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MATLAB Based Simulation for Identify Transmission Line Fault Location

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Abstract — *An accurate fault detection and classification is required to transmit power from generating station to various load centers reliably. Transmission network Bus voltage and current is normally use for detect the fault in line. Using symmetrical component one can analyze the unbalance system. In this paper using symmetrical component sequence current is finding for different fault in transmission line. Faults are detected and classify using sequence current. Work carried out shows the simulation of fault location for double-circuit transmission lines based on only the voltage data of both ends of the faulted circuit. The ratio between the magnitudes of negative-sequence voltages measured at both ends of the faulted circuit is utilized to estimate the fault location. For detection of different fault and identification of fault location for L-G fault 400kv, 200km long transmission line is simulating using MATLAB software*

Keywords- *Double circuit Transmission Line, Fault type classifier, Sequence Network, Negative sequence Voltage Magnitude.*

I. INTRODUCTION

Electricity generate by a power plant is supply to load centers and electricity consumers through transmission lines shield by huge transmission tower. Numbers of transmission lines are also increase due to the rapid growth in the power grid from past few years. In power system continuous power flow is require for its reliable operation. Normally the power system is in balance condition. If fault is occurring then system is in unbalance condition. In power system fault is created by natural event such as falling of tree, wind and ice storm damaging a transmission line. By calculating system voltage and current in normal and fault condition system is analyze. Transmission line fault is classified in Symmetrical and Asymmetrical fault. L-L-L fault is symmetrical and L-L-G, L-L, L-G fault are asymmetrical. In case of Symmetrical fault system is in balance condition but in case of Asymmetrical fault system become unbalance. For analysis unbalance system is converted into balance system using Symmetrical component.

Using symmetrical component we can classify the fault in transmission line. Symmetrical component has three types, Positive, negative and zero sequence components. If there is no fault in line or in case of balance condition only the positive sequence component is present. If fault occur in line then negative and zero sequence component is present. Using sequence current we can classify the type of the fault. For L-L fault positive sequence current is equal but opposite to negative sequence current. For L-L-G fault positive sequence current is not equal to the negative sequence current and for L-G fault all three sequence currents are equal. This paper present a MATLAB based simulation for detection of fault in transmission network. Different types of faults are classifying using sequence current. Fault location is Identify forL-G Fault for different Value of Fault Resistance.

II. COMPUTATION OF FAULT CURRENTS

Unbalanced three phase systems can be split into three balanced component, namely Positive Sequence, Negative Sequence and Zero Sequence. [1]

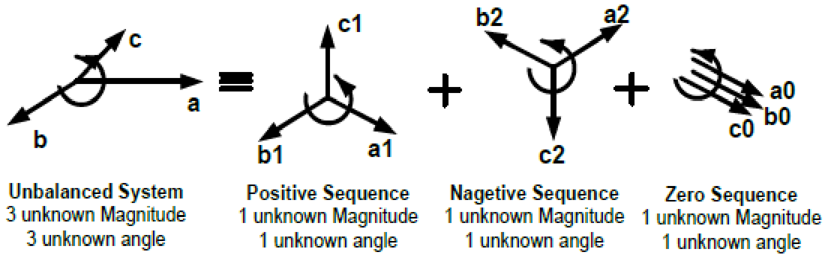

Fig.1: symmetrical components of unbalance three phases

Author Phase current is the addition of the symmetrical component so,

$$I_a = I_a^0 + I_a^+ + I_a^- \qquad (1)$$

$$I_b = I_b^0 + I_b^+ + I_b^- \qquad (2)$$

$$I_c = I_c^0 + I_c^+ + I_a^- \qquad (3)$$

The unknown unbalanced system has three unknown magnitudes and three unknown angle with respect to the referen ce direction. We can express all the sequence components in terms of the quantities for a phase using the properties of 0, 120 or 240 degree.

$$I_a = I_a^0 + I_a^+ + I_a^- \qquad (4)$$

$$I_b = (I_a^0 + \alpha^2 I_a^+ + \alpha I_a^-) \qquad (5)$$

$$I_c = (I_a^0 + \alpha I_a^+ + \alpha^2 I_a^-) \qquad (6)$$

Where,

$\alpha = -0.5 + j * 0.866$

(i) Single Line to Ground Fault: (L-G)

Headings Assume that Single line to ground fault is occur in a phase a. fault current is (I_f) and fault impedance is (Z_f) . Voltage and current at the point of fault is

$V_a = Z_f I_a$,$I_b = 0$, $I_c = 0$

In single phase to ground fault sequence current are equal and network is connected in series.

