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AUTOMATIC GENERATION CONTROL OF THREE AREA USING PI AND FUZZY CONTROLLER

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ABSTRACT

In the proposed work, AGC of three area power plant(all thermal) implemented using PI controller and Fuzzy Logic Controller.

Even when load fluctuates in one area, it affects the frequency in all the remaining areas as well. Model is developed by MATLAB/SIMULINK software and further the results derived from both the controllers are studied and compared. Results so obtained clearly imply that performance of FLC is much improved as compared to PI controller.

KEYWORDS: Area Generation Control (AGC), Proportional Integral (PI) Controller, FLC(Fuzzy Logic Controller).

INTRODUCTION

Nowadays, with the advancement, the demand for electricity is increasing day by day. Thereby leading to the rise in interconnected system. Efforts are being made to minimise the disparity which persists in demand and supply of electricity. Interconnected system operation enables secure and economic operation.

Primary function of electrical power system is to manage and control voltage and frequency at some nominal point. Maintaining balance between demand and generation provides reliable and improved quality power. Any minor change in load demands result in frequency and tie line power discrepancy.

he main objective of Load Frequency Control is to maintain system frequency at its nominal value by controlling active and reactive power. Following mentioned are three objectives of AGC:

1. To hold system frequency at or very close to a specified nominal values.
2. Interchange power between control areas are maintained at some specified value.
3. Each of the units' generation is maintained in the most economic way possible.

Consider a single generating unit supplying load. A small load change will produce change in the frequency. When the load shifts from its pre defined value, a supplementary control retrieves frequency to specified value by reset (integral) controller as shown in the Fig.1. The integral control will make the frequency error zero by adjusting speed reference set point.

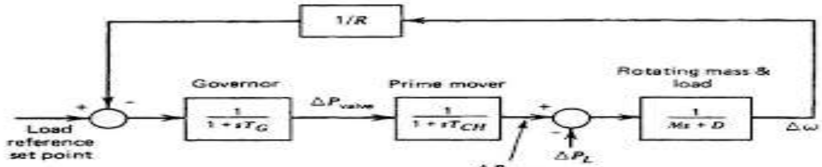

Fig.1 Isolated Power System Model

In conventional system, turbine reference power is set at the nominal value for each area by an integral controller and integral controller input is $B_i\Delta f_i + \Delta P_i (i = 1,2,3)$ known as area control error . Fig. above shows block diagram of power system consisting equivalent inertia M, load damping constant D, turbine and governing system with speed droop R.

If three such type is connected .it will be three area interconnected system.

$$B = \frac{1}{R} + D$$

Where,
B=bias-factor
R= speed droop
D=damping constant

MATHEMATICAL MODELLING OF AGC

In the proposed work, control of three thermal units are carried out using PI and Fuzzy controller. Each unit is taken for 2000MW.Load perturbation of 0.01 p.u MW is applied on the system. Various parameters used in the making of model are as in Table 1 and fuzzy inference table in Table 2.Model designed using SIMULINK are as shown in Fig.2 and 3.Type of FLC used is Mamdani-type which has IF-THEN Rules. Inputs are ACE and dACE.The Triangle membership functions are taken into account where NB,NS,ZZ,PS and PB imply negative big,negative small,zero,positive small and positive big respectively. S,M,B,VB,VVB denote smal ,medium ,big,very big and very very big respectively

