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Three Phase Load Flow Analysis on Four Bus System

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Abstract: **In this paper three phase load flow analysis on four bus system using Mi Power software is reformed. As power system never operates under steady state condition therefore single phase load flow analysis doesn't provide accurate results. Hence three phase load flow analysis which can be performed under different contingencies, provide data when system is unbalanced. The system is analysing on the basis of parameter values in MW & MVAR for transmission line and generator buses. Harmonic values of resistance, reactance, and susceptance can predict the condition of small and large kind of system network. This type of analysis is useful for solving the power flow problem in different power systems which will useful to calculate the unknown parameter.**

Keywords: **Mi Power, load flow, contingency weightage.**

1. INTRODUCTION

Load flow (power flow) analysis is the determination of current, voltage, active power and reactive power (volt amperes) at various points in a power system operating under normal steady state or static conditions. Load flow studies are made to plan the best operation and control of the existing system are well as to plan the future expansion to keep pace with the load growth. Such studies help in ascertaining the effects of new loads, new generating station, new lines and new interconnection before they are installed. The prior information serves to minimize the system losses and to provide a check on the system stability.

The flow of active and reactive power is called the power flow or load flow. Voltage of buses and their phase angles are affected by the power flow and vice versa.

One of the generator buses is selected as the reference bus for the reason therefore generator bus is made to take the additional real and reactive powers to supply the transmission losses so this bus is known as the slack bus or swing bus. The losses in system remain unknown until the load solution is complete. The profiles of voltage, the value and direction of active power and reactive power significantly. Load flow studies are performed to calculate the magnitude and phase angle of voltages at the buses and also the active power and reactive volt amperes flow for the given terminal or bus conditions. The following variables are associated with each bus or node.

- Magnitude of the voltage $|V|$
- Phase angle of the voltage (δ)
- Active power (P)
- Reactive volt amperes (Q)

2. METHODS USED FOR LOAD FLOW ANALYSIS

- Gauss seidal method
- Newton raphson method
- Fast decoupled method

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Following papers work has been taken as reference [1] A three-phase model for a DSSC based on SSSC (static synchronous series compensator) model suitable for power flow analysis is proposed in this paper. The DSSC (distributed static series compensator) system is a three phase system requiring a three phase power flow. The limitation in inserting all DSSC modules into the system leads to use three DSSC units on each compensated phase. The model implementation in Newton power flow algorithm is explained in order to control the active power flow. Numerical results carried out on the IEEE 30-bus and the 5-bus test system demonstrated the feasibility of the proposed Three phase DSSC model. Since the Newton power flow is basically dependent on initial values, a convergence problem observed in simulations due to such initialization.[2] developed a sequential three-phase power flow program with TZBD (three phase Z_{bus} distribution) in Mat lab environment for power flow calculation. The simulation results of this program also verified by the IEEE 4 Node Test Feeder. The outcomes of this paper are helpful to the planning and operation of the complicated distribution systems, which will be connected with distributed generation and energy storage systems in the near future, and furthermore to increase the operation benefits of the electric power distribution systems.[3] discusses how Zig-Zag transformer can be used to take care of zero sequence current component of unbalanced and distorted load current using existing method. Although existing method works well for balanced source voltages still source neutral current is not exactly zero and it depends on the impedance inserted in source neutral wire. In addition to that, existing method of neutral current compensation using Zig-Zag transformer fails in case of unbalanced source voltages. The analysis of Zig-Zag transformer shows that floating neutral of Zig-Zag transformer is at potential equal to the zero sequence voltages component of the source voltage. Thus, the removal of source neutral wire solves the problem of existing topology.[4] single and two phase lines are model by equivalent three phase lines with non-ganged switches disconnecting the virtual phases from the network. Modelling of these Non-ganged switches is only necessary at the line ends, which are connected to nodes where additional phases are present. This has the following advantage: All the lines of the network are model as symmetrical lines. Using the system for these lines, there exist no couplings between the components of these lines. The un-symmetry is modelled by additional equations for the currents and the voltages at both sides of the switch. Any coupling is limited only to the columns and rows of the matrix, which are affected by these switches. Model of these switches is not necessary for all terminals of a two phase or one phase branch. It is only to be implemented at the places, where the real phases at both sides of this non ganged switch differs, As a result, the couplings are reduced to a minimum of components speeding up load flow calculations in unbalanced networks significantly. [5] Unbalanced distribution power-flow based on sequence components. An unbalanced distribution network is decomposed into a main three-phase circuit and unbalanced laterals. The main three-phase network is solved using the sequence decoupled power-flow algorithm. The unbalanced laterals are solved using the forward/backward sweep method. This results in a hybrid solution in both sequence and phase components. The advantage of the proposed formulation is that a complicated distribution network is decomposed to many sub-problems. One of these sub problems is basically a standard single-phase power-flow used in the sequence decoupled power-flow algorithm. The decoupling features of the proposed formulation eventually reduce the size of the distribution power-flow problem which leads to improvements in both execution time and memory requirements. [6] Development of power flow solution for balanced, unbalanced and multiphase distribution systems. Satisfactory results have been obtained and verified Using MATPOWER and backward forward method based tool developed at MSU. Simulation results have been obtained using balanced/ unbalanced meshed system, shipboard power system and four node system. The developed tool can handle multiphase network, both radial and meshed system, balanced and unbalanced network and can also handle multiple generators. DGs can be used in the program which has been modelled as PV node. Power system generally consists of a combination of constant power, constant impedance and constant current loads. This program has been developed assuming loads as constant power. Different types of loads need to be considered for accurate representation of system loads.[7] three phase DG (distribution generation) model in unbalanced three-phase distribution power-flow and analysed their effect when they are connected in distribution networks. In this paper, the DG was modelled as PV node with an option to convert to a PQ node when it achieved Q limit. The model was tested and analysed using a practical 37 node distribution feeder with various size and location of DG. The simulation results show that DG size and location are important factors to improve voltage profile and line losses reduction. The DG location give more effect in voltage profile improvement compared to network loss reduction for DG modeled as PV node. In contrast the DG sizes give more effect in network loss reduction compared to voltage profile improvement.

