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# Fault Analysis  Using PSCAD/EMTDC for 150 kV South Sulawesi Transmission System

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*Abstract — Short circuit fault as one of the characteristics of transient disturbances in electric power systems that must be addressed by the safety equipment. The increase at occurrence of short circuit generates large electrical currents and at a very low voltage. This research will address the simulation of short circuit interruption in the 150 kV transmission line system. The method is used to perform the simulation with the help of PSCAD / EMTDC and PWS (Power World Simulator) software's to obtain the characteristic of current and voltage on the 150 kV transmission network system in South Sulawesi. This discussion aims to examine the changes in current and voltage during short circuit fault with or without fault impedance and fault location distance. In this case, it will be taken case of short circuit between the air ducts with Bus PKEP to  PPARE , For a distance fault  of 22.5 km obtained by the fault  current from the bus PKEP biggest , while at a distance of 66.5 km  is acquired the fault  current  of the largest  from the bus PPARE, of four types of errors are analyzed on the Z = 0 ohm is the largest short circuit interruption occurs in three phase fault (LLL), while at Z = 10 ohm = 15 ohm Z of the biggest mistakes of the line short-circuit line to ground faults (LLG)*

**Keywords: PSCAD/EMTDC , PWS , Fault Analysis**

## I. INTRODUCTION

In the operation of power systems, common faults can lead to disruption of electrical power supply to consumers [1]. Disruption of the barrier is a system that is operating or a state of electric power transmission systems that deviate from normal conditions [2] which gives rise to the surge magnitude higher than the normal state and the voltage at the site to be very low.  A disturbance in the electrical equipment is defined as the occurrence of a malfunction in the electrical network causes an electric current flow out of the channel. Based on ANSI / IEEE C37.010.1999 [3], the disorder is defined as a physical condition caused by failure of a device, component or an element to work in accordance with its function. While the standard to describe the techniques and determine the location of the transmission system based on IEEE.C37.114TM.2004 [4].  In analyzing the problems in South Sulawesi transmission system, simulations of PSCAD / EMTDC [5-6] and PWS (Power World Simulator) [7] software were used to simulate changes in electrical current and voltage during a disturbance Single phase to Ground, Line to Fault Line, Double Line to Ground and Three phase Short Circuit. Since 2002, the transmission system of South Sulawesi has introduced

Intelligent Electronic Devices (IEDs) such as Digital Protective Relays (DPRs) and the Digital Fault Recorders (DFRs) on all feeder transmission [8].. In the simulations of this total Power Plant 591.3 MW  and the total Load  of 568.9 MW.

## II. OVERVIEW SHORT CIRCUIT FAULT ANALYSIS

### A. Short Circuit Fault

Short circuit interruption is one of the disorders of electric power system transient characteristics that must be addressed by the safety equipment. The occurrence of short circuit current spikes results in a higher magnitude than the normal state and the voltage at the site to be very low can result in damage to the insulation, mechanical damage to the conductor, electrical sparks, and the worst is the failure of the overall system operation [9]. There are several types of short circuit interruption or short circuit of the power system. There are several types of short circuit fault  that fault  balance, among others, are three-phase fault (LLL) and three-phase to ground fault (LLLG), while the disorder is an unbalanced line to line fault (LL), double line to ground fault (LLG) and line to ground fault (LG).