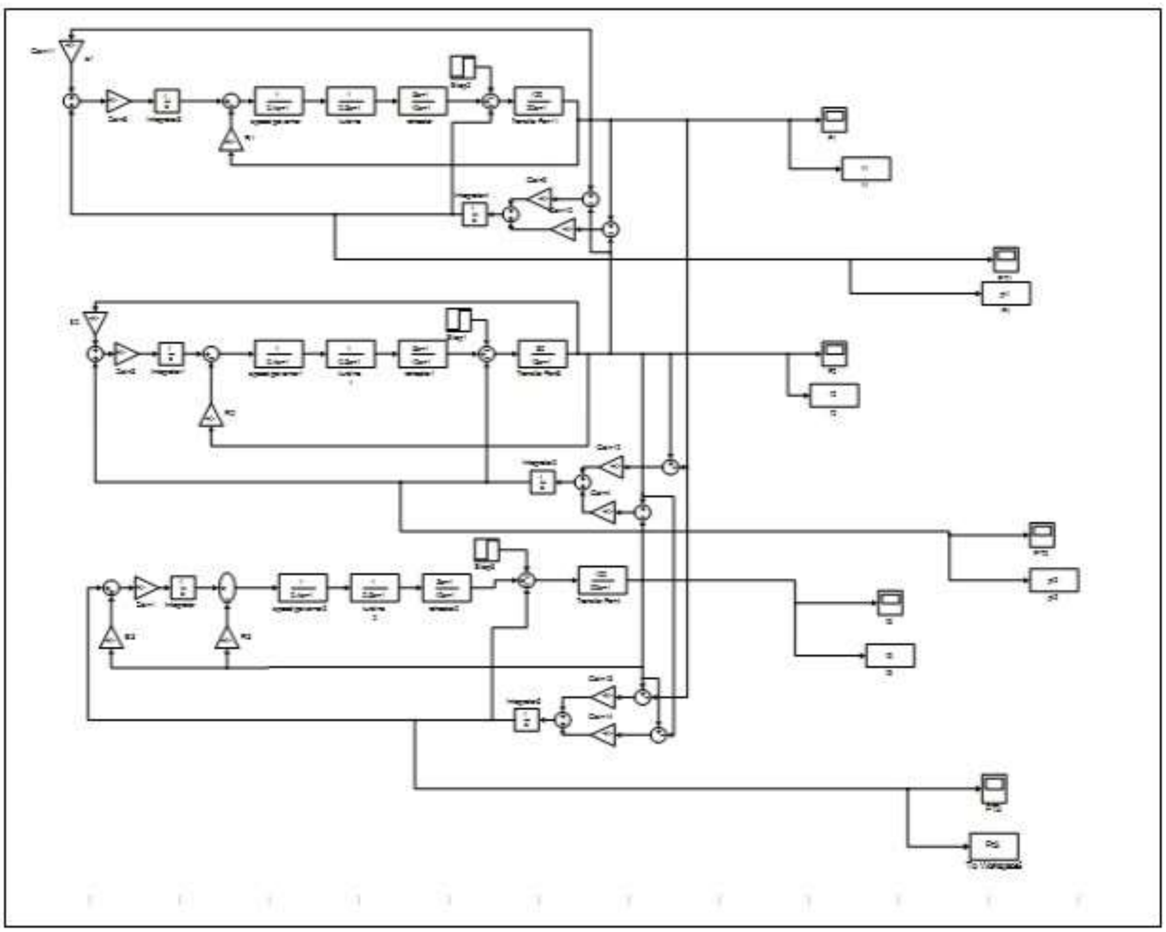

Fig.2 Simulink model for PI controller

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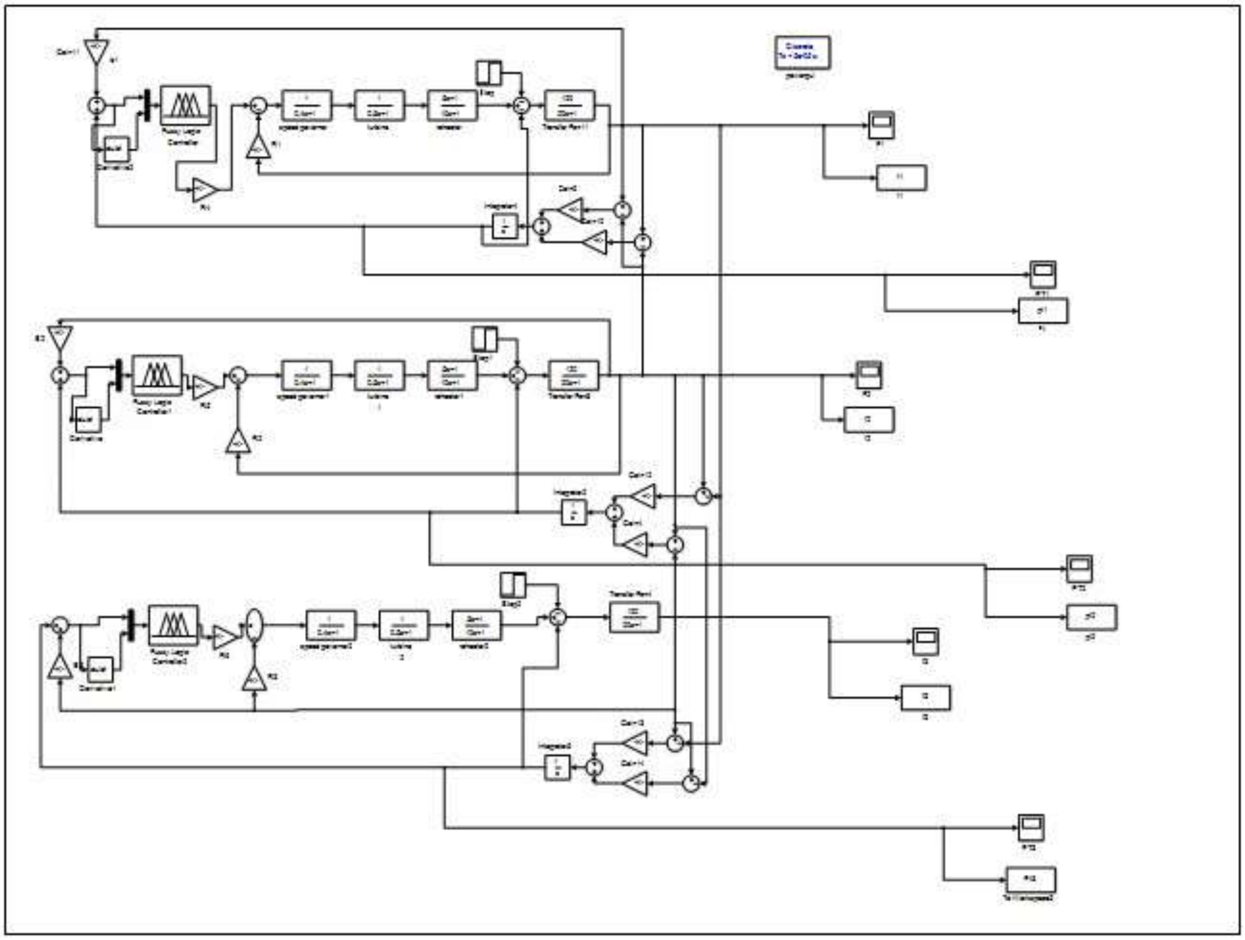

Fig.3 Simulink model for fuzzy controller

Table 1: Parameters table

Pl1=Pl2=Pl3=2000MW	Kt1=Kt2=Kt3=1, Tt1=Tt2=Tt3=0.5sec
Kr1=Kr2=Kr3=0.5, Tr1=Tr2=Tr3=10s	H1=H2=H3=5s , B1=B2=B3= 0.425 p.u/Mw Hz
R1=R2=R3=2.4Hz/p.u.MW	Ksg1=Ksg2=Ksg3= 1
Kgen1=Kgen2=Kgen3= 120	Tsg1=Tsg2=Tsg3= 0.4
Tgen1=Tgen2=Tgen3= 20s	D1=D2=D3=0.00833, F=50Hz

