

Short Circuit and Contingency Analysis Implementation for IEEE-14 Bus System using Mi Power Software

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Abstract: In this paper we have explained about the performance of IEEE-14 bus system by using Mi power technology. In the previous project the load flow analysis and stability analysis was found by using Mi power software. This project shows the short circuit and contingency analysis by using MI power technology. The maximum & minimum real and reactive power limit have been set & the results are obtained. The output result was found more efficient compared to the previous model. All the power system equipments were designed to withstand high efficiency and to withstand worst case condition. The MI power software is the advanced technology in order to improve the load flow analysis, stability analysis, short circuit and contingency analysis. This project explains about the MI power software to which it raises the efficiencies for the calculation of short circuit and contingency analysis. This project explains about the different fault conditions such as symmetrical and unsymmetrical fault analysis in which we are considering about the short circuit analysis. The transient and sub transient components are to be found and the system leads to the stable condition.

Keywords: IEEE 14 bus, Contingency Analysis, Mi Power Software 9.1

I. INTRODUCTION

The power was generated at the generating stations & it was feed into the transmission line via step up transformer. The electrical energy was travelled from generation station to the distribution station via the transmission lines. In between the generating station & distribution various voltage levels was used. High voltage was needed in the generating station & low voltage is used in the distribution side. The voltage in the distribution side was stepped down using transformer & it was utilized by the consumers. The electrical power was generated by generators in various forms like Coal, Nuclear, Wind etc., Generally voltage level is usually 11Kv,16.5 KV,33KV,. Over long distances more losses may be there so it may be step up to 132KV, 220KV, 400KV etc., & fed in to the sub transmission network & to the distribution substations. All the substations are situated at the load centers. Mostly the transformers in the commercial & residential area are step up transformer whereas in the load side we will have step down transformer. Causes of Power System Faults The causes of faults are numerous, e.g. Lightning

- Heavy winds
- Transmission lines faults due to trees
- Vehicles collide with tower
- Short circuit due to birds
- Aircraft collide with the line
- Small organisms entering into switchgear
- Line gets breakdown due to high load

II. COMMON POWER SYSTEM FAULTS

Power system faults may be classified as two types; in the order of frequency of occurrence, they are: Un Symmetrical Fault & Symmetrical Fault The first fault constitutes rigorous unbalanced operating conditions which involves only one or two phases hence referred to as unsymmetrical faults. In the fourth type, a fault involving all the three phases occurs therefore referred to as symmetrical (balanced) fault.

III. EFFECTS OF POWER SYSTEM FAULTS

Faults may lead to fire breakout that consequently results into loss of property, loss of life and destruction of a power system network. Faults also leads to cut of supply in areas beyond the fault point in a transmission and distribution network leading to power blackouts; this interferes with industrial and commercial activities that supports economic

growth, stalls learning activities in institutions, work in offices, domestic applications and creates insecurity at night.

IV. THREE-SEQUENCE IMPEDANCES AND SEQUENCE NETWORKS

Positive sequence currents give rise to positive sequence voltage, & the negative sequence current give rise to negative sequence voltages and zero sequence current give rise to zero sequence voltages, hence each network can be regarded as flowing within in its own network through impedances of its own sequence only.

V. SEQUENCE NETWORK OF SYNCHRONOUS ALTERNATORS

An unloaded synchronous machine having its neutral earthed through impedance, Z_n , is shown in fig. 2(a) below. A fault at its terminal causes currents I_a , I_b and I_c to flow in lines. If fault involves earth, a current I_n flows into the neutral from the earth. This current flows through the neutral impedance Z_n . Thus depending on the type of fault, one or more of the line currents may be zero.

