

FAULT ANALYSIS OF THREE PHASE SYSTEM

Submitted in partial fulfillment of the requirements for the award of

Bachelor of Engineering Degree in
Electrical and Electronics Engineering

By

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SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

Accredited with Grade “A” by NAAC

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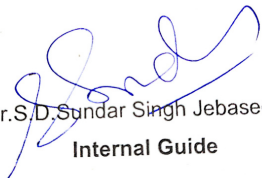
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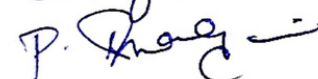
This is to certify that this Project Report is the bonafide work of **POORNIMA K(40140025)** and **MALATHI C(40140023)** who carried out the Project entitled **"FAULT ANALYSIS OF THREE PHASE SYSTEM"** under our supervision from February 2023 to April 2023.


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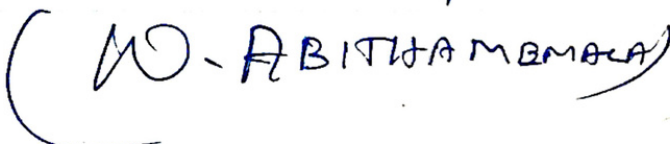
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DECLARATION

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DATE: 20.04.2023

PLACE: Chennai

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CHAPTER 1

INTRODUCTION

1.1 GENERAL BACKGROUND

Faults often occur in three-phase power systems. With the increasing demand for electrical power, one key challenge is the ability to identify and analyze these faults when they occur.

In this paper, the performance of long transmission line in a balanced system has been discussed. This paper is fault analysis in a three-phase system. A three lines to ground fault occurred in the system, which automatically operated the circuit breakers and left them open.

Simulink was used to view the waveforms of the current and voltage at both normal and fault conditions. The result showed that at the fault point, the sudden increase in current was accompanied by a drop in voltage. The system was also able to leave the breaker open all through the operation, suggesting the occurrence of a permanent fault.

1.2 SCOPE OF THE PROJECT

The main objective of this dissertation is to analyze the fault and improve the voltage stability and power flow control in power system network.

When different types of fault occurs in power system then in the process of transmission line fault analysis, determination of bus voltage and the rms line current are possible.

While consulting with the power system the terms bus voltage and rms current of line are very important.

1.3 ADVANTAGES

The fault analysis of a power system is required in order to provide information for the selection of switch gear, setting of relays and stability of system operation. A power system is not static but changes during operation (switching on or off of generators, transmission lines and downstream loads) and during planning (addition of generators, transmission lines, transformers and downstream loads). Thus fault studies need to be routinely performed by utility engineers.

Faults usually occur in a power system due to insulation failure, flash over, physical damage or human error. These faults may either be three phases in nature involving all three phases in a symmetrical manner, or may be asymmetrical where usually only one or two phases may be involved.

Faults may also be caused by either short-circuits to earth or between live conductors, or may be caused by broken conductors in one or more phases. Sometimes simultaneous faults may occur involving both short-circuit and broken conductor faults (also known as open-circuit faults).

When a fault (e.g., a short circuit) occurs at some point in the network, the normal operating conditions of the system are upset, if the fault is persistent severe loss of load, property damage due to fire or explosion, and steep economic losses can arise as undesirable consequences. Therefore, the correct modeling of components and the correct fault analysis are critical to ensuring safety and reliability.

CHAPTER 2

TRANSMISSION LINE

2.1 BALANCED TRANSMISSION LINE

In telecommunication and professional audio, a **balanced line** or **balanced signal pair** is a circuit consisting of two conductors of the same type, both of which have equal impedances along their lengths and equal impedances to [ground](#) and to other circuits.^[1] The primary advantage of the balanced line format is good rejection of common-mode noise and interference when fed to a differential device such as a [transformer](#) or [differential amplifier](#).^[2]

As prevalent in [sound recording](#) and reproduction, balanced lines are referred to as [balanced audio](#).

