The design programming simulation as a reference for the adjustment of the relay GFR on the protection of the airway medium voltage 20 KV

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Abstract. Short circuit fault phase to ground and phase to phase is one of the problems that may arise in the operation of the power transformer in a Substation. The interference caused by the presence of a short circuit caused a lot of losses, losses on the transmission system of electricity and losses on the part of consumers of electric energy. One way to overcome this disorder is with safety protection relay OCR and GFR that works with the Power Breaker (Circuit Breaker). This research will create a Programming-Based Object (PBO) using the GUI of MATLAB, where programs are designed is one answer to cope with the calculation of the adjustment GFR (Ground Fault Relay) attached on the network, the validation of the programming that is done using armed forces data from the company, which for reasons of privacy mentioned as XYZ. Great protection Setting of the interference 1 phase ground occurs along the feeder can be concluded that the working time of GFR on the side of the outgoing and incoming have a difference of 0.4 seconds, thus the design of programming windows in this study can be used as a reference as setting tms on GFR which is mounted on an equipment of protection of electric power because it has been in accordance with the applicable standards.

1. Introduction

The system of electric power distribution from power plant to consumer is very important to learn because the process of distribution through several stages starting from the power plants that produce electrical energy, transmitted to the network transmission of Air Channel High Voltage (SUTT) directly to the substation, from the substation the electric power is distributed to the primary distribution network Voltage Air Channel Medium (SUTM), usually channel this electrical energy is utilized industry-large capacity. Through a network of SUTM this electric power is distributed through substations secondary distribution Air Ducts Low Voltage (SUTR) and through the SUTR electric power is delivered to consumers [1].

The Distribution network is part of the electric power systems that deliver electricity from the substation, wherein the distribution using the conductor of the cable channel through the air duct. Disturbances experienced by the network installed on the airway medium voltage 20 KV, is the disturbances caused by lightning, animals and trees that exposed a network of electric power that can cause interference 1 phase ground, interference 2 phase and interference 3 phase, as a result the distribution of electric power is interrupted or is experiencing outages [2]. Analysis of short circuit is a part of the power system, in order to maintain the security of the distribution of electrical energy. need

count large short circuit current interruption for the purposes of tuning protection on the side of the feeder.

In this research carried out the study setup protection on the side of the feeder caused by the fault short circuit single phase to ground. To calculate the large short circuit current is the basic formula used is OHM's law as shown in equation (1), namely:

$$I = \frac{V}{Z} \qquad (1)$$

where I is the short circuit current (Ampère), V is the voltage source (Volts), Z is the impedance equivalent from the source to the point disorders (Ohm). Short circuit fault single phase to ground using the following equation [1]:

2. Setting OCR and GFR

Relay over current and relay ground fault is a protection relay that works with the power Breaker (Circuit Breaker), wherein the power Breaker will work if you get a response from the relay are attached. The characteristics of the OCR Inverse work if the flows are perceived to exceed the current setting, the relay current is this will open the child's contacts with time delays have been determined [3]. To setup the Current relay is installed in the feeder is calculated based on the magnitude of current from each type of disorder.

Relay setting relay:
Based on the current
    Relay Definite = 1.2 x I Load
    Relay Inverse = 1.05 x I Load
Based on time
    Relay Definite = Directly on the TAP
    Relay Inverse = Calculated based on fault current

The Calculation of The Coordination Relay Inverse
I Set Primary = 1.05 x I Load
I Set Secondary = I Primary x 1/Ratio of CT

For the calculation of the settings on the relay, theoretically described in the equation (2) below

$$tms = \frac{t_{set} \; x \left(\left(\frac{I_f}{I_{Set}} \right)^{0,02} - 1 \right)}{0,14} \qquad (2)$$

where: tms is time multiplier setting, t_{set} is the time setting on relay incoming and outgoing usually set of the section downstream of the first (outgoing) with the provisions of 0.3 seconds, for setting the incoming 0.4 seconds longer, If is the fault current (Ampere), and I_{set} is the current setting (Amperes). Setting the relay as the protection starts from the outgoing Substation, to get a longer trip time of the PMT used the equation (3) below.

$$t_{set} = \frac{0,14 \; x \; tms}{\left(\left(\frac{I_f}{I_{Set}} \right)^{0,02} - 1 \right)} \qquad (3)$$

