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AN EXPERIMENT ON THREE PHASE FAULTS WITH AUTO RECLOSER

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ABSTRACT----- *The electrical substation which supplies the power to the consumers can have failures due to some faults which can be temporary or permanent.These faults lead to substantial damage to the power system equipment. The faults might be L-G, L-L (Line to Line), L-L-L (Three lines) in three phase supply system.To overcome this problem the project is designed to develop an automatic tripping mechanism for the three phase supply system, named Auto recloser is built, which can sense these faults and automatically reset system or disconnects the supply. But for the study and to know the actual behavior of system in faulty condition it is difficult to represent as on actual system.Therefore we will make a demo model by which we can easily performing and analyzing 3 phase faults like LL, LLG, LG, etc. at laboratories.*

Keyword----- *Auto Recloser , Temporary Fault , Parmenant Fault , Three Phase , Power System*

I. INTRODUCTION

The Electric Power System is divided into many different sections. One of which is the transmission system, where power is transmitted from generating stations and substations via transmission lines into consumers. Both methods could encounter various types of malfunctions is usually referred to as a “Fault”.

Fault is simply defined as a number of undesirable but unavoidable incidents can temporarily disturb the stable condition of the power system that occurs when the insulation of the system fails at any point.

In distribution system of electric power, a circuit breaker equipped with a mechanism that can sense the fault and close the breaker after it has been opened due to a fault which is known as auto recloser.Reclosers are employed in distribution systems to sense and interrupt momentary faults. As we know thattemporary short circuit faults clear themselves,so we can use auto recloser which restores power and improves continuity of supply to the consumers.

II. DESCRIPTION

A 3 phase power system is simulated in MatLab is shown in above Fig.:4. A 3 phase transformer is used to step-up the voltage. A three phase generator is supplying the load through a 600 km transmission line. Circuit Breakers are provided at both ends of the line to disconnect the line from both sides and discharge the fault current.

A fault block is provided at the middle of transmission line to simulate the fault conditions. It can simulate LL, LLL, LG, LLG, LLLG faults.

To study the behavior of voltage and current under fault conditions we have created fault by fault block and timing is provided to the circuit breakers with suitable delay.

when system is running under normal steady state condition the waveform of voltages and currents are sinusoidal in all phases.

When the ground fault occurs at R phase the current in that phase increases as current is fed to the ground fault and magnitude of voltage also falls down. After few cycles from the occurrence of fault the circuit breakers are opens so the fault current and current in becomes zero but voltage appears across the circuit breaker as the supply to the bus is not interrupted.

As the circuit breaker remains open till the human interruption regardless of the type of fault i.e. temporary or permanent. Therefore the continuity of the supply gets interrupted until the circuit breakers are closed by operator manually or by sending a signal.

If we have autorecloser system then it can close the circuit breaker automatically after some predefined time and therefore minimum interruption of the supply can be achieved in case of temporary faults. If the fault sustains after reclosing operation the breaker opens again and recloses after predetermined time and the cycle is repeated generally 3 or 4 times and if the fault is still there then the breaker closes permanently and human interruption is required to find and clear the fault cause.

2.1 Faults in Transmission Network:

It is not practical to design and build electrical equipment or networks so as to completely eliminate the possibility of failure in service. It is therefore an everyday fact of life that different types of faults occur on electrical systems, however infrequently, and at random locations. Faults can be broadly classified into two main areas which have been designated “Active” and “Passive”.

2.1.1 Active Faults:

The “Active” fault is when actual current flows from one phase conductor to another (phase-to-phase) or alternatively from one phase conductor to earth (phase-to-earth).This type of fault can also be further classified into two areas, namely the “solid “fault and the “incipient” fault.

The solid fault occurs as a result of an immediate complete breakdown of insulations would happen if, say, a pick struck an underground cable, bridging conductors etc. In these circumstances the fault current would be very high, resulting in an electrical explosion.

2.1.2 Passive Faults:

Passive faults are not real faults in the true sense of the word but are rather conditions that are stressing the system beyond its design capacity, so that ultimately active faults will occur.

