

A SIMULATION STUDY ON CAPACITOR SWITCHING

**This thesis is presented in partial fulfillment for the award of the
Bachelor of Electrical Engineering (Honors)
Universiti Teknologi MARA**



**NOORASMAH BINTI MOHD ALI FACULTY OF
ELECTRICAL ENGINEERING
UNIVERSITI TEKNOLOGI MARA
40450 SHAH ALAM
SELANGOR DARUL EHSAN
MALAYSIA
MAY 2010**

ACKNOWLEDGEMENT

In the name of ALLAH S.W.T, the Beneficent, the Merciful. Thanks to Allah who has given me the strength and the ability to completed this final project and thesis successfully. Peace be upon our prophet Muhammad S.A.W who has given light to mankind.

I would like to take this opportunity to express my heartfelt gratitude and appreciation to my supervisor PM Dr. Chan Sei for his continuous and valuable guidance and help in completing this study. I am truly indebted with all the helps that he has done for me in completing this final project from the beginning until the end of this thesis.

My thanks also go to my beloved parents for their support and endless encouragement throughout my life. They have been a wonderful source of support, inspiration, and encouragement throughout my education, and they deserve much credit for where I am today.

My personal gratitude also goes to my entire friends, especially Mohamed Fadhil bin Mohamed Razali and Mohd Fakhurulradzi bin Zahri@Zahari for their help during completing this project. They have been with me for the time I needed them the most. Their idea, suggestion and encouragement help me a lot going through all the process.

Last but not least, my deepest appreciation to all the persons that involved directly and indirectly in this project with full willingness in contributing their efforts, time, energy and idea in helping me completes this thesis. There are no other words that would able to express my feeling of gratitude toward them except thank you.

ABSTRACT

The subject of power quality has achieved substantial consideration in recent years. From the largest industrial consumer to the smallest commercial facility, power quality affect the day to day of almost every process in operation today. Transient is the most common power quality disturbances encountered today. Transient in distribution network can damage key equipment in which potentially having a great impact on the system reliability. These transient may occur during the switching operation. Capacitor bank switching (CBS) is the example of switching operation that is used for power factor improvement, elimination of voltage drop on long feeder and control of reactive power. When a capacitor bank energized, the transient occur are not typically harmful to utility equipment but the highest transient voltage occur when the uncharged capacitor is switched at the voltage peak. This project focus on simulating the capacitor switching and methods to reduced the transient impact in distribution network.

TABLE OF CONTENTS

CONTENT	PAGE
DECLARATION	i
ACKNOWLEDGEMENT	ii
ABSTRACT	iii
TABLE OF CONTENTS	iv
LIST OF FIGURES	vii
LIST OF TABLES	ix
LIST OF ABBREVIATIONS	x
CHAPTER 1: INTRODUCTION	1
1.1 OBJECTIVE OF THE PROJECT	2
1.2 SCOPE OF WORK	3
1.3 PROJECT ORGANIZATION	4
1.4 THESIS OUTLINE	5

CHAPTER 1

INTRODUCTION

Capacitors are commonly found in distribution systems and usually installed on a power system in a three-phase configuration rather than single phase. The individual capacitor unit making up a bank may either be single phase or three phases. Capacitors may be installed on the customer service or utility system. Capacitors are used to increase the performance of distribution system by reducing losses, freeing up capacity and reducing voltage drop. Utilities typically employ them to improve voltage regulation and reduce losses. Customers may use them for power factor correction.

Capacitors store reactive power and supply it when the reactive load needs it. The most common form of distribution capacitor is the pole-mounted capacitor bank, the pad-mounted capacitor bank and also the substation capacitor bank. Capacitor banks may be controlled. They may employ a switch to control the time a capacitor is either energized or de-energized. Capacitors without controllable switches, which are called fixed capacitor banks, are either on or off all the time. Regardless of the fact that capacitors provide an advantage to distribution system, they also can create losses and overvoltage when they are not properly employed. They also generate transient inrush current when a capacitor bank is closed on an energized circuit.

During a capacitor switching operation, any sudden change in circuit condition will bring about a transient. Switched capacitors cause the most severe switching transient in distribution system compared to a typical utility operation such as energizing a cable or large load. Capacitive switching requires special attention because, after a current