GNITED MINDS
Journals

Journal of Advances in Science and Technology

Vol. III, No. VI, August-2012, ISSN 2230-9659

STUDY ON CONTROL MECHANISM IN A POWER SYSTEM IN ORDER TO INCREASE THE EFFICIENCY OF POWER GENERATION

www.ignited.in

Journal of Advances in Science and Technology
Vol. III, No. VI, August-2012, ISSN 2230-9659

Study on Control Mechanism in a Power System In Order To Increase the Efficiency of Power Generation

Poonam[1] Dr. Radhey Shyam Jha[2]

[1]Research Scholar, Monad University, Hapur, U.P

[2]Principal, BMCTM, Farukhnagar (HR)

Abstract – Energy management system is the process of monitoring, coordinating and controlling the generation, transmission and distribution of electrical energy. The physical plant to be managed includes generating plants that produce energy fed through transformers to the HV transmission network (grid), interconnecting generating plants, and load centers. Since transmission systems provide negligible energy storage, supply and demand must be balanced by either generation or load. Production is controlled by turbine governors at generating plants, and automatic generation control is performed by control center computers remote from generating plants. Load management, sometimes called demand-side management, extends remote supervision and control to sub transmission and distribution circuits, including control of residential, commercial, and industrial loads. Energy management is performed at control center, typically called system control centers, by computer systems called energy management systems /EMS/. Data acquisition and remote control is performed by SCADA.

Key words: management, monitoring, coordinating, energy storage, acquisition.

---------------------------♦-----------------------------

INTRODUCTION:

AGC consists of two major and several minor functions that operate on –line in real time to adjust the generation against load at minimum cost. The major functions are load frequency control and economic dispatch, and the minor functions are reserve monitoring, which assures enough reserve on the system; interchange scheduling, which initiates and completes scheduled interchanges; and other similar monitoring and record functions /load forecast, fault allocation, trouble analysis. Generation control and ED minimize the current cost of energy production and transmission within the range of available controls. Energy management is a supervisory layer responsible for economically scheduling production and transmission on a global basis and over time intervals consistent with cost optimization.

REVIEW OF LITERATURE:

Although there are many things to control in power system, majorly we control voltage and frequency by controlling other parameters of the generators, load and other devices in the system. For efficient and secured power system- maintain reliability, security, stable, operate in most economical way, better quality (frequency with in the limit (3%), voltage (5% HV, 10% LV)).
Frequency is global phenomena (same in one node and other), voltage is local phenomena (one point and another point is different). Eg. Change of frequency and voltage affect normal operation of the system. Frequency control can be achieved by controlling active power which is possible at generation (injecting power) and load end (consuming power). It is preferred to control the power at generation side and load end control is done during the emergencies. Total Generation < demand = frequency fall. -- generation increase, or load decrease/ very expensive b/c it affect power reliability. Total Generation > demand = frequency rise. – generation decrease /load increase not at hand/ Therefore, the explanation is energy can go no where but stored in the form of kinetic energy and when load increases, this stored energy will be taken to supply the demand and hence stored kinetic energy will decrease and hence speed decrease. -> the frequency of the system will decrease because of the reduction of speed of generator [f=NP/120]. The same is true for 2nd case! Reactive power control is responsible mainly for voltage control which is a local problem. In a power system the load demand is continuously changing. In accordance with it the power input has also to vary. If the input - output balance is not maintained a change in frequency will occur. The control of frequency is achieved primarily through speed governor mechanism aided by supplementary means for precise control. LFC

consists of three major parts.
(i) Speed governing system

(ii) Rotating components (turbine-generator)

(iii) load and power system.

- The speed governing mechanism includes

MATERIAL AND METHOD:

The essential part are centrifugal flyballs driven directly or through gearing by the turbine shaft. The mechanism provides upward and downward vertical movements proportional to the change in speed.
Linkage Mechanism
These are links for transforming the fly balls movement to the turbine valve through a hydraulic amplifier and providing a feedback from the turbine valve movement.
- Hydraulic Amplifier

Very large mechanical forces are needed to operate the steam valve. Therefore, the governor movements are transferred into high power forces via several stages of hydraulic amplifiers.

- Speed Changer

The speed changer consists of a servomotor which can be operated manually or automatically for scheduling load at nominal frequency. By adjusting this set point, a desired load dispatch can be scheduled at nominal frequency.
The speed governing system is the primary LFC loop and its simple schematic representation is shown above. In order to understand the operation, we should consider two cases, i.e. the first is when speed changer is given Raise or Lower command but speed of the turbine remains constant and second when speed of turbine is changed but command is not given to the speed changer. Under these conditions, the position of the joints will be changed according to the applied phenomena.

CASE I: Speed changer is given Raise command and speed is constant.

xa=downward∆
xb=0∆
xc=upward∆
xd=upward∆
xe=downward∆

CASE II: Speed changer is constant and speed is increased.

xa=0∆
xb=downward∆
xc=downward∆
xd=downward∆
xe=upward∆

Hence a relation can be established based on the above facts.

xc∆ Pref∆ f– k2 ∆= k1

xd∆ xc∆= k3 xe∆+ k4

xe∆ xd∆ ∫= - k5 dt

Where k1 , k2, k3 and k4 are constants and depend on the length of arms and k5 depends on oil pressure and geometries of cylinder.

