International Journal of Engineering Research & Management Technology

May- 2015 Volume 2, Issue-3
ISSN: 2348-4039

Email: editor@ijermt.org www.ijermt.org

"Sharpening Skills..... Serving Nation"

Special Issue: 2nd International Conference on Advanced Developments in Engineering and Technology
Held at Lord Krishna College of Engineering Ghaziabad, India

Effect of Disturbance on Two Area Power System

Silky Jindal
Research Scholar
Mewar University, Chittorgarh

Arvind Sharma
Professor
Electrical Engineering Deptt.
Mewar University,Chittorgarh

ABSTRACT-
Two area power systems restore frequency to its nominal value and maintain the power interchange among areas by adjusting the output of selected generators. Two area power systems consider the two hydro power systems. The paper represents the effect of disturbance on two area power systems and analysis of frequency deviation in terms of disturbance. The dynamic response of two area power system is controlled by droop characteristics and conventional PID Controller. This analysis is done using MATLAB SIMULINK.

Key words: LFC, PID –controller, SIMULINK

I. INTRODUCTION

For the reliable operation of a power system, the frequency should not change with respect to time i.e. frequency deviation should be zero. The frequency of a power system is dependent on active power balance. In electric power generation, system perturbations caused by load fluctuations results in changes to the desired frequency value [1]. The basic purpose of load frequency control is to maintain desired power output of a generator unit and contribution in controlling the frequency of larger interconnected systems. LFC controls during normal (small) changes and abnormal changes in load and frequency [2]. An area control error (ACE), which is defined as a linear combination of total power interchange and frequency deviations, is generally taken as the controlled output of LFC. Primary control is performed by the speed governors of the generating units, which provide immediate action to sudden change of load.

II. MODELLING OF LOAD FREQUENCY CONTROL

The load frequency control is an interconnection of various components. The modeling of each component is done by transfer function. The components are [4]:-

A. Governor

Governor units are used in power systems to sense the frequency bias caused by the change in load and cancel it by varying the inputs of the turbines. The transfer function of governor is written as-

$$G_g(s) = \frac{\Delta P_V}{\Delta P_g} = \frac{1}{1+sT_g} \qquad (1)$$

T_g is time constant for governor and its value is typically around 0 .1sec.

B. Turbines

A turbine unit in power systems is used to transform the natural energy, such as the energy obtained from steam or water, into mechanical power that is supplied to the generator. Generally, Steam and hydraulic turbines are use in power system for analysis of load frequency control (LFC).The transfer function of non- Reheat turbine is written as

$$G_t(s) = \frac{1}{1+sT_T} \quad (2)$$

C. Machine

Using equation of motion for a synchronous machine to small disturbance, the equation is written as:

$$\frac{2H}{w}\frac{d^2\delta}{dt^2} = \Delta P_m - \Delta P_e \quad (3)$$

Taking the Laplace transformation of equation

$$\Delta W_r(s) = \frac{1}{2Hs}(\Delta P_m - \Delta P_e) \quad (4)$$

D. Load

The speed-load characteristic of the composite load is given by

$$\Delta P_e = \Delta P_L + D\Delta f \quad (5)$$

Where, ΔP_L is the deviation of the load (does not change with frequency).DΔf is the frequency dependent load deviation.

D is expressed as % change in load with respect to % change in frequency.

Power system is expressed by transfer function

$$G(s) = \frac{K_P}{1+sT_P} \quad (6)$$

Where, K_P = Gain of load, T_P =Time constant of load.

E. Single area power system

A complete block diagram of a power system consists of turbine, generator, governor and load. These individual components are interconnected to form a complete power system[6,7].

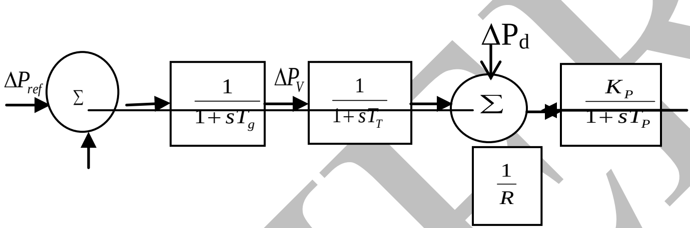

Fig.1 Single area power system

F. Two area Power system

Two areas power system connected by a tie line reactance. Each area represented by a voltage source behind an equivalent reactance [12].