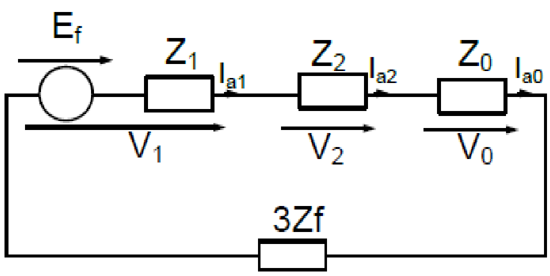

Fig. 2: Conn. of Sequence Network for L-G fault

$$I_a^0 = I_a^+ = I_a^- = \frac{V_f}{Z_0 + Z_+ + Z_- + 3Z_f} \qquad (7)$$

$$I_f = \frac{3V_f}{Z_0 + Z_+ + Z_-} \qquad (8)$$

(ii) Double Line to ground fault: (L-L-G)

Sub- Assume that phase b and phase c is connected to ground through the fault impedance (Z_f).
Fault current on phase a is $I_a = 0$

$$I_a^0 + I_a^+ + I_a^- = 0 \qquad (9)$$

Fault voltage at phase b and c are,

$$V_b = V_c = Z_f(I_b + I_c) \qquad (10)$$

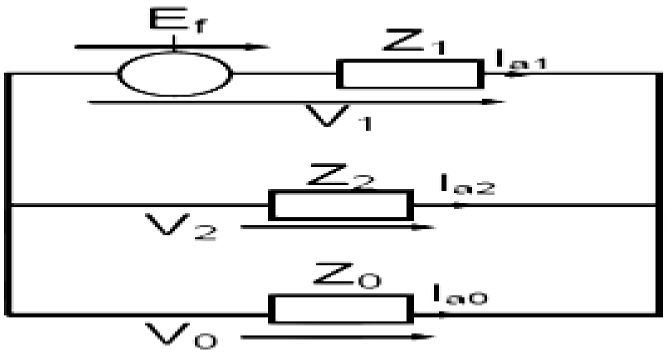

Fig.3: Connection for LLG faults

$$I_a^+ = \frac{V_f}{Z_1 + [\frac{Z_2(Z_0 + 3Z_f)}{Z_2 + Z_0 + 3Z_f}]} \qquad (11)$$

(III) LINE TO LINE FAULT: (L-L)

Assume that fault is occurring due to the connection of phase b and phase c.

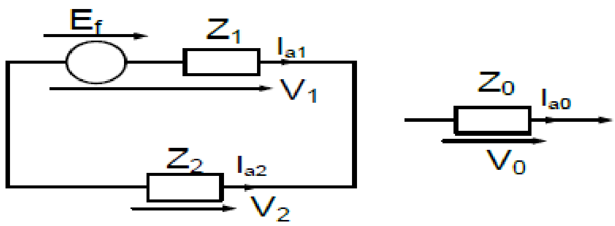

Fig.4: Connection of Sequence Networks for L-L fault

$$V_b - V_c = I_b Z_f \qquad (12)$$

$$I_f = -j\sqrt{3} I_a^+$$

III. SYSTEM SIMULATION

A 400kv, 200km long transmission line has been selected for detecting the fault. It is simulate using MATLAB Software.