1. Overloading
2. Overvoltage
3. Under frequency
4. Power swings

2.1.3 Transient & Permanent Faults:

Transient faults are faults which do not damage the insulation permanently and allow the circuit to be safely re-energized after a short period of time. A typical example would be an insulator flashover following a lightning strike, which would be successfully cleared on opening of the circuit breaker, which could then be automatically reclosed.

Transient faults occur mainly on outdoor equipment where air is the main insulating medium.Permanent faults, as the name implies, are the result of permanent damage to the insulation.In this case, the equipment has to be repaired and reclosing must not be entertained.

2.2 Types of Faults on a Three Phase System:

The short circuit faults can be classified as:

1. Symmetrical faults
2. Unsymmetrical faults

Subtypes of faults on a three phase system are following:

(A) Phase-to-earth fault

(B) Phase-to-phase fault

(C) Phase-to-phase-to-earth fault

(D) Three phase fault

(E) Three phase-to-earth fault

(F) Phase-to-pilot fault *

(G) Pilot-to-earth fault *

(* In underground mining applications only)

2.2.1 Symmetrical & Asymmetrical Faults:

A symmetrical fault is a balanced fault with the sinusoidal waves being equal about their axes, and represents a steady state condition [8].An asymmetrical fault displays a D.C. offset, transient in nature and decaying to the Steady state of the symmetrical fault after a period of time [8].

