“ I hereby declare that I have read through this report entitle “Time and Current Grading for Inverse Definite Minimum Time (IDMT) Coordination Relay Setting” and found that it has comply the partial fulfilment for awarding the degree of Bachelor of Electrical Engineering (Industrial Power)”

Signature : ....

Supervisor’s Name : ....

Date : ....

TIME AND CURRENT GRADING FOR INVERSE DEFINITE MINIMUM TIME (IDMT) COORDINATION RELAY SETTING

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This Report is Submitted in Partial Fulfilment of Requirements for the Degree of Bachelor in Electrical Engineering (Industrial Power)

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2015

I declare that this report entitle "*Time and Current Grading for Inverse Definite Minimum Time (IDMT) Coordination Relay Setting*" is the result of my own research except as cited in the references. The report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : ....

Name : ....

Date : ....

ACKNOWLEDGEMENT

Grace be upon to ALLAH the Almighty, with HIS blessings, the Final Year Project II report "Time and Current Grading for Inverse Definite Minimum Time (IDMT) Coordination Relays Setting" is ready for sending this report to fulfill the requirement of project scope and it is suitable to being awarded the Bachelor of Electrical Engineering majoring in Power Industrial. First and foremost, thanks too Allah for giving me strength to complete this progress report. Next, the special thanks I would like to give to my supervisor En. Mohamad Faizal Bin Baharom who always guide me and give me his information to complete this project.

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Thank you.

ABSTRACT

Protections are viral due to the safety. It is the main aspects due to safety matters in the network systems. In fact, the maximum percentage fault occurs in the reality life is more due to unbalanced fault compare to balanced fault. In transmission line faults, roughly 5% are balanced fault. This is in contrast to an unbalanced fault, where the three phases are not affected equally. Lack of coordination in the relay setting might lead to inherent tripping in the system. The impact will reduce the system efficiency and might be cause danger to the consumers. This problem can be solved by proposing the proper relay setting technique by coordination the value of current and time in particular system. Relay that used in this project is inverse definite minimum time relay (IDMT) and it is have a widely application in distribution system. On the other hand, this study will use Computer Aided Protection Engineering (CAPE) software to analyze the selected area to determine the performance of the network system. As a result, the values of the simulation which is the fault and the relay coordination will be recorded. The result from the CAPE software is more accurate in term of power flow, fault analysis and relay coordination. As a conclusion, the CAPE can be used to analyze the values of power, fault analysis and relay coordination. Then, the impact of the relay setting will be avoided miscommunication, tripping happen to the network.

ABSTRAK

Perlindungan adalah perkaitan kepada keselamatan. Ia adalah aspek utama kepada hal-hal keselamatan dalam sistem rangkaian. Malah, peratusan kerosakan maksimum berlaku dalam kehidupan realitinya adalah lebih disebabkan oleh kesalahan yang tidak seimbang berbanding dengan kesalahan yang seimbang. Dalam kerosakan talian penghantaran, kira-kira 5% adalah salah seimbang. Ini berbeza dengan suatu kesalahan yang tidak seimbang, di mana ketiga-tiga fasa tidak terjejas sama. Kekurangan penyelarasan dalam suasana geganti mungkin menyebabkan tersandung wujud dalam sistem. Kesan ini akan mengurangkan kecekapan sistem dan mungkin menyebabkan bahaya kepada pengguna. Masalah ini boleh diselesaikan dengan mencadangkan teknik penetapan geganti yang betul dengan penyelarasan nilai dan waktu semasa dalam sistem tertentu. Relay yang digunakan dalam projek ini adalah songsang yang pasti masa geganti minimum (IDMT) dan ia mempunyai aplikasi secara meluas dalam sistem pengagihan. Sebaliknya, kajian ini akan menggunakan Berbantukan Komputer Kejuruteraan Perlindungan (CAPE) perisian untuk menganalisis kawasan yang dipilih untuk menentukan prestasi sistem rangkaian. Akibatnya, nilai-nilai simulasi yang bersalah dan penyelarasan geganti akan direkodkan. Hasil daripada perisian CAPE adalah lebih tepat dari segi aliran kuasa, analisis kesalahan dan penyelarasan geganti. Kesimpulannya, yang CAPE boleh digunakan untuk menganalisis nilai-nilai kuasa, analisis kesalahan dan penyelarasan geganti. Kemudian itu, kesan penetapan geganti akan dielakkan, tersandung berlaku kepada rangkaian.

