MONITORING AND ANALYSIS POWER QUALITY PROBLEMS AT DISTRIBUTION SYSTEM

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" I hereby verify that I have read this report and I find it sufficient in terms of quality and scope to be awarded with the Bachelor's Degree in Electrical Engineering (industrial Power)"

Signature : .....

Supervisor's Name : IR ROSLI OMAR

Date : 19/5/06

"It is hereby declared that all materials in this thesis are the effort of my own work and materials which are not the effort of my own work have been clearly acknowledged."

Signature : .....

Name : NORSHAHIDA BT MUSA

Date : 4 MAY 2006

For my beloved parents, Puan Hajjah Ramlah bt Taib and En Haji Musa bin Abdul Rahman , and my dearest siblings Suraya Fitriah , Nurul Huda , Mohd Asma'I , Abdul Rauf , Nurul Syuhada , Khairul Hadi and Nurul Nadiah , also all my friends.

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In the name of ALLAH S.W.T, thanks for Him, finally I have completed my project thesis completely. Also praise upon the prophet Muhammad S.A.W, his family, friends and followers.

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Thank You Again.

ABSTRACT

With the advancement in technology and the increasing growth of industrial commercial facilities in many regions, problems in power quality have always been a major concern among engineers. This is particularly true in distribution system, where usage of power is very high as there are many large-scale types of equipment being used. Thus, it would be valuably useful to monitor and simulate these problems in power quality. This project, titled "Monitoring and Analysis of Power Quality Problems at Distribution Systems" is aimed to propose solutions to reduce power quality problems achieved through measuring and simulation using the PS-CAD simulator. During this project, the mitigation method suggested was to reduce the harmonics current on the three phase systems by using harmonic transformer mitigation (HMT).

ABSTRAK

Masalah kualiti kuasa banyak mendapat perhatian para jurutera pada masa kini berikutan peningkatan serta kecangihan teknologi dan pembangunan kemudahan perindustrian serta komercial di setiap kawasan . Gangguan kualiti kuasa kebiasaannya banyak berlaku pada sistem pengagihan kerana penggunaan kuasa yang tinggi diperlukan bagi setiap peralatan yang digunakan pada sistem ini.Oleh yang demiakian , kualiti kuasa amat perlu dipantau dari semasa kemasa untuk mengurangkan gangguan tersebut. Tajuk projek saya ialah memantau dan menganalisa gangguan kualiti kuasa pada sistem penghantaran. Tujuan utama projek ini dijalankan ialah untuk mencadangkan satu cara bagi mengurangkan gangguan kualiti kuasa pada system penghantaran. Didalam projek ini , antara cadangan yang dibuat untuk megurangkan gangguan kualiti kuasa ialah membuat simulation menggunakan PScad dan menggunakan transformer sambungan secara delta – star. Data dan nilai bacaan bagi arus harmonic pada sistem diambil dengan cara membuat pengukuran arus menggunakan fluke meter analysis.

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BMI	Basic measuring instrument
UPS	Uninterrupted supplied
RPM	Reliable power meter
LC	Inductance and capacitance
PSCAD	Power systems computer aided design
RMS	Root mean square
PLC	Programmable logic controller
PC	Personal computer
THD	Total harmonic distortion
HMT	Harmonic mitigation transformer
VCR	Videocassette recorder
SMPS	Switch mode power supply
AC	Alternative current
DC	Direct current
EMTDC	Electromagnetic transient for HVDC
FFT	Fast Fourier transform

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CHAPTER 1

INTRODUCTION

1.0 The introduction of project :

Power quality disturbances have been present since we began using electrical energy; however, yesteryear's equipment was more forgiving of disturbances than todays. As manufacturers continue to reduce the size of circuits and components within their equipment, they are also reducing the voltage required to supply these components. The result is equipment that is faster and more powerful, but also more sensitive to power fluctuations. Power quality is very important to anyone who relies on equipment and systems that are sensitive to electrical disturbances. The effect of the power quality problem will cause a lot of damage [1].

Since there are many type of power quality problems that all the users may face, it necessary to perform analysis in order to determine the types of power quality problems an also the effect of power quality problems. This analysis may involve measurement, monitoring, and mitigation. The focus of my project is to measure and then monitor the current harmonic at non – linear load. This is because in distribution system the major type of power quality problem is harmonic especially third, five, seven or nine harmonic. The harmonics produced overheating in the transformer and the neutral suffers from overheating due to the third harmonic [1]. In this project, transformer will be used as the mitigation method to reduce harmonic.

