IJITKM Special Issue (ICFTEM-2014) May 2014 pp. 162-165 (ISSN 0973-4414)

Study of Different Parameters of Transient Stability of a General Power System under different Faults Condition

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Abstract**:** The objective of this paper is to investigate and understand the stability of power system, with the main focus on power system modelling. The paper first explains the need for power system stability studies. It then proceeds to discuss the various stability problems after which the paper provided a brief introduction on basic control theory and study. Next, the paper examines the concept of system stability. The paper then performs a power system modeling and simulation of a power system. Examples of the parameters that were varied include the fault position λ, the power angle δ, rotor angle deviation dw, rotor speed wm and the mechanical power input Pm.

1. INTRODUCTION

An interconnected power system basically consists of several essential components. They are namely the generating units, the transmission lines, the loads, and the transformer. During the operation of the generators, there may be some disturbances such as sustained oscillations in the speed or periodic variations in the torque that is applied to the generator. These disturbances may result in voltage or frequency fluctuation that may affect the other parts of the interconnected power system. External factors, such as lightning, can also cause disturbances to the power system. All these disturbances are termed as faults. When a fault occurs, it causes the motor to lose synchronism if the natural frequency of oscillation coincides with the frequency of oscillation of the generators. With these factors in mind, the basic condition for a power system with stability is synchronism. Besides this condition, there are other important condition such as steady-state stability, transient stability, harmonics and disturbance, collapse of voltage and the loss of reactive power.

2. . STABILITY OF A SYSTEM

Since the industrial revolution man's demand for and consumption of energy has increased steadily. The invention of the induction motor by Nikola Tesla in 1888 signaled the growing importance of electrical energy in the industrial world as well as its use for artificial lighting. A major portion of the energy needs of a modern society is supplied in the form of electrical energy.Industrially developed societies need an ever-increasing supply of electrical power, and the demand on the North American continent has been doubling every ten years. Very complex power systems have been built to satisfy this increasing demand. The trend in electric power production is toward an interconnected network of transmission lines linking generators and loads into large integrated systems, some of which span entire continents.

Successful operation of a power system depends largely on the engineer's ability to provide reliable and uninterrupted service to the loads. Ideally, the loads must be fed at constant voltage and frequency at all times. In practical terms this means that both voltage and frequency must be held within close tolerances so that the consumer's equipment may operate satisfactorily. For example, a drop in voltage of 10-15% or a reduction of the system frequency of only a few hertz may lead to stalling of the motor loads on the system. Thus it can be accurately stated that the power system operator must maintain a very high standard of continuous electrical service [2].

The first requirement of reliable service is to keep the synchronous generators running in parallel and with adequate capacity to meet the load demand. If at any time a generator loses synchronism with the rest of the system, significant voltage and current fluctuations may occur and transmission lines may be automatically tripped by their relays at undesired locations.

A second requirement of reliable electrical service is to maintain the integrity of the power network. The high-voltage transmission system connects the generating stations and the load centers. Interruptions in this network may hinder the flow of power to the load. This usually requires a study of large geographical areas since almost all power systems are interconnected with neighboring systems. Economic power as well as emergency power may flow over interconnecting tie lines to help maintain continuity of service. Therefore, successful operation of the system means that these lines must remain in service if firm power is to be exchanged between the areas of the system.[4] While it is frequently convenient to talk about the power system in the "steady state," such a state never exists in the true sense. Random changes in load are taking place at all times, with subsequent adjustments of generation. Furthermore, major changes do take place at times, e.g., a fault on the network, failure in a piece of equipment, sudden application of a major load such as a steel mill, or loss of a line or generating unit. We may look at any of these as a change from one equilibrium state to another.

3. OBJECTIVE OF WORK

The present work has been carried out with the objective for study of performance of a power system during different faults conditions. Further, the aim is to study the different parameter variation during these faults**.**

4. SINGLE LINE DIAGRAM OF THE SYSTEM

Fig. 1 shows the single line diagram of the systems that include generating unit connected with an infinite bus.

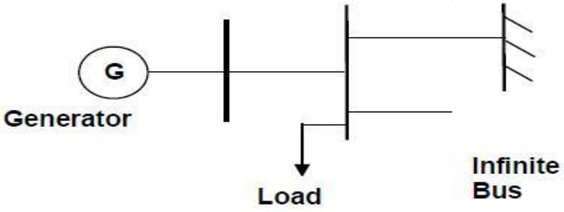

Fig 1. Single Line Diagram Of A Power System

A resistive load also connected in between the generator and infinite bus. The prime mover for the generating unit (not shown) may be a gas turbine, hydro turbine, diesel turbine.

5. SIMULINK MODEL OF THE POWER SYSTEM

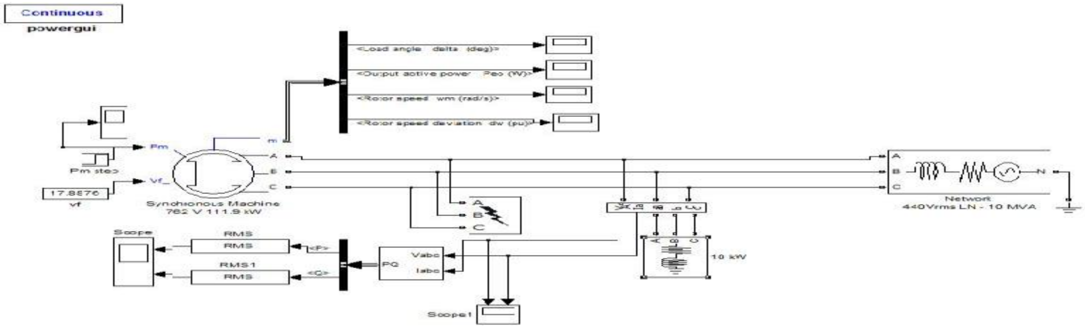

Fig 2. Simulink Model

6. RESULTS: Effect on parameters under phase to phase fault

In the above shown model line to line or phase to phase faults is applied at 2.5 sec and clear this fault at 2.6 sec. the variations in the parameters of the model are shown below.

