American Journal of Engineering Research (AJER)
e-ISSN: 2320-0847 p-ISSN : 2320-0936
Volume-6, Issue-12, pp-278-282
www.ajer.org
Research Paper Open Access

Formation of Ybus Martix By Using Direct Inspection MethodFor “12”Bus Power System.

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ABSTRACT:*Power flow analysis is the backbone of power system analysis and design. They are necessary for planning, operation, economic scheduling and exchange of power between utilities. The principal information of power flow analysis is to find the magnitude and phase angle of voltage at each bus and the real and reactive power flowing in each transmission lines. Power flow analysis is an importance tool involving numerical analysis applied to a power system. In this analysis a general and procedural algorithm for- Y matrix building is proposed in this paper. We know that the procedure for obtaining Y bus or Z bus matrices in any frame of reference. Requires matrix transformation involving inversion and multiplications. It Could Be Very Laborious and time consuming process for large system involving hundreds of nodes or buses. Such an algorithm would be very convenient for various large system that may needed while the system is in operation such as addition of line, removal of lines and change in parameters. The bus impendence matrix can be directly found by using building algorithm and analysis of large no of bus system can be done easily.As compared to other methods of Ybus formation Direct inspection method is convenient we have mention algorithm to calculate Ybus by taking a casestudy of 440kv Talandge, India substation of 12 bus by using tool MATLAB R2010a,version 7.10.0.499 by this method calculation is easy and required less time as compared to hand calculation Hand calculationis time consuming as the no buses increases.*

Keywords:*Load flow, Direct inspection method, formulation of Ybus or Zbus*

Date of Submission: 05-12-2017 Date of acceptance: 22-12-2017

I. INTRODUCTION

Load flow studies are used to ensure that electrical power transfer from generators to consumers through the grid system is stable, reliable and economic. Conventional techniques for solving the load flow problem, using the Direct inspection method or the step by step methods. Load flow analysis forms an essential prerequisite for power system studies. Considerable research has already been carried out in the development of computer programs for load flow analysis of large power systems. However, these general purpose programs may encounter convergence difficulties when a radial distribution system with a large number of buses is to be solved and, hence, development of a special program for radial distribution studies becomes necessary. There are many solution techniques for load flow analysis[1]. The solution procedures and formulations can be precise or approximate, with values adjusted or unadjusted, intended for either on-line or offline application, and designed for either single-case or multiplecase applications. Since an engineer is always concerned with the cost of products and services, the efficient optimum economic starting, transformer energizing, earth faults and short circuit faults will cause short duration increase operation and planning of electric power generation system have always occupied an important position in the electric power industry[5]. With large interconnection of the electric networks, the energy crisis in the world and continuous rise in prices, it is very essential to reduce the running charges of the electric energy. A saving in the operation of the system of a small percent represents a significant reduction in operating cost as well as in the quantities of fuel consumed. The classic problem is the economic load dispatch of generating systems to achieve minimum operating cost.[15]

II. FORMATION OF Y BUS AND Z BUS

The bus admittance matrix, YBUS plays a very important role in computer aided power system analysis. It can be formed in practice by either of the methods as under:

(1) Direct Inspection Method
(2) Singular & Non-Singular Transformation
(3) Step by Step Method

2.1 Rules for Direct Inspection Method

Consider the 3-node admittance network as shown in Figure 1 Using the basic branch relation: I = (YV), for all the elemental currents and applyingKirchhoff'sCurrent Law principle at the nodal points, we get he relations as under:

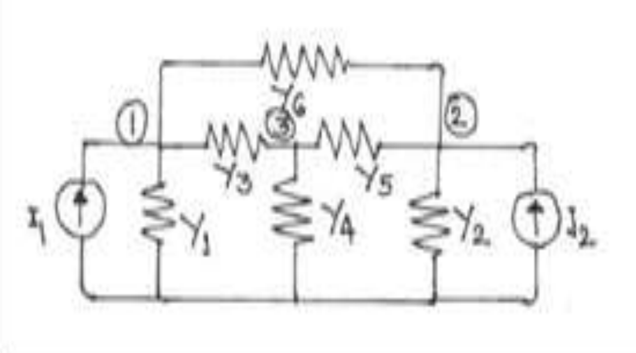

Figure1. Example System for finding YBUS

At node 1: I1 =Y1V1 + Y3 (V1-V3) + Y6 (V1– V2) ...1
At node 2: I2 =Y2V2 + Y5 (V2-V3) + Y6 (V2– V1) ...2
At node 3: 0 = Y3 (V3-V1) + Y4V3 + Y5 (V3– V2) ...3