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CHAPTER 1

INTRODUCTION

1.1 Research Background

The primary function of a protection system in electrical power network is to ensure the continuity of the electrical supply. To achieve this, the protection system must be able to detect the abnormal condition in electrical circuit or piece of equipment, to identify the location of fault and to isolate the fault section of circuit or the faulty equipment without disrupting the electricity supply to the rest of network. The simple protective system device is a fuse or CB. Upon sensing the abnormal current passing through a circuit, the fuse or CB will disconnect the electrical supply to the circuit by self-destructive. The protective equipment used in a protection system includes current transformer (CT), relays, timers and trip coils.

An overcurrent relay provides turn out to be one the majority of essential protective devices. It has recently been applied as the main and backup protection in power system for its functions of high reliability, selectivity and cost effective. Additionally, a unique function that the IDMT overcurrent relay is getting quick fault clearing times. The magnitude of the current is inversely proportional due to the operating time of the relay. This means that for higher fault current, shorter operating time is required to clear the fault.

Usually, much more complex network system, the protective relay coordination problem occurs because of the bad relay coordination. A careful concern in selecting the overcurrent setting, usually time multiple setting and plug setting are usually essential to obtain the greatest protection in making sure the reliabilities throughout the incident of any faulty circumstances. For interconnected networks, it is needed to take a look at the performance of a complete relay setting scheme. For example review is practically difficult by hand for a complex interconnected system, and additionally digital computers should be used [1].

The conventional and traditional technique that includes of lots of tiresome and hard task and in determining the plug and time multiple setting for every own relay is adoptive and is still significant for a basic network. This technique is almost difficult for a complex and interconnected network. Therefore, the review in determining the functionality of the IDMT protection can be achieved by the execution of the Computer Aided Protection Engineering software, CAPE [2]. Cape consists of an involved set of ten data management and evaluation programs developed to help protection engineers with their day-to-day actions of selecting, setting, and coordinating protective relays [3]. The functionality of the relays in a radial system is anticipated and is decided by the real relay settings. This project provides the study of the time and current grading for inverse definite minimum time coordination relays setting of a simple radial distribution system network.

1.2 Problem Statement

A few disruptions in power supply were due to the inappropriate setting or wrong selection of the power protection devices. Therefore, it had caused inherent tripping, inadequate over current protection and inactivated earth fault. This information of design power system protection play very crucial rules to make sure that is no disruption of power supply. It is include the load flow analysis, fault analysis, proper setting and technique of relay setting.

1.3 Objective Project

The main objectives for this project are:

- To analyze load flow, fault analysis and coordination of the relay power at system network by using simulation software Cape.
- To analyze the performance of time and current grading method designed for power system network based on IDMT relay.
- To develop proper setting technique for over current and earth fault using the IDMT MK 2000 relay.

1.4 Project Scope

The scopes of this project are:

- To analyze the load flows, fault analysis and coordination of the relays at power system network using simulation software Cape.
- To focus on overcurrent and earth fault relay operation, the relay setting current and time and the relay characteristic.
- To study the fault analysis for the over current, short circuit and earth fault.
- To determine the components and parameters that used in the network system such as calculate the fault, fault MVA, time multiple setting (TMS), and time operating of the relays.

1.5 Expected Project Outcome

Project should be:

- Successful analyze the load flow, fault analysis and coordination of the relay power at system network by using simulation software Cape.
- Successful in setting the IDMT MK 2000 relays for over current protection in the system.
- Successful in coordination and implementing the IDMT MK 2000 relays in the selected power network system.

