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Tie line power control of Two Area System using Tie-line bias Controller

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ABSTRACT: In a power system load demand is continuously changing, in accordance with it power generation has also to vary. If power generation and demand is not maintained a change in frequency will occur. Conventional power system the control of frequency is achieved primarily through speed governor mechanism aided by supplementary means for precise control. In this paper ,frequency control and tie line power flow of two area interconnected system is implemented in mat lab is discussed.

KEYWORDS::frequency, generator, tie-line, power, control two-area system, AGC.

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I. INTRODUCTION

The power system is basically dependent upon the synchronous generator for frequency and voltage. In India power system is designed for 50 HZ frequency and it needs to be maintained constant.[1] Constant frequency means, there is power balance between the power generation and load demand and losses. generally frequency control is achieved through generator control mechanism. when the real power balance between generation and demand is achieved the frequency specification is automatically satisfied.Similarly,with a balance between reactive power generation and demand ,voltage profile is also maintained within the prescribed limits.[2] Under steady state condition, the total real power generation in the system equals the total MW or frequency .Generators are fitted with speed governors adjust the input to match the demand within their limits.There are four basic needs to be satisfied for the satisfied operation of the power system.(i)The generation must be adequate to meet all load demand.(ii)The system frequency must be maintained within narrow and rigid limits.(iii) The system voltage profile must be maintained within reasonable limits and (iv)In case of interconnected operation ,tie line power flows must be maintained at the specified values.

For the interconnected operation, tie-line power must be maintained at the specified limits in order maintain the frequency within its limits by deriving an error signal from the deviations in the specified tie-lie power flows to neighbouring utilities and adding this signal to the control signal of the load frequency control system.[3] There are three types of frequency controls available (i) Flat frequency control(ii) Flat -tie line and flat frequency control(iii) Tie-line Bias control.

Flat frequency control is useful only when a small system is connected to a much larger system. In flat-tie line and flat frequency control, if one of the regulators is sluggish in any area where changes in power demand take place, than the other regulators, it cannot assist in getting the desired control. In order to obtain the desired control flat-tie line controller is to be biased to obtain a tie-line bias controller.

II.SYSTEM CONFIGURATION

Consider a two areas are interconnected. Each area consists of governor ,steam turbine and its power system. when two areas is interconnected power balance needs to be maintained between the areas. In this system transfer functions of the power system components are used for the load frequency analysis[3]. In India we are using constant frequency power system, the allowable frequency deviation is $\pm$ 3%.[4] The power generated should be able to full fill the load demand and losses. When two systems are interconnected ,and there is a power imbalance, there is frequency deviation in the system[5]. In any power system frequency should remain constant. In this method by changing the rotor inertia frequency is controlled.

In order to keep the frequency constant steam inlet value is adjusted to maintain the frequency. adjusted to maintain the frequency. when load demand and losses is more than the power generated ,there is dip in the frequency response. steam turbine inlet valve is opened little further and steam supply to the turbine is increased and steam turbine generator increases its generation.[6] Likewise, when generation more than the power demand and losses ,frequency increases the steam inlet valve adjusted to reduce the steam to turbine and thereby reducing the power generation. and controlling frequency deviation. By maintaining the frequency constant, loads connected to the system are protected.

III. ANALYSIS OF THE SYSTEM

Analysis of two area system is implemented using transfer functions of the governor, turbine and power system as shown in fig1. Two Area system is shown in fgure1.The system is widely used in literature for the design and analysis of AGC [8]. In Fig. 1, Transfer functions of governor ,turbine and power system are used for convenient analysis. The transfer functions are as given below.

Governor transfer functionGs1 = $\frac{Ks}{1+sTs}$ ....(1)

Turbine-generator transfer functionGT$_G$= $\frac{KTG}{1+sTG}$ ..(2)

Power system transfer function Gp= $\frac{Kp}{1+Tp}$ ....(3)

in equations (1),(2),(3) Ts,TG,and Tp are time constants of governor ,turbine and power system in seconds. B1 and B2 are the frequency bias parameters; ACE1 and ACE2 are area control errors; u1 and u2 are the control outputs from the controller; R1 and R2 are the governor speed regulation parameters in p.u. Hz; ; ΔPG1 and ΔPG2 are the governor output command(p.u.);