3. Methodology

Ground Fault Relay (GFR) which serves to detect the existence of a short circuit to the ground while overcurrent relays (OCR) to detect short circuit interruption between phases.
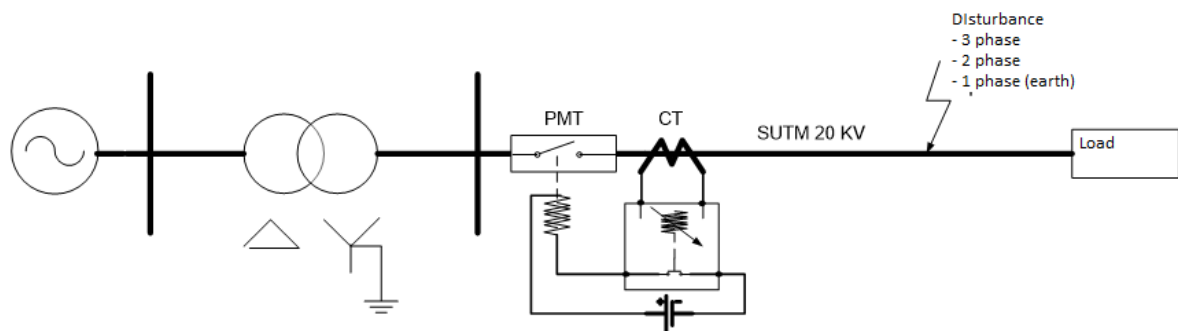
Figure 1. Single Line Interference on The Side of the Feeder

To determine the setting of the protection GFR on the side of the feeder then first calculate the fault current of short circuit. The purpose of the calculation of the short circuit fault is to calculate the magnitude short-circuit current maximum and minimum, which occurs along the feeders [2].

3.1. Model Flow of Research
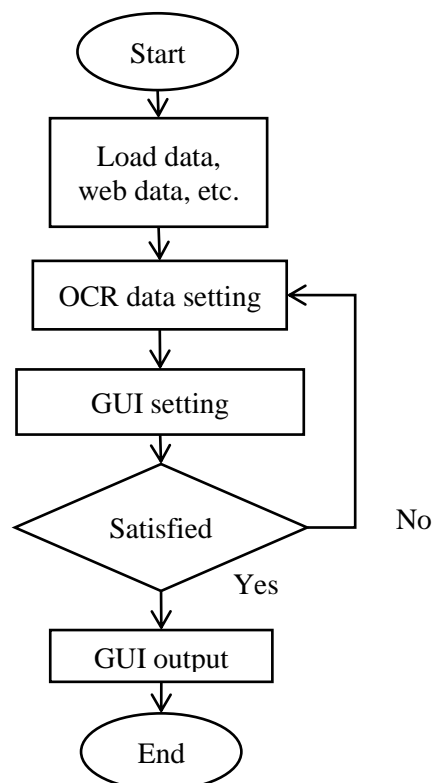The research methods used in this study are generally structured as the flow chart shown in Figure 2.

Figure 2. The Flow of Research
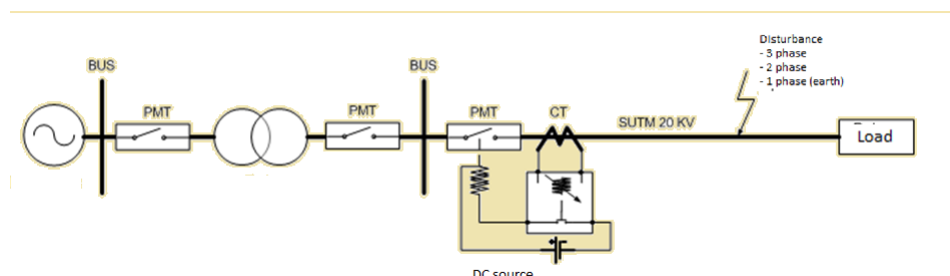
3.2. Parameters of the Research
The data assumptions of this research study is as shown in Table 1.