CHAPTER 2

LITERATURE REVIEW

2.1 Theory and Basic Principles

Protection system for power system has been developed to minimize the damage and to make sure supply in safe condition, continuously and economically. Relay is one of the most important components in protections system. There is several kind of relay that each kind has own characteristic. A relay is device that makes a measurement or receives a signal that causes it to operate and to effect the operation of other equipment. It responds abnormal conditions in faulty section of the system with the minimum interruption of supply. The advantages of isolating a system faults as quickly as possible include for personnel a public, minimizing damage to plant and minimizing effects on system stability.

Protection towards extra present is usually the primary protection system to build. Through this simple theory, the graded overcurrent system and discriminative fault protection has been created. This should not be confused with „overload" protection, that generally can make apply of relays that work in a time connected in some degree to the thermal capability of the plant to be guarded. Overcurrent protection is targeted totally to the clearance of faults, although with the settings usually obtained several determine of overload protection may be obtained [4].

2.1.1 Discrimination

A protection system must be able to discriminate between healthy and faulty equipment and circuits. It can be achieved by current (magnitude), time and comparison. The simple radial distributions network system as shown in Figure 2.1.

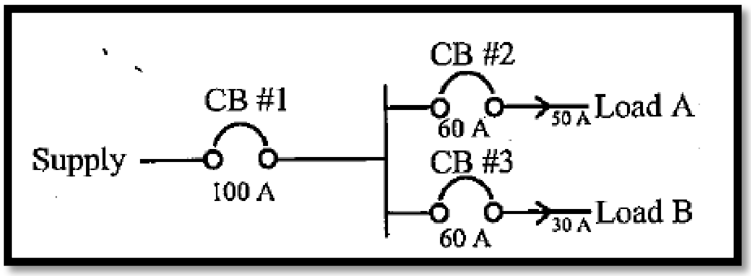

Figure 2.1: Simple radial distributions.

The CB 1 is set to trip at 100A and CB 2 and CB 3 is set to trip at 60A. After that, current drawn by a load A is 65 A and load B is 30A. CB 2 will trip since current drawn exceed 60A. CB 1 will not trip since total current drawn is 95 A and less than 100A. For this case, discrimination between CB 1 and CB 2 is archived by current grading.

Now let‟s consider the condition of CB 1 is set to trip at 100A CB 2 and CB 3 is set to trip at 60A. The current drawn by load A is 90A and load B is 30A Then, CB 2 will trip since current drawn exceed 60A. CB 1 will trip since total current drawn is 120 A and more than 100A. There will be no supply for both load A and B even though load B draws current less than tripping value. Thus in order to prevent this, time delay device is necessary for each breaker. Figure 2.2 show the time delay for each CB.

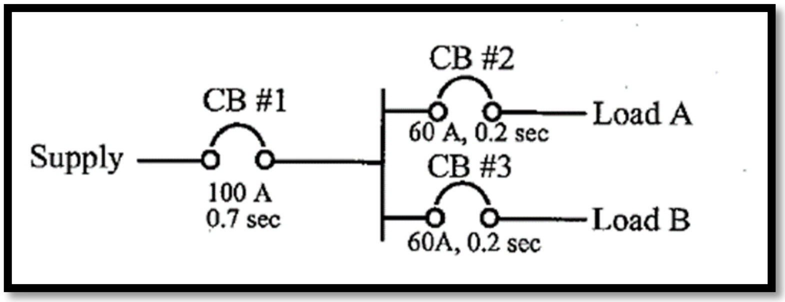

Figure 2.2: Time delay for each CB.

The minimum time interval is usually between 0.3 and 0.5s. It is required to prevent simultaneous tripping. CB 1 is set to trip at 100A at 0.7s. CB 2 and CB 3 is set to trip at 60A at 0.2s. Then, current drawn by load A is 90A and load B is 30A. After that, CB 2 will trip first since current drawn by exceed 60A and shorter time delay. CB 1 will not trip since longer time delay. There will be no supply for load A and load B is still operating. This discrimination between CB 1 and CB 2 is achieved by time grading.