### B. Transient on a Transmission Line

Transient short circuit on the transmission line can be simplified with certain assumptions based on the following stages:
1. The line is fed from a constant voltage source.
2. Short circuit takes place when the line is unloaded.
3.Line capacitance is negligible, and the line can be represented by a lumped RL series circuit.
With the above assumptions, the line can be represented by the circuit model of Figure 1.
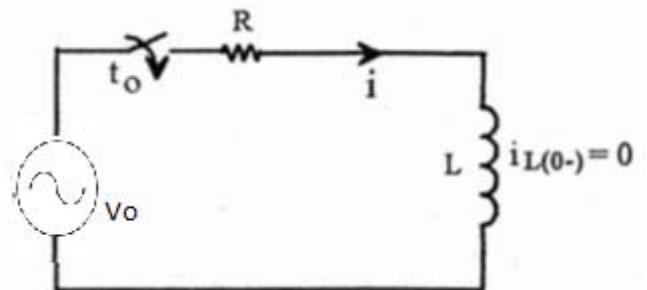


Figure 1. Transmission Line Model

The short circuit is assumed to take place at $t_0 = 0$. The parameter $\alpha$ the instant on the voltage wave when short circuit occurs. It is known from circuit theory that the current after short circuit. It is composed of two parts, i.e.

$$i = i_{ac} + i_{dc} \qquad (1)$$

Where $i_s$ Represent the steady state alternating current

$$i_{ac} = \frac{\sqrt{2U}}{Z} \sin(wt + \alpha - \emptyset) \qquad (2)$$

And $i_t$ Represent the transient direct current

$$i_{dc} = \frac{\sqrt{2U}}{Z} \sin(\emptyset - \alpha)e^{-(\frac{R}{L})t} \qquad (3)$$

With,

$$Z = \sqrt{R^2 + (wL)^2} < (\emptyset = tan^{-1}\frac{wL}{R}) \qquad (4)$$

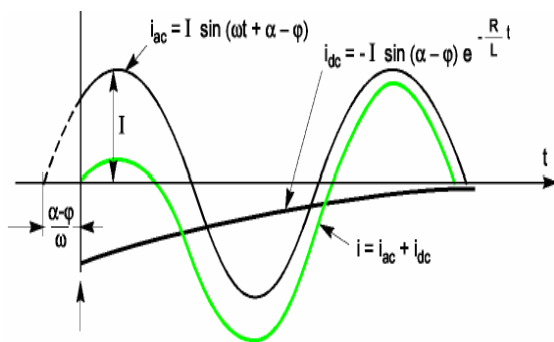A plot of $i = i_{ac} + i_{dc}$ in show in Figure 2.



Figure 2. Waveform of a short circuit current on transmission-line [10]

## III. RESEARCH METHOD

### A. PSCAD/EMTDC

This research analysis using PSCAD (Power System CAD) is to simulate fault conditions of the transmission system in South Sulawesi were presented by using the transmission-line model line Bergeron of PSCAD / EMTDC [11] . PSCAD enables users to build a circuit schematic, running simulations, analyzing results, manage data in a fully integrated graphical environment, control and meter so that users can change system parameters during the simulation run and can obtain immediate results [11]. PSCAD comes with a library of models that have been programmed and tested, ranging from simple passive elements, control functions and more complex models such as electric machines, FACTS devise, transmission lines, transformers and cables. EMTDC (Electromagnetic Transient, Including DC) proposes and solves differential equations in time domain. The solution is calculated based on fixed time step, and the program structure allows for the representation of the control system.

### B. PWS ( Power Worlds Simulator)

PSW is a power system simulation package consists of a number of integrated products. This simulator allows the user to visualize the system through the use of color charts online, complete with animated zooming capabilities and planning. System models can be modified and quickly built from scratch using a full-featured graphics editor special simulator. Transmission lines can be switched in or out of service, the new transmission line can be added and created.

This simulation package capable of solving the power system consists of up to 100,000 buses covering of Integrated Economic Dispatch, Power transfer distribution factor Computation, Short Circuit Analysis, and contingency analysis. PWS had the ability to import data from all sources of data. Moreover, in order to power flow model of PWS, a text file interface to exchange data and execute command scripts BATCH [7]
.

