COST OPTIMAL SURGE PROTECTIVE SYSTEM FOR LOW VOLTAGE INSTALLATIONS

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Degree of Master of Science

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April 2017

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DECLARATION

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Dr. W.D.A.S. Rodrigo Date:……..

ABSTRACT

Surge protective devices (SPDs) have become an integral part of residential, commercial and industrial power quality applications. A wide selection of surge SPDs are promoted by greater number of manufactures for the protection of electrical and electronic systems damaging effects of electrical transients and lightning. The selection of the appropriate cost effective SPD is great difficult due to some manufactures use different technologies and many manufactures specify their SPD performance differently.

One of the difficult tasks encountered when specifying a SPD is identifying and understanding the ratings associated with its application. There are many performance values and ratings associated with an SPD, such as Maximum Continuous Operating Voltage (MCOV), Voltage Protection Rating (VPR), Nominal Discharge Current (In), and Short Circuit Current Rating (SCCR). The most important and misunderstood rating is the Surge Current Rating. In today's market there are numerous SPDs with surge current ratings ranging from 10 kA through 1000 kA with different prices.

The research presents a methodology to select cost optimal surge protection devices for low voltage installations. The procedure for the selection of SPD is considered the steps of risk assessment, IES standard, manufacture technical details, the applied technology and the data bank of SPD available in local market. The cost optimal solution has been obtained by user friendly software considering the risk assessment result, area lightning density, location and the geographical factors.

ACKNOWLEDGEMENT

First and foremost, I would like to offer my sincere gratitude to supervisor, Dr. W.D.A.S. Rodrigo for kind guidance, advice, expertise, encouragement, insights, attention extended towards me for successful flow of the dissertation.

I would also like to express my sincere gratitude to course coordinator, all senior lectures, visiting lectures in the Msc programme, for their valuable teaching, guidance, assistance and co-operation delivered throughout the course.

I take this opportunity to records my sincere thanks to my staff in the electrical and electronic department of university hospital project at Sir Jhon Kotelawala Defence University for providing assistance in numerous ways to carry out the studies of the project.

I express my thanks and appreciation to my family for their understanding, motivation and patience. I also thanks to all colleagues and friends for giving their fullest co-operation throughout the time of research and writing of the thesis.

I also place on record, my sense of gratitude to one and all who, directly or indirectly, have lent their helping hand in this process.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDIX

SYMBOLS AND ABBREVIATIONS

Ad - Collection area for flashes to an isolated structure

Ai - Collection area for flashes near a service

Al - Collection area for flashes to a service

Cd - Location factor Ce Environmental factor

Ct - Correction factor for a HV/LV transformer on the service

D1 - Injury to living beings

D2 - Physical damage

D3 - Failure of electrical and electronic systems

hz- Factor increasing the loss when a special hazard is present

H - Height of the structure

Ha - Height of the structure connected at end “a” of a service

Hb- Height of the structure connected at end “b” of a service

Hc- Height of the service conductors above ground

Kd- Factor relevant to the characteristics of a service

KMS - Factor relevant to the performance of protection measures against LEMP

Kp- Factor relevant to adopted protection measures in a service

KS1 - Factor relevant to the screening effectiveness of the structure

KS2 - Factor relevant to the screening effectiveness of shields internal to the structure

KS3 - Factor relevant to the characteristics of internal wiring

KS4 - Factor relevant to the impulse withstand voltage of a system

L - Length of structure

La - Length of the structure connected at end “a” of a service

LA - Loss related to injury to living beings

LB - Loss in a structure related to physical damage (flashes to structure)

L′B - Loss in a service related to physical damage (flashes to service)

Lc- Length of service section

LC - Loss related to failure of internal systems (flashes to structure)

L′C - Loss related to failure of service equipment (flashes to structure)

Lf - Loss in a structure due to physical damage

LZ - Loss related to failure of service equipment (flashes near a service)

L1 - Loss of human life in a structure

L2 - Loss of service to the public in a structure

L2 - Loss of service to the public in a service

L3 - Loss of cultural heritage in a structure

L4 - Loss of economic value in a structure

L4 - Loss of economic value in a service

NX - Number of dangerous events per annum

ND - Number of dangerous events due to flashes to a structure

NDa - Number of dangerous events due to flashes to a structure at

Ng - Lightning ground flash density

NI - Number of dangerous events due to flashes near a service

NL - Number of dangerous events due to flashes to a service

NM - Number of dangerous events due to flashes near a structure

P - Probability of damage

PA - Probability of injury to living beings (flashes to a structure)

PB - Probability of physical damage to a structure (flashes to a structure)

PC - Probability of failure of internal systems (flashes to a structure)

PLD - Probability of failure of internal systems (flashes to a connected service)

PLI - Probability of failure of internal systems (flashes near a connected service)

PM - Probability of failure of internal systems (flashes near a structure)

PMS - Probability of failure of internal systems (with protection measures)

PSPD- Probability of failure of internal systems or a service when SPDs are installed

PU Probability of injury to living beings (flashes to a connected service)

PV - Probability of physical damage to a structure (flashes to a connected service)

PW - Probability of failure of internal systems (flashes to a connected service)

PX - Probability of damage to a structure

PZ - Probability of failure of internal systems

ra - Reduction factor associated with the type of surface of soil

ru- Reduction factor associated with the type of surface of floor

rp- Factor reducing the loss due to provisions against fire

R - Risk

RA - Risk component (injury to living beings – flashes to a structure)

RB - Risk component (physical damage to a structure – flashes to a structure)

RC - Risk component (failure of internal systems -flashes to a structure)

RD - Risk for a structure due to flashes to the structure

rf- Factor reducing loss depending on risk of fire

RF - Risk due to physical damage to a structure

RI - Risk for a structure due to flashes not striking the structure

RM - Risk RM when protection measures are adopted

RO - Risk due to failure of internal systems

Rs- Shield resistance per unit length of a cable

RS - Risk due to injury to living beings

RT - Tolerable risk

RU - Risk component (injury to living being – flashes to a connected service)

RV - Risk component (physical damage to structure – flashes to a connected service)

RW - Risk component (failure of internal systems – flashes to the connected service)

RX - Risk component for a structure

RZ - Risk component (failure of internal systems – flashes near a service)

R1 - Risk of loss of human life in a structure

R2 - Risk of loss of service to the public in a structure

R3 - Risk of loss of cultural heritage in a structure

R4 - Risk of loss of economic value in a structure