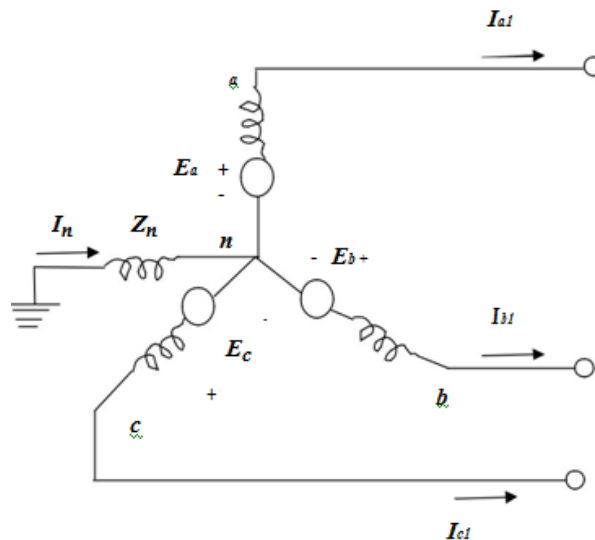


Fig:1 Sequence Network

VI. POSITIVE SEQUENCE NETWORK

The generated voltages of a synchronous machine are of positive sequence only since the windings of a synchronous machine are symmetrical. Positive sequence network consist of an emf equal to no load terminal voltages and is in series with the positive impedance Z_1 of the machine. Fig shows the paths for positive sequence currents and positive sequence network respectively on a single phase basis in the synchronous machine. The neutral impedance Z_n will disappear in circuit because the phasor sum of I_{a1} , I_{b1} and I_{c1} are zero & no positive sequence current can flow through Z_n

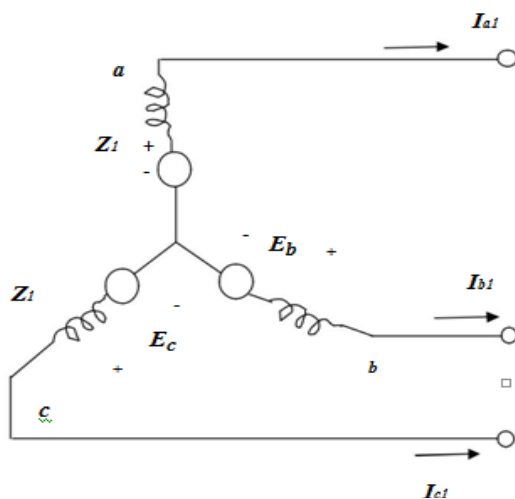


Fig:2 Circuit of Positive Sequence

VII. NEGATIVE SEQUENCE NETWORK

A synchronous machine won't generate any negative sequence voltage. Flow of negative sequence currents in the stator winding creates an mmf which rotate at synchronous speed in the direction opposite to direction of rotor, i.e., at double the synchronous speed with respect to rotor.

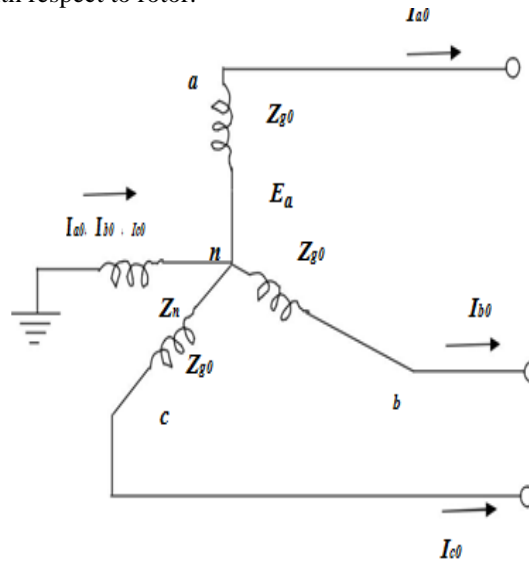


Fig:3 Negative Sequence Network

VIII. ZERO SEQUENCE NETWORK

Zero sequence voltage is not induce in a synchronous machine. The run of zero sequence current in the stator winding produces three mmf which are in the time phase. If each phase winding produced a sinusoidal space mmf, then with the rotor removed, the flux at a point lying on the axis of the stator due to zero sequence current would be zero at every instant. When the flux in the air gap or the leakage flux around slots or end connections is considered, no point in these regions is equidistant from all the three -phase windings of the stator. The mmf produced by a phase winding departs from a sine wave, by amounts which depend upon the arrangement of the winding.

