CURRENT COMPARISON SCHEME IN TNB TRANSMISSION LINE SYSTEM

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" I admitted that this project is written by me and is my own effort and that no part has been plagiarized without citation"

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" For my loves father and mother
En. Azman bin Mohd Nor and Pn. Mariah bte Mohammad Sharif
In appreciation of support and understanding during my project
In progressing "

ACKNOWLEDGEMENT

Alhamdulillah, thanks to the Allah Almighty with his permission finally I have finished my Projek Sarjana Muda II in a whole semester. The report is the outcome of my project and its has been submitted following the due date time.

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ABSTRACT

This report are presenting about the current comparison scheme in TNB transmission line system. This scheme used to find and detecting fault that occur at the transmission line. By using the current comparison relay, this situation can be safe from the fault. The objectives of this project are to make sure that the current comparison relays detect the fault that occur and transmitted the signal to the system to trip the circuit breaker at the substation. When current through the transmission line exactly not the same that the values of TNB setting, so this relay will operate in a few second and transfer the data to the system to make sure the others equipment in the substation its not damage. This failure always happens when the unbalanced load happens. In this project, all the data that the current comparison relays received is from the fibre optic connection between the substations.

ABSTRAK

Laporan ini menerangkan tentang skim perbandingan arus pada talian penghantaran TNB. Skim ini dapat membantu untuk mengesan sebarang kegagalan arus yang berlaku pada talian penghantaran. Dengan menggunakan geganti perbandingan arus pada system talian ini, maka keadaan kegagalan dapat dielakkan. Objektif utamanya ialah untuk mengesan sebarang keadaan kegagalan dan menghantar isyarat ke system pemutus litar di pencawang masuk utama. Semasa kadaran arus yang melalui talian penghantaran tidak sama atau berubah, gegati arus ini akan beroperasi dalam beberapa saat dan akan menghantar isyarat pada system dan bertujuan untuk memastikan tiada sebarang kerosakan alatan di pencawang masuk utama. Kegagalan ini sering berlaku apabila beban tidak stabil atau seimbang. Didalam projek ini, segala penghantaran data-data dilakukan melalui talian fiber optik yang dihubungkan diantara pencawang masuk utama.

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CHAPTER 1

INTORDUCTION

1.1 Current Comparison Scheme In TNB Transmission Line System.

Current comparison scheme in the transmission line is the situation that the current is not the same and these phenomena will make that the system not in stable situation. This failure can be avoid by using this current comparison relays where this device can detect any failure in the transmission line. This case study is to purpose to get the data and setting about the operational current comparison relays from the TNB.

In this case study, the current comparison scheme is the new technology to expose in the TNB transmission line system. This device is similarly like the current differential relays, and this device will operate when the current is not stable or the fault happen in transmitting the power in the transmission line. So this protection device always be definite or detecting the current through into the transmission is always in the standard values of current.

We can see the operating relay in the formula below:

$$I_1 - I_2 = 0$$

When the I_1 through the operational relay is not equal the I_2, this relay will be operate and the breaker will be trip.

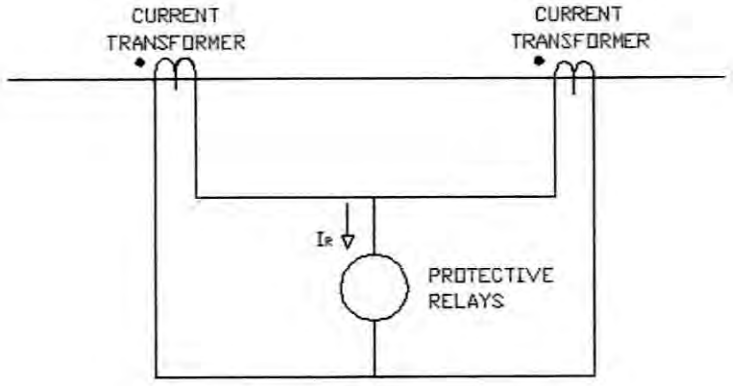

Figure 1.1: Simplified Circuit Diagram of Current Comparison

1.2 Basic Current Comparison Relaying.

Current differential relaying is applied to protect many elements of a power system. The simplest example of a current comparison relaying scheme is shown in Figure 1.1. The protected element might be a length of circuit conductor, a generator winding, a bus section, etc. From Figure 1.1 it can be seen that current comparison relaying is a basic application of Kirchhoff's Current Law. The relay operates on the sum of the currents flowing in the CT secondary, $I_1 + I_2$. For through current conditions, such as load or an external fault, the currents in the two CT's will be equal in magnitude and opposite in phase (assuming the CT's have the same ratio and are properly connected), and there will be no current flow in the relay operate coil.

