COMPARATIVES STUDY ON IDMT OVERCURRENT AND EARTH FAULT RELAY: MIKRO MK2000 AND ABB SPAJ 140 c

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APRIL 2009

"I hereby declare that I have read through this report and found that it has comply the partial fulfillment for awarding the degree of Bachelor of Electrical Engineering (Control, Instrumentation and Automation)"

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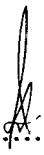
"I hereby declare that this report is a result of my own work except for the experts that have been cited clearly in the reference."

Signature : 

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ABSTRACTS

This project is about comparatives study between two IDMT overcurrent and earth fault relays due to their performance of currents and timing in reacting when fault occurs in plant. Both of this relays will be tested in real time and injected with real secondary currents based on calculating fault that occurs in Measat Cyberjaya plant.

In current situation, there is major loss for any factory if inherent tripping occurs. Meaning of inherent tripping are relay did not trip when fault occurs, relay trip when fault did not occurs and relay trip because starting current of machine used in factory. Usually this could inherent tripping could happen because of unskilled testing Engineer, improper setting of relays and malfunction of relay.

The result of this project is compiling documentation for a setting of IDMT relays. This documentation will be an assessment for student and new engineer to starting their engineering careers.

ABSTRAK

Projek ini berkenaan perbandingan antara dua geganti IDMT lebihan arus dan kerosakan ke bumi dari segi pencapaian reaksi terhadap arus dan masa dan reaksi apabila berlakunya kerosakan di dalam sistem elektrik sesuatu tempat. Di mana kedua-dua geganti ini akan diuji pada waktu sebenar dengan pengaliran arus sekuder berdasarkan kiraan nilai kerosakan litar yang berlaku di system elektrik Measat Cyberjaya.

Dalam situasi sekarang, sesebuah syarikat akan mengalami kerugian yang besar sekiranya terdapat pemotongan arus tanpa keperluan. Iaitu berlakunya ketidakfungsian geganti semasa berlakunya kerosakan sistem elektrik, geganti beroperasi walaupun tidak berlakunya sebarang kerosakan pada sistem elektrik dan geganti beroperasi apabila sesuatu mesin dihidupkan. Kebiasaannya, keadaan ini boleh berlaku kerana ketidakcekapan jurutera yang mengendalikan atau menetapkan nilai PS atau TMS pada geganti tidak diaturkan dengan tepat dan kerosakan pada geganti.

Untuk pengakhiran bagi projek ini adalah menyiapkan sebuah dokumen untuk penentuan nilai PS dan TMS pada geganti. Dokumen ini akan memberi bantuan kepada jurutera dan pelajar untuk membantu menyiapkan projek mereka.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYM

IDMT	-	Inverse Definite Minimum Time
TMS	-	Time Multiplier Setting
PS	-	Plug Setting
PSM	-	Plug Setting Multiplier
ACB	-	Air circuit breaker
VCB	-	Vacuum Circuit Breaker
MCB	-	Miniature Circuit Breaker
MCCB	-	Molded Case Circuit Breaker

LIST OF APPENDIX

CHAPTER 1

INTRODUCTION

1.1 Project Background

This project is conducts to investigate the proper setting of overcurrent and earth fault IDMT relay. Most of the inherent tripping occurs due to relay wrongly setting and miscalculation of fault.

This proposal is focus on a study of a power plant network. The study involved of the plan network including the load, power setting and fault. Total load connected would be analyzed and maximum current will then be determined to find the setting for the relay. Then the systems would then be simulating with ERACS software. Fault then will be determine for each zone, where each zone will be a different type of fault. As example, for zone A, fault occurs are phase to phase fault. For zone B, fault occurs are phase to earth fault. After both zone's fault had been determined. This fault will be simulated with ERACS software.

Plant taken for this project is Measat Cyberjaya Substation. The reason of actual plant was taken due to realistic this study. As the documentation to be accomplished is the actual referring document for new engineers and students.

