Load Flow Analysis using Distributed Generation in an IEEE 33 Bus System: A Review

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Abstract—In this dissertation work we are mainly focussed on Load flow analysis of Radial distribution system. In this dissertation work, we are going to simulate an IEEE-33 Bus system by using the BFS Algorithm in MATLAB, for solving the load flow problems. Firstly, we are going to make the radial distribution system of proposed test system in MATLAB in which we have to estimate the voltage magnitude profile and active power and reactive power losses at individual bus. In this work we use the BFS algorithm is utilized for calculating the load flow investigation in proposed system. By using the concept of distributed generation, we are going to estimate the optimum allocation of DG which is best suited for this system, where we have to manage the voltage value and power losses of the whole system. In this work we are estimating Voltage Stability Index at each bus, To estimate the accurate place of Distributed generation. After that size of DG is our main concern. When Distributed generation is inserted in the system, find the voltage profile and power of the system, and find the losses of the system. After DG placement, comparative analysis is being made for voltage profile and loss minimization. And Voltage Stability Index is being calculated with and without DG. On comparing the results we see that the voltage profile and power losses are very much reduced by using distributed generation concept.

Key words: IEEE, 33 Bus System

I. INTRODUCTION

A. Introduction to Power System

An electric power system is utilized to provide electricity and utilize that power which is a network of electrical components. An example of this is the network that provides electricity to a particular area's homes and industry, this type of system is known as the grid system and classified as generators that generate and transfer electric power. A system which transmits electric power from the generating centres to the load centres known as transmitting system whereas system which distribute power to houses and industries known distribution system.

There are some criteria or characteristics for effective operation of a power system and they are stated as:

To satisfy the demands of various load buses and many losses requires a satisfactory amount of power generation. The magnitude of the bus voltage should be maintained at a very close value to the rated voltage value. At any instant of time, the generators.

II. LOAD FLOW STUDY

A. Introduction

Load flow study is considered as one of the considerable parts of the power systems arranging & also the process. And also it give the sine wave based stable state or situation for the whole system including the voltages, the genuine and also the mechanical power formed and ingested and also the line delicate. And as the load is the static sum and also the power circulated via transmission lines, the idealist likes to know as the Power Flow concentrate as opposed to load flow study.

Standard Procedure For the formulation of load flow problem in power system

III. PROPOSED WORK

This chapter deals with the problem formulation for optimal sizing and location of distributed generation in the radial distribution network.

A. Problem Formulation

This section deals with development of mathematical model for objective function and different constraints for radial distribution system in the presence of Distributed generation.

B. Objective Function

The objective of the optimal size and location of DG problem to minimize the total power loss and voltage profile can be expressed as

Minimize

\[ PL = \sum_{i=1}^{n} \sum_{j=1}^{n} [\alpha ij (Pij + Qij) + \beta ij (Qij - Pij)] \]  \[ (5.1) \]

Where

\[ \alpha ij = \frac{rij}{vivj} \cos (\delta_i - \delta_j) \]

\[ \beta ij = \frac{rij}{vivj} \cos (\delta_i - \delta_j) \]

\[ Zij = rij + jxij \]

Where

- \( Zij \) is the impedance of the line between bus i and bus j.

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C. Backward-Forward Sweep Algorithm Method

1) Introduction

Power engineers facing many problems due to the increase in the power demand, voltage instability and transmission line overloading. Reactive power unbalancing, voltage collapse, unexpected lines and generator outages are the major cause of voltage instability. The problems of improving voltage profile and decreasing power losses in any system can be solved by optimal ways. There are the problems of single and three phases.

Now, FACTS devices and load flow studies are the solution for the improvement of the voltage profile and stability of present power system. For minimize transmission line losses and improve voltage stability, a backward forward sweep method based on the approach for load flow analysis of an IEEE 33 bus test system is used.

To understand the nature of the installed network load low studies are performed. It is used to determine the static performance of the system. Power systems are analysed in steady-state operation. Some special features of distribution networks are as follow in category
- Radial or weakly meshed networks
- High R/X ratios
- Multi-phase, unbalanced operation
- Unbalanced distributed load
- Distributed generation

In this paper, a new method for solving the power flow problem for distribution feeders without using conventional load flow methods (Gauss Seidel, Newton Raphson, and Fast Decoupled) is presented. This method uses simple algebraic equations to find out iteratively of outgoing powers and voltage magnitudes of various nodes and mismatches at the last nodes of main feeder and so on and depending upon mismatches the substation injection is corrected judiciously and this process is repeated until convergence. This makes the algorithm very robust and numerically efficient for convergence for wide variation of distribution network.

D. What is Distributed Generation?

Distributed generation (or DG) can be defined in many ways but in general it bring up as a moderate (typically 1 kW – 50 MW) electric power generators which produces electricity next to a location which is nearby to the customers or we can say these are secured as an electric distribution system. Distributed generators comprises of:
- Synchronous generators, induction generators, reciprocating engines, micro turbines (combustion turbines that run on high-energy fossil fuels such as oil, propane, natural gas, gasoline or diesel), combustion gas turbines, fuel cells, solar photovoltaic and wind turbines.

We can also define, Distributed Generation (DG) as any kind of electrical generator or static inverter which generates alternating current and having following features such as:
- It has the competency for parallel operation with the utility distribution system.
- It has the capability to function individually from the utility system and also feed a load which can be fed by the utility electrical system. Sometimes it referred as a “generator”.
- Distributed generator can be introduced into an electric power system for the improvement of the voltage magnitude profile and also reduces the total transmission losses in the power system.
- When the Distributed generators are connected to the power system grid, it affects the various profiles of the system such as the voltage regulation, sustained interruptions, harmonics, sags, swells, etc.
- Along with the different features, DG comprises of an often function in which it make use of the surplus heat from the generation method as a further form of energy for space heating, process heating, dehumidification and also for cooling over absorption refrigeration.

We can also call the term Distributed Generation as Distributed Resources (DR) as these both the terms are simply interchangeable. But then, we found a major difference in both the terms and it was that the DR is envisioned to embrace non generating technologies for instance power storage devices like batteries and flywheels along with generators despite the fact that DG is restricted to only minimal scale (less than 20 MW) in energy generation sited adjacent to point of use.

IV. SIMULATION & RESULTS

A. Introduction

In order to test the effectiveness of the proposed controller, the algorithm was tested on standard IEEE radial distribution networks. These are the IEEE 33-bus radial network. These networks were chosen because they have been used extensively in literature for radial distribution network analysis. The proposed controller was first tested on the IEEE 33 bus network. Load and line data for this network are given in tables. The total installed peak loads on the system are 3715 kW and 2290 kVAR. Base voltage is 12.66kv. The topology of the network is illustrated below.

In this chapter we have done the load flow analysis of IEEE 33 bus system using forward backward sweep algorithm and find out the voltage profile and power losses of the particular radial distribution system. We also find the voltage stability index of IEEE 33 bus system. Further we have to use the concept of distributed generation and find the optimal location of DG in IEEE 33 bus system, where we got the minimum losses and size of DG is also our main concern. Here we use three type of DG which has different power factor. For different power factor, size of DG is also different and then find the comparative analysis of all DG in this work. Algorithm for Load Flow analysis of IEEE 33 Bus System:

1) Step 1: Load bus data and line data of IEEE -33 bus for base case
2) Step 2: Using forward backward sweep method make the load flow analysis
3) Step 3: find out the voltage profile and power losses in load flow analysis
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References