Should a short circuit occur within the protected section between the two CT's, current will flow through the operate circuit causing the relay to issue a trip output. To improve the selectivity and security of the current comparison scheme, it

is often designed as a percentage restraint comparison relay. In a percentage restraint current differential relay, the operating current is the vector sum of the CT currents.

•Normal Condition $I_1 + I_2 = I_c$

•Fault Condition $I_1 + I_2 \neq I_c$

1.3 Objectives and Project Scope.

Objective from this final project is to get the knowledge and skill of the student research and also to make the student can get to solve any problem during the project in progress. Below there is a few objective during the final project is going on.

1. To learn by theorical for this protection scheme and compared with the actual.
2. To get know the operation of the protection relay in the trannsmission line.
3. To recognize the problem and complication during progressing in this project.
4. To make sure that the system in use will operate when the fault occur.
5. To solve the problem during progressing in this final project.
6. To expose ourselves in the experience and how to manage this project properly and in follow the procedure.

For the scope of the project,

1. To compare between theory and practical.
2. To examine about the setting of the protection relays.
3. To examine about the operating of the protection relays.
4. To analyze the current system protection at the transmission line.
5. To analyze the current comparison relays at the transmission line

1.4 Methodology .

In this study case project, this project is focus on the examine and observation of current comparison scheme at the transmission line system. This study case also including of the between theory and practical on the TNB system. Firstly, on this project we look at the equipment or device protection that TNB use in their protection system. So, in this project, TNB using the current comparison relay made from SIEMEN for the protection device. This model is able to protect the system from fault occur in the transmission line for overhead lines and cables.

This is also, we learn about the characteristic of the relays and the operational of this protection device. This research can assist others research to understanding about this current comparison scheme. In Malaysia, this protection device is new technology used in the protection system at the transmission line. Otherwise, this protection is similarly like the current differential protection system in use.

The operating of this protection device is passing through by the fiber optic at the transmission line. The connection for coupling with opposite of two substation is direct wire connection, direct fiber optic connection and via optical fiber transmission device. So, by using this data transmission the protection device more sensitive and more efficiency when fault occur at the transmission line.

1.5 Report Outline.

In this project report, it has 6 chapters. In chapter 1, it explains about the introduction of project and also about the objectives and scope project. Where in

chapter 1 it's also explain about the methodology of project title. In this chapter, the providing information is including the model in use at the TNB protection system.

For chapter 2 is it about the explanation of literature review of this project. In chapter 3, the explanation is about the project background. These chapters show the main ideas explanation about the current comparison at TNB system.

The experiment and result of this project will explain in chapter 4. in this chapter we can see the operating relay and also the equipment use in the lab protection. During this experiment, the setting of the set of the protection equipment is given to make sure the equipment is not damage when over voltage or overcurrent.

Lastly, in chapter 5, there will be the conclusion and discussion about this project. Also including in this report is appendix for the reference during in this project progress.

CHAPTER 2

LITERATURE REVIEW

Basically, this chapter will review existing project created to get an idea on the project of current comparison scheme in the transmission line system. For this study case, the TNB are using this current comparison relays to protect the system from the fault. On the next page, is the model that the TNB use in the system of protection. Actually, there is many type of current comparison relay that TNB use but on this project, the TNB protection system using the SIEMENS model.

The numerical current comparison protection is a fast and selective short circuit protection for cable and overhead lines. Since the comparison of the measured data is performed individually per phase, the treatment of the network neutral is without importance as long as the short circuit current is sufficiency high for the protection device to pick up or operate.

Fig. 56: 7SD512

Figure 2.1: SIEMENS Current Comparison Relay.

Makes : SIEMENS

Model : 7SD512

This current comparison relay, is effort to received data at the transmission line in speed at 19.2 kbits/sec where all the signal is transmitted by fiber optic cable. It is capable to received and sending the data in about 15 kilometers and this device also can received or sending in 150 kilometers if we install the data signal device (model 7VR5012) in the system. [1]

With the short and long distance, this current comparison relay can operate in high efficiency and more sensitive when fault occur in the system. [1]

2.1 Current-comparison protection for overhead lines and cables.

1. Line differential protection
2. Overload protection
3. Autorecloser
4. Breaker failure protection
5. Emergency time overcurrent backup protection
6. Event recording
7. Fault recording

2.2 Current comparison protection.

1. Protection for all kinds of short circuit in system with earthed or non earthed star point.
2. Reliable distinction between load conditions and faults
3. Phase segregated measurement, thus pick up sensitivity independent of the type of faults.
4. Single pole trip possible for single phase faults (for operation with single pole or single and three pole auto reclosure).
5. Adjustable steady state pick up level together with high dynamic sensitivity.
6. Insensitive to inrush and charging currents as well as to high frequency transients.
7. Insensitive to dc components and transformer errors of current transformer.
8. High stability even with differing current transformer saturation.
9. Data exchange with opposite station via optical fiber for data transmission, isolated interface possible for connection with a optical fiber transmission device.
10. Intertripping signal for rapid phase segregated trip even at line ends without infeed or with weak infeed
11. Continuous supervision of data link and data transmission time
12. Automatic correction of the data transmission time is possible.

