CHAPTER 1
INTRODUCTION

1.1 INTRODUCTION

Over the past few decades, distribution systems have received considerably less attention than have transmission and generating systems [1]. This is due mainly to the fact that transmission and generating systems are usually very capital intensive, and inadequacies in either often lead to widespread catastrophic consequences. Consequently, more effort has gone into ensuring the adequacy of this part of the power system. Distribution systems are relatively cheap, and outages have a very localized effect [18]. However, while relatively inexpensive, large sums of money are spent collectively on such systems.

Distribution systems are critical links between the utility and customer in which sectionalizing switches are used for both protection and configuration management. Usually distribution systems are designed to be most efficient at peak load demand. Obviously, the network can be made more efficient by reconfiguring it according to the variation in load demand. Recent studies indicate that up to 13% of the total power generation is wasted in the form of line losses at the distribution level. Hence, it is of great benefit to investigate methods of network reconfiguration [8].

Electric power distribution networks reconfiguration means the reduction of losses or the minimization of losses in the distribution network through better feeder configuration [21]. Reduced losses can result in generator fuel saving and possibly some reduction in generation capacity, hence, proving the proverb “energy saved is energy produced” and moreover environmental cost for pollution. Reconfiguration can be used for isolating faulted feeder section and restore service to faulted section of distribution network after correction. Service restoration is achieved by switching loads on outage to adjacent energized feeders.

Electric power distribution network reconfiguration system can be defined as altering the topological structure of distribution network by changing the status (ON/OFF) of the sectionalizing, and/or tie line switches such that the specified operating conditions and objective are met [25]. Under normal operating condition, the objectives
are to avoid transformer or feeder thermal overloading and abnormal voltages while simultaneously minimizing the real power losses, life time of network feeder can also be increased [30]. During emergency conditions, the system can be reconfigured so that maximum number of customer retain electric services, and also helpful in planning and predicting the desired configuration for different contingency cases of network [31], [102].

A radial distribution system consists of a set of series components including lines, cables, disconnects, busbars and transformers between a utility and its customer. A customer connected to any load point in a distribution system requires all of the components between the point of connection and the supply point to be operating [173].

To help restore power to customers following a circuit/feeder fault, most feeders have a tie to the neighboring feeders [50]. Load varies with time in days, weeks and season with different time profile and each feeder serves a different mix of loads. Load on each feeder varies constantly, with different variation on each feeder. This creates an opportunity to constantly keep losses at minimum by reconfiguring the feeder during the day or week. Automatic switches for network reconfiguration are installed to perform the distribution automation at cost that must be balanced against the minimum occurrence of losses in the system [44], [142].

Network reconfiguration is one of the analyses, needed for the real time monitor and operation of distribution network. The need for reconfiguration occurs in emergency conditions, following the faults to isolate branch, and in the normal condition to reduce or to minimize the system losses and to avoid the overloading of the network branches. The reconfiguration for loss reduction is enabled by specific structure of distribution networks and varying nature of customer loads [137]. Most of the distribution networks build as weakly meshed but operated radially, for effective co-ordination of their protection system. Nevertheless, these are usually several inter-connecting tie lines available to increase the network reliability. Sectional switches in a network together with circuit breaker at beginning of each feeder permit the network reconfiguration.

The load profile in distribution network is a function of customer served, residential, commercial, industrial loads posses’ differing daily, and season load curves.
Load profile varies from feeder to feeder because of the mix and dispersion of the customer served [39].

Moreover, feeder peaks are non-coincident because of diversity of load at large degree resulting from type of customer served by the system. The time and topology variation of the networks load profile makes the reconfiguration for loss reduction utilizing system capacity for faulty system as well [153].

Distribution network planning is a combinational optimization problem where the objective is to determine the optimum way of supplying a given set of load, through a substation and a feeder configuration such that the network losses are minimized along with the network cost, while maintaining the radiality of the network and at the same time not violating the capacity and voltage drop constraints in any part of the networks [109].

Most electric distribution network feeders are configured radially for effective coordination of their protection system [107]. In an automated distribution system, the configuration is changed from time to time so that the loads are supplied at the cost of the minimum line losses. Under normal operating condition the distribution engineer periodically reconfigure distribution network feeder, by opening or closing a network branches by switching operation of a switch, in order to reduce the losses occurring in the line and to increase network reliability. Resulting network should be a radial one and meet all the load requirements [96]. Co-ordination of the protection scheme of the new configuration is then necessary. The function of the feeder reconfiguration is to determine the status of these feeder switches (ON/OFF) for different multiobjective purpose [170].

Modifying the radial structure of the distribution networks feeders from time to time, by changing the position of switches, to transfer from one feeder to another may significantly improve the operating condition of the overall system. Network reconfiguration allows the transfer of loads from heavily loaded feeder. Such type of transfer are not only effective in terms of altering the level of load on the feeder being switched, but also in improving the voltage profile along with feeders effecting reduction in the overall power losses in network, and the power factor of the system [183].

A flow chart of the heuristic feeder reconfiguration system is shown in Figure 1.1. After the user-provided information has been input, the program retrieves the