Table 1. Data Assumptions of the Study Research

Power of 80 MVA	Power of 80 MVA
The Secondary voltage of 150 KV	The Secondary voltage of 150 KV
Primary voltage 20 KV	Primary voltage 20 KV
The ratio of CT Power Transformers 2000/5	The ratio of CT Power Transformers 2000/5
The Relationship of Delta Transformer There	The Relationship of Delta Transformer There
The capacity of the Entanglement Delta 20 MVA	The capacity of the Entanglement Delta 20 MVA
Reactance (%) 10	Reactance (%) 10
Ground Resistor 40	Ground Resistor 40
The ratio of CT (current transformer) 300/5	The ratio of CT (current transformer) 300/5
Data Feeders (SUTM 20 KV)	
The Length of The Feeder 20 Km	The Length of The Feeder 20 Km
AAC 240 mm2	AAC 240 mm2
AAAC 240 mm2	AAAC 240 mm2
Generator	
MVA Short Circuit 7547 MVA	MVA Short Circuit 7547 MVA
Load Current 320 Ampere	Load Current 320 Ampere
Data attached	
GFR Incoming GFR Outgoing	GFR Incoming GFR Outgoing
Tms = 0.9	Tms = 0.9

4. Results and Discussion

The main Menu in programming windows GUI is a display that leads to the simulation of network impairments, in this view in the program menu there is a choice of the type of interference that is 1 phase to ground. The appearance of the GUI is as shown in Figure 3 below.

Figure 3. The appearance of the GUI

Every choice of the type of disturbance on the menu the program will provide information about the data input disorders, where this information should be input based on the channel data attached.

4.1 Display Data Input Interruption 1 Phase to Ground

To simulate disorders 1 phase to ground occurs on the channel, then the parameters study discussed in the previous chapter to be a reference research for analyzing the short circuit fault and setting GFR. The simulation results of the parameter study shown in Figure 4
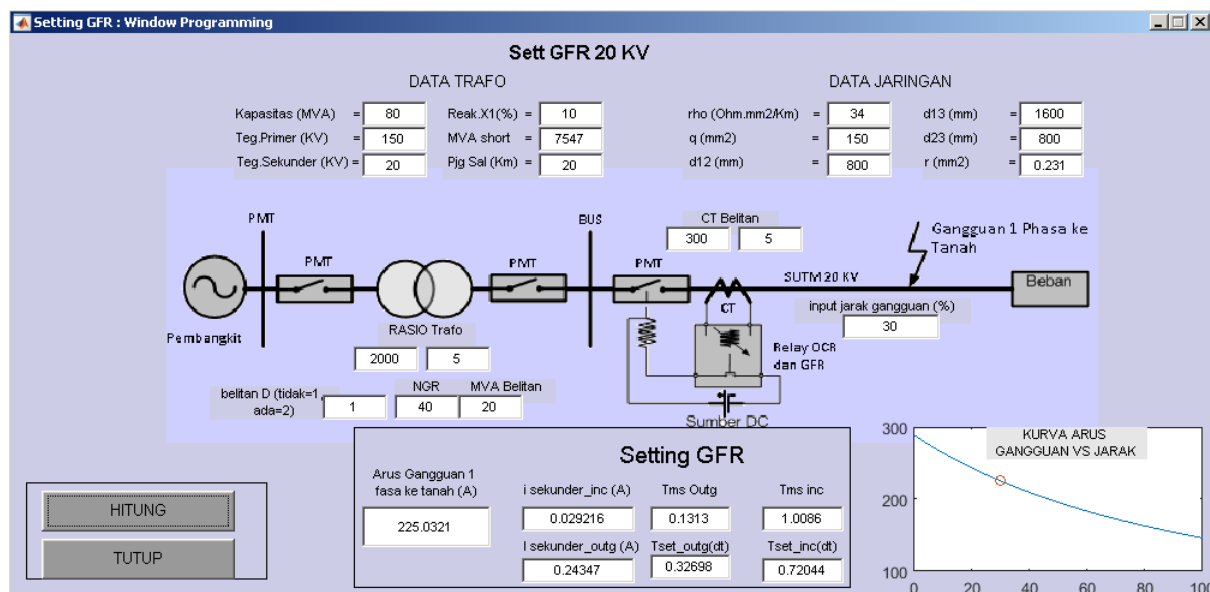
Figure 4. Display data input interruption 1 phase to ground