2.3 Emergency overcurrent function.

1. For "emergency operation" during disturbance or failure on the data transmission link.
2. Operates as definite time or inverse time overcurrent protection with selectable characteristics
3. Separate high current stage with definite time characteristics or instantaneous trip
4. Separate earth current stages with separately selectable characteristics

2.4 External local trip.

1. Tripping of the local circuit breaker from an external source with adjustable delay and reset time
2. Includes signal of external protective or supervisory devices into the processing of trip commands and signaling.

2.5 `Transfer trip.

1. Provides tripping of the remote and circuit breaker by an external signal for example breaker failure protection

2.6 User definable annunciation.

1. Includes user definable signals and messages into the processing of annunciation
2. Transmission of user definable signals and messages to the remote line end.

2.7 Automatic Reclose function.

Single pole, three poles or single and three poles.

2.8 Current Comparison Protection.

The line protection operates according to the comparison principle. Each phase current at each of the protected line is required. The data to be compared must be transmitted from one end of the line to the other end and vice versa. The comparison and thus the resulting trip decision for the circuit breakers is made individually for each end of the line.

The current comparison protection system comprises the 7SD51 units to be installed at each end of the line and the signal transmission link between the units.

2.9 Matching Of Measured Values.

The measured currents are fed to the unit per phase via input transformers in the current input section. The inputs are galvanically isolated from each other and from the electronics circuitry. This allows the star point to be formed outside the unit or to include further devices in the current circuit.

If the current transformers secondary rating is $I_N = 5A$ at one of the line and $I_N = 1A$ at the other end of the line, then the 5A model [1]

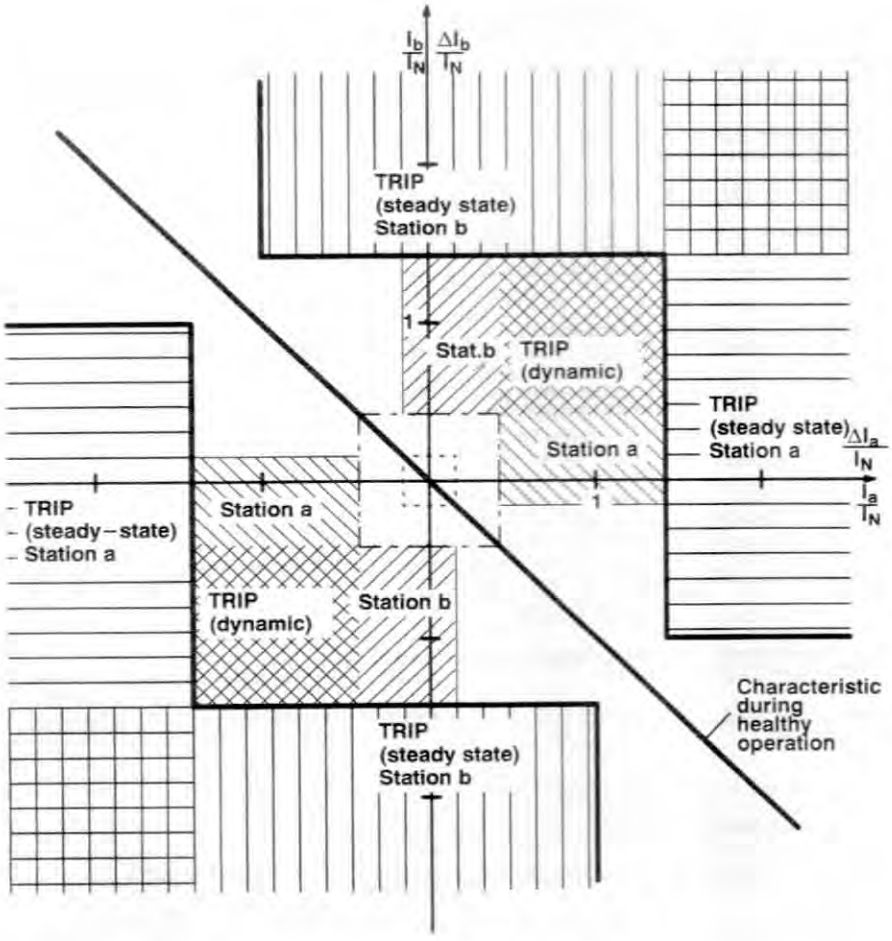

Figure 2.2: Communication between 2 Substations.

