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Title of the Thesis: Price Based Intelligent Automatic Generation and Control.

Abstract

The Automatic Generation Control (AGC) helps to regulate grid frequency due to load deviation or changes in power generation from Renewable Energy Sources (RESs). Simultaneously, in India, frequency linked UI price that is a part of the ABT mechanism, also play a similar role in regulating the grid frequency. But the actual generator system characteristics remains nonlinear due to sudden load variation, governor dead band, generation rate constraint and fluctuating power of grid-connected RESs. Governor under the control of AGC and UI price may be incapable of controlling sudden load changes and would also result in the fuel consumption and sometimes fall out either in frequency deviation or tripping of generators. So, the AGC operation becomes very difficult. The objective of this study is to design and develop additional control loop in AGC to reduce frequency overshoot and settling time.

In this study the general framework for deriving the state-space model of two area restructured power system having 2 numbers of Generating Companies (GENCOs) with the thermal-thermal non-reheat unit in each area, and 2 numbers of Distribution Companies (DISCOs) with renewable energy sources and bidirectional charge for Electrical Vehicle (EV) model have been developed. The model for UI price of ABT mechanism (CERC, 2016) has been used to analyse AGC performance based on real-time price linked to frequency. The developed model is simulated in MATLAB/Simulink environment under different market with different loading conditions.

This research work has resulted in a unique solution that has minimized the deviation in the frequency as well as UI price by load variation and renewable power generation. The dynamic storage (EV) mechanism suggested in this research has given a better solution to normalize the frequency fluctuations in restructured IPS with the help of the bidirectional charge controller. This PhD Thesis will help in the development of the bidirectional charging mechanism for the Indian grid.

List of Publication(s):

1. YR Prajapati and V N Kamat, "Secondary frequency regulation / Automatic Generation Control under Deregulated Power System along with renewable energy sources using Electric Vehicle/ Distributed Energy Storage Systems", IEEE International Conference on Electrical, Electronics, and Optimization Techniques (ICEEOT),2016.
2. YR Prajapati, V N Kamat and J J Patel "Price Based Automatic Generation Control (AGC) in a restructured power system by considering peak hours and off-peak", Wulfenia Journal, Klagenfurt, Austria, ISSN- 1561 882X, vol. 25, No.3, March 2018.
3. Yogesh R Prajapati, Vithal N Kamat and Jatinkumar J Patel, "Load Frequency Control Under Restructured Power System Using Electrical Vehicle as Distributed Energy Source", IE(I) Series B, SPRINGER vol.101, pp.379–387, 2020.
4. Yogesh R Prajapati, Jatinkumar J Patel and Vithal N Kamat, "Automatic Generation Control (AGC) operation in a restructured power system under Availability Based Tariff (ABT) mechanism by considering peak hours and off-peak hours", IJST, vol.13(33), pp.3400-3408, 2020.