OVERCURRENT SCHEME AND DISCRIMINATION USING PSCAD

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DECLARATION

I declare that this thesis entitled “OVERCURRENT SCHEME AND DISCRIMINATION USING PSCAD is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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Date 5/7/2021

APPROVAL

I hereby declare that I have checked this report entitled "OVERCURRENT SCHEME AND DISCRIMINATION USING PSCAD" and in my opinion, this thesis it complies the partial fulfilment for awarding the award of the degree of Bachelor of Electrical Engineering with Honours

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Date : 5/7/2021

DEDICATIONS

Special thanks to my beloved mother and father

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ABSTRACT

Based on an electrical power system, protection is the most important thing for a power system to protect users and equipment from harmful things. It can also detect abnormal situations, such as an overcurrent in the power system.Then, the benefits of protection can also prevent equipment from being damaged and avoid short circuit breakers. Generally, overcurrent occurs when a short circuit happens in the power system. These are caused by injury to a cable or disturbance in the environment. As a result, the current flowing through the system has increased dramatically. Aside from that, earth faults can occur between phases of the ground.There are different types of faults, such as single phase on the ground, two phase on the ground, and three phase on the ground.The goal of this project is to identify the capabilities of a relay on the various types of power system faults.Also, PSCAD software was used to determine whether the circuit assembly was installed correctly and the same thing happened with the drawing. In this project, the drawings from electrical distribution at the TNB Manjung thermal power plant were obtained to determine more effectively by using PSCAD software.

ABSTRAK

Berdasarkan sistem kuasa elektrik, perlindungan adalah perkara terpenting bagi sistem kuasa untuk melindungi pengguna dan peralatan daripada perkara berbahaya. Ia juga dapat mengesan situasi yang tidak normal, seperti arus berlebihan dalam sistem kuasa. Kemudian, faedah perlindungan juga dapat mengelakkan peralatan rosak dan mengelakkan pemutus litar pintas. Secara amnya, arus lebihan berlaku apabila berlaku litar pintas dalam sistem kuasa. Ini disebabkan oleh kecederaan pada kabel atau gangguan di persekitaran. Akibatnya, arus yang mengalir melalui sistem telah meningkat secara mendadak. Selain itu, kerosakan bumi boleh berlaku antara fasa tanah. Terdapat pelbagai jenis kesalahan, seperti fasa tunggal di tanah, dua fasa di tanah, dan tiga fasa di tanah. Matlamat projek ini adalah untuk mengenal pasti keupayaan geganti pada pelbagai jenis kerosakan sistem kuasa. Juga, perisian PSCAD digunakan untuk menentukan sama ada pemasangan litar dipasang dengan betul dan perkara yang sama berlaku dengan lukisan. Dalam projek ini, gambar dari pengedaran elektrik di loji janakuasa termal TNB Manjung diperoleh untuk menentukan dengan lebih berkesan dengan menggunakan perisian PSCAD.

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LIST OF SYMBOLS AND ABBREVIATIONS

IDMT	-	Inverse Definite Minimum Time Overcurrent Relay
PSM	-	plug setting multiplier
TMS	-	time multiplier setting
CT	-	current transformer
TNB	-	Tenaga Nasional Berhad
PT	-	Potential transformer
ROT	-	Relay Operating Time

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Protection of the power system is a branch of electrical power engineering that protects the electrical power system from damage caused by the failure of parts of the entire electrical network. The purpose of the protection scheme is to protect the public, improve the stability of the system, minimize equipment damage, protect against overloads, employ relay technology and engineering [1]. Meanwhile, for this project, the overcurrent scheme and discrimination used in the power system are more focused.

The concept of overcurrent is a situation in which excessive heat is generated by large quantities of current through the conductor and may cause fire or damage to equipment. Besides that, because of a short circuit, overload, motor starting impact and ground-fault, this overcurrent occurs. The fault of the earth often occurs when the phase or neutral conductor comes into contact with the earth or through a metal frame.

It protects the equipment from damage by using overcurrent protection to prevent the current from exceeding its predefined level. It normally operates instantly. Short circuits cause an overcurrent of some kind. To provide overcurrent protection, magnetic circuit breakers, fuses and overcurrent relays are commonly used [2].

The protection at medium voltage (MV) of voltage feeders is provided by overcurrent relays from electrical distribution at the TNB Manjung thermal power plant. This paper focuses on the practical protection coordination of electrical distribution by the use of the TNB Manjung thermal power plant as a case study.

1.2 Problem Statement

Failure of a properly functioning current relay can cause components in the power system to be damaged by excessive current. As a result, if the current relay fails to function properly, it can cause huge losses. In addition, for the current relays, timing is also very critical as these devices will operate based on the time specified.

However, there are different working hours for each relay used in the power system and this condition is called discrimination. However, each relay must be timed with each other in order for the power system to function properly and prevent overflow. As it will cause the relay to fail properly, the time limit should not be too quick or too late. The overhead relay cannot sense or perceive the current through it when the time is too fast, and thus it chooses to go offline from the power system. On the other hand, if it takes a long time for the relay to disconnect the circuit, the fault will proceed until it moves towards the main source of electricity. The current would also increase through the line and cause damage to components such as generators and transformers.

