Rating (kA)	Positive Sequence R(pu)	Positive Sequence X(pu))	Positive Sequence B(pu)	Zero Sequence R(pu)	Zero Sequence X(pu)	Zero Sequence B(pu)	Equivalent Pi Model
BB3-11kV	BB10-11kV	L1	1	2.00	Line1	0.459	0.16694	0.12793	0.00001	1.98347	0.50909	0.00000	
BB9-11kV	BB15-11kV	L2	1	1.00	Line1	7.000	0.00826	0.00701	0.00002	0.00826	0.00701	0.00002	
BB1-11kV	BB3-11kV	L3	1	1.00	Line1	7.000	0.00826	0.00701	0.00002	0.00826	0.00701	0.00002	
BB2-11kV	BB5-11kV	L4	1	1.00	Line1	7.000	0.00826	0.00701	0.00002	0.00826	0.00701	0.00002	

TRANSFORMER DATA

System Busbar	Winding No.	Rating (MVA)	Winding Type	Angle (deg.)	Pos/Neg. Sequence R(pu)	Pos/Neg. Sequence X(pu)	Zero Sequence R(pu)	Zero Sequence X(pu)	Neutral Earth R(pu)	Neutral Earth X(pu)	Voltage Ratio	Off-Nom Tap (%)
DATA for Transformer with ID. T5				No. of units	1 using library key T004							
BB4-11kV	1	2.500	D	30.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00
BB1-415V	2	2.500	YN	0.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00
DATA for Transformer with ID. T6				No. of units	1 using library key T006							
BB5-11kV	1	1.500	D	30.00	0.0000	4.0000	0.1603	1.6033	0.0000	0.0000	1.0000	0.00
BB2-415V	2	1.500	YN	0.00	0.0000	4.0000	0.3333	1.6667	0.0000	0.0000	1.0434	0.00
DATA for Transformer with ID. T7				No. of units	1 using library key T003							
BB6-11kV	1	2.000	D	30.00	0.0000	3.0000	0.1176	1.1755	0.0000	0.0000	1.0000	0.00
BB3-415V	2	2.000	YN	0.00	0.0000	3.0000	0.1176	1.1755	0.0000	0.0000	1.0000	0.00

Run on 04-Jun-2009 by Supervisor from data set up on 04 Jun 2009 by Supervisor

Network Name : CASE4
Data State Name : BB11-11kV & BB13-11kV BB7OPEN

TRANSFORMER DATA

System Busbar	Winding No.	Rating (MVA)	Winding Type	Angle (deg.)	Pos/Neg. R(pu)	Sequence X(pu)	Zero Sequence R(pu)	Zero Sequence X(pu)	Neutral Earth R(pu)	Neutral Earth X(pu)	Voltage Ratio	Off-Nom Tap (%)	
DATA for Transformer with ID. T8				No. of units		1 using library key T004							
BB7-11kV	1	2.500	D	30.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00	OPEN AT SYSTEM BUS
BB4-415V	2	2.500	YN	0.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00	
DATA for Transformer with ID. T9				No. of units		1 using library key T003							
BB8-11kV	1	2.000	D	30.00	0.0000	3.0000	0.1176	1.1755	0.0000	0.0000	1.0000	0.00	
BB5-415V	2	2.000	YN	0.00	0.0000	3.0000	0.1176	1.1755	0.0000	0.0000	1.0000	0.00	
DATA for Transformer with ID. T10				No. of units		1 using library key T004							
BB10-11kV	1	2.500	D	30.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00	
BB6-415V	2	2.500	YN	0.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00	
DATA for Transformer with ID. T11				No. of units		1 using library key T006							
BB11-11kV	1	1.500	D	30.00	0.0000	4.0000	0.1603	1.6033	0.0000	0.0000	1.0000	0.00	OPEN AT SYSTEM BUS
BB7-415V	2	1.500	YN	0.00	0.0000	4.0000	0.3333	1.6667	0.0000	0.0000	1.0434	0.00	
DATA for Transformer with ID. T12				No. of units		1 using library key T004							
BB12-11kV	1	2.500	D	30.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00	
BB8-415V	2	2.500	YN	0.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00	
DATA for Transformer with ID. T13				No. of units		1 using library key T003							
BB13-11kV	1	2.000	D	30.00	0.0000	3.0000	0.1176	1.1755	0.0000	0.0000	1.0000	0.00	OPEN AT SYSTEM BUS
BB9-415V	2	2.000	YN	0.00	0.0000	3.0000	0.1176	1.1755	0.0000	0.0000	1.0000	0.00	
DATA for Transformer with ID. T14				No. of units		1 using library key T004							
BB14-11kV	1	2.500	D	30.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00	
BB10-415V	2	2.500	YN	0.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00	
DATA for Transformer with ID. T15				No. of units		1 using library key TX027							
BB15-11kV	1	2.500	D	30.00	0.0800	0.8000	0.0600	0.6000	0.0000	0.0000	1.0000	0.00	
BB11-415V	2	2.500	YN	0.00	0.1600	1.9240	0.0800	1.4000	0.0000	0.0000	1.0000	0.00	
BB12-415V	3	2.500	YN	0.00	0.0800	1.9240	0.0640	0.1400	0.0000	0.0000	1.0000	0.00	

Network Name : CASE4
Data State Name : BB11-11kV & BB13-11kV BB7OPEN

TRANSFORMER DATA

System Busbar	Winding No.	Rating (MVA)	Winding Type	Angle (deg.)	Pos/Neg. R(pu)	Sequence X(pu)	Zero Sequence R(pu)	Zero Sequence X(pu)	Neutral Earth R(pu)	Neutral Earth X(pu)	Voltage Ratio	Off-Nom Tap (%)
DATA for Transformer with ID. T1				No. of units		1 using library key T002						
BB 132kV	1	4.000	D	30.00	0.0000	3.3750	0.0591	0.5907	0.0000	0.0000	1.0000	0.00
BB1-11kV	2	4.000	YN	0.00	0.0000	3.3750	0.0591	0.5907	0.0000	0.0000	1.0000	0.00
DATA for Transformer with ID. T2				No. of units		1 using library key T002						
BB 132kV	1	4.000	D	30.00	0.0000	3.3750	0.0591	0.5907	0.0000	0.0000	1.0000	0.00
BB2-11kV	2	4.000	YN	0.00	0.0000	3.3750	0.0591	0.5907	0.0000	0.0000	1.0000	0.00
DATA for Transformer with ID. T3				No. of units		1 using library key T001						
BB2 132kV	1	6.000	D	30.00	0.0000	2.2500	0.0540	0.5390	0.0000	0.0000	1.0000	0.00
BB8-11kV	2	6.000	YN	0.00	0.0000	2.2500	0.0540	0.5390	0.0000	0.0000	1.0000	0.00
DATA for Transformer with ID. T4				No. of units		1 using library key T001						
BB3 132kV	1	6.000	D	30.00	0.0000	2.2500	0.0540	0.5390	0.0000	0.0000	1.0000	0.00
BB9-11kV	2	6.000	YN	0.00	0.0000	2.2500	0.0540	0.5390	0.0000	0.0000	1.0000	0.00

INDUCTION MACHINE DATA

Busbar Identifier	Motor Identifier	No.Of Units	Library Key	Motor Ratings MVA	MW	kV	Input MW	Slip (%)	Stator R(pu)	Stator X(pu)	Magnet. X(pu)	Standstill R(pu)	Standstill X(pu)	Rotor R(pu)	Running X(pu)
BB1-415V	IM	1	M003	0.196	0.196	0.415	0.000	0.0000	0.0185	0.0918	5.8000	0.0215	0.1060	0.0134	0.1910
BB8-415V	IM2	1	M003	0.196	0.196	0.415	0.100	0.6837	0.0185	0.0918	5.8000	0.0215	0.1060	0.0134	0.1910
BB10-415V	IM3	1	M002	1.000	1.000	0.415	0.100	0.1340	0.0185	0.0918	5.8000	0.0215	0.1060	0.0134	0.1910

Network Name : CASE4
Data State Name : BB11-11kV & BB13-11kV BB7OPEN

INFINITE GENERATOR DATA

Busbar Identifier	Machine Identifier	Machine MVA	Ratings MW	kV	Assigned V(pu)	Pos. Sequence R(pu)	Pos. Sequence X(pu)	Neg. Sequence R(pu)	Neg. Sequence X(pu)	Zero Sequence R(pu)	Zero Sequence X(pu)
BB 132kV	TNB A	150.00	14.93	132.00	1.000	0.0995	0.9950	0.0995	0.9950	0.0995	0.9950
BB2 132kV	TNB B	150.00	14.93	132.00	1.000	0.0995	0.9950	0.0995	0.9950	0.0995	0.9950

SYNCHRONOUS MACHINE DATA

Busbar Identifier	Machine Identifier	Type	No.Of Units	Library Key	Generator Ratings MVA BASE	Generator Ratings MW	Generator Ratings kV	Assigned V(pu)	Assigned MW	MVAR	Pos. Sequence R(pu)	Pos. Sequence X(pu)	Neg. Sequence R(pu)	Neg. Sequence X(pu)	Zero Sequence R(pu)	Zero Sequence X(pu)
BB12-11kV	SG1	SLACK	1	GMIN	50.000	50.000	11.000	1.000	0.000	0.000	0.0120	0.2770	0.0200	0.1840	0.0150	0.0800
					Neutral earthing						0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

SHUNT DATA

Busbar Identifier	Shunt Identifier	No.Of Units	Type	Library Key	Rating MVA	Data Values Positive/Negative Sequence		Zero Sequence	
BB2-415V	Load1	1	MW/pf	Ld1		1.000 MW	0.800 pf		
BB3-415V	Load2	1	G/B pu Base	SampleG/Bpu1	1.00	0.008 G pu	-0.006 B pu	0.008 G pu	-0.006 B pu
BB4-415V	Load3	1	kW/pf	samplekW/pf		600.000 kW	0.800 pf		
BB5-415V	load 4	1	R/X Ohm	sampleR/X	1.50	100.000 R Ohm	75.000 X Ohm	100.000 R Ohm	75.000 X Ohm
BB6-415V	Load5	1	kW/pf	samplekW/pf		600.000 kW	0.800 pf		
BB7-415V	Load6	1	MW/pf	Ld2		0.900 MW	0.800 pf		
BB9-415V	load7	1	MW/pf	Ld1		0.500 MW	0.800 pf		
BB9-11kV		1	MW/MVAR	Load1		1.000 MW	0.750 MVAr		
BB11-415V	load8	1	MW/pf	Ld2		0.900 MW	0.800 pf		
BB12-415V	load9	1	MW/pf	Ld2		0.400 MW	0.800 pf		

Network Name : CASE4
Data State Name : BB11-11kV & BB13-11kV BB7OPEN

BUS SECTION DATA

First Busbar	Second Busbar	Status
BB3-11kV	BB4-11kV	Closed
BB4-11kV	BB5-11kV	Closed
BB5-11kV	BB6-11kV	Closed
BB6-11kV	BB7-11kV	Closed
BB7-11kV	BB8-11kV	Closed
BB2 132kV	BB3 132kV	Closed
BB10-11kV	BB11-11kV	Closed
BB11-11kV	BB12-11kV	Open
BB13-11kV	BB14-11kV	Closed
BB14-11kV	BB15-11kV	Closed

Network Name : CASE1
Data State Name : NORMAL

SYSTEM STATISTICS

Study Base MVA	=	100.000
Study Base Frequency (Hz)	=	50.000
Number of Busbars	=	30
Number of Shunts	=	10
Number of Lines	=	4
Number of Cables	=	0
Number of Transformers	=	15
Number of Tap Changers	=	0
Number of Synchronous Machines	=	3
Number of Induction Machines	=	3
Number of Wind Turbine Generators	=	0
Number of Bus Sections	=	10
Number of Series Elements	=	0

STUDY PARAMETERS

Load Power Multiplier	=	1.000000
Load Reactive Multiplier	=	1.000000
Convergence Tolerance	=	0.000005
Convergence Control	=	Method 2
Maximum Iterations	=	25
Overload Flag Level	=	100.0% Of Rating
Automatic Tap Changers		OFF

BUSBAR DATA

Busbar Identifier	Nominal kV	Three Phase Fault MVA	Three Phase Fault kA	Single Phase Fault MVA	Single Phase Fault kA	Transf. Shift Angle (deg.)	Nominal Bus Freq. (Hz)
BB 132kV	132.000	1500.0	6.561	2000.0	8.748	0.0	50.0
BB1-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB3-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB4-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB5-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB6-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB7-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB8-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB9-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB2-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB2 132kV	132.000	1500.0	6.561	2000.0	8.748	0.0	50.0
BB3 132kV	132.000	1500.0	6.561	2000.0	8.748	0.0	50.0
BB10-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB11-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB12-11kV	11.000	500.0	26.243	700.0	36.740	0.0	50.0
BB15-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB14-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB13-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB1-415V	0.415	31.0	43.127	45.0	62.604	60.0	50.0
BB2-415V	0.415	31.0	43.127	45.0	62.604	60.0	50.0
BB3-415V	0.415	31.0	43.127	45.0	62.604	60.0	50.0
BB4-415V	0.415	31.0	43.127	45.0	62.604	60.0	50.0
BB5-415V	0.415	31.0	43.127	45.0	62.604	60.0	50.0

Network Name : CASE1
Data State Name : NORMAL

BUSBAR DATA

Busbar Identifier	Nominal kV	Three Phase Fault MVA	Three Phase Fault kA	Single Phase Fault MVA	Single Phase Fault kA	Transf. Shift Angle (deg.)	Nominal Bus Freq. (Hz)
BB6-415V	0.415	31.0	43.127	45.0	62.604	60.0	50.0
BB7-415V	0.415	31.0	43.127	45.0	62.604	60.0	50.0
BB8-415V	0.415	31.0	43.127	45.0	62.604	30.0	50.0
BB9-415V	0.415	31.0	43.127	45.0	62.604	60.0	50.0
BB10-415V	0.415	31.0	43.127	45.0	62.604	60.0	50.0
BB11-415V	0.415	31.0	43.127	45.0	62.604	60.0	50.0
BB12-415V	0.415	31.0	43.127	45.0	62.604	60.0	50.0

