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Study Of Reliability Of Over Current Relay (OCR) On Power Transformer Based On Matrix Laboratory

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Abstract

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Distribution of electrical energy by There are many aspects that need to be considered, one of which is the reliability of the protection system. The protection system is a system that functions to prevent or limit damage to equipment due to interference and in the distribution of the electric power system cannot be separated from interference, therefore a protection is needed so that electrical energy can be channeled to consumers properly, where the types of protection include: overcurrent relay. This study describes an overcurrent detector that exceeds a predetermined setting value, whether caused by a short circuit between phases or an overload, from the calculation of the interphase fault current that occurs, the largest value of the short circuit fault current between phases is located at the 0% point. of 8113.79 Ampere and the smallest value of short-circuit fault current between phases is located at the 100% point of 1208.10 Ampere and comparison with experiments using the Matrix Laboratory (MATLAB) application obtained results that are not too far from the results of manual calculations.

Keywords : Reliability, Over Current Relay (OCR), Matrix Laboratory (MATLAB)

1. Introduction

The need for electricity supply in the electric power system has become a basic need in everyday life. There are many aspects that need to be considered, one of which is the reliability of the protection system in the electric power system. Electrical energy is a very important requirement in the electric power distribution system for the present and in the future, in the distribution of the electric power system it cannot be separated from disturbances. One of the disturbances that occur in the electric power system is a short circuit, this of course can damage the equipment and hinder the continuity distribution of electrical energy. (Great, 2014).

The transformer is an electrical device that is included in the classification of static , where the function of the transformer is to distribute electrical power or power from high voltage to low voltage and vice versa. (Kustanto, 2014).

To overcome this, it is necessary to have a good protection relay arrangement to ensure that the disturbance does not spread. A protection is needed to maintain reliability of the transformer and electrical equipment at the Paya Geli substation. Protection system is a system that functions to prevent or limit damage to equipment due to interference. (Kamal A, 2014).

In addition, it can also isolate the disturbed part so that the other parts are in a safe condition. The types of protection in transformers include overcurrent relays or over current relays. The working principle of an overcurrent relay is to detect an overcurrent that exceeds a predetermined setting value, whether caused by a short circuit or overload. (A Tjahjono, 2015).

The power transformer which is protected by an overcurrent relay functions as a backup protection or back up outgoing feeder. OCR can be installed on the high voltage side only, or on the medium voltage side only or on the high voltage and medium voltage side at the same time, then OCR can drop PMT on both sides of the power transformer. (Arif, 2017).

2. Method

2.1 Electrical Power System Protection.

Electric power system protection is electrical safety in the electric power system, in the event of an electrical disturbance or overload. The placement starts from the generator to the installation in residential houses. Protection of the electric power distribution system is a way to limit equipment damage, so that the continuity of electricity distribution can run well. (Sarimun, 2012).

The problem in the electric power system is that disturbances often occur which cause the distribution of electrical energy to be hampered. The disturbance that occurs is a short circuit that will cause a large enough current. A large current if not removed immediately will damage the equipment in its path, to release the disturbed area, a protection system is needed. The objectives of the protection system include: (Sarimun, 2012).

Avoid and reduce damage to equipment due to interference. The faster the reaction of the protective device used, the less interference will affect equipment damage.
Isolate the disturbed areas only so that the electrical parts that are not disturbed remain safe.
Provide electrical services with high reliability to consumers.
Protecting humans from the dangers posed by electricity.

2.2 Protection System Requirements

Several requirements that need to be known in an electric power protection system are: (Irfan, 2009).

1. **Sensitivity**
   One of the principles of current relay is that it must be sensitive in detecting disturbances, meaning that the relay must be able to determine whether what it perceives is a disturbance or not. The safety principle must be reliable or be able to detect and remove the disturbed part. The protection relay must not fail to work. Reliability consists of 3 aspects, namely: (Irfan, 2009)
2. **Dependability**
   That is the level of certainty of its work. The working principle of safety must be reliable when working (can detect and release disturbed parts). Can't fail at work.
3. **Security**
   That is the level of certainty not to work wrong. The error of work referred to in this case is that the relay does not have to work but the relay does work, for example because the location of the disturbance is outside the safety area or there is no disturbance at all or the work is too fast or too slow. Wrong work can result in blackouts that shouldn't need to happen, so in principle a safety guard shouldn't go wrong.
4. **Availabilty**
   That is the ratio between the time when the safety is in working condition/ready to work and the total time in operation with relay electromechanicalIn addition, a good protection system is also equipped with the ability to detect tripping circuit , circuit , and circuit as well as loss of direct voltage (DC voltage), and provide an alarm so that it can be repaired, before the protection fails in a real or serious fault. really happened.

