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Implementation of LFC for multi-area power systems using the conventional PI controller

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ABSTRACT

In an interconnected power system, small disturbance occurs in load at each area that causes fluctuate the frequency from its nominal value and also tie-line power flow between different areas are fluctuate. Therefore the main role of load frequency control is to maintain the frequency at nominal value and to keep the net interchange power between pool members at the predetermined values. This can be done by conventional controllers. In this paper, the conventional PI controller is used as a controller in the multi-area interconnected power system. Comparisons between with PI controller and without a PI controller is presented using Matlab/Simulink.

Keywords: *Load frequency control (LFC), Automatic generation control (AGC), Interconnected power system, Proportional-integral (PI) controller.*

1. INTRODUCTION

Most of the power systems are interconnected with their neighboring areas. In interconnected multi-area power system as a power load demand varies randomly, in the case of any small sudden systems are divided into various areas. In an interconnected multi-area power system, as the power load demand varies randomly, the frequency and tie line power flow interchange also vary. The objective of the LFC is to maintain the frequency of each area within limits and to keep tie-line power flow within some pre-specified tolerances by adjusting the MW outputs of the generators so as to accommodate fluctuating load demands [1]. The basic role of LFC is to maintain the desired megawatt output power of generator matching with the changing load. If there is unbalanced between supply and load demand which cause the fluctuate the system frequency and which can degrade the power system performance. Automatic generation control plays a major role to maintain the system frequency at or very close to the specified nominal value and to sustain the scheduled exchange of power. The main problem that occurs during the interconnection power system is damping out the tie line power deviation and frequency oscillation. If no adequate damping is provided, the oscillations may persist for a long duration causing breakdown of the system [3]. Automatic generation control has a speed governing linkage mechanism. If the generator speed suddenly falls or exceeds to its nominal pre-specified value then governor sense the generator speed and it will adjust the input steam or water which is given to turbine for thermal and hydro system. Because electromagnetic torque is produced by the turbine is regulated then the speed of generator becomes regulate and output power comes to its nominal value.

2. REASONS FOR KEEPING FREQUENCY CONSTANT

The speed of AC motors is directly related to the frequency. Even though most of AC drives are not much affected by a frequency variation of even 50 0.5Hz but there are certain applications where speed consistency must be of higher order [5]. If the normal operating frequency is 50Hz and turbines run at a speed corresponding to frequencies less than 47.5Hz or above 52.5Hz, then the blades of turbines may get damaged. Hence a strict limit on frequency shoul be maintained [2].

The overall operation of the power system can be controlled better if maintained the strict limit on frequency deviation. The frequency is closer related to real power balance in the overall network. Change in frequency, cause a change in speed of the consumers' plant affecting production processes [5].

3. THREE AREA POWER SYSTEM

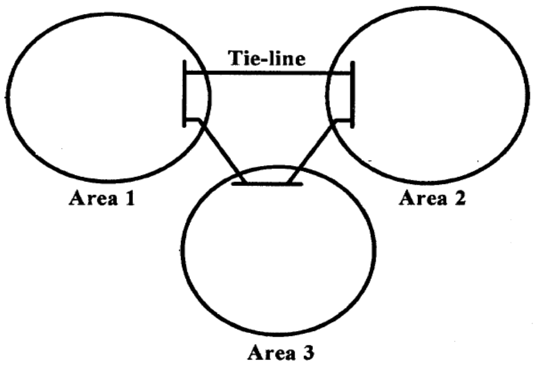

Fig 1: three area interconnection

Three interconnected areas are considered in this paper. Area 1 is reheated thermal plant area 2 is hydro plant and area 3 is also reheat thermal plant. All these three areas are interconnected through tie lines. The transmission lines that connect an area to its neighboring area are called tie-lines. Power sharing between different areas occurs through these tie lines. Load frequency control, as the name signifies, regulate the power flow between different area while holding the frequency constant.

Thermal unit: A steam turbine converts the energy that is stored in the form of high pressure and high-temperature steam into rotating energy, that energy is again converted into electrical energy by moving the generator [3].

Hydro unit: A hydro turbine converts potential energy of the water into kinetic energy that into rotating energy then it converted into electrical energy by generators.

PI controller

A proportional integral (PI) controller is a control loop feedback mechanism (controller) commonly used in the industrial control system. As the name suggests, PI algorithm consists of two basic coefficients are proportional (Kp) and integral (Ki) which are varied to get optimal response.

The combination of proportional and integral result the PI controller, the advantages of PI controller increase the speed of the response and also to eliminate the steady state error. Kp and Ki are the tuning coefficients, are adjusted so that the desired output is obtained. PI controller used for minimizing the frequency deviation in the multi-area power system employing AGC.