1.3Objective

1. To design the circuit network of the electrical distribution from the power plant, TNB Manjung thermal power plant uses PSCAD.
2. To simulate the relay operating time of an overcurrent relay with different types of faults,
3. To design the discrimination time between primary protection and backup protection

1.4 Scope

The goal of this project is to safeguard the distribution system against overcurrent schemes and discrimination. Thus, there is a need to determine the relay operating time based on the plug setting, time multiplier setting (TMS) and the type of characteristic curve for the overcurrent relay. The discrimination time is used between the primary protection relay and the backup protection relay. The following are the details of this project:

1. In the power system, the circuit network is used at 23/11.5 kV.
2. Implementation of three types of faults, such as single-line-to-ground, double-line-to-ground and three-line-to-ground fault forms.
3. In order to examine the impact of the IDMT characteristic curve on relay operating time, using the IEC 60255 standard.

1.5 Thesis Framework

For the project, each topic needs to create a report that relates to the topic being studied. This is to ensure that the project can be enhanced from time to time and thus facilitate further community research. It includes several phases or topics, including topics related to the introduction, summary view, methodology, decisions, and so on, based on this report. The introduction addresses the context of a project based on the first title, such as the importance of maintaining the power grid, listing a project's goals and how to implement those goals by researching the projects that are being worked on more closely.

The second chapter focuses on the project's theories and facts about current schemes and discrimination. These include the types of offenses, the basic characteristics of interest in protection, and the types of relay currents. The next chapter is about the methodology for using the PSCAD software to test that the circuit network of the TNB can operate very well. The results of the simulation will be analyzed and discussed in Chapter 4. Lastly, the conclusion and recommendations of this project will be elaborated on in Chapter 5.

1.6 Motivation

Every power system requires protection. Protection is one of the major devices that the power system must have. The power system cannot be successfully operated without a protective device. In addition, it not only protects equipment, but also protects the environment and our lives. The different types of relays that can be used depending on their characteristic curve and standards are the most interesting thing about protection. The IDMT relay is probably the best relay, as it is already widely used in the industry. In addition, it is also flexible compared to an instantaneous and definite time relay. The operating time for the IDMT refers to their pick-up current and the value of TMS. As an inversely proportional system, the IDMT will operate and save the power system. The larger the fault current, the less the operating time of the relay to trip the fault in the power system.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The literature review of the previous study on overcurrent schemes and discrimination will be discussed in this chapter. As guidance before moving to another chapter, the understanding of the researchers is the most important aspect. Therefore, in particular for overcurrent schemes and discrimination, there is more data that will be covered in more detail.

2.2 Fault's occurrences in Power System

An abnormal condition that occurs in the power system is always described as a fault [1]. Therefore, the simple insulation between the phase conductor and the grounding will be reduced [1]. Short circuits and overloads are the major electrical system faults [1]. Short circuits occur due to factors such as excessive heat insulation, damage to electrical equipment and overloading or other abuse [2]. In addition, a short circuit can also occur between one or more phase conductors and the ground [2]. However, there is a major factor that causes faults in the power system, such as injury to underground cables, lightning strikes, falling trees and exposure to animals such as snakes, squirrels and rats [7].

2.3 Types of faults

Faults will occur when there is a short circuit in the power system. Furthermore, there are two types of electrical faults, which are symmetric faults and asymmetric faults.

2.3.1 Symmetrical Faults

This symmetrical fault has also been called the balance fault. All three phases are short-circuited, and all three phases have a ground fault; each of the following occurs only infrequently in the power system. This type is caused by the breakdown of the insulation between all three phases and all phases of the ground. Moreover, during the faults, the angle between all phases is the same, which is 120 ° in a positive sequence.

