VOLTAGE SAG ANALYSIS AND DETERMINATION OF THE SOURCE OF DISTURBANCE IN INDUSTRIAL SECTOR

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To my beloved mother and father

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In the name of ALLAH S.W.T., the Most Compassionate, the Most Merciful.

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ABSTRACT

Power quality analysis has become one of the main objective of study in electric power systems. Voltage sag is a phenomena where voltage decrease to 90% to 10% of the rated voltage, with a typical duration of 0.5 to 30 cycle. The purpose of this study is to analyze the voltage sag events in order to identify the source and the cause of voltage sag. Voltage sag is a power quality problem that seldom occurred, but once it occur, it will cause severe problems, such as industrial processes malfunction, producing great economic losses and reduce the power quality. To improve power quality, it is important to identify the source of disturbance. The analysis performed by using the data of voltage sag event shows that the major source of the voltage sag is because of the external factor, while the cause of the voltage sag are mainly by the short circuit. The mitigation technique shall be propose along the analysis, because the effect of the voltage sag can be reduce when applying the mitigation technique such as by using an Uninterruptable Power Supply (UPS) and Voltage Stabilizer at both utility and customer side.

ABSTRAK

Analisis kualiti kuasa menjadi salah satu objektif penting dalam pembelajaran sistem kuasa elektrik.. Voltan lendut ialah suatu fenomena di mana nilai voltan jatuh kepada 90% sehingga 10% daripada nilai sebenar voltan, dengan masa biasa berlaku voltan lendut adalah dalam tempoh 0.5 sehingga 30 kitaran. Tujuan kajian ini dilaksanakan adalah untuk mengkaji tentang aktiviti voltan lendut, supaya dapat mengenal pasti bahan penyebab dan punca berlakunya voltan lendut tersebut. Voltan lendut adalah masalah kualiti kuasa yang jarang berlaku, tetapi, apabila ianya berlaku, ia akan menyebabkan beberapa masalah, seperti operasi di industri tidak dapat berfungsi, ini menyebabkan kerugian besar ekonomi dan mengurangkan kualiti kuasa. Untuk memperbaiki masalah kualiti kuasa, adalah sangat penting untuk mengenalpasti penyebab kepada gangguan tersebut. Analisis yang dilaksanakan dengan menggunakan data voltan lendut menunjukkan bahawa faktor luaran merupakan penyebeb utama kepada gangguan kuasa, manakala punca utama berlakunya voltan lendut ini adalah kerana litar pintas. Kaedah pencegahan voltan lendut perlu diperkenalkan seiring dengan analisis yang dilakukan, kerana kesan daripada aktiviti voltan lendut dapat dikurangkan apabila teknik pemulihan seperti pengunaan Uninterruptable Voltage Supply (UPS system) dan penstabil voltan (Voltage Stabilizer) digunakan di kedua-dua bahagian iaitu pada pembekal kuasa dan pengguna kuasa.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

In this modern year, a sophisticated and technologically based electronics were widely used among the customer's facility. Recently, the power quality problems have become a greatest concern among the utilities, manufacturers and the consumers as it will cause a huge loss in the production in term of maintaining, cost and time. In fact, the common denominator of any kind of power quality problems is cost. Power quality is also be known as a dirty power, which define as a power which has a distorted sinusoidal in the currents or voltages, or operates beyond their designated current or voltage limits / tolerance.

There are various kinds of power quality problems such as voltage sags (dips), harmonics, voltage swell, under voltages, voltage unbalance, electrical noises interruption and also voltage fluctuations. Among all these types of power quality problems, there are two major concerns for both utilities and the consumers, which are voltage sags and harmonics. This research will be focusing more on the voltage sags.

Figure 1.1 below shows a various type of power quality problem.

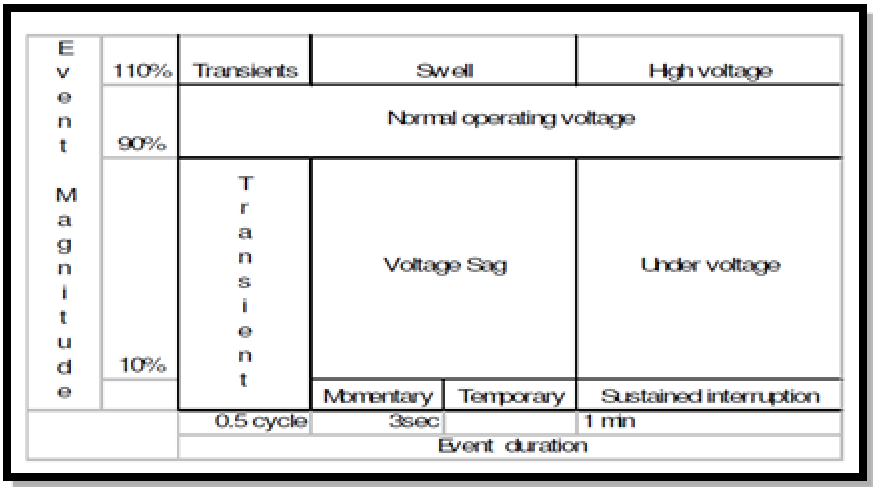

Figure 1.1: Definition of voltage disturbances (IEEE 1159:1995) [1]