Let us define

k1 k2/ k4 = kg – static gain of governor

1 / k4 k5 = Tg – static gain of governor

k2/ k1 = R – Regulation of speed governor

Substituting and Simplifying , we get The turbine-generator model depends on whether we have hydro-turbines, or in case of steam turbines we have reheat or non-reheat type of steam turbines. For a simple a non-reheat type turbine model is given by a single time constant, Taking input power to the turbine is Pv /power from the valve opening/ and output power is mechanical power Pm, the block diagram becomes **Generator Model** Here, based on swing equation, in mechanical and electrical power, the above equation using per unit system becomes,∆For a change Taking Laplace transform, we get **Load Model** In general, power system loads are a composite of a variety of electrical devices, For resistive loads, such as lighting and heating loads, the electrical power is independent of frequency. In case of motor loads, such as fans and pumps, the electrical power changes with frequency due to changes in motor speed. The overall frequency-dependent characteristics of a composite load may be expressed as f∆PL is the non-frequency-sensitive load change, ∆Where is the frequency-sensitive load change, and D is expressed as percent change in load divided by percent change in frequency. Substituting the above equation to the previous model (generator model), we get the following block diagram
Using transfer function of closed loop can be G(s)/1 + G(s) H(s), the above model can be further simplified as follows [taking G(s) = 1/2Hs and H(s) = D]
models for turbine-generator, power system and speed governing systems are obtained. In practice, rarely a single generator feeds a large area. Several generators connected in parallel, located also, at different places will supply the power needs of a geographical area. Quite normally, all these generators have the same response characteristics in load demand. Such a coherent area is called a control area in which the frequency is assumed to be the same throughout in static as well as dynamic conditions. In such a case, it is possible to define a control area, grouping all the generators in the area

Poonam[1] Dr. Radhey Shyam Jha[2]

together and treating them as a single equivalent generator, i.e for purpose of developing a suitable control strategy, a control area can be reduced to a single speed governor, turbo-generator and load system.

CONCLUSION:

The basic requirements to be fulfilled for successful operation of the system are
The generation must be adequate to meet all the load demand. The system frequency must be maintained with narrow and rigid limits. The system voltage profile must be maintained within reasonable limits In case of interconnected operation, the tie line power flows must be maintained at the specified values. Should the generation be not adequate to balance the load demand, it is imperative that on e of the following alternatives be considered for keeping the system in operating condition: Starting fast peaking units Load shedding for unimportant loads, and Generation rescheduling The block diagram of single area system, where the gain and time constant in each block are as described in the individual section before, is as shown below.

REFERENCES:

[1] O. I. Elgerd and C. E. Fosha, "Optimum Megawatt-frequency Control of Multi-area Electric Energy Systems," *IEEE Transactions on Power Apparatus and Systems*, Vol. PAS-89, No.4, pp. 556-563, April 1970.

[2] C. E. Fosha and O. I. Elgerd, "The Megawatt Frequency Control Problem: A New Approach via Optimal Control Theory," *IEEE Transactions on Power Apparatus and Systems*, Vol. PAS-89, No. 4, pp. 563-571, April 1970.

[3] Ibraheem, P. Kumar, and D. P. Kothari, "Recent Philosophies of Automatic Generation Control Strategies in Power Systems," *IEEE Transactions on Power Systems*, Vol. 20, No. 1, February 2005.

[4] H. Shayeghi, H.A. Shayanfar and A. Jalili, "Load Frequency Control Strategies: A State-of-the-art Survey for the Researcher," *Energy Conversion and Management*, Vol. 50, pp. 344-353, 2009.

[5] M. Calovic, "Linear Regulator Design for a Load and Frequency Control," *IEEE Power Engineering Society Winter Meeting*, New York, January/February 30-04, 1972.

[6] M. S. Sachdev, R. J. Fleming and J. Chand, "Optimal Control of a HVDC Transmission Link," *IEEE Transactions on Power Apparatus and Systems*, Vol. PAS-92, No. 6, pp. 1958-1965, November 1973.

[7] R. K. Cavin, M. C. Budge and P. Rasmussen, "An Optimal Linear Systems Approach to Load-frequency Control," *IEEE Power Engineering Society Winter Meeting*, New York, January/February 31-05, 1971.

[8] D. M. Patel, R. K. Yadav and D. B. Trivedi, "Automatic Power Generation Control and Simulation," *Proceedings of IEEE Conference on Power Systems*, pp. 1-5, 2006.

[9] E. Rakhshani, K. Rouzbehi and S. Sadeh, "A New Combined Model for Simulation of Mutual Effects between LFC and AVR Loops," *Proceedings of IEEE Conference on Power and Energy Engineering*, Wuhan, China, pp. 1-5, 2009.

[10] T. W. Reddoch, P. M. Julich, T. O. Tan and E. C. Tacker, "Model and Performance Functionals for Load Frequency Control in Interconnected Power Systems," *Proceedings of IEEE Conference on Decision and Control*, pp. 492-493, December 1971.

[11] S. Bittanti and S. Bittanti, "Multi-variable Model Predictive Control of a Thermal Power Plant with Built-in Classical Regulation," *International Journal of Control*, U. K., Vol. 74, No. 11, pp. 1118-1130, July 20, 2001.