

Abstract

Surge Protective Devices (SPDs) are used to protect electrical and electronic equipment against damages and operational malfunctions caused by surges. The commonly employed SPDs are composed of Metal Oxide Varistors (MOVs). MOVs are typically known for being inexpensive and for withstanding reasonable high values of current transients; they degrade over time depending on the severity and frequency of the surges they are subjected to. When MOVs are not properly monitored, the equipment they are meant to protect may remain unprotected and susceptible to surges. Reference voltage and leakage current of the MOV are commonly measured to deduce the operational status of the MOV. However, measuring the reference voltage only provides a pass or fail status of the MOV and not the degree of degradation, and measuring the leakage current and other dielectric parameters of the MOV (such as return voltage, decay voltage, etc.) is not always practical depending on the manner in which the MOVs are connected, especially the low voltage MOVs. This results in limited preventative maintenance techniques since the degree of degradation of the MOV is not known and other parameters of the MOV cannot always be measured. Therefore, the preventative maintenance mechanisms are sought. Extensive studies have been done to investigate the electrical and microstructural degradation of MOVs. However, the relationship between the current impulse injected and the degree of electrical degradation of the MOV have not been clearly defined. Therefore, defining this relationship can help to achieve preventative maintenance on lightning protection composed of MOVs by characterising and quantifying the degree of degradation of the MOV caused by a lightning impulse current without physically measuring dielectric parameters of the MOV. Thus, the study done in this dissertation answers the research question entitled: ***What is the relationship between an 8/20 μ s lightning impulse current applied and the degree of degradation of the MOV?*** This question is answered through proposing a mathematical model that characterises the percentage of degradation of the MOV caused by a lightning impulse current. The mathematical model is specifically for MOVs with sizes ranging from 5 mm to 40 mm. The proposed model is tested against experimental test results and is found to match them by at least 75%. The discrepancy in matching is due to the assumption used in the matching process that all the MOVs exhibit the same response when subjected to the same impulse current. Nonetheless, the proposed model provides a minimum possible degradation level caused by a particular impulse current. The proposed model is thus deemed suitable to describe the relationship between the lightning impulse current injected and the degradation of the MOV.