## IV. ANALYSIS OF THE SIMULATION RESULTS

### A. Simulation System

Simulation system is performed during a short circuit on the 150 kV transmission system south Sulawesi as shown in Figure 3. Transmission line simulation between bus PPKEP and bus PPARE fault lines to ground (LG), three-phase (LLL), double fault line (LL) and double fault line to ground (LLG) by fault impedance 0 ohm and 45 km from Pangkep to Pare-Pare. During the simulation, load flow data is the total power plan 591.3 MW, the total load, 568,9 MW and the power loss 22.4 MW with a base of 150 kV and 100 MVA.

Figure 4. shows the waveform of the signal before the fault which is = 509 Ampere, and Figure 5 shows the waveform current and voltage fault line to ground (LG) where current and voltage fault is $I_A = 2618.14$ Ampere and $V_A = 74.88$ kV, respective Figure 6 shows the waveform of the signal in the event of a double line to ground fault (LLG) which is $I_A = 3129.23$ Ampere ,$I_B = 2914.3$ Ampere and $I_C = 524$ amperes, and voltage fault is $V_A = 58$ kV, $V_B = 73.92$ kV, and $V_C = 188$ Kv , Figure 7. Shows the waveform of the signal in the event of a double line fault (LL) is with current $I_A = 2444.26$ Ampere, $I_B = 2100$ Ampere, and $I_C = 505$ amperes, and voltage fault is $V_A = 98.73$ kV , $V_B = 114.5$ kV, and $V_C = 189$ kV. and Figure 8. shows the signal waveforms during a three-phase fault (LLL) is a in which the fault electric current $I_A = 2695$ Ampere, $I_B = 2628$ Ampere, and $I_C = 2519$ Ampere, and the voltage disturbance is $V_A = 56$ kV, $V_B = 56$ kV, and $V_C = 56$ kV
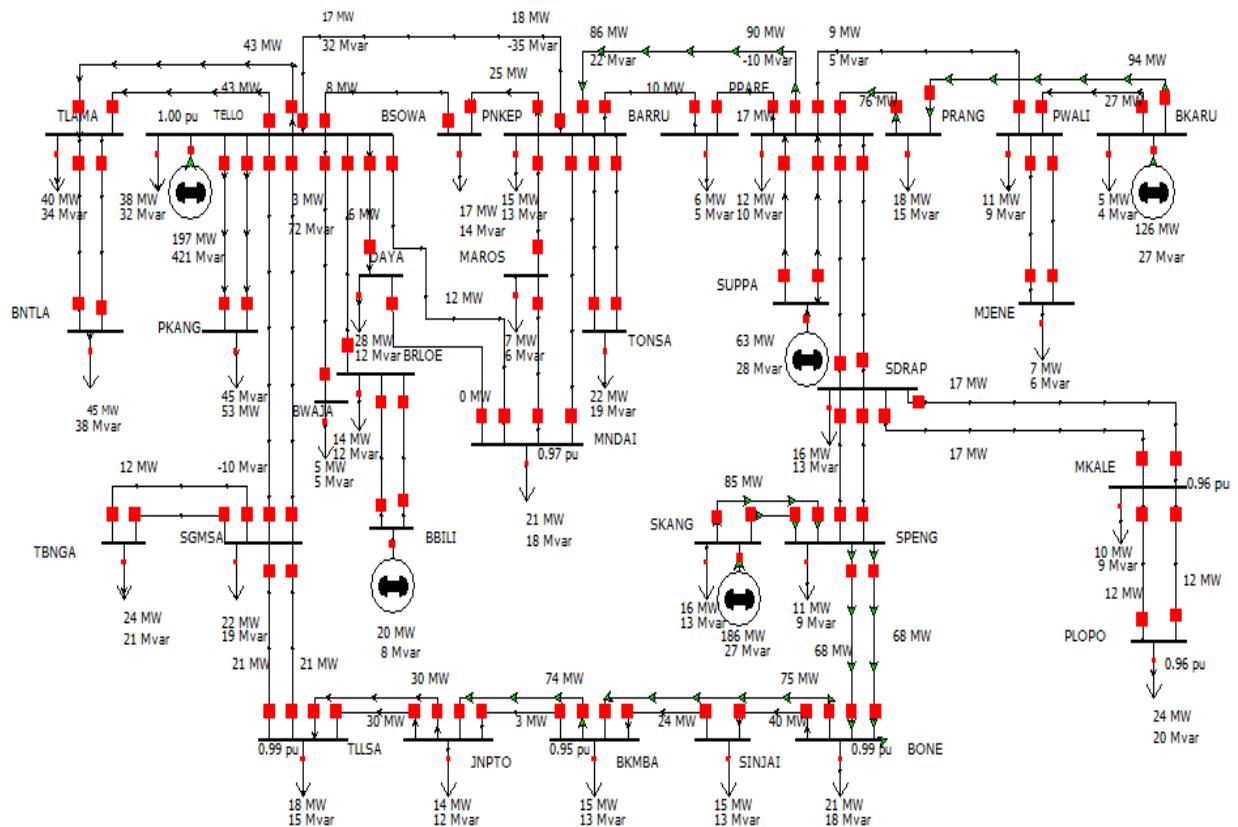
Figure 3. Single Line Diagram of 150 kV transmission South Sulawesi
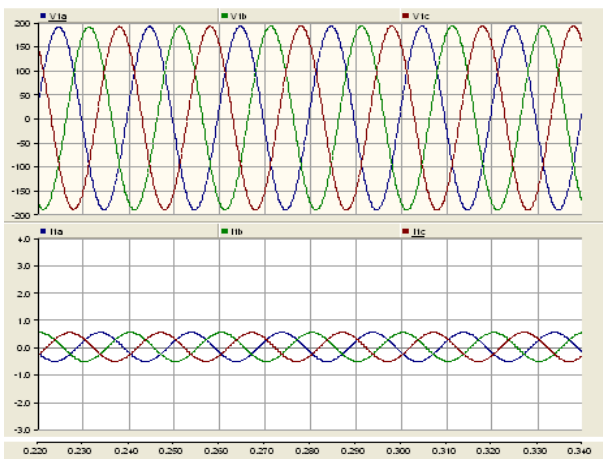