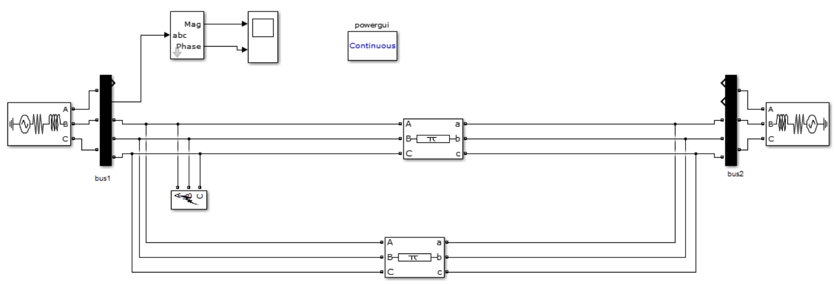

Fig 5: 400kV system simulation for fault type identification

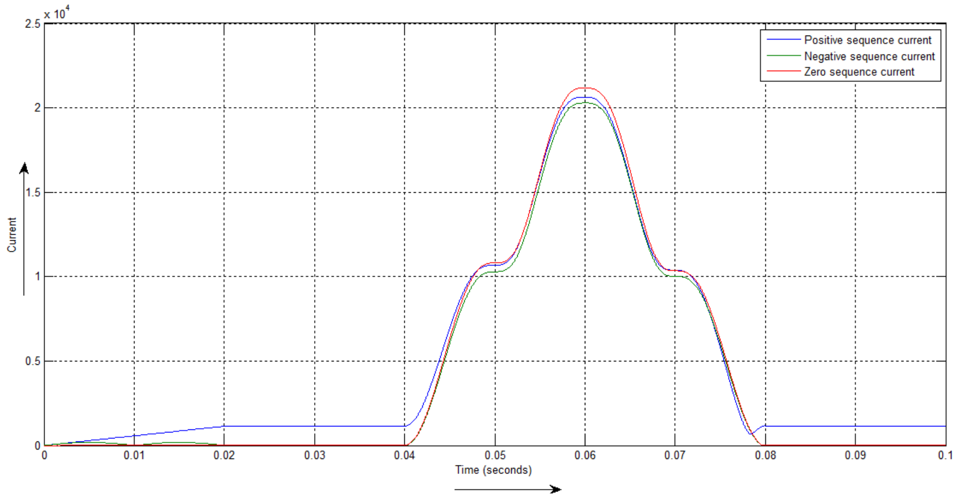

Fig.6: L-G Fault Sequence current