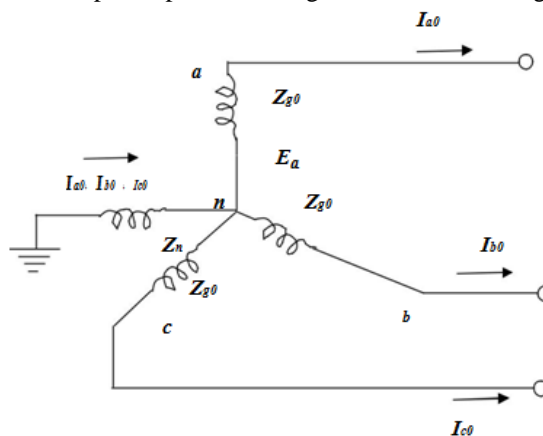
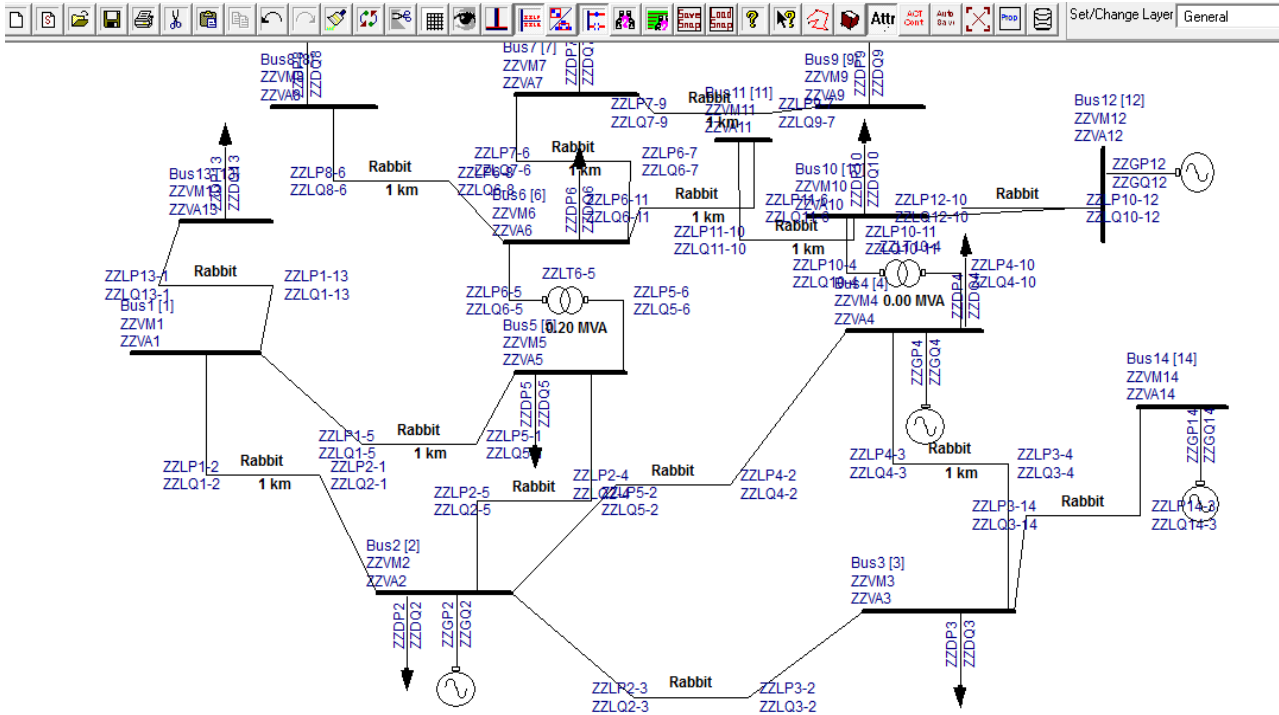


