Contribution ID: **8** Type: **Poster Presentation**

"Large"HV Structures: Transient Analysis of Voltage Distribution from First Principles

Tuesday 5 June 2018 13:30 (1h 30m)

One of the intrinsic properties of HV devices is that voltage distribution along their physical structures at transients is largely governed by parasitics. By transients, we rigorously mean a state when dv/dt is not zero, which includes also periodic processes. Examples range from garlands of insulators to HV dividers and their components to machine and transformer windings.
Traditionally, analyses of such structures are made with use of equivalent circuits (EC). Parameters are derived from geometry, and then circuit analysis is executed, either analytically, for simple cases of homogeneous ladder circuits, or numerically. Such analyses have a long history; they are well developed and are fast and powerful. The main problem for numerical analysis is sufficient discretization and faithful derivation of circuit parameters. The latter actually calls for field analysis!
It is possible to analyze the electric field directly by solving Maxwell equations with commercial software packages. Thus, stresses on components and insulation, as well as parasitic parameters for further use, can be determined from first principles.
HV constructions may be "long"compared to characteristic wavelength. Then wave formulations of Maxwell equations need to be invoked. In this paper, we exclude such cases from consideration. We limit analysis to an example of a mixed resistive-capacitive divider driven by a step or a ramp voltage. Modeling is done with Comsol Mutiphysics, which also allows a limited mix of field and circuit analysis. Modeling options for actual resistors and capacitors are described. Conductive problem is solved; both conduction and displacement currents are accounted for. Similar to circuit analysis with EC, it is seen that voltage distribution along the divider can be far from linear; moreover, field along the resistor body can vary greatly. Results of field and EC simulations are compared. Influence of design parameters on the nonuniformity is discussed.

Author: POKRYVAILO, Alexander (Spellman High Voltage Electronics Corp.)

Session Classification: Poster 2 - High Voltage Design and Power Modulator Components