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Proposed Method to Control Load Frequency in Single Area Power System

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Abstract: *In order to supply reliable electric power of good quality Load Frequency Control (LFC) in power system is very important. In industries, the speed of the machines depends on the frequency. Any Fluctuation in the frequency may lead to fault of system. The load-frequency control is used to create the balance between load and generation of each control area by means of speed control. So load frequency control is the key problem in the power system. In this paper frequency deviation problem associated with load frequency control is evaluated by integral controller and proportional integral controller for one area power system. The results of two controllers are compared using MATLAB/Simulink software package. Comparison results of Integral Controller and PI controller System are presented hereunder.*

Keywords: **Single area Load Frequency Control, Integral Controller, PI Controller, Area Control Error**

I. INTRODUCTION

The modern power systems with industrial and commercial loads required to operate at fixed Frequency with reliable power. Load Frequency Control (LFC) is a very important issue in power System operation and control for supplying sufficient and reliable electric power of good quality. The main objective of the LFC is to maintain zero steady state errors for frequency deviation and good tracking load demands in a multi-area restructured power system [1]. Load frequency control is the basis of many advanced concepts. The dynamic behavior of many industrial Plants is heavily influenced by disturbances and, in particular, by changes in the operating point. This is typically the case for power systems [2].Frequency is an explanation of stability criterion in power systems. To provide the stability, active power balance and steady frequency are must. If any change occurs in active power demand/generation in power systems, frequency cannot be hold in its rated value. So oscillations increase in both power and frequency. Thus, system is subjected to a serious instability problem. In electric power generation, system, disturbances caused by load fluctuations result in changes to the desired frequency value. Load Frequency Control (LFC) is a very important issue in power system operation and control for supplying sufficient and both good quality and reliable power [3].Changes that happens in load of power system, can affect the frequency and in addition it will make the power quality crisis on the customers' super sensitive equipment's. To avoid this frequency must be regulating inside the limit. In the power system the load changes are arbitrary without control and there is unbalance in real and reactive power. For controlling frequency in power system a load frequency control (LFC) is needed and it plays an essential role in power system control [4,7].The conventional controllers such as proportional integral and integral controller are utilized for Load Frequency Control. However, these methods have the capacity to control the single area, perform well under load variation, and good robustness. It also has some crisis such as damping oscillation, long settling time and maximum overshoot of frequency. As the load varies constantly the control is actually difficult due to the gain value of the controller is fixed of these controller. The results of the two controllers are compared using MATLAB/Simulink software package. Comparison results of Integral Controller and PI controller System are presented.

II. SINGLE AREA LOAD FREQUENCY CONTROL MODEL

The goal of LFC is to maintain real(active) power balance in the system through control of system frequency. Whenever the active power demand changes, a frequency change occurs. This frequency error is amplified, mixed and changed to a command signal which is sent to turbine governor. The governor operates to restore the balance between the input and output by changing the turbine output. This method is also known as Power frequency control [5,6]. One generating unit or bunch of generating units placed in close vicinity to distribute the electricity in

the same area is called single area system. More than one control area power systems with a single control zone is actually a combination of power systems and the problems of each region, combining a control structure. Figure 1 is a single zone with a power system block diagrams. Here a regulator, balance the speed of synchronous generator and the load is comprised. Only the generating unit present in that area is responsible to balance the desired frequency in normal and abnormal conditions.

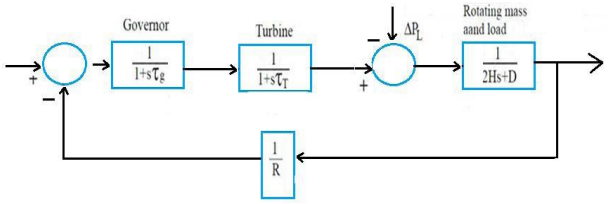

Fig1: Single-zone power system block diagram

III. DESIGN OF CONVENTIONAL CONTROLLER

A. Integral Controller: The integral controller used for the purpose of LFC is comprised of a frequency sensor and an integrator. The work of frequency sensor is to sense the frequency error (Δf) of the system due to load change or fault condition. This frequency error signal is then fed to the integrator. This frequency error which is given as the input to integrator is known as "Area Control Error". So we can say that ACE is the frequency change of an area which is given to integral control action loop to bring the system in steady state and keep frequency error as zero.

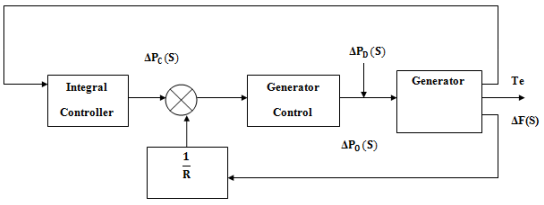

Fig 2: Integral controller

B. PI Controller: PI controllers are very often used in industry, especially when speed of the response is not an issue. Out of various methods of load frequency controller, the PI controllers are mostly used in speed-governing system for LFC scheme.

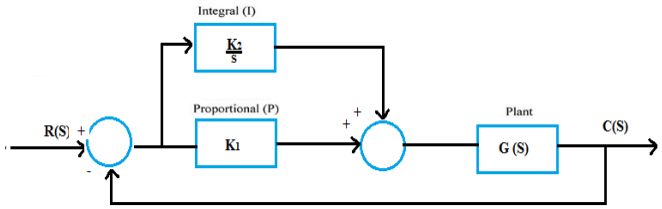

Fig 3: PI controller

The proportional plus integral (PI) controller produces an output signal consisting of two terms-one proportional to error signal and the other proportional to the integral of error signal. An advantage of the PI control technique is to reduce the steady-state error to zero by feeding the errors in the past forward to the plant .P-I controller is mainly used to remove the steady state error resulting from Integral controller. However, in terms of the speed of the response and overall stability of the system, it has a negative impact. This controller is mostly used in areas where speed of the system is not an issue. Since P-I controller has no ability to forecast the future errors of the system it cannot decrease the rise time and eliminate the oscillations.

