PROTECTION COORDINATION AGAINTS SHORT-CIRCUIT SINGLE PHASE INTERERENCE ON INTERMEDIATE VOLTAGE NETWORK IN FEEDER OF WONOSARI 2 IN PT. PLN (PERSERO) RAYON DELANGGU

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Abstract – *The reliability of the distribution system is influenced by how fast the system protection equipment works to minimize current's disruption. FCO is the first protection equipment to minimize current's disruption in single phase networks (11,547 kV). If the FCO does not work, the Recloser and PMT will work to minimize the current's disruption in the three-phase network (20 kV). Based on setting's data of Recloser and PMT, recloser has working time is 0.26 s. PMT Outgoing for 0.41 s and PMT Incoming for 0.52 s. Whereas, based on recloser and PMT load's currents (March 2019), recloser has operating time can be calculated for 0.268 s. PMT Outgoing has working time 0.408 s and PMT Incoming has working time 0.519 s.*

Keywords*: FCO, Working Time Recloser, Working Time PMT Outgoing and PMT Incoming*

I. Introduction

I.1. Background

Electrical energy has become a basic need in our society. Every year, the number of electricity consumers is increasing rapidly. Because of that PT. PLN (Persero) really concern about quality and reliability of services.

The process of distributing electrical energy requires a fairly long process, there will be many interference on the network. Interference often occur is short-circuit current on single phase network. One of the tools can protect interference in a single phase network are Fuse Cut Out (FCO), Recloser and PMT.

In the Final Assignment report, the author will discuss Protection Coordination Againts Single Phase Short-Circuit Intererence on Intermediate Voltage Network in Feeder Of Wonosari 2 In PT. PLN (Persero) Rayon Delanggu.

I.2. Problem

Based on the background, the problem will be raised by the author.

1. The value of a short circuit current that able to break the fuselink
2. The load current in the single-phase network.
3. Analyze the use of the right size of fuselink to be able to isolate interference
4. Coordinate the protection of single phase networks against short-circuit current interference.

I.3. Aim

Based on the previous explanation, the aim will be raised by author.

1. Calculate the short-circuit current causing the FCO to break up.
2. Calculate the maximum load current of each branch to find how much current is passed

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based on the load of the transformer.

3. Know the analysis of the use of the right size fuselink from the upstream to downstream.
4. Know the coordination of protection on single phase networks against short-circuit interference.

II. Methods

II.1. Teory and Data

The writer uses primary and secondary data. The primary data the author gets from the actual situation, such as setting recloser setting PMT, FCO and current load of transformation distribution. The secondary data the author gets from the book reference, such as SPLN and related theses.

II.2. Simulation

The author use ETAP 12.6. for the data simulation. The simulation consists of two experiment that are Load Flow's Simulation and Star-Protective Device Coordination.