LINE DATA

First Busbar	Second Busbar	Line Identifier	No.Of Ccts	Line Length	Library Key	Rating (kA)	Positive Sequence R(pu)	Positive Sequence X(pu))	Positive Sequence B(pu)	Zero Sequence R(pu)	Zero Sequence X(pu)	Zero Sequence B(pu)	Equivalent Pi Model
BB3-11kV	BB10-11kV	L1	1	2.00	Line1	0.459	0.16694	0.12793	0.00001	1.98347	0.50909	0.00000	
BB9-11kV	BB15-11kV	L2	1	1.00	Line1	7.000	0.00826	0.00701	0.00002	0.00826	0.00701	0.00002	
BB1-11kV	BB3-11kV	L3	1	1.00	Line1	7.000	0.00826	0.00701	0.00002	0.00826	0.00701	0.00002	
BB2-11kV	BB5-11kV	L4	1	1.00	Line1	7.000	0.00826	0.00701	0.00002	0.00826	0.00701	0.00002	

TRANSFORMER DATA

System Busbar	Winding No.	Rating (MVA)	Winding Type	Angle (deg.)	Pos/Neg. Sequence R(pu)	Pos/Neg. Sequence X(pu)	Zero Sequence R(pu)	Zero Sequence X(pu)	Neutral Earth R(pu)	Neutral Earth X(pu)	Voltage Ratio	Off-Nom Tap (%)
DATA for Transformer with ID. T5				No. of units		1 using library key T004						
BB4-11kV	1	2.500	D	30.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00
BB1-415V	2	2.500	YN	0.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00
DATA for Transformer with ID. T6				No. of units		1 using library key T006						
BB5-11kV	1	1.500	D	30.00	0.0000	4.0000	0.1603	1.6033	0.0000	0.0000	1.0000	0.00
BB2-415V	2	1.500	YN	0.00	0.0000	4.0000	0.3333	1.6667	0.0000	0.0000	1.0434	0.00
DATA for Transformer with ID. T7				No. of units		1 using library key T003						
BB6-11kV	1	2.000	D	30.00	0.0000	3.0000	0.1176	1.1755	0.0000	0.0000	1.0000	0.00
BB3-415V	2	2.000	YN	0.00	0.0000	3.0000	0.1176	1.1755	0.0000	0.0000	1.0000	0.00

Network Name : CASE1
Data State Name : NORMAL

TRANSFORMER DATA

System Busbar	Winding No.	Rating (MVA)	Winding Type	Angle (deg.)	Pos/Neg. R(pu)	Sequence X(pu)	Zero Sequence R(pu)	Zero Sequence X(pu)	Neutral Earth R(pu)	Neutral Earth X(pu)	Voltage Ratio	Off-Nom Tap (%)
DATA for Transformer with ID. T8				No. of units		1 using library key T004						
BB7-11kV	1	2.500	D	30.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00
BB4-415V	2	2.500	YN	0.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00
DATA for Transformer with ID. T9				No. of units		1 using library key T003						
BB8-11kV	1	2.000	D	30.00	0.0000	3.0000	0.1176	1.1755	0.0000	0.0000	1.0000	0.00
BB5-415V	2	2.000	YN	0.00	0.0000	3.0000	0.1176	1.1755	0.0000	0.0000	1.0000	0.00
DATA for Transformer with ID. T10				No. of units		1 using library key T004						
BB10-11kV	1	2.500	D	30.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00
BB6-415V	2	2.500	YN	0.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00
DATA for Transformer with ID. T11				No. of units		1 using library key T006						
BB11-11kV	1	1.500	D	30.00	0.0000	4.0000	0.1603	1.6033	0.0000	0.0000	1.0000	0.00
BB7-415V	2	1.500	YN	0.00	0.0000	4.0000	0.3333	1.6667	0.0000	0.0000	1.0434	0.00
DATA for Transformer with ID. T12				No. of units		1 using library key T004						
BB12-11kV	1	2.500	D	30.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00
BB8-415V	2	2.500	YN	0.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00
DATA for Transformer with ID. T13				No. of units		1 using library key T003						
BB13-11kV	1	2.000	D	30.00	0.0000	3.0000	0.1176	1.1755	0.0000	0.0000	1.0000	0.00
BB9-415V	2	2.000	YN	0.00	0.0000	3.0000	0.1176	1.1755	0.0000	0.0000	1.0000	0.00
DATA for Transformer with ID. T14				No. of units		1 using library key T004						
BB14-11kV	1	2.500	D	30.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00
BB10-415V	2	2.500	YN	0.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00
DATA for Transformer with ID. T15				No. of units		1 using library key TX027						
BB15-11kV	1	2.500	D	30.00	0.0800	0.8000	0.0600	0.6000	0.0000	0.0000	1.0000	0.00
BB11-415V	2	2.500	YN	0.00	0.1600	1.9240	0.0800	1.4000	0.0000	0.0000	1.0000	0.00
BB12-415V	3	2.500	YN	0.00	0.0800	1.9240	0.0640	0.1400	0.0000	0.0000	1.0000	0.00

Network Name : CASE1
Data State Name : NORMAL

TRANSFORMER DATA

System Busbar	Winding No.	Rating (MVA)	Winding Type	Angle (deg.)	Pos/Neg. Sequence R(pu)	Pos/Neg. Sequence X(pu)	Zero Sequence R(pu)	Zero Sequence X(pu)	Neutral Earth R(pu)	Neutral Earth X(pu)	Voltage Ratio	Off-Nom Tap (%)
DATA for Transformer with ID. T1				No. of units		1 using library key T002						
BB 132kV	1	4.000	D	30.00	0.0000	3.3750	0.0591	0.5907	0.0000	0.0000	1.0000	0.00
BB1-11kV	2	4.000	YN	0.00	0.0000	3.3750	0.0591	0.5907	0.0000	0.0000	1.0000	0.00
DATA for Transformer with ID. T2				No. of units		1 using library key T002						
BB 132kV	1	4.000	D	30.00	0.0000	3.3750	0.0591	0.5907	0.0000	0.0000	1.0000	0.00
BB2-11kV	2	4.000	YN	0.00	0.0000	3.3750	0.0591	0.5907	0.0000	0.0000	1.0000	0.00
DATA for Transformer with ID. T3				No. of units		1 using library key T001						
BB2 132kV	1	6.000	D	30.00	0.0000	2.2500	0.0540	0.5390	0.0000	0.0000	1.0000	0.00
BB8-11kV	2	6.000	YN	0.00	0.0000	2.2500	0.0540	0.5390	0.0000	0.0000	1.0000	0.00
DATA for Transformer with ID. T4				No. of units		1 using library key T001						
BB3 132kV	1	6.000	D	30.00	0.0000	2.2500	0.0540	0.5390	0.0000	0.0000	1.0000	0.00
BB9-11kV	2	6.000	YN	0.00	0.0000	2.2500	0.0540	0.5390	0.0000	0.0000	1.0000	0.00

INDUCTION MACHINE DATA

Busbar Identifier	Motor Identifier	No.Of Units	Library Key	Motor Ratings MVA	Motor Ratings MW	Motor Ratings kV	Input MW	Slip (%)	Stator R(pu)	Stator X(pu)	Magnet. X(pu)	Standstill R(pu)	Standstill X(pu)	Rotor Running R(pu)	Rotor Running X(pu)
BB1-415V	IM	1	M003	0.196	0.196	0.415	0.000	0.0000	0.0185	0.0918	5.8000	0.0215	0.1060	0.0134	0.1910
BB8-415V	IM2	1	M003	0.196	0.196	0.415	0.100	0.6837	0.0185	0.0918	5.8000	0.0215	0.1060	0.0134	0.1910
BB10-415V	IM3	1	M002	1.000	1.000	0.415	0.100	0.1340	0.0185	0.0918	5.8000	0.0215	0.1060	0.0134	0.1910

Network Name : CASE1
Data State Name : NORMAL

INFINITE GENERATOR DATA

Busbar Identifier	Machine Identifier	Machine Ratings MVA	MW	kV	Assigned V(pu)	Pos. Sequence R(pu)	Pos. Sequence X(pu)	Neg. Sequence R(pu)	Neg. Sequence X(pu)	Zero Sequence R(pu)	Zero Sequence X(pu)
BB 132kV	TNB A	150.00	14.93	132.00	1.000	0.0995	0.9950	0.0995	0.9950	0.0995	0.9950
BB2 132kV	TNB B	150.00	14.93	132.00	1.000	0.0995	0.9950	0.0995	0.9950	0.0995	0.9950

SYNCHRONOUS MACHINE DATA

Busbar Identifier	Machine Identifier	Type	No.Of Units	Library Key	Generator Ratings MVA BASE	MW	kV	V(pu)	Assigned MW	MVAR	Pos. Sequence R(pu)	Pos. Sequence X(pu)	Neg. Sequence R(pu)	Neg. Sequence X(pu)	Zero Sequence R(pu)	Zero Sequence X(pu)
BB12-11kV	SG1	SLACK	1	GMIN	50.000	50.000	11.000	1.000	0.000	0.000	0.0120	0.2770	0.0200	0.1840	0.0150	0.0800
					Neutral earthing						0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

SHUNT DATA

Busbar Identifier	Shunt Identifier	No.Of Units	Type	Library Key	Rating MVA	Data Values Positive/Negative Sequence		Zero Sequence	
BB2-415V	Load1	1	MW/pf	Ld1		1.000 MW	0.800 pf		
BB3-415V	Load2	1	G/B pu Base	SampleG/Bpu1	1.00	0.008 G pu	-0.006 B pu	0.008 G pu	-0.006 B pu
BB4-415V	Load3	1	kW/pf	samplekW/pf		600.000 kW	0.800 pf		
BB5-415V	load 4	1	R/X Ohm	sampleR/X	1.50	100.000 R Ohm	75.000 X Ohm	100.000 R Ohm	75.000 X Ohm
BB6-415V	Load5	1	kW/pf	samplekW/pf		600.000 kW	0.800 pf		
BB7-415V	Load6	1	MW/pf	Ld2		0.900 MW	0.800 pf		
BB9-415V	load7	1	MW/pf	Ld1		0.500 MW	0.800 pf		
BB9-11kV		1	MW/MVAR	Load1		1.000 MW	0.750 MVAr		
BB11-415V	load8	1	MW/pf	Ld2		0.900 MW	0.800 pf		
BB12-415V	load9	1	MW/pf	Ld2		0.400 MW	0.800 pf		

Network Name : CASE1
Data State Name : NORMAL

BUS SECTION DATA

First Busbar	Second Busbar	Status
BB3-11kV	BB4-11kV	Closed
BB4-11kV	BB5-11kV	Closed
BB5-11kV	BB6-11kV	Closed
BB6-11kV	BB7-11kV	Closed
BB7-11kV	BB8-11kV	Closed
BB2 132kV	BB3 132kV	Closed
BB10-11kV	BB11-11kV	Closed
BB11-11kV	BB12-11kV	Open
BB13-11kV	BB14-11kV	Closed
BB14-11kV	BB15-11kV	Closed

Network Name : CASE1
Data State Name : NORMAL

AT STUDY END - No of iterations = 4 Convergence = 0.1125E-05
Voltage Range from 0.839pu at BB11-415V to 1.000pu at BB 132kV

AC BUSBAR VALUES

Busbar		Busbar	Voltage			Synch. Machines		Ind Motor Load		Shunt Loads		3 Phase Fault		Ph - E Fault	
Identifier	Merge	Type	PU	kV	ANG-DEG	MW	MVAr	MW	MVAr	MW	MVAr	kA	X/R	kA	X/R
BB 132kV	.	INF.BUS	1.000	132.000	0.000	1.967	1.794	0.000	0.000	0.000	0.000	0.71	11.315	0.68	9.898
BB2 132kV	M6	INF.BUS	1.000	132.000	-0.685	4.134	4.495	0.000	0.000	0.000	0.000	0.72	11.345	0.69	9.025
BB3 132kV	M6	LOAD	1.000	132.000	-0.685	0.000	0.000	0.000	0.000	0.000	0.000	0.72	11.345	0.69	9.025
BB12-11kV	.	SLACK	1.000	11.000	2.093	0.101	0.048	0.000	0.000	0.000	0.000	9.51	22.816	14.55	11.459
BB1-11kV	.	LOAD	0.942	10.360	-4.043	0.000	0.000	0.000	0.000	0.000	0.000	2.38	10.865	3.26	10.677
BB10-11kV	M7	LOAD	0.937	10.309	-4.030	0.000	0.000	0.000	0.000	0.000	0.000	2.24	6.206	2.50	1.923
BB11-11kV	M7	LOAD	0.937	10.309	-4.030	0.000	0.000	0.000	0.000	0.000	0.000	2.24	6.206	2.50	1.923
BB13-11kV	M9	LOAD	0.867	9.540	-9.363	0.000	0.000	0.000	0.000	0.000	0.000	1.21	5.189	1.58	5.501
BB14-11kV	M9	LOAD	0.867	9.540	-9.363	0.000	0.000	0.000	0.000	0.000	0.000	1.21	5.189	1.58	5.501
BB15-11kV	M9	LOAD	0.867	9.540	-9.363	0.000	0.000	0.000	0.000	0.000	0.000	1.21	5.189	1.58	5.501
BB2-11kV	.	LOAD	0.942	10.360	-4.043	0.000	0.000	0.000	0.000	0.000	0.000	2.38	10.865	3.26	10.677
BB3-11kV	M3	LOAD	0.942	10.358	-4.043	0.000	0.000	0.000	0.000	0.000	0.000	2.38	11.064	3.27	10.922
BB4-11kV	M3	LOAD	0.942	10.358	-4.043	0.000	0.000	0.000	0.000	0.000	0.000	2.38	11.064	3.27	10.922
BB5-11kV	M3	LOAD	0.942	10.358	-4.043	0.000	0.000	0.000	0.000	0.000	0.000	2.38	11.064	3.27	10.922
BB6-11kV	M3	LOAD	0.942	10.358	-4.043	0.000	0.000	0.000	0.000	0.000	0.000	2.38	11.064	3.27	10.922
BB7-11kV	M3	LOAD	0.942	10.358	-4.043	0.000	0.000	0.000	0.000	0.000	0.000	2.38	11.064	3.27	10.922
BB8-11kV	M3	LOAD	0.942	10.358	-4.043	0.000	0.000	0.000	0.000	0.000	0.000	2.38	11.064	3.27	10.922
BB9-11kV	.	LOAD	0.868	9.544	-9.363	0.000	0.000	0.000	0.000	1.000	0.750	1.21	5.228	1.59	5.564
BB1-415V	.	LOAD	0.940	0.390	-3.937	0.000	0.000	0.000	0.029	0.000	0.000	14.69	1.468	20.14	1.625
BB10-415V	.	LOAD	0.852	0.354	-9.247	0.000	0.000	0.100	0.127	0.000	0.000	15.66	2.416	20.97	2.654
BB11-415V	.	LOAD	0.839	0.348	-11.399	0.000	0.000	0.000	0.000	0.900	0.675	18.92	4.907	24.44	5.412
BB12-415V	.	LOAD	0.849	0.352	-10.692	0.000	0.000	0.000	0.000	0.400	0.300	18.80	5.897	26.61	5.900
BB2-415V	.	LOAD	0.906	0.376	-9.660	0.000	0.000	0.000	0.000	1.000	0.750	12.70	7.406	16.13	7.275
BB3-415V	.	LOAD	0.942	0.391	-4.047	0.000	0.000	0.000	0.000	0.001	0.001	16.24	43.061	21.25	30.309
BB4-415V	.	LOAD	0.874	0.363	-4.628	0.000	0.000	0.000	0.000	0.600	0.450	13.81	1.270	18.97	1.418
BB5-415V	.	LOAD	0.942	0.391	-4.047	0.000	0.000	0.000	0.000	0.001	0.001	16.24	43.061	21.25	30.309
BB6-415V	.	LOAD	0.869	0.361	-4.621	0.000	0.000	0.000	0.000	0.600	0.450	13.50	1.253	18.58	1.398
BB7-415V	.	LOAD	0.909	0.377	-9.088	0.000	0.000	0.000	0.000	0.900	0.675	12.50	7.172	15.92	7.083
BB8-415V	.	LOAD	0.992	0.412	1.923	0.000	0.000	0.100	0.047	0.000	0.000	17.67	1.203	24.20	1.345
BB9-415V	.	LOAD	0.840	0.349	-11.724	0.000	0.000	0.000	0.000	0.500	0.375	12.58	7.726	16.74	7.930