From Figure 4 above can be explained that the disorder occurs in 30% of the length of the channel where the channel length is 20 km, the fault current obtained 225.03 Amperes where each setting tms outgoing and tms incoming obtained by 0.1313 seconds and 1.0086 seconds
the chart of working time on the side of the outgoing when the interference occurs along the feeder shown in figure 5 below.
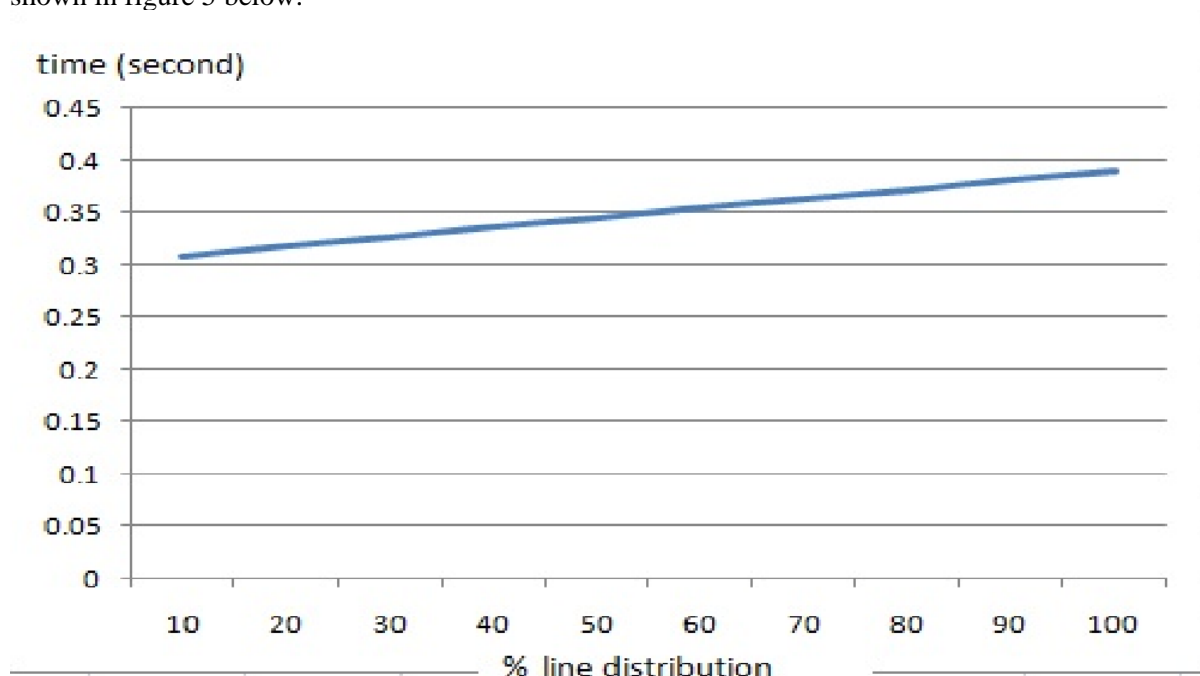

Figure 5. The chart Setting GFR outgoing

while the chart of working time on the side of the incoming when an interruption occurs along the feeders is shown in Figure 6 below.
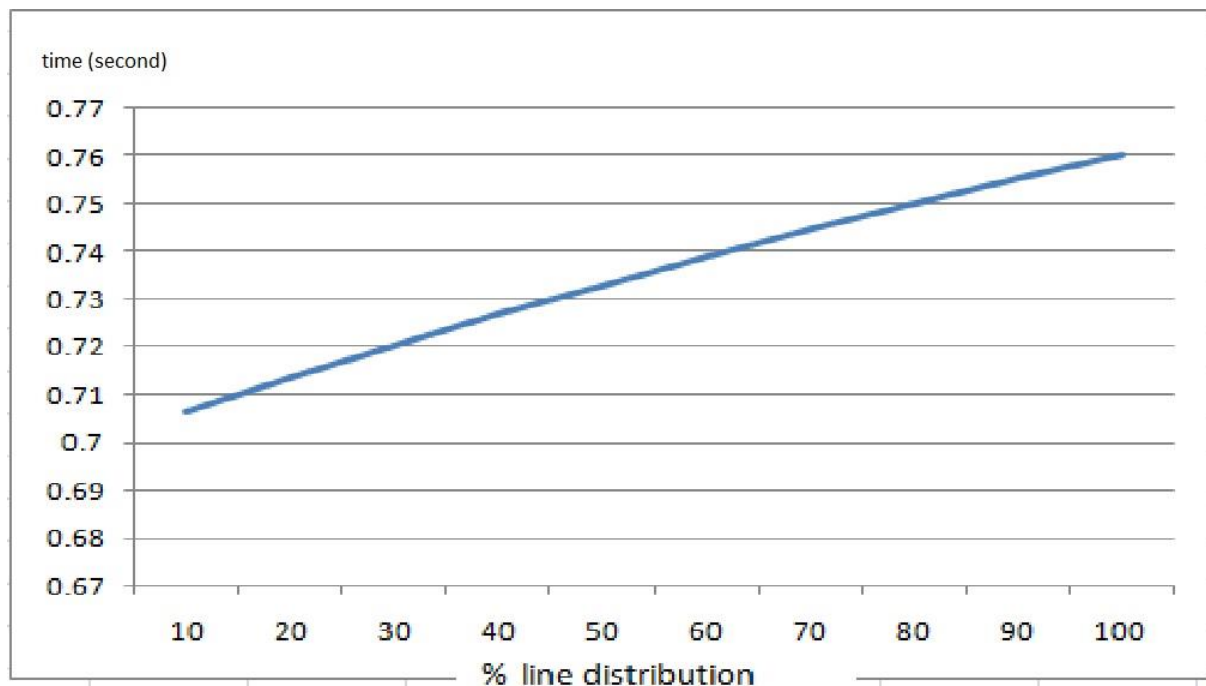
Figure 6. The chart Setting GFR incoming

