EXPERIMENTAL STUDY ON BEHAVIOR OF MOV BASED SURGE ARRESTORS UNDER DISTORTED SUPPLY VOLTAGES

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Thesis/Dissertation submitted in partial fulfillment of the requirements for the degree of Master of Science in Electrical Engineering

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March 2020

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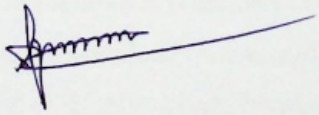

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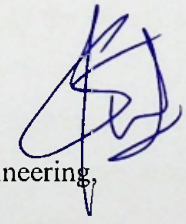

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ABSTRACT

Surges due to lightning and various switching operations are a common phenomenon in electrical power systems. Due to surges, there can be transient overvoltages in the lines as high as many times the normal supply voltage. Equipment connected to the line cannot withstand these high voltages since the internal circuitry has not been designed to withstand surges. Metal oxide Varistor (MOV) is one of the best clamping devices used for electronic equipment from surges. Metal Oxide Surge Arrestor (MOSA) is made by stacking several numbers of MOV blocks to match system voltages for power system applications. Throughout life, MOVs are exposed to system voltage stress endlessly. Thus, the stress these devices experience is comparatively higher especially in the case of MOSAs.

Supply voltage distortion due to harmonics is another common phenomenon found in power systems due to modern non-linear loads connected to power systems. This study is conducted to access the effect of supply voltage harmonics on the life expectancy of MOVs. Electrical and thermal experiments performed to validate relevant models for MOVs. Using simulations, and a life expectancy model, the effect of various cases of voltage distortion studied to find the effect on life expectancy.

Based on the above results, recommendations have been made on how to select maximum continuous voltage of surge arrestors to minimize the effect of supply voltage harmonics on life expectancy.

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List of Abbreviations

Abbreviation	Description
CEB	Ceylon Electricity Board
MOV	Metal Oxide Varistor
IEC	International Electrotechnical Commission
R&D	Research and Development
SPD	Surge Protection Device
RMS	Root Mean Square
V	Voltage
I	Current
GDT	Gas Discharge Tubes
TOV	Temporary Overvoltage
TVS	Transient Voltage Suppression
PCC	Point of Common Coupling
MOSA	Metal Oxide Surge Arrestor
LV	Low Voltage
HV	High Voltage
MV	Medium Voltage
MCOV	Maximum Continuous Operating Voltage
IEEEE	Institute of Electrical and Electronic Engineers
AC	Alternating Current
DC	Direct Current
TSC	Thermally Stimulated Current
THC	Third Harmonic Component
MSCM	Modified Shifted Current Method
RMS	Root Mean Square