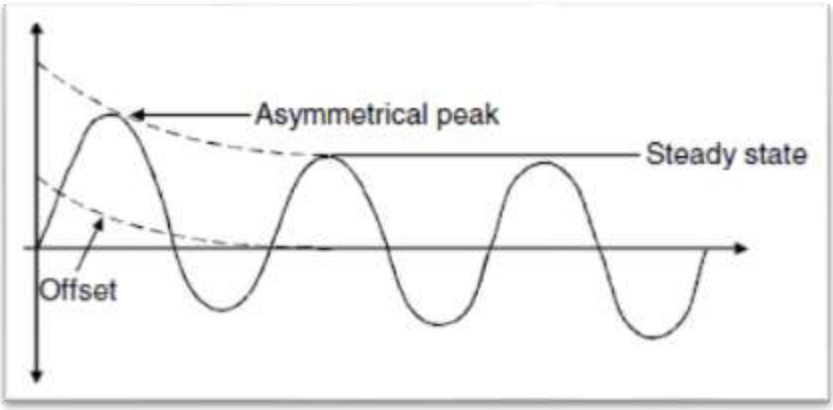


Figure 1: Symmetrical and Asymmetrical Faults

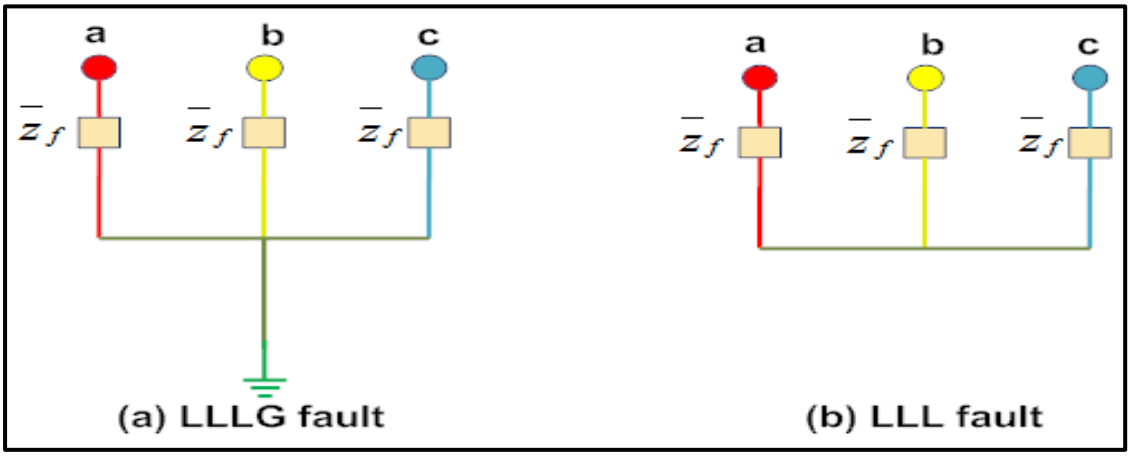


Figure 2: Symmetrical faults

2.2.2 Unsymmetrical faults:

Faults in which the balanced state of the network is disturbed are called unsymmetrical or unbalanced faults. The most common type of unbalanced fault in a system is a single line to ground fault (LG fault). [8]

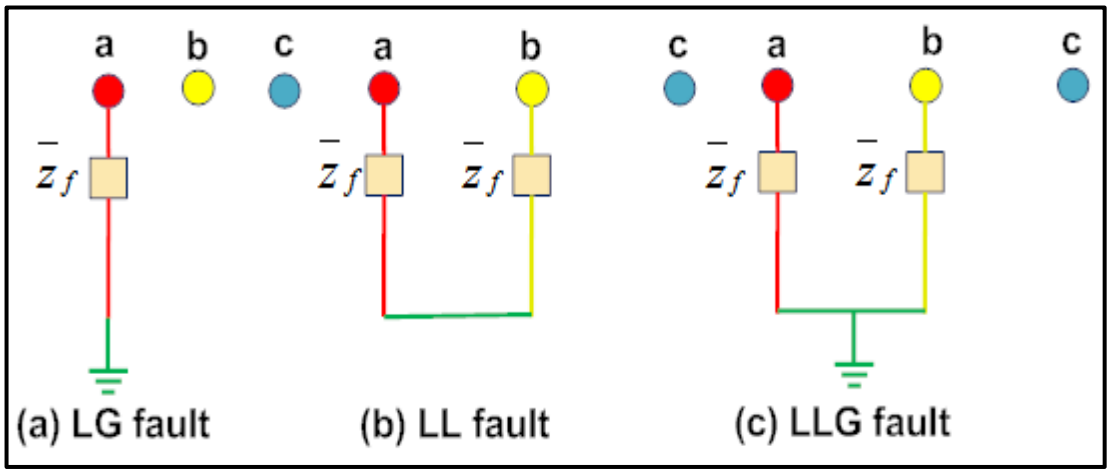


Figure 3: Unsymmetrical faults

- **Problem summary:**

The nature of fault simply defines as abnormal condition which causes a reduction in the basic insulation strength between phase conductor and between phase conductors and earth, and any earthed screens surrounding the conductors. The probability of the failure or occurrence of abnormal condition is more on the power lines, simply because of their greater length and exposure to the atmosphere.