By referring to this plant's single line diagram, Fault will be calculated and the setting of IDMT overcurrent and earth fault relays could be determine. The parameters due to the calculation and noted inside the single line diagram will be use for this documentation,

hence would be use for IDMT overcurrent and earth fault relays of MIKRO MK2000 and ABB SPAJ 140 c setting.

IDMT relays that already been set due to the setting developed from before will be test using secondary test set. The setting will be record for a further analysis to develop proper setting documentation. Then, two IDMT relays MIKRO MK2000 and ABB SPAJ140c will be using for testing. Both IDMT SPAJ 140c and MK2000 will be tested and compared for their performance in current and timing. This to be done in accordance finding which relay is perfect in their performance based on BS 142 and IEC 60255 Normal curve standards.

1.2 Problem Statement

In reality, IDMT relays setting procedure are not clear because it is normally setting according of load. So the relays did not working precisely to protect the systems. As example:

- Relay did not trip when fault occurs
- Relay trip when fault did not occurs
- Relay trip because starting current of Machine used in factory

In current situation, inherent tripping will cost loss to an industry that depends on electricity such as MEASAT, ASTRO and mostly online company. Cause of inherent tripping:

- Unskilled testing Engineer
- Improper setting of relays
- Relay malfunction

Difficulty to get actual performance for IDMT relays unless proper documentation taken.

1.3 Project Objective

Below are the objectives of this project.

- To analyze systems load fault for determine IDMT relay setting.
- To develop proper IDMT relays setting procedure to be a reference for new engineers and students.
- To get comparison data for two IDMT relays MIKRO MK2000 and ABB SPAJ 140c based on their time and current performance.

1.4 Scope of Project

- In the Power of Electrical subjects, this project is about analyzing, determining and calculating zone by zone fault for the plant, where the fault level of the plant would be analyze for setting of IDMT
- One part of Electrical Engineering as this project would compiled as documentation due to design and calculating in determining and finishing their design.
- Comparing the performance of IDMT relays MIKRO MK2000 and ABB SPAJ 140c by making a series of testing using MEASAT CYBERJAYA plant.
- This research would be done within part of Power studies by utilizing fault studies, Cable sizing and Power Systems protection. Which consist Per Unit as references of calculation, and then expanded for fault level and fault currents. While cable sizing, need to study the part of design currents.

CHAPTER 2

LITERATURE REVIEW

2.1 Inverse Definite Minimum Time (IDMT)

From graph above, IDMT explain as Inverse Definite Minimum time which explain as time and current discrimination for overcurrent and earth fault relay. Meaning, the relay that uses IDMT as its discrimination protection scheme, would operate and trip under influence of the graph. As the graph above shows whenever the Plug Setting multiplier (PSM) is increasing, the time operate would decrease.

This type of relay use Plug Setting (PS) to set the limit of current should go through the relay without trip. It is mean if the relay were set at 95% of 100A. The relay would only allowed 95A to go through the systems.

IDMT relay also need a Time Multiplier Setting (TMS) setting to help him in calculate the tripping time due to the fault level in any systems. This is explaining in equation (2.1), (2.2), (2.3) and (2.4).

$$PS = \frac{I_L}{(CT)(\mathrm{R}_R)} \tag{2.1}$$

$$PSM = \frac{I_F}{(PS)(CT)(\mathrm{R}_R)} \tag{2.2}$$

$$t_{CHA} = \frac{0.14}{(PSM)^{0.02} - 1} \tag{2.3}$$

$$TMS = \frac{t_{OP}}{t_{CHA}} \tag{2.4}$$

Where:

I_L = Load currents

I_F = Fault currents

PS = Plug Setting

PSM = Plug Setting Multiplier

TMS = Time Multiplier Setting

Figure 2.1: IDMT curves

Four IDMT curves comply with BS 142 and IEC 60255:

1. Normal Inverse
2. Very Inverse
3. Extreme inverse
4. Long-time inverse

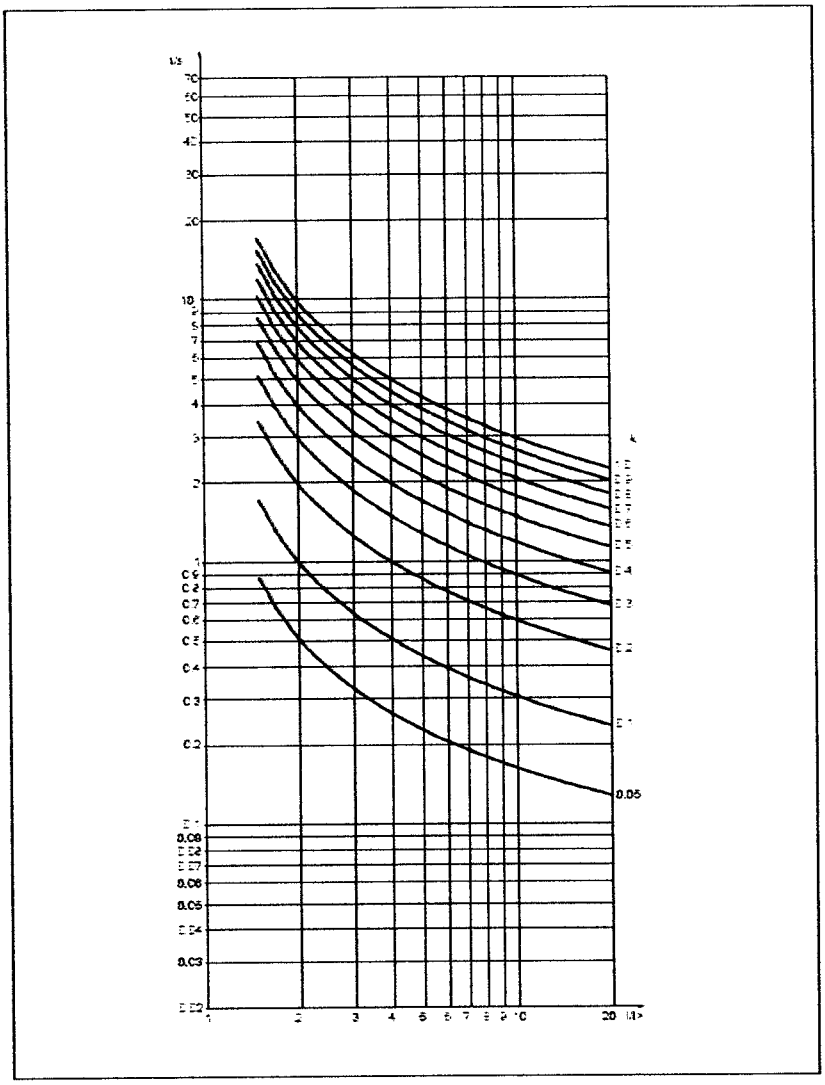

Figure 2.1: Normal Inverse Curves

2.2 IDMT Overcurrent and Earth Fault Relay

ABB SPAJ Manual book interpreting a relay is to receive secondary currents from current transformer (CT) and react according to it. IDMT Overcurrent and Earth Fault Relay relay will continuously measure every phase of system's secondary current to determine its state[5].

It also mention that the relay would detects faults that occurs in the systems, it will reacts according to TMS of the relay and then refer IDMT curves that determine the level of fault and trip in the range of time that accepted by BS 142 and IEC 60255 IDMT curves standard. When the time elapsed, the relay will give a signal to trip the circuit breaker.

2.3 SECONDARY CURRENT INJECTION TEST SET

A secondary current injection test set was used in testing the IDMT overcurrent and earth faults relay. As taken the use of secondary current injection tests from Secondary current test set 100ADM mk2 manual book. This testing set is injecting an amount of needed current to starting the setting current of relays; means replaced the job of current transformer to inject a current inside the relays. But this test set is used when the supply were isolated from relays.