Common forms of balanced line are [twin-lead](#), used for radio frequency signals and [twisted pair](#), used for lower frequencies. They are to be contrasted to [unbalanced lines](#), such as [coaxial cable](#), which is designed to have its return conductor connected to [ground](#), or circuits whose return conductor actually is ground (see [earth-return telegraph](#)). [Balanced](#) and [unbalanced circuits](#) can be interfaced using a device called a [balun](#).

Circuits driving balanced lines must themselves be balanced to maintain the benefits of balance. This may be achieved by transformer coupling ([repeating coils](#)) or by merely balancing the impedance in each conductor.

Lines carrying symmetric signals (those with equal amplitudes but opposite polarities on each leg) are often incorrectly referred to as "balanced", but this is actually [differential signalling](#). Balanced lines and differential signalling are often used together, but they are not the same thing. Differential signalling does not make a line balanced, nor does noise rejection in balanced cables require differential signalling.

2.2 UNBALANCED TRANSMISSION LINE

In [telecommunications](#) and [electrical engineering](#) in general, an **unbalanced line** is a pair of conductors intended to carry electrical signals, which have unequal [impedances](#) along their lengths and to [ground](#) and other circuits. Examples of unbalanced lines are [coaxial cable](#) or the historic [earth return](#) system invented for the telegraph, but rarely used today. Unbalanced lines are to be contrasted with [balanced lines](#), such as [twin-lead](#) or [twisted pair](#) which use two identical conductors to maintain impedance balance throughout the line. Balanced and unbalanced lines can be interfaced using a device called a [balun](#).

The chief advantage of the unbalanced line format is cost efficiency. Multiple unbalanced lines can be provided in the same cable with one conductor per line plus a single common return conductor, typically the [cable shielding](#). Likewise, multiple [microstrip](#) circuits can all use the same [ground plane](#) for the return path. This compares well with balanced cabling which requires two conductors for each line, nearly twice as many. Another benefit of unbalanced lines is that they do not require more expensive, balanced driver and receiver circuits to operate correctly.

Unbalanced lines are sometimes confused with [single-ended signalling](#), but these are entirely separate concepts. The former is a cabling scheme while the latter is a signalling scheme. However, single-ended signalling is commonly sent over unbalanced lines. Unbalanced lines are not to be confused with [single-wire transmission lines](#) which do not use a return path at all.

CHAPTER 3

THEOROTICAL BACKROUND OF FAULTS ON TRANSMISSION LINE

3.1 BASIC CONCEPT OF FAULTS

A fault is defined as any unusual condition in the transmission line due to any reason. This may include smoke, fire, sparking, broken insulation or any other effect.

Two basic types of Faults in **Transmission Lines** are:

- ❖ series faults.
- ❖ shunt faults.

The series faults are also considered as open conductor faults. While shunt faults are also referred to as short circuit faults. Let's discuss both types in detail.

3.1.1 Series Faults (*Open Circuit Faults*)

This type of faults is also referred to as open Circuit fault. And can be defined as faults caused due to the failure of a single or multiple conductor.

3.1.1.1 Causes Of Series Faults:

- ❖ The major causes of open-circuit faults are joint failures of overhead lines.
- ❖ Similarly, failure of a circuit breaker or function of the circuit breaker in multiple phases.
- ❖ Melting of fuse conductor.
- ❖ Cut in the conductor. This fault I meet regularly in my work, because of the aged conductors.

3.1.1.2 Effects Of Series Faults

Series faults are dangerous for live things like animals as well as humans.

Due to a series of faults, the system operations disturb and the system goes to an abnormal or unstable state.

Due to abnormal conditions, voltage fluctuations occur, High voltages can cause short circuit faults.

Troubleshooting To protect the system from damages it is mandatory to make regular inspection to detect any abnormal condition and to overcome the situation as soon as possible.

3.1.2 Shunt Faults (Short Circuit Faults)

Shunt faults are caused due to low impedance between two points with different voltage levels. This allows the flow of a high amount of current into Overhead transmission lines.

3.1.2.1 Causes Of Shunt Faults

The main causes of shunt faults are insulation failure between different phases of conductors, but as you know OHTL conductors are not insulated, so this fault can happen if a bird break down the air insulation between two conductors. Other causes may include aging of transmission line, damage by any reason and lightning, etc.