Figure. 4. Pre-Fault Voltage and current waveform between Bus PPKEP and Bus PPARE
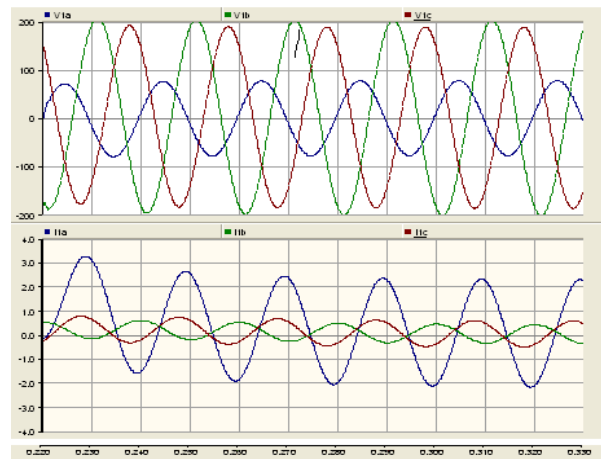


Figure 5. Voltage and current waveform of Line to Ground Fault (LG) between Bus PPKE and Bus PPARE
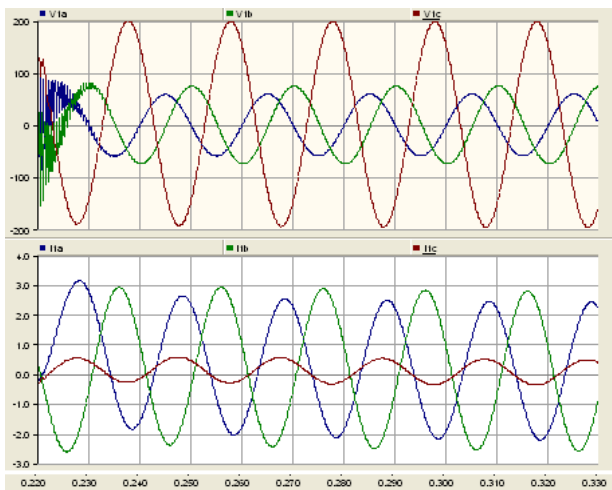
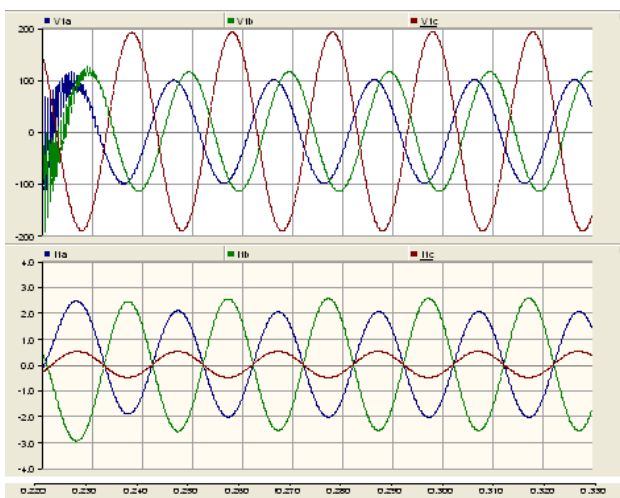Figure 6. Voltage and current waveform of Line-Line to Ground Fault (LLG) Between Bus PPKE and Bus PPARE



Figure 7. Voltage and current waveform of Line-Line Fault (LL) between Bus PPKE and Bus PPARE
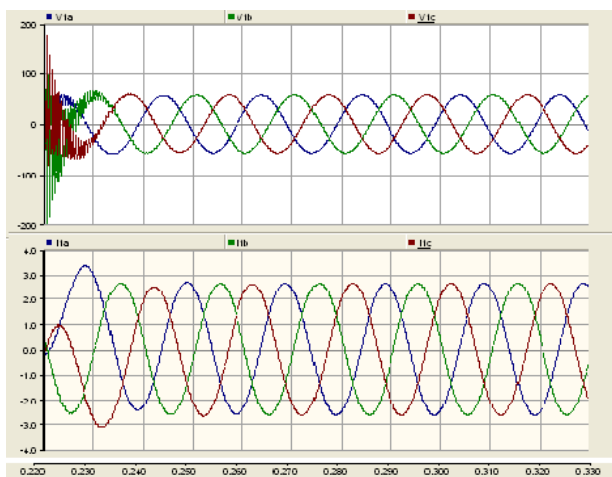


Figure 8. Voltage and current waveform of Line-Line- Line Fault (LLL) between Bus PPKE and Bus PPARE

## B. *Fault Analysis Transmission South Sulawesi Bus PKEP and PPARE*

From the simulation results it can be analyzed from the characteristics of electric current and voltage at Bus PKEP, that bus signal waveform of PPARE has a peak value of electric current equal to 509 Amperes when a fault line to ground (LG), three-phase fault (LLL), double line fault (LL) and double line to ground faults (LLG),. Table 1 shows the short circuit current with fault impedance Z = 0 ohm where at a distance of 22.5 km interference currents obtained from the bus PKEP greater than the short circuit of the bus PPARE .. Distance fault of 45 km similar trend of a short circuit current and the bus PKEP with bus PPARE as well as fault distance of 65 km short circuit current from the bus PKEP smaller than the short circuit current of PPARE bus. As shown in Table 2, the fault impedance Z = 10 ohm, fault of the largest short circuit occurs on the line - line to ground (LLG) faults, with distance fault of 66.5 km of bus PPARE obtained results of 4.56 pu and table 3 shows that the fault impedance Z = 15 ohm, the fault current is smaller than the fault impedance Z = 0 ohm and Z = 10 ohms in all type fault

