ADAPTIVE DISTANCE PROTECTION TO PREVENT MAL OPERATION WITH STATCOM ON A TRANSMISSION LINE

JOSEPH TING LIAN HOCK

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Faculty of Engineering
Universiti Teknologi Malaysia

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ABSTRACT

This paper planned associate adaptive algorithm setting for distance protection relay to stop mal operation for transmission line with presence of static synchronous compensator (STATCOM). With STATCOM in transmission line will improve power transferability and power system controllability but it brings some challenge to the protection schemed especially distance protection. Adaptive distance method able to overcome the under-reaching or over-reaching by conventional distance characteristics. The effect of STATCOM on distance protection for various type of fault, such as single phase fault, phases to phase fault and STATCOM installation locations will be investigate. The power system and STATCOM with controller are modelling using PSCAD/EMTD software. The simulation result shows the effect STATCOM on conventional distance relay unable fulfil the protective duties during the fault condition. Therefore, adaptive distance protection is required to overcome the situation.

ABSTRAK

Kajian ini dilakukan bertujuan mengakaji masalah relay perlindungan jarak jauh untuk menghentikan operasi waktu talian penghantaran dengan kehadiran pemampat penyegerakan statik (STATCOM). Dengan STATCOM dalam talian penghantaran akan meningkatkan kebolehpindahan dan kawalan kekuasaan sistem kuasa tetapi ia membawa beberapa cabaran kepada perlindungan terutamanya perlindungan jarak jauh. Kaedah penyesuaian sendiri bagi perlindungan jarak jauh dapat mengatasi masalah ini berbanding dengan cara perlindungan jarak jauh konvensional. Kesan STATCOM pada perlindungan jarak jauh denagn pelbagai jenis masalah seperti, rintangan kesalahan yang berbeza, sudut beban dan lokasi pemasangan STATCOM akan disiasat. Siasatan in akan mengunakan perisian PSCAD/EMTDC untuk memodelkan STATCOM dan perlindungan jarak jauh. Keputusan menunjukkan kesan STATCOM pada relay jarak konvensional tidak dapat memenuhi tugas perlindungan semasa kewujudan STATCOM. Oleh itu, perlindungan jarak penyesuaian diperlukan untuk mengatasi keadaan ini.

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LIST OF ABBREVIATIONS

STATCOM	-	Static Synchronous Compensator
FATCS	-	Flexible Alternating Current Transmission System (FATCS)
VSC	-	Voltage Source Inverter
DC	-	Direct Current
AC	-	Alternating Current
CT	-	Current Transformer
UTM	-	Universiti Teknologi Malaysia
GTO	-	Gate Turn Off
FFT	-	Fast Fourier Transform
POTT	-	Permissive Overreach Transfer Trip
PUTT	-	Permissive Underreach Transfer Trip

LIST OF SYMBOLS

U_s	-	AC System Voltage
U_g	-	Converter Output Voltage
X_g	-	Total Reactance of the Transformer Leakage
R_g	-	Total Resistance Summation the STATCOM
I_g	-	Current Flow Through the STATCOM
δ	-	Phase different Between U_g and U_s
S	-	Apparent Power
P	-	Active Power
Q	-	Reactive Power
E_s, E_r	-	Voltage of Two Source G1 and G2
Z_s, Z_r	-	Source Impedance of Two Source G1 and G2
I_S	-	Current from Two Source G1 and G2
G1	-	Generator 1
I_{St}	-	Current Injected From The STATCOM
N	-	Per unit Length of the Line Within The Fault and Relaying Point
V_R	-	Phase Voltage at Relay Point

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Transmission line is very important part of electrical transmission system, it transfers power from generation to the load. Any fault in transmission line cause disruption of electricity for reliable operation and lead to a wide scale of blackout. [1] Hence, protection of transmission line is very important to isolate fault furthermore, guarantee the security of a power matrix. It has various type of protection theories has be implement on transmission line such as over current, distance protection, line current differential, directional over current and etc. One of the most common used as the main protection for transmission line in power system is distance protection. [2] This relay operated base on estimation of the ratio of voltage and current, which is corresponding apparent impedance trajectory. When the fault falls inside the apparent impedance trajectory or operating zone, the trip signal will be activated by the relay.

In the ongoing years, Flexible Alternating Current Transmission System (FATCS) device are acquaint in power system with increment the transmitting limit and improve controllability of the line. [3] The impact of FACTS controllers on transmission system is significant because it will cause fast changes of the necessary system parameter like voltage, current, impedance, and phase angle. [4] This fast change will impact on performance of distance relay which corresponding base on impedance of the line. Static Synchronous Compensators (STATCOM) are devise that work receptive power at the purpose of the association with keep up the voltage profile and lift up the power exchange capacity. [5] The paper will examine execution of a distance protection relay in transmission line with presence of STATCOM by use PSCAD/EMTDC.

1.2 Problem Statement

The installation STATCOMs in transmission lime is upgrading controllability and expanding the power exchange ability on transmission lines. [6] STATCOM will control or direct regulate the voltage at reference an incentive value by providing or drawing reactive power at its associated connected point during or after faults. [7] For distance relays, it will react distinctively to fault because of the STATCOM's capacity to give momentary current compensation. At the point when STATCOM are infusing capacitive current, distance relay will be under-reach and another hand distance relay will over-reach when STATCOM are devouring reactive power. [8] Therefore the adaptive distance protection has to propose to overcome the issue.

1.3 Objectives of Study

This research embarks on the following objectivize:

1) To investigate the effect of STATCOM position in transmission line.

2) To analyses the impact Distance Protection, relay single phase fault, phases to phase fault.

3) Propose adaptive algorithm for distance relay to prevent mal-operation.

1.4 Scope of Work

The research work will carry out base on below aspects:

i) Modelling STATCOM in transmission line.

ii) Investigate the performance of STATCOM in transmission line in different position for the line such as mid-point, end-point and source point.

iii) Modelling distance protection relay

iv) Analyze the impact distance protection relay on single phase fault and three phases to phase fault condition.

v) Modelling simulation by using PSCAD/EMTDC

1.5 Report Outline

This proposal report has 4 chapters. The first chapter is introduction of the project research objective and problem statement. Literature review have presented in chapter 2 and mathematical STATCOM impedance will be introduce in the report. Chapter 3 will present the research methodology and simulation model. For Chapter 4 will be discuss the result of this project and Chapter 5 is discussion and future work.

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