



Load following in a bilateral market with local controllers

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ABSTRACT

In this paper, the conventional Automatic Generation Control (AGC) of two-area interconnected power system is modified to take into account the effect of bilateral contracts between the supplier and customer. A load following controller on each generator involved in the bilateral contract is considered. A separate control scheme for generators taking part in load-following is proposed to share the uncontracted power demanded by some customers. Simulation studies show that both the control schemes are very effective for the generators taking part in load following.

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1. Introduction

Electric power utilities throughout the world are currently undergoing major restructuring processes and are adapting the deregulated market operation. Competition has been introduced in power systems around the world based on the premise that it will increase the efficiency of the industrial sector and reduce the cost of electrical energy of all customers. Most of the ancillary services of a vertically integrated utility will have a different role to play in restructured environment and hence these ancillary services have to be modelled differently. Automatic Generation Control (AGC) is one of these ancillary services. In the new environment, a customer can contract individually with a supplier for power.

Recent literature on AGC shows that researchers have paid attention to reformulate the AGC problem in restructured environment. The various issues of load frequency control after deregulation have been discussed in length in [1]. The authors of [2] have studied the AGC problem in a deregulated environment and proposed a ramp following controller which ensures that selected generators will automatically follow the load changes. The differences between the AGC operation in a vertically integrated industry and a horizontally integrated industry have been reported in [3,4]. The market structure proposed by them is kept generic enough to capture all possibilities in marketing load following capability. Donde et al. [5] have also reformulated the two area AGC model in a restructured environment similar to that of [3,4]. The feasibility of providing load following competitively has been demonstrated in [6]. They have attempted to decentralise the market for load fol-

lowing. Delfino et al. [7] have addressed the subject of load frequency control from the point of view of the restructuring process of the electrical industry. They have treated load frequency control as an ancillary service essential for maintaining the electrical system reliability at an adequate level and proposed two control schemes namely, the pluralistic and hierarchical load frequency control. Liu et al. [8] have proposed a framework for optimal load frequency control in deregulated environments. They have optimised an objective function which incorporates both the indices of economy as well as stability. A decentralised controller for multi-area AGC for the restructured electricity markets using the Eigen structure assignment technique has been suggested in [9].

In view of the above developments, the present work reformulates the AGC problem in the deregulated environment and the main objectives of the present work are:

- (1) To study the performance of load following controller on each generator involved in the bilateral contract.
- (2) To propose a suitable control scheme such that a generator can take part in load following as well as share the portion of uncontracted power demanded by the customer.

2. Restructured environment

In restructured environment, the generation companies (GENCOs) supply power to various distribution companies (DISCOs) at competitive prices. Thus, DISCOs may or may not have contracts with the GENCOs in their own area because they have freedom to choose the GENCOs of other areas too. For the sake of clarity, consider a two-area system as shown in Fig. 1. In area-1, there is one generation company designated by GENCO₁ with two

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