HIGH VOLTAGE IMPULSE TEST ON THE SAFETY BOOTS

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" I hereby declare that I have read through this report entitle "VOLTAGE IMPULSE TEST ON THE SAFETY BOOTS" and found that it has comply the partial fulfillment for awarding the degree of Bachelor of Electrical Engineering (Industrial Power)"

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Date	:	10 MAY 2010

"I declare that this report entitle "VOLTAGE IMPULSE TEST ON THE SAFETY BOOTS" is the result of my own research except as cited in the references. The report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree."

Signature	:	……..
Name	:	MOHD SHAIFUDIN BIN ADAM
Date	:	10 MAY 2010

Specially dedicated to

My beloved parents, sisters and brothers.

Thank you for the endless support and encouragement

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CHAPTER 1

INTRODUCTION

1.1 Project Background

In modern times, high voltages are used for a wide variety of applications covering the power systems, industry, and research laboratories [1]. Such applications have become essential to sustain modern civilization.

One of high voltage lab equipments is HAEFLEY High Voltage equipment. This HV equipment can be used in multiple applications in high voltage technology and used in generation of High Voltage Direct Current (HVDC), High Voltage Alternating Current (HVAC) and Impulse voltage.

The High Voltage Laboratory at Faculty of Electrical Engineering, Universiti Teknikal Malaysia Melaka (UTeM) is a new laboratory facilitated with this High Voltage equipment. This equipment will be used in Teaching and Learning (T&L) of high voltage subject in which this will involve all electrical engineering students. Besides, this equipment is also essential in Research and Development (R&D). Since this equipment generates high voltages, necessary handling steps and safety precaution need to be taken when handling the equipment. Hence, proper testing procedure manual describing all the steps and safety precautions as a guidelines is very important when use the High Voltage equipment.

1.2 Project Abstract

Human being have looked at lightning as an object of owe for its sheer destructive capability. For electrical system, lightning poses a source of over voltage. In the way to handle this over voltage, we have able to design some equipment or some practical procedure that used to make impulse test. This is used to testing and to simulate overvoltage that occur in power system, its work to maintain the quality of the customers products. The purpose of this project is to perform a specific study on a high voltage impulse test in terms of: high voltage impulse test definition, types of impulse testing, configuration, characteristics of impulse test, wave shapes and high voltage impulse testing standard. To achieve this objective, some design type such as lightning impulses was used. The design will be subsequently constructed and tested to validate the simulation result using the multisim software and come out with the proved wave shapes.

1.3 Problem statement

1. To design the procedure to make the high voltage Impulse test.
2. To do a detailed case study on High Voltage Impulse Test.
3. To Perform a High Voltage Impulse Test on a consumer product, safety boots to simulate the effect of overvoltage.

1.4 Project Objective

1. To be familiar with high voltage Impulse Test.
2. To be able to design some practical procedure that used to make Impulse Test.
3. To be familiar with High Voltage laboratory equipment, Procedure and techniques such as Voltage divider, generator and oscilloscope.
4. To be able to construct and test set up to a consumer product, which in this case are safety boots.

1.5 Scope of the project

This project has been confined to three relatively simple aspects which they are:

(a) The nature of high voltage applied for consumer product, safety boots as test objects for impulse voltage.

(b) To study the breakdown voltage for electrical characteristic of safety boots as test objects.

(c) To generate the nature of high voltage for below or not less than 100kV as the maximum required in the laboratory

(d) To know the dielectric strength of safety boot after applied the impulse voltage.

1.6 Report Outline

Basically, this report consists of 6 chapters. Each of chapter can be describe in the following term:

(a) Chapter 1 : Introduction

This chapter is representing the introduction that consists of project background and problem statement.

(b) Chapter 2 : Literature Review

On this chapter will overview the theory and research about this case study. It will more understand about this study and can help in represent the best of case study.

(c) Chapter 3 : Research Methodology

This chapter will be cover about methodology of this research. The step from starting and ending of this research will be described in this subtopic.

(d) Chapter 4 : Experimental Work

The scope of this project will be focus on the Impulse voltage Testing lab procedure and the safety boots strength.

(e) Chapter 5 : Result and Analysis

In this chapter will cover all part of result that we get from the experiment.

This chapter represents the part of experimental work. This research will conduct the breakdown voltage depend on the flow chart of experimental work.

