Simulation and Analysis of ZnO block Characteristics Using MATLAB

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Abstract— Lightning arresters are vital protective components in power system. Ageing of the arrester is an important issue under research. Simulation of the arrester and analysis using the simulation tool plays an important role in validating the experimental results.

The leakage current that flows through the arrester blocks due to continuous electric stress on the arrester, ambient temperature, pollution on the surface of the arrester etc., causes heating of the arrester blocks. The increase in temperature of the arrester blocks causes the blocks to age. In order to understand the various mechanism of ageing it becomes necessary conduct experiments on the arrester subjecting it to various conditions and analyzing. It has been observed by many researchers that the resistive component of the leakage current and in particular the third harmonic component of the resistive component of the total leakage current is responsible for heating of the blocks[1]–[9].

In the present paper ZnO block of the surge arrester is simulated using MATLAB. V-I characteristics with resistive component of the total leakage current at different temperatures obtained. The resistive and capacitive components of the total current at different temperatures obtained. Also the harmonic components of the resistive component of the total leakage current obtained and analyzed. From the analysis of results of simulations it is observed that they conform with the experimental results of the earlier researchers.

Keywords— ZnO Block, MATLAB, Resistive component of leakage current, third harmonic component of resistive component of leakage current, Ageing.

I.INTRODUCTION

Surge arresters are widely used in power distribution and transmission networks to protect systems against lightning surges as well as overvoltage's due to switching or other mechanical operations. Usually, these protection devices have a useful life that varies from 20 to 25 years, even in critical operation conditions. The overvoltage surge protection using polymer-housed arresters in the distribution network is widely used. Polymer-housed arresters composed of ZnO blocks are usually subject to environmental and electrical stresses. Due to this their useful life decreases.

Degradation of surge arresters is a critical issue and understanding the causes and mechanism of degradation is important from the point of view of improving the design as well as manufacturing process of surge arresters. The main cause of degradation is due to thermal ageing. Thermal ageing occurs when the temperature of the arrester rises. Various causes for the temperature rise are pollution on the arrester which results in an increase in leakage current and hence the temperature of ZnO blocks. As a result variation in voltage distribution along the length of the arrester and an increase in third harmonic component in the resistive component of the arrester which is main cause for thermal degradation of the arrester.

This research proposes an analysis of ZnO surge arrester block using MATLAB. Simulation of surge arrester block using its electrical parameters viz., resistance and capacitance in its simplest equivalent circuit model is done and its leakage current waveform analysis carried out. Behavior of V-I characteristics and variation of harmonic components of the total current obtained from the simulation validate the experimental results obtained.

In the present work MATLAB software is used to simulate the ZnO block. Algorithm is developed to simulate the equivalent circuit of the ZnO block consisting of non linear parameters. V-I characteristics and leakage current waveforms are computed and analyzed.

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