1.1 Objective

After analyzing the disturbance, one may proceed with measurement and monitoring which an initial procedure to identify the kind of power quality problems. There have several objectives by done this project. After completed this project I must achieved this objective. The main objective of analyzing and monitoring power quality problems at distribution systems are as follows:

1. To know about the power quality problem including the type of power quality and theirs effect especially at power electronic equipment.
2. To determines the effect of power quality problems on the non-loads and their sensitive
3. To monitor the problems of power quality at distribution system by measurement
4. To reduced current harmonic using transformer delta –star connection.
5. To performed basic measurement of supply voltage and current
6. To know how to measured power quality problems especially during the current harmonic
7. To know how to simulate the current harmonic by using the PS-CAD simulator.
8. To achieve the criteria for graduate student in bachelor electrical engineering

1.2 Scope of Project

This project is about analysis and monitoring of power quality problem at distribution system or at low voltage. The first stage of this project is analysis and research about the entire power quality problem. Since there are many type of power quality problems that all the users may face, it necessary to perform analysis in order to determine the types of power quality problems an also the effect of power quality problems. This analysis may involve monitoring and measurement, and mitigation. Focused on my project is to measure and then monitor the current harmonic at non – linear load. This is because harmonic is one of the major in power quality problems besides the voltage sag. In measurement, the testing was done at the circuit with harmonic load, transformer without harmonic load and harmonic load with transformer. Therefore, the aim of this project is to propose to reduce Power Quality problem during harmonic by measured and simulate using the PS-CAD simulator.

1.3 Problem Statement

In this day, and age of sophisticated electronics, monitoring power quality has become too importance to ignore. The widespread use of high-tech devices has complicated every aspect of electrical power. These devices are more sensitive to the effect of power quality. Poor power quality can result in lost productivity, loss and corrupt data, damage equipment and poor power efficiency [2].

During this project all the stage, have their own problems especially difficult to collect the data of current harmonic during measurement and to run the circuit on PSCAD during simulation.

1.4 Literature Review

In previously, case studies are in valuable examples of how power quality problems are solve in practice. For each case study, the analysis of the problems will describe followed by results site survey, monitoring, analysis and recommended solution. In Malaysia, several cases have been documented in which problem analysis; site survey and monitoring of power quality problems were performed. Most of these cases related to the voltage sag and harmonic problems [2].

1.4.1 Power monitoring Using Dranetz BMI

This project was done by Mr Ellen Leinfus.Power monitoring is the key to maximizing uptime and ensuring that facility's power infrastructure and critical equipment functions properly and efficiently. It is used to detect deterioration in power quality, trending data and alerting facility managers of looming problems before they occur, and improve overall facility reliability. Power monitoring is also an invaluable tool for evaluating, reducing and negotiating user's facility's energy costs [3].Figure 1.1 shows the perfect sine wave in three phases.

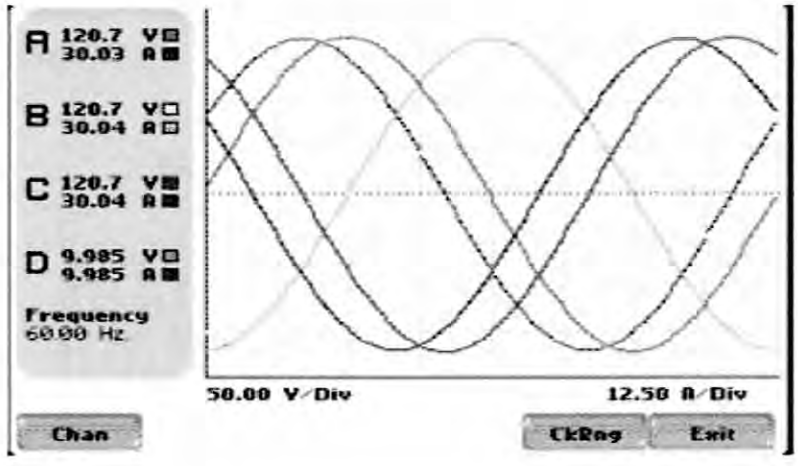

Figure 1.1: Perfect sine wave

1.4.1.1 Benefits for Continuous Monitoring

Power monitoring provides a continual health check-up for a facility's power system, giving data center managers the ability to see, diagnose and avert looming problems. Much like the squeaky brakes on your car, there are leading indicators of impending problems that can be seen through these systems. Another anecdote is like the black box on an airplane, the data from a power monitoring system will tell about what, when and where the event occurred, to prevent it from recurring. Among the benefits [3] Figure 1.2 shows the voltage swell which increase in voltage level, usually above 110 % of nominal

1. A continuous evaluation of the electric supply system to first benchmark, and then identify disturbances and power quality variations that could cause disruption of data center operations or impact the operation of power conditioning equipment. This information is invaluable to proper sizing and testing of that equipment [3].
2. The monitoring of power quality characteristics of computers, servers and other key equipment within the facility. Important examples can include harmonic interactions between loads and power conditioning equipment, inrush characteristics for loads that can impact backup generator operations, transients associated with switching events within the facility, and many others [3].

