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Determination of Power Flow in PQ Bus System By Using Gauss Seidel Method

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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, iterative techniques are used due to there no known analytical method to solve the problem. To finish this analysis there are methods of mathematical calculations which consist plenty of step depend on the size of system. This process is difficult and takes a lot of times to perform by hand. The objective of this paper is to develop a toolbox for power flow analysis that will help the analysis become easier. As compared to other methods of V_{bus} formation Gauss Seidel method is convenient. In this paper mention the alogtrhim to calculate V_{bus} by taking a case study of 33/11kv Karad ,India substation of 5 bus by using tool MATLAB version by this method .Hand calculation's time consuming as the no buses increases.*

***Keywords**: Power flow, Gauss-Seidal method, Matlab, Voltage profil,Flow chart.*

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I. INTRODUCTION

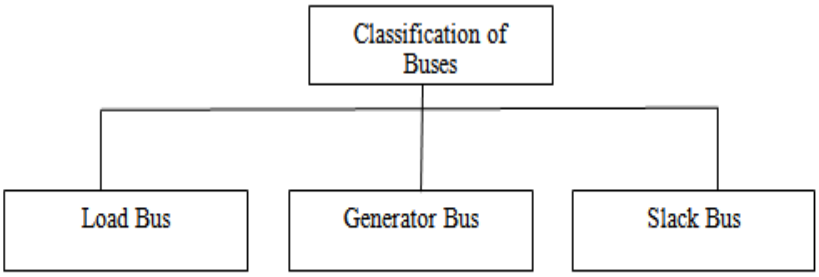
The main purpose of the load flow studies is to insure that the power transferred by the generator to the consumer side through the grid system this power is stable and reliable and economically strong system. For this the calculation of the load flow is made by the Gauss seidal and Newton Rapson method it is iterative method The research of the computer program is carried out already. This program is in difficulties when the radial system is connected large no of buses. The load flow for no of buses are available for off line and online precises which designed for one case and multi case applications. Since the engineers are always think about the cost of the product and services [7] . The travelling and Translation of the energy is vey important roll in the industry operation with large interconnected network . It is very important to redus the economical charges of electrical energy. The saving operation is the charges is reduces the capital cost of energy .The prices issue is the very affected on the newly arranged system. For reduces this reduces the generating cost of the system for this many computer designs are available.[15]For that we using the particular manner we know about the generation of the energy we use the fuel which is affected on pollution constraints of the environment. The many time avairness is the roll of collapse of the system sometime the inner system is causable for the system collapse. The healthy system is the sign of the good power flow. For the purpose of optimation of economic dispatch the relevant and the modern power system theory is applicable for the reducing the optimal capital cost of the system[7],[14]. In the Load flow studies we obtain the voltage magnitude and angle of each bus in the steady state condition. This important to getting the voltage magnitude of the load voltage of the voltage bus within specified limit[4]. The calculation of the load flow is taken the values of voltage magnitude and the voltage angle for the computed the real and reactive power of the each bus of the system. Based on the power flow in the sending end and reiceving end of the bus the losses can be calculated in the particular line or that line. Over the power flow in the line determine in the steady state and the load condition we obtain the power flow in that line. The steady state and the reactive power flow of the line is given the nonlinear algebraic equation[7],[15]. For this equation solving we use the iterative method. In this paper we explain the Gauss seidel method which is easier and the simplest method than other iterative method[2].

II. Power flow Analysis

The load flow studies is the important tool of the system analysis involving with the numerical treatment. Compare to the tradition circuit theory we use the some notations like one line diagram , line data ,bus data, in the per unit values and only focused on the reactive power , active power compare than the only the current and voltages[5]-[9]. The main advantage of the load flow study is the calculating the future expansion as well as determine the existing system. For the power flow studies we use the gauss seidel method.

2.1Bus Classification

A bus where the all nodes are connected generator are connected. In power each bus have a 4 quantities is voltage magnitude, voltage angle, active power and reactive power. In the system 2 quantities are given and 2 quantities are determine. Depend on the calculation of the quantities the buses are classified into three types. For the load flow studies the load are constant and they are defined for the real and reactive power consumption. The main purpose of load study is to determine the voltage angle and the voltage magnitude of each bus when the power generated. For that classify different busses shown in the following figure:



Figurel. Classification of Buses

2.2 Load Buses: Load bus are connected to the load side of the system. Which is known quantities are active power(P) and reactive power (Q). And the determine quantities are voltage magnitude(|V|) and the voltage angle(δ). In the system the 20% of load buses are present.