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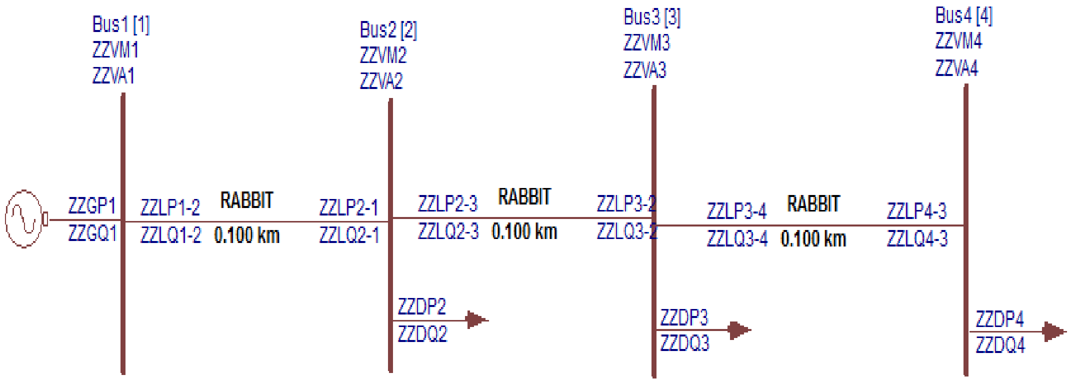

fig. four bus based single line diagram

3. MODEL CONFIGURATION

I have performed three phase load flow analysis on four bus system which comprises of generator buses and load bus. bus 1 is generator bus and rest of buses are load buses, following data sheet has been used different components like generator, load, buses etc. connected. in power system.

On the basis of above methods load flow analysis is performed. The base voltage taken as 415 volts and system frequency is 50 Hz, base MVA as 0.25 MVA.

4. GENERATOR DATA

Bus no.	Bus voltage	MVA	Xn(pu)	X_0(pu)
1	1.00+j0.0	0.25	0.0001	0.0001
2	1.00+j0.0	0.25	0.0001	0.0001
3	1.00+j0.0	0.25	0.0001	0.0001

Generator element data:

Sr.no.	Detailed element	Values
1.	No. of units in parallel	1
2.	Specified voltage	0.415
3.	DE rated MVA	0.25
4.	Scheduled power	0.2
5.	Real power- minimum	0
6.	Real power- maximum	0.2
7.	Reactive power- minimum	0
8.	Reactive power- maximum	0.15
9.	Droop %	4 %

Generator library data:

Sr.no.	Detail and name	Values in
1.	Negative sequence reactance (X_n)	0.0001 pu
2.	Zero sequence reactance	0.0001 pu
3.	MVA rating	0.25 mva
4.	MW rating	0.2 mw
5	KV rating	0.415 kv
6.	Direct axis transient reactance	0 pu

Transmission line element data:

Transmission line connects the entire power system network. Its value essential for healthy network. Here value of thermal rating is 0.131541 and the De rated MVA is 0.13154.