- **Project objectives and usefulness:**

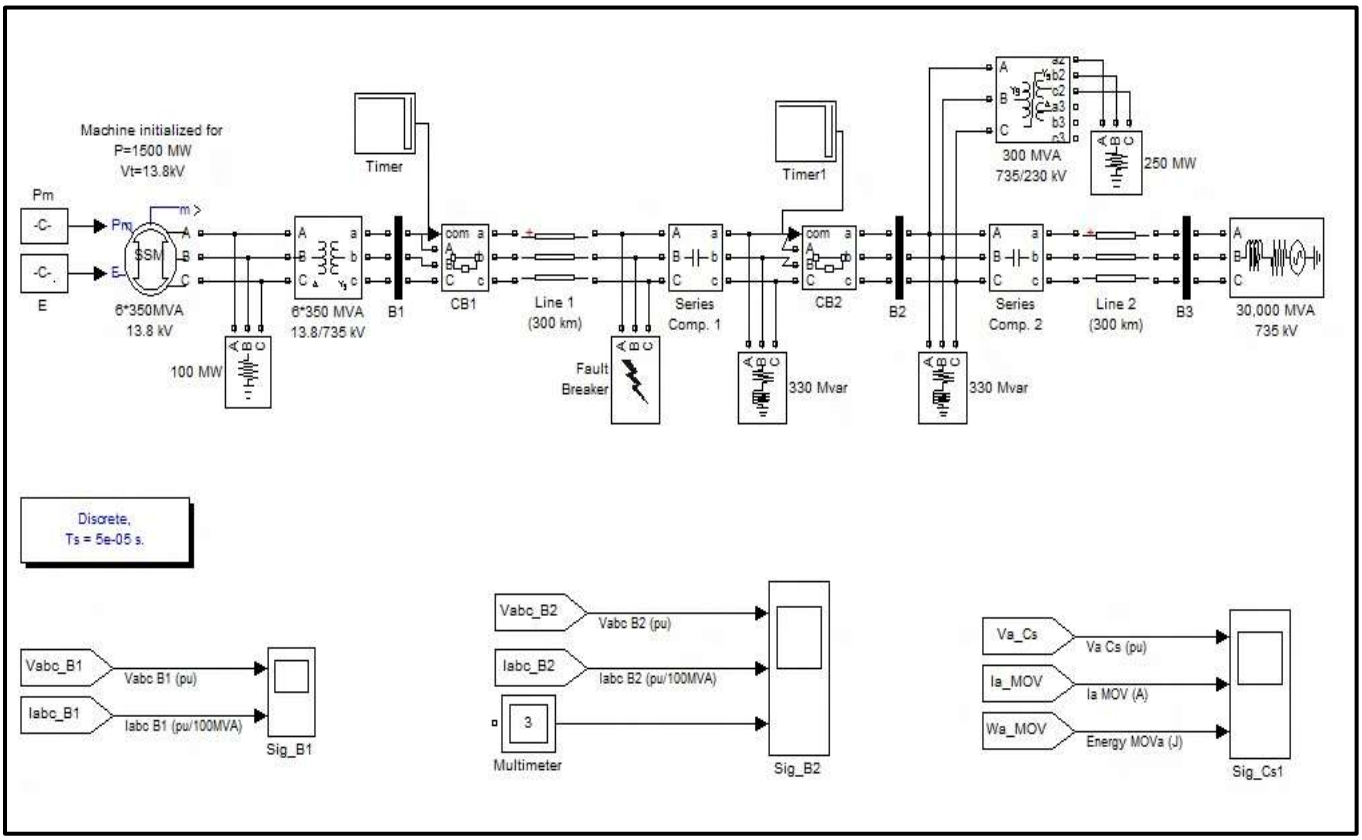
An electrical power system should ensure the availability of electrical energy without interruption to every load connected to the system. The high voltage transmission line carrying bulk

power, since these lines are overhead lines, so there are faults are occurs in it.In actual power system no matter how much perfect it is; chances of fault always there. Therefore various faults can occur at various locations.

By using this project the three phase faults are detected. If the faults are temporary suppose 1-2 seconds then the supply goes out for a short period and returns back after the clearance of fault, but if the fault is of longer duration suppose 5-7 seconds then circuit is tripped permanently. Hence this project can be used in the fields where three phase loads are used. Such loads can be protected using this circuitry.This project is also used for study and analysis of 3 phase faults in college laboratories. So if there is any fault in line, then this circuit detect those fault, analysis fault and if fault is big, then disconnect the line from circuit.

3 . SIMULATION

3.1 Simulation model:



3.2 Description:

A 3 phase power system is simulated in MatLab is shown in above Fig.:4. A 3 phase transformer is used to step-up the voltage. A three phase generator is supplying the load through a 600 km transmission line. Circuit Breakers are provided at both ends of the line to disconnect the line from both sides and discharge the fault current.A fault block is provided at the middle of transmission line to simulate the fault conditions. It can simulate LL, LLL, LG, LLG, LLLG faults.To study the behavior of voltage and current under fault conditions we have created fault by fault block and timing is provided to the circuit breakers with suitable delay.As we can see in the

Fig.:5 when system is running under normal steady state condition the waveform of voltages and currents are sinusoidal in all phases.