Performance of rotor speed under phase to phase fault

As observed from the analysis of the system under phase to phase fault the rotor speed of the synchronous machine decreases.

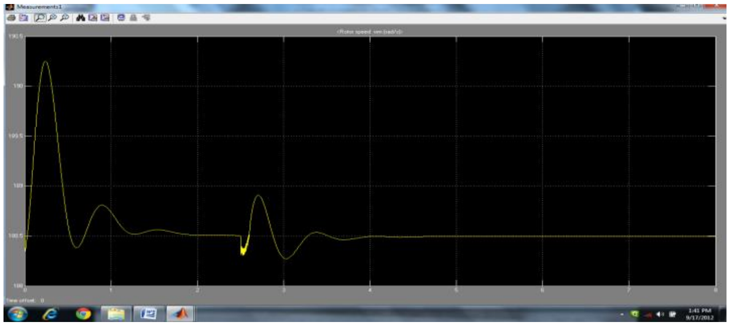

Fig. 3 Rotor speed performance under phase to phase fault.

Performance of output active power

Under phase to phase fault, it is observed that the output active power is moving towards zero. As shown in the fig.

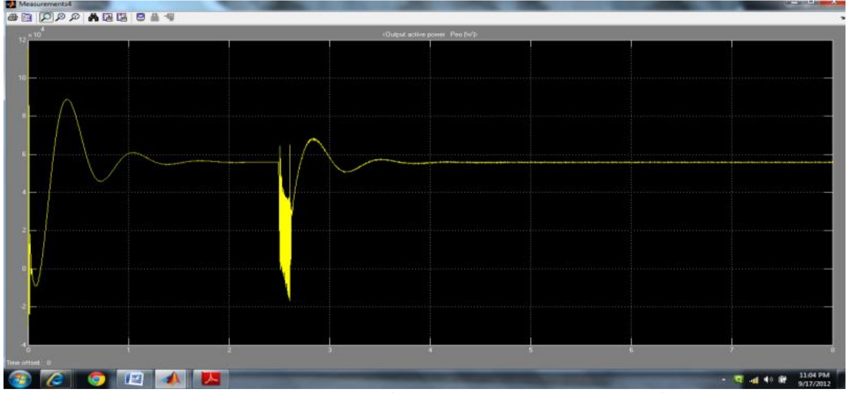

Fig 4 Output active power performance under phase to phase fault.

Performance of load angle

When a phase to phase fault is occur in the system there is variations in the load angle is observed. The effect on the load angle is shown in the fig below

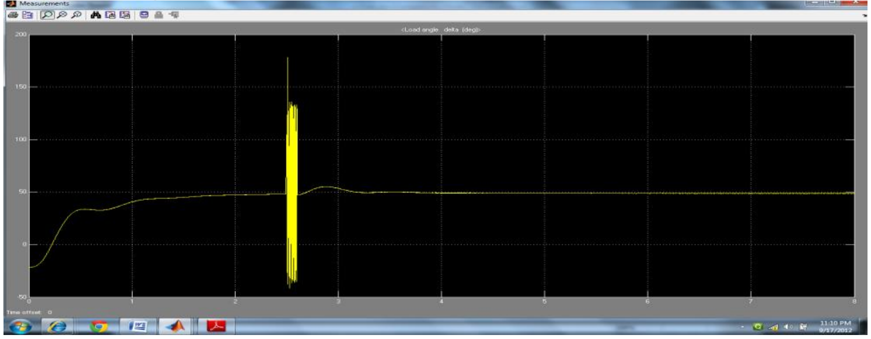

Fig 5 Load angle performance under phase to phase fault.

Performance of rotor speed deviation

As **s**imilar to the rotor speed the rotor speed deviation is also slows down and also shown in the fig below

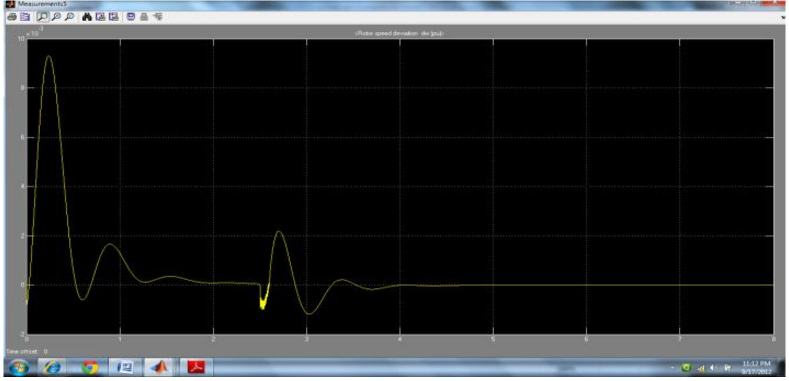

Fig.6 rotor speed deviation performance under phase to phase fault.

7. CONCLUSION

The system under phase to phase fault the rotor speed of the synchronous machine decreases, output active power is moving towards zero and rotor speed deviation is also observed.

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