Network Name : CASE1
Data State Name : NORMAL

BUSBAR TOTALS	6.203	6.337	0.200	0.204	5.902	4.426
TOTAL BUS LOAD	6.102	4.630				
SYSTEM LOSSES	0.100	1.707				

LINE VALUES

First Busbar	Second Busbar	Branch Identifier	No.Of Ccts	Rating kA	First MW	End MVAr	Flow kA	Second MW	End MVAr	Flow kA	Loading (%)	O/L FLAG
BB3-11kV	BB10-11kV	L1	1	0.459	1.549	1.305	0.113	-1.542	-1.300	0.113	24.6	
BB9-11kV	BB15-11kV	L2	1	7.000	1.909	1.582	0.150	-1.908	-1.583	0.150	2.1	
BB1-11kV	BB3-11kV	L3	1	7.000	0.984	0.777	0.070	-0.984	-0.779	0.070	1.0	
BB2-11kV	BB5-11kV	L4	1	7.000	0.984	0.777	0.070	-0.984	-0.779	0.070	1.0	

TRANSFORMER VALUES

Transformer Identifier	No.Of Units	Winding No.	Connected Busbar	Winding kV	Voltage Ratio	Off Nominal Tap %	Rating MVA	Flow From Busbar MW	MVAr	Current kA	Percent Loading	O/L Flag
T5	1	1	BB4-11kV	11.000	1.0000	0.000	2.500	0.000	0.029	0.002	1.2	
		2	BB1-415V	0.415	1.0000	0.000	2.500	0.000	-0.029	0.043	1.2	
T6	1	1	BB5-11kV	11.000	1.0000	0.000	1.500	1.000	0.916	0.076	90.4	
		2	BB2-415V	0.433	1.0434	0.000	1.500	-1.000	-0.750	1.920	83.3	
T7	1	1	BB6-11kV	11.000	1.0000	0.000	2.000	0.001	0.001	0.000	0.1	
		2	BB3-415V	0.415	1.0000	0.000	2.000	-0.001	-0.001	0.002	0.1	
T8	1	1	BB7-11kV	11.000	1.0000	0.000	2.500	0.641	0.491	0.045	32.3	
		2	BB4-415V	0.415	1.0000	0.000	2.500	-0.600	-0.450	1.193	30.0	
T9	1	1	BB8-11kV	11.000	1.0000	0.000	2.000	0.001	0.001	0.000	0.1	
		2	BB5-415V	0.415	1.0000	0.000	2.000	-0.001	-0.001	0.002	0.1	
T10	1	1	BB10-11kV	11.000	1.0000	0.000	2.500	0.642	0.492	0.045	32.3	
		2	BB6-415V	0.415	1.0000	0.000	2.500	-0.600	-0.450	1.200	30.0	
T11	1	1	BB11-11kV	11.000	1.0000	0.000	1.500	0.900	0.808	0.068	80.6	
		2	BB7-415V	0.433	1.0434	0.000	1.500	-0.900	-0.675	1.721	75.0	
T12	1	1	BB12-11kV	11.000	1.0000	0.000	2.500	0.101	0.048	0.006	4.5	
		2	BB8-415V	0.415	1.0000	0.000	2.500	-0.100	-0.047	0.155	4.4	

Network Name : CASE1
Data State Name : NORMAL

TRANSFORMER VALUES

Transformer Identifier	No.Of Units	Winding No.	Connected Busbar	Winding kV	Voltage Ratio	Off Nominal Tap %	Rating MVA	Flow From Busbar MW	Flow From Busbar MVAr	Current kA	Percent Loading	O/L Flag
T13	1	1	BB13-11kV	11.000	1.0000	0.000	2.000	0.500	0.408	0.039	32.3	
		2	BB9-415V	0.415	1.0000	0.000	2.000	-0.500	-0.375	1.035	31.2	
T14	1	1	BB14-11kV	11.000	1.0000	0.000	2.500	0.102	0.129	0.010	6.6	
		2	BB10-415V	0.415	1.0000	0.000	2.500	-0.100	-0.127	0.263	6.5	
T15	1	1	BB15-11kV	11.000	1.0000	0.000	2.500	1.306	1.046	0.101	66.9	
		2	BB11-415V	0.415	1.0000	0.000	2.500	-0.900	-0.675	1.865	45.0	
		3	BB12-415V	0.415	1.0000	0.000	2.500	-0.400	-0.300	0.819	20.0	
T1	1	1	BB 132kV	132.000	1.0000	0.000	4.000	0.984	0.897	0.006	33.3	
		2	BB1-11kV	11.000	1.0000	0.000	4.000	-0.984	-0.777	0.070	31.3	
T2	1	1	BB 132kV	132.000	1.0000	0.000	4.000	0.984	0.897	0.006	33.3	
		2	BB2-11kV	11.000	1.0000	0.000	4.000	-0.984	-0.777	0.070	31.3	
T3	1	1	BB2 132kV	132.000	1.0000	0.000	6.000	1.226	1.332	0.008	30.2	
		2	BB8-11kV	11.000	1.0000	0.000	6.000	-1.226	-1.185	0.095	28.4	
T4	1	1	BB3 132kV	132.000	1.0000	0.000	6.000	2.909	3.163	0.019	71.6	
		2	BB9-11kV	11.000	1.0000	0.000	6.000	-2.909	-2.332	0.226	62.1	

BRANCH LOSS SUMMARY

	(MW)	(MVAr)
SERIES LOSSES	0.100	1.713
SHUNT LOSSES	0.000	-0.006
TOTAL LOSSES	0.100	1.707

Network Name : CASE1
Data State Name : NORMAL

INDUCTION MACHINE VALUES

Busbar Identifier	Machine Identifier	No.Of Units	Slip %	Terminal Voltage kV	Machine MW	Input MVAr	Current kA	O/L Flag
BB1-415V	IM	1	0.00	0.390	0.000	0.029	0.043	
BB8-415V	IM2	1	0.74	0.412	0.100	0.047	0.155	
BB10-415V	IM3	1	0.19	0.354	0.100	0.127	0.263	

SYNCHRONOUS MACHINE VALUES

Busbar Identifier	Machine Identifier	No.Of Units	Terminal Voltage kV	Power MW	Output MVAr	Current kA	O/L Flag
BB 132kV	TNB A	1	132.000	1.967	1.794	0.012	
BB2 132kV	TNB B	1	132.000	4.134	4.495	0.027	
BB12-11kV	SG1	1	11.000	0.101	0.048	0.006	

SHUNT VALUES

Busbar Identifier	Shunt Identifier	Shunt MW	Load MVAr	Current kA	O/L Flag
BB2-415V	Load1	1.000	0.750	1.920	
BB3-415V	Load2	0.001	0.001	0.002	
BB4-415V	Load3	0.600	0.450	1.193	
BB5-415V	load 4	0.001	0.001	0.002	
BB6-415V	Load5	0.600	0.450	1.200	
BB7-415V	Load6	0.900	0.675	1.721	
BB9-415V	load7	0.500	0.375	1.035	
BB9-11kV		1.000	0.750	0.076	
BB11-415V	load8	0.900	0.675	1.865	
BB12-415V	load9	0.400	0.300	0.819	

Network Name : CASE1
Data State Name : NORMAL

BUS SECTION VALUES

First Busbar	Second Busbar	MW	MVAr	kA
BB3-11kV	BB4-11kV	-0.566	-0.526	0.043
BB4-11kV	BB5-11kV	-0.566	-0.556	0.044
BB5-11kV	BB6-11kV	-0.582	-0.692	0.050
BB6-11kV	BB7-11kV	-0.583	-0.693	0.050
BB7-11kV	BB8-11kV	-1.225	-1.184	0.095
BB2 132kV	BB3 132kV	2.909	3.163	0.019
BB10-11kV	BB11-11kV	0.900	0.808	0.068
BB11-11kV	BB12-11kV	0.000	0.000	0.000
BB13-11kV	BB14-11kV	-0.500	-0.408	0.039
BB14-11kV	BB15-11kV	-0.602	-0.537	0.049

Run on 04-Jun-2009 by Supervisor from data set up on 04-Jun-2009 by Supervisor

Network Name : CASE2
Data State Name : BB11-11kV OPEN

SYSTEM STATISTICS

Study Base MVA	=	100.000
Study Base Frequency (Hz)	=	50.000
Number of Busbars	=	30
Number of Shunts	=	10
Number of Lines	=	4
Number of Cables	=	0
Number of Transformers	=	15
Number of Tap Changers	=	0
Number of Synchronous Machines	=	3
Number of Induction Machines	=	3
Number of Wind Turbine Generators	=	0
Number of Bus Sections	=	10
Number of Series Elements	=	0

STUDY PARAMETERS

Load Power Multiplier	=	1.000000
Load Reactive Multiplier	=	1.000000
Convergence Tolerance	=	0.000005
Convergence Control	=	Method 2
Maximum Iterations	=	25
Overload Flag Level	=	100.0% Of Rating
Automatic Tap Changers		OFF

BUSBAR DATA

Busbar Identifier	Nominal kV	Three Phase Fault MVA	Three Phase Fault kA	Single Phase Fault MVA	Single Phase Fault kA	Transf. Shift Angle (deg.)	Nominal Bus Freq. (Hz)
BB 132kV	132.000	1500.0	6.561	2000.0	8.748	0.0	50.0
BB1-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB3-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB4-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB5-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB6-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB7-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB8-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB9-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB2-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB2 132kV	132.000	1500.0	6.561	2000.0	8.748	0.0	50.0
BB3 132kV	132.000	1500.0	6.561	2000.0	8.748	0.0	50.0
BB10-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB11-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB12-11kV	11.000	500.0	26.243	700.0	36.740	0.0	50.0
BB15-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB14-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB13-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB1-415V	0.415	31.0	43.127	45.0	62.604	60.0	50.0
BB2-415V	0.415	31.0	43.127	45.0	62.604	60.0	50.0
BB3-415V	0.415	31.0	43.127	45.0	62.604	60.0	50.0
BB4-415V	0.415	31.0	43.127	45.0	62.604	60.0	50.0
BB5-415V	0.415	31.0	43.127	45.0	62.604	60.0	50.0

Run on 04-Jun-2009 by Supervisor from data set up on 04-Jun-2009 by Supervisor

Network Name : CASE2
Data State Name : BB11-11kV OPEN

BUSBAR DATA

Busbar Identifier	Nominal kV	Three Phase Fault MVA	Three Phase Fault kA	Single Phase Fault MVA	Single Phase Fault kA	Transf. Shift Angle (deg.)	Nominal Bus Freq. (Hz)
BB6-415V	0.415	31.0	43.127	45.0	62.604	60.0	50.0
BB7-415V	0.415	31.0	43.127	45.0	62.604	0.0	50.0NOT IN USE
BB8-415V	0.415	31.0	43.127	45.0	62.604	30.0	50.0
BB9-415V	0.415	31.0	43.127	45.0	62.604	60.0	50.0
BB10-415V	0.415	31.0	43.127	45.0	62.604	60.0	50.0
BB11-415V	0.415	31.0	43.127	45.0	62.604	60.0	50.0
BB12-415V	0.415	31.0	43.127	45.0	62.604	60.0	50.0

LINE DATA

First Busbar	Second Busbar	Line Identifier	No.Of Ccts	Line Length	Library Key	Rating (kA)	Positive Sequence R(pu)	Positive Sequence X(pu))	Positive Sequence B(pu)	Zero Sequence R(pu)	Zero Sequence X(pu)	Zero Sequence B(pu)	Equivalent Pi Model
BB3-11kV	BB10-11kV	L1	1	2.00	Line1	0.459	0.16694	0.12793	0.00001	1.98347	0.50909	0.00000	
BB9-11kV	BB15-11kV	L2	1	1.00	Line1	7.000	0.00826	0.00701	0.00002	0.00826	0.00701	0.00002	
BB1-11kV	BB3-11kV	L3	1	1.00	Line1	7.000	0.00826	0.00701	0.00002	0.00826	0.00701	0.00002	
BB2-11kV	BB5-11kV	L4	1	1.00	Line1	7.000	0.00826	0.00701	0.00002	0.00826	0.00701	0.00002	

TRANSFORMER DATA

System Busbar	Winding No.	Rating (MVA)	Winding Type	Angle (deg.)	Pos/Neg. Sequence R(pu)	Pos/Neg. Sequence X(pu)	Zero Sequence R(pu)	Zero Sequence X(pu)	Neutral Earth R(pu)	Neutral Earth X(pu)	Voltage Ratio	Off-Nom Tap (%)
DATA for Transformer with ID. T5				No. of units		1 using library key T004						
BB4-11kV	1	2.500	D	30.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00
BB1-415V	2	2.500	YN	0.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00
DATA for Transformer with ID. T6				No. of units		1 using library key T006						
BB5-11kV	1	1.500	D	30.00	0.0000	4.0000	0.1603	1.6033	0.0000	0.0000	1.0000	0.00
BB2-415V	2	1.500	YN	0.00	0.0000	4.0000	0.3333	1.6667	0.0000	0.0000	1.0434	0.00
DATA for Transformer with ID. T7				No. of units		1 using library key T003						
BB6-11kV	1	2.000	D	30.00	0.0000	3.0000	0.1176	1.1755	0.0000	0.0000	1.0000	0.00
BB3-415V	2	2.000	YN	0.00	0.0000	3.0000	0.1176	1.1755	0.0000	0.0000	1.0000	0.00