4. SIMULATION AND RESULT

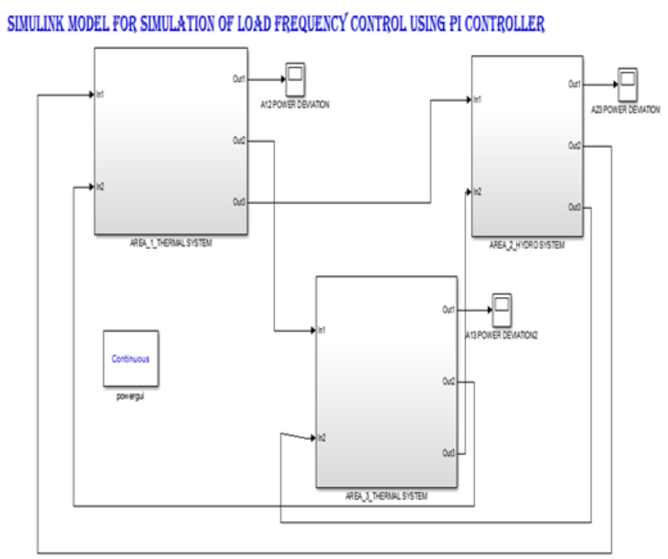

Fig 2: Simulink model of three area power system using the PI controller

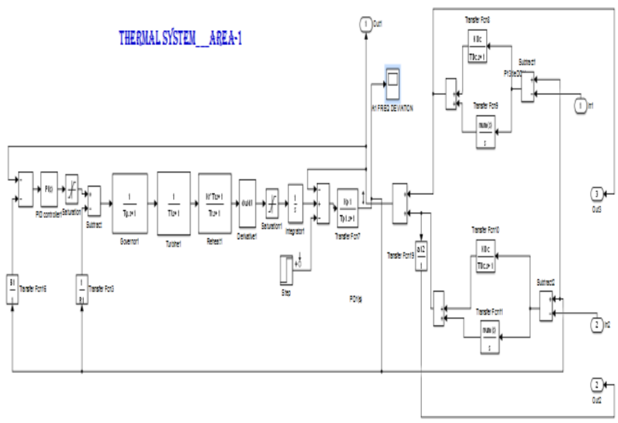

Fig 3: Simulink model of area 1 thermal system

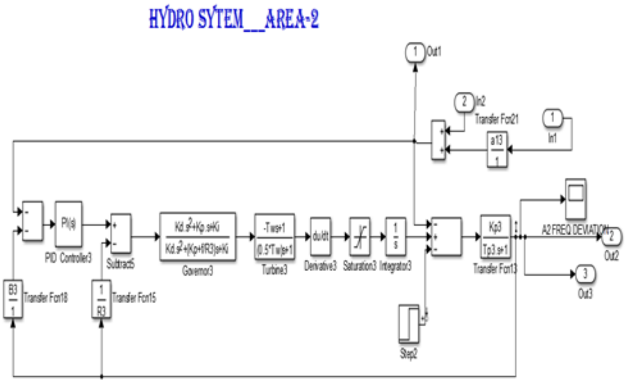

Fig 4: Simulink model area 2 hydro system

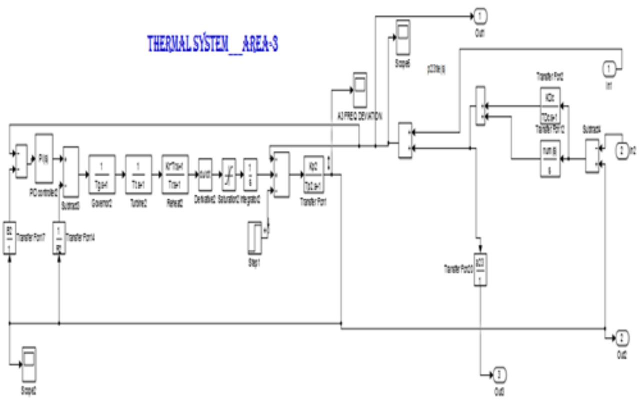

Fig 5: Simulink model area 3 thermal system

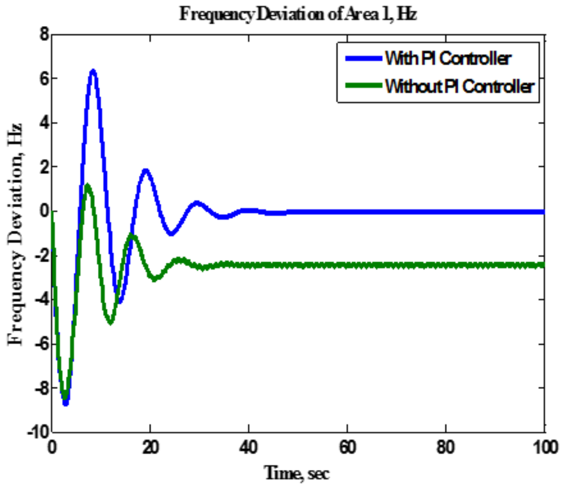

Fig 6: Frequency deviation of the area1 thermal system

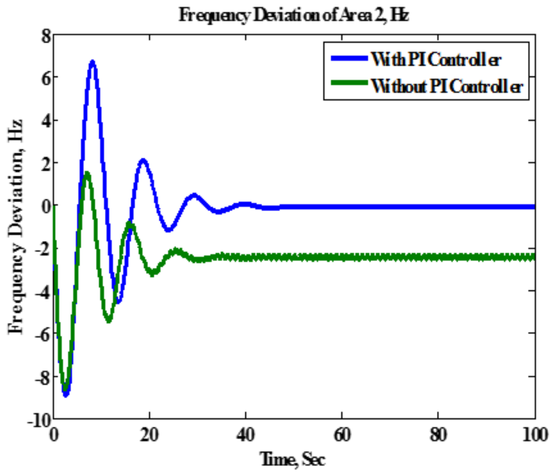

Fig 7: Frequency deviation of area 2 hydro system

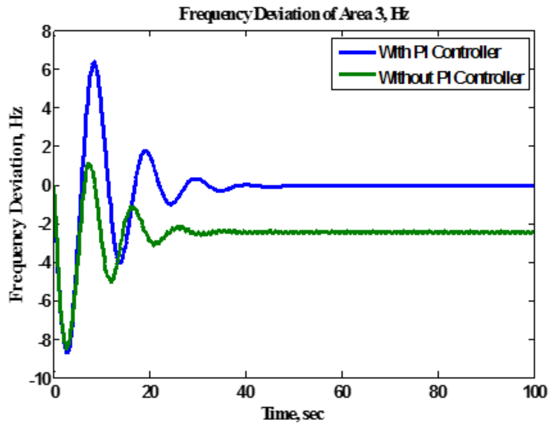

Fig 8: Frequency deviation of area 3 thermal system

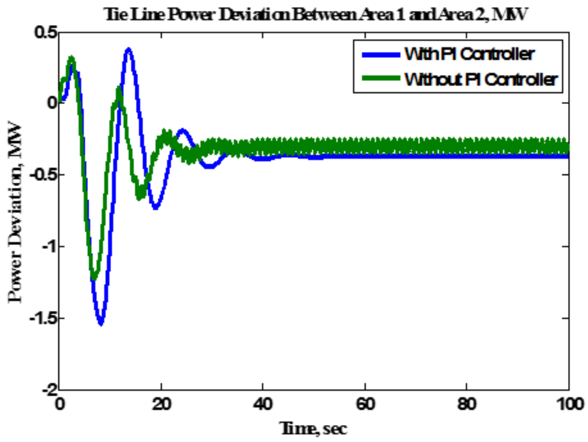

Fig 9: Tie line power deviation of area 1 and area 2