Fig:4 Zero Sequence Network

IX. MI POWER SOFTWARE VERSION 9.1

Mi Power 9.1 is extremely user-friendly windows based software on Power System Analysis. It has set of module for designing the whole power system by simulation diagram. It has a capability to do Load flow analysis, Short circuit analysis, Transient stability, Relay coordination, Line & cable parameter calculation, Network reduction. Analysis of harmonics & Dynamic stability can also be analyzed by this software. In this paper we have fin out the contingency & short circuit analysis of a IEEE 14 bus system. By using this software we can analyze the Planning of power system well before the installation happen

X. OUTPUT RESULTS



~~~~~ INPUT DATA ~~~~~

\*\*\*\*\* SYSTEM SPECIFICATION \*\*\*\*\*

|                                    |   |    |                                      |   |   |
|------------------------------------|---|----|--------------------------------------|---|---|
| Largest Bus Number Used            | : | 14 |                                      |   |   |
| Actual Number of Buses             | : | 14 |                                      |   |   |
| Number of Two winding Transformers | : | 1  | Number of Three winding Transformers | : | 0 |
| Number of Transmission Lines       | : | 14 | Number of Series Reactors            | : | 0 |
| Number of Series Capacitors        | : | 0  | Number of Circuit Breakers           | : | 0 |
| Number of Shunt Reactors           | : | 0  | Number of Shunt Capacitors           | : | 0 |
| Number of Shunt Impedances         | : | 0  | Number of Generators                 | : | 4 |
| Number of Loads                    | : | 10 | Number of Load Characteristics       | : | 0 |
| Number of Frequency Relays         | : | 0  | Number of Gen.Capability Curves      | : | 0 |
| Number of Filters                  | : | 0  | Number of Tie Line Schedules         | : | 0 |
| Number of Convertors               | : | 0  | Number of DC Links                   | : | 0 |
| Number of Shunt Connected FACTS    | : | 0  | Number of Power Injections           | : | 0 |
| Number of TCSC Connected           | : | 0  | Number of SPS Connected              | : | 0 |
| Number of UPFC Connected           | : | 0  | Number of Wind Generators            | : | 0 |
| Number of wtg Curves               | : | 0  | Number of wtg Detailed Curves        | : | 0 |
| Number of solar plants             | : | 0  |                                      |   |   |

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|                                                   |   |         |                               |  |  |
|---------------------------------------------------|---|---------|-------------------------------|--|--|
| Contingency Analysis - Option                     | : | 4       |                               |  |  |
| Number of Zones                                   | : | 1       |                               |  |  |
| Print Option                                      | : | 3       | - Both Data and Results Print |  |  |
| Plot Option                                       | : | 1       | - Plotting with p.u. Voltage  |  |  |
| No Frequency Dependent Load Flow, Control option: | : | 0       |                               |  |  |
| Base MVA                                          | : | 100.0   |                               |  |  |
| Nominal System Frequency (Hz)                     | : | 50.0    |                               |  |  |
| Frequency Deviation (Hz)                          | : | 0.0     |                               |  |  |
| Flows in MW and MVAR, Option                      | : | 0       |                               |  |  |
| Slack Bus                                         | : | 0       | (Max. Generation Bus)         |  |  |
| Transformer Tap Control Option                    | : | 0       |                               |  |  |
| Q Checking Limit (Enabled)                        | : | 4       |                               |  |  |
| Real Power Tolerance (p.u.)                       | : | 0.00100 |                               |  |  |