From the figure 2.2, we can see that the connection between two substation. I_a Current in the station A is a local station in direction of line. For substation B the I_b Current is opposite to the station A and in direction of line. In this situation, two substation is always communicate between each other by using data transmission to detect any occur happened at the transmission system. The line across between the substations is representing the characteristic during the healthy operation. [1]

The relay is designed for use in the industrial environment, for installation in standard relay rooms and compartment so that with proper installation electromagnetic compatibility is ensured. All contactors and relays which operate in the same cubicle or on the same relay panel as the digital protection equipment should, as a rule, be fitted with suitable spike quenching elements. [1]

The external connection leads in substation from 100 KV upwards should be screened with a screen capable of carrying power current and earthed at both sides of the substation. It is not permissible to withdraw or insert individual modules under voltage. In the withdrawn condition, some components are electro statically endangered during handling the standard for electro statically endangered component must be observed.

2.10 Features.

1. Processor system with powerful 16 bit microprocessor.
2. Complete digital measured value processing and control from data acquisition and digitizing of the measured values up to the trip and close decision for the circuit breakers.
3. Complete galvanic and reliable separation of the internal processing circuits from the measurement, control and supply circuits of the system, with screened analog input transducers, binary input and output modules and dc converter.
4. Comprehensive supplementary function.
5. Continuous calculation of operational measured values and indication on the front display.
6. Simple setting and operation using the integrated operation panel or a connected personal computer with menu guided software.
7. Storage of fault data, storage of instantaneous values during a fault for fault recording.
8. Data exchange with opposite station via optical fiber for data transmission, isolated interface possible for connection with a optical fiber transmission device.
9. Communication with central control and storage devices via serial interfaces is possible with optical fiber connection.
10. Continuous monitoring of the measured values and the hardware and software of the relay.

CHAPTER 3

PROJECT BACKGROUND

In chapter 3, it's explained about the project background and the theory of current comparison scheme. This protection scheme is able to detect and disconnect the power at the transmission line when fault happen to the system.

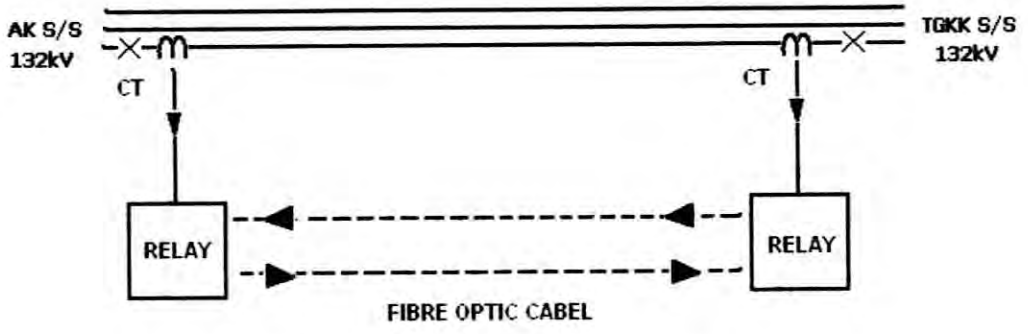

Figure 3.1: Study Case between Ayer Keroh S/S to Tangkak S/S

3.1 Current Comparison Scheme in TNB Transmission System.

The numerical current comparison protection is a fast and selective short circuit for cables and overhead lines. Since the comparison of the measured data is performed individually per phase, the treatment of the network neutral is without

importance as long as the short circuit current is sufficiently high for the protection to pick up.

It is particularly suited to short lines, for example, the first zone of a distance protection cannot be set sufficiently short. It can be used with lines down to any length. One set of current transformers is required at each end of the line. Voltage transformers are not required.

An essential advantage of the current comparison protection is its ability to initiate the immediate disconnection of any short circuit at any location in the protected zone. The current transformers at each end separate the protected zone cut off is the reason for the absolute selectivity of the comparison protection principle. This eliminates the need to delay the trip signal which necessary with time graded protection.

The current comparison protection system requires the installation of one 7SD512 or 7SD511 (from firm ware version V2.0 or higher) unit each end of the line. The data exchange required for the interaction of both units is performed by digital signals via an interface and a data link. For this, optical fibres are recommended. Since fault free data transmission is a prerequisite for the correct functioning of the protection system, it is continuously supervised within the relay.

When the data link fails, or when the received data are not plausible, the relay can switch automatically over to emergency overcurrent time protection mode. In this case the relay can continue operating either as definite or as inverse time overcurrent protection for phase and earth faults.

Since the comparison protection does not disconnect faults outside the protection zone, an additional time graded protection must be installed at least one end of the line to serve as superimposed back up protection.

In cases where a transformers is directly connected (without a circuit breaker) to a cable or to an overhead line, current transformers should be installed at the