

**A COST OPTIMIZATION METHODOLOGY FOR DESIGN
OF SUBSTATION EARTHING SYSTEM**

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159359B

Degree of Master of Science

Department of Electrical Engineering

University of Moratuwa

Sri Lanka

March 2020

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Thesis/Dissertation submitted in partial fulfillment of the requirements for the degree
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Abstract

Current practice for earthing grid design for AC substations is mainly guided by IEEE 80 ; 2000 standard. This practice is an iterative process of changing design variables until safety requirements for step and touch voltages and maximum earth grid resistance are met. During this iterative process, the assignment of values for design variables is mainly based on the experience and assumptions of designers.

However, this practice is not guided by concerns about cost minimization. Since the earth grid construction occupies a large part of the total cost of AC substation construction, an appropriate cost optimization methodology for the earth grid design for AC substations should be fully identified.

The aim of this work is to develop a cost optimization methodology based on a Genetic Algorithm using Microsoft Excell based on IEEE guidelines. This paper analyzes the effect of each earth grid design parameter on the total cost of constructing earth grid and formulation of the optimization problem. This work is also supported by a few sample calculations for a few real-time applications. The calculations show that the developed methodology ensures cost savings of between 30% and 40%.

Keywords: IEEE 80 :2000, Cost optimization , Earthing grid design, AC substaions, GA

Acknowledgement

I would like to express my sincere gratitude to my supervisor, Dr. Asanka S. Rodrigo, for his motivation and continuous support throughout this research. His support and motivations have been invaluable driving forces towards me to complete this study successfully.

I am also very grateful to Dr. Prasad, my Masters' Coordinator for his valuable advice on progress reviews by offering useful suggestions.

I would also like to thank my family, friends and all those who have helped and encouraged me throughout the time by motivating and providing unconditional support to achieve this target.

D.P.C.T.W. Gunaratne

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List of Abbreviations

Abbreviation	Description
<i>IEEE</i>	<i>Institute of Electrical and Electronics Engineers</i>
<i>MATLAB</i>	<i>Matrix Laboratory</i>
<i>IEEE Std 80 (2000)</i>	<i>Guide for Safety in AC Substation Grounding</i>
<i>RMS</i>	<i>Root Mean Square</i>
<i>AC</i>	<i>Alternating Current</i>
<i>DC</i>	<i>Direct Current</i>
<i>GPR</i>	<i>Ground Potential Rise</i>
<i>EHT</i>	<i>Extra High Tension</i>
<i>GA</i>	<i>Genetic Algorithm</i>
<i>EC</i>	<i>Evolutionary Computation</i>
<i>PES</i>	<i>Power Engineering Society (IEEE)</i>
<i>IEC</i>	<i>International Electromechanical Commission</i>
<i>ICEE</i>	<i>International Conference on Engineering Education</i>