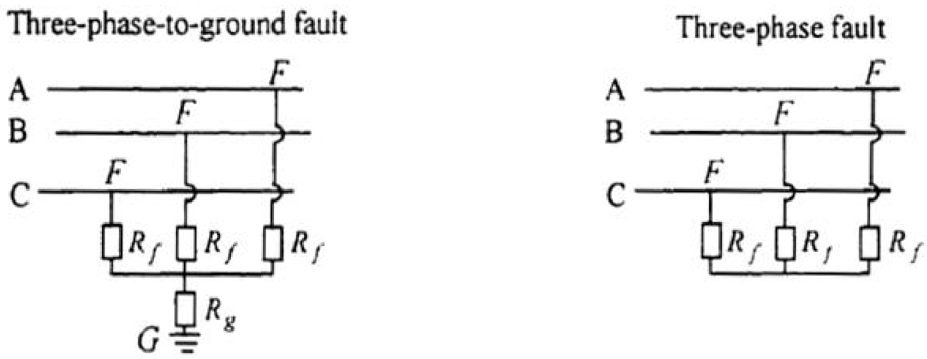

Figure 2.1: Balance fault

2.3.2 Asymmetrical faults

Asymmetrical faults are also referred to as unbalanced faults. The fault effect is on the related phase only and the current for each phase is not equal at all. The types of unbalances that occur are single line – ground fault (SLG), line– line fault (LL) and double line – ground fault (DLG) [1]. First, a single line – ground fault occurs when the conductor's single phase causes a short circuit in the ground. It is sometimes due to falling trees on the transmission line [1]. Then, for the line, the line fault occurs when only two phases have short circuits without the ground. This may have been due to a bird, squirrel or snake standing and touching both phases simultaneously inside the switchgear or at the top of the transmission line [1]. After that, the last fault that happens in the power line is a double line – a ground fault. It's much liked the same thing that happens with a single line – the ground is due to falling trees, but in this case, touching more than one phase at the same time [1].

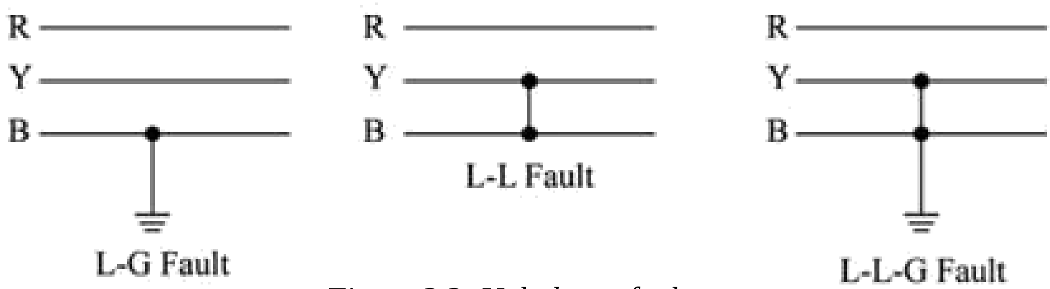

Figure 2.2: Unbalance fault

2.4 Power System Protection

The purpose of power system protection is to protect the system from excessive electrical supply while minimizing the damage to equipment, property and to save life in the surrounding area [4]. This happens when the faults that come through the power system are detected and isolated automatically by the protective device. There are several types of protection, such as overcurrent protection, earth fault protection, differential protection, distance protection, overvoltage and undervoltage protection and others. Furthermore, if the power system did not have protection, it would cause all related things to be a big problem because it is difficult to identify the causes of the offence [1]. Thus, it makes sense why power system protection is needed.

2.5 Power System Protection Components

Several major components involved in a protection system are CTs, PTs, protective relays and circuit breakers. The protective relay will get the information about current and voltage from the CT and PT, and then after that, it will inform the circuit breaker to trip if the system has an excessive measurement. All protection components must work together at the same time to make it work. If one of them doesn't work, the protection of the power system will fail. The following are the main components for the protection of the power system:

2.5.1 Current Transformers (CT)

A Current Transformer (CT) is one of the important components in power system protection. In practice, the standard value of the secondary is 5A and 1A. There are two kinds of CT scans. The first is to reduce the high current from the primary to a lower value that is suitable for the protective relay to operate on the secondary side [4]. Besides that, it is also isolated between the primary and secondary circuits [4]. However, mistakes can still happen, especially during practice. The error always occurs at a different magnitude and phase angle. These are all in ratio errors and phase angle errors. Even though the current transformer is used for measurement, there are differences between the protection CT and the metering CT [4]. The metering CT is designed to know the level of the limit for the relay to operate and protect the equipment from excessive current during normal conditions, while the protection CT is designed to have high accuracy during a fault condition and is required to have 5% to 10% for an error. [8]

Figure 2.3: Current Transformer (CT)

2.5.2 Voltage Transformers (VT)

For the Voltage Transformer (VT), it is used to reduce the high voltage to another level until it is suitable for the protective relay. According to the curve, the value of the voltage is always needed in the unsaturated region to make sure that the relay can be operated. Voltage Transformers (VT) are also called Potential Transformers (PT). In practice, the standard value of the secondary is 110V [4]. The PT primary is connected in parallel with the burden for the measurement, while the CT primary is connected in series to measure the current [4]. However, there are two main types of voltage transformers, which are Electromechanical VT's and Capacitor VT's (CVT). The function of Electromechanical VT's is the same as the power transformer, but it is not suitable for high voltages of more than 132kV [4]. Meanwhile, the Capacitor VT (CVT) is suitable for high voltage, but for the circuit, it uses the capacitor divider in front of the circuit.

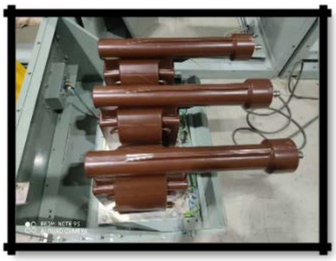

Figure 2.4: Voltage Transformer (VT)