CHAPTER 7

CONCLUSION

7.1 INTRODUCTION

In this chapter the significant results obtained during the research and the scope for future work are depicted. The major objective of the work is to formulate a MORPO problem with competing objects like minimization of real power loss, voltage deviation, investment cost of VAR sources and voltage stability index and to solve the MORPO problem using the fuzzy based stochastic algorithms like FMEP, FGTS and FPSO. Further the MORPO problem with FACTS controllers are solved with the proposed FMEP, FGTS and FPSO algorithms.

7.2 REVIEW OF WORK DONE

The various important conclusions of the previous chapter are highlighted in this section. They are:

i) The Multi-Objective Reactive Power Optimization (MORPO) problem is formulated as a constrained problem with competing objectives namely; minimization of the real power loss, minimization of voltage deviation, minimization of the investment cost of the compensating devices and minimization of the voltage stability index (L-index). The MORPO problem is subjected to the power balance equality constraints, limits on the control variables namely controllable voltage
magnitudes, switchable VAR compensators and transformer tap ratios, limits on the dependent variables namely reactive power generations and load bus voltage magnitudes and limits on MVA line flows.

ii) The MORPO problem is solved using EP and FMEP algorithms. The effectiveness of the proposed algorithm has been tested on a standard IEEE 30-bus, 66-bus (Indian utility) system and IEEE 118-bus system. The convergence obtained using EP and FMEP algorithms are smooth without any abrupt oscillations. The optimal results are obtained in lesser number of iteration for the proposed FMEP algorithm when compared with EP algorithm. The result obtained proves the ability of the proposed FMEP algorithm to generate diverse Pareto optimal solutions.

iii) The MORPO problem is solved using TS and FGTS algorithms. The effectiveness of the proposed algorithm has been tested on a standard IEEE 30-bus, 66-bus (Indian utility) system and IEEE 118-bus system. The convergence obtained using TS and FGTS algorithms are smooth without any abrupt oscillations. The optimal results are obtained in lesser number of iteration for the proposed FGTS algorithm when compared with TS algorithm. The result obtained proves the ability of the proposed FGTS algorithm to generate diverse Pareto optimal solutions.

iv) The MORPO problem is solved using PSO and FPSO algorithms. The effectiveness of the proposed algorithm has been tested on a standard IEEE 30-bus, 66-bus (Indian utility) system and IEEE 118-bus system. The convergence obtained
using PSO and FPSO algorithms are smooth without any abrupt oscillations. The optimal results are obtained in lesser number of iteration for the proposed FPSO algorithm when compared with PSO algorithm. The result obtained proves the ability of the proposed FPSO algorithm to generate diverse Pareto optimal solutions. The proposed FPSO algorithm attains faster convergence than the proposed FMEP and FGTS algorithms for MORPO problem.

v) The FACTS controllers namely SVC, TCSC and UPFC are included with the MORPO problem and solved using the proposed algorithms. The results of the algorithms are compared and analyzed. The analysis reveals that the proposed algorithms are able to handle the MORPO with FACTS controllers as a true multi-objective problem. The algorithms seem to be so simple and reliable for any type of engineering problems. The proposed FPSO algorithm attains faster convergence than the proposed FMEP and FGTS algorithms for MORPO problem.

### 7.3 SCOPE FOR FUTURE RESEARCH

i) The proposed algorithms for RPO problem with wind power penetration using more practical constraints like security constraints can be investigated.

ii) The co-ordination between various FACTS controllers pertaining to RPO problem with multiple FACTS controllers can be analyzed. For a higher degree of control, additional control variables corresponding to the modern FACTS controllers (STATCOM, SSSC, IPFC, generalized UPFC etc.)
and HVDC link can be implemented with the proposed algorithms.

iii) The proposed algorithms can be extended to RPO problem in a deregulated power system.

iv) The applicability and the effectiveness of the proposed algorithm can be tested on real time hardware power system simulator embedded with SCADA and EMS.

7.4 SUMMARY

The fuzzy logic based stochastic algorithms used to solve the MORPO can also be used to solve different multi-objective problems in power system and thereby enhancing the security and reliability of the power system. Hence the proposed algorithms will encourage further research in this field.