3.1.2.2 Effects Of Shunt Faults

Just like series faults, shunt faults also have a negative impact on transmission lines. Shunt fault can cause fire or explosion to equipment attached with transmission lines such as circuit breakers, transformers, etc.

- ❖ The voltage fluctuation can cause damage to the devices or equipment attached to the transmission line

- ❖ The supply of electric current disconnects if shunt faults persist for long times.
- ❖ Just like voltage fluctuation, shunt faults also cause current fluctuations. If the current level increase from the rated current of the device attached to the power system or transmission line.

It overheats and either completely damage the device or reduces the working life span of the equipment.

3.2 TYPES OF FAULTS

- line to ground (LG)
- line to line (LL)
- Double line to ground (LLG)
- Triple line (LLL)
- Triple line to ground (LLLG) faults.

3.2.1 Line to Ground Fault

This single L – G fault mainly occurs once a single conductor falls toward the ground terminal. So around 70 to 80 % of the fault within the power system is the single L – G fault.

3.2.2 Line to Line Fault

This L– L fault mainly occurs once two conductors are short-circuited and also due to heavy wind. So the line conductors can be moved because of heavy wind, they may touch with each other and causes short-circuit. So, 15 – 20% of the faults can occur approximately.

3.2.3 Double Line to Ground Fault

In this kind of fault, both the two lines get in touch with each other through the ground. So, there is a 10% probability for faults.

3.2.4 Triple Line Fault

These kinds of faults are balanced which means the system remains balanced after the fault occurs. So this fault rarely occurs, although it is the harsh kind of fault that holds the largest current. So this current is used to determine the rating of the CB.

3.2.5 Triple Line to Ground Fault

The 3-phase L – G fault mainly comprises all the 3- phase of the system. This fault mainly occurs among the 3-phases as well as the ground terminal of the system. So, there is a 2 to 3% of probability to occur the fault.

