CHAPTER – 8

CONCLUSIONS AND FUTURE SCOPE
8.1 CONCLUSION

The evaluation of composite power system reliability is essential for the modern power system to assess its capability to supply continuous power to the consumers. The power system network is affected by various uncertainties such as equipment failures and random variations in power generation and load demand. All these factors and complex network topology with large number of equipment leads to difficulties in the assessment of reliability in a composite power system. The research work presented in this thesis is mainly focused on composite power system reliability. The composite power system reliability combines both generation and transmission capacity adequacy. The uncertainties in generation and transmission system are studied in this research work. Evaluation of reliability is done through computation of various reliability indices. One of these indices is the probability of average power availability at the load node. The thesis is mainly concerned with various methods to evaluate the power availability at the load nodes considering the failure and repair rates of all components in the composite power system.

Chapter 2 summarizes the modelling of power system components for reliability analysis. The advantages, disadvantages and limitations of existing methods are discussed. A new methodology called “Node Elimination Method” is developed for reliability analysis. So far the Node Elimination method is used for power system analysis and for the first time this method used in evaluation of reliability. The developed models are validated by traditional methods such as series-parallel approach and Monte Carlo simulation method. Later two more methods are developed in chapter 3 for the calculation of power availability at load bus in composite power system.
Chapter 3 explores the algorithms based on conditional probability and modified cut set. Both the algorithms overcome the difficulties over the existing methods based on tracing of power flows. These algorithms are tested with practical test systems like IEEE 6, 14 bus systems and IEEE RTS-96 systems. The results achieved from the proposed algorithms are validated by Node Elimination method.

Chapter 4 discusses a search algorithm for optimal placing of DGs in power system. The classical node elimination method proposed in chapter 2 is used to evaluate power availabilities at load buses. The optimal location of DGs is achieved in different test systems like IEEE 6, 14 bus and RTS-96 systems. The proposed search algorithm is validated with the Monte Carlo Simulation method. The results obtained from both the methods are presented and discussed.

Chapter 5 discusses the causes of loss of load probability in composite power system. The composite power system used in this reliability analysis combines both wind power generation and conventional power generation. The wind velocity prediction models are developed and are validated by the data from MOSDAC. The probabilistic availability of power generated from the wind units is evaluated by considering the hourly wind velocity data. The Loss of load expected (LOLE) due to the variations in wind power generation is predicted in advance through the proposed methodology. This will help the power system planners to consider the requirement of spinning reserve and energy storage devises.

Chapter 6 explores the power transformer derating effect on composite power system reliability. New derating factor for power transformer rating is developed based on estimated tank temperature. A probabilistic methodology is developed for the calculation loss of load expected due to the derating of transformer capacity. Further the effect of power transformer derating on micro grid is analysed and
calculation of power capacity availability at load buses is evaluated. The results obtained are presented.

Chapter 7 provides a solution to reduce the loss of load probability. The Loss of Load has significant effect on the power system operation. The loss of load frequently happens due to the reduction in wind/solar power generation. The non-linear nature of the power generation is studied and day ahead power predictions are developed from the wind velocity prediction models. This chapter addresses a method to reduce the problem of loss of load probability by the addition of Energy storage unit (ESU) along with wind power generation. The choice of the optimal size for the ESU is achieved by minimizing the cost function which is based on the fixed annual cost plus the cost of annual energy not supplied. The results obtained from the proposed methodology are presented and discussed.

8.2 SPECIFIC CONCLUSIONS

The work is confined to Composite Power System Reliability (combines both the Generation & Transmission):

1. Modelling of power system components for reliability studies and implementation of Node Elimination method for reliability analysis.
2. New algorithms based on conditional probability and minimal cut set approach.
3. Search algorithm for optimal location of DGs in a composite power system.
4. Derating factor for power transformer is developed and a probabilistic methodology is developed for LOLE calculation.
5. The effect of power transformer derating on micro grid and a methodology is developed for calculation of power capacity availability at load buses.
6. A solution is developed for reduction of LOLE in wind integrated power systems.

8.2 **SPECIFIC CONTRIBUTIONS MADE BY THE RESEARCH CARRIED OUT**

1. Application of node elimination method for reliability evaluation.

2. Method of determining the derating factor of transformer based on the predicted tank temperature.


4. Simple method for optimal location of DGs in Micro grid.

5. Simple method for day ahead predicting wind velocity.