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Literature Review on Automatic Generation Control

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Abstract - *Now-a-days the requirement is to maintain a certain power system at a desired level according to frequency, voltage profile, load flow configurations. This can be done by regulating the active and reactive power generated in the system. This is done to avoid the mismatch between the generation and the load variations. Automatic Generation Control (AGC) is one of the most important issues in electric power system design and operation. The objective of the AGC in a power system is to maintain the frequency of the area. If interconnected power system is considered then the tie-line power is to be kept close to the scheduled values by adjusting the MW outputs the AGC generators so as to accommodate fluctuating load demands.*

Key Words: **Automatic Generation Control, Tie-line, Load frequency control, Automatic voltage regulation, speed governing system**

1. INTRODUCTION

Automatic generation control is requiring for controlling the electric power generation. Power system consists generation, transmission and distribution. In power system automatic generation control (AGC) is a system to control the output of generation. Due to sudden change in load frequency decrease or increase this will effect on the speed of the turbine. If constant frequency is not maintained it will affect the whole power system. Hence equipment of power system gets damaged. In an electrical power system AGC i.e. Automatic generation control is a technique of adjusting the power output of multiple generation units with respect to changes in the load. The performance of the system is judged according to the frequency. It's measured whether it is increasing or decreasing. Power system operation considered so far was under condition of steady load. However both active and reactive power demands are never steady and the continually change with the rising or falling trend. Steam input to turbo generator must, therefore, be continuously regulated to match the active power demand, failing which the machine speed will vary with consequent change in frequency which may be highly undesirable maximum permissible change in power frequency is ±0.5hz. In modern large interconnected system, manual regulation is not feasible and therefore automatic generation and voltage regulation equipment is installed on each generator. If load is increase at time frequency get decreased to maintain constant frequency by using AGC. Through automatic generation control we are maintain system frequency constant.

1.1 AUTOMATIC GENERATION CONTROL

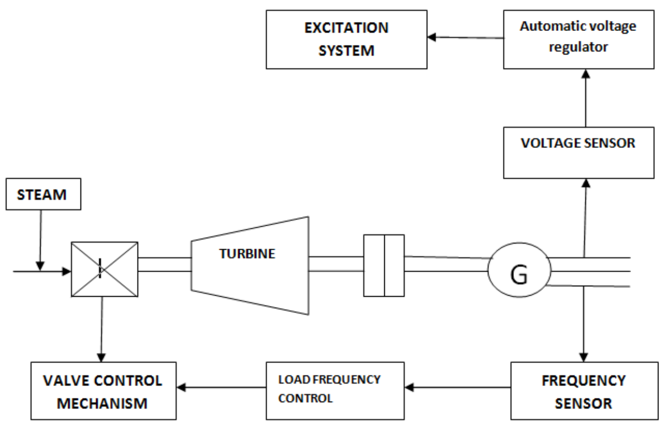


Fig-1 Schematic diagram of LFC and AVR of a synchronous generator

Automatic generation control is synonymous with load frequency control of power system. As the load of the system changes continuously the generation is adjusted automatically to restore the frequency to nominal value. This scheme is known as "Automatic Generation Control." The change in frequency is sensed when the rotor angle ∂ is changed. The error signals are transformed into real power command signal, which is sent to prime mover to call for an increment in the torque. In normal condition frequency is constant. When any reason load increase at that time frequency get decrease. Hence speed of turbine also decreases, to maintain turbine speed increasing flow of steam. In Automatic Generation control system main objective is that to maintain generation according to load changing. In automatic generation control voltage is also change, this change voltage sense by voltage sensor and give to automatic voltage regulator. Automatic voltage regulator regulates the voltage according to requirements. By using excitation system generator excitation will be control.

Types of AGC

In automatic generation control there are two types.

(1)Load frequency control (LFC)

(2)Automatic voltage regulator (AVR)