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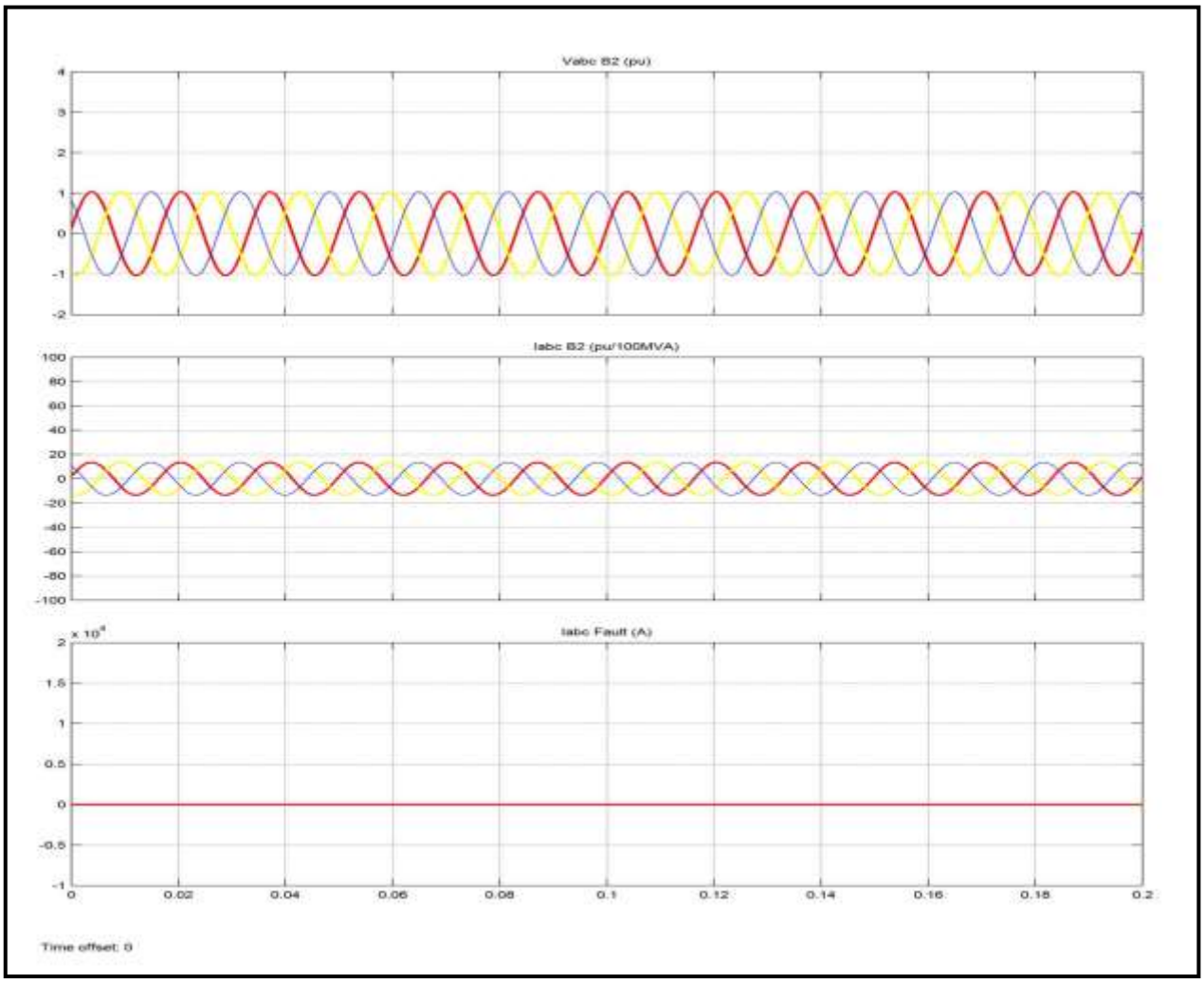
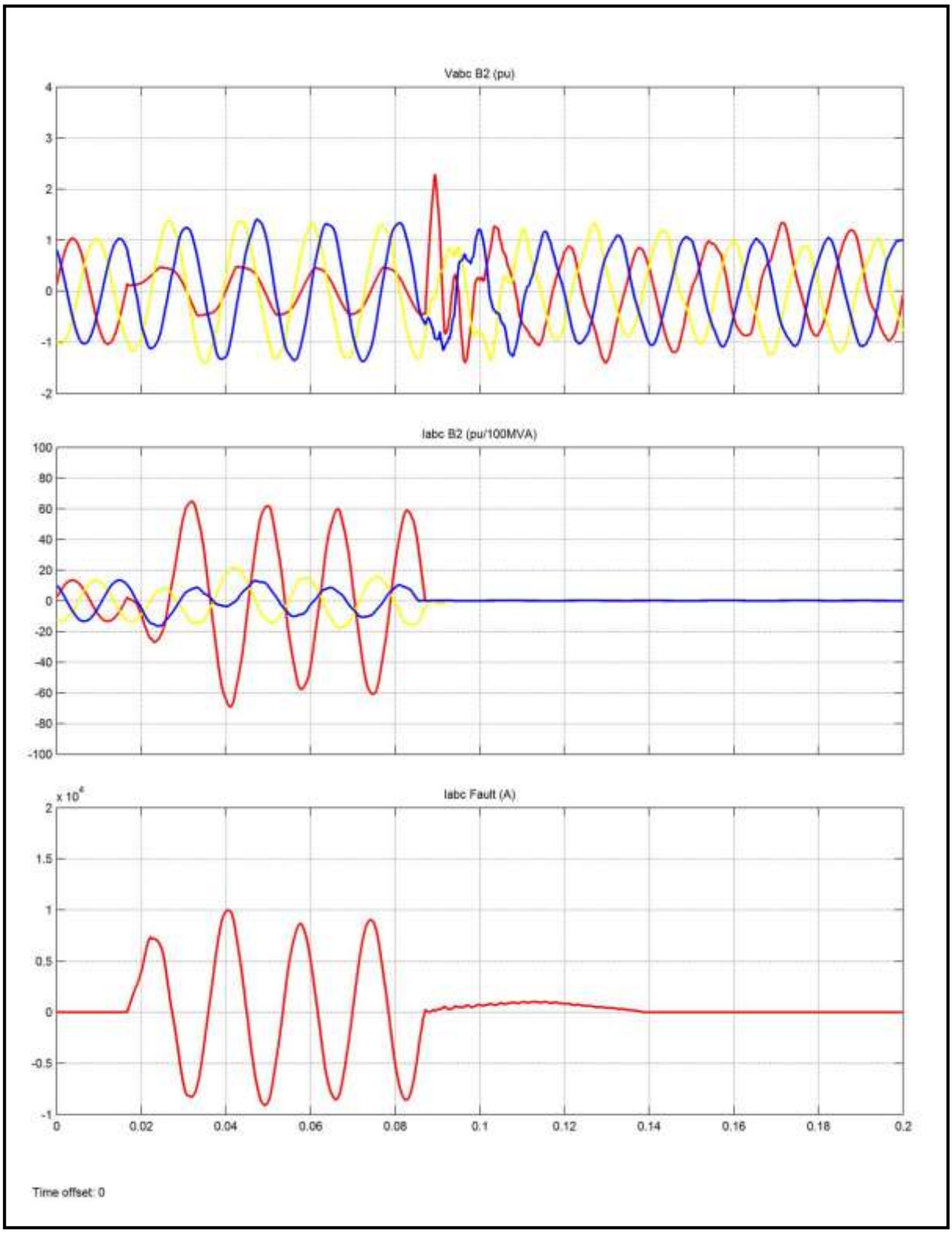
Three phase waveforms without fault





Three phase permanent fault waveforms

3.3 Conclusion of Simulation:

After simulating the three phase system under fault conditions we have analyzed the waveform of bus voltages, bus currents and fault current we can conclude that auto reclosing provides the minimum interruption to the supply and it also improves the stability of the system as the load is disconnected for short time.

Therefore we can conclude that the auto reclosing is beneficial in every aspect.

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