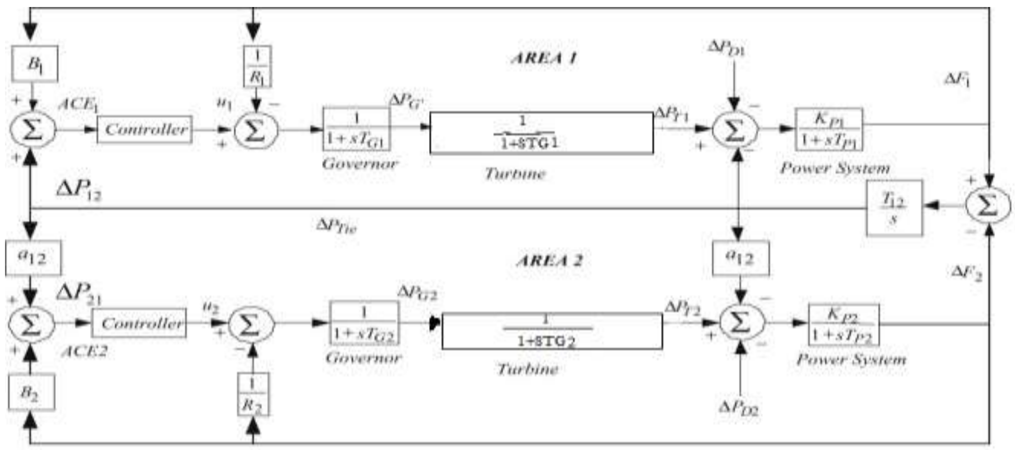

Fig.1:TwoArea System

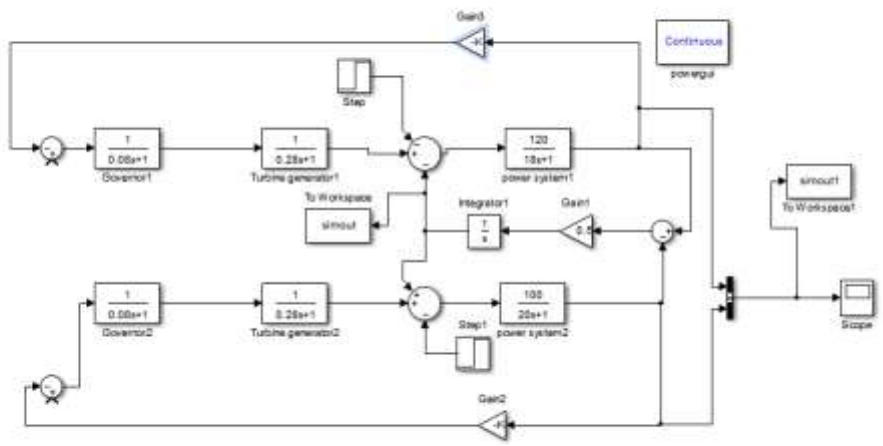

Fig.2 Tie-line control without controller

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ΔPT1and ΔPT2 are the change in turbine output Powers; ΔPD1 and ΔPD2 are the load demand changes; Ks1and Ks2 are the governor system gain:,KTG1 and KTG2 are turbine generator gains.,KP1 and KP2 are the power system gains; T12 is the synchronizing coefficient in p.u.; ΔPTie is the incremental change in tie line power (p.u.); ΔF1 and ΔF2 are the system frequency deviations in Hz.

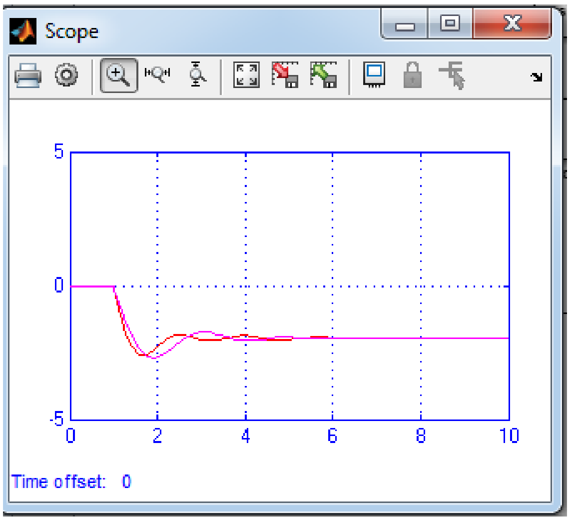

Fig3:Without Control

Fig.1 shows the two area system, and Fig.2shows without frequency control and fig 3 shows its frequency response. Fig4 and Fig5 shows the two area system with frequency control and its frequency response. The same frequency control can be applied to hydro power plant. By adjusting the water inlet to the hydro turbine frequency can be maintained. Similarly the same working principle can be applied to the wind turbine generator also.