A differential (or comparison) protection system compares the current flowing into equipment (i.e. cable, transformer) with the current flowing out. If there a difference, the protection will operate. The differential protection system is used for protection „a piece‟ of equipment such as a cable or a transformer. It is calling a „unit‟of protection system.

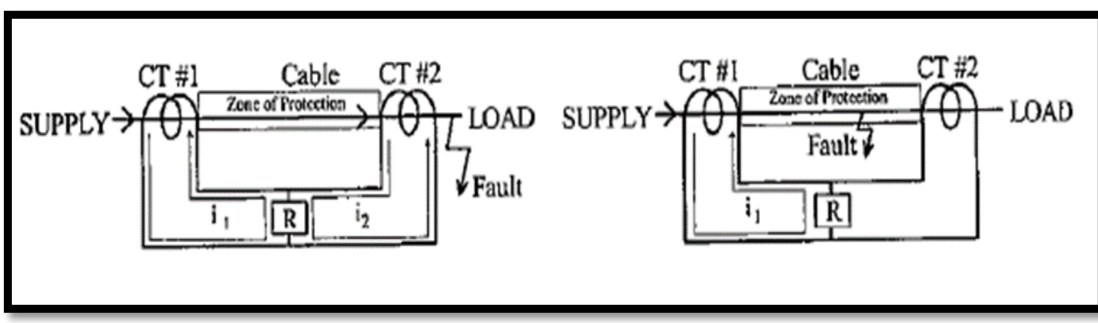

Figure 2.3: Balanced current.

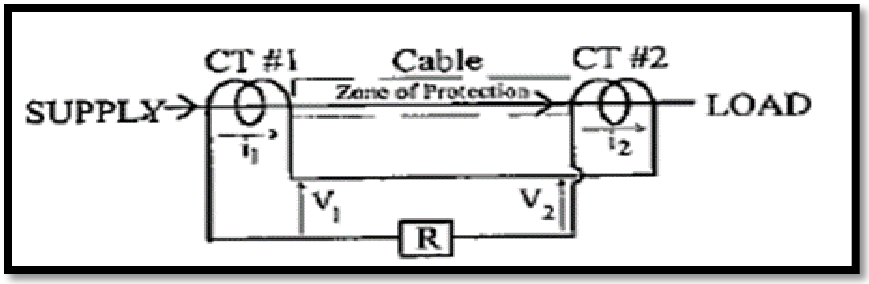

Figure 2.4: Balanced voltages.

2.1.2 Earth Fault Protection

Faults studies form essential things of power system. The issue consists of determining bus voltage and line currents throughout various sorts of faults. Faults on power are separated into two which is balanced and unbalanced faults. Types of unbalanced faults are single line to ground faults, line to line faults and double line to ground faults [5].

A fault in a circuit is any breakdown which will disturbs with the normal flow of current. The faults are associated with abnormal change in current, voltage and frequency of the power system. Faults occurs in a power system due to insulation breakdown of equipment, flashover of lines initiated by lightning stroke and because of permanent damage to conductors [6].

Other than, much more responsive protection towards earth faults can be achieved by using a relay which reacts only to the residual current of the system. The earth-fault relay is totally same by load currents, no matter if balanced or not. It can be provided a setting which is restricted only by the style of the equipment and the occurrence of unbalanced leakage or capacitance currents to earth. This is an essential concern if settings only a few percent of system rating are regarded, since leakage currents may make a residual quantity of this order.

The lower configurations allowable for earth-fault relays are really helpful. Earth faults are not only by far the many of all faults, but may be restricted in magnitude by the neutral earthing impedance. The basic connection shown in Figure 2.5 can be prolonged by connecting overcurrent elements in the individual phase leads, as shown in Figure 2.6, and applying the earth-fault relay between the star points of the relay group and the current transformer.

Phase fault overcurrent relays are frequently supplied on only two phases since these will identify any interphase fault; the connections to the earth-fault relay are not affected by this concern. The setup is shown in Figure 2.7.The typical settings for earth-fault relays are 30%-40% of the full-load current or minimum earth-fault current on the part of the system being guarded.