Network Name : CASE2
Data State Name : BB11-11kV OPEN

TRANSFORMER DATA

System Busbar	Winding No.	Rating (MVA)	Winding Type	Angle (deg.)	Pos/Neg. R(pu)	Sequence X(pu)	Zero Sequence R(pu)	Zero Sequence X(pu)	Neutral Earth R(pu)	Neutral Earth X(pu)	Voltage Ratio	Off-Nom Tap (%)	
DATA for Transformer with ID. T8				No. of units		1 using library key T004							
BB7-11kV	1	2.500	D	30.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00	
BB4-415V	2	2.500	YN	0.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00	
DATA for Transformer with ID. T9				No. of units		1 using library key T003							
BB8-11kV	1	2.000	D	30.00	0.0000	3.0000	0.1176	1.1755	0.0000	0.0000	1.0000	0.00	
BB5-415V	2	2.000	YN	0.00	0.0000	3.0000	0.1176	1.1755	0.0000	0.0000	1.0000	0.00	
DATA for Transformer with ID. T10				No. of units		1 using library key T004							
BB10-11kV	1	2.500	D	30.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00	
BB6-415V	2	2.500	YN	0.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00	
DATA for Transformer with ID. T11				No. of units		1 using library key T006							
BB11-11kV	1	1.500	D	30.00	0.0000	4.0000	0.1603	1.6033	0.0000	0.0000	1.0000	0.00	OPEN AT SYSTEM BUS
BB7-415V	2	1.500	YN	0.00	0.0000	4.0000	0.3333	1.6667	0.0000	0.0000	1.0434	0.00	
DATA for Transformer with ID. T12				No. of units		1 using library key T004							
BB12-11kV	1	2.500	D	30.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00	
BB8-415V	2	2.500	YN	0.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00	
DATA for Transformer with ID. T13				No. of units		1 using library key T003							
BB13-11kV	1	2.000	D	30.00	0.0000	3.0000	0.1176	1.1755	0.0000	0.0000	1.0000	0.00	
BB9-415V	2	2.000	YN	0.00	0.0000	3.0000	0.1176	1.1755	0.0000	0.0000	1.0000	0.00	
DATA for Transformer with ID. T14				No. of units		1 using library key T004							
BB14-11kV	1	2.500	D	30.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00	
BB10-415V	2	2.500	YN	0.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00	
DATA for Transformer with ID. T15				No. of units		1 using library key TX027							
BB15-11kV	1	2.500	D	30.00	0.0800	0.8000	0.0600	0.6000	0.0000	0.0000	1.0000	0.00	
BB11-415V	2	2.500	YN	0.00	0.1600	1.9240	0.0800	1.4000	0.0000	0.0000	1.0000	0.00	
BB12-415V	3	2.500	YN	0.00	0.0800	1.9240	0.0640	0.1400	0.0000	0.0000	1.0000	0.00	

Network Name : CASE2
Data State Name : BB11-11kV OPEN

TRANSFORMER DATA

System Busbar	Winding No.	Rating (MVA)	Winding Type	Angle (deg.)	Pos/Neg. Sequence R(pu)	X(pu)	Zero Sequence R(pu)	X(pu)	Neutral Earth R(pu)	X(pu)	Voltage Ratio	Off-Nom Tap (%)
DATA for Transformer with ID. T1				No. of units		1 using library key T002						
BB 132kV	1	4.000	D	30.00	0.0000	3.3750	0.0591	0.5907	0.0000	0.0000	1.0000	0.00
BB1-11kV	2	4.000	YN	0.00	0.0000	3.3750	0.0591	0.5907	0.0000	0.0000	1.0000	0.00
DATA for Transformer with ID. T2				No. of units		1 using library key T002						
BB 132kV	1	4.000	D	30.00	0.0000	3.3750	0.0591	0.5907	0.0000	0.0000	1.0000	0.00
BB2-11kV	2	4.000	YN	0.00	0.0000	3.3750	0.0591	0.5907	0.0000	0.0000	1.0000	0.00
DATA for Transformer with ID. T3				No. of units		1 using library key T001						
BB2 132kV	1	6.000	D	30.00	0.0000	2.2500	0.0540	0.5390	0.0000	0.0000	1.0000	0.00
BB8-11kV	2	6.000	YN	0.00	0.0000	2.2500	0.0540	0.5390	0.0000	0.0000	1.0000	0.00
DATA for Transformer with ID. T4				No. of units		1 using library key T001						
BB3 132kV	1	6.000	D	30.00	0.0000	2.2500	0.0540	0.5390	0.0000	0.0000	1.0000	0.00
BB9-11kV	2	6.000	YN	0.00	0.0000	2.2500	0.0540	0.5390	0.0000	0.0000	1.0000	0.00

INDUCTION MACHINE DATA

Busbar Identifier	Motor Identifier	No.Of Units	Library Key	Motor Ratings MVA	MW	kV	Input MW	Slip (%)	Stator R(pu)	X(pu)	Magnet. X(pu)	Standstill R(pu)	X(pu)	Rotor Running R(pu)	X(pu)
BB1-415V	IM	1	M003	0.196	0.196	0.415	0.000	0.0000	0.0185	0.0918	5.8000	0.0215	0.1060	0.0134	0.1910
BB8-415V	IM2	1	M003	0.196	0.196	0.415	0.100	0.6837	0.0185	0.0918	5.8000	0.0215	0.1060	0.0134	0.1910
BB10-415V	IM3	1	M002	1.000	1.000	0.415	0.100	0.1340	0.0185	0.0918	5.8000	0.0215	0.1060	0.0134	0.1910

Network Name : CASE2
Data State Name : BB11-11kV OPEN

INFINITE GENERATOR DATA

Busbar Identifier	Machine Identifier	Machine Ratings MVA	MW	kV	Assigned V(pu)	Pos. Sequence R(pu)	X(pu)	Neg. Sequence R(pu)	X(pu)	Zero Sequence R(pu)	X(pu)
BB 132kV	TNB A	150.00	14.93	132.00	1.000	0.0995	0.9950	0.0995	0.9950	0.0995	0.9950
BB2 132kV	TNB B	150.00	14.93	132.00	1.000	0.0995	0.9950	0.0995	0.9950	0.0995	0.9950

SYNCHRONOUS MACHINE DATA

Busbar Identifier	Machine Identifier	Type	No.Of Units	Library Key	Generator Ratings MVA BASE	MW	kV	V(pu)	Assigned MW	MVAR	Pos. Sequence R(pu)	X(pu)	Neg. Sequence R(pu)	X(pu)	Zero Sequence R(pu)	X(pu)
BB12-11kV	SG1	SLACK	1	GMIN	50.000	50.000	11.000	1.000	0.000	0.000	0.0120	0.2770	0.0200	0.1840	0.0150	0.0800
					Neutral earthing						0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

SHUNT DATA

Busbar Identifier	Shunt Identifier	No.Of Units	Type	Library Key	Rating MVA	Data Values Positive/Negative Sequence		Zero Sequence	
BB2-415V	Load1	1	MW/pf	Ld1		1.000 MW	0.800 pf		
BB3-415V	Load2	1	G/B pu Base	SampleG/Bpu1	1.00	0.008 G pu	-0.006 B pu	0.008 G pu	-0.006 B pu
BB4-415V	Load3	1	kW/pf	samplekW/pf		600.000 kW	0.800 pf		
BB5-415V	load 4	1	R/X Ohm	sampleR/X	1.50	100.000 R Ohm	75.000 X Ohm	100.000 R Ohm	75.000 X Ohm
BB6-415V	Load5	1	kW/pf	samplekW/pf		600.000 kW	0.800 pf		
BB7-415V	Load6	1	MW/pf	Ld2		0.900 MW	0.800 pf		
BB9-415V	load7	1	MW/pf	Ld1		0.500 MW	0.800 pf		
BB9-11kV		1	MW/MVAR	Load1		1.000 MW	0.750 MVAr		
BB11-415V	load8	1	MW/pf	Ld2		0.900 MW	0.800 pf		
BB12-415V	load9	1	MW/pf	Ld2		0.400 MW	0.800 pf		

Network Name : CASE2
Data State Name : BB11-11kV OPEN

BUS SECTION DATA

First Busbar	Second Busbar	Status
BB3-11kV	BB4-11kV	Closed
BB4-11kV	BB5-11kV	Closed
BB5-11kV	BB6-11kV	Closed
BB6-11kV	BB7-11kV	Closed
BB7-11kV	BB8-11kV	Closed
BB2 132kV	BB3 132kV	Closed
BB10-11kV	BB11-11kV	Closed
BB11-11kV	BB12-11kV	Open
BB13-11kV	BB14-11kV	Closed
BB14-11kV	BB15-11kV	Closed

Network Name   : CASE2
Data State Name : BB11-11kV OPEN

AT STUDY END - No of iterations = 4 Convergence = 0.1132E-05
Voltage Range from 0.839pu at BB11-415V to 1.000pu at BB 132kV

AC BUSBAR VALUES

Busbar Identifier	Merge	Busbar Type	Voltage PU	Voltage kV	Voltage ANG-DEG	Synch. Machines MW	Synch. Machines MVAr	Ind Motor Load MW	Ind Motor Load MVAr	Shunt MW	Loads MVAr	3 Phase Fault kA	3 Phase Fault X/R	Ph - E Fault kA	Ph - E Fault X/R
BB 132kV	.	INF.BUS	1.000	132.000	0.000	1.458	1.207	0.000	0.000	0.000	0.000	0.71	11.176	0.69	10.046
BB2 132kV	M6	INF.BUS	1.000	132.000	-0.724	3.733	4.058	0.000	0.000	0.000	0.000	0.72	11.192	0.69	9.115
BB3 132kV	M6	LOAD	1.000	132.000	-0.724	0.000	0.000	0.000	0.000	0.000	0.000	0.72	11.192	0.69	9.115
BB12-11kV	.	SLACK	1.000	11.000	1.716	0.101	0.048	0.000	0.000	0.000	0.000	9.51	22.816	14.55	11.459
BB1-11kV	.	LOAD	0.961	10.566	-2.937	0.000	0.000	0.000	0.000	0.000	0.000	2.37	14.214	3.26	13.561
BB10-11kV	M7	LOAD	0.959	10.545	-2.938	0.000	0.000	0.000	0.000	0.000	0.000	2.23	7.177	2.52	2.027
BB11-11kV	M7	LOAD	0.959	10.545	-2.938	0.000	0.000	0.000	0.000	0.000	0.000	2.23	7.177	2.52	2.027
BB13-11kV	M9	LOAD	0.867	9.540	-9.402	0.000	0.000	0.000	0.000	0.000	0.000	1.21	5.187	1.58	5.499
BB14-11kV	M9	LOAD	0.867	9.540	-9.402	0.000	0.000	0.000	0.000	0.000	0.000	1.21	5.187	1.58	5.499
BB15-11kV	M9	LOAD	0.867	9.540	-9.402	0.000	0.000	0.000	0.000	0.000	0.000	1.21	5.187	1.58	5.499
BB2-11kV	.	LOAD	0.961	10.566	-2.937	0.000	0.000	0.000	0.000	0.000	0.000	2.37	14.214	3.26	13.561
BB3-11kV	M3	LOAD	0.960	10.564	-2.937	0.000	0.000	0.000	0.000	0.000	0.000	2.38	14.555	3.27	13.957
BB4-11kV	M3	LOAD	0.960	10.564	-2.937	0.000	0.000	0.000	0.000	0.000	0.000	2.38	14.555	3.27	13.957
BB5-11kV	M3	LOAD	0.960	10.564	-2.937	0.000	0.000	0.000	0.000	0.000	0.000	2.38	14.555	3.27	13.957
BB6-11kV	M3	LOAD	0.960	10.564	-2.937	0.000	0.000	0.000	0.000	0.000	0.000	2.38	14.555	3.27	13.957
BB7-11kV	M3	LOAD	0.960	10.564	-2.937	0.000	0.000	0.000	0.000	0.000	0.000	2.38	14.555	3.27	13.957
BB8-11kV	M3	LOAD	0.960	10.564	-2.937	0.000	0.000	0.000	0.000	0.000	0.000	2.38	14.555	3.27	13.957
BB9-11kV	.	LOAD	0.868	9.544	-9.402	0.000	0.000	0.000	0.000	1.000	0.750	1.21	5.225	1.59	5.562
BB1-415V	.	LOAD	0.959	0.398	-2.831	0.000	0.000	0.000	0.031	0.000	0.000	14.97	1.489	20.51	1.646
BB10-415V	.	LOAD	0.852	0.354	-9.286	0.000	0.000	0.100	0.127	0.000	0.000	15.66	2.415	20.97	2.653
BB11-415V	.	LOAD	0.839	0.348	-11.438	0.000	0.000	0.000	0.000	0.900	0.675	18.92	4.906	24.44	5.411
BB12-415V	.	LOAD	0.849	0.352	-10.731	0.000	0.000	0.000	0.000	0.400	0.300	18.80	5.895	26.61	5.899
BB2-415V	.	LOAD	0.927	0.385	-8.316	0.000	0.000	0.000	0.000	1.000	0.750	12.88	7.907	16.38	7.681
BB3-415V	.	LOAD	0.960	0.399	-2.941	0.000	0.000	0.000	0.000	0.001	0.001	16.46	55.584	21.56	35.248
BB4-415V	.	LOAD	0.895	0.371	-3.498	0.000	0.000	0.000	0.000	0.600	0.450	14.05	1.289	19.31	1.437
BB5-415V	.	LOAD	0.960	0.399	-2.941	0.000	0.000	0.000	0.000	0.001	0.001	16.46	55.584	21.56	35.248
BB6-415V	.	LOAD	0.893	0.370	-3.500	0.000	0.000	0.000	0.000	0.600	0.450	13.76	1.273	18.95	1.418
BB8-415V	.	LOAD	0.992	0.412	1.546	0.000	0.000	0.100	0.047	0.000	0.000	17.67	1.203	24.20	1.345
BB9-415V	.	LOAD	0.840	0.349	-11.763	0.000	0.000	0.000	0.000	0.500	0.375	12.58	7.725	16.74	7.929
BB7-415V		BUS DISCONNECTED													