A safeguard must be able to separate the disturbed parts of the system as small as possible, i.e. only the disturbed equipment is included in the main safety area. Such protection is called selective safety, so the relay must be able to distinguish whether: (Irfan, 2009)

a. The disturbance is located in the main safety area where the relay must work quickly.
b. The fault lies in the next section where the relay must work with a time delay (as a backup safety) or refrain from tripping.

c. The disturbance is outside his safety area or there is no disturbance at all, where he does not have to work at all.

Relays in the system are located in series, coordinated by adjusting the time (time grounding) or increasing the current setting (current grounding), or a combination of both .settings relay –coordinated. A protection must be able to minimize damage when a disturbance occurs, so the disturbed part must be separated as quickly as possible from the rest of the system. The total loading time of the system from the disturbance is the time since the appearance of the disturbance, until the disturbed part is completely separated from the rest of the system.

This speed serves to: (Irfan, 2009)

Avoid damage to equipment through which fault currents pass and limit damage to disturbed equipment.

Maintain system stability.

Limiting arcing when a fault occurs in the airways will mean increasing the likelihood of successful PMT reclosing and shortening the dead time (the time interval between opening and closing).

2.3 Protection System Equipment Medium Voltage Distribution System

Protection consists of the following components: (Persero, 2014). Current transformers and voltage transformers, as tools that function to measure the amount of current or voltage in large-scale primary electrical installations by transforming from large currents or voltages into small currents or voltages accurately to detect a disturbance which then gives an order to the breaker to trip. Power breaker (PMT) to separate the disturbed part of the system from the uninterrupted system.
The battery and its charger (battery charger) as a source of power for the operation of relays and tripping aids. Wiring consists of secondary circuit, tripping circuit and auxiliary equipment circuit.

2.4 Overcurrent

Over Current relay (OCR) is equipment used as a local in a transformer that functions to detect excessive current, whether caused by a short circuit or overload that can damage electrical power system equipment within the protected area. This overcurrent relay is used in almost all electrical power system security patterns. (Irfan, 2009)

The Over Current Relay (OCR) on the power transformer only functions as a backup protection (back up protection) or as a back up for the outgoing feeder. OCR can be installed on the high voltage side only, or on the medium voltage side only, or on the high and medium voltage side at the same time. Furthermore, the OCR can drop the PMT on the side where the relay is attached or it can drop the PMT on both sides of the power transformer. (Arif, 2017)

2.5 Short

Circuit fault analysis Analysis of short-circuit faults (which may occur at any point in the system) studied mainly is the magnitude of the contribution of short-circuit fault currents in each branch in transmission, distribution, transformer and at each node. amount of current or voltage. The results of this analysis are needed by the protection engineer to adjust the protection, so that if the short circuit actually occurs in the system, the protection equipment can work to secure the disturbed part of the system as expected. Disturbances that may occur in the system are: (Badaruddin, 2014)

3-phase disturbance, occurs due to a break in one of the phase wires which is located at the top of the transmission/distribution network with the wire configuration between the phases arranged vertically. The possibility of this happening is very small, but in the analysis it must still be taken into account. Another possibility is the result of a tree that is quite tall swaying when blown by strong winds so that it touches the three wires of the transmission or distribution phase.

Two-phase fault occurs due to a break in the middle phase wire in a transmission/distribution network with a vertically. Another possibility is the damage to the insulator in the

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transmission/distribution network at once in two phases. Such a fault is usually a two phase to ground. Or it could also be due to back flashover between the pole and two phase wires at the same time when the transmission/distribution pole that has a high foot resistance is struck by lightning.

