Abstract

Load frequency control (LFC) of a large interconnected power system is the backbone of any power utility. The fundamental purpose of load frequency control is to maintain equilibrium between the generation and load demand. In case there is such equilibrium, based on power system nature, it is easy to conclude that power exchange with neighboring areas, are not violating the constraints on operating supply frequency.

LFC problem of a large interconnected power system has been studied by dividing the whole system into a number of control areas. A control area in power system is defined as a part of a whole or a combination of sub systems to which a common generation control scheme is applied. The electrical interconnections within each control area are very strong as compared to the ties with the neighboring areas. All the generators in a control area swing in unison and it is characterized by a single frequency. In normal steady state operation each control area of a power system should strive to meet its own load demand and in addition each control area of a power system should participate in regulating the frequency of the whole system in response to load/generation changes.

Since power systems are complex and multi-variable, to realize automatic load frequency control is not always an easy task. Due to complexity of large interconnected power system and its multi-variable states of operation, the classic methods of automatic control have almost become obsolete. Limitations and problems, which appear when classic regulators are used, may be surpassed, if fuzzy logic control is applied. The advantages of fuzzy logic controllers over conventional controllers, such as their less dependence on rigorous mathematical models, and ability to take care of non-linear control

actions, make fuzzy logic controller appropriate to tackle LFC problem of interconnected power system.

The research work carried out in this thesis has been made to develop controllers for two and three area interconnected power systems and to analyze the dynamic performance in terms of settling time and peakovershoot under sudden load change in any one or two areas. First, the optimal controller is designed based on linear quadratic regulator theory used for two area interconnected system. Second the fuzzy logic based integral controller is developed for two and three area systems and tested with different system conditions such as non-reheat turbines, reheat turbines, non-reheat and hydro turbines, reheat and hydro turbines. The non-linearity associated with speed-governing system i.e., generation rate constraint has been included in the proposed research work. Dynamic performance of the multi-area interconnected system is also analyzed by adding a parallel HVDC link to the existing tie-line. In addition to this, robustness in controller behavior is also achieved by varying three system parameters: frequency bias constant, tie-line constant, and power system time constant to ± 30 % of their nominal values.

The proposed fuzzy based controller is fed with two inputs i.e. area control error and rate of change of area control error. In this direction, novel automatic load frequency control problem solution with fuzzy logic based improved integral control scheme has been proposed, developed and validated through simulation results tested with IEEE standard data for both two and three area systems.

The complete computational models of two and three area interconnected power systems are developed in MATLAB/SIMULINK 7.0 to study its behavior under various operating conditions like sudden load change in any one area or in two areas simultaneously. Details of various blocks of computational model and the method used to develop these blocks have been presented. Simulation results have also been presented, analyzed and compared with the results of other researchers.

Finally, the conclusions and future scope of this research work have been discussed. It is hoped that the investigations reported in this thesis will lead to further research in strengthening the existing control schemes.