Network Name : CASE2
Data State Name : BB11-11kV OPEN

BUSBAR TOTALS	5.292	5.314	0.200	0.205	5.002	3.752
TOTAL BUS LOAD	5.202	3.956				
SYSTEM LOSSES	0.090	1.358				

LINE VALUES

First Busbar	Second Busbar	Branch Identifier	No.Of Ccts	Rating kA	First MW	End MVAr	Flow kA	Second MW	End MVAr	Flow kA	Loading (%)	O/L FLAG
BB3-11kV	BB10-11kV	L1	1	0.459	0.641	0.490	0.044	-0.640	-0.490	0.044	9.6	
BB9-11kV	BB15-11kV	L2	1	7.000	1.909	1.582	0.150	-1.908	-1.583	0.150	2.1	
BB1-11kV	BB3-11kV	L3	1	7.000	0.729	0.543	0.050	-0.729	-0.545	0.050	0.7	
BB2-11kV	BB5-11kV	L4	1	7.000	0.729	0.543	0.050	-0.729	-0.545	0.050	0.7	

TRANSFORMER VALUES

Transformer Identifier	No.Of Units	Winding No.	Connected Busbar	Winding kV	Voltage Ratio	Off Nominal Tap %	Rating MVA	Flow From Busbar MW	MVAr	Current kA	Percent Loading	O/L Flag
T5	1	1	BB4-11kV	11.000	1.0000	0.000	2.500	0.000	0.031	0.002	1.2	
		2	BB1-415V	0.415	1.0000	0.000	2.500	0.000	-0.031	0.044	1.2	
T6	1	1	BB5-11kV	11.000	1.0000	0.000	1.500	1.000	0.908	0.074	90.1	
		2	BB2-415V	0.433	1.0434	0.000	1.500	-1.000	-0.750	1.876	83.3	
T7	1	1	BB6-11kV	11.000	1.0000	0.000	2.000	0.001	0.001	0.000	0.1	
		2	BB3-415V	0.415	1.0000	0.000	2.000	-0.001	-0.001	0.002	0.1	
T8	1	1	BB7-11kV	11.000	1.0000	0.000	2.500	0.639	0.489	0.044	32.2	
		2	BB4-415V	0.415	1.0000	0.000	2.500	-0.600	-0.450	1.166	30.0	
T9	1	1	BB8-11kV	11.000	1.0000	0.000	2.000	0.001	0.001	0.000	0.1	
		2	BB5-415V	0.415	1.0000	0.000	2.000	-0.001	-0.001	0.002	0.1	
T10	1	1	BB10-11kV	11.000	1.0000	0.000	2.500	0.640	0.490	0.044	32.2	
		2	BB6-415V	0.415	1.0000	0.000	2.500	-0.600	-0.450	1.169	30.0	
T11	1	1	BB11-11kV	- WINDING DISCONNECTED								
		2	BB7-415V	- WINDING DISCONNECTED								
T12	1	1	BB12-11kV	11.000	1.0000	0.000	2.500	0.101	0.048	0.006	4.5	
		2	BB8-415V	0.415	1.0000	0.000	2.500	-0.100	-0.047	0.155	4.4	

Network Name : CASE2
Data State Name : BB11-11kV OPEN

INDUCTION MACHINE VALUES

Busbar Identifier	Machine Identifier	No.Of Units	Slip %	Terminal Voltage kV	Machine MW	Input MVAr	Current kA	O/L Flag
BB1-415V	IM	1	0.00	0.398	0.000	0.031	0.044	
BB8-415V	IM2	1	0.74	0.412	0.100	0.047	0.155	
BB10-415V	IM3	1	0.19	0.354	0.100	0.127	0.263	

SYNCHRONOUS MACHINE VALUES

Busbar Identifier	Machine Identifier	No.Of Units	Terminal Voltage kV	Power MW	Output MVAr	Current kA	O/L Flag
BB 132kV	TNB A	1	132.000	1.458	1.207	0.008	
BB2 132kV	TNB B	1	132.000	3.733	4.058	0.024	
BB12-11kV	SG1	1	11.000	0.101	0.048	0.006	

SHUNT VALUES

Busbar Identifier	Shunt Identifier	Shunt MW	Load MVAr	Current kA	O/L Flag
BB2-415V	Load1	1.000	0.750	1.876	
BB3-415V	Load2	0.001	0.001	0.002	
BB4-415V	Load3	0.600	0.450	1.166	
BB5-415V	load 4	0.001	0.001	0.002	
BB6-415V	Load5	0.600	0.450	1.169	
BB7-415V	Load6	SHUNT DISCONNECTED			
BB9-415V	load7	0.500	0.375	1.035	
BB9-11kV		1.000	0.750	0.076	
BB11-415V	load8	0.900	0.675	1.865	
BB12-415V	load9	0.400	0.300	0.819	

Run on 04-Jun-2009 by Supervisor from data set up on 04-Jun-2009 by Supervisor

Network Name : CASE2
Data State Name : BB11-11kV OPEN

BUS SECTION VALUES

First Busbar	Second Busbar	MW	MVAr	kA
BB3-11kV	BB4-11kV	0.088	0.055	0.006
BB4-11kV	BB5-11kV	0.088	0.025	0.005
BB5-11kV	BB6-11kV	-0.183	-0.338	0.021
BB6-11kV	BB7-11kV	-0.184	-0.339	0.021
BB7-11kV	BB8-11kV	-0.823	-0.828	0.064
BB2 132kV	BB3 132kV	2.909	3.163	0.019
BB10-11kV	BB11-11kV	0.000	0.000	0.000
BB11-11kV	BB12-11kV	0.000	0.000	0.000
BB13-11kV	BB14-11kV	-0.500	-0.408	0.039
BB14-11kV	BB15-11kV	-0.602	-0.537	0.049

Run on 04-Jun-2009 by Supervisor from data set up on 05-Mei-2009 by Supervisor

Network Name : CASE3
Data State Name : BB11-11kV & BB13-11kVOPEN

SYSTEM STATISTICS

Study Base MVA	=	100.000
Study Base Frequency (Hz)	=	50.000
Number of Busbars	=	30
Number of Shunts	=	10
Number of Lines	=	4
Number of Cables	=	0
Number of Transformers	=	15
Number of Tap Changers	=	0
Number of Synchronous Machines	=	3
Number of Induction Machines	=	3
Number of Wind Turbine Generators	=	0
Number of Bus Sections	=	10
Number of Series Elements	=	0

STUDY PARAMETERS

Load Power Multiplier	=	1.000000
Load Reactive Multiplier	=	1.000000
Convergence Tolerance	=	0.000005
Convergence Control	=	Method 2
Maximum Iterations	=	25
Overload Flag Level	=	100.0% Of Rating
Automatic Tap Changers		OFF

BUSBAR DATA

Busbar Identifier	Nominal kV	Three Phase Fault MVA	Three Phase Fault kA	Single Phase Fault MVA	Single Phase Fault kA	Transf. Shift Angle (deg.)	Nominal Bus Freq. (Hz)
BB 132kV	132.000	1500.0	6.561	2000.0	8.748	0.0	50.0
BB1-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB3-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB4-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB5-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB6-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB7-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB8-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB9-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB2-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB2 132kV	132.000	1500.0	6.561	2000.0	8.748	0.0	50.0
BB3 132kV	132.000	1500.0	6.561	2000.0	8.748	0.0	50.0
BB10-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB11-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB12-11kV	11.000	500.0	26.243	700.0	36.740	0.0	50.0
BB15-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB14-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB13-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB1-415V	0.415	31.0	43.127	45.0	62.604	60.0	50.0
BB2-415V	0.415	31.0	43.127	45.0	62.604	60.0	50.0
BB3-415V	0.415	31.0	43.127	45.0	62.604	60.0	50.0
BB4-415V	0.415	31.0	43.127	45.0	62.604	60.0	50.0
BB5-415V	0.415	31.0	43.127	45.0	62.604	60.0	50.0

Network Name : CASE3
Data State Name : BB11-11kV & BB13-11kVOPEN

BUSBAR DATA

Busbar Identifier	Nominal kV	Three Phase Fault MVA	Three Phase Fault kA	Single Phase Fault MVA	Single Phase Fault kA	Transf. Shift Angle (deg.)	Nominal Bus Freq. (Hz)
BB6-415V	0.415	31.0	43.127	45.0	62.604	60.0	50.0
BB7-415V	0.415	31.0	43.127	45.0	62.604	0.0	50.0NOT IN USE
BB8-415V	0.415	31.0	43.127	45.0	62.604	30.0	50.0
BB9-415V	0.415	31.0	43.127	45.0	62.604	0.0	50.0NOT IN USE
BB10-415V	0.415	31.0	43.127	45.0	62.604	60.0	50.0
BB11-415V	0.415	31.0	43.127	45.0	62.604	60.0	50.0
BB12-415V	0.415	31.0	43.127	45.0	62.604	60.0	50.0

LINE DATA

First Busbar	Second Busbar	Line Identifier	No.Of Ccts	Line Length	Library Key	Rating (kA)	Positive Sequence R(pu)	Positive Sequence X(pu))	Positive Sequence B(pu)	Zero Sequence R(pu)	Zero Sequence X(pu)	Zero Sequence B(pu)	Equivalent Pi Model
BB3-11kV	BB10-11kV	L1	1	2.00	Line1	0.459	0.16694	0.12793	0.00001	1.98347	0.50909	0.00000	
BB9-11kV	BB15-11kV	L2	1	1.00	Line1	7.000	0.00826	0.00701	0.00002	0.00826	0.00701	0.00002	
BB1-11kV	BB3-11kV	L3	1	1.00	Line1	7.000	0.00826	0.00701	0.00002	0.00826	0.00701	0.00002	
BB2-11kV	BB5-11kV	L4	1	1.00	Line1	7.000	0.00826	0.00701	0.00002	0.00826	0.00701	0.00002	

TRANSFORMER DATA

System Busbar	Winding No.	Rating (MVA)	Winding Type	Angle (deg.)	Pos/Neg. Sequence R(pu)	Pos/Neg. Sequence X(pu)	Zero Sequence R(pu)	Zero Sequence X(pu)	Neutral Earth R(pu)	Neutral Earth X(pu)	Voltage Ratio	Off-Nom Tap (%)
DATA for Transformer with ID. T5				No. of units	1 using library key T004							
BB4-11kV	1	2.500	D	30.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00
BB1-415V	2	2.500	YN	0.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00
DATA for Transformer with ID. T6				No. of units	1 using library key T006							
BB5-11kV	1	1.500	D	30.00	0.0000	4.0000	0.1603	1.6033	0.0000	0.0000	1.0000	0.00
BB2-415V	2	1.500	YN	0.00	0.0000	4.0000	0.3333	1.6667	0.0000	0.0000	1.0434	0.00
DATA for Transformer with ID. T7				No. of units	1 using library key T003							
BB6-11kV	1	2.000	D	30.00	0.0000	3.0000	0.1176	1.1755	0.0000	0.0000	1.0000	0.00
BB3-415V	2	2.000	YN	0.00	0.0000	3.0000	0.1176	1.1755	0.0000	0.0000	1.0000	0.00

Network Name : CASE3
Data State Name : BB11-11kV & BB13-11kVOPEN

TRANSFORMER DATA

System Busbar	Winding No.	Rating (MVA)	Winding Type	Angle (deg.)	Pos/Neg. Sequence R(pu)	Pos/Neg. Sequence X(pu)	Zero Sequence R(pu)	Zero Sequence X(pu)	Neutral Earth R(pu)	Neutral Earth X(pu)	Voltage Ratio	Off-Nom Tap (%)	
DATA for Transformer with ID. T8				No. of units 1 using library key T004									
BB7-11kV	1	2.500	D	30.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00	
BB4-415V	2	2.500	YN	0.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00	
DATA for Transformer with ID. T9				No. of units 1 using library key T003									
BB8-11kV	1	2.000	D	30.00	0.0000	3.0000	0.1176	1.1755	0.0000	0.0000	1.0000	0.00	
BB5-415V	2	2.000	YN	0.00	0.0000	3.0000	0.1176	1.1755	0.0000	0.0000	1.0000	0.00	
DATA for Transformer with ID. T10				No. of units 1 using library key T004									
BB10-11kV	1	2.500	D	30.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00	
BB6-415V	2	2.500	YN	0.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00	
DATA for Transformer with ID. T11				No. of units 1 using library key T006									
BB11-11kV	1	1.500	D	30.00	0.0000	4.0000	0.1603	1.6033	0.0000	0.0000	1.0000	0.00	OPEN AT SYSTEM BUS
BB7-415V	2	1.500	YN	0.00	0.0000	4.0000	0.3333	1.6667	0.0000	0.0000	1.0434	0.00	
DATA for Transformer with ID. T12				No. of units 1 using library key T004									
BB12-11kV	1	2.500	D	30.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00	
BB8-415V	2	2.500	YN	0.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00	
DATA for Transformer with ID. T13				No. of units 1 using library key T003									
BB13-11kV	1	2.000	D	30.00	0.0000	3.0000	0.1176	1.1755	0.0000	0.0000	1.0000	0.00	OPEN AT SYSTEM BUS
BB9-415V	2	2.000	YN	0.00	0.0000	3.0000	0.1176	1.1755	0.0000	0.0000	1.0000	0.00	
DATA for Transformer with ID. T14				No. of units 1 using library key T004									
BB14-11kV	1	2.500	D	30.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00	
BB10-415V	2	2.500	YN	0.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00	
DATA for Transformer with ID. T15				No. of units 1 using library key TX027									
BB15-11kV	1	2.500	D	30.00	0.0800	0.8000	0.0600	0.6000	0.0000	0.0000	1.0000	0.00	
BB11-415V	2	2.500	YN	0.00	0.1600	1.9240	0.0800	1.4000	0.0000	0.0000	1.0000	0.00	
BB12-415V	3	2.500	YN	0.00	0.0800	1.9240	0.0640	0.1400	0.0000	0.0000	1.0000	0.00	