CHAPTER 4

PROJECT DESCRIPTION

4.1 SIMULATION DIAGRAM

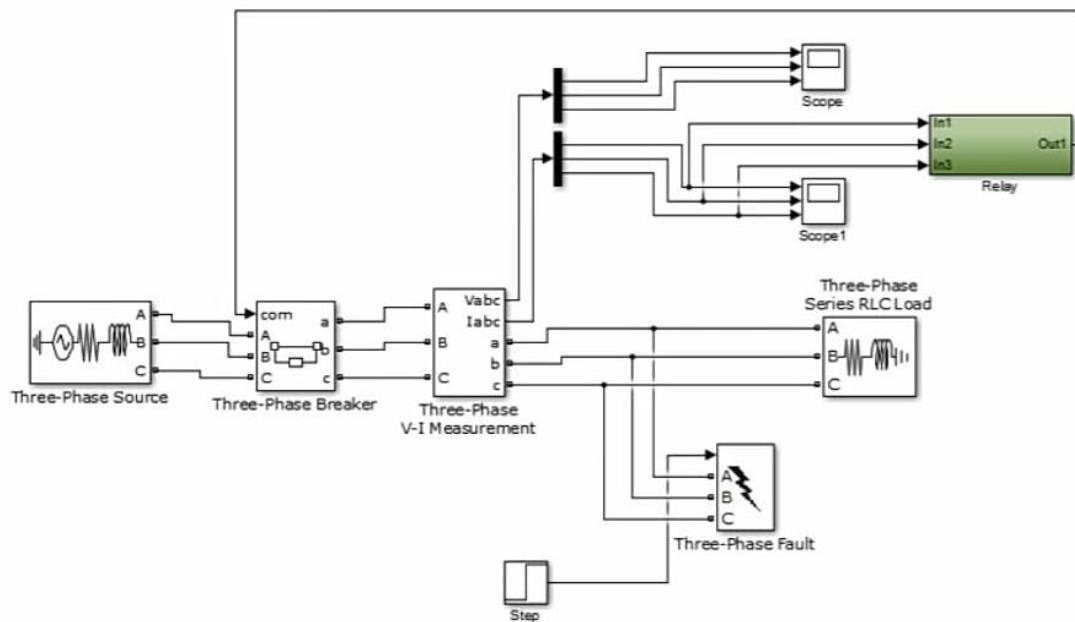


Figure 4.1 Simulation Diagram of Fault Analysis Of Three Phase System

4.3 OUTPUT WAVEFORM

4.3.1 Balanced Condition of voltage and current

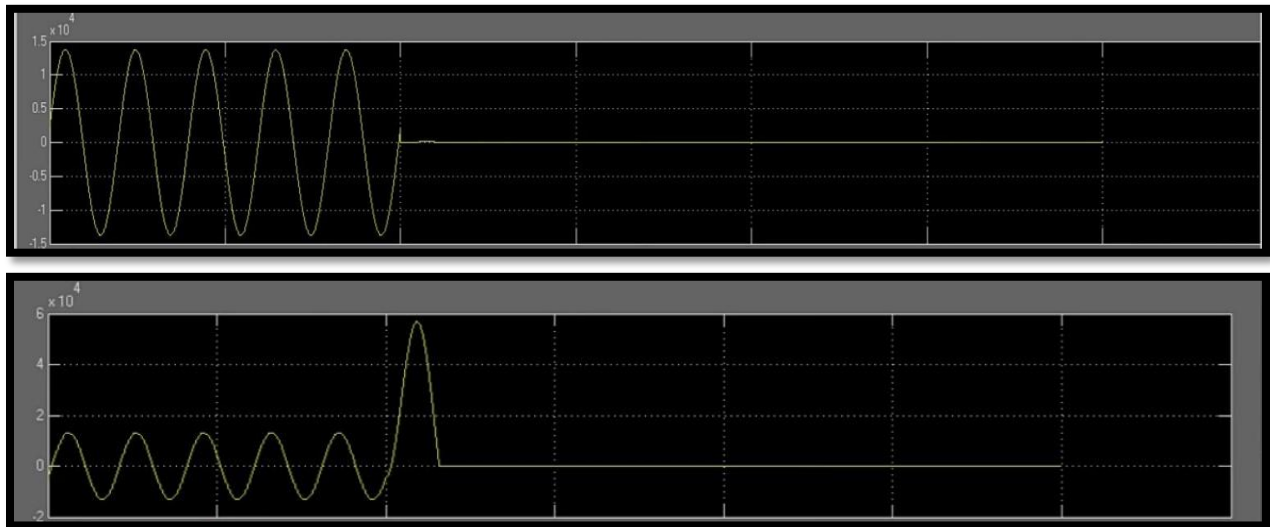


Figure 4.2 Balanced Condition

4.3.2 UNBALANCED CONDITION OF VOLTAGE AND CURRENT

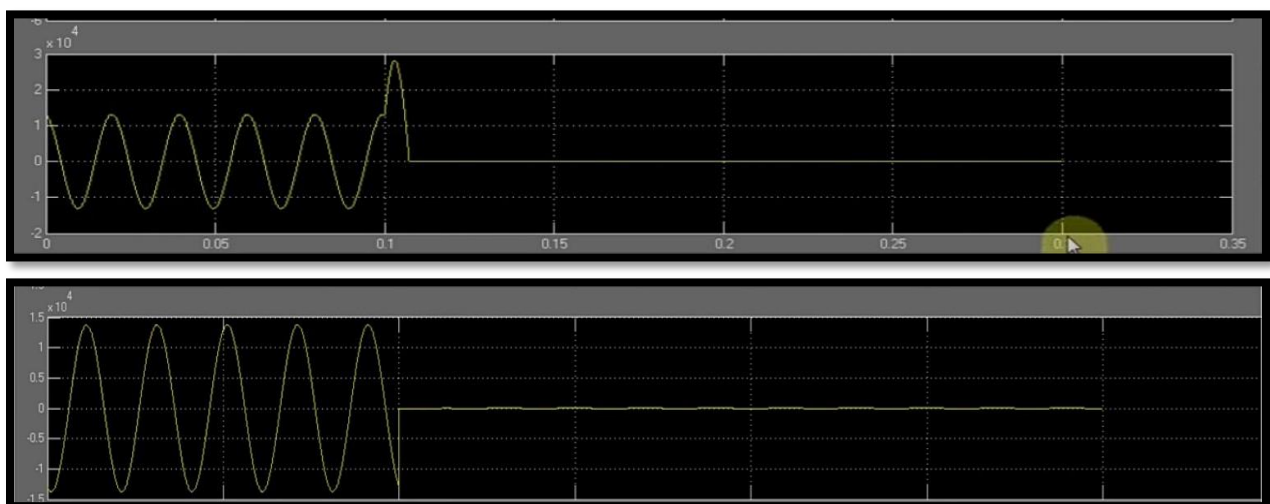


Figure 4.3 Unbalanced Condition

CHAPTER 5

PROPOSED SYSTEM

5.1 COMPONENTS

- Three Phase Source
- Three Phase Breaker
- Three Phase V-I measurement
- Three Phase Fault
- Three Phase Series RLC Load
- Scope
- Step
- Demux
- Relay

5.1.1 Three Phase Source

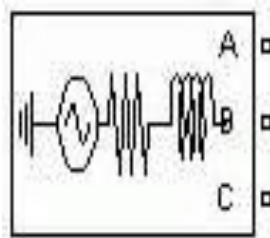


Figure 5.1 Source

The Three-Phase Source block implements a balanced three-phase voltage source with an internal R-L impedance. The block connects the three voltage sources in Y with a neutral connection that you can internally ground or make it accessible. You can specify the source internal resistance and inductance either directly by entering R and L values or indirectly by specifying the source inductive short-circuit level and X/R ratio.

5.1.2 Three Phase Breaker

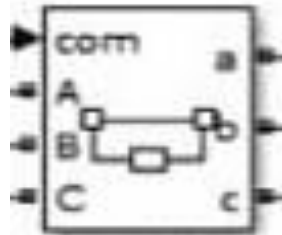


Figure 5.2 Breaker

The Three-Phase Breaker block implements a three-phase circuit breaker where the opening and closing times can be controlled either from an external Simulink® signal (external control mode), or from an internal control timer (internal control mode).

5.1.3 Three Phase V-I Measurements