(f) Chapter 6 : Conclusion and Recommendation

This chapter concludes all of experimental result and the end of report. This is the important part of this report that wills recommendation for future study work.

CHAPTER 2

LITERATURE REVIEW

2.1 High Voltage

High Voltage define as those with more than 1000 V for alternating current and at least 1500 V for direct current, and distinguish it from low voltage (50-1000 V AC or 120-1500 V DC) and extra low voltage (<50 V AC or <120 V DC) circuits. The high voltage test and also called dielectric strength test can be made in AC,DC and impulse. If the high voltage test is made in DC, it is then combined with insulation ; if the high voltage test is made in AC, it is then, more stressful for the test object. Measurement of high voltage test under alternating current is performed using an alternating voltage (50Hz) adjustable to an effective 50V to 1,500V. As is the case with direct current, the high voltage test detects any sudden rise of current up to a programmed threshold.[1,2,3] Table 2.1 below show the international standard rated operation (line to line) voltage levels.

Table 2.1: International standard rated operation (line to line) voltage levels.[10]

Voltage class	**Normal line Voltage**	
	Europe(50 hz)	**Europe(60 hz)**
Low voltage (LV)	220/240 380 /415 650 1000	120 (single phase) 208 600
	kV	kV
Medium voltage	- 5 11 22 33 66	2.42.4 4.6 12.47 23 34.5 69
High voltage (HV)	110 132 220	115 145 230

2.2 Types of high voltages

2.2.1 A.C VOLTAGE

The alternating current the movement (or flow) of electric charge periodically reverses direction. An electric charge would for instance move forward, then backward, then forward, then backward, over and over again. And also we can defined the alternative current as electric current that flows for an interval of time in one direction and then in the opposite direction; that is, a current that flows in alternately reversed directions through or around a circuit. Electric energy is usually generated as alternating current in a power station, and alternating currents may be used for the power. The voltage of an alternating current can be changed by a transformer. This simple, inexpensive, static device permits generation of electric power at moderate voltage, efficient transmission for many miles at high voltage, and distribution and consumption at a conveniently low voltage. With direct (unidirectional) current it is not possible to use a transformer to change voltage. On a few power lines, electric energy is transmitted for great distances as direct current, but the electric energy is generated as alternating current, transformed to a high voltage, then rectified to direct current and transmitted, then changed back to alternating current by an inverter, to be transformed down to a lower voltage for distribution and use.[1]

2.2.2DIRECT CURRENT(DC)

Direct voltage is used mainly to test equipment used in high voltage DC transmission system. It is additionally used in insulation testing of arrangements with high capacitance, such as capacitors and cables. It is also used in fundamental investigations in discharge physics and dielectric behavior. The value of test voltage is defined by its arithmetic mean. The test voltage, as applied to the test object, should not as AC components corresponding to a ripple factor of more than 5% when normal current is drawn. Direct current (DC) is the unidirectional flow of electric charge. Direct current is produced by such sources as batteries and thermocouples. Direct current may flow in a conductor such as a wire, but can also be through semiconductors, insulators, or even

through a vacuum as in electron or ion beams. The electric charge flows in a constant direction, distinguishing it from alternating current (AC). Direct current may be obtained from an alternating current supply by use of a current-switching arrangement called a rectifier, which contains electronic elements (usually) or electromechanical elements (historically) that allow current to flow only in one direction. Direct current may be made into alternating current with an inverter or a motor-generator set.[1]

2.2.3 IMPULSE

Impulse Test generally is about to testing and to simulate over voltages and testing with several hundred's of amperes that occur in power systems in the term to maintain the quality of the consumer's products. Electrical transmission and distribution system are using to change of over voltages, amplitudes of which may get the peak value of the normal system voltage by the large amount. Over voltage are normally called external over voltage and are independent by the system voltage. Switching over voltages are internal over voltage caused by switching operation and it always related with the system operating voltage.[1]

The wave shapes of these voltages are influenced by the impendent of the system and switching conditions. Thought the actual shape of both kinds of over voltage varies strongly, it becomes necessary to simulate these changed voltage by relatives simple means for testing purpose. National and International standards have accepted that high voltage having an impulse wave shape should be used for testing insulations to simulate lightning and switching surge over voltage.[1]