Table 2: Fuzzy inference table

dACE/ACE	***NB***	***NS***	***ZZ***	***PS***	***PB***
NB	***S***	***S***	***M***	***M***	***B***
NS	***S***	***M***	***M***	***B***	***VB***
ZZ	***M***	***M***	***B***	***VB***	***VB***
PS	***M***	***B***	***VB***	***VB***	***VVB***
PB	***B***	***VB***	***VB***	***VVB***	***VVB***

FUZZY LOGIC CONTROLLER

AGC utilising fuzzy logic is implemented in the paper. Controller parameters can be rapidly changed as evaluation of parameters is not needed in implementing a non-linear system. Hence, A fuzzy system is a control system based on fuzzy logic concept i.e., a mathematical system that analyzes analog input values in the form of logical variables that take continuous values between 0 and 1, in contradiction to classical or digital logic, which runs on discrete values that can be either 1 or 0 (true or false, respectively).

Fuzzy control has emerged as as one of the most effective and fruitful of research mainly in industrial application because of increased reliability over conventional controllers.

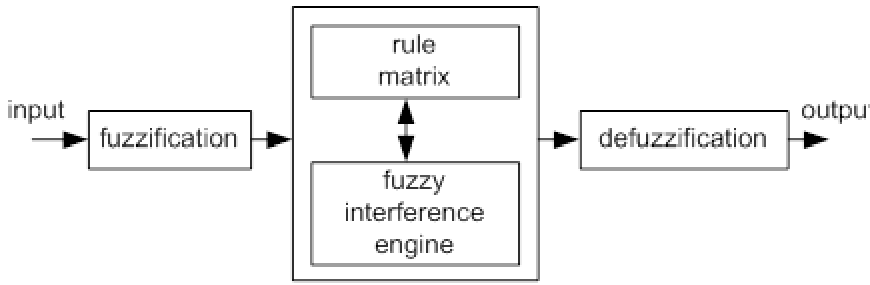

Fig. 4 Basic fuzzy logic design

Fuzzy control system has following four elements:
1. A rule-base (a set of If-Then rules), which contains a fuzzy logic quantification of the expert's linguistic description of how to achieve good control.
2. An inference mechanism, which emulates the expert's decision making in interpreting and applying knowledge about how best to control the plant.
3. A fuzzification interface, which converts controller inputs into information that the inference mechanism can easily use to activate and apply rules.
4. A defuzzification interface, which converts the conclusions of the inference mechanism into actual inputs for the process.

SIMULATION RESULTS

Simulations run for PI and FLC for frequency and tie line power deviations are as in the graphs obtained

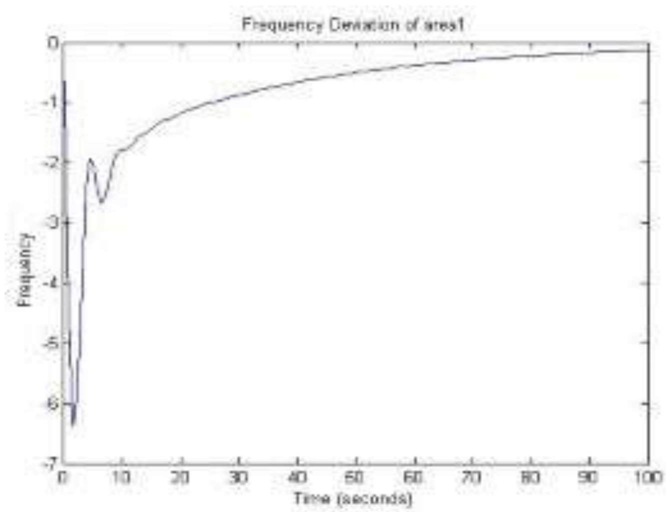

Fig. 5: Frequency deviation for area 1(PI)