Example:

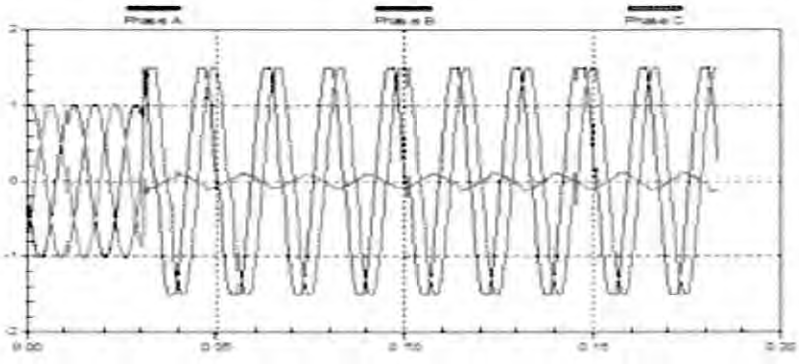

Figure 1.2: Increase in voltage level, usually above 110 % of nominal

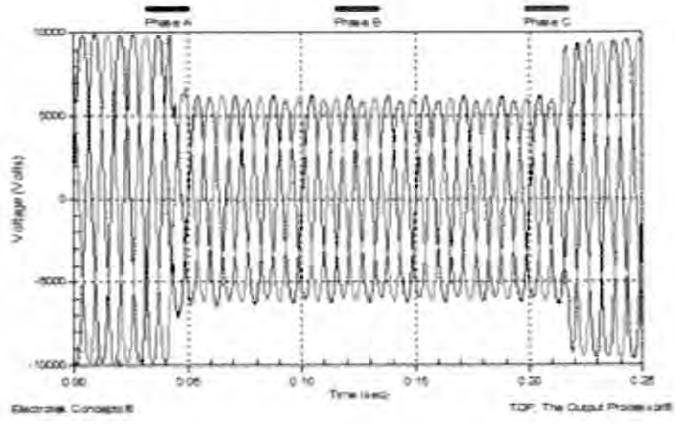

Figure 1.3: Decrease in normal voltage level, typically to 90% or less of nominal

Figure 1.2 shows the voltage sag which will decrease in normal voltage. With a continuous power monitoring system, any deterioration in power quality can be seen long before it causes damage. Individual monitoring devices can be placed at the service entrance of a facility to assess incoming power, at critical load centers to ensure proper distribution and protection, pre-and post mitigation devices such as UPS systems to oversee transfer, and within the facility to assess server electric power performance, as well as room temperature, humidity and other related physical parameters [3].

1.4.1.2 Identified power quality problems:

The only thing worse than having a power system failure does not know what caused it. Power disturbances generally fall into one of six categories: voltage sags and swells transient over voltages; outages or interruptions; harmonic distortion; electrical noise; and wiring problems. A power monitoring system will characterize these events, providing complete voltage and current waveform information. Beyond determining the nature, magnitude and duration for each event, data from a power monitoring system is the key for evaluating equipment interaction issues and the response of that equipment to Power Quality disturbances such as microsecond voltage variations, harmonics, or high-speed transient [3].Figure 1.4 shows the waveform of the interruption or also called an outages.

Example:

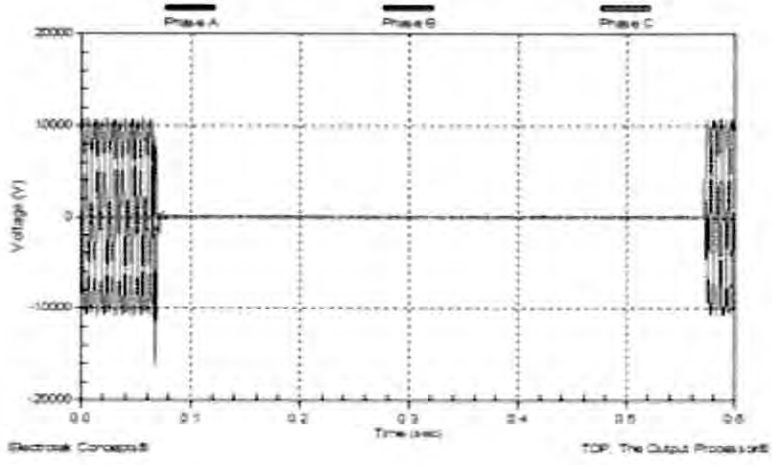

Figure 1.4:Also called outages, when the voltage goes below 10% of nominal

Each power quality event has its own distinctive "Signature". The signature, much like a fingerprint, can be used to identify the type of power quality problem and often help to locate the source of the problems [3].

This project is about monitoring the power quality problems at others type such as voltage sag, swell, outage and others. Ellen Leinfuss used Dranetz BMI as to measure and monitor all this type of power quality problems. Compare with my project, the monitoring is focused on current harmonic problem that occur on non-linear loads. The monitoring and measured was done by using Fluke View Analysis version 4.0 [3].

1.4.1.3 Monitoring:

These table show a number of electronic instrument that are used to monitor or record the power as it varies during the normal operation of facilities .These instruments are generally referred to as power monitors. Table 1 is provides guidelines for selecting the type of power quality monitors based on the types of power quality problems [3].