2.3 Voltage Controlled Buses: The generator bus is connected to the generator of the system. The known quantities of the system is active power(V) and the voltage magnitude(|V|) . And the unknown quantities are reactive power(Q) and voltage angle(δ).The generator of the bus controlled by the prime mover and voltage by the voltage. The generator bus are70% are present in the system[1]-[4].

2.4 Slack or Swing Bus: This bus known as bus no 1 also called as the reference bus because of reference of all other buses. It is the reference against the all other bus are measured. For this angle of this bus is 0^0.The known quantities of this bus is voltage magnitude(|V|) and voltage angle(δ) .The slack bus is 10% in the system.

2.5 Bus Admittance Matrix

1. The first step is to number all the nodes of the system from 0 to *n* . Node 0 is the reference node (or ground node).
2.Rreplace all generators by equivalent current sources in parallel with an admittance.
3. Replace all lines, transformers, loads to equivalent admittances whenever possible.
4. The bus admittance matrix *Y* is then formed by inspection as follows (this is similar to what we learned in circuit theory): sum of admittances connected to node *iiy* = *i* and *yij* = *y ji* = -sum of admittances connected from node *i* to node *j*
5. The current vector is next found from the sources connected to nodes 0 to *n*. If no source is connected, the injected current would be 0.
6. The equations which result are called the node-voltage equations and are given the "bus" subscript in power studies thus: bus I = Y V.

III.POWER FLOW SOLUTION

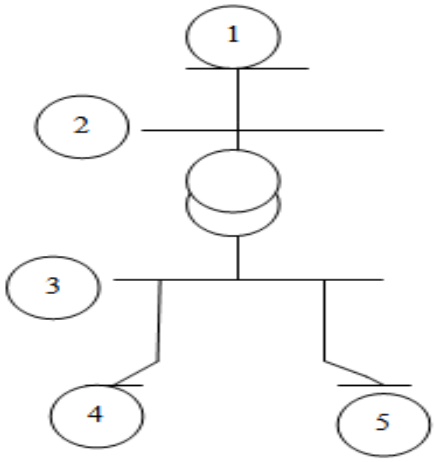


Figure 2. One Line Diagram of 6 Bus System

1.Karad Substation Data

Line no.	SB	EB	Name of the Line	Impedance	Off Nominal Ratio
1	1	2	33Kv Manipur feeder	0.026+j0.108	-
2	2	3	Transformer	j0.218	0.976
3	3	4	11Kv Nagarpalika	0.035+j0.25	-
4	3	5	11Kv Highway	0.01+j0.08	-
5	4	5	11Kv Market yard	0.123+j0.518	-

Table No 1. Line Data

2. Bus Data

Bus no	P_G(pu)	Q_G(pu)	P_D(pu)	Q_D(pu)	$\|V_{sp}\|$(pu)	δ
1	-	-	-	-	1.02	0^0
2	-	-	0.60	0.30	-	-
3	1.0	-	-	-	1.04	-
4	-	-	0.40	0.10	-	-
5	-	-	0.60	0.20	-	-

Table No 2. Bus Data

Gauss- Seidel method

The Gauss Seidel Method (GS) is an iterative algorithm for solving a set of non-linear algebraic equations. To start with, a solution vector is assumed, based on guidance from practical experience in a physical situation. One of the equations is then used to obtain the revised value of a particular variable by substituting in it the present values of the remaining variables. The solution vector is immediately updated in respect of this variable. The process is then repeated for all the variables thereby completing one *iteration.* The iterative process is then repeated till the solution vector converges within prescribed accuracy. The convergence is quite sensitive to the starting values assumed. Fortunately, in a load flow study a starting vector close to the final solution can be easily identified with previous experience.To explain how the Gauss Seidel Method is applied to obtain the load flow solution, let it be assumed that all buses other than the slack bus are *PQ* buses. We shall see later that the method can be easily adopted to include *PV* buses as well. The slack bus voltage being specified, there are *(n* — 1) bus voltages starting values of whose magnitudes and angles are assumed. These values are then updated through an iterative process. During the course of any iteration, the revised voltage at the ith bus is obtained as follows:

In this method of solving for power system analysis, the equation S=VI* is used where S=P+jQ and hence the equation becomes

$$P+jQ=VI^* \quad (1)$$

$$P-jQ=V^*I \quad (2)$$

From the above equation we can deduce that the current I is given by

$$I=(P-jQ)/V^* \quad (3)$$

But we also know that

$$I=YV \quad (4)$$

Now the voltages of the buses are calculated from the equation summarized as

$$VY= (P-jQ)/V^* \quad (5)$$

where after each iteration the voltages are replaced in the next iteration.