2. LOAD FREQUENCY CONTROL

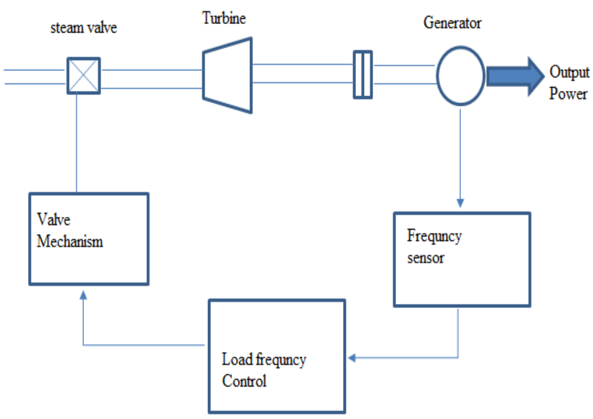


Fig-2 Schematic Diagram of Load Frequency Control

Load frequency control is the basic control mechanism in the power system operation. Whenever there is a variation in load demand on generating unit, there is momentarily an occurrence of unbalance between real-power input and output. The load frequency also controls the real power transfer through the interconnecting transmission lines by sensing the change in power flow through the tie lines. In load frequency control when load increase at that time frequency decrease so our main objective is that to maintain frequency constant. Power systems are divided into various areas. Each of there areas are generally interconnected. Load frequency control as, name signifier, regulates the power flow between different areas while holding the frequency constant. As shown figure (2) general block diagram of load frequency control. If load is increase at that time frequency is decrease and turbine speed also decreases. To maintain constant frequency increase the turbine speed by using of speed governing system. To maintain turbine speed steam flow is increase by using the steam valve. By increase steam turbine speed is maintain according to frequency. Hence the constant frequency is achieved. The purpose of load frequency is to exert control over the frequency and real power load of a generator both in isolated and grid connected modes.

3. SPEED GOVERNING SYSTEM

The speed governor is the main primary tool for the load frequency control. By using speed governing system we are maintain the turbine speed as per requirement. If load is increase due to any reason turbine speed gets decrease. To maintain turbine speed changer is use. Linkage mechanism is connected with speed governor, through speed governor linkage mechanism is operate. Hydraulic amplifier is use to operate valve mechanism. It is a single-state hydraulic servomotor interposed between the governor and valve. It consists of a pilot valve and main piston. With this arrangement, hydraulic amplification is obtained by converting the movement of low power pilot valve into movement of higher power level main piston. By using of valve mechanism flow of steam is control as per requirement

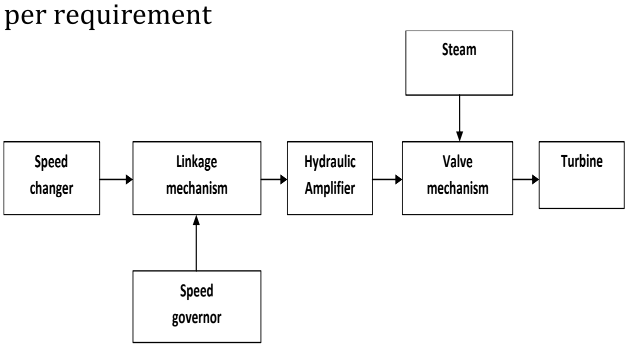
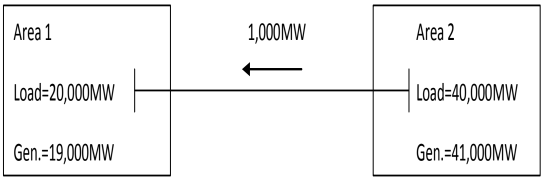


Fig-3 Block diagram of speed governing system.

4. CASE STUDY

Consider two interconnected area as follows,



The connected load at 60 Hz is 20,000MW in area 1 and 40,000MW in area 2. The load in each area varies 1% for every 1% change in frequency. Area 1 is importing 1,000 MW from area 2. The speed regulation, R, is 5% for all units. Area 1 is operating with a spinning reserve of 1,000MW spread uniformly over a generation of 4,000MW capacity, and area 2

is operating with a spinning reserve of 1,000MW spread uniformly over a generation of 10,000MW.[2]

$$\frac{1}{R_1} = 6,666.67\ MW/Hz$$

$$\frac{1}{R_2} = 14,000.00 MW/Hz$$

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} = 20,666.67\ MW/Hz$$

$$D_1 = 316.67\ MW/Hz$$

$$D_2 = 666.67\ MW/Hz$$

$$D = D_1 + D_2 = 983.33\ Mw/Hz$$

$$\Delta f = \frac{-\Delta P_L}{\frac{1}{R} + D} = 0.04619\ HZ$$

$$\Delta P_{G1} = -\frac{1}{R_1}\Delta f = -307.93\ MW$$

$$\Delta P_{G2} = -\frac{1}{R_2}\Delta f = -646.65\ MW$$

Parameter	Area 1	Area 2
Load (MW)	20,000-1,000+14.63 = 19,014.63MW	40,000+30.79 = 40,030.79MW
Generation (MW)	19,000-307.93 = 18,692.07MW	41,000-646.65 =40,353.35MW

By using this case study we are conclude that if change in load at that time how it will affect on speed and system frequency. By this case study we are find out speed regulation of system.

5. CONCLUSIONS

In power system there is change in load due to any reason at that time frequency also changes. By using load frequency control of two area system we are maintain system frequency constant.

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