ABSTRACT

Many electric distribution system planners in the industry utilize computer programs, such as load flow programs for radial or meshed distribution networks as well as other tools such as load forecasting, voltage regulation, regulator setting, capacitor planning, reliability, network reconfiguration and optimal distribution system planning algorithms.

In this thesis, a comprehensive analysis of radial distribution system is presented. For selecting an optimal branch conductor for radial distribution networks, optimal capacitor size and its location, network reconfiguration of distribution systems by using simple load flow technique. The effect of these approaches in distribution system planning is also illustrated.

In **Chapter 1,** the various aspects of distribution system in general are presented. Literature survey of the past work concerning distribution load flow, optimum branch conductor selection, optimal capacitor size selection and its location, network reconfiguration and distribution system planning is introduced. The objectives and motivations for the research work presented in the thesis are also discussed in this chapter.

A simple method of load flow technique for solving radial distribution networks is described in **Chapter 2.** The proposed method involves only the evaluation of a simple algebraic expression of receiving end node voltages and no trigonometric functions are involved as in the conventional load flow case. The proposed method has been implemented and solved on several radial distribution networks.

In **Chapter 3,** the branch conductor optimization of radial distribution networks is presented. The problem is posed as an optimization problem with an objective to minimize the overall cost of annual energy losses and depreciation on the cost of conductors. The main constraints of the proposed method are minimum voltage should be within prescribed limits and the current flowing through each branch

should be less than the maximum current carrying capacity of the corresponding branch conductor.

The proposed method is simple and its effectiveness is demonstrated through two illustrative examples.

The optimization of capacitor size and its location aspects are presented in **Chapter 4**. The reduction of power losses loss in distribution systems is very essential to improve the overall efficiency of power delivery. The real power loss can be separated into two parts based on the active and reactive components of branch currents. In this chapter, a simple method for minimizing the loss associated with the reactive component of branch currents by placing shunt capacitors in a radial distribution networks has been presented. This method, first determines a sequence of best nodes to be compensated by capacitors. The size of the optimal capacitor at these nodes is then determined by optimizing the saving due to reduction of losses with respect to the capacitor currents. The efficiency of the above-proposed method is investigated with two different radial distribution networks.

In **Chapter 5,** the network reconfiguration approach to improve the overall efficiency of power distribution systems is presented. Network reconfiguration is necessary to reduce the losses and it is an operation to alter the topological structure of distribution feeders by changing open / closed systems of sectionalizing and tie switching of open loop distribution system. The stress to improve overall efficiency has forced utilities to look for greater efficiency in electric power distribution. This study presents an effective approach to feeder reconfiguration for power loss reduction in radial distribution systems. The technique followed in the proposed method can be relied to solve the problem efficiently. The merit of the method is that it is very simple and does not involve any further mathematical expressions for feeder reconfiguration.

The aspects of planning of distribution system are dealt with in **Chapter 6**. The distribution system planning problem is divided into three sub problems: (1) radial feeder planning problem, (2) selection of optimum type of branch conductor, (3) selection of tie-lines for open loop design of distribution systems.

A simple procedure is proposed for obtaining the optimal radial path by satisfying all constraints. After obtaining the optimal radial feeder path, branch conductors are optimized by using proposed conductor optimization algorithm.

For the purpose of reconfiguration of feeder under normal operating conditions, the feeder is planned as open loop structure and the final choice of tie lines are selected based on proposed network reconfiguration algorithm, which ensures minimum power loss.

The major conclusions of the work presented in this thesis and the scope for further research in this area are presented in **Chapter 7.**