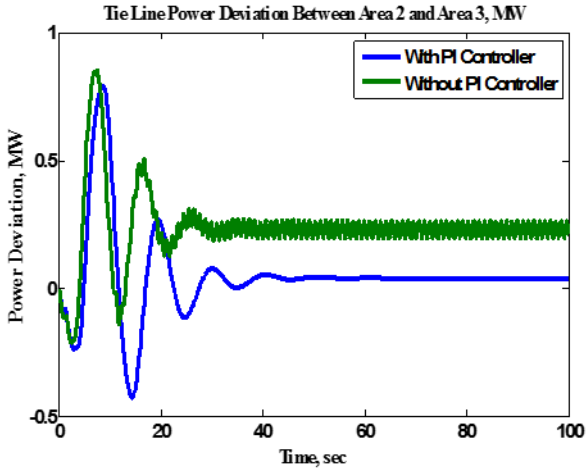

Fig 10: Tie line power deviation of area 2 and area 3

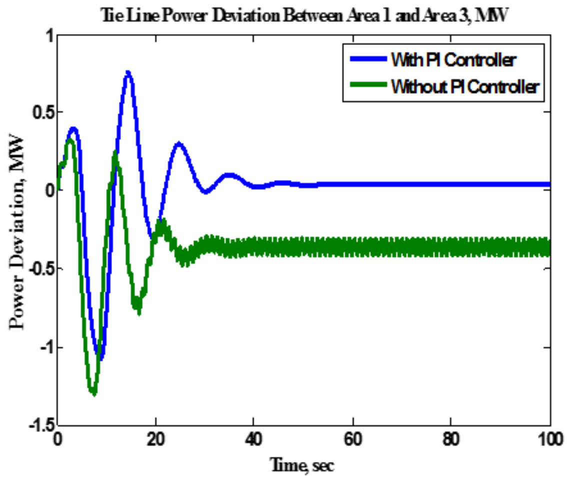

Fig 11: Tie line power deviation of area 1

5. CONCLUSION

The automatic generation control is used for to regulate the frequency at nominal value and balance between the supply and load demand. The AC tie line is used parallel with DC tie line because it improves the system performance. The disadvantages of AC tie line is overcome by using DC tie line. The conventional controller is also used for scheduled the power and frequency. In this paper seen that the load frequency control with PI controller is better than without PI controller.

6. REFERENCES

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