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Design Of Single Phase Voltage Loss Relay System On Three Phase Motors At Blang Pidie Substation

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ABSTRACT
Three-phase motors are one of the main equipment in the electric power system used to drive various industrial machines, including the Blang Pidie Substation. One of the problems that often occurs in three-phase motors is the loss of voltage in one phase (single phasing), which can cause current imbalance, motor temperature increase, and the potential for greater damage. Therefore, a protection system is needed that can detect the loss of single-phase voltage and automatically stop motor operation to prevent further damage. This study aims to design and build a single-phase voltage loss protection relay system on three-phase motors at the Blang Pidie Substation. This system uses a voltage relay as the main component to detect voltage loss in one phase, which will then activate the current breaking mechanism to protect the motor. Testing is carried out by simulating various voltage loss conditions to analyze the response speed and effectiveness of the relay system in protecting the motor. The results of the study show that the designed relay system is able to detect single-phase voltage loss with high accuracy and fast response time. When a disturbance occurs, the system immediately cuts off the electricity to the motor to prevent overheating and permanent damage. The implementation of this system is expected to improve the reliability of three-phase motor operations and reduce the risk of failure at the Blang Pidie Substation.

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INTRODUCTION

Nowadays, many people use electric machines to run various types of machines in both large and small industries. The electric machine in question is an induction motor that works by converting electrical energy into mechanical energy. With this induction motor, of course, human work can be done more easily and can also help in the work process. To maintain the benefits of this induction motor, of course, users must provide protection for it. The protection that can be provided is by installing a protection system where this system consists of safety components. One type of component that can be used in a protection system is a relay. According to Setiyo, Muji (2017: 101) "A relay is a component used to control a large current flow through a small voltage". The relay will provide protection against a disturbance by disconnecting the connection between the network to be secured and the network that has a disturbance. By installing this protection system, of course, the

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disturbance can be secured so that the impact caused by the disturbance does not affect the condition of the induction motor. According to Umam, Faikul, et al (2021:68) "An induction motor is a device that converts electrical energy into mechanical energy, the electricity that is converted is three-phase electricity".

A three-phase induction motor is equipment that often works for a long time, electrical energy from the power center will be distributed to the Substation. This study discusses the disturbances that often occur in three-phase induction motors, one of which is a phase loss. Based on the results of field observations at the Blang Pidie Substation, phase failure disturbances caused by the release of one phase or one of the two three-phase source connections result in the load not being supplied properly. The addition of relays (protection) in the electric power system aims to reduce the area (zone) of disturbances, losses or damage. So that disturbances can be avoided or reduced, with a large and fast-working, selective and reliable protection system, damage caused by disturbances or damage to the equipment system through which the disturbance current passes can be avoided, so that system stability can be maintained with the presence of a single-phase voltage loss relay on the three-phase motor. Based on the background that has been described, it can be assumed that by planning the design of a relay system that is missing one phase on a three-phase motor, it can prevent the motor from working stably and overcome the disturbance from getting wider. So the researcher is interested in raising the problem in a writing entitled "Design and Construction of a Single Phase Voltage Relay System on a Three-Phase Motor at the Blang Pidie Main Substation."

METHOD

The type of approach used in this study is a quantitative approach. According to Sugiyono (2017:13) "A quantitative approach is an approach whose data is in the form of numbers and analysis using statistics" This type of research is a descriptive type. According to Sugiyono (2017:11) "Descriptive research is research conducted to determine the value of independent variables, either only on one variable or more without making comparisons, or connecting one variable with another". Quantitative descriptive research is research that uses a quantitative approach to describe a variable or event as it is. This research uses data in the form of numbers generated from the actual situation. Pure descriptive research only describes facts about things that appear so that it does not require a hypothesis.

The research method is a way or process chosen to solve problems in research. The research method used must be scientific to obtain valid data.

1. Formulating the Problem
   The formulation of the problem is a short writing that contains specific questions related to the topic or theme raised by the author as written in Chapter I section and the answers to this problem formulation will be the results of the research.
2. Literature Study
   This literature study contains a study of writing from several references related to the research title, this source can be obtained either from scientific works, journals, books, or from the internet as research support and to make it easier for the author to

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complete this research.