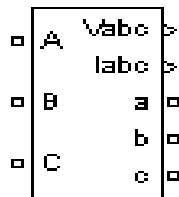


Figure 5.3 V-I Measurements

The Three-Phase V-I Measurement block is used to measure instantaneous three-phase voltages and currents in a circuit. When connected in series with three-phase elements, it returns the three phase-to-ground or phase-to-phase peak voltages and currents.

5.1.4 Three Phase Fault



Figure 5.4 Fault

The Three-Phase Fault block uses three Breaker blocks that can be individually switched on and off to program phase-to-phase faults, phase-to-ground faults, or a combination of phase-to-phase and ground faults. The arc extinction process of the Three-Phase Fault block is the same as for the Breaker block. See the **Breaker** block for details on the modeling of the single-phase breakers.

5.1.5 Three Phase Series RLC Load

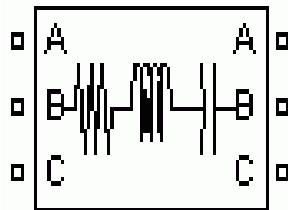


Figure 5.5 Series RLC Load

The Three-Phase Series RLC Branch block implements three balanced branches consisting each of a resistor, an inductor, or a capacitor or a series combination of these. Use the **Branch type** parameter to select elements you want to include in each branch.

Negative values are allowed for resistance, inductance, and capacitance.

5.1.6 Scope

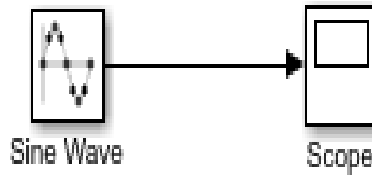


Figure 5.6 Scope

The scope function is **defined in the context of a model**. If you place a Simulink Function block in a model at the root level, the function is scoped to the model by default. The Trigger block Function visibility parameter is set to scoped.