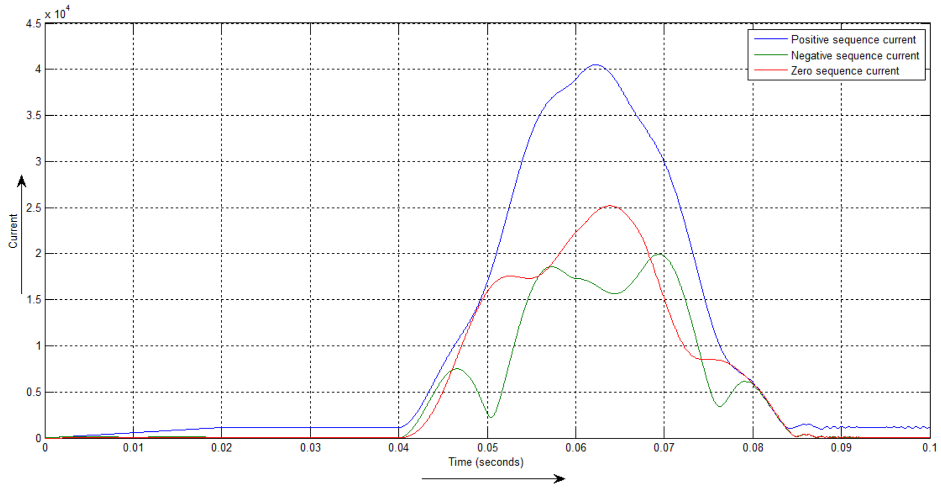

Fig.7: L-L-G Fault Sequence current

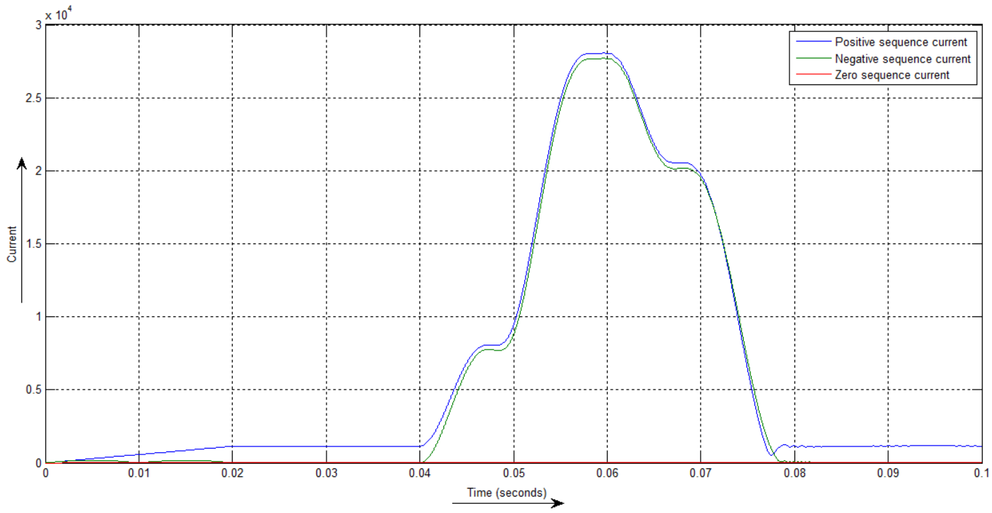

Fig.8: L-L Fault Sequence current

Test System Simulation for Fault Location:

