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Simulation Model for Various Alternator Fault Protection

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Abstract: The alternator is the main part of any power system which provides power to the grid system which used as emergency power supply using prime-mover, as it is very costly, necessary to protect it from different faults and abnormal conditions. This report contains the alternator protection matlab simulation and demo panel. In demo panel contains five faults such as phase to phase, short circuit, over voltage, under voltage, overloading and loss of excitation occurred in alternator. If generator is not protected then power system may get collapse. A comprehensive and transient simulation model is established for various faults. All of faults in stator windings including internal faults and ground fault can be simulated in this unified model. Using the model to study the variation of current and voltage is conductive to analyse the features of fault and design the protection scheme. It is shown that the model accurately predicts the voltage and current waveforms under fault conditions. Hence it used to analyse important features of faults and to design appropriate protection schemes. The internal and external faults can result in a damage caused by the heavy transient short-circuit current. Compared with the internal and external faults, the ground fault is slight destructive but it will extend to the internal short-circuit faults in long running. The protection of the ground fault sensitively and correctly operates can reduce the probability of those severe faults occurring. So it is very important for relay protection of generator to correctly analyse the characteristics of these faults of windings using matlab simulation.

Keywords: Alternator Protection, Simulation Model, Internal and External Fault.

I. INTRODUCTION

A comprehensive and transient simulation model is established for various faults. All of faults in stator windings including internal faults and ground fault can be simulated in this unified model. Using the model to study the variation of current and voltage is conductive to analyse the features of fault, and design the protection scheme. Predictions from the model are validated by experiments, and it is shown that the model accurately predicts the voltage and current waveforms under fault conditions and also healthy condition. Hence, it can be used to analyse important features of faults and to design appropriate protection schemes.

The internal and external faults can result in a damage caused by the heavy transient short-circuit current. Compared with the internal and external faults, the ground fault is slight destructive, but it will extend to the internal short-circuit faults in long running. The protection of the ground fault sensitively and correctly operates can reduce the probability of those severe faults occurring.

For reliability of power system, protection of generator is important.

There are different types of generator protection which are existing in actual field like stator earth fault protection, over current protection, over voltage protection, under speed protection, over speed protection, over excitation protection, under voltage protection, under current protection etc. to give a feel and exposure of this protection MATLAB simulation is implemented. Protection against faults and abnormalities has been simulated.

II. SIMULATION MODEL

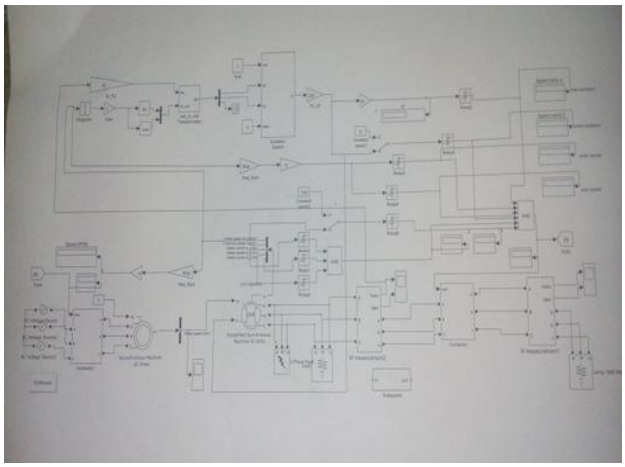

Fig. 2.1 Simulation model for alternator fault protection

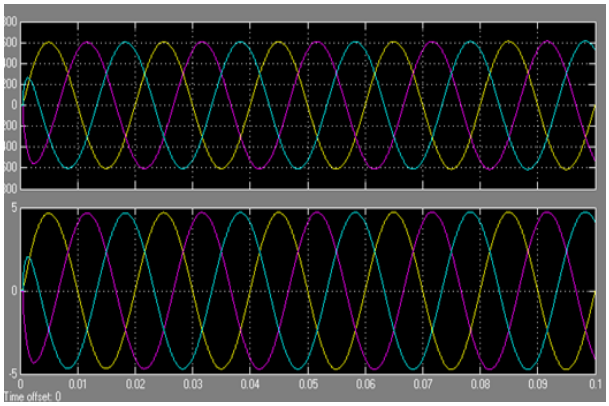

Fig. 2.2 Output of alternator without fault

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➢ **Description:**
This system consists of alternator and protection equipment's such as relay, contactor etc. also some logical instruction is used for alternator protection. Input mechanical energy 1500 rpm give to the Alternator and also excitation voltage 260 V dc. So that, alternator give 440V, 50Hz supply to external load. In this system 3000 W resistive load used.

Alternator worked on principal that, when current carrying conductor placed in magnetic field EMF induced in that conductor. This EMF generated according to Fleming right hand rule. In this system first we have done alternator model as shown fig.1. Alternator and load specification given below.

• **Alternator Specifications**
Name-Simplified Synchronous Machine SI Units
Connection Type-3-wire Y
Mechanical Load-Speed w
Nominal Parameters VA V Hz- [5000 440 50]
Inertia Damping factor Pole- [3.89e6 0 20]
Internal R L- [1.0204 0.810e-3]

• **Load Specifications**
Configuration-Y grounded
Nominal voltage- 440
Nominal frequency- 50
Active power- 1500
Inductive power- 0
Capacitive power- 0

III.PROTECTION OF FAULTS

A] L-G/L-L/LL-G/LLL-G FAULT

Along with the development of electric power industry, accurate analysis of the faults in generators becomes more important. The faults in the stator winding of synchronous generators, which occur due to a combination of thermal, electrical, mechanical and environmental stresses that act on the stator, are found to be some major causes of synchronous generator failure.