These are the performance equations of the given network in admittance form and they can be represented in matrix form as:

[I1 I2 0] =[Y1+Y3+Y6 –Y6 Y2;-Y6 Y2+Y5+Y6 -Y5;Y3
-Y5 Y9+Y4+Y5]

In other words, the relation of equation can be represented in the form
Ibus= YbusEbus
Where, YBUS is the bus admittance matrix, IBUS is the bus current and Ebus is bus voltage vectorsrespectively. By observing the elements of the bus admittance matrix, YBUS of equation it is observed that the matrix elements can as well be obtained by a simple inspection of the given system diagram:
Diagonal elements: A diagonal element (Yaa) of the bus admittance matrix, YBUS, is equal to the sum total of the admittance values of all the elements incident at the bus/node aOff Diagonal elements:An off-diagonal element (Yab) of the bus admittance matrix, YBUS, is equal to the negative of the admittance value of the connecting element present between the buses a and b, if any.This is the principle of the rule of inspection. Thus the algorithmic equations for the rule of inspection are

obtained as:
Yaa= ∑ yab(b = 1,2,…….n)… 4
Yab= - yab(b = 1,2,…….n)…. 5

For a = 1, 2,….n, n = no. of buses of the given system, Yabthe admittance of element connected between buses 'a' and 'b'andYaais the admittance of element connected between bus 'a'and ground (reference bus).
Thus by inspecting network ,bus admittance matrix can be foarmed by above rule.It should be noted that this method is not applicable to mutual coupling exits b/w two element .The bus admitance can be obtained by premitve n/w transformation .The modelling of various compoents which are included in admittance matrix are bleow

1)**Modeling of Transmission Lines:**
Transmission line are modeled by the nominal method. The model is $Z_{L=}R_{L+}jX_L$is the series impedance of the line and $y_c/2$ is the half of the line charging admittance connected in shunt at two buses.Every time new line is added b/w buses i, j the element of bus matrix are to be modified as follow;

$$Y_{L=}1/Z_{L=}1/(R_L+jX_L)$$

$$Y_{ii(new)=}y_{ii(old)}+y_L+y_{c/2}$$
$$Y_{jj(new)=}y_{jj(old)}+y_L+y_{c/2}$$
$$Y_{ij(new)=}y_{ij(old)}-y_L$$

2)Modeling of shunt :[17]
shunt elements are like capictor ,rectors and resistor are connected between a bus and ground .Let admitance of the shunt element at bus i be $y_{sh.}$this elements affects only the diagonal element's of the bus admitance matrix.

$$Y_{ii(new)}=Y_{ii(old)+}y_{sh}$$

3)Modeling Loads:[23]
In transient stability programs,it common to model the loads as constantadmittance at the rated voltage. If the Load at bus i is $P_{Li}+Q_{Li.}$and the voltage at the bus is V,The load can replaced by an equivalentadmittance given by

$$Y_{Li}=(P_{Li}-Q_{Li})/v_i^2$$

This admittance can be viewed as a shunt element connected at bus iIt will therefore affected only the dioganal element. Hence

$$Y_{ii(new)}=Y_{Li(old)}+Y_{Li}$$

4)Modeling of generator Internal Impedance:
The generator can be modeled either current source or voltage source.Here,under steady state,$y_G=1/(R_a+jX_d)$,where R_a is the resistance of the stator winding and X_d is the reactance.

$$Y_{ii(new)}=Y_{ii(old)}+Y_G$$

III. Load Flow Solution

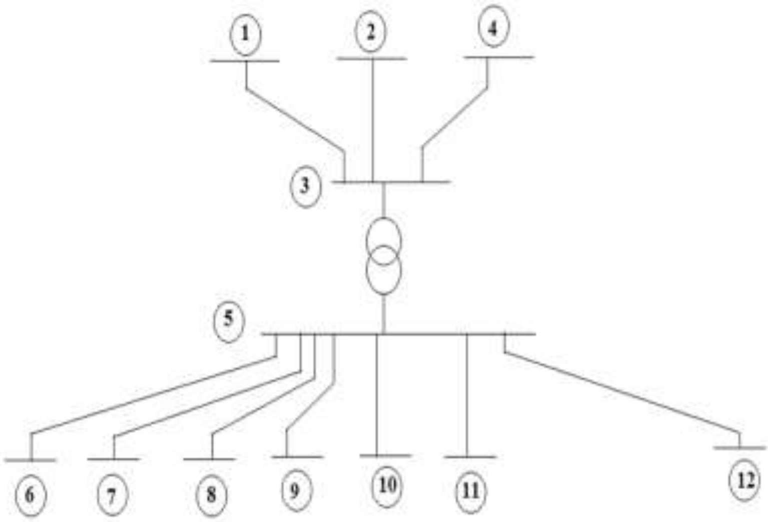

Figure 2 : One Line Diagram of "12" Buses System.