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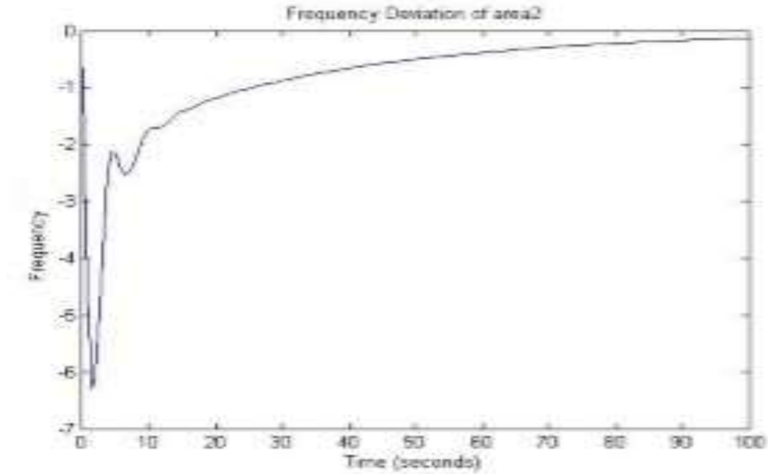

Fig.6: Frequency deviation for area 2 (PI)

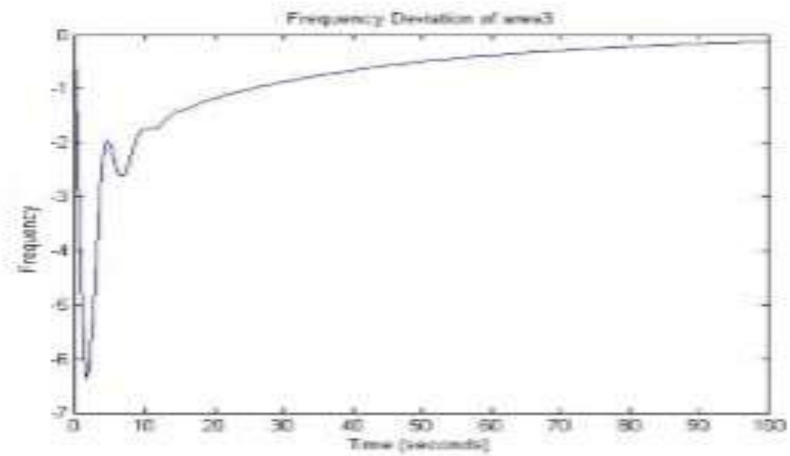

Fig.7: Frequency deviation for area 3 (PI)

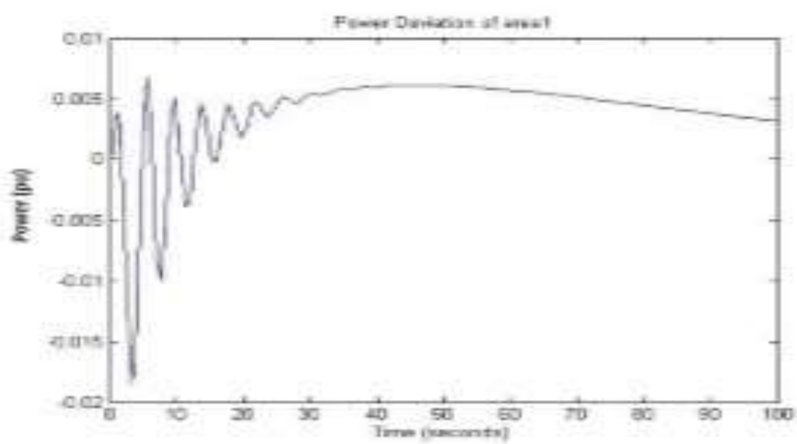

Fig. 8: power deviation for area 1 (PI)

