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Effect of line length on the fault current due to line to ground fault in transmission line using MATLAB Simulink

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Abstract

Today, electrical power is a necessity for many aspects of daily living, including works in homes, businesses, industries, and agriculture. This article is created to ensure that the electrical power needed by these sectors is maintained. In an electrical system, numerous faults can arise owing to line-to-ground (L-G), line-to-line (L-L), and three lines (L-L-L). This study addresses the analysis of fault current under line-to-ground (L-G) and how it varies with the fault position. MATLAB Simulink has been utilized in this work to demonstrate how fault current depends on the line length of transmission system during L-G faults.

Keywords: Power System, Transmission Line Fault Current; L-G fault; Line Length

1. Introduction

Any abnormal electric current flow in the circuit is referred to as a fault or fault current in an electric power system, and current "always flows in short circuit path or least resistive path." High voltage surges, reversed power, low voltage, overcurrent, and phase imbalance are all caused by power network issues. Any abnormal condition of the network involving the breakdown of equipment in a power network, such as, generators, bus-bars, transformers etc. is denoted as a fault of a power network. The abnormal situation caused by the defect weakens the insulation between the conductors [1]. The system sustains significant damage as a result of the insulating reduction.

A variety of factors, including equipment insulation failure, falling trees, bird shorting, line overloads, lightning, strong winds, earthquakes, and other natural disturbances, can cause faults in a three- or single-phase electrical system. Additional causes of power system failures include frequent electrical surges, transmission line sags and dips, circuit overloads, tripping circuit breakers, etc. Protecting the electrical power system requires performing crucial activities including fault detection and classification on transmission lines [2]. The fluctuation of voltage and current from their standard levels is known as a fault. Electrical power network components and lines transmit normal voltage and current when operating under usual circumstances, making the power network safer to operate.

A power system is a network that is used to supply and transmit electricity. It is made up of both active and passive electrical components. Faults in these systems are regarded as anomalous electric current parameters. A system's failure can be attributed to a variety of things. Therefore, systems are built for power system analysis in order to identify and stop various kinds of power system failures. The basic purpose of power system protection is to meet this requirement. There are numerous ways to find and identify power system issues[3]-[5].

In this paper, a method has been devised to calculate fault currents due to L-G fault at different location of transmission line and respective values of fault current of the faulted phase has been noted,

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1.1. Line to Ground fault

A fault in which the normal current avoids the path of normal load is known as an earth fault or short circuit. An open-circuit fault happens when a network is broken by a malfunction; this can happen physically or electrically, with a conductor opening up due to a cut or loss of contact. Short circuit faults or ground faults (L-G, LL-G, and L-L-L-G) can occur in three-phase systems [6]. A "earth fault" or "ground fault" is where current enters the earth due to abnormal configuration of the system. In the majority of cases, the projected short-circuit current of a anticipated fault may be computed [7].

Protective devices in power systems can operate CBs to limit the flow of high currents resulting a breakdown, and they can detect fault situations utilizing instrument transformers like voltage transformers and current transformers. When a fault develops, it results in the passage of abnormally high currents, damaging electronics and equipment [8]-[10]. To design appropriate protective equipment such as relays, CBs, and other protection devices, fault detection and investigation are essential. When a fault develops, it results in the passage of abnormally high currents, which damages devices and equipment.

L-G fault is basically a short circuit between any one line of a three phase power system and ground, generally caused by physical contact, for example due to strom damage., Almost 65% - 70% of the total fault of transmission lines are L=G faults.

2. Result and Simulation

To study how the fault currents due to L-G fault in a transmission lines varies with respect to the fault position, a 300 KM long transmission line has been modeled in MATLAB Simulink as shown in