IV. SIMULATION RESULTS

The MATLAB simulation has been organize in MATLAB (R2010a) for single area power system with Integral Controller and PI controller is design for Power plant model using MATLAB Simulink.

Case 1 (uncontrolled load frequency control)

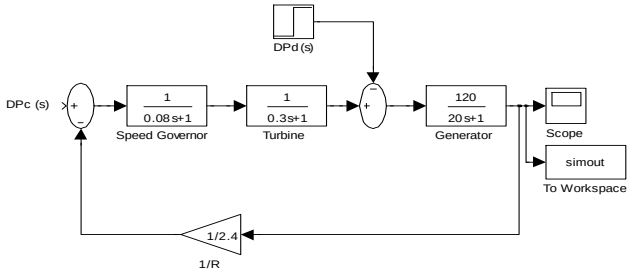

Fig 4: MATLAB Diagram of Uncontrolled model of single Area Load Frequency Control

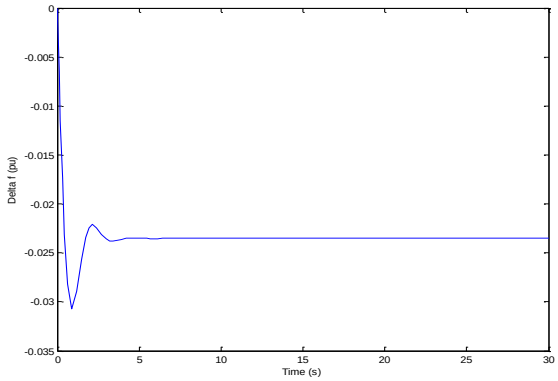

Fig 5: Frequency response of Uncontrolled model of single Area Load Frequency Control

Case 2 (Load frequency control with using integral controller)

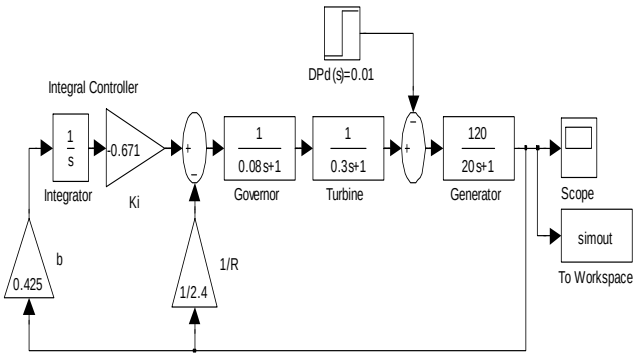

Fig 6: MATLAB Diagram of Integral Controller for single Area Load Frequency Control

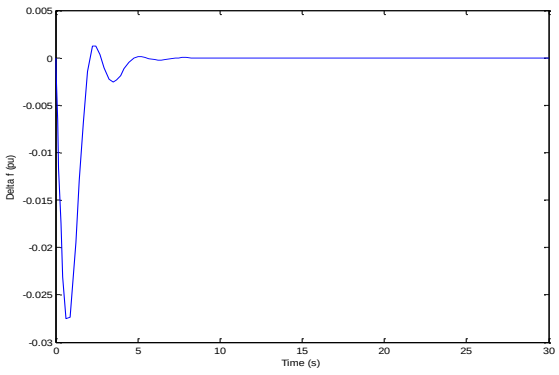

Fig 7: Frequency response of Integral controller

Case3 (Load frequency control with using P I controller)

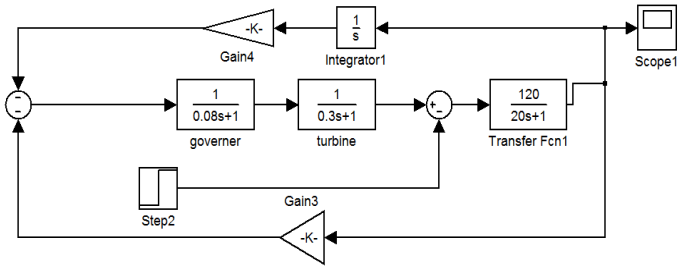

Fig 8: MATLAB Diagram of PI Controller for single Area Load Frequency Control

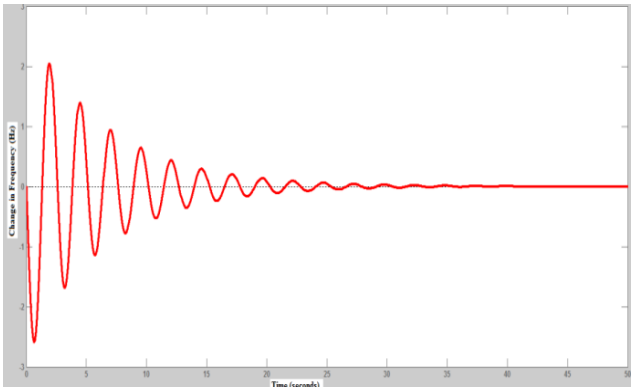

Fig 9: Frequency response of PI controller

V. CONCLUSION

In this paper, the above results show that we can stabilize the frequency by using integral controller and PI controller for single area power system. Simulation results show that Integral controller is frequency deviations of power system has a better performance than the PI controller, because of reduced the settling time and minimize overshoot.

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