The slack bus where V is known the voltage equation for that bus is not formulated. For the P-Q buses the voltage magnitudes and angles are obtained directly from the power flow equations. But for the P-V buses where we know the magnitude of the voltage of those buses, the voltages are calculated in the following way

$$V_{new}=V_{oLD}*\text{angle}\ (V_{New}) \quad (6)$$

Hence, the voltages of the buses are calculated and the error of their values with the old values are calculated and checked with the tolerance value to decide whether iteration would be needed or not.

III. FLOW CHART OF GAUSS SEIDEL METHOD

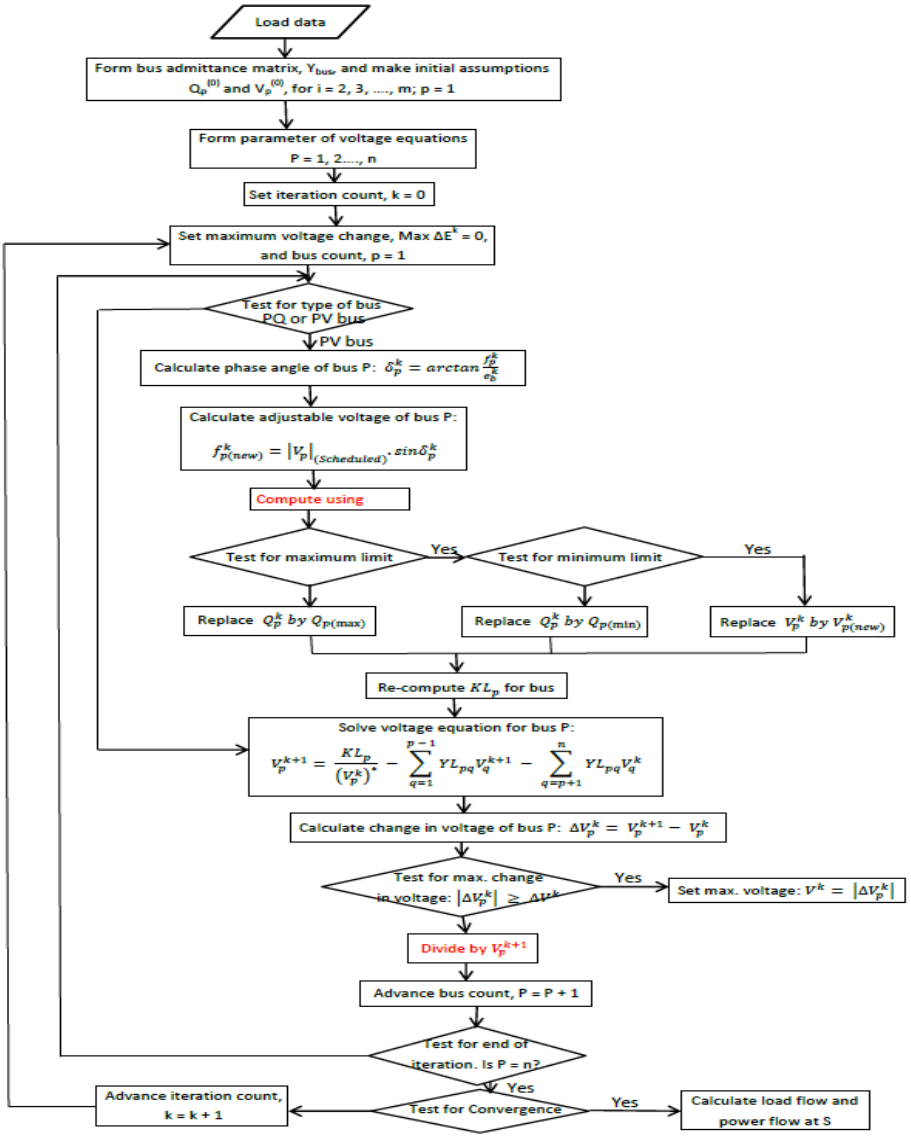


Figure 3. Flow Chart Gauss Seidel Method

IV. RESULT

Load flow is carried out by the Gauss seidel method and the voltage s and angle is following:

$V_1=1.02<0^0$pu
$V_2=0.98140<-3.066$pu
$V_3=1.04<3.077^0$pu
$V_4=0.955715<-7.303^0$pu
$V_5=0.994618<-1.5616^0$pu

V. CONCLUSION

Power flow are important for the future planning of the expansion as well as the determine the existing system operation. The principal of the load is obtaining the voltage angle, magnitude and active and reactive power flowing in the each bus.We have formulated the algorithm and designed the new MATLAB programme for bus admittance matrix for converting polar to rectangular form. We use the Gauss Siedel method analysing the 5 bus system in this paper . We analysing the voltage magnitude of 6 bus system and observing the difference Reacting loading values. TheGauss sidel method is simple to calculation and execute but when the no of buses increase the no of iteration are increases.

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