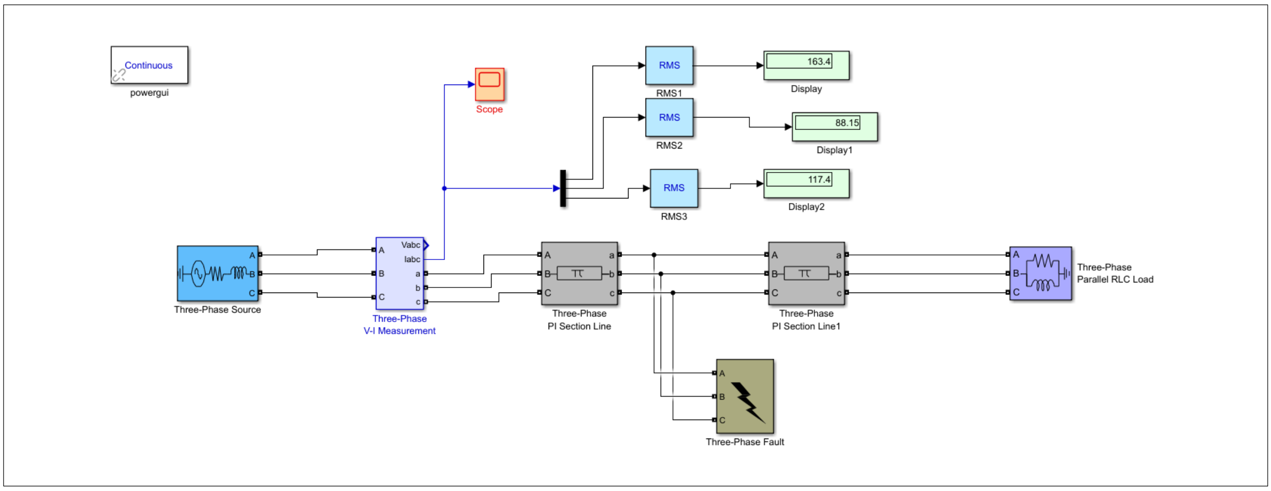

Figure 1 300 KM long Transmission line model

Figure-1. At first a L-G fault is created in phase A at the source end of the transmission line, ie, at 0 kmdistance. After running the model in this situation in MATLAB Simulink it is observed that the current in phase A (I_A=2327Amp) is much higher compared to other two phases of the system. The waveforms of the fault currents of different phases as obtain from the oscilloscope connected to the system is shown in Figure-2.

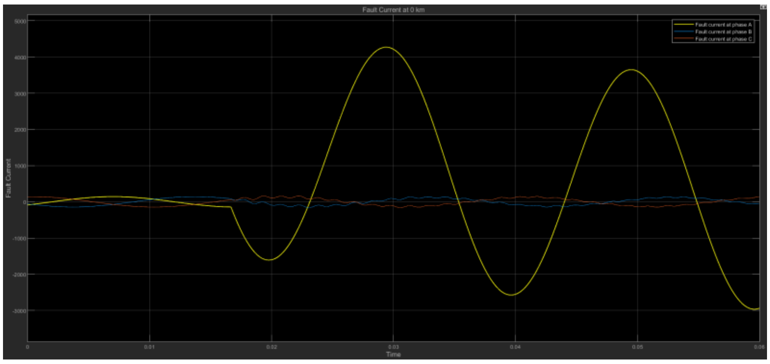

Figure 2 Waveforms of fault currents when fault occurs at a distance of 0 km.

In a similar manner the fault currents under different conditions are obtained by changing the fault positions. In each case L-G fault is created at phase A to compare how the fault current varies with the length of transmission line. To obtain this relation fault has been created at 50 km, 100 km, , 200 km, and 300 km (far end) distances, the respective waveforms of fault currents are shown in Figure-3, Figure-4, Figure-5 and Figure-6.

