COMPARATIVE STUDIES OF OPTIMUM POWER FLOW APPROACH AND FUZZY CONTROLLED PROGRAMMING TECHNIQUE FOR LOSS REDUCTION IN DISTRIBUTION SYSTEM RECONFIGURATION.

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ABSTRACT:

Distribution system are normally configure radially for effective co-ordination of their protective system. Networks are reconfiguring to reduce the system power loss and relieve loads in the network (loss reduction and load balancing). This operation transfer loads from one feeder to another, which will significantly improve the operating condition of the overall system. So it is need to require re-configure the network from time to time, Optimal reconfiguration of Radial Distribution System (RDS) is done under the umbrella of Supervisory Control and Data Acquisition (SCADA) systems to achieve the best voltage profile and minimal kW losses amongst several objectives. This problem requires the purpose of the best combination of feeders from each loop in the RDS to be switched out such that the resulting RDS gives the optimal performance in the chosen circumstance. The problem has a irregular solution space and certain problem variables assume discrete values of zero or one. This paper introduces a method that uses fuzzy alteration of Evolutionary Programming (FEP) as a solution technique. FEP technique has been chosen as it is particularly suited while solving optimization problems with discontinuous solution space and when the global optimum is desired. Fuzzy adaptation of EP is necessitated while considering optimization of multiple objectives.

KEYWORDS: *Network Reconfiguration, Radial Distribution System (RDS), Fuzzy alteration of Evolutionary Programming (FEP).*

1. INTRODUCTION

Power utilities are interested in many ways to improve reliability of distribution system. As loads have increase in recent times, a highly reliable electrical energy supply is required. So the distribution system need to be upgrade and adding advanced electrical equipment are possible solution to improve reliability. However these conventional solutions require additional investment in the distribution system. Optimal distribution system reconfiguration is a effective and very efficient way to enhance the distribution system reliability, improve voltage profile and loss reduction. Distribution system reconfiguration (DSR) can be seen as a combination of optimization problem, comprising distribution system planning, loss reduction, energy restoration and improvisation of reliability.

In order to deal with these problems several methodologies have been developed. Distribution system are normally configure radially for effective co-ordination of their protective system.
So it is need to require re-configure the network from time to time, since distribution lines show different characteristics as each of the distribution feeders consists of industrial, commercial, residential etc. type of load because of above reason some part of distribution system become heavily loaded at certain time of the day and lightly loaded at other time.

For load balancing the loads are required to be rescheduled more efficiently by modifying the radial structure of the distribution feeders.

There are many methods are existing for determining feeder configuration. Network reconfiguration in distribution systems is realized by changing the status of sectionalizing switches and usually done for loss reduction. The distribution reconfiguration belongs to a complex combinatorial optimization problem. This is because there are multiple constrains, which must not be violated while finding the optimal or near - optimal solution to the distribution network reconfiguration problem.

This paper is structured in four more sections. In section 2 presents the concepts relating to Network Reconfiguration. In section 3 presents the proposed work. In section 4 presents the outcome of Proposed Work.

2. NETWORK RECONFIGURATION

There are many methods existing for determining feeder configuration Network reconfiguration in distribution systems is realized by changing the status of sectionalizing switches and usually done for loss reduction. The distribution reconfiguration belongs to a complex combinatorial optimization problem. This is because there are multiple constrains, which must not be violated while finding the optimal or near - optimal solution to the distribution network reconfiguration problem.

The algorithm uses a heuristic strategy that start with meshed distribution system, obtained by considering all switches closed; then the switches are open successively to eliminate the loops. In this sequential switch opening technique, the opening criterion is based on the minimum total power loss increase, and this determines using a power flow program. A refinement on the above method is made by using fuzzy controlled programming involving neighboring open switches. A mutation fuzzy logic controller is developed to speed up the process by adaptively adjusting the mutation rate.

In distribution system, the lines are normally denominated as feeder, and these may be composed by one or many branches.

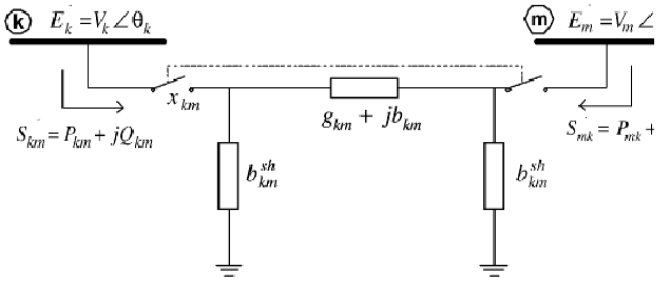

Fig. 1 Network Reconfiguration concept [6]

Fig . 1 shows a branch represented by the π- equivalent model, with a switched embedded. The switch is modelled using a continuous variable x km for the representation of its position, which can be assume any value between 1(fully closed) and 0(fully open) . These limits will be represented in OPF through a canalization restriction.

