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Analysis of Protection System on Three-phase Induction Motor PT South Pacific Viscose

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Abstract

This paper describes the three-phase induction motor protection system used in PT South Pacific Viscose. The induction motor studied is a motor with a power of 90 kW. The nominal current obtained from the calculation is 151.934 A. Protection system in the form of MCCB and TOR. From the results of the calculation of the MCCB rating that must be used 379.835 A and the TOR rating of 189.917 A, while the installed MCCB is 400 A and TOR 200 A. By comparing the results of calculation observations with the field, it can be concluded that the use of the protection system is appropriate.

Keywords: *Induction Motor, Protection System, Three-Phase.*

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INTRODUCTION

Nowadays, the electrical energy available in Indonesia is mostly consumed by industry. The use of energy in industry is widely absorbed by the use of electric motors. The use of this motor as a drive for production equipment.

Induction motors are widely used due to several reasons, including; Their simple construction, and relatively low price. Maintaining continuity or smooth production is a staple in an industry, this means that keeping the driving motor operating optimally is very important

In operation, unwanted conditions are often encountered that can interfere with and can even damage the running of the driving motor. These conditions include more load, short circuits, overheating, and others. Another thing that can interfere with and even damage the driving motor is the lack of attention to the protection/security system of the motor.

In order for operation of the motor to run properly, and avoid various conditions that can cause damage to the motor, a reliable motor protection system is needed. The motor protection system is aimed at preventing the onset of interference, and in the event of a disturbance, limiting the consequences to the motor.

The protection system can also prevent other damage due to more load on the motor because the higher the load current through the form of heat will cause higher losses which will further increase the excitation load on the conducting wire which can cause fire.

To overcome these problems, it is necessary to find a good motor safety/protection system and the selection of a good safety system. In connection

with this, this research was made to choose a good and correct motor protection system

A. Motor Protection in General

Protection of a motor can be of various types, shapes, designs, and with various combinations, as well as in the form of packages. The basic and main purpose of a motor protection system is to keep the motor capable of operating above normal conditions but not exceeding mechanical and thermic limitations at times of overload and at times when the motor operates abnormally and has sensitivity at times of interference. This can be achieved in the following ways:

1. Phase Fault Protection
   The directionless overcurrent relay can be used for induction motor protection. The disturbance that occurs will generally produce a fault current greater than the ignition current of the locked rotor motor, except for the interference between the windings. Fault currents can flow between the windings, but unfortunately, there is little evidence that can be felt at the rotor terminals until the fault turns into an inter-phase fault or between phases to the ground.
2. Differential Protection
   Differential protection is preferred, but this type of protection cannot be used for all motors. For those motors that do not have both ends of the winding, then this relay cannot be used. When both windings are available, differential advantages in sensitivity, speed, and security are passed through a winding conductor. Typical of the maximum open or window section of this CT with a diameter of 8 inches.
3. Ground Fault Protection
   As in Phase protection, instantaneous overcurrent rele is also used for soil fault protection. If possible, the method provided is to use a Ring-type CT, with all three conductors of the Motor passed through the CT window.

B. Protection Function

The functions of the protection relay in the electric power system are as follows:

1. Sense, measure and determine the disturbed parts of the system and separate as soon as possible so that other uninterrupted systems can operate normally.
2. Reduces more severe damage from disrupted equipment.
3. Reduce the effect of interference on other undisturbed parts of the system and prevent widespread interference.
4. Minimize harm to humans.

C. Protection System Requirements

For a motor protection system, it must meet several conditions, including:

1. Selective

The protection system must be selective and choose exactly which part/area the disturbance occurs and must be separated from the part/area that is not disturbed and must operate continuously

2. Sensitive

The protection system must have a high level of sensitivity, so that interference can be detected as early as possible so that the disturbed part or the possibility of damage is as small as possible

3. Reliable

The protection system must have a high level of reliability and always be able to work in conditions that can occur. Under normal circumstances, there is no disruption of the protection system not working for months or years. But if one day there is a disturbance, then the protection system must work

4. Speed

The protection system must have a speed level as determined, the faster the protection system works, it not only minimizes damage due to interference but also minimizes damage to interference

METHODS

To simplify the processes in the study, it is necessary to design several flow diagrams since the design processes could be carried out in a sequence as shown in Fig. 1.

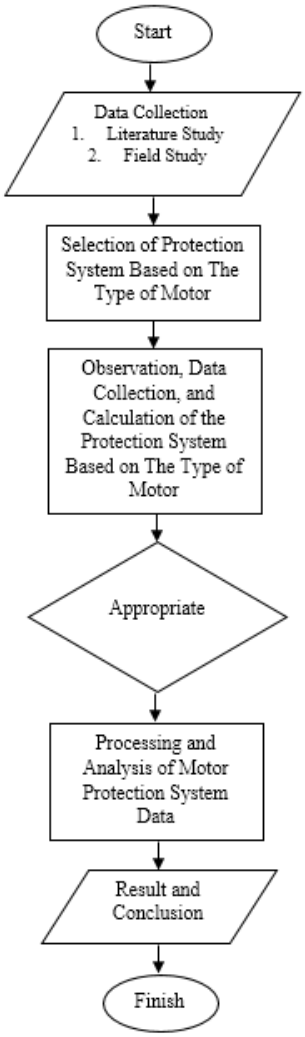

Figure 1. Flowchart of research method

RESULTS & DISCUSSION

Results

More than 500+ induction motors are used by South Pacific Viscose company. This study focused on a motor with a power of 90 KW.

