



اَوْنُوْزِ سَبِيْتِيْ بِاَتِيْكَوْ لُوْ كِيْ بِاَبَاْرَا  
UNIVERSITI  
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**IDENTIFICATION OF FAULT AND LOAD INCREASE TO  
PREVENT DISTANCE RELAY MAL-OPERATION**

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## ABSTRACT

Zone 3 distance relay mal-operation due to overloading has been identified as one of the factors of blackouts in the world. One of the causes that lead to this problem is it cannot differentiate between fault occurrence and load increase in transmission lines. Therefore, it is important for us to distinguish between two of the disturbances in order to improve the reliability of distance relay performance. The main objective of this project is to find an indicator that can differentiate between fault occurrence and load increase. This paper presents a proposed method to identify fault occurrence and load increase in transmission line by analyzing instantaneous voltage and root mean square (RMS) voltage signal waveform measured at the remote buses. The proposed technique is designed and validated through simulations of IEEE 9-bus test system in PSCAD. The waveforms of instantaneous voltage as well as RMS voltage measured have been plotted using Microsoft Excel. Analyses of the waveforms have been carried out in order to differentiate the characteristics between two of the disturbances. The results show that there are different characteristic of voltage waveform that can clearly indicates fault occurrence and load increase. The difference between two of them can be identified as fast as in time of one cycle after the occurrence. Therefore, it is suitable to be implemented on Zone 3 distance relay operation because the operation of the zone has time delay in the order of 90 cycles.

# CONTENTS

	<b>Page</b>	
<b>DECLARATION</b>	ii	
<b>ACKNOWLEDGEMENT</b>	iii	
<b>ABSTRACT</b>	iv	
<b>CONTENTS</b>	v	
<b>LIST OF FIGURES</b>	vii	
<b>LIST OF ABBREVIATIONS</b>	ix	
<b>CHAPTER 1</b>	<b>INTRODUCTION</b>	
1.1	Research Background	1
1.2	Problem Statement	2
1.3	Objective of Research	3
1.4	Scope of Work	3
1.5	Thesis Organization	3
<b>CHAPTER 2</b>	<b>LITERATURE REVIEW</b>	
2.1	Distance Relay	5
	2.1.1 Distance Relay Operating Zones	5
	2.1.2 Time Setting for Operation of Distance Relay	6
	2.1.3 R-X Diagram	7
2.2	Previous Work to Enhance Zone 3 Distance Relay Performance	9
	2.2.1 Zone 3 with Advanced Load Blinder	9
	2.2.2 Defining Load Encroachment Region in the Impedance Plane	11
<b>CHAPTER 3</b>	<b>METHODOLOGY</b>	
3.1	Proposed Technique to Differentiate between Fault Occurrence and Load Increase	13

# CHAPTER 1

## INTRODUCTION

### 1.1 RESEARCH BACKGROUND

Distance relay is one of protective devices used in electrical power system. It is typically used for the protection of transmission lines. Its function is to discriminate between the normal operations and fault conditions. A relay will initiate a trip signal to the associated circuit breaker when a fault occurs within its operating zone. However, it has been observed that unwanted tripping signal caused by unexpected loading conditions have often contributed to the mal-operation of distance relay and lead to blackouts.

On 14 August, 2003, the largest North American blackout has occurred about 4:10 p.m. Eastern Daylight Time (EDT) [1-3]. It resulted in more than 70,000 megawatts (MW) of electrical load loss in parts of Ohio, Michigan, New York, Pennsylvania, New Jersey, Connecticut, Massachusetts, Vermont, and the Canadian provinces of Ontario and Quebec. The number of people that have been affected is predicted about 50 million. According to the report, there are many different factors that caused the wide area system collapse. One of them is many of the key lines that tripped operated on Zone 3 impedance (distance) relays (or Zone 2 relays set to operate like Zone 3s), which responded more to overloads than faults on the protected facilities.