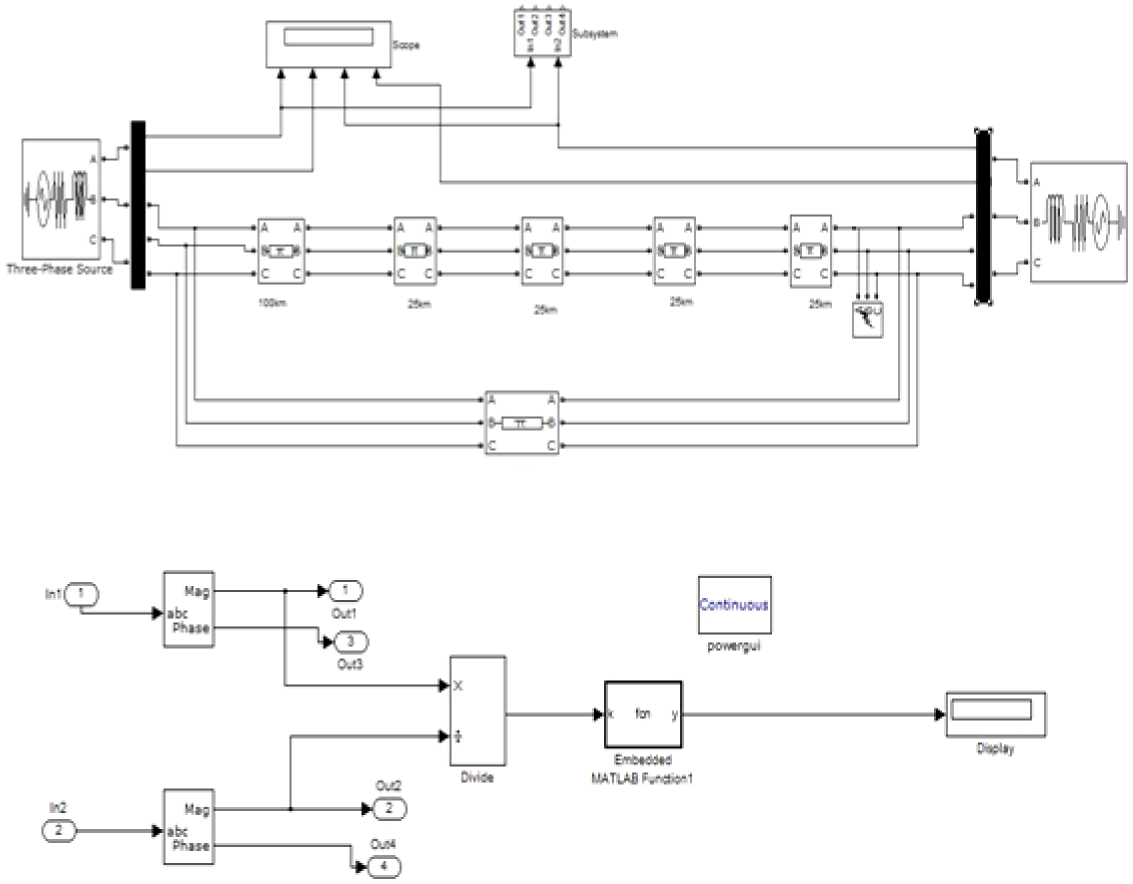

Fig.9: Test system simulation for Fault location

%Error = [(Actual Fault location- Estimated Fault location)/200]*100

From the above equation, percentage error is finding for the different fault location of L-G Fault.

