MATEC Web of Conferences 248, 02006 (2018) https://doi.org/10.1051/matecconf/201824802006
ESTIC 2018

Analysis of Characteristics Over Current Relay and Ground Fault Relay on Feeder Rayon Tabing

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Abstract. The reliability of power distribution of PT PLN (Persero) branch of Padang especially in Rayon Tabing most of the repeaters is still not optimal. This is due to an uncoordinated protection relay on each feeder. One effort made to improve the reliability of electric power is to rearrange the protection of overcurrent relays and ground disturbance relays on the feeder. So coordinated with each other well and is expected if there is interference in one of the repeater will not bring black out on other repeater.In this research we analyzed short circuit current at 20 kV side. From the analysis results obtained new relay protection settings based on the calculation of short-circuit current settings and compare the results with existing protection relays. By making efforts to improve the reliability of electric power is to rearrange the protection relay on each feeder. Based on short circuit current analysis on each repeater, the largest short circuit in 3 phase, 2 phase, and 1 phase disturbance is located at 1% disturbance location and the smallest disturbance is at 100% disturbance location. It can be concluded that the farther the location of the disturbance that occurs the smaller the disturbance, and vice versa, if the location of the disturbance that occurs closer then the greater the noise flow.

1 Introduction

In the access operation can not be used for error conditions (errors). One of the main tools in the protection system used is the current relay (overcurrent relay) [1] and soil relocation (Ground Faul Relay) [2, 3]. This relay instructs the breaker (CB) to disconnect if a short circuit occurs. Common problems in distribution systems include feeder discharge at 20 kV. caused by short circuit. If the protection release settings are not good. can cause total blackout.

To determine the protection system is already working in coordination with each other between the substation with another substation circuit required analysis of the current setting and working time overcurrent relays at distribution feeders Rayon Tabing.

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2 Literature Review

The voltage drop of the transmission network was first performed at the substation by a step-down transformer voltage [4, 5]. The resulting voltage is called voltage or voltage primary distribution medium. PLN primary distribution voltage is generally worth 20 kV. Network between power stations / plants and substations called the transmission network. while the network is out of the substation to the consumer / customer called with a distribution network.

2.1 Distribution system

Distribution is a system that serves to distribute electricity to the beneficiaries. The distribution system is divided into two (2) sections [6]. namely the medium-voltage distribution systems and low voltage distribution systems. Medium voltage distribution network begins Substation Electrical Center or on separate systems / isolated. At some point started from plants. Network form can be radial or closed (radial open loop) [7]. Single line diagram distribution system as in figure 1.

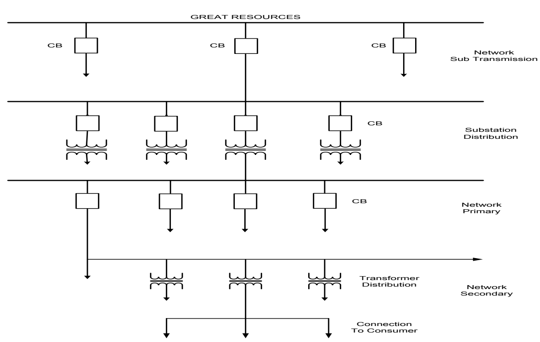

Fig. 1. Single Line Diagram Distribution System

2.2 Short-circuit

In a distribution system. rationing power through transmission network system that radial pattern that is by generator at the base. then large positive and negative sequence impedance of the system can be calculated by adding up all the positive and negative sequence impedance components ranging from the generator to subtation. While the zero sequence impedance is determined in other ways

2.2.1 Source sequence impedance

Sequence impedance source can be calculated by the equation

$$X_{1s} = \mathrm{X}_{2s} = \frac{\mathrm{kV}^2}{MVA_{\mathrm{hs\text{-}3}\phi}} \tag{1}$$

$$X_{0s} = \frac{3kV^2}{MVA_{sc-1\phi}} - \left(X_{1s} + X_{2s}\right) \tag{2}$$

Impedance resources:

$$Z_{1s} = Z_{2s} = X_{1s}$$

$$Z_{0s} = X_{0s} \tag{3}$$

2.2.2 The sequence impedance transformer

For the calculation of the impedance transformer is taken reaktansinya. while tahananya ignored because they are small. In ohms. impedance is large is calculated by the equation:

$$Z_{1T} = Z_{2T} = +\,j\,z_1 \;\; x\,\frac{V_d^{\;2}}{S_d} \tag{4}$$

2.2.3 Sequence Impedance Conductor

If an unknown type of conductor is used. then the conductor cross-sectional area sequence impedance obtained by viewing the table in the appendix. Line impedance value of positive and negative same sequence. ie X1 = X2 = XL. while the value of its zero sequence impedance is different. Based PLN Standart No. 64: 1985. the impedance value of the order of positive. negative and zero sequence in Annex IV. Sequence impedance so that the channel can be calculated by the equation:

