PRIMARY FREQUENCY CONTROL

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Abstract

The frequency value represents the correlation between the balance of the generated and consumed active power in the energy system. Besides the frequency level is an indicator of the quality of the electric energy and shows the work regimes that exist in the energy system at the present moment. Control of the generation and consumption in power supply systemismaintained by System Operator of the Unified Power System.

Actuality

This paper describes primary frequency control. It is carried out by automatic controls speed turbines. All installations in the power network are projected to operate at 50 Hz due to the fact that under normal operating conditions the frequency in the power system varies in terms of power variation and according to the response speed of its control systems. For normal system operationof equipment it is necessary to adjustincremental speed regulation.

The purpose of the article is to show that changing of the incremental speed regulation will change the load of the generator.

Introduction

In the course of the electric energy system operation there occurs an imbalance of relative active power which is caused by instability of consumption, power demand change, disconnections of generators or power transmission lines. These imbalance events in active powers produce changes in the level of frequency. Turbine generators are equipped with special device – speed governor. While changing the frequency in the power system speed governor changes regulators turbine. This method is called the primary frequency control. This method is based on the changes in the rotation speed of the turbine by means of changes in supplying the fuels to the boiler. This means that the rotation frequency of the generator will change with alternating current frequency in the grid respectively. The objective of primary control is to re-establish a balance between generation and demand at a frequency different from the nominal value. The operate time is 0 to 30 s after disturbance of the balance between generation and demand.

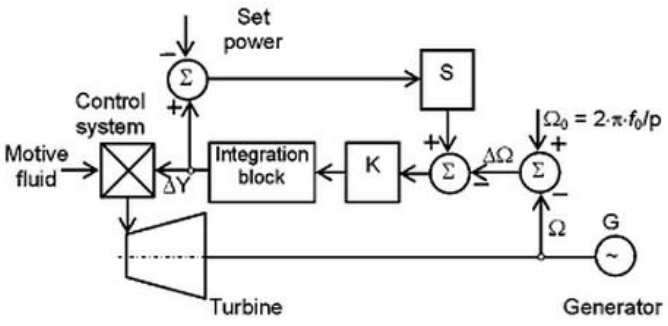

Figure 1. Scheme of a static speed generator

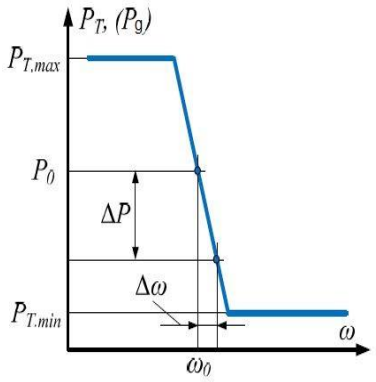

Figure 2. Idealized static characteristic variable turbine

Static characteristic variable turbine is called characteristic control unit.

The interconnection between the rotational speed and turbine mechanical power represents the static feature of the unit. This feature is a line that has a slope named statism.

$$k_d = \frac{\Delta\omega}{\omega_{nom}} \frac{P_{nom}}{\Delta P} = \frac{\Delta f}{f_{nom}} \frac{P_{nom}}{\Delta P} = \frac{\Delta f_*}{\Delta P_*}$$

Δf_* - relative frequency variation;

ΔP_* - relative power variation.

For example, let's consider the tie-line trippingand increase the load on the generatorin theMUSTANGprogramme.

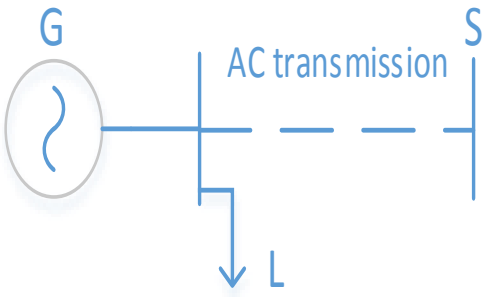

Figure 3. Example of the power system

Disturbance of balance due to disconnection of a large native load causes a change in frequency.

This deflection in the system frequency will cause the primary controller of generator subject to primary control. The controller alters the power delivered by the generators until a balance between the power output and consumption is established. At the moment when the balance is reestablished, the system frequency stabilizes and remains at a quasi-steady-state value, but differs from the frequency set point because of the generator drop [1].

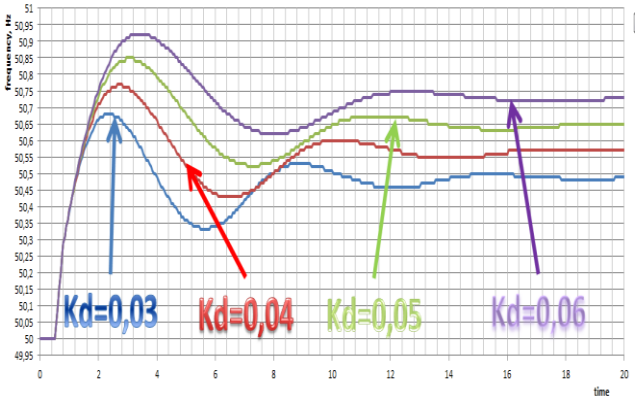

Figure 4. Frequency variation after disturbance with different statism

The less statism of characteristic variable turbine, the better the frequency in power system.

Conclusion

The frequency of a power system is dependent on the real power balance. A change in real power demand at one point of a network is reflected throughout the system by a change in frequency. Therefore, system frequency provides a useful factor to indicate system generation and load imbalance.

Parameters of the equipment should be selected so as to reduce the frequency deviation.However the statism is influenced by many parameters of energy system and actual values of statism:

For turbo-generator statism equals 5% ($k_d = 0,05$).

For hydro-generator statism equals 6% ($k_d = 0,06$).

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3. Cohn N., Control of Generation and Power Flow on Interconnected Power Systems, Second Edition. John Wiley & Son, Inc., New York. 1971.

ТРОПЫ КАК СРЕДСТВА ВЫРАЗИТЕЛЬНОСТИ РЕКЛАМЫ

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Современная реклама является неотъемлемым элементом современной культуры и как результат является предметом исследования многих гуманитарных наук, в том числе и лингвистики. Лингвистика при изучении рекламы использует такие понятия как «язык рекламы», «рекламный текст»,