

Electrostatic Induction on Stationary Vehicles Under High Voltage Power Lines

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Abstract

The National Electrical Safety Code (NESC) requires that high voltage power lines in the United States be designed to limit the impact of electrostatic effects on nearby equipment. An example is that of a large vehicle parked underneath a transmission line (Figure 1). The rubber tires insulate the vehicle's chassis from ground allowing charge to accumulate on the surface. If a person standing on the ground makes contact with the vehicle, 60 Hz alternating current can flow through the person to ground (Figure 2). The NESC states that the short-circuit current between the equipment and ground must be limited to 5 milliamperes (often referred to as the 5 mA Rule). Common methods in use today for analyzing this phenomenon make use of significant geometrical simplifications, empirical formulas, and look-up tables. The author used COMSOL's AC/DC module to perform three-dimensional finite element analysis of a semi-trailer parked underneath high-voltage conductors. The study utilized COMSOL physics interfaces for Electric Currents and Electrical Circuits to calculate the steady-state voltage induced on the vehicle and to determine the resulting current flow when the chassis was short-circuited to ground. Parametric sweeps provided insight into how the vehicle size, vehicle orientation, and overhead conductor configuration affected the short-circuit results. COMSOL significantly reduced the geometric uncertainty inherent in previous analysis methods and allowed the authors to assess the consequence of geometric simplifications in terms of personnel safety and transmission structure costs.

Reference

1. Raymond J. Lings, EPRI AC Transmission Line Reference Book: 200 KV and Above, Third Edition, Electric Power Research Institute, 2005
2. National Electrical Safety Code, Institute of Electrical and Electronics Engineers, Inc., 2012

Figures used in the abstract

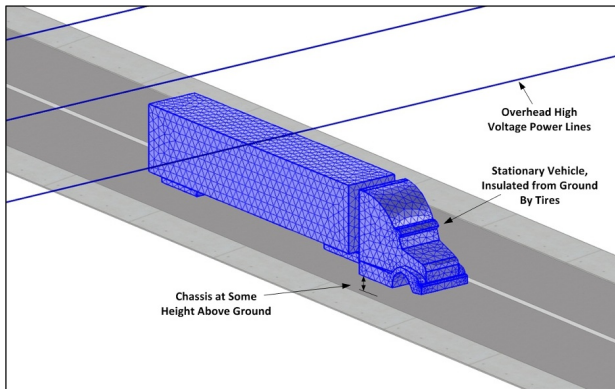


Figure 1: Example 3D Geometry for Analysis of Electrostatic Induction of a Vehicle under a Power Line.

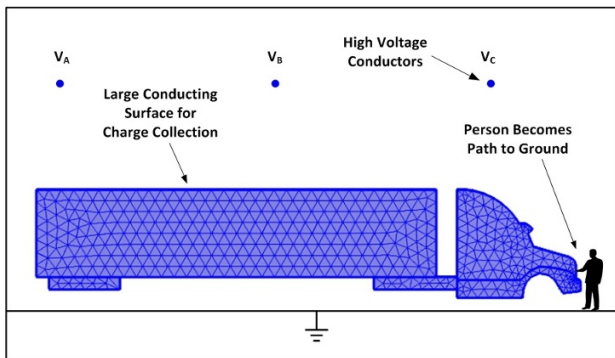


Figure 2: Illustration of Electric Shock Hazard.