Network Name : CASE3
Data State Name : BB11-11kV & BB13-11kVOPEN

TRANSFORMER DATA

System Busbar	Winding No.	Rating (MVA)	Winding Type	Angle (deg.)	Pos/Neg. R(pu)	Sequence X(pu)	Zero Sequence R(pu)	Zero Sequence X(pu)	Neutral Earth R(pu)	Neutral Earth X(pu)	Voltage Ratio	Off-Nom Tap (%)
DATA for Transformer with ID. T1				No. of units		1 using library key T002						
BB 132kV	1	4.000	D	30.00	0.0000	3.3750	0.0591	0.5907	0.0000	0.0000	1.0000	0.00
BB1-11kV	2	4.000	YN	0.00	0.0000	3.3750	0.0591	0.5907	0.0000	0.0000	1.0000	0.00
DATA for Transformer with ID. T2				No. of units		1 using library key T002						
BB 132kV	1	4.000	D	30.00	0.0000	3.3750	0.0591	0.5907	0.0000	0.0000	1.0000	0.00
BB2-11kV	2	4.000	YN	0.00	0.0000	3.3750	0.0591	0.5907	0.0000	0.0000	1.0000	0.00
DATA for Transformer with ID. T3				No. of units		1 using library key T001						
BB2 132kV	1	6.000	D	30.00	0.0000	2.2500	0.0540	0.5390	0.0000	0.0000	1.0000	0.00
BB8-11kV	2	6.000	YN	0.00	0.0000	2.2500	0.0540	0.5390	0.0000	0.0000	1.0000	0.00
DATA for Transformer with ID. T4				No. of units		1 using library key T001						
BB3 132kV	1	6.000	D	30.00	0.0000	2.2500	0.0540	0.5390	0.0000	0.0000	1.0000	0.00
BB9-11kV	2	6.000	YN	0.00	0.0000	2.2500	0.0540	0.5390	0.0000	0.0000	1.0000	0.00

INDUCTION MACHINE DATA

Busbar Identifier	Motor Identifier	No.Of Units	Library Key	Motor Ratings MVA	MW	kV	Input MW	Slip (%)	Stator R(pu)	Stator X(pu)	Magnet. X(pu)	Standstill R(pu)	Standstill X(pu)	Rotor R(pu)	Running X(pu)
BB1-415V	IM	1	M003	0.196	0.196	0.415	0.000	0.0000	0.0185	0.0918	5.8000	0.0215	0.1060	0.0134	0.1910
BB8-415V	IM2	1	M003	0.196	0.196	0.415	0.100	0.6837	0.0185	0.0918	5.8000	0.0215	0.1060	0.0134	0.1910
BB10-415V	IM3	1	M002	1.000	1.000	0.415	0.100	0.1340	0.0185	0.0918	5.8000	0.0215	0.1060	0.0134	0.1910

Network Name : CASE3
Data State Name : BB11-11kV & BB13-11kVOPEN

BUS SECTION DATA

First Busbar	Second Busbar	Status
BB3-11kV	BB4-11kV	Closed
BB4-11kV	BB5-11kV	Closed
BB5-11kV	BB6-11kV	Closed
BB6-11kV	BB7-11kV	Closed
BB7-11kV	BB8-11kV	Closed
BB2 132kV	BB3 132kV	Closed
BB10-11kV	BB11-11kV	Closed
BB11-11kV	BB12-11kV	Open
BB13-11kV	BB14-11kV	Closed
BB14-11kV	BB15-11kV	Closed

Network Name : CASE3
Data State Name : BB11-11kV & BB13-11kVOPEN

AT STUDY END - No of iterations = 4 Convergence = 0.1274E-05
Voltage Range from 0.868pu at BB11-415V to 1.000pu at BB12-11kV

AC BUSBAR VALUES

Busbar Identifier	Merge	Busbar Type	Voltage PU	Voltage kV	Voltage ANG-DEG	Synch. Machines MW	Synch. Machines MVAr	Ind Motor Load MW	Ind Motor Load MVAr	Shunt MW	Loads MVAr	3 Phase Fault kA	3 Phase Fault X/R	Ph - E Fault kA	Ph - E Fault X/R
BB 132kV	.	INF.BUS	1.000	132.000	0.000	1.430	1.206	0.000	0.000	0.000	0.000	0.71	11.154	0.69	10.048
BB2 132kV	M6	INF.BUS	1.000	132.000	-0.592	3.260	3.356	0.000	0.000	0.000	0.000	0.72	11.118	0.69	9.262
BB3 132kV	M6	LOAD	1.000	132.000	-0.592	0.000	0.000	0.000	0.000	0.000	0.000	0.72	11.118	0.69	9.262
BB12-11kV	.	SLACK	1.000	11.000	1.588	0.101	0.048	0.000	0.000	0.000	0.000	9.51	22.816	14.55	11.459
BB1-11kV	.	LOAD	0.961	10.566	-2.880	0.000	0.000	0.000	0.000	0.000	0.000	2.37	14.206	3.26	13.555
BB10-11kV	M7	LOAD	0.959	10.545	-2.881	0.000	0.000	0.000	0.000	0.000	0.000	2.23	7.175	2.52	2.026
BB11-11kV	M7	LOAD	0.959	10.545	-2.881	0.000	0.000	0.000	0.000	0.000	0.000	2.23	7.175	2.52	2.026
BB13-11kV	M9	LOAD	0.896	9.852	-7.539	0.000	0.000	0.000	0.000	0.000	0.000	1.21	6.080	1.59	6.354
BB14-11kV	M9	LOAD	0.896	9.852	-7.539	0.000	0.000	0.000	0.000	0.000	0.000	1.21	6.080	1.59	6.354
BB15-11kV	M9	LOAD	0.896	9.852	-7.539	0.000	0.000	0.000	0.000	0.000	0.000	1.21	6.080	1.59	6.354
BB2-11kV	.	LOAD	0.961	10.566	-2.880	0.000	0.000	0.000	0.000	0.000	0.000	2.37	14.206	3.26	13.555
BB3-11kV	M3	LOAD	0.960	10.565	-2.881	0.000	0.000	0.000	0.000	0.000	0.000	2.38	14.547	3.27	13.950
BB4-11kV	M3	LOAD	0.960	10.565	-2.881	0.000	0.000	0.000	0.000	0.000	0.000	2.38	14.547	3.27	13.950
BB5-11kV	M3	LOAD	0.960	10.565	-2.881	0.000	0.000	0.000	0.000	0.000	0.000	2.38	14.547	3.27	13.950
BB6-11kV	M3	LOAD	0.960	10.565	-2.881	0.000	0.000	0.000	0.000	0.000	0.000	2.38	14.547	3.27	13.950
BB7-11kV	M3	LOAD	0.960	10.565	-2.881	0.000	0.000	0.000	0.000	0.000	0.000	2.38	14.547	3.27	13.950
BB8-11kV	M3	LOAD	0.960	10.565	-2.881	0.000	0.000	0.000	0.000	0.000	0.000	2.38	14.547	3.27	13.950
BB9-11kV	.	LOAD	0.896	9.855	-7.539	0.000	0.000	0.000	0.000	1.000	0.750	1.21	6.133	1.59	6.438
BB1-415V	.	LOAD	0.959	0.398	-2.774	0.000	0.000	0.000	0.031	0.000	0.000	14.97	1.489	20.51	1.646
BB10-415V	.	LOAD	0.881	0.366	-7.398	0.000	0.000	0.100	0.135	0.000	0.000	16.13	2.496	21.60	2.737
BB11-415V	.	LOAD	0.868	0.360	-9.444	0.000	0.000	0.000	0.000	0.900	0.675	19.15	5.410	24.81	5.920
BB12-415V	.	LOAD	0.878	0.364	-8.783	0.000	0.000	0.000	0.000	0.400	0.300	19.03	6.563	26.97	6.527
BB2-415V	.	LOAD	0.927	0.385	-8.259	0.000	0.000	0.000	0.000	1.000	0.750	12.88	7.907	16.38	7.681
BB3-415V	.	LOAD	0.960	0.399	-2.884	0.000	0.000	0.000	0.000	0.001	0.001	16.46	55.555	21.56	35.238
BB4-415V	.	LOAD	0.895	0.371	-3.441	0.000	0.000	0.000	0.000	0.600	0.450	14.05	1.289	19.31	1.437
BB5-415V	.	LOAD	0.960	0.399	-2.884	0.000	0.000	0.000	0.000	0.001	0.001	16.46	55.555	21.56	35.238
BB6-415V	.	LOAD	0.893	0.370	-3.443	0.000	0.000	0.000	0.000	0.600	0.450	13.76	1.273	18.95	1.418
BB8-415V	.	LOAD	0.992	0.412	1.418	0.000	0.000	0.100	0.047	0.000	0.000	17.67	1.203	24.20	1.345
BB7-415V		BUS DISCONNECTED													
BB9-415V		BUS DISCONNECTED													

Network Name : CASE3
Data State Name : BB11-11kV & BB13-11kVOPEN

BUSBAR TOTALS	4.791	4.610	0.200	0.213	4.502	3.377
TOTAL BUS LOAD	4.702	3.589				
SYSTEM LOSSES	0.089	1.021				

LINE VALUES

First Busbar	Second Busbar	Branch Identifier	No.Of Ccts	Rating kA	First MW	End MVAr	Flow kA	Second MW	End MVAr	Flow kA	Loading (%)	O/L FLAG
BB3-11kV	BB10-11kV	L1	1	0.459	0.641	0.490	0.044	-0.640	-0.490	0.044	9.6	
BB9-11kV	BB15-11kV	L2	1	7.000	1.408	1.177	0.108	-1.408	-1.178	0.108	1.5	
BB1-11kV	BB3-11kV	L3	1	7.000	0.715	0.544	0.049	-0.715	-0.546	0.049	0.7	
BB2-11kV	BB5-11kV	L4	1	7.000	0.715	0.544	0.049	-0.715	-0.546	0.049	0.7	

TRANSFORMER VALUES

Transformer Identifier	No.Of Units	Winding No.	Connected Busbar	Winding kV	Voltage Ratio	Off Nominal Tap %	Rating MVA	Flow From Busbar MW	MVAr	Current kA	Percent Loading	O/L Flag
T5	1	1	BB4-11kV	11.000	1.0000	0.000	2.500	0.000	0.031	0.002	1.2	
		2	BB1-415V	0.415	1.0000	0.000	2.500	0.000	-0.031	0.044	1.2	
T6	1	1	BB5-11kV	11.000	1.0000	0.000	1.500	1.000	0.908	0.074	90.1	
		2	BB2-415V	0.433	1.0434	0.000	1.500	-1.000	-0.750	1.876	83.3	
T7	1	1	BB6-11kV	11.000	1.0000	0.000	2.000	0.001	0.001	0.000	0.1	
		2	BB3-415V	0.415	1.0000	0.000	2.000	-0.001	-0.001	0.002	0.1	
T8	1	1	BB7-11kV	11.000	1.0000	0.000	2.500	0.639	0.489	0.044	32.2	
		2	BB4-415V	0.415	1.0000	0.000	2.500	-0.600	-0.450	1.166	30.0	
T9	1	1	BB8-11kV	11.000	1.0000	0.000	2.000	0.001	0.001	0.000	0.1	
		2	BB5-415V	0.415	1.0000	0.000	2.000	-0.001	-0.001	0.002	0.1	
T10	1	1	BB10-11kV	11.000	1.0000	0.000	2.500	0.640	0.490	0.044	32.2	
		2	BB6-415V	0.415	1.0000	0.000	2.500	-0.600	-0.450	1.169	30.0	
T11	1	1	BB11-11kV	- WINDING DISCONNECTED								
		2	BB7-415V	- WINDING DISCONNECTED								
T12	1	1	BB12-11kV	11.000	1.0000	0.000	2.500	0.101	0.048	0.006	4.5	
		2	BB8-415V	0.415	1.0000	0.000	2.500	-0.100	-0.047	0.155	4.4	

Network Name : CASE3
Data State Name : BB11-11kV & BB13-11kVOPEN

TRANSFORMER VALUES

Transformer Identifier	No.Of Units	Winding No.	Connected Busbar	Winding kV	Voltage Ratio	Off Nominal Tap %	Rating MVA	Flow From Busbar MW	Flow From Busbar MVAr	Current kA	Percent Loading	O/L Flag
T13	1	1	BB13-11kV	- WINDING DISCONNECTED								
		2	BB9-415V	- WINDING DISCONNECTED								
T14	1	1	BB14-11kV	11.000	1.0000	0.000	2.500	0.102	0.137	0.010	6.8	
		2	BB10-415V	0.415	1.0000	0.000	2.500	-0.100	-0.135	0.265	6.7	
T15	1	1	BB15-11kV	11.000	1.0000	0.000	2.500	1.306	1.041	0.098	66.8	
		2	BB11-415V	0.415	1.0000	0.000	2.500	-0.900	-0.675	1.802	45.0	
		3	BB12-415V	0.415	1.0000	0.000	2.500	-0.400	-0.300	0.792	20.0	
T1	1	1	BB 132kV	132.000	1.0000	0.000	4.000	0.715	0.603	0.004	23.4	
		2	BB1-11kV	11.000	1.0000	0.000	4.000	-0.715	-0.544	0.049	22.5	
T2	1	1	BB 132kV	132.000	1.0000	0.000	4.000	0.715	0.603	0.004	23.4	
		2	BB2-11kV	11.000	1.0000	0.000	4.000	-0.715	-0.544	0.049	22.5	
T3	1	1	BB2 132kV	132.000	1.0000	0.000	6.000	0.852	0.897	0.005	20.6	
		2	BB8-11kV	11.000	1.0000	0.000	6.000	-0.852	-0.828	0.065	19.8	
T4	1	1	BB3 132kV	132.000	1.0000	0.000	6.000	2.408	2.460	0.015	57.4	
		2	BB9-11kV	11.000	1.0000	0.000	6.000	-2.408	-1.927	0.181	51.4	

BRANCH LOSS SUMMARY

	(MW)	(MVAr)
SERIES LOSSES	0.089	1.028
SHUNT LOSSES	0.000	-0.007
TOTAL LOSSES	0.089	1.021

Network Name : CASE3
Data State Name : BB11-11kV & BB13-11kVOPEN

INDUCTION MACHINE VALUES

Busbar Identifier	Machine Identifier	No.Of Units	Slip %	Terminal Voltage kV	Machine MW	Input MVAr	Current kA	O/L Flag
BB1-415V	IM	1	0.00	0.398	0.000	0.031	0.044	
BB8-415V	IM2	1	0.74	0.412	0.100	0.047	0.155	
BB10-415V	IM3	1	0.18	0.366	0.100	0.135	0.265	

SYNCHRONOUS MACHINE VALUES

Busbar Identifier	Machine Identifier	No.Of Units	Terminal Voltage kV	Power MW	Output MVAr	Current kA	O/L Flag
BB 132kV	TNB A	1	132.000	1.430	1.206	0.008	
BB2 132kV	TNB B	1	132.000	3.260	3.356	0.020	
BB12-11kV	SG1	1	11.000	0.101	0.048	0.006	

SHUNT VALUES

Busbar Identifier	Shunt Identifier	Shunt MW	Load MVAr	Current kA	O/L Flag
BB2-415V	Load1	1.000	0.750	1.876	
BB3-415V	Load2	0.001	0.001	0.002	
BB4-415V	Load3	0.600	0.450	1.166	
BB5-415V	load 4	0.001	0.001	0.002	
BB6-415V	Load5	0.600	0.450	1.169	
BB7-415V	Load6	SHUNT DISCONNECTED			
BB9-415V	load7	SHUNT DISCONNECTED			
BB9-11kV		1.000	0.750	0.073	
BB11-415V	load8	0.900	0.675	1.802	
BB12-415V	load9	0.400	0.300	0.792	