A. Induction Motor Specifications

Brand : CMG Australia
Type : SGA280M-4
Power : 90 kW
Voltage : 380 V
Current : 152.1 A
Cos φ : 0.9
Frequency : 50 Hz
Weight : 662 kg
RPM : 1487

B. MCCB

MCCB (Moulded Case Circuit Breaker) is a panel component that functions as a circuit breaker/connector from the source to the next panel components, and also functions as a safety when overcurrent and short circuits occur.

Figure 2. MCCB

Generally, the MCCB is set to a minimum of 115% of the full load current of the motor. For the MCCB winding rotor motor it is set at a value of 150% of the full load current of the motor, while for the rotor the cage is set at 250% of the full load of the motor.

According to the provisions issued by NEMA (National Electrical Manufactures Association) that the breaker rating for motors with a start of Y - A is 250% of the nominal current (In):

$$I_n = \frac{P}{v\ x\ \cos phi\ x\ \sqrt{3}}$$

$$I_n = \frac{90.000}{380\ x\ 0.9\ x\sqrt{3}}$$
$$I_n = 151.934\ \text{A}$$

The MCCB rating that must be used is:
MCCB rating $= 250\%\ x\ I_n$
$= 250\%\ x\ 151.934$ A
$= 379.835$ A

379.835 A is the minimum MCCB rating current used, so if rounded MCCB what should be used is MCCB with a rating of 400 A

From the data obtained in the field it is known that the MCCB used is the NS400H type with the following data.
Frame size : 400 A
Operating current : 250 – 400A
Setting MCCB: 400 A
By comparing the data obtained:
MCCB analyst : 400 A
MCCB installed : 400 A
It can be concluded that the MCCB selection is appropriate.

C. Thermal Overload Relay

Generally, relays can be divided into two types, namely relays that work on an electromagnetic basis and relays that work based on heat (thermic). An electromagnetic relay is a relay that works on the electromagnetic principle. This relay consists of a coil fed by phase current and an iron core that drives its contacts.

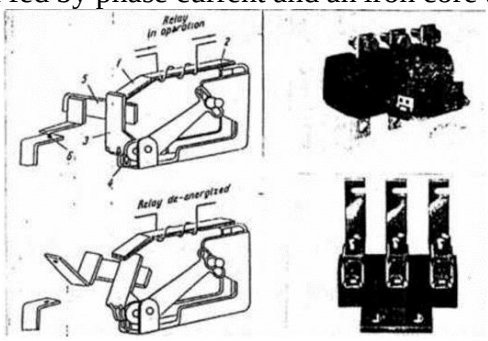

Figure 3. Thermal overload relay diagrams

Thermal Overload Relay is a type of relay that works based on thermal or heat. This relay contains bimetallic elements with different temperature coefficients, so that if the element is fed by a current (directly or indirectly) exceeding its setting current, then the element will reflect or bend and immediately trip to separate the motor from the network.

In accordance with the rules issued by NEMA (National Electrical Manufactures Association) that the rating of TOR is 125% of in. It is intended not only to protect the motor from the danger of overload, also to protect the cable from overheating due to excess current flowing on the cable.

According to the provisions issued by NEMA (National Electrical Manufactures Association) that the rating of the TOR is 125 % of nominal current (In):

$$I_n = \frac{P}{v\ x\ \cos phi\ x\ \sqrt{3}}$$

$$I_n = \frac{90.000}{380\ x\ 0.9\ \ x\ \sqrt{3}}$$

$$I_n = 151.934 \text{ A}$$

151.934 A is the minimum TOR rating current used, so if rounded TOR what should be used is TOR with a rating of 200 A

The TOR rating that must be used is:

TOR rating = $125\%\ x\ I_n$

= $125\%\ x$ 151.934 A

= 189.917 A

By comparing the TOR data obtained:

TOR analyst : 200 A

TOR installed : 200 A

It can be concluded that the TOR selection is appropriate

CONCLUSION

Based on the results of the study, it can be concluded that the use of a protection system is very important to prevent damage to the three-phase induction motor. The protection system used in the 90 kW motor at PT South Pacific Viscose is MCCB and TOR. The calculation result for the MCCB rating is 379.835 A, while the one installed in the field is 400 A. The calculation result for the TOR rating is 189.917 A, while the one installed in the field is 200 A. By comparing the calculation results and the field, it can be concluded that the use of the protection system is right.

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