A bus is a node at which one or many lines, one or many loads and generators are connected. In a power system each node or bus is associated with 4 quantities, such as magnitude of voltage, phage angle of voltage, active or true power and reactive power in load flow problem two out of these 4 quantities are specified and remaining 2 are required to be determined through the solution of equation. Depending on the quantities that have been specified, the buses are classified into 3 categories. Slack bus or reference bus in this bus active and reactive power is unkown .Generator Bus and Load bus .For load flow studies it is assumed that the loads are constant and they are defined by their real and reactive power consumption. The main objective of the load flow is to find the voltage magnitude of each bus and its angle when the powers generated and loads are prespecified.There is a shown the single line diagram of bus system in this 3are incoming buses and 7 are outgoing buses. For Ybus formation the bus impedance are required so the different lines are different impedance. For calculation we use the direct inspection method which is very simple calculation..In single Line diagram Transformer is connected to bus no3&5.The off Nominal Ratio Of transformer is given its 0.976. The Turns Ratio is equal to Rated Voltage Ratio then it is called NOMINAL RATIO if the ratio is not equal it is called OFFNMINAL RATIO of Transformer.

3.1 Talandage

Line No.	SB	EB	Name of the Line	Impedance	Off Nominal Ratio
				Positive Sequence	
1	1	3	400KV Karad	0.029086+j0.3072	-
2	2	3	400KV Solapur	0.02979+j0.332	-
3	3	4	400KV Mhapsa	0.0288+j0.307	-
4	3	5	Transfomer	j0.1196	0.976
5	5	6	220KV Mudshingi	0.0752+j0.398	-
6	5	7	220KV Ichalkaranji	0.0752+j0.398	-
7	5	8	220KV Hamidwada	0.0752+j0.398	-
8	5	9	220KV Five Star	0.0752+j0.398	-
9	5	10	220KV Sawantwadi	0.0752+j0.398	-
10	5	11	220KV Bidri	0.0665+j0.42	-
11	5	12	220KV Chikodi	0.0752+j0.398	-

Substation Data

Table no 1: Line Data

IV. RESULT

$$
\begin{bmatrix}
0.1305-j0.5692 & 0 & -0.1305+j0.3293 & 0 & 0 & 0 & 0 & 0 \\
0 & -j9.3778 & j9.5694 & 0 & 0 & 0 & 0 & 0 \\
-0.1305+j0.3293 & j9.5694 & 1.9102-j12.0305 & -0.2364+j0.3370 & -0.5318+j0.7582 & -0.3162+j0.0451 & -0.1636+j0.233 & -0.5318+j0.7582 \\
0 & 0 & -0.2364+j0.3370 & 0.2364-j0.3370 & 0 & 0 & 0 & 0 \\
0 & 0 & -0.5318+j0.7582 & 0 & 0.5318-j0.7582 & 0 & 0 & 0 \\
0 & 0 & -0.3162+j0.0451 & 0 & 0 & 0.3162-j0.0451 & 0 & 0 \\
0 & 0 & -0.1636+j0.233 & 0 & 0 & 0 & 0.1636-j0.2333 & 0 \\
0 & 0 & -0.5318+j0.7582 & 0 & 0 & 0 & 0 & 0.5318-j0.7582a
\end{bmatrix}
$$

V. CONCLUSION

Power flow or load-flow studies are important for planning future expansion of power systems 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 power flowing in each line.Beforecalcltion of voltage we have to form Ybus matrix.We have formulated the algorithm and designed the MATLAB programs for bus admittance matrix, converting polar form to rectangular form by using direct inspection method. Direct inspection method for analyzing the Ybus matrix of the 12 bus systems. The Ybusmatrix formation for 12 bus system were observed for different number of buses or 12 buses it is concluded that Direct inspection method has simple calculations and is easy to execute as compared to Singular and Nonsingular Transformation methods and step by step method by using MATLAB programing tools .The Advantage of direct inspection is requires less time as compared to other methods of YBus formation but their some Disadvantages also of this methods as the no of buses increases time required for calculation is more and this method is not applicable to Mutual coupling it is applicable only to n-bus system.

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