World Academy of Science, Engineering and Technology
International Journal of Energy and Power Engineering
Vol:17, No:06, 2023

Thermal and Dielectric Breakdown Criterium for Low Voltage Switching Devices

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Abstract : The goal of an alternative current (AC) switching device is to allow the arc (created during the opening phase of the contacts) to extinguish at the current zero. The plasma temperature rate of cooling down, the electrical characteristic of the arc (current-voltage), and the rise rate of the transient recovery voltage (TRV) are critical parameters which influence the performance of a switching device. To simulate the thermal extinction of the arc and to obtain qualitative data on the processes responsible for this phenomenon, a 1D MHD fluid model in the air was developed and coupled to an external electric circuit. After thermal extinction, the dielectric strength of the hot air (< 4kK) was then estimated by the Bolsig+ software and the critical electric fields method with the temperature obtained by the MHD simulation. The influence of copper Cu and silver Ag vapors was investigated on the thermal and dielectric part of the simulation with various current forms (100A to 1kA). Finally, those values of dielectric strength have been compared to the experimental values obtained in the case of two separating silver contacts. The preliminary results seem to indicate the dielectric strength after multiples hundreds of microseconds is the same order of magnitude as experimentally found.

Keywords : MHD simulation, dielectric recovery, Bolsig+, silver vapors, copper vapors, breakers, electric arc
Conference Title : ICPPT 2023 : International Conference on Plasma Physics and Technology
Conference Location : Paris, France
Conference Dates : June 22-23, 2023