Table 1 Short circuit Current without fault Impedance Z= 0

| Fault Distance | Fault Type | Current Fault From Bus PKEP ( Pu ) | | | Current Fault From Bus PPARE (pu) | | |
|---|---|---|---|---|---|---|---|
| | | *IA* | *IB* | *IC* | *IA* | *IB* | *IC* |
| 22.5 Km | L-G | 2.86 | 1.02 | 0.78 | 1.99 | 1.03 | 0.77 |
| | L-L-G | 0.89 | 3.38 | 4.46 | 0.91 | 2.61 | 2.56 |
| | L-L | 0.91 | 3.35 | 4.26 | 0.92 | 2.87 | 2.06 |
| | L-L-L | 4.39 | 4.39 | 4.39 | 2.84 | 2.84 | 2.84 |
| 45 Km | L-G | 2.26 | 1.01 | 0.78 | 2.59 | 1.02 | 0.78 |
| | L-L-G | 0.90 | 2.51 | 3.42 | 0.90 | 3.31 | 3.37 |
| | L-L | 0.91 | 2.41 | 3.32 | 0.92 | 3.59 | 2.77 |
| | L-L-L | 3.31 | 3.31 | 3.31 | 3.67 | 3.67 | 3.67 |
| 66.5 Km | L-G | 1.80 | 1.02 | 0.78 | 3.43 | 1.03 | 0.78 |
| | L-L-G | 0.91 | 1.85 | 2.66 | 0.91 | 4.24 | 4.52 |
| | L-L | 0.91 | 1.72 | 2.63 | 0.92 | 4.58 | 3.78 |
| | L-L-L | 2.51 | 2.51 | 2.51 | 4.81 | 4.81 | 4.81 |

Table 2. Short circuit Current with fault Impedance Z= 5 Ohm

| Fault Disance | Fault Type | Current Fault From Bus PKEP ( pu ) | | | Current Fault From Bus PPARE (pu) | | |
|---|---|---|---|---|---|---|---|
| | | *IA* | *IB* | *IC* | *IA* | *IB* | *IC* |
| 22.5 Km | L-G | 0.94 | 0.92 | 0.91 | 0.92 | 0.95 | 0.83 |
| | L-L-G | 0.91 | 3.34 | 4.27 | 0.92 | 2.86 | 2.08 |
| | L-L | 0.91 | 0.85 | 1.05 | 0.92 | 0.95 | 0.83 |
| | L-L-L | 0.94 | 0.94 | 0.94 | 0.89 | 0.89 | 0.89 |
| 45 Km | L-G | 0.93 | 0.92 | 0.91 | 0.89 | 0.92 | 0.91 |
| | L-L-G | 0.91 | 2.41 | 3.32 | 0.92 | 3.58 | 2.79 |
| | L-L | 0.91 | 0.86 | 1.02 | 0.92 | 0.98 | 0.82 |
| | L-L-L | 0.93 | 0.93 | 0.93 | 0.89 | 0.89 | 0.89 |
| 66.5 Km | L-G | 0.92 | 0.92 | 0.91 | 0.90 | 0.92 | 0.91 |
| | L-L-G | 0.91 | 1.72 | 2.63 | 0.92 | 4.56 | 3.78 |
| | L-L | 0.91 | 0.87 | 0.99 | 0.92 | 1.01 | 0.80 |
| | L-L-L | 0.92 | 0.92 | 0.92 | 0.90 | 0.90 | 0.90 |