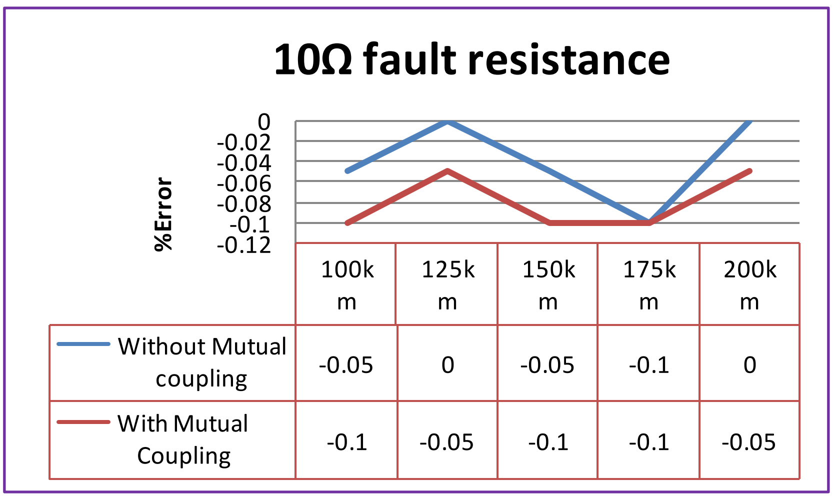

Fig.10: %Error for 10Ω fault resistance

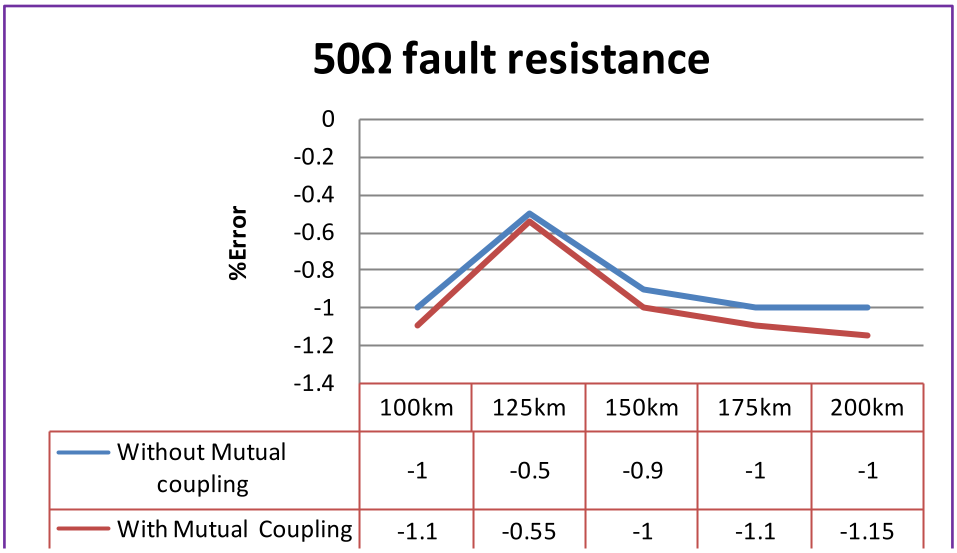

Fig.11: %Error for 50Ω fault resistance

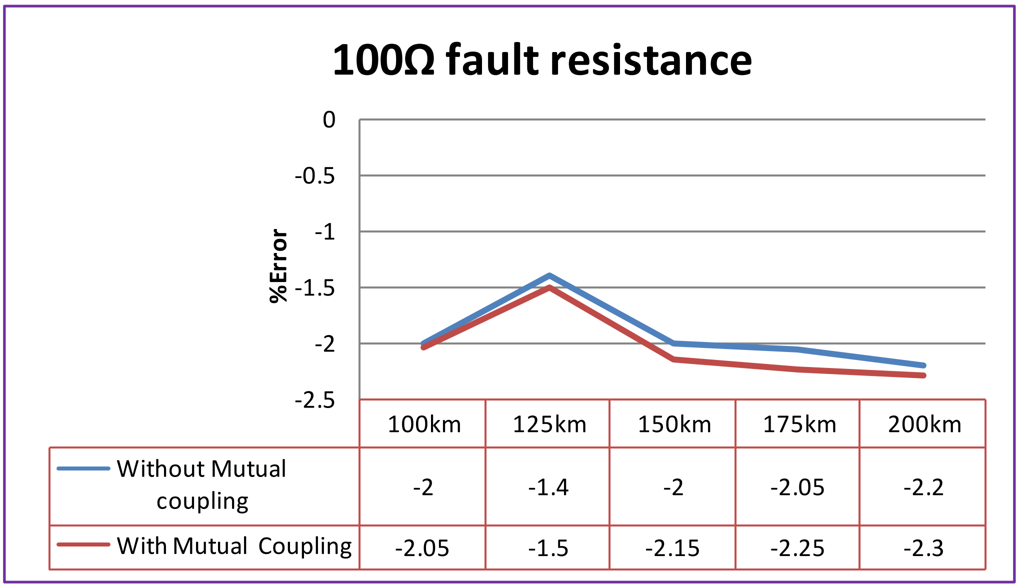

Fig.12: %Error for 100Ω fault resistance

Above Figure shows the %Error for the different fault location estimated with 10Ω, 50Ω, 100Ω fault resistance for Line to ground fault. It is observe that fault location is estimated with and without considering the effect of transmission line mutual coupling gives the same error. So the transmission line mutual coupling effect is not produce the large error in fault location.