II.3. Flowchart

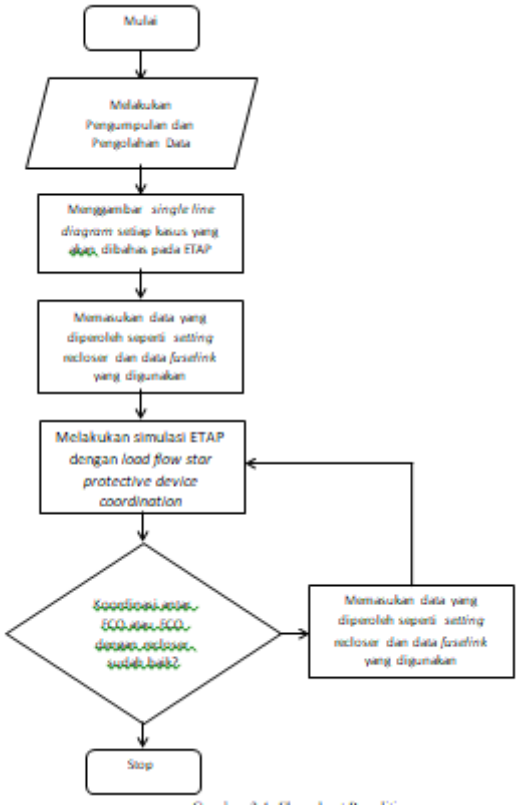

Figure 1. Flowchart

III. Tables and Figures

Table 1. Spesification of Protection Relay and PMT' Setting

Jenis Relay	Relay Incoming			Relay Outgoing		
	Merk	Inominal (A)	Rasio CT	Merk	Inominal (A)	Rasio CT
OCR	AREVA MICOM 122	1	2000:1	Schneider	1	1000:1
GFR	AREVA MICOM 122	1	2000:1	Schneider	1	1000:1
DATA SETTING						
Jenis Relay	Setting	*Incoming*		*Outgoing*		
OCR	TMS	0.30		0.25		
	t_{op}	0.52		0.41		
GFR	TMS	0.44		0.33		
	t_{op}	0.76		0.57		

Table 1 is the setting used on the PMT in GI Wonosari 150kV Transformator I. Ratio Current Transformator PMT Incoming and Outgoing are 2000:1 and 1000:1 with nominal current is 1 A.

Table 2. OCR and GFR Setting of Recloser K1-281/73

No	Relay	Setting	
		TMS	$t_{op(s)}$
1	OCR	Tx0.15	0.26
2	GFR	Tx0.15	0.26

Table 2 is the setting OCR and GFR used on Recloser K1-281/73. Recloser have TMS 0.15 with t_{op} 0.26.

Table 3. The Result of PMT and Recloser Calculation Setting

Relay	Result of Calculation			
	Setting	Recloser	PMT Outgoing	PMT Incoming
OCR	$I_{set\ primer}$(A)	312.4	353.1	1905.255
	$I_{set\ selunder}$(A)	0.781	0.353	0.952
	TMS	0.143	0.218	0.277
	t_{op} (s)	0.268	0.408	0.519
GFR	$I_{set\ primer}$(A)	56.416	70.52	70.52
	$I_{set\ selunder}$(A)	0.141	0.070	0.035
	TMS	0.96	0.138	0.175
	t_{op} (s)	0.268	0.408	0.519

Table 3 is the result of PMT and Recloser calculation with the formulas.TMS and top are different each section. TMS and top are made different cause to give working time for each section. Therefore, each section protection can work in sequence.

Table 4. The Result of Short Circuit Current Calculation

Length Network (%)	Length Network (kms)	Three Phase (A)	Two Phase (A)	Single Phase (A)
0	0.000	12,930.00	11,198.20	7,796.64
Recloser	2.000	7,458.75	6,459.47	3,845.42
25	4.865	4,589.90	3,974.97	2,223.50
50	9.730	2,765.25	2,394.78	1,291.83
75	14.595	1,976.79	1,711.95	910.05
100	19.460	1,537.83	1,331.80	705.20

Table 4 is the result of short circuit current calculation. Short circuit current depends on the impedance.The impedance increasing, then the short circuit current decreasing and vice versa. The size of impedance caused by many factors, two of them are length network and diameter of network.

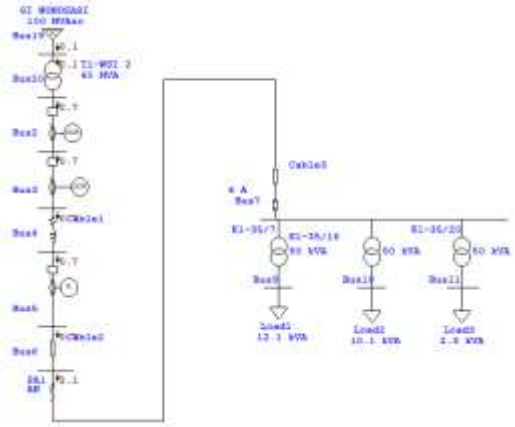

Figure 3. The Simulation of Load Flow Interference 1

Figure 1 is the simulation of load flow Interference 1. In this case, it's three distribution transformator. Each trafo have load 13.1 kVA, 10.1 kVA and 2.3 kVA. Based on the simulation, it's nominal current 2.1 A.