Table 3. Short circuit Current with fault Impedance Z= 15 Ohm

| Fault Distance | Fault Type | Current Fault From Bus PKEP ( pu ) | | | Current Fault From Bus PPARE (pu) | | |
|---|---|---|---|---|---|---|---|
| | | IA | IB | IC | IA | IB | IC |
| 22.5 Km | L-G | 0.92 | 0.91 | 0.91 | 0.91 | 0.92 | 0.91 |
| | L-L-G | 0.91 | 3.35 | 4.26 | 0.92 | 2.87 | 2.07 |
| | L-L | 0.91 | 0.89 | 0.96 | 0.92 | 0.92 | 0.88 |
| | L-L-L | 0.92 | 0.92 | 0.92 | 0.91 | 0.91 | 0.91 |
| 45 Km | L-G | 0.92 | 0.91 | 0.91 | 0.91 | 0.91 | 0.91 |
| | L-L-G | 0.91 | 2.41 | 3.32 | 0.92 | 3.59 | 2.78 |
| | L-L | 0.91 | 0.89 | 0.95 | 0.92 | 0.93 | 0.88 |
| | L-L-L | 0.92 | 0.92 | 0.92 | 0.91 | 0.91 | 0.91 |
| 66.5 Km | L-G | 0.91 | 0.92 | 0.91 | 0.91 | 0.92 | 0.91 |
| | L-L-G | 0.91 | 1.72 | 2.63 | 0.91 | 4.57 | 3.77 |
| | L-L | 0.91 | 0.89 | 0.94 | 0.91 | 0.94 | 0.87 |
| | L-L-L | 0.91 | 0.91 | 0.91 | 0.90 | 0.91 | 0.91 |

Tables 4, 5 and 6 show the value of voltage fault, where the impedance disturbance is inflamed, the greater the voltage fault will be obtained for all types of fault.

Table 4 .Fault Voltage with Fault Impedance Z = 0

| Fault Distance | Fault Type | Voltage    Fault (pu) | | |
|---|---|---|---|---|
| | | VA | VB | VC |
| 22.5 Km | L-G | 0.00000 | 1.28369 | 1.11016 |
| | L-L-G | 1.24471 | 0.00000 | 0.00000 |
| | L-L | 0.97664 | 0.48832 | 0.48832 |
| | L-L-L | 0.00000 | 0.00000 | 0.00000 |
| 45 Km | L-G | 0.00000 | 1.27150 | 1.10281 |
| | L-L-G | 1.23761 | 0.00000 | 0.00000 |
| | L-L | 0.97964 | 0.48982 | 0.48982 |
| | L-L-L | 0.00000 | 0.00000 | 0.00000 |
| 66.5 Km | L-G | 0.00000 | 1.26953 | 1.08917 |
| | L-L-G | 1.23352 | 0.00000 | 0.00000 |
| | L-L | 0.98405 | 0.49202 | 0.49202 |
| | L-L-L | 0.00000 | 0.00000 | 0.00000 |

Table 5. Fault Voltage with Fault Impedance Z = 10 Ohm

| Fault Distance | Fault Type | Voltage    Fault (pu) | | |
|---|---|---|---|---|
| | | VA | VB | VC |
| 22.5 Km | L-G | 0.93833 | 0.98530 | 0.98338 |
| | L-L-G | 0.98435 | 0.47478 | 0.47478 |
| | L-L | 0.97664 | 0.93249 | 0.95222 |
| | L-L-L | 0.95319 | 0.95319 | 0.95319 |
| 45 Km | L-G | 0.94053 | 0.98815 | 0.98596 |
| | L-L-G | 0.97825 | 0.53227 | 0.54470 |
| | L-L | 0.97964 | 0.93363 | 0.95319 |
| | L-L-L | 0.95482 | 0.95482 | 0.95482 |
| 66.5 Km | L-G | 0.94722 | 0.99213 | 0.98919 |
| | L-L-G | 0.99068 | 0.47939 | 0.47939 |
| | L-L | 0.98405 | 0.93953 | 0.95831 |
| | L-L-L | 0.96000 | 0.96000 | 0.96000 |

