VOLTAGE STABILITY ENHANCEMENT AND LOSS REDUCTION IN DISTRIBUTION NETWORKS THROUGH DG PLACEMENT AND RECONFIGURATION

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by

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Chapter 6

CONCLUSION AND FUTURE SCOPE

6.1 GENERAL

High R/X ratio in distribution networks result in increased power loss that deteriorates its voltage profile particularly towards remote ends in case of radial feeders. Increased loading and occurrence of contingencies may further aggravate the situation where voltage at some part of network may go beyond acceptable limits leading to voltage instability. Apart from these, high percentage of power loss causes overheating of conductors and wastage of energy and resulting in loss of revenue. Therefore, effective measures are to be adopted to reduce power loss, improve voltage profile as well as voltage stability margin in distribution networks. Placement of distributed generations seems to be a viable solution to address these issues. Reconfiguration of the network through opening and closing of tie and sectionalizer switches may further support in resolving these issues. Looking on these aspects, an attempt has been made in this thesis to reduce power loss and enhance voltage profile as well as voltage stability margin through optimal DG placement and network reconfiguration. As radial feeders are more prone to voltage profile deterioration and voltage instability, the work carried out in this thesis has been restricted to radial distribution networks, only. Considering effectiveness of meta-heuristic algorithms in getting optimal solution, a modified GWO algorithm was used to obtain optimal placement of distributed generations. Case studies were performed on IEEE 33-bus and 69-bus test systems. Main contributions of this thesis and future research directions are presented below.

6.2 SUMMARY OF IMPORTANT FINDINGS

- In Chapter-2, modification of the acceleration coefficients for gray wolf optimization was proposed to solve the optimization problem for optimal placement of different types of multiple DG units considering minimization of network losses. The proposed optimization approach proved to be convergent in lesser number of iterations.
- In Chapter-3, the network reconfiguration and simultaneous DG placement was carried out to enhance the maximum system loadability and reduce power loss. This was accomplished through a multi-objective fitness function formulated which contains the objectives of loss reduction and system voltage stability margin enhancement. The simulation results reveal the efficacy and validity of proposed work through comparison made with the existing literature. It was found that the proposed method works better than the existing method in terms of reduced system loss, enhanced maximum loadability and improved voltage profile.
- In Chapter-4, the concept of remotely voltage controlled PQV bus was accomplished through regulated reactive power injection at P bus and variable dispatchable real power injection at Q bus. The introduction of P/Q and PQV buses were proved quite efficient for enhancing the maximum system loadability and reducing the network loss through strategic allocation of these buses in the distributions system. Simultaneous reconfiguration and DG placement were done in presence of P/Q and PQV buses. A new multi-objective function based on network loss and voltage magnitude along with loading at different buses was proposed. Proposed multi-objective function resulted in better

enhancement in voltage stability margin and loss reduction compared to same obtained through multi-objective function proposed in Chapter-3.

- In chapter-5, loss minimization and voltage profile improvement in presence of time varying voltage dependent loads were presented. Investigations were carried out under exponential voltage dependent load model for a set pattern of load variations for 24 hours period considered. Optimal location of Type 3 DG was obtained through collective power sensitivity, whereas, its optimal size was obtained through modified GWO algorithm presented in Chapter-2. Thereafter, network reconfiguration was done in the system employed with optimally placed DG. Investigations carried on two test systems have produced very encouraging results in terms of real as well as reactive power loss reduction and voltage profile improvement.

6.3 FUTURE SCOPE

The presented thesis work can be further extended in the following directions:

- The thesis considers use of network reconfiguration and simultaneous placement of single DG, only. Further investigations may be carried out to see the impact of multiple DGs of different types in the system.
- The remote voltage control of PQV bus was obtained with use of single P or Q bus in this thesis. However, this can also be accomplished with multiple numbers of P or Q buses or their combinations, too.
- The economic analysis of the system considering installation and maintenance cost of DG, system losses as well as switching cost associated with the tear and wear conditions of switches during reconfiguration may

be carried out. Different transient issues such as development of transient overvoltages (TOVs) as a result of switching operations and protection of system against these need to be investigated further.

- The whole study in this thesis was done considering balanced system. However, a practical distribution system is unbalanced in nature most of the times. Hence, further research may be carried out in seeing impact of DGs and reconfiguration in unbalanced distribution networks.
- The work carried out in this thesis has not investigated voltage stability margin enhancement using DG and network reconfiguration under time varying voltage dependent loads. Further research may be carried out in examining the impact of optimal DG placement and network reconfiguration for a distribution network employed with time varying voltage dependent loads. Further effort is also required for consideration of time varying DG output with due consideration of their intermittency and other practical constraints.
- Further research may consider power oscillation damping alongwith voltage stability enhancement through DG placement and reconfiguration.