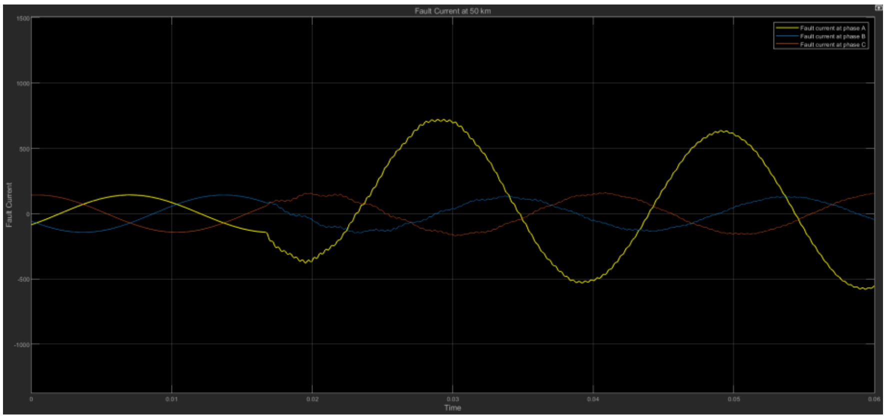

Figure 3 Waveforms of fault currents when fault occurs at a distance of 50 km

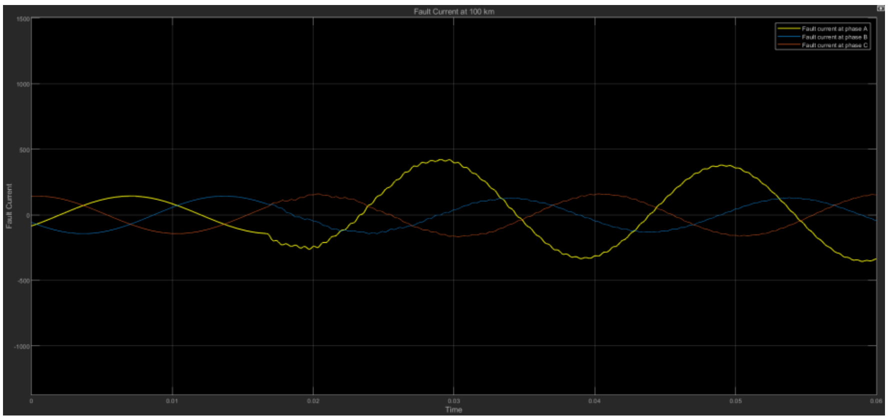

Figure 4 Waveforms of fault currents when fault occurs at a distance of 100 km.

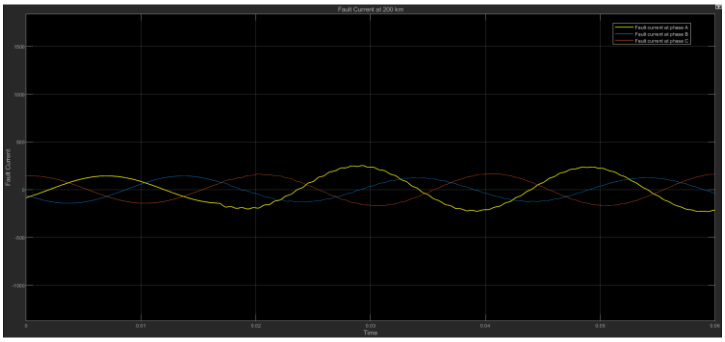

Figure 5 Waveforms of fault currents when fault occurs at a distance of 200 km.

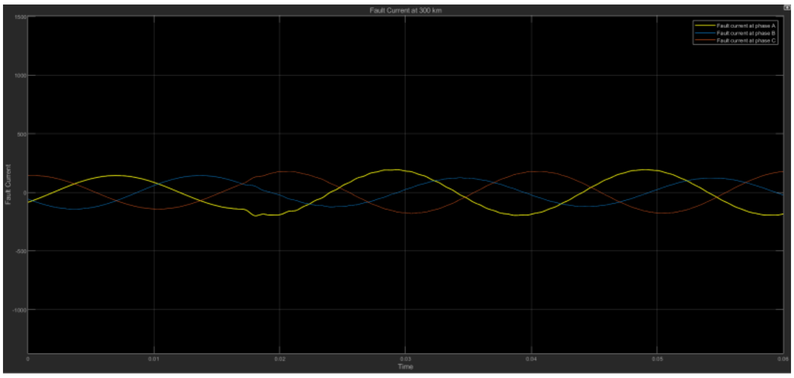

Figure 6 Waveforms of fault currents when fault occurs at a distance of 300 km.

From the above figures it is observed that as the fault point moves away from the sending end the magnitude of fault currents goes on decreasing. The fault current is highest when fault occurs near the source and it is lowest when fault occurs close to the load end. The magnitudes of fault currents have been recorded during different fault positions and are shown in Table-1.

Table 1 Fault current at different line length

SL. No.	Line Length (inKm)	Fault Current at Phase A
1	0	2327
2	50	421.7
3	100	255.9
4	150	194.6
5	200	163.4
6	250	146.2
7	300	137.4

3. Conclusion

In this study it is observed that faults involving gear the generator is most severe compared to the other location of fault in the transmission lines. When fault point moves ways from the generator the severeness of the fault goes on decreasing. From the tabulated data power system engineers may predict an approximate location of the fault based on the location of the fault in the transmission line.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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