DISTRIBUTION NETWORK RECONFIGURATION TO IMPROVE SYSTEM PERFORMANCE AND REDUCE POWER LOSSES

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ABSTRACT
Optimal Reconfiguration of Radial Distribution System. Which can be obtained by closing switches (tie-switch normal open) and opening closed switches (sectionalizing switch – normal close) to satisfy Radial Distribution System for getting improvement system voltage, and power losses. This can be made by The Proposed Method which consists of two Parts:
1-Determining the tie switches which their terminal voltage less than specified value by ± 5% from the rated value
2- Transferring load from lower voltage side of tie switch to higher voltage side after checking the power of transformer and all feeders to avoid over loading.
3-calculate system power losses before and after change the switch action we obtained improve system performance and improvement feeders end voltages and reducing power losses
If the problem (under voltage) is still found connect capacitor bank in the feeders which contain this problem.
By using ETAP software program on real time and the application by FORTRAN software, we can make the switches options, calculation of power flow of each transformer and feeder. So, This Paper Presents an Optimal Reconfiguration Of Radial Distribution System.

Keywords

INTRODUCTION
In the reconfiguration strategy described here, it is assumed that the distribution system is radial. So, each load is served through only source. All loads in distribution system are served by substation transformers through distribution feeders. The loads are modeled at their peak value, and it is assumed that each line section contains switches, whose status may be opened or closed. The primary goal of heuristic strategy eliminate overloading transformers, under voltages and thermal constraint violations by determining the open / closed status of all switches in the system [1].

The network reconfiguration problem in distribution system is to find a configuration with minimum losses while satisfying the operation constraints under a certain load pattern. The operating constraints are voltage drop, current capacity and radial operating structure of the system [2]. The voltage and power on/through both ends of a feeder are used to describe the load and its distribution pattern within the feeder line [3]. The optimal allocation of the reactive sources reduces the losses due to the reduction current in distribution system [4]. Balancing of load plays a key role in reducing losses in addition to enhancing stability and reliability of electrical power network. Distribution network is divided into subsystems of radial feeder equipped by numbers of sectionalizing switches and tie switches [5]. Methodology is reconfiguration of electrical power distribution network under normal operation condition. In order To reduce the active losses of network or to balance the load, based on the branch exchange where different radial configuration are generated [6]. The optimal flow pattern of network is the branch flow pattern that will cause minimum resistive line losses. The method starts by closing all network switches, thus forming a meshed distribution network, loops are open one after another in such away that the optimal flow pattern [7]. Network reconfiguration in distribution system is realized by changing the status of sectionalizing switches to reduce the power losses in the system [8]. Network reconfiguration in distribution system is realized by changing the status of sectionalizing switches, and usually done for losses reduction proposed by [9]. To improve the system reliability and operational efficiency, a distribution automation system. Feeder reconfiguration for fault restoration and load balancing. By changing the open / close status of the line switches along distribution feeders [10].

PROPOSED MODEL:
The network reconfiguration problem in a distribution system is to find a configuration with minimum losses while satisfying the operation constraints under a certain load pattern. The operation constraints are voltage drop, current capacity and radial operation of the system. The
The mathematical formulation for minimization of power loss reconfiguration problems is presented in literature in different ways.

The formulation is presented as:

Minimize \( f = \min (P_{\text{loss}}) \)  
Subjected to \( V_{\text{min}} \leq |V| \leq V_{\text{max}} \)

Where, \( P_{\text{loss}} \) is the total real power loss of the system, \( |V| \) voltage magnitude of bus \( I \)

\( V_{\text{max}}, V_{\text{min}} \) are the maximum and minimum voltage limits respectively. \( I, I_{\text{max}} \) are current magnitude and maximum current limit of branch \( I \) respectively A set of simplified feeder – line flow formulation is employed. Considering a single line diagram depicted in Fig. 1.

Network reconfiguration problem is normally assumed as symmetrical system and constant load. Therefore, the distribution line are represented as series impedances of value \( Z_{ij} = R_{ij} + jX_{ij} \) and load demand as constant and balanced power sinks \( S_i = P_i + jQ_i \). The real and reactive power flows at the receiving end of branch \( i+1 \), \( P_{i+1}, Q_{i+1} \) and voltage magnitude at the receiving end.

\[ |V_{i+1}|^2 = |V_i|^2 + 2 \cdot (R_{i,i+1} \cdot P_i + X_{i,i+1} \cdot Q_i) + (R_{i,i+1}^2 + X_{i,i+1}^2) \cdot \frac{(P_i^2 + Q_i^2)}{|V_i|^2} \]  (9)

Where \( P_i = P_i + P_{Li} \) and \( Q_i = Q_i + Q_{Li} \)

The power loss of the line section connecting between buses \( i \) and \( i+1 \) is computed as

\[ P_{\text{loss, (i,i+1)}} = R_i \cdot |V_i|^2 + Q_i \]  (10)

The total power losses of the feeder \( P_F\text{losses} \) is determined by summing up the losses of all line sections of the feeder, which given by:

\[ P_F\text{losses} = \sum_{i=0}^{n-1} P_{\text{loss, (i,i+1)}} \]  (11)

Where the total system power losses \( P_{\text{Tlosses}} \) is the sum of power losses of all feeders in the system.

**PROPOSED METHOD**

In fig2. Explain flow chart of program to improve system performance and reduce system power losses.

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**Fig. 1 Single line diagram of main feeder**

**Fig. 2 flow chart**
The transformers of Fig. 3 describe the network that consists of three transformers and each transformer consists of four feeders. The first and third are 20MVA and the second is 25MVA. Table 1 describes the network data and load data of transformer 2 under case study.

Table 1 describes the network and load of transformer 2.

<table>
<thead>
<tr>
<th>Feeder name</th>
<th>From bus</th>
<th>To bus</th>
<th>R (Ω)</th>
<th>X (Ω)</th>
<th>Active Power (KW)</th>
<th>Reactive Power (KVAR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feeder 5</td>
<td>1, 2</td>
<td>3, 4</td>
<td>5, 6</td>
<td>7, 8</td>
<td>9, 10</td>
<td>11, 12</td>
</tr>
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<td></td>
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In this paper, a new method approach is developed to improve the system. This method gives the optimal solution with a few numbers of load flow runs and the CPU time needed is much less. Therefore, this method can be effectively used in real time application of the large distribution system under widely varying load conditions. Considering the cost of KWH (0.2 LE), and number of units (6*300 KVAR) with cost of one unit / year equal = 11000 LE / life time (20 year) = 3300 LE.

The remarkable results of this application are:
- The losses before reconfiguration = 540.6 KW
- The losses after reconfiguration without using capacitor bank = 468.9 KW (percentage reduction 13.2 %).
- The losses after reconfiguration with using capacitor bank = 445.3 KW (percentage reduction 17.6 %).
- The annual saving without using capacitor bank = 125618.4 LE (Egyptian pound).
- Annual saving with using capacitor bank = 166965.6 LE
- Total annual saving with using capacitor bank equal : 166965.6 – 3300 = 163665.6 LE

CONCLUSION

In this paper, a new method approach is developed to improve the system. This method gives the optimal solution with a few numbers of load flow runs and the CPU time needed is much less. Therefore, this method can be effectively used in real time application of the large distribution system under widely varying load conditions. Considering the cost of KWH (0.2 LE), and number of units (6*300 KVAR) with cost of one unit / year equal = 11000 LE / life time (20 year) = 3300 LE.

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