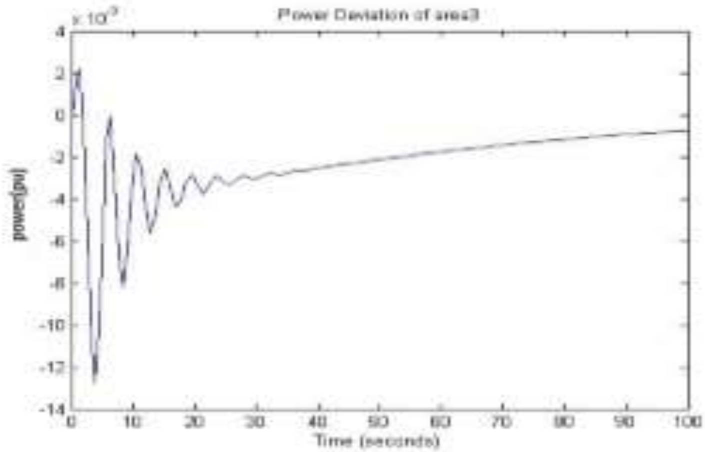

Fig.9: Power deviation of area 3(PI)

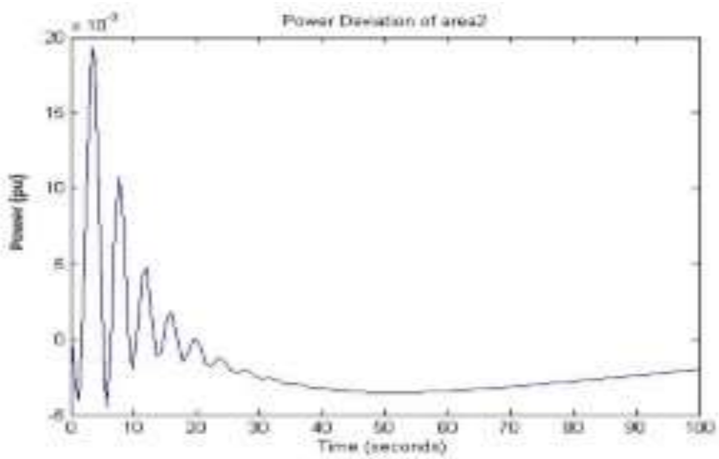

Fig.10: Power deviation of area 2(PI)

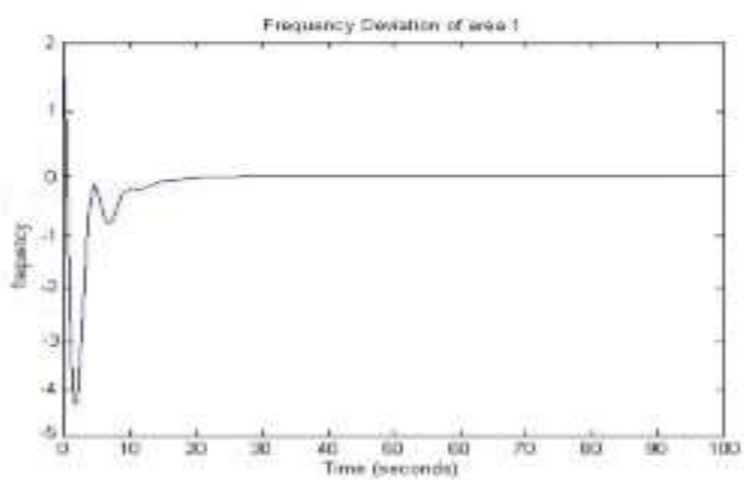

Fig.11: Frequency deviation of area 1 (Fuzzy)

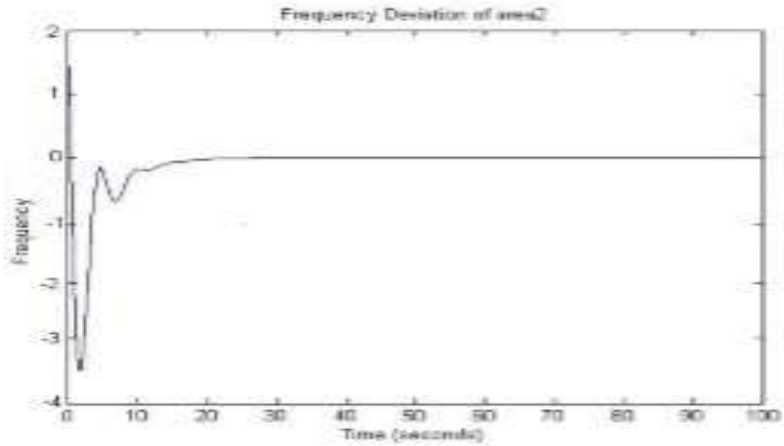

Fig. 12: Frequency deviation of area 2 (Fuzzy)