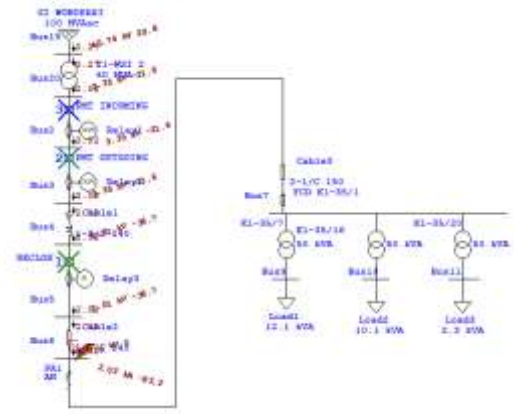

Figure 4. The Simulation of Star Protective Device Coordination

Figure 2 is the simulation of star protective device coordination Interference 1. Based on the simulation, The Device work first time is recloser. The relay of recloser will be detect the current. If it's the current bigger then the setting, relay will send signal to Recloser to work trip.

The second device work is PMT Outgoing, and the last is PMT Incoming. PMT work as same as recloser. The relay of PMT will be detect and then will send the signal to PMT Outgoing and Incoming to work.

IV. Abbreviation and Acronyms

PMT/CB = Circuit Breaker
OCR = Over Current Relay
GFR = Ground Fault Relay
T_{op} = Time Operation

TMS = Time Multiple Setting

V. Equations

$$I_{set}(prim) = 1.1\ x\ I_{nominal\ trafo} \quad (1)$$

Equation 1, used for calculate primer's current OCR and GFR for PMT and Recloser. Nominal current transformator used for PMT Incoming, while PMT Outgoing and Recloser used load current.

$$I_{set}(sek) = I_{set}(prim) x \frac{1}{Ratio\ CT} \quad (2)$$

Equation 2, used for calculate primer's current OCR and GFR for PMT and Recloser.

$$Tms = \frac{t_{op}[(\frac{I_{hs}}{I_{set}})^{0.02} - 1]}{0.14} \quad (3)$$

Equation 3, used for TMS's calculate. It is used for PMT and Recloser.

$$t_{op} = \frac{TMS\ x\ 0.14}{(\frac{I_{hs}}{I_{set}})^{0.02} - 1} \quad (4)$$

Equation 4 used for calculating relay working. It is used for PMT and recloser.

$$I_n = \frac{S}{V\sqrt{3}} A \quad (5)$$

Equation 5, used for calculating nominal current on single phase network.

$$Nilai\ fuselink = 1{,}3\ x\ In \quad (6)$$

Equaton 6, used for calculating the size of proper fuselink.

VI. Conclusion

Based on the previous explanation, the author give the conlusion. There are:

1. The short circuit current are affected by the network length and type of conductor.
2. The proper use of fuselink is the multiplication between nominal current (In) and 1.1.
3. Waktu operasi peralatan berbeda agar koordinasi dapat berjalan secara berurutan.
4. Berdasarkan pengujian jika FCO tidak berkerja, peralatan pertama yang menghilangkan arus hubung singkat adalah recloser, lalu PMT *Outgoing* terakhir PMT Incoming

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Authors' information

Ario Bima Tri Wicaksono was born in Bantul, D.I. Yogyakarta January 1st, 1997. He was Graduate from Universitas Muhammadiyah Yogyakarta for Bachelor Degree major Electrical Engineering and Universitas Gadjah Mada for Diploma Degree major Electrical Engineering.
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