2.4 REVIEWS ON PAST STUDIES

A lot of studies for IDMT relays were done before. By implementing the relays in their experiments and focusing about the relays has improving the understandability of this IDMT relay. The use of IDMT relay has been widen and been more complexity in determine and applying the relays inside distribution systems.

By reviewing optimal coordination of Overcurrent Relays, a group of students studied the way to optimizing the coordination of overcurent relays. The optimal programming coordination is known as efficient method to set overcurrent relays time and currents setting.However, the large number of constraints may limit the benefits of the optimal programming. So, they were doing studies to present the effective method to reduce the number of constraints. They were approaching the linear optimization techniques to obtain the optimal setting of overcurrent relays. This method applied, has two phases which is phase 1 and phase 2. Phase 1 is based on the intersection of a constraint with an area, which is called Possible Solution Area (PSA) as shown in figure 2.3. PSA is a square bounded area by the maximum and minimum values of Time Multiplier Setting (TMS), which actually relay pose [8].

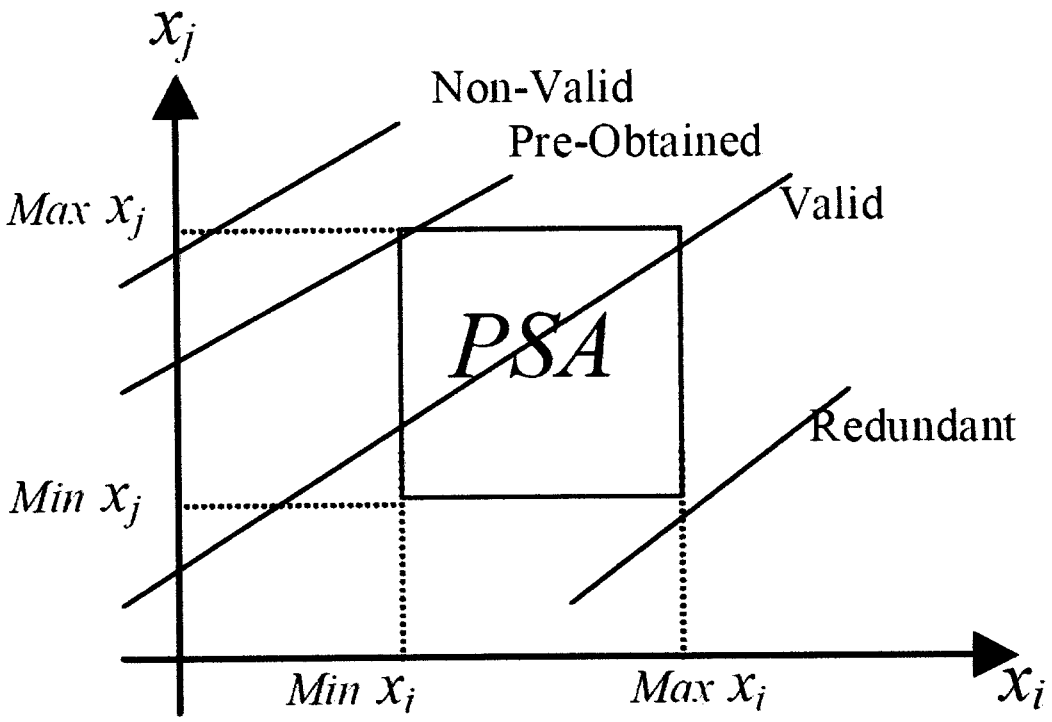

Figure 2.2: Possible Solution Area (PSA)

Phase 2 is based on the location of the crossing point of two valid constraints, where each constraint is compared with another and the smallest Feasible Solution Area (FSA) of the optimal problem will be obtained. It is illustrated in figure 2.4.