5.1.7 Step



Figure 5.7 Step

The Step block provides a **step between two definable levels at a specified time**. If the simulation time is less than the Step timeparameter value, the block's output is the Initial valueparameter value. For simulation time greater than or equal to the Step time, the output is the Final valueparameter value.

5.1.8 Demux

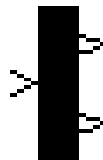


Figure 5.8 Demux

The Demux block extracts the components of an input signal and outputs the components as separate signals. The block accepts either vector (1-D array) signals or bus signals (see Signal Buses in *Using Simulink* for more information). The **Number of outputs** parameter allows you to specify the number and, optionally, the dimensionality of each output port. If you do not specify the dimensionality of the outputs, the block determines the dimensionality of the outputs for you.

5.1.9 Relay



Figure 5.9 Relay

The output for the Relay block switches between two specified values. When the relay is on, it remains on until the input drops below the value of the **Switch off point** parameter. When the relay is off, it remains off until the input exceeds the value of the **Switch on point** parameter. The block accepts one input and generates one output.

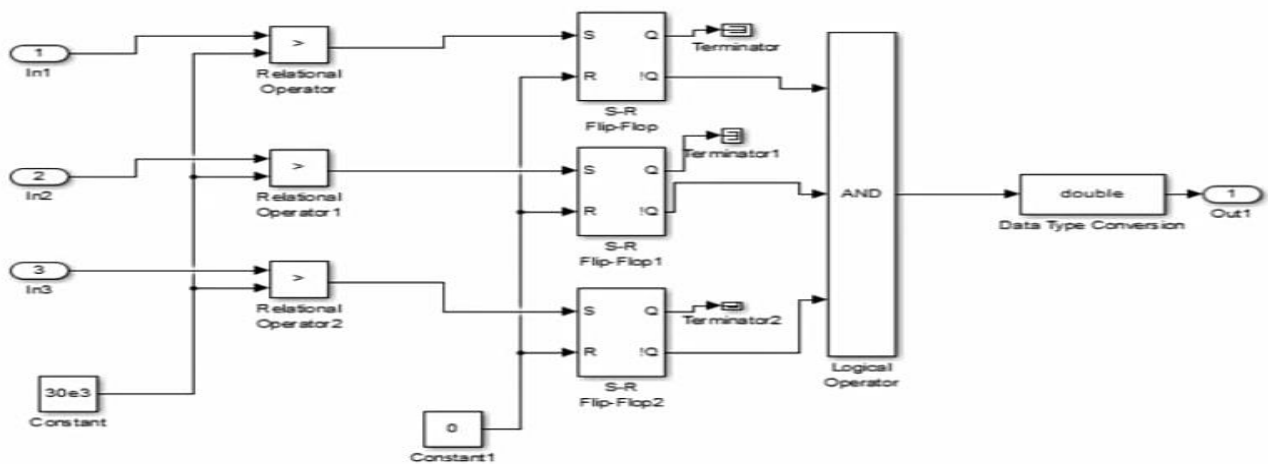


Figure 5.10 Detailed Relay Diagram

Chapter 6

Conclusion and future scope

6.1 Summary

The main objective of this dissertation is to analyze the fault and improve the voltage stability and power flow control in power system network

When different types of fault occurs in power system then in the process of transmission line fault analysis, determination of bus voltage and the rms line current are possible. While consulting with the power system the terms bus voltage and rms current of line are very important.

The circuit breakers and its rating is depends on triple line fault. The reason behind is that the triple line fault current is very high as compare to other fault current.

Hence by using MATLAB simulation in computer, the analysis of transmission line fault can be easily carried out. The main purpose of this paper is to study the general fault type which is Unbalance faults of transmission line in the power system.

6.2 Future Scope

In this dissertation, bus system with 3 phase fault observe and controller is use to limit the fault and improve the voltage stability and power flow control in power system network. We reach at the conclusion that is one of the fast acting power electronic controller which can provide a smoothly variable series capacitive reactance.

This is a new approach bus system with TCSC to improve the voltage stability, limit fault and power flow control in power system network. bus system with and without , comparative result and simulation result waveform show that, using we can improve the

voltage stability and power flow control in power system network and also limit the three phase fault.

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