Line no.	From bus no.	To bus no.	No. of circuits	Structure ref. no.	Length in KM
1.	1	2	1	1	0.1
2.	2	3	1	1	0.1
3.	3	4	1	1	0.1

Transmission line library data:

Library data come further by entering in main transmission line element data.

Structure ref. no.	Structure ref name	Line harmonic no.	Thermal rating MVA
1	RABBIT	1	0.131541

Transmission line and cable data need for line harmonic information of resistance, inductance, susceptance following data is given –

Resistance (ohms/km):

	A	B	C
A	0.5	0	0
B	0	0.5	0
C	0	0	0.5

Reactance (ohms/km):

	A	B	C
A	0.4	0	0
B	0	0.4	0
C	0	0	0.4

Susceptance (mho/km):

	A	B	C
A	0	0	0
B	0	0	0
C	0	0	0

Bus element data:

Bus no.	Bus name	Nominal voltage KV
1.	Bus1	0.415
2.	Bus2	0.415
3.	Bus3	0.415
4.	Bus4	0.415

In bus data minimum voltage is 0.39425 and the maximum voltage 0.43575 to support other element of bus network.

Unbalanced load data:

Load connected in Bus2, Bus3, Bus4 in the network system which support the network in healthy condition unbalanced load data shows as follow-

Ph	Load 1		Load2		Load3	
	MW	MVAR	MW	MVAR	MW	MVAR
R	0.05	0.025	0	0	0	0
Y	0	0	0.05	0.025	0	0
B	0	0	0	0	0.05	0.025

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Power System network work in inter connect buses. In power system network in bus have load i.e real power in MW 0.0500000007 and reactive power of load in bus and unbalanced load MVAR is 0.0250000003 and breaker rating of load in MVA is 50 & breaker rating of load in kA 69.562.

5. RESULT

In the system four bus, three load, three transmission line and one source (generator) through this entire system number of iteration taken 15 for solving the model, Q check limit 4 and the P tolerance 0.001, q tolerance 0.001 for analysis the three phase load flow case no 1 [unbalanced load] and scheduled no: 0 number of line types 3×3, number of zone are 1, transformer R/X ratio is 0.05000, circuit breaker X-PU 0.00010

Detail and name	Result
Total real power generation	0.174 MW
Total react, power generation	0.095 MVAR
Total real power load	0.150 MW
Total reactive power load	0.075 MVAR
Total real power loss	0.025 MW
Total reactive power loss	0.020 MVAR

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Zone wise distribution for phase A

Distribution	zone #1
MW generation	0.0530
MVAR generation	0.0275
MW load	0.0500
MVAR load	0.0250
MW loss	0.0031
MVAR loss	0.0025

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Zone wise distribution for phase B

Distribution	Zone #1
MW generation	0.0573
MVAR generation	0.0310
MW load	0.0500
MVAR load	0.0250
MW loss	0.0074
MVAR loss	0.0059

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Zone wise distribution for phase C

Distribution	Zone #1
MW generation	0.0641
MVAR generation	0.0364
MW load	0.0500
MVAR load	0.0250
MW loss	0.0142
MVAR loss	0.0114

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Zone wise distribution for total

Description	Zone #1
MW generation	0.1744
MVAR generation	0.0949
MW load	0.1500
MVAR load	0.0750
MW loss	0.0248
MVAR loss	0.0198

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6. CONCLUSION

The three phase load flow or power flow analysis a important for planning future expansion of power system as well as in determining the best operation of existing systems. The principal information obtained from the power flow study is the magnitude and phase angle of the voltage at each bus, and the real and reactive in each line. MiPower is applicable in any bus to get solution. Concluded here is generation of power in different is drastically varies and in losses in transmission line for transfer the power also varies but the load values does not change on different area further check-up for load flow analysis. MiPower software works easily and can operate by any professional workers.

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