433/15/11/17

Name of Candidate: Reetu

Name of Supervisor: Prof. Shabana Mehfuz and Prof. Parmod kumar

Department: Department of Electrical Engineering, JMI, New Delhi

Title: Intelligent decision support systems for power system restoration

ABSTRACT

The objective of this research work is to develop the intelligent algorithms for reconfiguration of distribution network in the power system. Since most of the faults occur in the distribution networks and revenue to the utility depends on the continuity of the supply to the end users, the studies related to reconfiguration of distribution is an important problem. Due to techno economical factors, power system operates near to critical point. The stability margin is very less. The operator finds it difficult with the conventional tools and methods to restore the distribution networks promptly, effectively and efficiently. Intelligent algorithms have become a need of such complex distribution networks and provide aid to the operator for decision making and automation. Outages of a feeder or overloading of it can cause deterioration of power supply quality, enhances the power distribution losses and overall inefficiency to the distribution network. An intelligently fast operation and systematic restoration process and planning can reduce the power loss, damage of distribution system.

The thrust area of this research work is to review and propose efficient and intelligent algorithm for restoration of power distribution system. This algorithm will help the operators and system engineers during blackout and restoration with the intelligent restoration plan so that the process can be fast and efficient.

The first contribution of this research work is development of power flow algorithm for distribution system which addresses the losses and also calculate the sensitivity index (SI) of various parameters. Smart distribution network load may vary considerably during day as it comprises of non conventional energy sources and various types of consumer's load characteristics. Uneconomical and inefficient operation may increase the line losses and revenue losses to utilities. The voltage and frequency at the consumers end needs to be maintained near the rated value of loads. It is, therefore, important to calculate the sensitivity index of various parameters which is helpful in studying the changes in response of system with percentage change in any of its parameter.

The second contribution of research work is development of Fuzzy- Grey restoration algorithm for ranking of various restoration plans, which satisfies the objective function and constraints of distribution system. In order to develop and implement the restoration plan for restoration effectively, the equalities/objective function considered for system should be satisfied. Feeder reconfiguration alters the topological structure of distribution system by changing the open/ closed status of the sectionalizing and tie switches. The radial structure of the system should remain same with the loading of lateral, feeder and

transformer within specified limits. The crisp value of current loading index and switching index are used as a bench mark to check the health of restoration plan and is used as an input for any corrective action.

The third contribution of research work is to Design and implementation of new algorithm for reconfiguration with the objectives to minimize the loading of equipments using Particle swarm optimizer. This proposes a Fuzzy particle swarm optimization (FPSO) algorithm using global optimization to deal with multidimensional multi constraint and multi-objective problems. To deal with the problems of power loss and optimization of objective function of an unbalanced radial distribution network, the simple algorithm is presented. The algorithm uses the velocity and position updates, which results in the objective function minimization and feeder reconfiguration. The condition for convergence is finding the best solution or iteration reaching maximum limits, whichever is earlier.

Finally towards the end, development of Petri Net model based restoration approach to solve feeder overloading and contingency raised due to fault. In this,a Petri Net (PN) based system restoration approach is proposed to solve the feeder overloading contingency due to fault. The parallel like inference capability has been applied to find switching operation for fault detection, isolation and restoration. The PN model is based on the state space technique to perform the restoration process. A model for restoration of distribution system is developed for faulty condition of system and overloading of system components. The model based techniques are more robust, easily maintained and straightforward knowledge acquisition, because system behaviour and structure is known.

The cost evaluation function is calculated to find out the priorities of simultaneously enabled operation. Higher priority of operation is determined with lower value of cost function. Overloading index and ideal load level of equipments helps in finding the current load balancing of components. The PN modelling algorithm gives the overloading index during contingency which is helpful during switching operation. Feeder current before and after switching is compared and feeder load found more uniform and balanced after reconfiguration of system. The distribution system losses are also reduced by 9.56 % after proposed algorithm, the load balance index of components is also improved. For fault contingency, this PN algorithm provides stable loading profiles of distribution transformer which makes this research more advanced and improved over the other previous methods.