$$Z_{n\,feeder} = Z_n x 1 \tag{5}$$

2.2.4 General Disorders Short-circuit equation

Short-circuit Disorders Three Phases: Large fault currents equal to the amount of current positive sequence is: $I_f = I_{a1}$

$$I_{hs\text{-}3\phi} = I_{a1} = \frac{V_f}{Z_1} \tag{6}$$

Short-circuited two phases: In this disorder is determined by the magnitude of the fault current impedance positive sequence and negative sequence alone. while komponn zero sequence does not exist. because at the moment there are no. Short circuited to the ground:

$$I_{hs-2\phi} = -\,j\sqrt{3}\,\frac{V_f}{Z_1 + Z_2} = \left|\,0{,}866\; x\, I_{hs-3\phi}\right| \tag{7}$$

2.2.5 Adjustment Working Time Relay

Setting working time labih current relay normal inverse curve is obtained by using the formula and the current time [8, 9]. These formulas vary according to design manufacturer of relays. Setting working time overcurrent relay with inverse characteristics by "Standart BS.142.1996" and "Standard IEC 255-4" obtained:

$$\left(\frac{I}{I_{\rangle}}\right) = \frac{I_{\text{shortcircuitat theend of theline}}}{I_{set}} \tag{8}$$

Multiple Time setting (TMS):

$$t = \frac{TMSx\beta}{\left(\frac{I}{I>}\right)^{\alpha} - 1} \quad \text{or} \quad TMS = \frac{t(s)x\left(\frac{I}{I>}\right)^{\alpha} - 1}{\beta} \tag{9}$$

In the overcurrent relay with inverse characteristics. the value α and β the inverse normal type can be seen in Table 1.

Tabel 1. Characteristics *Inverse*

Setting arus	α	β
Normal Inverse	0.02	0.14
Very Inverse	1.0	13.5
Extremely Inverse	2.0	80.0
Long-time Inverse	1.0	120.0

3 Results and Discussion

3.1 Data

Voltage = 20 kV
$MVA_{SC\ 3ph}$ = 1805,84 MVA
$MVA_{SC\ 1ph}$ = 504,91 MVA

Power Transformer Data
Brands = PAUWELS
Capacity = 30 MVA
Vector group = YNyn0
Tegangan = 150 / 20 kV
Impedance transformer = 12.4 %
Grounding (20 kV) = 40 Ω
Ratio CT = 1000/5 A

Data Conductor

Table 2. Data Feeders

Feeders	**Conductor type**	**Long Conductor (km)**	**Ratio CT**	$I_{load\ max}$ **(A)**
Air Pacah	A3C 3x150 mm^2	46.578	400/5A	150
J4.Exp – Lubuk Buaya	A3C 3x240 mm^2	6.559	400/5A	263

3.2 Results

From the figure 3 and 4 can be concluded that the data of the calculation already meets the characteristics of the more current relays, the characteristics that are achieved is the standard inverse.

1. Flow of the biggest upsets in 3-phase short circuit. the farther the distance from the location of the relay fault location. the smaller the perceived fault current relay.
2. The short circuit currents on the feeder Air Pacah. for 3-phase short circuit at fault location 1%. which amounted to 5685.09 Ampere. channel length = 46.578 km and the

load current = 150 Ampere (the second largest). Rated impedance channel and the channel length will affect the value of short circuit current.

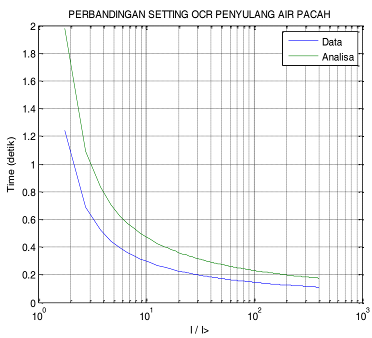

Fig. 3 Characteristics OCR for feeder Air Pacah

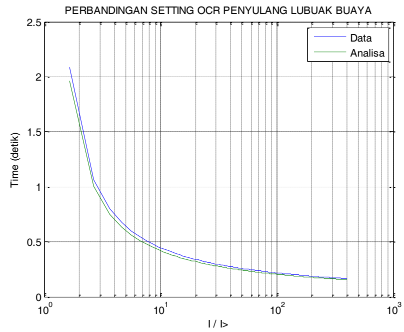

Fig. 4 Characteristics OCR for feeder Lubuak Buaya

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