Table 6 .Fault Voltage with Fault Impedance Z = 15 Ohm

| Fault Distance | Fault Type | Voltage    Fault (pu) | | |
|---|---|---|---|---|
| | | VA | VB | VC |
| 22.5 Km | L-G | 0.96354 | 0.97955 | 0.97896 |
| | L-L-G | 0.97926 | 0.48372 | 0.48372 |
| | L-L | 0.97664 | 0.96143 | 0.96827 |
| | L-L-L | 0.96871 | 0.96871 | 0.96871 |
| 45 Km | L-G | 0.96626 | 0.98251 | 0.98182 |
| | L-L-G | 0.98216 | 0.48520 | 0.48520 |
| | L-L | 0.97964 | 0.96375 | 0.97056 |
| | L-L-L | 0.97124 | 0.97124 | 0.97124 |
| 66.5 Km | L-G | 0.97147 | 0.98678 | 0.98582 |
| | L-L-G | 0.98630 | 0.48774 | 0.48774 |
| | L-L | 0.98405 | 0.96869 | 0.97522 |
| | L-L-L | 0.97591 | 0.97591 | 0.97591 |

## V.    CONCLUSION

For short circuit fault with impedance Z = 0, the fault tends to electrical current higher than the short circuit fault using impedance Z = 10 ohm and Z =15 ohm, this is due to the absence of resistance to the flow of electric short circuit fault. The interference voltage at Z = 15 Ohm tends to be greater than the voltage at Z = 0 ohm impedance and Z = 10 Ohm, this is due to large resistance causes a very small electric current flows so that the voltage is higher.

For a distance fault of 22.5 km obtained by the fault current from the biggest bus PKEP, while at a distance of 66.5 km, it is acquired by the fault current of the largest from the bus PPARE, four types of errors are analyzed in which the Z = 0 ohm is the largest short circuit interruption occurs in three phase fault (LLL). While at Z = 10 ohm = 15 ohm Z, the biggest mistakes of the line short-circuit line is ground faults (LLG).

## REFERENCES

[1] N.Vijiysimha, , C.H.Chengalah," Evaluation of Fault Analysis in Transmission Line Using Relay," *Journal of Theoretical and Applied Information Technology,* vol 4 No 2 , pp. 127 – 134 , 2010

[2] M. A. Yalcin, M. Turan, Z. Demir," Effects of Transmission Line Faults on Dynamic Voltage Stability," *Electrotechnic Conference*, Melecon, Mediterranean, pp. 80 – 81 , 1998

[3] Application guide for AC high-voltage circuit breakers rated on a symmetrical basis," ANSI/IEEE Std. C37.010-1979.

[4] IEEE Guide for Determining Fault Location on AC Transmission and Distribution Lines," *,* C37.114TM -2004

[5] Manitoba HVDC Research Centre, "PSCAD/EMTDC: Electromagnetic transients program including dc systems,", 1994.

[6] A. M. Gole, O. B. Nayak, T. S. Sidhu, and M. S. Sachdev, "A graphical electromagnetic simulation laboratory for power  Systems  engineering programs," *IEEE Trans. Power Syst.*, vol. 11, pp. 599–606, May 1996.

[7] Simulator  Version 16," Interactive power system  simulation, analysis and  visualization," Power World Coorporation , 2011

[8] M. Musaruddin , R. Zivanovic," Automated Fault Analysis in the Indonesian Power Utility: A Case Study of South Sulawesi Transmission System," Power Engineering Conference , AUPEC ,Australia ,pp. 1 – 6 _,2008

[9] N. D. Tleis ," **Power Systems Modelling and Fault Analysis,"** Published by Elsevier Ltd. All rights reserved , 2008

[10] M. Noblat , F.Dumas, and C.Poulain, "Calculation of short-circuit currents" < URL :http://www .schneider electric. Com > ,- September, 2010

[11] Manitoba Research Centre, *PSCAD V4.2 Copyright (C)*, Canada, 2005.