2.2.3.1Objective To Using The Impulse Test

- To determine the impulse strength of consumer products against impulse voltage [1]
- To simulate the occurrence of a switching surges or lightning stroke to the consumer products [1]
- To prevent and enhanced protection against accident.[2]
- To insulated testing of various component's in power system for different types of voltages, power frequency, high frequency, switching and lightning impulse.[2]

2.2.3.2 IMPULSE VOLTAGE

High Voltage impulse test are required for testing purposes to simulate over voltages that occur in power system due to lightning or switching surge action. The test is done by applying standard impulse voltage of specified value order dry condition with both positive and negative polarities of the wave.[1]

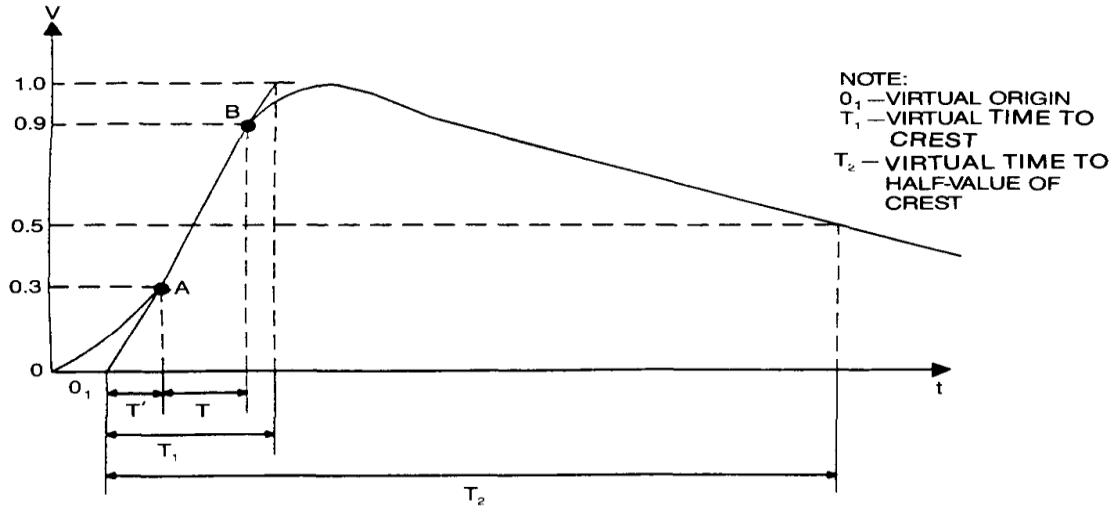

Figure 2.1: Wave Shape for Voltage Impulse Test. [1]

An impulse voltage is an unidirectional voltage which rises more or less rapidly to a maximum value without appreciable oscillations and then decays, relatively, slowly to zero. The maximum value of the impulse voltage is called the peak value of the impulse, and the impulse voltage is specified with this value.[2]

Wave front- The wave front of an impulse voltage is the rising portion of the voltage time characteristic(portion OA). The duration of the wave front is the total time occupied by the impulse voltage while rising from zero to peak value. This time is known as time to peak value and donated by t1.[2]

Wave tail-The wave tail of an impulse voltage is the rising portion of the voltage-time characteristic(portion AB). The time to half value of the wave tail of the impulse voltage is the total time occupied by the impulse voltage in rising to peak value and declining there from to half the peak value of the impulse. This denoted by t2.[2]

Specification-An impulse wave is specified by i) its peak value, ii) the time to peak value in microsecond, and iii) the time to half value on wave tail in microseconds.[2]

Virtual origin- It is quite difficult to obtain a smooth slope within the first voltage rise, as the capacitance of measurement system along with stray capacitance and inductances may cause oscillations. To overcomes this difficulty a virtual origin O1 is defined, which is obtained on the time axis by intersection of the straight line joining the point corresponding to 10 per cent and 90 per cent of the peak values located on the wave front.[2]

Switching impulse-A switching over voltage is a short duration transient voltage produce in electric transmission line and distribution system due to sudden opening or closing of circuit breakers or a switching or due to acting in a fault. The wave forms of transient voltage are not unique. Generally, these are damped oscillator waves of frequencies ranging from a few hundred of hertz, depending upon the required natural frequency of the system.[2]