An open switch is simulated by assigning a value closed to zero to x km and this value is multiplied by the corresponding line parameters (g and b). The resulting small admittance will mean that the impedance will assume a high value and thus the line will behave as a fictitious branch. So that network will always connect and the nodal impedance matrix will not be singular.
Now when switches that assume values of x km closed to one as calculated by OPF, will indicate that power which naturally tend to flow through them, as a result the discovery of power flow path

3. PROPOSED WORK

Flávio Vanderson Gomes *et.al*. [41] was presented a new approach for distribution system reconfiguration (DSR) based on optimum power flow (OPF) in which the branch statuses (open/close) are represented by continuous functions. In this approach, all branches are initially considered closed, and from the OPF results, a heuristic technique is used to determine the next loop to be broken by opening one switch. Then the list of switches that are candidates to be opened is updated, and the above process is repeated until all loops are broken, making the distribution system radial.

More over encoding and decoding used in [13] is very complicated and slows down the speed of the algorithm. Fuzzy set theory provides an excellent framework for integrating the mathematical and heuristic approaches into a more realistic formulation of the reconfiguration.

Jaydeep Chakravorty[42] was introduced the new type of evolutionary search methodology for determining the minimum loss configuration of a radial distribution system. To improve the performance of evolutionary programming a fuzzy controlled evolutionary programming (FCEP) based on heuristic information was proposed. The designed mutation fuzzy controller adaptively adjusts the mutation rate during the evolutionary process. In addition to it a chain-table and depth breadth search strategy was employed to further speed up the optimization process. The equality and inequality constraints are embedded into the fitness function by some penalty factors to guarantee the optimal solutions searched by the FCEP became feasible.

The results of a fuzzy distribution load flow study are not only the possibility distributions of substation current, node voltages, real and reactive power losses, but also to assess the robustness of the system performance and the degree of exposure to an uncertain future.

3.1 PROPOSED WORK AND METHODOLOGY

On the basis of literature survey, and the contributions of researchers in the field of distribution system reconfiguration, it is observed that branch utilization cost and power loss is very important in electrical distribution system. So to resolve certain issues to be addressed above will required following steps:-

[1] Set up maneuverable switch list : Initially, a maneuverable switch list (MSL) is set up. This list must contain all the switches of the system that should be considered in the optimization procedure. The proposed solution method starts with a meshed distribution system obtained by considering all switches closed.
[2] Optimum power flow calculation: The OPF will provide the values of x km for all the maneuverable switches. In order to reduce the number of power flow solutions required in Step 3, a subset of switches can be chosen. This subset is called CSL and contains the closest to zero switches. Experience with the

algorithm has shown that a subset, consisting of twice the number of normally open switches that are required to ensure radiality, is adequate.

[3]Power flow calculation

[4] Definitely open the switch that produced minimum loss increase

[5] Update MSL

[6] Algorithm loop: The above procedure is applied in sequence to the updated MSL, up to the point when the MSL becomes empty, which means that all loops have been broken or, in other words, the system has become radial. Thus, while MSL is not empty, return to Step 2.

After implementing the optimum power flow technique for analyzing the switching process of proposed distribution system, the network reconfiguration problem in distribution system is to find a configuration with minimum loss while satisfying the operating constrain under certain load condition. The operating constrains will be voltage drop, current capacity, and radial operating structure of the system. Finally to achieve the solution of above problem a fuzzy controlled evolutionary technique will propose. Steps for implementing fuzzy controlled programming are as follows :

I) Switching status description
II) Generation of initial population
III) New network formulation
IV) Searching for feeder
V) Fitness function
VI) Fuzzy controlled mutation

A mutation fuzzy logic controller is developed to speed up
The evolutionary process by adaptively adjusting the mutation rate.
This method can be effectively used in real time application of the large distribution system under widely varying load conditions.

4. OUTCOME OF PROPOSED WORK

Expected outcome of the proposed work: A new approach for distribution system reconfiguration (DSR) based on optimum power flow (OPF) in which the branch statuses (open/close) will be represented by continuous functions. In the proposed approach, all branches are initially considered closed, and from the OPF results, a heuristic technique is used to determine the next loop to be broken by opening one switch. Then the list of switches that are candidates to be opened is updated, and the above process will repeat until all loops are broken, making the distribution system radial. Results will obtain on a real large-

Scale distribution system. Then after a fuzzy controlled evolutionary programming (FCEP) based on the heuristic information will introduced for determining the minimums loss configuration of a radial distribution system. The designed mutation fuzzy controller adaptively adjusts the mutation rate during the evolutionary process. In addition to it a chain-table and depth breadth search strategy will employed to further speed up the optimization process. The equality and inequality constraints are embedded into the fitness function by some penalty factors to guarantee the optimal solutions searched by the FCEP will be feasible.

Simulation and pictorial diagrams for performance analysis are carried out using MATLAB environment.

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