From Figure 5 and Figure 6 above, the difference in working time of GFR from the side of the outgoing and incoming when an interruption occurs along the channel shown in Figure 7 below
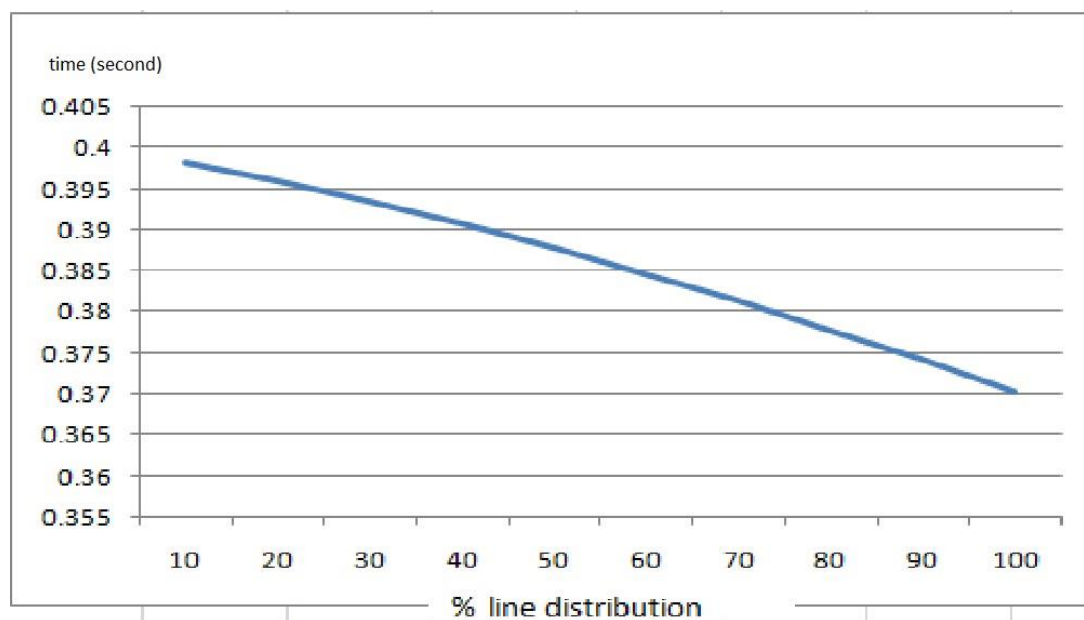

Figure 7. The difference in working time of GFR on the side of the outgoing and incoming

5. Conclusion
From the analysis of the calculation of the simulation GUI is made large, the protection Setting of the interference 1 phase ground occurs along the feeder can be concluded that the working time of GFR on the side of the outgoing and the incoming have the difference between the average of 0.38 seconds, thus

the design of programming windows in this study can be used as a reference as setting tms on GFR which are attached to a protection equipment of electric power.

References

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