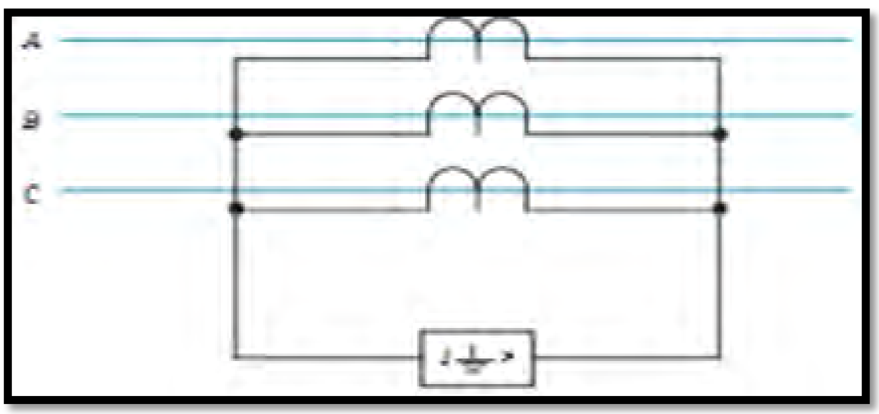

Figure 2.5: Residual connection of fault transformer to earth fault relays.

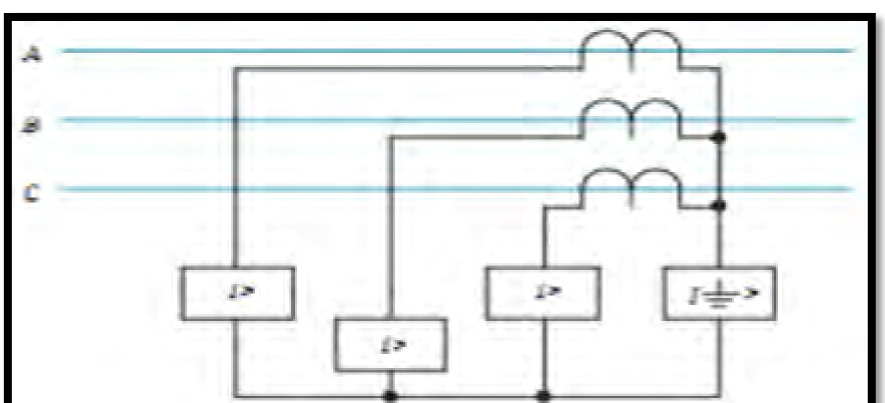

Figure 2.6: Residual connection of fault transformer to earth fault relays.

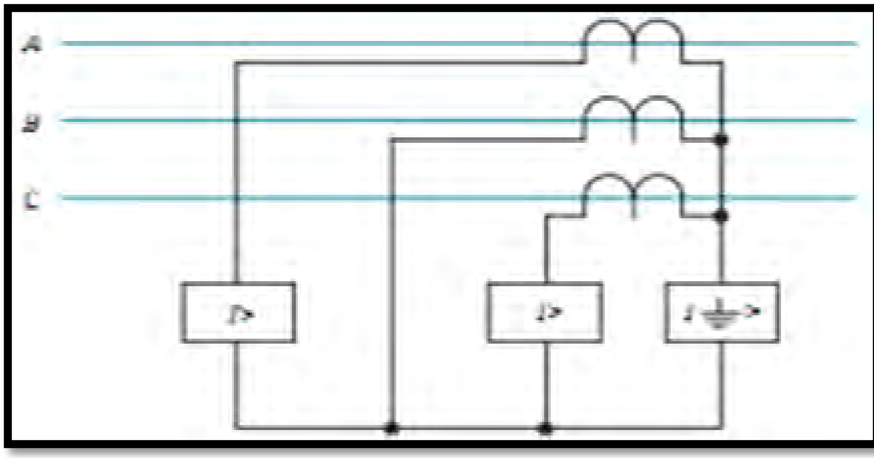

Figure 2.7: Residual connection of fault transformer to earth fault relays.

