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E) **TITLE OF THESIS:** INTELLIGENT METHOD FOR OPTIMAL OPERATION OF RADIAL DISTRIBUTION NETWORK

F) ABSTRACT

World Bank data shows that in developing countries, the percentage of active power losses in a distribution network is around 20%. In India for the year 2008, losses were accounted as high as 23% of the total energy generation. In addition to losses, voltage collapse, islanding & instability are other common problems reported in distribution networks. The traditional loss reduction methods lack intelligence and are often based on rule of thumb approach without techno-economic analysis, which can result in the system becoming more expensive. The thrust area of this research work is to review and propose efficient and intelligent computational algorithms for optimized operation of distribution networks. The research work focuses mainly on the Radial Distribution Network (RDN). The important task in achieving the above objective is to simulate the system, identify the sensitive nodes, address the uncertainty and propose corrective action using fast and efficient algorithm based on simple mathematical model. In this respect, the important contributions of research work are as follows:

1. Development of an efficient three phase Load Flow algorithm for distribution systems, which addresses uncertainty and also calculates node Stability Index (SI).
2. Development of a new index 'Vulnerability Index (VI)', which is a function of node voltages & stability index and indicates the status of node health. VI is later used as a benchmark to check the health of the node and is used as an input for any corrective action.
3. Design and implementation of a new algorithm for reconfiguration with the objective to make nodes with unacceptable vulnerability index value as acceptable in turn reduction for the total loss.
4. Development of a new algorithm to site and size capacitors that provide maximum savings as well as meet the constraints defined.

5. Simulation & verification of item 1 to 4.

The thesis includes an extensive review of traditional methods of distribution system optimization and proposes unique methodology. The methodology addresses uncertainties using fuzzy and probabilistic techniques and defines a new index known as vulnerability index. The reconfiguration solution is converged by planning the best combination of feeders switched out and tie switches switched in, such that the resulting configuration gives the optimal performance i.e. best voltage profile, node VI value and minimal kW losses. For capacitor sizing and siting, power loss index calculation along with cost optimization algorithm is used.

G) FINDINGS

The following findings are reported in the thesis:

- The thesis work presents extensive literature reviews of traditional load flow solution methods, their limitations and proposes an efficient three phase load low calculation algorithm using simple mathematical expressions with good convergence characteristics.
- Uncertainty in the data is addressed using two methods i.e. FAC (Fuzzy Alpha Cut) and Probabilistic (Monte Carlo Simulation) and the results are compared. The algorithm also calculates the voltage stability index for all the nodes.
- The research work proposes a new index known as 'Vulnerability Index', which is a function of node voltages and stability index and is an indicator of status of the node health.
- Reconfiguration and its convergence criteria is achieved using Vulnerability index as an assessment parameter and with an objective to make nodes with unacceptable Vulnerability index value as acceptable by changing the status of existing tie and sectionalizing switches.
- The research also proposes a method of capacitor sizing and placing. The algorithm uses power loss index calculation and determines capacitor size and the candidate node locations for capacitor placing and is optimized by running the cost optimization algorithm that provides the optimum capacitor values & siting locations.