The fault occurs mainly due to the insulation failure of the stator windings. The main types of stator windings fault, in order importance are,

1. Phase to ground fault
2. Phase to Phase fault
3. Triple Phase fault
4. Triple Phase to ground fault

The stator winding fault are most dangerous and are likely to cause considerable damage to the expensive machinery therefore, automatic protection is absolutely necessary to clear such fault in the quickest possible time in order to minimize the extent of damage. For protection of alternator against such fault using relay.

For creating fault, 3 phase fault block is used from Simulink library. Fault resistance 0.01 ohm, switching time 0.1sec and Snubber resistance, Snubber capacitance inf. are selected. When fault created using this block, it instantly removed and alternator will stop.

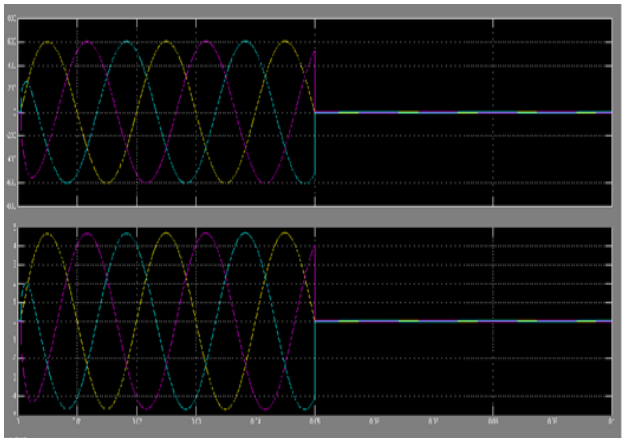

Fig. A] Alternator output after line faults

B] Loss of Excitation Fault

The chances of loss of excitation of alternator are undoubtedly very more. If it does occur, no immediate damage will be caused by permitting the alternator to run with very low output voltage. But grid voltage has constant, so grid protected against such fault.

In simulation model we also protected against such fault. Excitation of alternator is 260 V dc. When it is below pick value i.e. 250 V alternator will stop, because relay has set to 250V due to that it detect this fault and send information to contactor and contactor will open.

The excitation system is created depends upon output of alternator, it has closed loop system. The excitation voltage is above the pickup value contactor will open and alternator will stop.

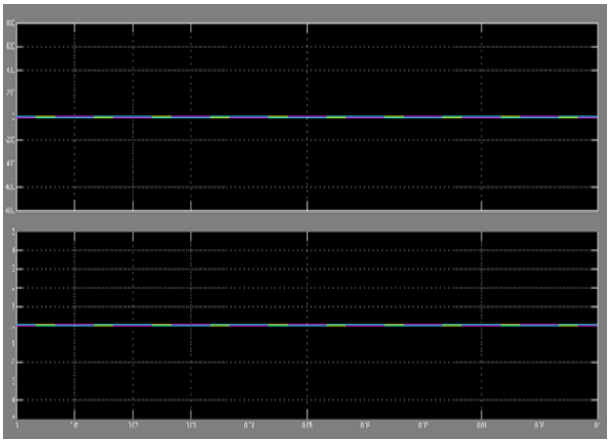

Fig. B] Alternator output after loss off Excitation

C] Over current Protection

The chances of over current of alternator are undoubtedly very more. If it is occur, no immediate damage will be caused by permitting the alternator to run with insulation failure and develop into internal short-circuit faults.

In simulation model we also protected against such fault current alternator is 4 A. When it is above peck value i.e. 10 A alternator will stop, because relay has set to 4 A due to that it detect this fault and send information to contactor and contactor will open.

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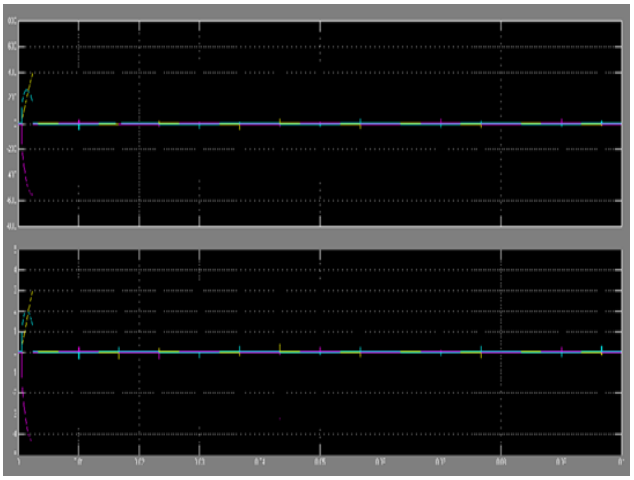

Fig. C] Alternator Output after over current Fault

IV. CONCLUSION

The whole project is different types of relays and CT's and contactors for detection and removing different types of faults.

As a result we successfully had done protection of alternator from different faults like over current, overvoltage, L-L short circuit etc. and immediate detection and indication of fault through relay and alarm circuit and the supply alternator in MATLAB and demo panel.

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