Run on 04-Jun-2009 by Supervisor from data set up on 05-Mei-2009 by Supervisor

Network Name : CASE3
Data State Name : BB11-11kV & BB13-11kVOPEN

BUS SECTION VALUES

First Busbar	Second Busbar	MW	MVAr	kA
BB3-11kV	BB4-11kV	0.074	0.056	0.005
BB4-11kV	BB5-11kV	0.074	0.025	0.004
BB5-11kV	BB6-11kV	-0.211	-0.337	0.022
BB6-11kV	BB7-11kV	-0.212	-0.338	0.022
BB7-11kV	BB8-11kV	-0.851	-0.827	0.065
BB2 132kV	BB3 132kV	2.408	2.460	0.015
BB10-11kV	BB11-11kV	0.000	0.000	0.000
BB11-11kV	BB12-11kV	0.000	0.000	0.000
BB13-11kV	BB14-11kV	0.000	0.000	0.000
BB14-11kV	BB15-11kV	-0.102	-0.137	0.010

Run on 04-Jun-2009 by Supervisor from data set up on 04-Jun-2009 by Supervisor

Network Name : CASE4
Data State Name : BB11-11kV & BB13-11kV BB7OPEN

SYSTEM STATISTICS

Study Base MVA	=	100.000
Study Base Frequency (Hz)	=	50.000
Number of Busbars	=	30
Number of Shunts	=	10
Number of Lines	=	4
Number of Cables	=	0
Number of Transformers	=	15
Number of Tap Changers	=	0
Number of Synchronous Machines	=	3
Number of Induction Machines	=	3
Number of Wind Turbine Generators	=	0
Number of Bus Sections	=	10
Number of Series Elements	=	0

STUDY PARAMETERS

Load Power Multiplier	=	1.000000
Load Reactive Multiplier	=	1.000000
Convergence Tolerance	=	0.000005
Convergence Control	=	Method 2
Maximum Iterations	=	25
Overload Flag Level	=	100.0% Of Rating
Automatic Tap Changers		OFF

BUSBAR DATA

Busbar Identifier	Nominal kV	Three Phase Fault MVA	Three Phase Fault kA	Single Phase Fault MVA	Single Phase Fault kA	Transf. Shift Angle (deg.)	Nominal Bus Freq. (Hz)
BB 132kV	132.000	1500.0	6.561	2000.0	8.748	0.0	50.0
BB1-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB3-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB4-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB5-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB6-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB7-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB8-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB9-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB2-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB2 132kV	132.000	1500.0	6.561	2000.0	8.748	0.0	50.0
BB3 132kV	132.000	1500.0	6.561	2000.0	8.748	0.0	50.0
BB10-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB11-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB12-11kV	11.000	500.0	26.243	700.0	36.740	0.0	50.0
BB15-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB14-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB13-11kV	11.000	500.0	26.243	700.0	36.740	30.0	50.0
BB1-415V	0.415	31.0	43.127	45.0	62.604	60.0	50.0
BB2-415V	0.415	31.0	43.127	45.0	62.604	60.0	50.0
BB3-415V	0.415	31.0	43.127	45.0	62.604	60.0	50.0
BB4-415V	0.415	31.0	43.127	45.0	62.604	0.0	50.0NOT IN USE
BB5-415V	0.415	31.0	43.127	45.0	62.604	60.0	50.0

Network Name : CASE4
Data State Name : BB11-11kV & BB13-11kV BB7OPEN

BUSBAR DATA

Busbar Identifier	Nominal kV	Three Phase Fault MVA	Three Phase Fault kA	Single Phase Fault MVA	Single Phase Fault kA	Transf. Shift Angle (deg.)	Nominal Bus Freq. (Hz)	
BB6-415V	0.415	31.0	43.127	45.0	62.604	60.0	50.0	
BB7-415V	0.415	31.0	43.127	45.0	62.604	0.0	50.0	NOT IN USE
BB8-415V	0.415	31.0	43.127	45.0	62.604	30.0	50.0	
BB9-415V	0.415	31.0	43.127	45.0	62.604	0.0	50.0	NOT IN USE
BB10-415V	0.415	31.0	43.127	45.0	62.604	60.0	50.0	
BB11-415V	0.415	31.0	43.127	45.0	62.604	60.0	50.0	
BB12-415V	0.415	31.0	43.127	45.0	62.604	60.0	50.0	

LINE DATA

First Busbar	Second Busbar	Line Identifier	No.Of Ccts	Line Length	Library Key	Rating (kA)	Positive Sequence R(pu)	Positive Sequence X(pu))	Positive Sequence B(pu)	Zero Sequence R(pu)	Zero Sequence X(pu)	Zero Sequence B(pu)	Equivalent Pi Model
BB3-11kV	BB10-11kV	L1	1	2.00	Line1	0.459	0.16694	0.12793	0.00001	1.98347	0.50909	0.00000	
BB9-11kV	BB15-11kV	L2	1	1.00	Line1	7.000	0.00826	0.00701	0.00002	0.00826	0.00701	0.00002	
BB1-11kV	BB3-11kV	L3	1	1.00	Line1	7.000	0.00826	0.00701	0.00002	0.00826	0.00701	0.00002	
BB2-11kV	BB5-11kV	L4	1	1.00	Line1	7.000	0.00826	0.00701	0.00002	0.00826	0.00701	0.00002	

TRANSFORMER DATA

System Busbar	Winding No.	Rating (MVA)	Winding Type	Angle (deg.)	Pos/Neg. Sequence R(pu)	Pos/Neg. Sequence X(pu)	Zero Sequence R(pu)	Zero Sequence X(pu)	Neutral Earth R(pu)	Neutral Earth X(pu)	Voltage Ratio	Off-Nom Tap (%)
DATA for Transformer with ID. T5				No. of units		1 using library key T004						
BB4-11kV	1	2.500	D	30.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00
BB1-415V	2	2.500	YN	0.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00
DATA for Transformer with ID. T6				No. of units		1 using library key T006						
BB5-11kV	1	1.500	D	30.00	0.0000	4.0000	0.1603	1.6033	0.0000	0.0000	1.0000	0.00
BB2-415V	2	1.500	YN	0.00	0.0000	4.0000	0.3333	1.6667	0.0000	0.0000	1.0434	0.00
DATA for Transformer with ID. T7				No. of units		1 using library key T003						
BB6-11kV	1	2.000	D	30.00	0.0000	3.0000	0.1176	1.1755	0.0000	0.0000	1.0000	0.00
BB3-415V	2	2.000	YN	0.00	0.0000	3.0000	0.1176	1.1755	0.0000	0.0000	1.0000	0.00

Network Name : CASE4
Data State Name : BB11-11kV & BB13-11kV BB7OPEN

TRANSFORMER DATA

System Busbar	Winding No.	Rating (MVA)	Winding Type	Angle (deg.)	Pos/Neg. Sequence R(pu)	Pos/Neg. Sequence X(pu)	Zero Sequence R(pu)	Zero Sequence X(pu)	Neutral Earth R(pu)	Neutral Earth X(pu)	Voltage Ratio	Off-Nom Tap (%)	
DATA for Transformer with ID. T8				No. of units		1 using library key T004							
BB7-11kV	1	2.500	D	30.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00	OPEN AT SYSTEM BUS
BB4-415V	2	2.500	YN	0.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00	
DATA for Transformer with ID. T9				No. of units		1 using library key T003							
BB8-11kV	1	2.000	D	30.00	0.0000	3.0000	0.1176	1.1755	0.0000	0.0000	1.0000	0.00	
BB5-415V	2	2.000	YN	0.00	0.0000	3.0000	0.1176	1.1755	0.0000	0.0000	1.0000	0.00	
DATA for Transformer with ID. T10				No. of units		1 using library key T004							
BB10-11kV	1	2.500	D	30.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00	
BB6-415V	2	2.500	YN	0.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00	
DATA for Transformer with ID. T11				No. of units		1 using library key T006							
BB11-11kV	1	1.500	D	30.00	0.0000	4.0000	0.1603	1.6033	0.0000	0.0000	1.0000	0.00	OPEN AT SYSTEM BUS
BB7-415V	2	1.500	YN	0.00	0.0000	4.0000	0.3333	1.6667	0.0000	0.0000	1.0434	0.00	
DATA for Transformer with ID. T12				No. of units		1 using library key T004							
BB12-11kV	1	2.500	D	30.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00	
BB8-415V	2	2.500	YN	0.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00	
DATA for Transformer with ID. T13				No. of units		1 using library key T003							
BB13-11kV	1	2.000	D	30.00	0.0000	3.0000	0.1176	1.1755	0.0000	0.0000	1.0000	0.00	OPEN AT SYSTEM BUS
BB9-415V	2	2.000	YN	0.00	0.0000	3.0000	0.1176	1.1755	0.0000	0.0000	1.0000	0.00	
DATA for Transformer with ID. T14				No. of units		1 using library key T004							
BB14-11kV	1	2.500	D	30.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00	
BB10-415V	2	2.500	YN	0.00	2.8000	2.8000	0.0938	0.9384	0.0000	0.0000	1.0000	0.00	
DATA for Transformer with ID. T15				No. of units		1 using library key TX027							
BB15-11kV	1	2.500	D	30.00	0.0800	0.8000	0.0600	0.6000	0.0000	0.0000	1.0000	0.00	
BB11-415V	2	2.500	YN	0.00	0.1600	1.9240	0.0800	1.4000	0.0000	0.0000	1.0000	0.00	
BB12-415V	3	2.500	YN	0.00	0.0800	1.9240	0.0640	0.1400	0.0000	0.0000	1.0000	0.00	

Network Name : CASE4
Data State Name : BB11-11kV & BB13-11kV BB7OPEN

TRANSFORMER DATA

System Busbar	Winding No.	Rating (MVA)	Winding Type	Angle (deg.)	Pos/Neg. Sequence R(pu)	Pos/Neg. Sequence X(pu)	Zero Sequence R(pu)	Zero Sequence X(pu)	Neutral Earth R(pu)	Neutral Earth X(pu)	Voltage Ratio	Off-Nom Tap (%)
DATA for Transformer with ID. T1				No. of units 1 using library key T002								
BB 132kV	1	4.000	D	30.00	0.0000	3.3750	0.0591	0.5907	0.0000	0.0000	1.0000	0.00
BB1-11kV	2	4.000	YN	0.00	0.0000	3.3750	0.0591	0.5907	0.0000	0.0000	1.0000	0.00
DATA for Transformer with ID. T2				No. of units 1 using library key T002								
BB 132kV	1	4.000	D	30.00	0.0000	3.3750	0.0591	0.5907	0.0000	0.0000	1.0000	0.00
BB2-11kV	2	4.000	YN	0.00	0.0000	3.3750	0.0591	0.5907	0.0000	0.0000	1.0000	0.00
DATA for Transformer with ID. T3				No. of units 1 using library key T001								
BB2 132kV	1	6.000	D	30.00	0.0000	2.2500	0.0540	0.5390	0.0000	0.0000	1.0000	0.00
BB8-11kV	2	6.000	YN	0.00	0.0000	2.2500	0.0540	0.5390	0.0000	0.0000	1.0000	0.00
DATA for Transformer with ID. T4				No. of units 1 using library key T001								
BB3 132kV	1	6.000	D	30.00	0.0000	2.2500	0.0540	0.5390	0.0000	0.0000	1.0000	0.00
BB9-11kV	2	6.000	YN	0.00	0.0000	2.2500	0.0540	0.5390	0.0000	0.0000	1.0000	0.00

INDUCTION MACHINE DATA

Busbar Identifier	Motor Identifier	No.Of Units	Library Key	Motor Ratings MVA	MW	kV	Input MW	Slip (%)	Stator R(pu)	Stator X(pu)	Magnet. X(pu)	Standstill R(pu)	Standstill X(pu)	Rotor Running R(pu)	Rotor Running X(pu)
BB1-415V	IM	1	M003	0.196	0.196	0.415	0.000	0.0000	0.0185	0.0918	5.8000	0.0215	0.1060	0.0134	0.1910
BB8-415V	IM2	1	M003	0.196	0.196	0.415	0.100	0.6837	0.0185	0.0918	5.8000	0.0215	0.1060	0.0134	0.1910
BB10-415V	IM3	1	M002	1.000	1.000	0.415	0.100	0.1340	0.0185	0.0918	5.8000	0.0215	0.1060	0.0134	0.1910

Network Name : CASE4
Data State Name : BB11-11kV & BB13-11kV BB7OPEN

INFINITE GENERATOR DATA

Busbar Identifier	Machine Identifier	Machine Ratings MVA	MW	kV	Assigned V(pu)	Pos. Sequence R(pu)	X(pu)	Neg. Sequence R(pu)	X(pu)	Zero Sequence R(pu)	X(pu)
BB 132kV	TNB A	150.00	14.93	132.00	1.000	0.0995	0.9950	0.0995	0.9950	0.0995	0.9950
BB2 132kV	TNB B	150.00	14.93	132.00	1.000	0.0995	0.9950	0.0995	0.9950	0.0995	0.9950

SYNCHRONOUS MACHINE DATA

Busbar Identifier	Machine Identifier	Type	No.Of Units	Library Key	Generator Ratings MVA BASE	MW	kV	V(pu)	Assigned MW	MVAR	Pos. Sequence R(pu)	X(pu)	Neg. Sequence R(pu)	X(pu)	Zero Sequence R(pu)	X(pu)
BB12-11kV	SG1	SLACK	1	GMIN	50.000	50.000	11.000	1.000	0.000	0.000	0.0120	0.2770	0.0200	0.1840	0.0150	0.0800
					Neutral earthing						0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

SHUNT DATA

Busbar Identifier	Shunt Identifier	No.Of Units	Type	Library Key	Rating MVA	Data Values Positive/Negative Sequence		Zero Sequence	
BB2-415V	Load1	1	MW/pf	Ld1		1.000 MW	0.800 pf		
BB3-415V	Load2	1	G/B pu Base	SampleG/Bpu1	1.00	0.008 G pu	-0.006 B pu	0.008 G pu	-0.006 B pu
BB4-415V	Load3	1	kW/pf	samplekW/pf		600.000 kW	0.800 pf		
BB5-415V	load 4	1	R/X Ohm	sampleR/X	1.50	100.000 R Ohm	75.000 X Ohm	100.000 R Ohm	75.000 X Ohm
BB6-415V	Load5	1	kW/pf	samplekW/pf		600.000 kW	0.800 pf		
BB7-415V	Load6	1	MW/pf	Ld2		0.900 MW	0.800 pf		
BB9-415V	load7	1	MW/pf	Ld1		0.500 MW	0.800 pf		
BB9-11kV		1	MW/MVAR	Load1		1.000 MW	0.750 MVAr		
BB11-415V	load8	1	MW/pf	Ld2		0.900 MW	0.800 pf		
BB12-415V	load9	1	MW/pf	Ld2		0.400 MW	0.800 pf		