One-phase to ground fault, the possibility of occurrence is due to back flashover between the poles to one of the transmission/distribution phase wires shortly after the pole is struck by a large lightning bolt, even though the resistance of the toe of the pole is quite low. It is also possible that a single phase to ground fault occurs when one of the transmission/distribution phase wires is touched by a tall tree.

This research was conducted at PT. PLN (Persero) Paya Geli Substation, having its address at Jalan Medan-Binjai Km.10 Paya Geli, Medan Binjai, North Sumatra. The methods to be implemented in this research are:

Study Literature, which is to collect references related to the subject matter of this thesis.

setting data relay protection, impedance, transformer capacity and current transformer in the transformer.

At the calculation stage the author uses the electric circuit method to calculate the short-circuit fault current.

The author observes the data directly on the objects that have been selected which are related to discussion and decision making.

The author compares the results of manual calculations that have been obtained with the results of calculations in the Matlab software.

Table 1. Data Relay on Power Transformer 2 at Paya Geli Substation

No.	Name Bay TD 2	Data Setting					
		OCR (Td)			OCR(Inst)		
		I Set (A)	Time (ms)	Curve	I Set (A)	Time (ms)	Curve
1.	150 kV	276	0.37	SIT	0	0	DEF
2.	Inc 20 kV	2000	0.25	SIT	0	0	DEF
3.	Feeder PL 7	480	0.125	SIT	3400	0	DEF
4.	Feeder PL 8	480	0.125	SIT	3400	0	DEF

3. Result And Discussion

3.1 Calculating Short Circuit Fault Current Short

Circuit disturbances that occur in the electric power system network, especially in Over Current Relay (OCR) protection, namely:

1. Short circuit faults between phases or two phases

The author calculates short circuit faults between phases based on the value of the fault current short and based on the length of the feeder which is assumed to occur at 0%, 25%, 50%, 75%, 100% of the length of the feeder. calculate the MVA short circuit on the transformer side of 1039.2 then the author calculates the source impedance (Xsc), namely:

$$\text{Xsc (sisi 150 KV)} = \frac{KV^2}{MVA}$$

$$= \frac{150^2}{1039{,}2}$$

$$= 21{,}651\ \Omega$$

Impedance on the 20 KV side, namely:

$$\text{Xsc (sisi 20 KV)} = \frac{KV^2}{MVA} \text{ X Xsc (Sisi 150 KV)}$$

$$= \frac{20^2}{150^2} \text{ X } 21{,}651\ \Omega$$

$$= 0{,}3849\ \Omega$$

3.2 Calculating Transformer Reactance The

Author initially got the power transformer reactance value 2 (TD2) at the Paya Geli Substation of 12.41% then the author calculated the reactance of the positive and negative in ohms, so first the writer calculated the ohm value at 100% can be obtained asfollowing:

$$X_T\ (100\%) = \frac{KV^2}{\text{MVA TRAFO}}$$

$$= \frac{20^2}{60000}$$

$$= 6{,}67\ \Omega$$

Power transformer reactance value
Positive and negative sequence reactance ($X_{T1} = X_{T2}$)

$$X_{T1}\ (100\%) = 12{,}41\% \text{ X } 6{,}67\ \Omega$$

$$= 0.827747\ \Omega$$

4. Conclusion

The results of the calculations that the author got from the value of the 2-phase short-circuit fault current on the incoming side of TD 2 at the fault location determined by the author, namely 0 %= 8246.42 Ampere and 100%= 5247.19 Ampere. The results of the calculations that the authors get from the value of the 2-phase short-circuit fault current on the feeder side PL 07 at the fault location determined by the author are 0% = 8113.97 Ampere and 100% = 1208.10 Ampere. The results of the calculations that the author got from the short-circuit fault current between the phases, the writer can see that the fault point greatly affects the short-circuit current value, because the farther the fault point, the smaller the short-circuit fault current and vice versa, the closer the fault point is, the fault current short circuit will be even greater. The relay installed on the power transformer 2 at the Paya Geli substation is a relay that has met the standards of an equipment. No matter how often or how big the disturbance is,the relay can still work well.

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