| Reactive Power Tolerance (p.u.)                   | : | 0.00100 |                               |  |  |
| Maximum Number of Iterations                      | : | 15      |                               |  |  |
| Bus voltage below which Load Model is changed     | : | 0.75000 |                               |  |  |
| Circuit Breaker Resistance (p.u.)                 | : | 0.00000 |                               |  |  |
| Circuit Breaker Reactance (p.u.)                  | : | 0.00010 |                               |  |  |
| Transformer R/X Ratio                             | : | 0.05000 |                               |  |  |



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Fault Type :2(Single Phase to Ground Fault)
Phase Fault Resistance :0.00000
Phase Fault Reactance :0.00000
Ground Fault Resistance :0.00000
Ground Fault Reactance :0.00000

%-----%
%-----%
|-----ITERATIVE SHORT CIRCUIT DATA -----|
Magnitude Tolerance :0.01000p.u.
Angle Tolerance :1.000deg
Maximum Number of Iterations :15
%-----%

|-----MULTIPLICATION FACTORS-----|

TRANSFORMER MULTIPLICATION FACTORS

Transformer R/X Ratio :0.05000
Transformer Zero Sequence Impedance :0.01745

TRANSMISSION LINE MULTIPLICATION FACTORS

Number of Transmission voltage Levels :1
%-----%
Transmission Line|Zero Sequence Impedance |Zero Sequence Admittance
Voltage |Resistance Factor|Reactance Factor|Admittance Factor
%-----%
          400.00000          2.50000          2.50000          0.80000
%-----%

GENERATOR MULTIPLICATION FACTORS
Negative Sequence Resistance :0.17500
Negative Sequence Reactance :0.17500
Zero Sequence Resistance :0.03750
Zero Sequence Reactance :0.03750

LOAD MULTIPLICATION FACTORS
Negative Sequence Impedance :0.81000
Zero Sequence Impedance :1.60000
    
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%% First Power System Network

|~~~~~ INPUT DATA ~~~~~|

|\*\*\*\*\* SYSTEM SPECIFICATION \*\*\*\*\*|

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Largest Bus Number Used : 3
Actual Number of Buses : 3
Number of Two Winding Transformers : 0 Number of Three winding Transformers : 0
Number of Transmission Lines : 3 Number of Series Reactors : 0
Number of Series Capacitors : 0 Number of Circuit Breakers : 0
Number of Shunt Reactors : 0 Number of Shunt Capacitors : 0
Number of Shunt Impedances : 0 Number of Generators : 3
Number of Loads : 0 Number of Load Characteristics : 0
Number of Frequency Relays : 0 Number of Gen.Capability Curves : 0
Number of Filters : 0 Number of Tie Line Schedules : 0
Number of Convertors : 0 Number of DC Links : 0
Number of Shunt Connected FACTS : 0 Number of Power Injections : 0
Number of TCSC Connected : 0 Number of SPS Connected : 0
Number of UPFC Connected : 0 Number of wind Generators : 0
Number of wtg Curves : 0 Number of wtg Detailed Curves : 0
Number of solar plants : 0
    
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Load Flow - Fast De-Coupled Technique : 0
Number of Zones : 1
Print Option : 3 - Both Data and Results Print
Plot Option : 1 - Plotting with p.u. voltage
No Frequency Dependent Load Flow, Control Option: 0
Base MVA : 100.0
Nominal System Frequency (Hz) : 50.0
Frequency Deviation (Hz) : 0.0
Flows in MW and MVAR, Option : 0
Slack Bus : 0 (Max. Generation Bus)
Transformer Tap Control Option : 0
Q checking Limit (Enabled) : 4
Real Power Tolerance (p.u.) : 0.00100
Reactive Power Tolerance (p.u.) : 0.00100
    
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**XI. CONCLUSION**

This paper represents the short circuit analysis and contingency analysis for the IEEE 14 bus system by using Mi power software 9.1 in which the transient and sub transient reactance of the components in a system are monitored and the stability of the system has been improved. The sequence impedances are considered and the system has been designed accordingly to improve the performance. Hence the project concludes “the performance of the IEEE-14 bus system” by implementing the calculation of short circuit analysis and contingency analysis for improving by considering the stability criteria to maintain the system as a stable system.

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