Network Name   : CASE4
Data State Name : BB11-11kV & BB13-11kV BB7OPEN

BUS SECTION DATA

First Busbar	Second Busbar	Status
BB3-11kV	BB4-11kV	Closed
BB4-11kV	BB5-11kV	Closed
BB5-11kV	BB6-11kV	Closed
BB6-11kV	BB7-11kV	Closed
BB7-11kV	BB8-11kV	Closed
BB2 132kV	BB3 132kV	Closed
BB10-11kV	BB11-11kV	Closed
BB11-11kV	BB12-11kV	Open
BB13-11kV	BB14-11kV	Closed
BB14-11kV	BB15-11kV	Closed

Network Name : CASE4
Data State Name : BB11-11kV & BB13-11kV BB7OPEN

AT STUDY END - No of iterations = 4 Convergence = 0.1289E-05
Voltage Range from 0.868pu at BB11-415V to 1.000pu at BB 132kV

AC BUSBAR VALUES

Busbar Identifier	Merge	Busbar Type	Voltage PU	Voltage kV	Voltage ANG-DEG	Synch. Machines MW	Synch. Machines MVAr	Ind Motor Load MW	Ind Motor Load MVAr	Shunt Loads MW	Shunt Loads MVAr	3 Phase Fault kA	3 Phase Fault X/R	Ph - E Fault kA	Ph - E Fault X/R
BB 132kV	.	INF.BUS	1.000	132.000	0.000	1.072	0.872	0.000	0.000	0.000	0.000	0.71	11.057	0.69	10.156
BB2 132kV	M6	INF.BUS	1.000	132.000	-0.620	2.979	3.108	0.000	0.000	0.000	0.000	0.72	11.014	0.69	9.327
BB3 132kV	M6	LOAD	1.000	132.000	-0.620	0.000	0.000	0.000	0.000	0.000	0.000	0.72	11.014	0.69	9.327
BB12-11kV	.	SLACK	1.000	11.000	1.326	0.101	0.048	0.000	0.000	0.000	0.000	9.51	22.816	14.55	11.459
BB1-11kV	.	LOAD	0.971	10.684	-2.134	0.000	0.000	0.000	0.000	0.000	0.000	2.37	17.952	3.26	16.596
BB10-11kV	M7	LOAD	0.969	10.664	-2.134	0.000	0.000	0.000	0.000	0.000	0.000	2.23	8.025	2.54	2.095
BB11-11kV	M7	LOAD	0.969	10.664	-2.134	0.000	0.000	0.000	0.000	0.000	0.000	2.23	8.025	2.54	2.095
BB13-11kV	M9	LOAD	0.896	9.852	-7.567	0.000	0.000	0.000	0.000	0.000	0.000	1.21	6.078	1.59	6.352
BB14-11kV	M9	LOAD	0.896	9.852	-7.567	0.000	0.000	0.000	0.000	0.000	0.000	1.21	6.078	1.59	6.352
BB15-11kV	M9	LOAD	0.896	9.852	-7.567	0.000	0.000	0.000	0.000	0.000	0.000	1.21	6.078	1.59	6.352
BB2-11kV	.	LOAD	0.971	10.684	-2.134	0.000	0.000	0.000	0.000	0.000	0.000	2.37	17.952	3.26	16.596
BB3-11kV	M3	LOAD	0.971	10.683	-2.134	0.000	0.000	0.000	0.000	0.000	0.000	2.37	18.500	3.27	17.193
BB4-11kV	M3	LOAD	0.971	10.683	-2.134	0.000	0.000	0.000	0.000	0.000	0.000	2.37	18.500	3.27	17.193
BB5-11kV	M3	LOAD	0.971	10.683	-2.134	0.000	0.000	0.000	0.000	0.000	0.000	2.37	18.500	3.27	17.193
BB6-11kV	M3	LOAD	0.971	10.683	-2.134	0.000	0.000	0.000	0.000	0.000	0.000	2.37	18.500	3.27	17.193
BB7-11kV	M3	LOAD	0.971	10.683	-2.134	0.000	0.000	0.000	0.000	0.000	0.000	2.37	18.500	3.27	17.193
BB8-11kV	M3	LOAD	0.971	10.683	-2.134	0.000	0.000	0.000	0.000	0.000	0.000	2.37	18.500	3.27	17.193
BB9-11kV	.	LOAD	0.896	9.855	-7.567	0.000	0.000	0.000	0.000	1.000	0.750	1.21	6.130	1.59	6.436
BB1-415V	.	LOAD	0.969	0.402	-2.028	0.000	0.000	0.000	0.031	0.000	0.000	15.13	1.502	20.73	1.660
BB10-415V	.	LOAD	0.881	0.366	-7.426	0.000	0.000	0.100	0.135	0.000	0.000	16.13	2.496	21.60	2.737
BB11-415V	.	LOAD	0.868	0.360	-9.472	0.000	0.000	0.000	0.000	0.900	0.675	19.15	5.409	24.81	5.919
BB12-415V	.	LOAD	0.878	0.364	-8.811	0.000	0.000	0.000	0.000	0.400	0.300	19.03	6.562	26.97	6.526
BB2-415V	.	LOAD	0.940	0.390	-7.383	0.000	0.000	0.000	0.000	1.000	0.750	12.98	8.254	16.52	7.958
BB3-415V	.	LOAD	0.971	0.403	-2.138	0.000	0.000	0.000	0.000	0.001	0.001	16.59	69.861	21.74	39.801
BB5-415V	.	LOAD	0.971	0.403	-2.138	0.000	0.000	0.000	0.000	0.001	0.001	16.59	69.861	21.74	39.801
BB6-415V	.	LOAD	0.904	0.375	-2.683	0.000	0.000	0.000	0.000	0.600	0.450	13.91	1.285	19.14	1.429
BB8-415V	.	LOAD	0.992	0.412	1.156	0.000	0.000	0.100	0.047	0.000	0.000	17.67	1.203	24.20	1.345
BB4-415V			BUS DISCONNECTED												
BB7-415V			BUS DISCONNECTED												
BB9-415V			BUS DISCONNECTED												

Network Name : CASE4
Data State Name : BB11-11kV & BB13-11kV BB7OPEN

BUSBAR TOTALS	4.151	4.027	0.200	0.213	3.902	2.927
TOTAL BUS LOAD	4.102	3.140				
SYSTEM LOSSES	0.049	0.887				

LINE VALUES

First Busbar	Second Busbar	Branch Identifier	No.Of Ccts	Rating kA	First MW	End MVAr	Flow kA	Second MW	End MVAr	Flow kA	Loading (%)	O/L FLAG
BB3-11kV	BB10-11kV	L1	1	0.459	0.640	0.489	0.044	-0.639	-0.489	0.044	9.5	
BB9-11kV	BB15-11kV	L2	1	7.000	1.408	1.177	0.108	-1.408	-1.178	0.108	1.5	
BB1-11kV	BB3-11kV	L3	1	7.000	0.536	0.404	0.036	-0.536	-0.406	0.036	0.5	
BB2-11kV	BB5-11kV	L4	1	7.000	0.536	0.404	0.036	-0.536	-0.406	0.036	0.5	

TRANSFORMER VALUES

Transformer Identifier	No.Of Units	Winding No.	Connected Busbar	Winding kV	Voltage Ratio	Off Nominal Tap %	Rating MVA	Flow From Busbar MW	MVAr	Current kA	Percent Loading	O/L Flag
T5	1	1	BB4-11kV	11.000	1.0000	0.000	2.500	0.000	0.031	0.002	1.3	
		2	BB1-415V	0.415	1.0000	0.000	2.500	0.000	-0.031	0.045	1.3	
T6	1	1	BB5-11kV	11.000	1.0000	0.000	1.500	1.000	0.904	0.073	89.9	
		2	BB2-415V	0.433	1.0434	0.000	1.500	-1.000	-0.750	1.851	83.3	
T7	1	1	BB6-11kV	11.000	1.0000	0.000	2.000	0.001	0.001	0.000	0.1	
		2	BB3-415V	0.415	1.0000	0.000	2.000	-0.001	-0.001	0.002	0.1	
T8	1	1	BB7-11kV	- WINDING DISCONNECTED								
		2	BB4-415V	- WINDING DISCONNECTED								
T9	1	1	BB8-11kV	11.000	1.0000	0.000	2.000	0.001	0.001	0.000	0.1	
		2	BB5-415V	0.415	1.0000	0.000	2.000	-0.001	-0.001	0.002	0.1	
T10	1	1	BB10-11kV	11.000	1.0000	0.000	2.500	0.639	0.489	0.044	32.2	
		2	BB6-415V	0.415	1.0000	0.000	2.500	-0.600	-0.450	1.154	30.0	
T11	1	1	BB11-11kV	- WINDING DISCONNECTED								
		2	BB7-415V	- WINDING DISCONNECTED								
T12	1	1	BB12-11kV	11.000	1.0000	0.000	2.500	0.101	0.048	0.006	4.5	
		2	BB8-415V	0.415	1.0000	0.000	2.500	-0.100	-0.047	0.155	4.4	

Run on 04-Jun-2009 by Supervisor from data set up on 04-Jun-2009 by Supervisor

Network Name : CASE4
Data State Name : BB11-11kV & BB13-11kV BB7OPEN

TRANSFORMER VALUES

Transformer Identifier	No.Of Units	Winding No.	Connected Busbar	Winding kV	Voltage Ratio	Off Nominal Tap %	Rating MVA	Flow From Busbar MW	Flow From Busbar MVAr	Current kA	Percent Loading	O/L Flag
T13	1	1	BB13-11kV	- WINDING DISCONNECTED								
		2	BB9-415V	- WINDING DISCONNECTED								
T14	1	1	BB14-11kV	11.000	1.0000	0.000	2.500	0.102	0.137	0.010	6.8	
		2	BB10-415V	0.415	1.0000	0.000	2.500	-0.100	-0.135	0.265	6.7	
T15	1	1	BB15-11kV	11.000	1.0000	0.000	2.500	1.306	1.041	0.098	66.8	
		2	BB11-415V	0.415	1.0000	0.000	2.500	-0.900	-0.675	1.802	45.0	
		3	BB12-415V	0.415	1.0000	0.000	2.500	-0.400	-0.300	0.792	20.0	
T1	1	1	BB 132kV	132.000	1.0000	0.000	4.000	0.536	0.436	0.003	17.3	
		2	BB1-11kV	11.000	1.0000	0.000	4.000	-0.536	-0.404	0.036	16.8	
T2	1	1	BB 132kV	132.000	1.0000	0.000	4.000	0.536	0.436	0.003	17.3	
		2	BB2-11kV	11.000	1.0000	0.000	4.000	-0.536	-0.404	0.036	16.8	
T3	1	1	BB2 132kV	132.000	1.0000	0.000	6.000	0.570	0.648	0.004	14.4	
		2	BB8-11kV	11.000	1.0000	0.000	6.000	-0.570	-0.614	0.045	14.0	
T4	1	1	BB3 132kV	132.000	1.0000	0.000	6.000	2.408	2.460	0.015	57.4	
		2	BB9-11kV	11.000	1.0000	0.000	6.000	-2.408	-1.927	0.181	51.4	

BRANCH LOSS SUMMARY

	(MW)	(MVAr)
SERIES LOSSES	0.049	0.894
SHUNT LOSSES	0.000	-0.007
TOTAL LOSSES	0.049	0.887

Run on 04-Jun-2009 by Supervisor from data set up on 04-Jun-2009 by Supervisor

Network Name : CASE4
Data State Name : BB11-11kV & BB13-11kV BB7OPEN

INDUCTION MACHINE VALUES

Busbar Identifier	Machine Identifier	No.Of Units	Slip %	Terminal Voltage kV	Machine MW	Input MVAr	Current kA	O/L Flag
BB1-415V	IM	1	0.00	0.402	0.000	0.031	0.045	
BB8-415V	IM2	1	0.74	0.412	0.100	0.047	0.155	
BB10-415V	IM3	1	0.18	0.366	0.100	0.135	0.265	

SYNCHRONOUS MACHINE VALUES

Busbar Identifier	Machine Identifier	No.Of Units	Terminal Voltage kV	Power MW	Output MVAr	Current kA	O/L Flag
BB 132kV	TNB A	1	132.000	1.072	0.872	0.006	
BB2 132kV	TNB B	1	132.000	2.979	3.108	0.019	
BB12-11kV	SG1	1	11.000	0.101	0.048	0.006	

SHUNT VALUES

Busbar Identifier	Shunt Identifier	Shunt MW	Load MVAr	Current kA	O/L Flag
BB2-415V	Load1	1.000	0.750	1.851	
BB3-415V	Load2	0.001	0.001	0.002	
BB4-415V	Load3	SHUNT DISCONNECTED			
BB5-415V	load 4	0.001	0.001	0.002	
BB6-415V	Load5	0.600	0.450	1.154	
BB7-415V	Load6	SHUNT DISCONNECTED			
BB9-415V	load7	SHUNT DISCONNECTED			
BB9-11kV		1.000	0.750	0.073	
BB11-415V	load8	0.900	0.675	1.802	
BB12-415V	load9	0.400	0.300	0.792	

Network Name : CASE4
Data State Name : BB11-11kV & BB13-11kV BB7OPEN

BUS SECTION VALUES

First Busbar	Second Busbar	MW	MVAr	kA
BB3-11kV	BB4-11kV	-0.104	-0.083	0.007
BB4-11kV	BB5-11kV	-0.104	-0.114	0.008
BB5-11kV	BB6-11kV	-0.568	-0.613	0.045
BB6-11kV	BB7-11kV	-0.569	-0.614	0.045
BB7-11kV	BB8-11kV	-0.569	-0.614	0.045
BB2 132kV	BB3 132kV	2.408	2.460	0.015
BB10-11kV	BB11-11kV	0.000	0.000	0.000
BB11-11kV	BB12-11kV	0.000	0.000	0.000
BB13-11kV	BB14-11kV	0.000	0.000	0.000
BB14-11kV	BB15-11kV	-0.102	-0.137	0.010