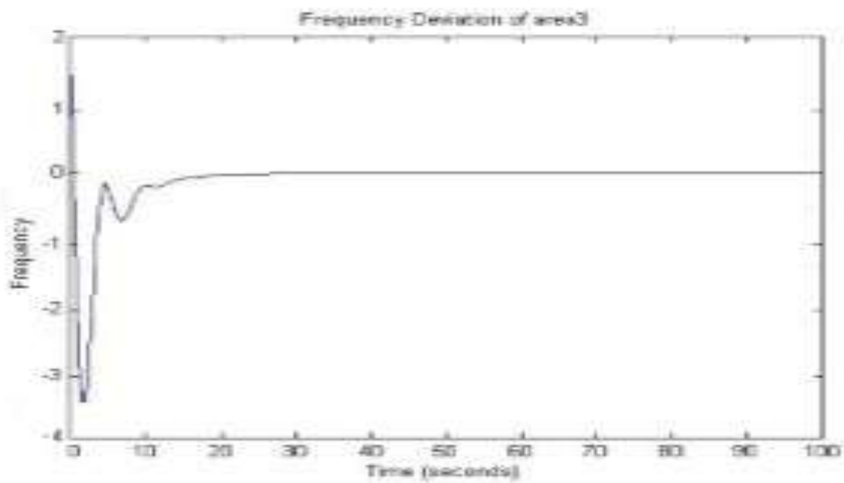

Fig.13:.Frequency deviation of area 3(Fuzzy)

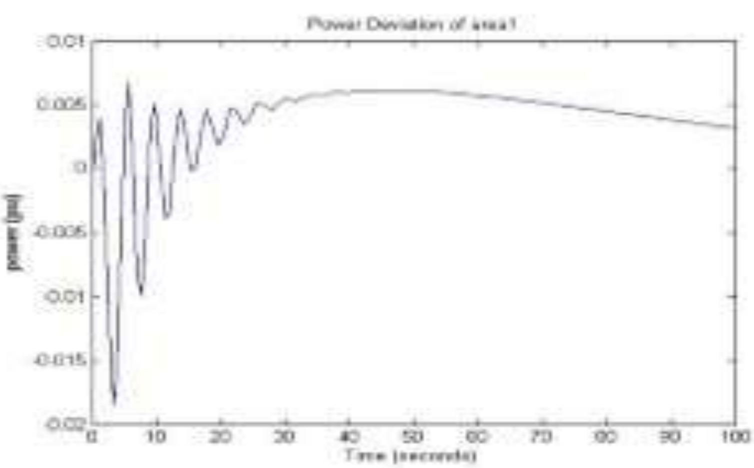

Fig.14: Power deviation of area 1(Fuzzy)

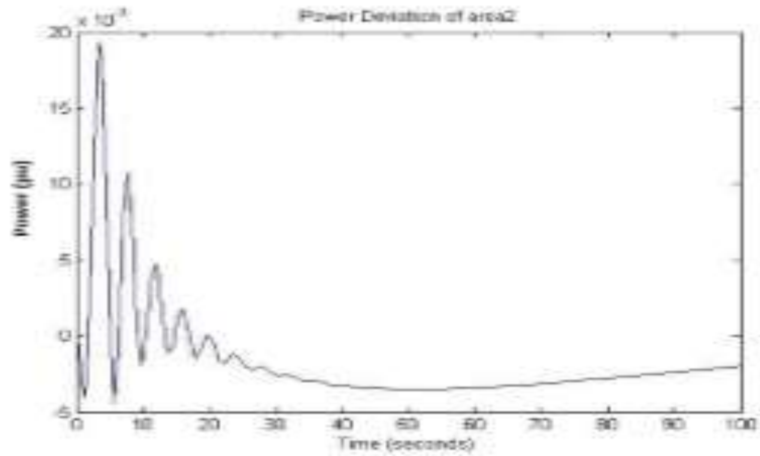

Fig.15: Power deviation of area2 (Fuzzy)