2.1.3 Relay Coordination Concept

2.1.3.1 Radial System

The specific protective relay as primary or backup is important in distribution system. When the relay applied to protect its own system element it is thought of primary relay, when to backup other relays for fault at remote location, it is serving as backup relay. Providing both functions simultaneously; serving primary relay for its own zone protection and backup relay for remote zone of protection. Besides, the protective relay must be time-coordinated, so that the primary relay will always operate faster than the backup relay. So, the setting and coordination of the relay is the very important part to make sure which relay stands for primary and the other one for backup.

2.1.4 Relay Current Setting

An overcurrent relay has a minimum operating current, known as the current setting of the relay. The current setting must be chosen so that the relay does not operate for the maximum load current in the circuit being protected, but does operate for a current equal or greater to the minimum expected fault current. Although by using a current setting that is only just above the maximum load current in the circuit a certain degree of protection against overloads as well as faults may be provided, the main function of overcurrent protection is to isolate primary system faults and not to provide overload protection.

In general, the current setting will be selected to be above the maximum short time rated current of the circuit involved. Since all relays have hysteresis in their current settings, the setting must be sufficiently high to allow the relay to reset when the rated current of the circuit is being carried. The amount of hysteresis in the current setting is denoted by the pick-up/drop-off ratio of a relay – the value for a modern relay is typically 0.95. Thus, a relay minimum current setting of at least 1.05 times the short-time rated current of the circuit is likely to be required.

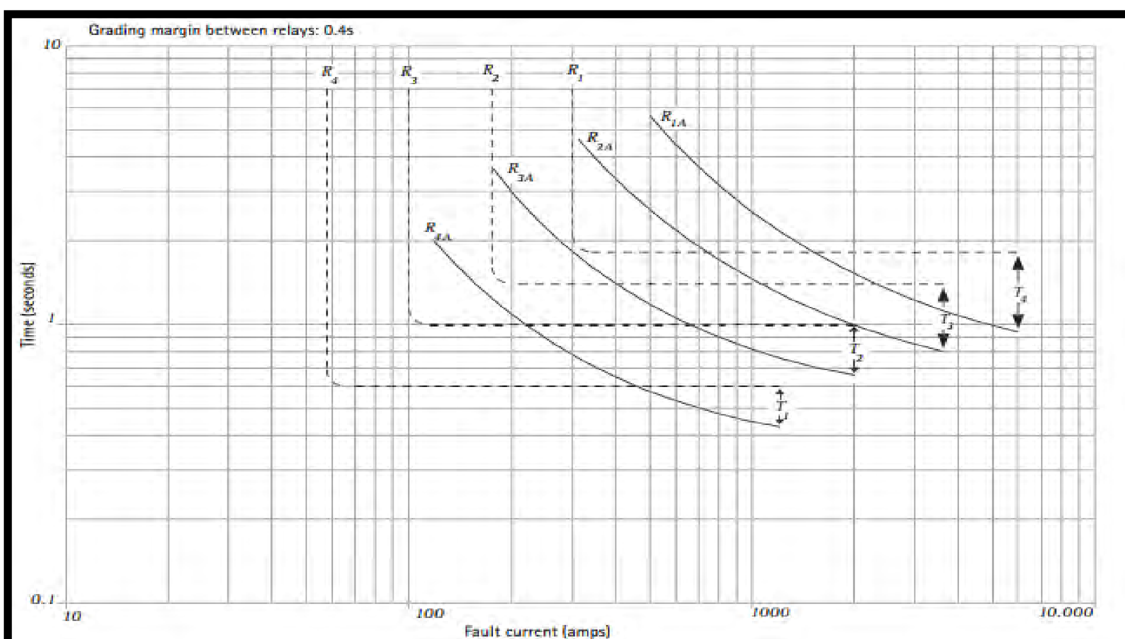

Figure 2.8: Definite Time Characteristic for Overcurrent Relay