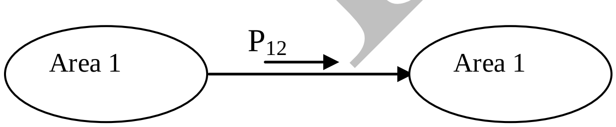

Fig.2 Two area power system

Area control error (ACE) is defined as a control signal made up of tie line flow deviation added to frequency deviation weighted by a bias factor. Thus, the area control error for area 1 and area 2 is

$$ACE_1 = \Delta P_{12} + B_1 \Delta f \quad (7) \qquad B_1 = \frac{1}{R_1} + D_1 \quad (8)$$

$$ACE_2 = \Delta P_{21} + B_2 \Delta f \quad (9)$$

$$B_2 = \frac{1}{R_2} + D_2 \quad (10)$$

B_1, B_2 = Frequency bias constant for area1 and area 2R_1, R_2 = Speed droop characteristics for area 1 &ar2D_1, D_2 = Damping constant for area 1 and area 2ACE_1, ACE_2 = Area error control for area 1 & area 2 Δf = supply frequency

Table .1 Parameters of two area power system

Parameters	Area 1	Area 2
T_P	6 sec	6sec
T_G	0.2	0.2
T_w	0.5	0.5
R	0.05	0.05
K_P	1	1
a_{12}	-1	-1
T_{12}	0.0707	0.0707

Different parameters which are used in two area power system has fixed value for area 1 and area 2 as given in table.

III. METHODOLOGY

PID Controller is used to control the frequency deviation. The function of PID Controller in time domain is written as [9, 10]:-

$$u(t) = K\left(e(t) + \frac{1}{T_i}\int_0^t e(t)dt + T_d \frac{de(t)}{dt} \right) \quad (11)$$

Where, u = control signal, e = y_{sp}-y = control error

y = measured process variable, r = reference variable, the reference variable is often called the set point

K,T_i,T_d = proportional gain, integral time and derivative time.

The steady state error will reduce with increase in gain, but the tendency towards oscillation will also increase. With the increase in derivative time damping increases, but decreases again when derivative time becomes too large.

IV. RESULTS

Two area interconnected power system explained with different step load (1% and 2%). PID controller is used to minimize the frequency deviation occurs due disturbance.

