

**COST OPTIMAL SURGE PROTECTIVE SYSTEM FOR LOW
VOLTAGE INSTALLATIONS**

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Degree of Master of Science

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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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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.

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- B. Data table for calculation as per IEC 62305
- C. Database of SPD available in local market for TT system

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