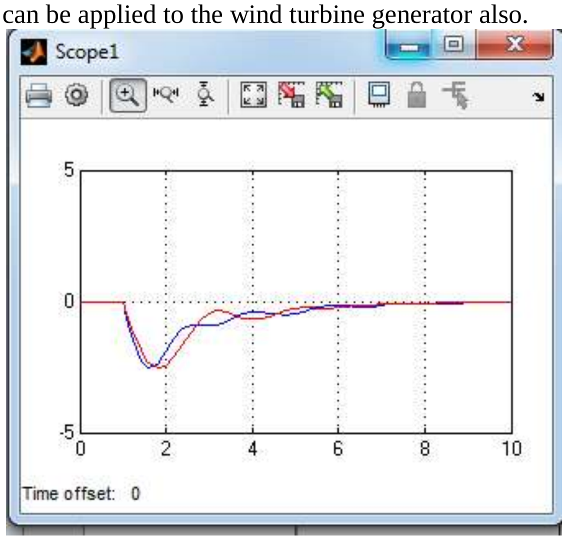

Fig5:withController

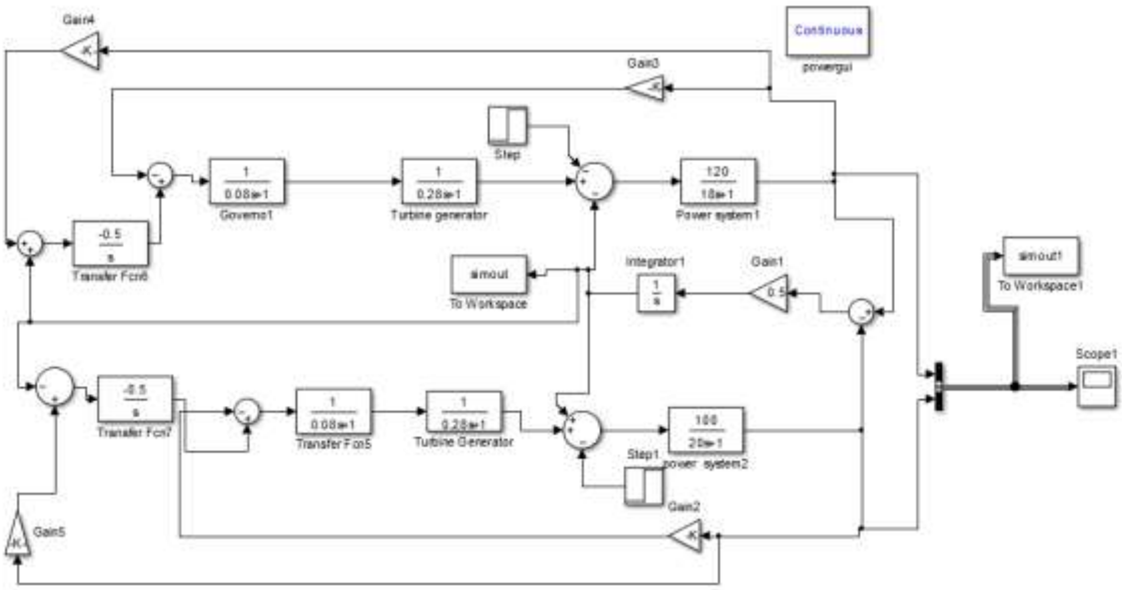

Fig4: Tie-line control with Tie-line bias controller

IV.CONCLUSION

From the obtained results it is observed that with tie line bias control effectively controls the frequency deviations. Time required for the control action is also less. This method can also implemented to three area system and extended to multi area system. Similarly the same working principle can be applied to the wind turbine generator also. By changing the speed of the wind generator power generation of wind turbine generator can be increased or decreased there by frequency can be maintained constant. As wind turbine generation is intermittent in nature ,when it penetrates into the main grid maintaining the frequency constant becomes essential.

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