

**DESIGNING OF DISTRIBUTION SUBSTATION  
LIGHTNING PROTECTION SYSTEM TO MINIMISE  
DAMAGE DUE TO LIGHTNING**

W.A.K.T. Indrajith

09/8659



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Degree of Master of Science

Department of Electrical Engineering

University of Moratuwa  
Sri Lanka

March 2014

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Dissertation submitted in partial fulfillment of the requirements for the  
Degree Master of Science in Electrical Engineering

Department of Electrical Engineering

University of Moratuwa

Sri Lanka

March 2014

## Declaration

“I declare that this is my own work and this dissertation does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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The above candidate has carried out research for the Masters Dissertation under my supervision.

.....  
Signature of the supervisor Date:  
(Dr. Asanka S. Rodrigo)

## Abstract

Lightning interferences in the Distribution lines is a major problem in CEB network. A significant number of substation failures are reported due to lightning. These failures occurred due to over voltages in the distribution line and it is impossible to prevent. These over voltages lead to a failure in the insulation of the transformer. Selecting transformers having high insulating level will increase the costs and volume of it. Therefore to decrease insulation levels and its cost, it is necessary to control over voltages and let them to earth by means of arresters. Performance of the arrester depends on the impulse resistance of the earth electrode, lead wire length and the substation installation. It is not necessary for earthing resistance of earth electrode to be of same value for all locations. It depends on the lightning level of each location. The Ground Flash Density in the area is an important parameter to decide the maximum lightning current experienced during the life time of the equipment and the required failure rate.

This dissertation discusses the over voltages due to lightning and its danger to Distribution Substation. The effect of arrester earthing resistance, Lead wire length, Substation configuration and medium voltage line arrangements at the substation in the CEB distribution Network are also studied for this investigation.

Digital simulation has a very important role on predicting the lightning performance of the distribution substation and distribution lines. PSCAD software is used for transient modeling of a three phase distribution line, substation and arrester for analyzing their performance during lightning. The method used to analyze the increase in voltage due to lightning was analyzed by using this software.

Keywords – Lightning, over voltages, Lightning Arrester, Earth Resistance, Lead wire

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