3. Data Collection
   Data collection is a systematic process for collecting and measuring information elated to the variables that are the focus of the research. Such as collecting data obtained after conducting research at the Blang Pidie Main Post.
4. Conclusion of Research Results
   The conclusion is the final part of a written work that contains answers to research questions, conclusions must be based on data that has been obtained in the research results

RESULTS AND DISCUSSION

Analysis of Phase Voltage Breaker Time R-S-T

This study will discuss the performance of the phase voltage breaker to find out how long it takes from ON to OFF or OFF to ON.

Table 1. Results of Phase Voltage Breaker Time Test R-S-T

Fasa	ON ke OFF	OFF ke ON
R	00.00,18	00.00,19
S	00.00,24	00.00,23
T	00.00,19	00.00,23

Table 1 above is the value of the test results of the R-S-T phase voltage breaker time. Based on the data above, we can see that the tool only takes less than 1 second to disconnect the load from ON to OFF when a phase failure is detected. Likewise, when the tool is operating, it only takes less than 1 second to operate the load from OFF to ON, the disconnection of the load on the three-phase induction motor must be operated quickly for safety.

Figure 1. R Phase ON to OFF Test

Performance Testing of R-S-T Phase Voltage Breaker

The performance testing of the device on the phase voltage breaker is as follows:

Table 2 Results of Performance Testing of R-S-T Phase Voltage Breaker

No.	Fasa R-S-T			Beban
	R	S	T	
1.	1,1V	235V	235V	Padam
2.	234V	1,8V	233V	Padam

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3.	233V	233V	1,0V	Padam
4.	233V	1,0V	0,9V	Padam
5.	1,0V	234V	0,9V	Padam
6.	0,9V	0.9V	234V	Padam

Table 2 above is the value of the test results of the RST phase voltage breaker performance. Based on the data above, it can be concluded that if one or two phases are disconnected, the relay works to detect phase failure and will disconnect the load so that no damage occurs to the three-phase induction motor.

Figure 2. Test Results 1

3-phase electrical voltage is generally around 380 volts which is widely used in industry or factories. 3-phase electricity is an electrical cable network consisting of 3 live cables (R, S, T) and 1 neutral cable (N). 3-phase electricity is AC (Alternating Current). 3-phase motors are capable of producing greater electric current than 1 phase. This measurement aims to measure the input voltage of 380V using a multitaster. Three-phase electrical voltage is generally used for industrial equipment such as three-phase induction motors, as well as large buildings for the installation of their electrical systems.

Table 3 Results of Voltage Measurement to Relay

Tegangan ke Relay	
ON	233 VAC
OFF	2,2VAC

Table 3 above is the value of the input voltage test results to the relay. Based on the data above, it can be concluded that if the relay receives a voltage input of 220 vAC, the relay will be ON and vice versa if the relay loses voltage input, the relay will be OFF. Here the relay is used as a voltage sensor on the R S and T phases. If one of the voltages is lost, the relay will send a signal to the contactor to disconnect the voltage. When measuring the relay voltage, it is necessary to activate the relay by connecting a 220V AC voltage current, make sure the voltmeter is in the vAC position, then one probe is neutral and the other probe is to the relay to be measured. This measurement uses a multimeter to check the input, output, and signal voltages.

Table 4 Results of Relay Voltage Measurement to Contactor

Tegangan Relay ke Kontaktor	
ON	234 VAC
OFF	5,8VAC

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Table 4 above is the value of the input voltage test results to the Contactor. Based on the data above, it can be concluded that if the Contactor receives a voltage input of 220 vAC, the Contactor will be ON, and vice versa if the relay loses voltage input, the Contactor will be OFF.

Table 5 R-S-T Phase Measurement Results

Pengukuran Tiap Fasa Sumber R-S-T	
Fasa R	233 VAC
Fasa S	233 VAC
Fasa T	233 VAC

Table 5 above is the value of the output voltage test results to the load. Based on the data above, it can be concluded that the output voltage remains stable operating all three phases to ensure the safety of the three-phase motor from trouble. If one of the voltages is lost, the relay will disconnect all three phases at once in a working time of less than 1 second.

CONCLUSION

The conclusion of the design of the protection device in this study is: The single-phase voltage loss relay device can work well. The single-phase voltage loss relay can disconnect the load properly. The magnetic relay with a single-phase voltage loss sensor can send a signal to the contactor. The suggestions for designing the tool in this study are: In applying the protection tool, a three-phase induction motor can use a single-phase voltage loss protection relay to minimize damage to the three-phase induction motor. In order to achieve protection (security) for the three-phase induction motor, a more efficient tool can be used for further development.

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