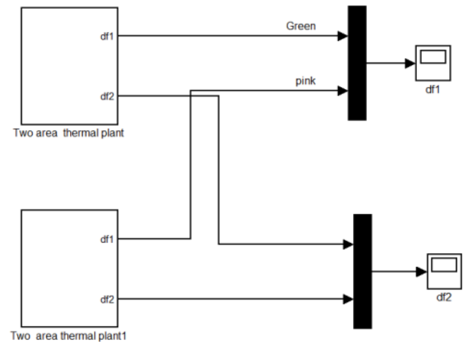

Fig.3 Simulink diagram for effect of disturbance on two area power system

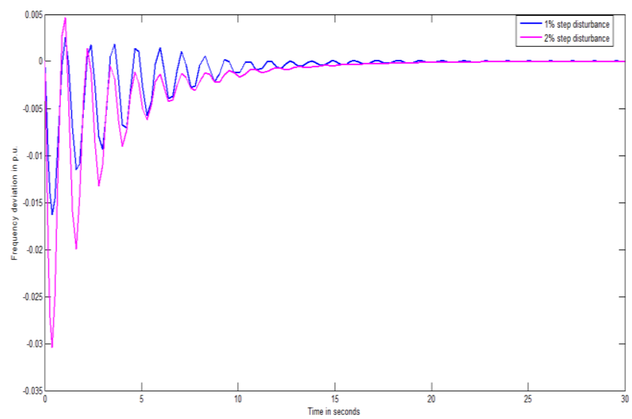

Fig.4 frequency deviation response for area 1

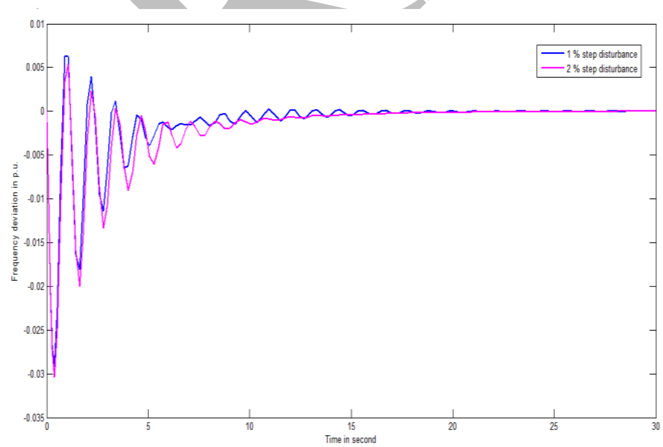

Fig.5 Frequency deviation response for area 2

V. CONCLUSIONS

Turbine characteristics are examined using linear load frequency model. The frequency response for two area power system is determined by simulation analysis. Frequency deviation occurs due to disturbance in two area power system. The objective of controller minimizes the frequency deviation. Thus, simulation results explain the behavior of two area power system. The control techniques improve the dynamic response of interconnected power system.

VI. FUTURE SCOPE

Load frequency control is done by PID Controller but it can be controlled by ANN and FUZZY Controller which gives the better dynamic response.

REFERENCES

1. P. Kundur, Power System Stability and Control. Mc Graw-Hill, 1994.
2. N. Jaleeli, L.S. Vanslyck, D. N. Ewart, L. H. Fink, and A. G. Hoffmann, "Understanding Automatic Generation Control", IEEE Transaction onPower System, vol. 7, no. 3, pp.1106-1122, Aug. 1992.
3. P. K. Ibraheem and D. P. Kothari, "Recent Philosophies of Automatic Generation Control Strategies in Power Systems", IEEE Transaction onPower Systems, vol. 20, no. 1, pp. 346-357, Feb. 2005.
4. Elgerd O. I. 1971. Electric Energy System Theory; An Introduction, Mc Graw Hill
5. CL Wadhawa" Electric Power System" New Age International Pub. Edition 2007.
6. C. E. Fosha and O. I. Elgerd, "The megawatt-frequency control problem: A new approach via optimal control theory," IEEE Trans.Power App. Syst., vol. PAS-89, no. 4, pp. 563–567, 1970
7. R. K. Cavin, M. C. Budge, and P. Rasmussen, "An optimal linear system approach to load frequency control," IEEE Trans. Power App.Syst., vol. PAS-90, no. 6, pp. 2472–2482, 1971
8. M. Calovic, "Linear regulator design for a load and frequency control theory," IEEE Trans. Power App. Syst., vol. PAS-91, no. 6, pp. 2271–2285, 1972.
9. W. Tan, J. Liu, T. Chen, and H. J. Marquez, "Comparison of some well-known PID tuning formulas," Comput. Chem. Eng., vol. 30, no. 9, pp. 1416–1423, 2006.
10. W. Tan, T. Chen, and H. J. Marquez, "Robust controller design and PID tuning for multivariable processes," Asian J. Control, vol. 4, no. 4, .439–451, 2002.
11. A. Magla, J. Nanda, " Automatic Generation Control of an Interconnected hydro- Thermal System Using Conventional Integral and Fuzzy logic Control", in Proc. IEEE Electric UtilityDeregulation , Restructuring and Power Technologies, Apr 2004.
12. H. Saadat, Power system analysis, USA: McGraw-Hill; 1999.
13. R. D. Christie and A. Bose, "Load frequency control issues in power system operations after deregulation," IEEE Trans. Power Syst., vol. 11, no. 3, pp. 1191–1200, Aug. 1996.