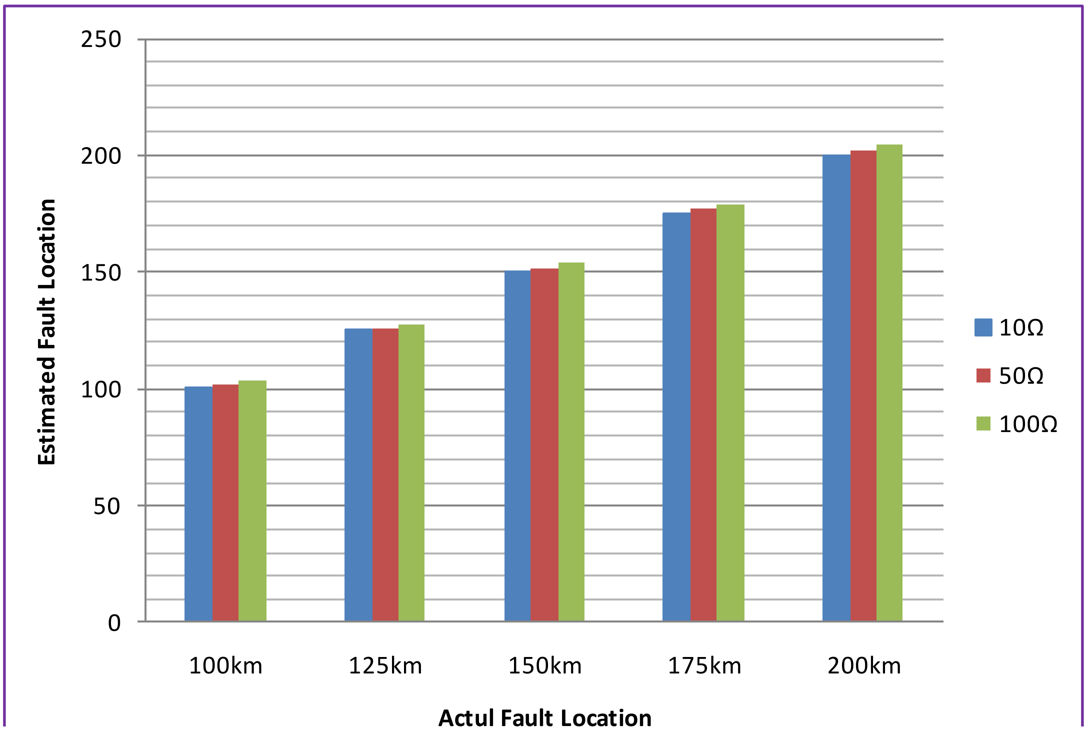

Fig.13: Effect of fault resistance for Fault Location of L-G Fault without Considering Mutual Coupling

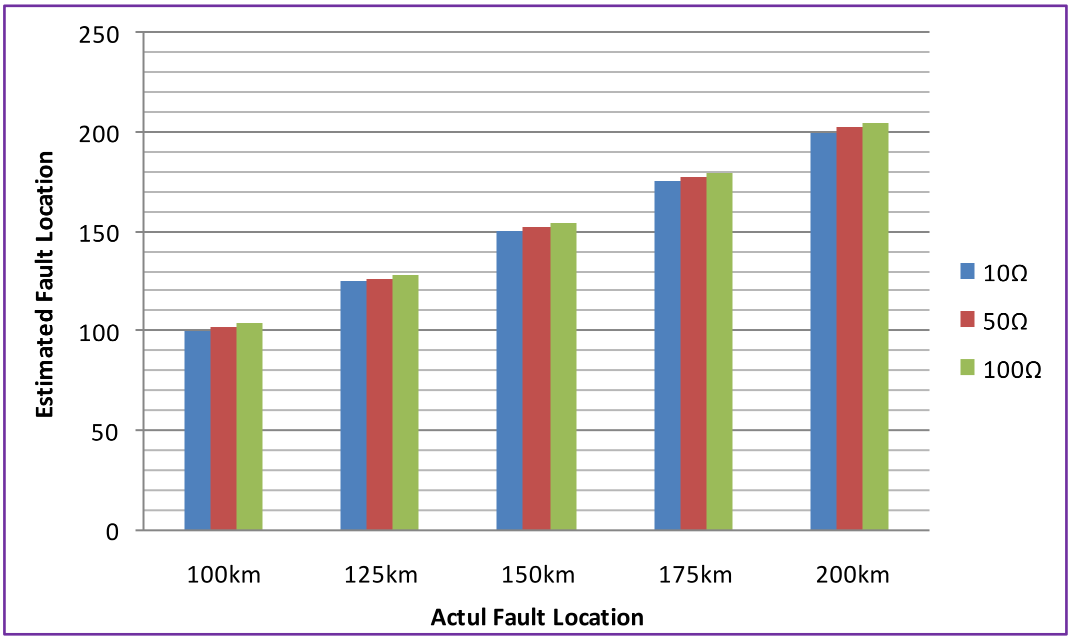

Fig.14: Effect of fault resistance for Fault Location of L-G Fault with Considering Mutual Coupling

IV. CONCLUSION

In this paper, Fault Classification and Location is represented. It is Classify using Positive, Negative and Zero Sequence Current. If there is no Fault in line then only the Positive sequence current is Present. For L-G Fault all three sequence Currents are equal. For L-L Fault only Positive and Negative Sequence currents are present. Zero sequence Current is not present. For L-L-G Fault all Three Sequence Currents are present but there are different from each other. .

For L-G Fault, Accurate Fault Location is finding Using ratio of Negative Sequence Voltage of sending and receiving end of transmission line. Fault resistance can not affect the fault location. This method gives accurate fault location in case of mutual coupling of transmission line.

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