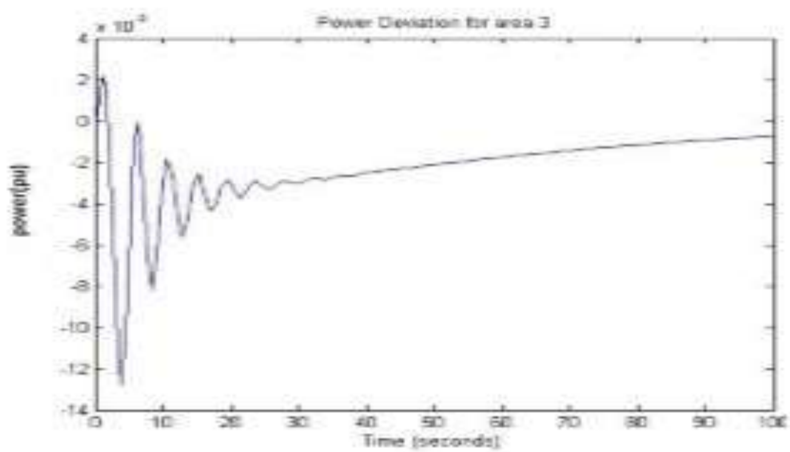

Fig.16: Power deviation of area3 (Fuzzy)

CONCLUSION
Fuzzy logic controller can be applied to multi area power system connected through tie lines.FLC can be use for non linear loads as well. MATLAB simulation results show that FLC produces better regulation than PI controller. Fuzzy logic controller minimised the deviations in frequency and tie line power.

REFERENCES
[1] Nanda, Janardan, and Ashish Mangla. "Automatic generation control of an interconnected hydro-thermal system using conventional integral and fuzzy logic controller." *Electric Utility Deregulation, Restructuring and Power Technologies, 2004.(DRPT 2004). Proceedings of the 2004 IEEE International Conference on*. Vol. 1. IEEE, 2004.

[2] Yesil, Engin, Aysen Demiroren, and Erkin Yesil. "Automatic generation control with fuzzy logic controller in the power system including three areas."*Department of Electrical Eng., Electric & Electronic Faculty Istanbul Technical University, Maslak, Istanbul, Turkey* (2009).

[3] Kumar, Prabhat, K. E. Hole, and R. P. Aggarwal. "Design of suboptimal AGC regulation for two-area hydro-thermal power system." *Journal of the Institution of Engineers. India. Electrical Engineering Division* 63.6 (1983): 304-309.

ISSN: 2277-9655
Impact Factor: 4.116

[4] Kocaarslan, Ilhan, and Ertuğrul Çam. "Fuzzy logic controller in interconnected electrical power systems for load-frequency control."*International Journal of Electrical Power & Energy Systems* 27.8 (2005): 542-549.
[5] Prabhat Kumar, and Ibraheem, "Dynamic performance evaluation of 2-area interconnected power systems", Journal of Institution of Engineers (India), Vol. 78, pp .199-209, 1998.
[6] AJ Wood and BF Wollenberg 'Power Generation Cperation and Control' John Wiley &sons , 1984.
[7] Nanda, J., and Lalit Chandra Saikia. "Comparison of performances of several types of classical controller in automatic generation control for an interconnected multi-area thermal system." *Power Engineering Conference, 2008. AUPEC'08. Australasian Universities*. IEEE, 2008.