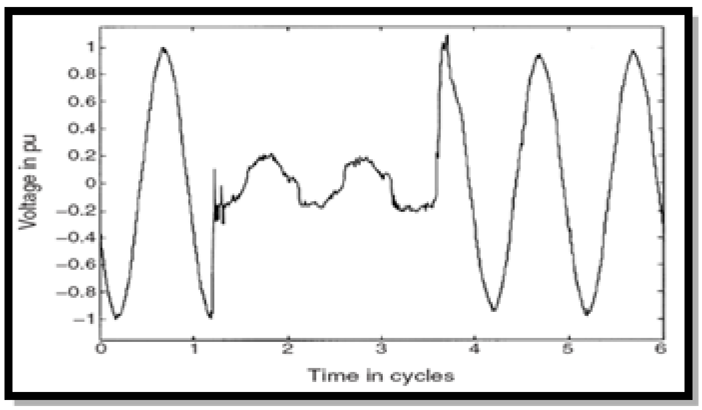

Figure 1.2: A Voltage Sag – Voltage sag in one phase in a time domain

The definition of voltage sag is variously described by International Electrotechnical Commission (IEC) and Institute of Electrical and Electronic Engineering (IEEE) standards. IEC standard [2] describes voltage sag (dips) as a sudden reduction of the voltage at a point in the electrical system, followed by a voltage recovery after a short period of time, from 0.5 cycles to a few seconds, meanwhile IEEE standard [3] describes voltage sag as a decrease to between 0.1 to 0.9 Pu in rms voltage (or current) at the power frequency, for the duration of 0.5 cycles to 1 minute. As shown in Figure 1.1, there are few types of voltage sags which are instantaneous, momentary and temporary. Table 1.1 below will categorize these voltage sags as to their category.

Table 1.1: Short duration varies (Voltage sags)

Short duration varies (Voltage sags)			
No.	Category	Duration of sag	Voltage magnitude in per unit
1	Instantaneous	0.5 – 30 cycles	0.1 – 0.9 pu
2	Momentary	30 cycles – 3s	0.1 – 0.9 Pu
3	Temporary	3s – 1 minute	0.1 – 0.9 pu

The common causes of voltage sags are identified to be; [1] the starting of large motor loads, faults on other branches of the supply network and faults in the internal supply scheme of the customer's installation. Although the utility side has done their best to provide a clean voltage to the customers, but the external factors that can cause a fault to occur, such as lightning, crane encroachment, tree encroachment and birds are beyond their control. Some of the electronic equipment, especially, are very sensitive towards the voltage sags. These equipment will trip or malfunction whenever the rms voltage drops to below 90% of their nominal voltage for the duration of longer than 1 or 2 cycles.

This is why the voltage tolerance curve, which set the immunity area for a safely operate equipment were needed in the case involving a sensitive equipment. There are few voltage tolerance curves which are widely used by the utilities, manufacturers and customers as their references. These voltage tolerance curves include Information Technology Industry Council (ITIC) curve; which formerly known as Computer and Business Equipment Manufacturers' Association (CBEMA) curve, Semiconductor Equipment and Materials International (SEMI) F47 and MS IEC 61000-4-34 (input current less than 16 A) / MS IEC 61000-4-11 (input current more than 16 A).

1.2 Project background

The seldom occurrence, yet having a greater effect of voltage sags in Malaysia is a major concern to the company and the utility companies. This project is to analyze the voltage sags event mainly in term of the depth sags, the source of the voltage sags and the cause of voltage sags. Since there are mitigation techniques that can be applied to the equipment for both customer and utility side, few suggestions of the mitigation technique will be discussed in this report. The analysis of the events is being done by the Power Analyzer software.

1.3 Problem statement

Voltage sags is one of a kind of problem in power quality. It can cause large losses in a production cost even though it is a reduction in voltage for a very short time. The utility may have tried their best in supplying the best power to the consumer, but the fact that voltage sags might occur with a certain cause cannot be avoided. To conduct a good research on voltage sags, one has to know about voltage sags, such as:

- What are voltage sags?
- What are the cause and effect of voltage sags?
- Usually when the voltage sags occur?
- What is the source of disturbance in industrial sector?
- Whose fault it is when this kind of event (voltage sag) occurs?
- Where does the voltage usually occur?
- What is the characteristic of voltage sag?

Who contribute to the voltage sag events? There are widespread beliefs among the utility customers that the voltage sag is problem that only originated from the utility system [1]. It is actually caused either by the customers or the utilities. So, between the customer and the utilities, which side contribute more on the voltage sag occurrence in Malaysia?

1.4 Objectives

There are few objectives of this research:

1. To study and identify the main causes of the voltage sag events.
2. To determine the source of disturbances in industrial sector.
3. To analyze voltage dips event using Power Analyzer Software.
4. To suggest a suitable mitigation technique for each type of cause of voltage sag involved.

1.5 Scope of Work / Limitation

1. Study and analyzing the voltage sags event in low and medium industry.
2. Reviewing the standards of voltage sag and ensure that the equipment involve comply with the standards (ITIC curve (formerly known as CBEMA curve), SEMI F47, IEC 61000 4-34 / IEC 61000 4-11, ANSI curve and so on)

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