

HIGHER TECHNICAL INSTITUTE

ELECTRICAL ENGINEERING DEPARTMENT

DIPLOMA PROJECT

EFFECTIVE EARTHING PRACTICES
USING SOFTWARE TECHNIQUES

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JUNE 1999

EFFECTIVE EARTHING PRACTICES
USING SOFTWARE TECHNIQUES

PROJECT REPORT SUBMITTED BY:

PAPHITIS M. KYRIACOS

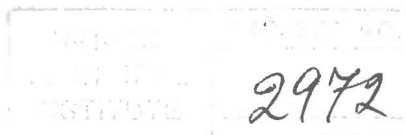
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ELECTRICAL ENGINEERING DEPARTMENT

DIPLOMA PROJECT

Academic year 1998/99

Project Number E.1161

Title: Effective Earthing Practices Using Software Techniques

Objectives:

- To study the origin of faults and lightning strikes and the magnitude of earth fault current
- To identify the dangers that can appear in the substation area from these high earth fault currents and how these are interpreted
- To identify the methods that international Standards recommend for containing these dangers
- To learn how to design effective earthing of Transmission Substations using user friendly computer software which is based on methods which are published in International Standards.

Terms and Conditions:

Utilities transmission substations suffer from high earth fault currents which are the result of system faults or lightning strikes. These high earth fault currents produce dangerous step and touch voltages which are dangerous to personnel working in the substation or to public which might be accidentally touching the fence at the time of the discharge to the ground.

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CONTENTS

	Page
<u>CHAPTER 1</u> INTRODUCTION	
<u>CHAPTER 2:</u> SOURCES OF HIGH CURRENTS AND VOLTAGES	
LIGHTNING	1
SYSTEM OVERVOLTAGES	7
<u>CHAPTER 3:</u> DANGERS ARISING FROM FAULT CONDITIONS	
EFFECT AND DAMAGE CAUSED BY LIGHTNINGS	12
STEP AND TOUCH VOLTAGES	13
DURATION, MAGNITUDE AND FREQUENCY	18
PERMISSIBLE BODY CURRENT LIMIT	21
<u>CHAPTER 4:</u> PROTECTION OF HOUSES AND OTHER BUILDINGS	
THE 'ROLLING SPHERE' CONCEPT	23
THE NEED FOR PROTECTION	23
ZONES OF PROTECTION	30
DESIGN CONSIDERATIONS	33
SOIL CONDITIONING	38
<u>CHAPTER 5:</u> SUBSTATION EARTHING	44
<u>CHAPTER 6:</u> CONCLUSIONS	

INTRODUCTION

The following project will try to cover the vast domain of earthing techniques used against high fault voltages and currents.

The second chapter deals with the origins of the faults and how this unavoidable events i.e. lightning strikes are produced and how they can interfere the earthing system.

The third chapter explains the dangers of a fault and how the fault current can influence the humans according to it's magnitude. It also describes touch and step voltages and how this may cause damage to our health.

The fourth chapter shows the methods of earthing techniques used for houses and for some other buildings which are faced as special cases due to their 'strange' shape i.e. churches and wind mills.

The fifth chapter is especially dedicated to substation earthing techniques and an example of the earthing design of an E.A.C substation is included.

In later chapters we will try to understand why earthing is so important and why all the buildings must be always earthed. Let us see now the main reasons for using earthing techniques:

- i) To protect people and livestock
- ii) To protect equipment
- iii) To permit the equipment to function correctly
- iv) To ensure the reliability of electrical services

In case of a fault (i.e. overload) or in case of a lightning strike a very high fault current is created which it must be dissipated to earth. This high current uses the earthing conductors to travel since the earth loop impedance is very low (this is a must for all cases of earthing and tables are used which determine the maximum resistance of such loops).

Now let us deal with the origins of such faults.

a) **Lightning**

The nature of lightning

Benjamin Franklin (1707-1790) was the first man to prove that storm clouds could generate, hold and discharge static electricity with his famous kite experiment. Lightning is a natural hazard, being the discharge of static electricity generated in parts, called "cells", of storm clouds.

Lightning may be defined as a gigantic electrical spark resulting from millions of volts between clouds and earth produced by separation of positive from negative electric charges. This involves positive charges called protons, negative charges called electrons and particles in a neutral stage of no electric charge called neutrons. Lightning is formed as a result of a natural build up of electrical charge separation in storm clouds.

There are two types of storm clouds which generate a static electrical charge.

- i) Heat storms
- ii) Frontal storms